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US national park visitor experiences during COVID-19: Data from Acadia, Glacier, Grand Teton, Shenandoah, and Yellowstone National Parks

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ABSTRACT

The COVID-19 pandemic has uniquely impacted US National Park Service (NPS) units. This study seeks to help inform future visitor use management and planning by compiling data from five NPS units (Acadia, Glacier, Grand Teton, Shenandoah, and Yellowstone National Parks), focusing on how the pandemic influenced management and impacted visitor use. Data were collected from both park managers and visitors. Results provide understanding regarding managerial changes, user-capacity limits, and documented changes in visitation in 2020 compared to 2019. These results are coupled with park visitor data from 2020, including visitor demographics, motivations and perceived outcomes, information sources for visiting during the pandemic, potential behavioral shifts in response to COVID-19 while on-site, and intent to visit in the future. The results suggest that the distinct shifts in visitation patterns during 2020 impacted park managers' ability to predict and efficiently respond to visitor use changes. This issue was exacerbated by staffing shortages attributed to the pandemic. Lessons learned regarding what worked well (e.g., respondents were able to achieve health-related outcomes), and what could be improved (e.g., knowing that visitors adapted behaviors to maintain personal safety, and future staffing allocations can be focused temporally and spatially based on these 2020 use trends) can be incorporated to help prepare park managers, surrounding gateway communities, and state tourism authorities for the future.

INTRODUCTION

COVID-19 and impacts on tourism

Since the beginning of 2020, the COVID-19 global pandemic has caused over 200 million cases and over four million deaths (WHO 2021). Beyond the health impacts, COVID-19 has directly and indirectly impacted businesses and industries associated with tourism, which has had substantial impacts to economies (Gössling, Scott, and Hall 2021). Additionally, residents of tourism destinations are assessing the tradeoffs between tourism

and livelihoods and personal and public health (Qiu et al. 2020). Nature- and wildlife-based tourism destinations may be hit particularly hard by the pandemic through the loss of funding and inability to employ rangers and other staff, which has resulted in increased illegal activities and degradation of resources during this time (Newsome 2020). While there are post-COVID projections for the tourism industry, there is still much uncertainty, as the pandemic presents unique challenges and responses are often context-specific.

COVID-19 and US national parks

The COVID-19 pandemic uniquely impacts units of the US National Park Service (NPS), as use increases in many areas that were already experiencing relatively high visitation levels (Kwak-Hefferan 2020). While some units fully or partially closed for periods at the onset of the pandemic, during the peak of the "first wave" of COVID-19 infection in the US, 96% of "all outdoor spaces" in the national park system remained open to the public (Allen and Newman 2021: 102). As a result, a large portion of NPS units implemented various restrictions and visitor capacity limits to reduce the transmission of COVID-19 among visitors (Jacobs et al. 2020), as evidenced by hundreds of compiled press releases (NPS 2020a). Additionally, NPS released a series of guidelines for "maintaining social distance and avoiding high-risk outdoor activities" (NPS 2020a).

For those units remaining open, the unique management challenges related to shifting use patterns and public health during summer 2020 (e.g., implementing new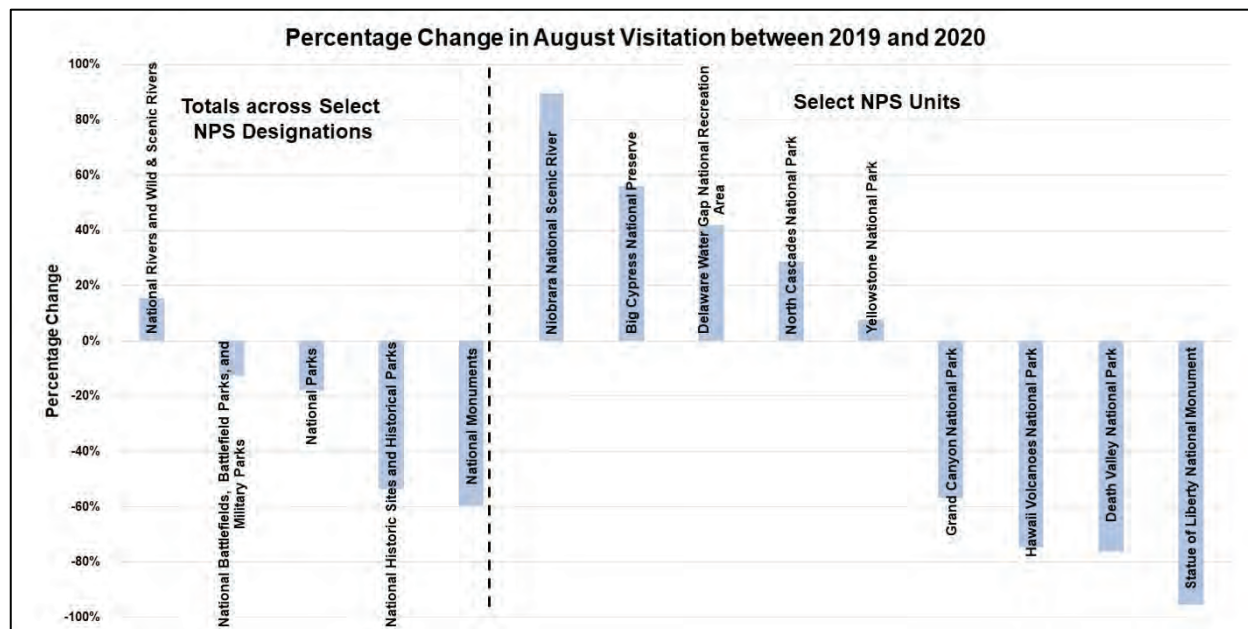 timed entry permitting systems, enforcing mask policies, etc.) were highly publicized (e.g., Chrobak 2020; Rott 2020). Additional attention was given to the variation of the pandemic's impacts to visitation volumes. As displayed in Figure 1, some parks experienced large surges in visitation compared to 2019, while others experienced large declines in visitation. While late-summer surges to visitation in some national parks (e.g., Indiana Dunes, and Yellowstone) garnered attention from the national media (e.g., Chrobak 2020; Kehoe 2020), 80% of NPS units experienced lower visitation in August 2020 than August 2019 (NPS, n.d.).

