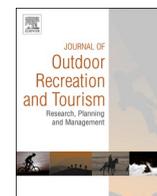




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The nature of the pandemic: Exploring the negative impacts of the COVID-19 pandemic upon recreation visitor behaviors and experiences in parks and protected areas

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ABSTRACT

The COVID-19 pandemic dramatically affected parks and protected areas and overall recreation visitation across the United States. While outdoor recreation has been demonstrated to be beneficial, especially during a pandemic, the resulting increase in recreation visitation raises concerns regarding the broader influence of social, situational, ecological, and behavioral factors upon overall visitor experiences. This study investigated the extent to which recreation visitors' behaviors and experiences have been impacted by the COVID-19 pandemic within the White Mountain National Forest (WMNF). A modified drop-off pick-up survey method was employed to collect population-level data from WMNF visitors from June to August of 2020 ($n=317$), at the height of the pandemic. Results from this mixed-method study suggest social factors (e.g., crowding and conflict), situational factors (e.g., access and closures), ecological factors (e.g., vegetation damage), behavioral factors (e.g., substitution), and sociodemographic factors (e.g., gender and income) significantly influenced overall visitor decision-making and experience quality within the WMNF. For example, more than one-third of visitors indicated the pandemic had either a *major* or *severe* impact upon their WMNF recreation experience. A more nuanced investigation of qualitative data determined that the majority of pandemic-related recreation impacts revolved around the themes of social impacts, general negative recreation impacts, situational and ecological impacts, and behavioral adaptation impacts. Moreover, historically marginalized populations (e.g., low-income households and females) within the sample reported significantly higher recreation experience impacts during the pandemic. This study demonstrates the influence of the pandemic upon outdoor recreation visitor experiences and behaviors and considers outdoor recreation as a central component within the broader social-ecological systems framework. This study demonstrates the influence of the pandemic upon outdoor recreation visitor experiences and behaviors and considers resource users a central component within the broader social-ecological systems conceptual framework.

Management implications: This study found that during the peak of the COVID-19 pandemic, social, situational, ecological, behavioral, and sociodemographic factors significantly influenced overall visitor decision-making and experience quality:

- Social and general recreation impacts were most common, with approximately 56% of the sample reporting these issues.
- Results suggest significant crowding and conflict impacts stemmed from interactions between in-state and out-of-state visitors, largely based upon perceived violations of pandemic protocols.

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- Moreover, historically marginalized populations stated unique recreation impacts during the pandemic. For instance, visitors from low-income households reported significantly less substitution options as opposed to high-income visitors.
 - Female visitors perceived significantly more pandemic-related conflict than male visitors.
- Study findings suggest visitor crowding and conflict should be prioritized by resource managers, especially amongst historically marginalized populations. Resource managers should consider adopting a broader social-ecological systems approach to parks and protected areas management, particularly during a global pandemic.

1. Introduction

In March 2020, the World Health Organization officially declared the COVID-19 outbreak a global pandemic. This declaration forced the sudden closure of schools, businesses, and recreation facilities worldwide (Dolesh, 2020; Rice et al., 2020). During challenging and unprecedented times individuals often turn to outdoor recreation within parks and protected areas (PPAs) for escape and solitude as well as the mental and physical health benefits provided by nature (CDC, 2020; OIA, 2021; Rice et al., 2020). As a result, the overall volume of recreation visitation amongst both experienced and inexperienced visitors increased dramatically during the pandemic within PPAs worldwide (Brassil, 2020; Ferguson et al., 2022; Hale, 2020). In the United States, local, state, and federal PPAs have witnessed consistent and incremental visitation growth over the past several decades which have caused significant strains within the overall public lands system (Ferguson et al., 2022; National Park Service NPS, 2020). For example, National Park Service visitation has grown steadily over the past 50 years with 26 million visitors in 1974, 101 million visitors in 1989, 276 million visitors in 2004, and 327 million visitors in 2019 (National Park Service NPS, 2020). Adding fuel to this fire, the pandemic rapidly and exponentially increased recreation visitation within an already overwhelmed PPA system (Ferguson et al., 2022). This sudden and unprecedented visitation spike caused an increase in the presence and severity of various social, ecological, and situational impacts upon visitor experiences, natural resources, and local communities (Carr, 2020; Freeman & Eykelbosh, 2020, p. 829). Moreover, many of these impacts forced visitors to engage in various behavioral adaptations to make the best of their recreation experiences (Ferguson et al., 2021).