These unprecedented times and associated challenges have left park managers in the difficult position of protecting and preserving delicate resources while providing for high-quality visitor experiences. Traditionally we have known who visits national parks (Xaio, Lee, and Larson 2021), their motivations (Manfredo, Driver, and Tarrant 1996), and their behaviors toward natural resources and other visitors (Backman et al. 2018). We have also learned that national park visitation typically decreases acutely by region over the short-term amid unique and challenging events such natural disasters (Woosnam and Kim 2013) or acts of terrorism (McIntosh et al.2020). Yet, we know very little about national park visitors or how management has adapted to manage for resource protection and visitor use and experience during the pandemic, which at the time of this publication had created unprecedented impacts globally for nearly two years.

Study purpose

The sustained presence of COVID-19 has created a need for managers to understand how visitor use has changed

FIGURE 1. Percentage change in August visitation between 2019 and 2020.

in response to the pandemic at NPS units (Jacobs et al. 2020). In part, this requires understanding evolving management at NPS sites. Simultaneously, information is needed regarding visitor use, including understanding who is visiting the parks, their motivations and information sources for visiting during the pandemic, potential behavioral shifts in response to COVID-19 while on-site, and intent to visit in the future. However, in the summer and fall of 2020, traditional in-person visitor use data collection efforts were not feasible and presented risks to both researchers and visitors. In many units, *in situ* data collection efforts continue to be further challenged with closures, and staffing and housing shortages. To this end, Jacobs et al. (2020) recommend researchers use "new methods for survey distribution, including a greater reliance on using participant-owned digital devices (i.e., employing electronic surveys delivered via QR [quick response] code)." With the above in consideration, this study seeks to inform visitor use in a variety of NPS units representing the eastern and western US during the COVID-19 pandemic by using QR code survey responses from visitors within five iconic NPS national parks: Acadia (ACAD), Glacier (GLAC), Grand Teton (GRTE), Shenandoah (SHEN), and Yellowstone (YELL). The survey responses were coupled with publicly available information and data from managers at each of these parks, all of which were synthesized to provide additional context to visitor responses.

METHODS

Park profiles

The five parks were selected because of their geographic distribution across the US and their relatively high annual visitor use in years prior to the pandemic. Profiles were developed for each that included managerial and park changes, user-capacity limits, and overall trends and changes in visitation due to COVID-19. This information was synthesized in conjunction with park staff and is presented in tables and additional figures below to illustrate the commonalities and differences in challenges, trends, and managerial responses across the parks due to COVID-19.

Visitor use and experiences recruitment, survey, and analysis

This study used a two-step, convenience sampling approach for online surveying beginning with pre-recruitment (Fricker 2017). First, respondents were recruited via QR code scannable signage installed in ACAD, GLAC, GRTE, YELL, and SHEN during the summer of 2020. Fourteen signs temporarily installed at each park (seven 7.33x11-inch flyers and seven 16x24-inch posters) to accommodate a variety of high-traffic areas (e.g., trailheads, visitor centers, and overlook kiosks)

where the signs could readily be seen by visitors (Figure 2). The signs asked visitors to scan a QR code with their smartphone camera app, or go to a listed website address to participate in a future study aimed at understanding "how COVID-19 is impacting your national park experience." Both the QR code and website link directed visitors to the same Qualtrics form where they were asked to select the national park where they encountered the sign and enter their email address so that they could be contacted in the autumn of 2020 to complete a forthcoming survey. Signs were installed beginning on July 4, 2020, and were removed on November 1, 2020, with varying time intervals between the parks based on availability to distribute and remove the signs safely.

QR codes are a class of matrix-based barcodes that may be scanned using the camera app on most smartphones, thereby allowing individuals to access linked websites (Lorenzi et al. 2014). NPS frequently uses QR codes to reach visitors (Cramer 2011; Lorenzi et al. 2014), and in recent years, QR codes have been used to distribute surveys to travelers (e.g., Begoña et al. 2015; Brownlee et al. 2020; Monzon et al. 2020). Previous surveying applications reveal a number of strengths and weaknesses. Notable strengths include the codes' ability to distribute surveys in a cost-effective (Monzon et al. 2020) and timely (Lorenzi et al. 2014) manner, even in remote areas (Brownlee et al. 2020). Weaknesses include relatively low response rates and the possibility of significant non-response bias resulting from the requirement of technical skills to participate, and from

FIGURE 2. Examples of sign placement at ACAD.

the discovery of "QR code-fatigue" stemming from the saturation of QR codes in advertising (Monzon et al. 2020). Additionally, respondents must have access to the internet and possess a smartphone (Monzon et al. 2020; Perez-Alba 2020). To reduce limitations resulting from these noted weaknesses, we included a website address that could be written down, or otherwise recorded, for use on a traditional computer or when internet access was regained.

Using the emails gathered during the solicitation period, a survey was distributed to initial respondents on November 11, 2020. Following the guidance of Dillman et al. (2014), a pre-letter, priming email was sent six days prior to the initial survey email and reminder emails were sent one week and ten days following the original distribution. Ultimately the survey closed on November 23, 2020, and respondents were only permitted to provide one response.

The survey included a series of questions concerning visitor demographics, motivations and outcomes, trip planning, and self-reported on-site behaviors with the intent to provide timely management insights to NPS managers during this challenging time. Given the limited number of respondents in some of the parks, across-park comparisons were not possible (see Limitations section below). Instead, all responses were combined to provide a holistic view of national park visitors during this pandemic. Survey responses were analyzed using SPSS statistics software. Analyses focused on frequencies and descriptives, providing summary statistics for the variables of interest, holistically examining results across all of the parks due to statistical power limitations.

RESULTS

Given the holistic need for understanding both evolving managerial conditions and visitor use during the pandemic, the results are organized in the following order:

- Park profiles and conditions, user-capacity limits, and documented changes in visitation in 2020 compared to 2019 (Tables 1 and 2, and Figure 3);
- Visitor/respondent data, as informed by park visitors from all parks combined: visitor demographics, motivations and perceived outcomes, information sources for visiting during the pandemic, potential behavioral shifts in response to COVID-19 while on-site (Tables 3–5), and intent to visit in the future (Table 6).

Park profiles and conditions attributed to COVID-19

The parks faced a variety of managerial modifications, which repeatedly changed throughout the sampling period (Table 1). All of the parks in this study were closed to visitors in some capacity (e.g., roads access closed, foot-traffic permitted, etc.) for a period of time at the beginning of the pandemic, with varying degrees of phased re-openings. For example, in ACAD, no shuttle services were in operation, and park campgrounds were closed for the entire season. In GLAC, the west side of the park was open, including a portion of the Going-to-the-Sun-Road for the entire season, while neither the park shuttle nor concession tour services (Red Bus, Sun Tours, boat and horse rides) operated, and staffing was reduced and reallocated due to safety regulations associated with housing capacities. In GRTE, several visitor centers were closed for the entire season, and in SHEN no visitor centers were open during the sampling period, while interpretive programs switched to virtual delivery. In YELL, Wyoming entrances were opened approximately two weeks prior to Montana entrances, altering access to and flow through the park. YELL also had reduced accommodations, services, and staffing challenges, similar to those of the other parks.

Park profiles and conditions:
Park user-capacity limits attributed to COVID-19

In an effort to help mitigate social and resource impacts and to attempt to keep visitors and staff safe, capacity limits were considered in some locations within the parks (Table 2). Except for some high-use areas, most of the parks did not impose explicit limits on visitor density; those that did found such limits difficult to enforce. For example, traffic and parking restrictions were implemented in GLAC and GRTE, while YELL concession facilities limited the number of visitors allowed inside to aid with social distancing regulations.

Park profiles and conditions: Changes in visitation quantities

Visitation trends varied considerably by park and season (Figure 3). On an annual basis, visitation was reduced slightly in all of the parks except for SHEN, while specific seasons (i.e., summer and fall months aligning with the QR code visitor survey) saw increases in visitor use. The annual visitation dip in most of the parks is a reflection of the park closures at the beginning of the pandemic.

Visitor/respondent responses: Who visited the parks?

A total of N=331 respondents across all five national parks completed the survey (ACAD: n=194; GLAC: n=38; GRTE: n=74; SHEN: n=28; YELL: n=98). Ninety-nine percent of the sample indicated being from the United States. Approximately 88% of the sample indicated being *White*, while only 4% indicated identifying as *Asian or Pacific Islander*, 0.3% as *Black or African American*, 0.3% as *Native American, American Indian, or Alaska Native*, and 7% indicated that they *prefer to not say*, or that they identify racially as something other than the aforementioned survey options. The average respondent was 45 years of

TABLE 1. Park managerial/park changes attributed to COVID-19.

	Acadia National Park (ACAD), ME[1]	Glacier National Park (GLAC), MT[1]	Grand Teton National Park (GRTE), WY[2]	Shenandoah National Park (SHEN), VA[1]	Yellowstone National Park (YELL), WY, MT, ID[2]
General opening restrictions	The state of ME initially required 14-day quarantining for out-of-state travelers; later changed to a 14-day quarantine or a negative COVID test. The park delayed openings of Park Loop Road, the visitor center, and bathrooms until June.	Unanimous decision of county, state and federal public health officials and the Blackfeet Tribal Business Council to close the park in March and then to keep the east side closed after the west side opened on June 8, 2020.	Beginning June 16, 2020, some visitor centers opened, backcountry permits were made available, and there were additional take-out food services available from park concessioners.	Closed from April 8, 2020, until May 23. The only government buildings open to the public (not managed by the concessionaire) were restrooms.	Closed to visitors on March 24, 2020. Strategy was created for a phased reopening sequence within the context of multiple jurisdictions. The park opened the two WY entrances on May 18, 2020. MT was in a 14-day quarantine restriction phase for out-of-state travelers, and opened entrances June 1, 2020.
	ACAD	GLAC	GRTE	SHEN	YELL
Employee Changes	Seasonal staff were severely reduced due to COVID guidelines for employee housing.	Operated with substantially less staff due to the restrictions of only being able to house one employee per bedroom; reallocated employees to different jobs and locations than they had originally been hired for.	N/A	Extra staffing efforts were focused on cleaning restrooms and picnic areas to prevent human/wildlife conflicts and improve visitor safety.	Seasonal hires were limited due to housing concerns.
	ACAD	GLAC	GRTE	SHEN	YELL
Transport-ation Changes	There was no shuttle system operating in the park.	Neither the park shuttle nor concession tours operated. The Going-to-the-Sun Road was only open to Rising Sun which required visitors to turn around and exit through West Glacier.	N/A	N/A	N/A