This research examined the impact of the COVID-19 pandemic upon recreation visitors' behaviors and experiences within the White Mountain National Forest (WMNF). Population-level mixed-method data were collected from WMNF visitors at the height of the pandemic, from June to August of 2020 ($n=317$). Findings suggest social, ecological, behavioral, and sociodemographic factors significantly influenced visitor decision-making and experience quality within the WMNF. A deeper assessment of qualitative data determined the majority of pandemic-related recreation impacts revolved around the themes of social impacts, general recreation impacts, situational and ecological impacts, and behavioral adaptation impacts. Moreover, study findings suggest various historically marginalized populations reported significantly higher recreation experience impacts during the pandemic. This research showcases the impact of the COVID-19 pandemic upon outdoor recreation visitor experiences and behaviors and suggests the relationship between resource users and public infrastructure providers is critical within the broader social-ecological systems conceptual framework.

2. Literature review

2.1. Social-ecological systems framework related to PPA during the COVID-19 pandemic

The recent increase in demand for outdoor recreation has been demonstrated to strain the natural resources, infrastructure, communities, and visitors' experiences which rely upon PPAs (Cole, 2021; Hauslohner & Thebault, 2020). Oftentimes, PPAs are researched and

managed within a narrow scope, concerned with only specific issues at unique locations or time periods (Ferguson et al., 2021; Morse, 2020). This narrow scope can be problematic as recreation does not take place in a vacuum; rather, each component of the recreation experience is interconnected, like a ripple in a pond. This recognition led to the development of an adaptive social-ecological systems (SES) framework which considers the complex, dynamic, and integrated relationships within entire systems (Morse, 2020). Thus, the SES conceptual framework considers the multiple scales and associated feedback loops between and within social and ecological sub-systems (Anderies et al., 2004; Walker et al., 2006). For example, SES considers the preexisting interaction and connections between visitors, resources, managers, communities, stakeholders, and external environments (e.g., the COVID-19 pandemic) and recognizes the interconnected impacts stemming from increasing PPA visitation (Ferguson et al., 2021; Morse, 2020). In addition, SES provides an ideal conceptual framework to explore the complex human-nature connection that is vital for informing equitable social, environmental, and economic policy (Anderies et al., 2004; Cole & Hall, 1992; Marion & Cole, 1996; Outdoor Foundation, 2021).

2.2. General PPA impacts during the COVID-19 pandemic

In the early stages of the pandemic, widespread closures, safety protocols, and stay-at-home mandates left millions of Americans with an unprecedented amount of discretionary free time and money (Center for Disease Control CDC, 2020; Kaiser, 2020; OIA, 2021; Rice et al., 2020). As the pandemic progressed, many leaders and health organizations encouraged and promoted the use of the outdoors (Randall, 2020; Wang, 2020). As a result, PPA visitation skyrocketed as individuals began to discover and/or re-remember their local natural resources (Carr, 2020; Derks et al., 2020; Goodnow & Mackenzie, 2020; OIA, 2021; Rice et al., 2020; Venter et al., 2020). For example, the National Forests of New England saw an approximately 60% increase in visitation during the summer months of 2020 (Ferguson et al., 2022). Further, nearly half of all Americans reported participation in an outdoor activity during the summer months of the pandemic (OIA, 2021). Amid all of this, a significant number of first time and inexperienced visitors also began recreating within PPAs (Hautamaki, 2020; OIA, 2021; 2020). Often these visitation increases stemmed from a desire for socially distanced activities, spending time with family, exercising and personal health, and a reduction in time spent indoors on screens (OIA, 2021). As visitation within PPAs continued to increase, numerous social (e.g., crowding and conflict), situational (e.g., state mandates and restricted access), and ecological (e.g., litter and vandalism) impacts became more pronounced (Brassil, 2020; Ferguson et al., 2021; Rice et al., 2020; Siler, 2020).