		A Congestion Management Group was implemented.			
	ACAD	**GLAC**	**GRTE**	**SHEN**	**YELL**
Concession and Lodging Changes	The three park campgrounds were closed for the season.	Lodging was open only at Village Inn and Lake McDonald. All campgrounds were closed except Fish Creek. The restaurants were only open for takeout.	All concessioner campgrounds within the park and the John D. Rockefeller, Jr. Memorial Parkway were open.	No access to backcountry camping until June 11. Park campgrounds were examined for spacing between sites, with reduced capacities through the end of June/early July, expanded to full capacity following state guidance.	Some overnight accommodations were available in the park, but limited. No commercial bus tours were allowed. Park-run campgrounds opened later in the season.
	ACAD	**GLAC**	**GRTE**	**SHEN**	**YELL**
Interpret-ation and Visitor Center Changes	Visitor center activities were much reduced and moved outside.	Interpretive talks and hikes were substantially reduced or canceled.	The L.S. Rockefeller Preserve Center, Flagg Ranch Information Station, and Jenny Lake Visitor Center were closed for the 2020 summer season.	Visitor centers were not open during the study, but outdoor services were provided. Park information was generally provided virtually—no in-person ranger programs were in service.	N/A

age, with an age range for all respondents of 18–81. The majority of respondents identified as women (65%). Of the five parks, GRTE yielded the highest percentage of first-time visitors (63%), followed by GLAC (56%), YELL (48%), ACAD (45%), and SHEN (22%). Overall, the average group size was M=2.8 (S.D.: 1.3). When asked about the number of other NPS units visited during their trip, approximately 11% of respondents indicated that they visited one other, 5% stated visiting two others, and 10% indicated visiting three to five others.

TABLE 2. Park user-capacity limits attributed to COVID-19.

Acadia National Park (ACAD), ME	Glacier National Park (GLAC), MT	Grand Teton National Park (GRTE), WY	Shenandoah National Park (SHEN), VA	Yellowstone National Park (YELL), WY, MT, ID
State-wide quarantine or negative test requirement not enforced at the park level, although social sanctioning occurred in various online forums (e.g., ACAD-related Facebook pages, etc.). Capacity limits were generally not enforced by the park. However, there was one section of the park, the Wild Gardens of Acadia, that had a 50-person capacity and was altered for one-way foot traffic. Unrelated use limits were initiated in October as part of a pilot for an ongoing transportation plan. The pilot (a vehicle parking reservation system) was planned pre-pandemic.	There were no specific capacity limits implemented. The park developed a ticketed entry system, but it was not implemented due to lack of support from the community, the short time frame to get it started, and strong concerns by park staff for implementation. We learned that if more than 1700 vehicles entered the corridor by 10 AM, congestion would result in closures in and around the West Entrance of the park, with park staff stopping traffic for 4–5 hours. Traffic was held frequently at the foot of Lake McDonald and Avalanche developed area. This led to new congestion issues when the road reopened to vehicles from visitors walking on the road. Eventually traffic was held at the West Entrance Station, rather than stopping traffic once inside the gate.	At one of the park's most popular sites, String Lake, it was more difficult for visitors to social distance due to the narrow and limited shoreline compared to other lakes. The park stated that parking will only be allowed in designated areas at String Lake and limited parking will help manage the number of people in the area and prevent spread of the virus.	Most restrictions ended by July. Initially in campgrounds but that was opened to full capacity by the start of the study for July 4 weekend. Other restrictions during the study were only for indoor government-managed facilities except for bathrooms. High-use trail systems were closed prior to this sampling period but then opened with guidance during the study period.	No restrictions to the number of visitors entering the park were implemented. Concession facilities limited numbers of visitors allowed inside at one time to accommodate adequate social distancing. Social distancing, hand sanitizing, and mask wearing (when appropriate) were encouraged throughout the 2020 summer season.

Visitor/respondent responses:
What were their motivations for visiting during the pandemic?
When asked to report motivations for visiting the park (see Manfredo et al. 1996), *Exercise* (94%), *Experience tranquility* (92%), *Physically relax* (88%), and *Be away from crowds* (87%), were top goals (i.e., the aggregated percentages of respondents who indicated that these motivations were either *moderately true*, *very true*, or *completely true* for them). The item *Get away from an area with a relatively high level of COVID-19 infections* resulted in the lowest reported motivation (51% of respondents indicating *moderately* to *completely true* regarding their motivations).

When asked about outcomes of their visit, *I improved my mood* (95%), *I helped maintain my physical health* (87%), *I restored my mind from unwanted stress* (87%), and *I reduced my anxiety* (86%) were top outcomes from visiting the park respectively (i.e., respondents indicating *moderately* to *completely true* regarding their perceived outcomes from their visit). The outcome with the lowest reported positive affect was *I restored my body from fatigue* (75% of respondents indicating *moderately* to *completely true* regarding their perceived outcomes from their visit).