2.3. Social PPA impacts during the COVID-19 pandemic

PPA managers were hurriedly forced to modify protocols to adhere to changing and inconsistent state and federal pandemic mandates which often resulted in various forms of visitor conflict and crowding (Derks et al., 2020; Langlois, 2020; Venter et al., 2020). For instance, at one point in 2020 the federal government was encouraging outdoor recreation, while various state governments were simultaneously closing

PPAs, sending mixed signals to visitors (Center for Disease Control CDC, 2020; VOREC, 2020). Visitor conflict is commonly framed around goal interference and is defined as any interference in a visitor's goal caused by other visitors' behaviors (Jacob & Schreyer, 1980). Visitor conflicts quickly emerged during the pandemic, largely driven by differences stemming from conflicting national, state, and local pandemic protocols (Rice et al., 2020). These inconsistencies often led to a lack of mask compliance, improper social distancing, unruly visitor behavior (i.e., illegal parking and arguments), out-of-state visitors being perceived as 'non-local', and a general lack of adherence to CDC protocols (Ramer, 2020; Rice et al., 2020; Siler, 2020). Other forms of visitor conflict centered on strains placed upon often underfunded rural gateway community infrastructure, as these communities attempted to accommodate increasing visitor demands (Erwin et al., 2020). As a result, gateway communities were often subjected to increased litter, vandalism, illegal dumping, dispersed camping, trail degradation, general trail erosion, and healthcare system overburden (Brassil, 2020; Chow, 2020; Cole, 2021).

Visitor perceptions of crowding commonly refers to any negative evaluation of the volume of visitors within a defined area (Manning et al., 2000). Instances of crowding also emerged due to a combination of site closures and a renewed interest in outdoor recreation (Siler, 2020; Venter et al., 2020). As a result of these accessibility restrictions, visitors often flocked to the few PPAs which remained open, leading to inevitable instances of overcrowding and associated pandemic protocol violations (Center for Disease Control CDC, 2020; Siler, 2020; Venter et al., 2020). Moreover, these social impacts combined with a rapid increase in visitation often resulted in a multitude of PPA infrastructure and management challenges such as visitor adaptations and site degradation (Beery et al., 2021; Landry et al., 2021).

2.4. Situational PPA impacts during the COVID-19 pandemic

In many cases, the pandemic and associated political pressures led to closures and loss of access within many PPAs across the United States which impacted both local and international visitation worldwide (Colman & Dolesh, 2020; Will, 2020). Furthermore, widespread travel restrictions halted park visitation among international travelers which in turn hurt local businesses and may have long-term consequences associated with the global tourism industry (Spenceley et al., 2021; Will, 2020). Within New England, pandemic protocols often varied by state, leading to access issues within their respective PPAs. For instance, certain states imposing laxer protocols (e.g., New Hampshire) while other states enforced more stringent protocols (e.g., Massachusetts, Maine, and Vermont) (Mawson, 2020; MOT, 2020; VOREC, 2020). As a result, states with stricter pandemic policies often experienced significant recreation displacement and overall visitation decreases. For example, Maine saw a 27% recreation visitation decrease from 2019 to 2020 (MOT, 2020; Valigra, 2021). Alternatively, states with more lenient protocols often experienced visitation spikes due to the abundant availability of PPA access (Ferguson et al., 2022). For instance, the WMNF saw record-breaking visitation amongst both in-state and out-of-state visitors resulting in unprecedented impacts (Callery, 2020; Ferguson et al., 2021; Ramer, 2020). Recreation sites and parking areas across New Hampshire often far exceeded capacity, resulting in pervasive instances of congestion, illegal parking, and overall non-compliance with pandemic protocols (Callery, 2020). Further, as the pandemic progresses and new variants such as Omicron emerged, travelers often altered their behaviors and locations as they either canceled plans or sought more solitude in remote and dispersed recreation settings such as Congressionally Designated Wilderness (Associated Press, 2021; Chow, 2020; Ferguson et al., 2021; LNT, 2020; Ramer, 2020). Sudden restricted access to PPAs worldwide also has broader implications such as negative economic impacts, decreased 116-118tional visitation, and unpredictable visitor behaviors (Hockings et al., 2020).

2.5. Behavioral adaptation and substitution behaviors in PPA during the COVID-19 pandemic

Substitution refers to behavioral changes or adaptations among recreationists in response to social, situational, or ecological impacts (Brunson & Shelby, 1993). In response to the pandemic and related impacts, visitors often found the need to modify, change, or substitute their behaviors and decision-making within PPAs (OIA, 2021; Rice et al., 2020). The WMNF experienced unprecedented levels of visitation during the pandemic which often led to the pervasive employment of various behavioral adaptations (Ferguson et al., 2021). Unsurprisingly, many local visitors were often in conflict with non-local visitors who were not as accustomed to traditional recreation etiquette and knowledge of the area (Brassil, 2020; Chow, 2020; Cole, 2021; Hautamaki, 2020; Hale, 2020; LNT, 2020). Research suggests non-local visitors may sometimes lack awareness and experience related to recreation safety, norms, and procedures (Brassil, 2020; LNT, 2020). Alternatively, local visitors often quickly adapt their behaviors, especially during the pandemic where in some instances they were able to take advantage of various pandemic protocols and loopholes (Chow, 2020). For example, local visitors within Rocky Mountain National Park often began recreating earlier in the morning to avoid the enforcement of timed entry systems and trail closures (Chow, 2020). Ultimately, the pandemic seems to have forced both local and non-local visitors alike to employ various behavioral adaptations in an effort to maintain their overall experience quality.

2.6. Impacts upon historically marginalized populations in PPA during the COVID-19 pandemic

While there have been substantial efforts, the outdoor industry continues to lack significant diversity. Approximately 40% of the U.S. population identified as non-White in 2020, yet nearly 75% of outdoor recreation visitors identified as White in the same year (OIA, 2021). For example, women and individuals from lower socio-economic backgrounds often face significant constraints in outdoor recreation, due in part to implicit prejudice and biases which frequently result in negative experiences (Mitten et al., 2018; More & Stevens, 2000; Powers et al., 2020; Rosa et al., 2020, pp. 1–21). For example, research indicates the cost of user entry fees often prevents participation and access for lower socio-economic visitors (More & Stevens, 2000; Trawalter et al., 2021). Recent research also suggests women are typically underrepresented and often marginalized in the outdoor recreation realm (Mitten et al., 2018). Yet, visitation to PPAs among certain historically marginalized populations was shown to increase during the pandemic (OIA, 2021). Specifically, a notable increase was observed amongst female visitors who sought out recreation opportunities in PPAs (OIA, 2021). Although this is a positive development, the long-term challenges of accessibility, engagement, and equity faced by marginalized populations continue to prevail in PPAs (OIA, 2021). Ultimately, the impact of the pandemic upon historically marginalized populations within outdoor recreation may have lasting and long-term positive effects upon diversity and equity related to public health, environmental stewardship, and economic prosperity (Derks et al., 2020; Hautamaki, 2020; Powers et al., 2020; Rice et al., 2020).