Visitor/respondent responses:
What were visitors' most frequently used information sources?
The most frequently used information sources for understanding changing park conditions due to COVID-19 were the *NPS website* (58% reported), followed by *Park rangers or Employees* (36%), and *Park brochure and map*
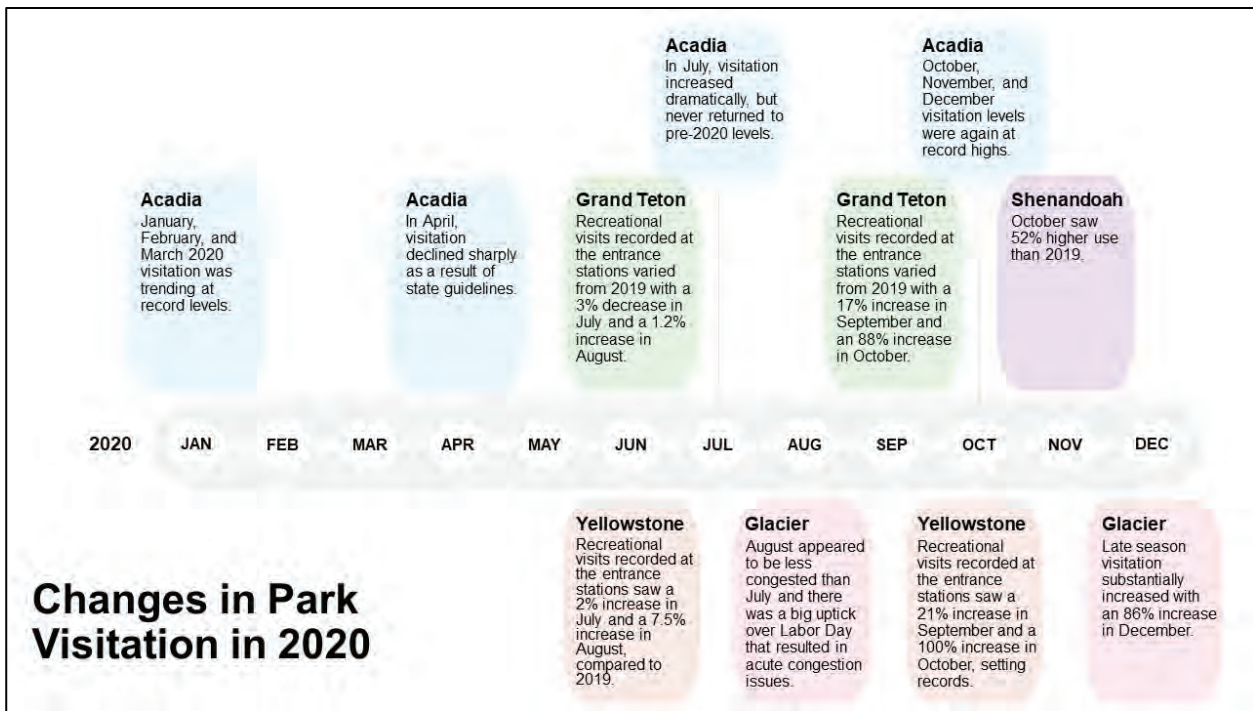
FIGURE 3. Park changes in visitation. Note: For GLAC specifically, the park saw a 40% reduction in visitation compared to 2019; however, only half of the park opened in 2020.

(28%). *Onsite signage* (23%), *Apps* such as *All Trails* (20%), and *Social media* (12%) were also reported, while only 7% indicated using information from *Health Department websites*.

Visitor/respondent responses: What were visitor behaviors in relation to the pandemic?

Approximately 71% of the respondents indicated altering travel plans or recreation behaviors due to the COVID-19 pandemic. Of those that indicated changes, a few notable behaviors yielded substantial percentages of respondents. For example, 32% indicated that it was *very true* or *completely true* that they *went to a different area of the park instead of [their] preferred area*, 30% stated that they *explored fewer sites within the national park than planned*, 24% indicated that they *visited a national park because the state where it is located had a relatively low number of confirmed COVID-19 cases*, and 21% *ended a visit to a particular site earlier than planned*.

Recommendations for social distancing and wearing masks onsite were present at all the parks during the data collection period, so these two factors were also evaluated in reference to how respondents may have altered their plans and behaviors (Tables 3 and 4). With regard to visitors reporting that they altered behaviors in an effort to honor social distancing (Table 3), most of the variables were reported as being important factors, with the exception of *ending their trip earlier than planned* (40% *not at all important*) and *going to an alternative park instead of a*

preferred area (37% *not at all important*). Notable factors that had more influence included *visiting earlier* (56% *very important* or *extremely important*), *going to a different area of the park instead of [their] preferred area* (42% *very important* or *extremely important*), *ending a visit to a site earlier than planned* (41% *very important* or *extremely important*), and *exploring fewer national parks than planned* (37% *very important* or *extremely important*).

Respondents were asked about their behaviors in areas where the level and/or type of mask wearing made them uncomfortable. In these circumstances, respondents noted that *visiting earlier* (46% *very important* or *extremely important*), going to a *different area of the park instead of [their] preferred area* (43% *very important* or *extremely important*), and *ending a visit to a site earlier than planned* (43% *very important* or *extremely important*) were all important factors (Table 4).