2.7. Summary and research questions

Policy makers and PPA managers must remain vigilant and continue to evolve their practices in response to increased visitation and impacts resulting from the pandemic. Previous studies have explored recreation related impacts and behavioral adaptations within a narrow scope, often focusing on a single issue (e.g., conflict) at a single site (e.g., a wilderness area). This research, however, is one of the first mixed-method studies to examine visitor impacts, behaviors, and decision-making related to the pandemic, across an entire National Forest system in New England. This

study serves to explore the impact of the COVID-19 pandemic upon recreation visitors' behaviors and experiences within the White Mountain National Forest. Study findings lend themselves to an SES conceptual framework which serves to comprehensively explore the interconnection sub-systems and their adaptive functions within the broader recreation ecosystem. It should be noted that study data was intentionally not weighted and should be interpreted with caution as it is not representative of and/or generalizable to *all* WMNF visitors. The following research questions were examined to directly address these phenomena:

R1: To what extent have visitors been impacted by the COVID-19 pandemic on the WMNF?

R2: To what extent have visitors altered their recreation behaviors and experiences as a result of the COVID-19 pandemic on the WMNF?

R3: To what extent have historically marginalized visitor populations altered their recreation behaviors and experiences as a result of the COVID-19 pandemic on the WMNF?

3. Methods

3.1. Study context- the White Mountain National Forest

The White Mountain National Forest (WMNF) is managed by the USDA Forest Service and is located in New Hampshire and Western Maine. The WMNF spans approximately 800,000 acres, hosts more than 6 million annual outdoor recreation visitors, and is located within one day's drive of more than 70 million people (National Forest Foundation NFF, 2020; United States Department of Agriculture Forest Service USDA FS, 2020). The forest serves as a major recreation destination, boasting more than 1,200 miles of hiking trails, 400 miles of snowmobile trails, 160 miles of the Appalachian Trail, 23 developed campgrounds, 6 ski touring areas, and 4 alpine ski areas (United States Department of Agriculture Forest Service USDA FS, 2020). The WMNF and adjacent communities serve as a crucial components of the state and regional outdoor industry and economy, supporting more than 5,000 jobs and generating more than \$193 million in labor income (United States Department of Agriculture Forest Service, 2016).

3.2. Data collection

A unique *knock-and-drop* survey method was employed in this study to collect population-level data from WMNF visitors from June to August of 2020. This *knock-and-drop* technique is a modification of a traditional drop-off/pick-up survey method (Jackson-Smith et al., 2016). Specifically, this technique required trained researchers to canvas and approach residential homes, hanging survey kits on doorknobs, knocking, briefly speaking to homeowners (if available), and then proceeding to more homes. A secondary analysis of National Visitor Use Monitoring zip code data was used to identify neighborhoods with significant percentages of WMNF visitors (Table 1) (United States Department of Agriculture Forest Service USDA FS, 2005; United States Department of Agriculture Forest Service, 2015). The survey kits employed in the study comprised of a clear plastic bag including a cover letter, a paper survey, and a return envelope. Respondents were provided two survey modality options: 1) an online survey via Qualtrics, or 2) a paper survey via a pre-paid return envelope. Two weeks after the initial survey distribution, trained researchers returned to non-respondent households and left a follow-up postcard. Only adults (18 years of age or older) were able to participate in the study. It should be noted that community bias checks were examined via a series of chi-square analyses. Results determined no significant differences between respondents from different communities across key study variables, thus, a lack of community bias was presumed.

As a qualifying screening question, potential respondents were asked

Table 1

WMNF visitation and survey response information.

Community Name	% of WMNF Visitation ^a	Distributed Surveys	Completed Surveys	Response Rate
Conway	5.8%	137	28	20.4%
Concord	5.4%	134	33	24.6%
Littleton	5.4%	137	34	24.8%
North Conway	4.5%	135	31	22.9%
Berlin	3.7%	136	18	13.2%
Gorham	3.7%	137	29	21.1%
Franconia	3.7%	134	26	19.4%
Portsmouth	3.7%	122	31	25.4%
Campton	2.9%	136	34	25.0%
Plymouth	2.5%	138	35	25.3%
Groveton	0.4%	136	18	13.2%
TOTAL	41.7%	1482	317	21.4%

*Note. Percentages may not equal 100 because of rounding.

Note.

^a 2015 National Visitor Use Monitoring data - White Mountain National Forest.

if they had recreated on the WMNF within the past year. A response of 'yes' to this question qualified respondents to begin the survey. A response of 'no' to this question disqualified respondents from the survey. Disqualified individuals were then asked to complete a discrete non-respondent socio-demographic survey. Once the survey was completed, respondents were thanked for their participation and offered a voluntary opportunity to enter into a prize raffle. Of the 1,482 surveys distributed in total, 317 were completed, representing a 21% response rate (Table 1). In terms of modality, approximately two-thirds of surveys were completed online, and one-third were completed via mail-back. These survey methods and associated response rate metrics are consistent with comparable research (Ferguson et al., 2021; Stedman et al., 2019; Wallen et al., 2016). Amongst the disqualified respondents, non-response and survey modality bias were both examined via a series of chi-square analyses. Results determined no significant differences between respondents and non-respondents; thus, a lack of non-response bias was presumed.

3.3. Survey instrumentation

For the entirety of the survey, respondents were asked to reference their "most recent trip to the WMNF". The entire 6-page survey instrument included a number of outdoor recreation variables regarding trip visitation patterns and socio-demographic information, perceptions of impacts, the COVID-19 pandemic, coping behaviors, use levels, management preferences, and beliefs and attitudes towards the environment. It is important to note that only specific and applicable quantitative and qualitative variables from the larger survey instrument were used in this study. First, respondents were asked questions pertaining to socio-demographic characteristics and trip visitation patterns. Next, respondents assessed the overall extent they had been impacted by the pandemic on the WMNF. Respondents were asked, "To what extent has Coronavirus (COVID-19) impacted your recreation experience at the WMNF". This previously validated single-item impact variable was evaluated on a seven-point Likert scale of 1-7; 1=no impact and 7=severe impact (Table 3) (Ferguson et al., 2018; White et al., 2008).

Respondents were then asked a dichotomous yes/no question, "Has your recreation experience on the WMNF been impacted by Coronavirus (COVID-19)?" (Table 4). This dichotomous single-item impact variable was created based on previously validated literature and conversations with WMNF natural resource managers (Rice et al., 2020). The respondents who answered 'yes' to this question, inferring their recreation experience on the WMNF had indeed been impacted by Coronavirus (COVID-19), were the primary focus of the qualitative portion of this study ($n=223$ or 70.3%). Finally, these respondents were then asked, "You have indicated that your recreation experience on the WMNF has

Table 2
WMNF visitor's sociodemographic characteristics.

Variable	% or Mean	n
Gender		
Male	55.2%	175
Female	44.2%	140
Annual Household Income		
Under \$25,000	1.6%	5
\$25,000-\$49,999	14.6%	43
\$50,000-\$74,999	19.0%	56
\$75,000-\$99,999	19.7%	58
\$100,000-\$149,999	24.5%	72
\$150,000 or more	20.4%	60

*Note. Percentages may not equal 100 because of rounding.

Table 3
WMNF visitors' perceived COVID-19 pandemic impact.

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.82 ^a	26.2%	13.9%	6.6%	11.4%	7.3%	16.1%	18.6%

*Note. Percentages may not equal 100 because of rounding.

^a Note. Response Code: 1 = No impact and 7 = Severe impact.

Table 4
Proportion of WMNF visitors impacted by the COVID-19 pandemic.

Response options	% or Mean	N
Yes	70.3%	223
No	29.7%	94

*Note. Percentages may not equal 100 because of rounding.

been impacted by Coronavirus (COVID-19). Please tell us more about that experience.” This open-ended qualitative follow-up question was created based on previously validated literature and conversations with WMNF natural resource managers (Rice et al., 2020).