Park data demonstrated that during several months in 2020, there were notable increases in visitor use compared to 2019 (Figure 3). With consideration to increases in visitor densities, behaviors related to perceived crowding and COVID-19 were also evaluated (Table 5). With regard to the amount of people encountered, associated feelings of crowding, and specific behaviors, the highest mean values and percentages resulted from respondents noting that it was *important* that they *ended a visit to a particular site earlier than planned* (89%), or *went to a different area of the park instead of [their] preferred area* (87%) (i.e., they fell

TABLE 3. Visitor behaviors based on attempts to honor social distancing.

In an effort to honor social distancing...	Not at all Important	Slightly to Moderately Important[a]	Very to Extremely Important[b]	Mean	S.D.
I visited earlier in the day than I planned	5.9%	37.6%	56.4%	3.5	1.2
I visited later in the day than I planned	23.9%	42.2%	33.8%	2.8	1.4
I went to a different area of the park instead of my preferred area	16.9%	41.6%	41.5%	3.1	1.3
I went an alternate park instead of my preferred area	37.3%	33.3%	29.4%	2.6	1.6
I explored fewer sites within the national park than planned	21.4%	45.3%	33.3%	2.9	1.4
I explored fewer national parks than planned	30.2%	32.6%	37.2%	2.9	1.6
I changed my preferred activity to a less favorable activity	22.6%	47.6%	29.8%	2.8	1.4
I ended a visit to a particular site earlier than planned	20%	38.9%	41.1%	3.0	1.4
I ended my trip earlier than planned	40%	23.3%	36.7%	2.6	1.6
I engaged in automobile touring instead of outdoor recreation	20.5%	46.5%	32.9%	2.9	1.3

Scale: 1 = Not at all important, 2 = Slightly important, 3 = Moderately important, 4 = Very important, 5 = Extremely important;
[a] = combined percentages from 2 = Slightly important, 3 = Moderately important; [b] = combined percentages from 4 = Very important, 5 = Extremely important

into either the *slightly to moderately important* or the *very to extremely important* category). Other notable items included *changing [their] preferred activity to a less favorable activity* (84% *slightly to moderately important* or *very to extremely important*) and *visiting earlier in the day than planned* (82% *slightly to moderately important* or *very to extremely important*).

Visitor/respondent responses:
What intent do 2020 visitors have for visiting in the future?
Finally, approximately 37% of respondents indicated that they intend to *visit the park sites in 2021 that [they] were unable to visit during 2020*, while approximately 73% indicated that they would *wait to travel to other national parks until the end of the COVID-19 pandemic* (Table 6). A relatively high degree of respondents noted *neither agreeing or disagreeing* with the future visitation items listed below, which may point to the continued uncertainty associated with the pandemic.

DISCUSSION AND IMPLICATIONS

Shifting motivations and behaviors of the national park visitor
National parks attract visitors for a range of reasons and

some of the parks included in this study are among the most frequently visited parks in the country. Despite closures, limitations, and restrictions, visitors sought the benefits these parks provide during the pandemic—and, in many seasonal instances, in higher numbers than in 2019. Our study further emphasized how COVID-19 may have accentuated the role of parks in supporting physical and mental health (Rice et al. 2020), as respondents directly attributed to their visit various health-related outcomes, which were largely achieved through maintaining physical health, improved mood, and reduced anxiety and stress. It should be noted that the respondents in this study largely achieved their health goals, but the sample reflects an almost entirely white (~88%) demographic, potentially pointing to health discrepancies for other non-represented groups. While national parks had been actively promoting Healthy Parks, Healthy People initiatives well before the pandemic, this study highlights a particular opportunity for these types of park programs to help facilitate escape and restoration, while focusing on safe and equitable access for all, to park resources during the pandemic and beyond.

The majority of visitors indicated altering behaviors due

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I visited later in the day than I planned	23.9%	42.2%	33.8%	2.8	1.4
I went to a different area of the park instead of my preferred area	16.9%	41.6%	41.5%	3.1	1.3
I went an alternate park instead of my preferred area	37.3%	33.3%	29.4%	2.6	1.6
I explored fewer sites within the national park than planned	21.4%	45.3%	33.3%	2.9	1.4
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I engaged in automobile touring instead of outdoor recreation	20.5%	46.5%	32.9%	2.9	1.3

Scale: 1 = Not at all important, 2 = Slightly important, 3 = Moderately important, 4 = Very important, 5 = Extremely important; [a] = combined percentages from 2 = Slightly important, 3 = Moderately important; [b] = combined percentages from 4 = Very important, 5 = Extremely important

to COVID-19. These respondents changed their travel plans, and noted coping behaviors, such as arriving earlier, going to different areas of the park, exploring fewer sites, engaging in more automobile touring rather than non-motorized outdoor recreation, or ending a visit earlier than planned. These self-reported behaviors amid the pandemic are in accord with the predictions and observations of other protected area researchers (Jacobs et al. 2021; Schneider et al. 2021), who found that visitor coping behaviors were the result of attempting to social distance, avoid areas where masks were not being worn at a level comfortable to the respondent, or avoid crowding in general.

Our findings reflect changes in behavior in the decision to travel to a national park and how visitors behave during the visit. It is also worth noting that many visitors may have been stopped from visiting parks altogether due to pandemic conditions, and therefore would not be represented in this study. While many national parks have ongoing visitor use monitoring to assess trends and adaptively manage, the distinct shifts in visitation

patterns during 2020 impacted managers' ability to predict and efficiently respond to visitor use changes. This issue was exacerbated by staffing shortages and staff reallocations attributed to the pandemic. Other studies have also found changes in visitor travel patterns and behaviors during the pandemic (e.g., Rice et al. 2020; Kane et al. 2021; Miller et al. 2021), yet our study is one of the first to look holistically across multiple national parks to gain a greater understanding of the impacts of COVID-19 from a visitor perspective, examining both empirical (e.g., actual densities of people, cars, etc.) and evaluative (e.g., subjective visitor perceptions of conditions) data.

National parks experienced challenges that were both similar and unique
Overall, parks experienced many similar challenges with regard to visitor use management due to COVID-19 (i.e., recommendations and restrictions for travel, masks, and social distancing; closures; and increases in shoulder-season use coupled with limited staff capacities). Yet, there were also challenges unique to each park. For example,

TABLE 4. Visitor behaviors to avoid settings where masks were not being worn at a comfortable level.

I wanted to avoid settings where mask wearing was not at a level I was comfortable with so...	Not at all Important	Slightly to Moderately Important[a]	Very to Extremely Important[b]	Mean	S.D.
I visited earlier in the day than I planned	17.9%	35.7%	46.4%	3.3	1.4
I visited later in the day than I planned	30%	32.8%	37.1%	2.9	1.6
I went to a different area of the park instead of my preferred area	20.3%	39.1%	30.7%	3.0	1.4
I went an alternate park instead of my preferred area	21.6%	35.3	43.2%	3.1	1.5
I explored fewer sites within the national park than planned	28.7%	39.1%	32.1%	2.8	1.5
I explored fewer national parks than planned	32.6%	28%	39.5%	2.8	1.6
I changed my preferred activity to a less favorable activity	25.6%	36.6%	37.8%	2.9	1.5
I ended a visit to a particular site earlier than planned	21.6%	35.2%	43.2%	3.1	1.5
I ended my trip earlier than planned	43.3%	26.6%	30%	2.6	1.7
I engaged in autotouring instead of outdoor recreation	21.2%	40%	38.9%	2.9	1.5

Scale: 1 = Not at all important, 2 = Slightly important, 3 = Moderately important, 4 = Very important, 5 = Extremely important;
[a] = combined percentzges from 2 = Slightly important, 3 = Moderately important; [b] = combined percentages from 4 = Very important, 5 = Extremely important

the proximity of GLAC to the Blackfeet Reservation led to a coordinated decision to close the east side of the park due to the vulnerability of the Blackfeet population to COVID-19, and in YELL, the transboundary state-level jurisdictions of the park entrances increased the complexity of a phased reopening.

Data suggest that SHEN had fewer first-time visitors and more repeat visitors than the other parks, while surpassing 2019 visitor use figures by 15%, potentially highlighting the park's accessibility from large cities compared to GLAC, YELL, and GRTE, with relatively few nearby large cities. By contrast, 63% of the respondents from GRTE were first-time visitors. Finally, ACAD noticed a substantive increase in local and regional traffic, particularly during the summer of 2020.

Anecdotal observations by park managers illuminated additional similarities and differences across the parks. There were perceptions of a *different type of visitor,* such as ACAD staff observing more younger visitors, as well as an increase in first-time visitors to national parks

observed in GLAC (which aligns with respondent data, as 56% indicated being first-time visitors). Managers noted unique challenges with first-time visitors, such as them not understanding NPS regulations and recommended behaviors in a national park setting. Two parks, GLAC and SHEN, observed more vandalism and graffiti as well as increases in litter. At YELL, discarded or dropped masks were observed in thermal areas as a new forms of litter. ACAD observed an increase in the number of personal vehicles (because shuttles were not available) and GLAC observed more recreational vehicles with lengths that were beyond those allowed on the park's roadways. While YELL experienced seasonal increases in visitation, managers observed a decrease in use on some of the more popular trails (aligning with respondent data indicating shifts towards more automobile touring). GLAC noticed an increase in social trails throughout the park as well as camping outside of designated areas. Lastly, GLAC observed an increase in felonies and disorderly conduct among visitors, and general brazenness with respect to minor offenses (e.g., dogs on trails).

TABLE 5. Visitation behaviors based on perceptions of crowding.

The amount of people I encountered made me feel crowded, so...	Not at all Important	Slightly to Moderately Important[a]	Very to Extremely Important[b]	Mean	S.D.
I visited earlier in the day than I planned	18.1%	25.3%	56.6%	3.4	1.5
I visited later in the day than I planned	31.3%	26.8%	41.8%	2.9	1.6
I went to a different area of the park instead of my preferred area	13.4%	33.8%	52.8%	3.4	1.4
I went an alternate park instead of my preferred area	22.9%	25.1%	52.1%	3.1	1.5
I explored fewer sites within the national park than planned	20.9%	31.4%	47.8%	3.1	1.5
I explored fewer national parks than planned	25%	25%	50%	3.2	1.6
I changed my preferred activity to a less favorable activity	16%	32.1%	51.9%	3.3	1.5
I ended a visit to a particular site earlier than planned	11.4%	28.4%	60.2%	3.6	1.4
I ended my trip earlier than planned	34.5%	13.7%	51.7%	3.1	1.7
I engaged in autotouring instead of outdoor recreation	17.6%	35.3%	47.1%	3.2	1.5

Scale: 1 = Not at all important, 2 = Slightly important, 3 = Moderately important, 4 = Very important, 5 = Extremely important; [a] = combined percentages from 2 = Slightly important, 3 = Moderately important; [b] = combined percentages from 4 = Very important, 5 = Extremely important

Moving forward

The COVID-19 pandemic re-emphasizes the need to conceptualize parks as complex social-ecological systems (McCool, Freimund, and Breen 2015). During one of the most trying times in contemporary memory, millions of visitors sought refuge in US national parks. These visitors came with health-related motivations, new behavioral coping mechanisms, and different patterns of travel compared to those of previous years. In response, managers had to be adaptive, with limited staff. Park architecture is typically designed to concentrate visitor use through personal vehicle travel, visitor centers, trail systems, and/or alternative transportation. Thus, management responses were forced to shift in light of social distancing: shuttles were discontinued, restrictions put in place, and even whole sections of national parks were shuttered. In some cases, local ecological conditions deteriorated through increased visitor use, yet in others wildlife rebounded because of closures (Miller 2020). Gateway communities experienced massive economic impacts reflective of closures and visitor use fluctuations (Spenceley et al. 2021).

However, the COVID-19 pandemic is just one example of a complex, uncertain situation in park and protected areas that impacts social, ecological, and managerial resources and requires managers to be adaptive in the face of uncertainty. In a rapidly changing world, the future will demand that park and protected area managers and scientists think at scales that transcend jurisdictional and conceptual boundaries (Perry et al. 2020) and have at their disposal a "toolbox" of actions they can use to respond to resource and visitor behaviors and impacts. Having organized committees of decision-makers and stakeholders across regional boundaries and jurisdictions, capable of making collaborative decisions at pre-determined trigger points, will be helpful for both land managers and gateway communities in the future. Finally, this study points to the need for ongoing monitoring of both evaluative and empirical data so that trends can emerge and inform future adaptive, collaborative management (Manning 2018).

This study focused on the global COVID-19 pandemic as it affected 2020 and 2021, but a myriad of unknown future events will require parks to adapt to emergent

TABLE 6. Future visitation plans.

	Disagree[a]	Neither Agree or Disagree	Agree[b]	Mean	S.D.
In 2021, I plan to visit more national parks than in 2020.	59.6%	32.9%	7.5%	−1.11	1.49
In 2021, I plan to spend more days in national parks than in 2020.	62.9%	28.4%	8.8%	−1.04	1.51
In 2021, I plan to visit national parks that I was unable to visit in 2020.	56.7%	28%	15.2%	-.91	1.59
In 2021, I plan to visit unvisited sites within the national parks I traveled to in 2020.	34.8%	28.4%	36.8%	.08	1.61
In 2021, I plan to visit places, other than national parks, that I was unable to visit in 2020.	71.9%	18.6%	9.5%	−1.38	1.5
I plan to wait for the end of the COVID-19 pandemic to visit national parks again.	14.7%	12.6%	72.8%	.94	1.38

Scale: –3 = Strongly disagree, –2 = Disagree, –1 = Somewhat disagree, 0 = Neither agree or disagree, 1 = Somewhat agree 2 = Agree, 3 = Strongly agree; [a] = combined percentages from –3 = Strongly disagree, –2 = Disagree, –1 = Somewhat disagree; [b] = combined percentages from 1 = Somewhat agree, 2 = Agree, 3 = Strongly Agree

conditions. Lessons learned regarding what worked well (e.g., respondents were able to achieve health-related outcomes), and what could be improved (e.g., knowing that visitors adapted behaviors to maintain personal safety, and future staffing allocations can be focused temporally and spatially based on these 2020 use trends) can be incorporated to help prepare park managers, surrounding gateway communities, and state tourism authorities for future visitation seasons.

Limitations and future research
This study provided understanding of the potential of QR-based approaches, but also highlighted some of the deficiencies associated with these methodologies, and specifically convenience samples such as these. While this study yielded timely visitor experience data, collected safely for both researchers and respondents during the pandemic, this research is likely not representative (Monzon et al. 2020; Perez-Alba 2020) of the "average" visitor to the parks during the summer

and fall of 2020. For example, there are virtually no international respondents, presumably due to travel restrictions, which is abnormal with regard to visitor demographics for any of these parks. Furthermore, these data do not represent any of the people that planned to visit national parks but decided not to during the pandemic. Future research should work to employ *in situ* data collection efforts with a stratified intercept protocol in a manner than keeps potential respondents and researchers safe, while maximizing representativeness. Geofencing or other ambulatory approaches could be useful (Joregenson et al. 2019), as well as more traditional *in situ* surveyor approaches if exercised with COVID-19-related safety protocols. A major limitation of this research is that the sample size was too small in some of the parks to make statistical inferences, either at the park level or in comparison across parks. We speculate that in some cases the quality of cell phone service influenced the response rate (e.g., cell service in SHEN is extremely limited), and

future efforts should consider alternative ambulatory strategies that instigate real-time *in situ* responses while not requiring cell phone service. Finally, this study only took place in the summer and fall of 2020, and missed potentially unique visitation patterns beyond this sampling period. Extending the data collection period to represent annual use, incorporating seasonality, and potentially, visitation variations attributed to COVID-19 changes (e.g., spikes in cases, etc.) would be useful in the future.

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NEW PERSPECTIVES ON Geoconservation IN PROTECTED AND CONSERVED AREAS

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The precipitous rock spires of Meteora World Heritage Site in Greece have a complex geological history. Over the centuries a number of Eastern Orthodox monasteries were built atop them, and today's World Heritage Site recognizes this cultural history as part of the overall geoheritage. | STATHIS FLOROS