3.4. Data analyses

All data were analyzed using Statistical Package for the Social Sciences (SPSS) version 24.0. To address research question R1, frequencies, percentages, and measure of central tendency were used. To address research question R2, open-ended qualitative responses were analyzed and thematically coded using the constant comparative method (Corbin & Strauss, 2014). Finally, to address research question R3, frequencies, valid percentages, and cross-tabulation procedures in conjunction with Pearson's Chi-Square analysis was applied.

4. Results

4.1. Descriptive statistics

Amongst survey respondents, 55% identified as male and 44% as female (Table 2). The average age of respondents was 56 years. A large majority of respondents (94%) reported their race/ethnicity as White. Other reported ethnicities included African American, Spanish/Hispanic/Latino, and Asian. More than one-third (35%) of respondents reported earning an annual household income of less than \$75,000, while approximately 20% of the sample reported earning \$150,000 or more. The political ideology distribution within the sample was fairly moderate, but liberal leaning (M=3.55). In terms of primary recreation activities, the most popular activity was hiking/walking (60%), followed by downhill skiing/snowboarding (10%), and sightseeing or viewing natural features (6%). Regarding trip visitation characteristics, respondents noted traveling a median distance of approximately 41 miles from their homes to the WMNF. These largely local and highly

experienced visitors reported recreating on the WMNF an average of approximately 5 days per month, 37 days per year, and 30 total years.

4.2. Research question one

To assess the extent to which visitors were impacted by the pandemic on the WMNF, respondents first evaluated a single-item seven-point Likert scale (1=no impact, 7=severe impact) (Table 3). Overall, respondents noted their recreation experiences had been significantly impacted by the pandemic (M=3.82); with more than one-third of visitors (35%) indicating the pandemic had either a major or severe impact upon their WMNF recreation experience. Next, visitors evaluated a single-item dichotomous variable (i.e., yes or no) specifically asking respondents if their WMNF recreation experience had been impacted by the pandemic (Table 5). Results demonstrate that a nearly three-quarters of the sample (70%) perceived the pandemic had indeed impacted their WMNF recreation experience.

4.3. Research question two

The quantitative analyses suggest WMNF visitors were significantly impacted by the pandemic. Specifically, a substantial proportion of respondents (n=223 or 70.3%) answered 'yes' to the dichotomous quantitative pandemic impact question (Table 5), inferring their recreation experience on the WMNF had indeed been impacted by the pandemic. To further understand and explore the nuanced impacts of the pandemic upon recreation behaviors and experiences on the WMNF, follow-up qualitative data were then collected via an open-ended question.

Qualitative responses were independently analyzed and thematically coded by four independent researchers using the constant comparative method (Corbin & Strauss, 2014). This iterative process involved a combination of inductive, deductive, and abductive reasoning, which is common in mixed-method research (Charmaz, 2006; Chun Tie, Birks, & Francis, 2019). First, the researchers independently applied open coding methods to identify key themes in the data (Corbin & Strauss, 2014). Next, axial coding methods were independently applied to organize the

Table 5
Frequency of COVID-19 pandemic impact themes and sub-themes.

Themes and Sub-Themes	Theme N (Sub-Theme N)	Theme Valid % (Sub-Theme Valid %)
Total Social Impacts	85	29.3
Crowding	(43)	(50.6)
Conflict	(42)	(49.4)
Total General Recreation Impacts	77	26.5
Decreased visitation	(53)	(68.8)
Negatively impacted recreation experience	(15)	(16.9)
Positively impacted recreation experience	(6)	(7.8)
Increased visitation	(5)	(6.5)
Total Situational and Ecological Impacts	69	23.8
Closures and/or restricted access	(35)	(49.2)
Litter/trash, vegetation damage, and/or water pollution	(21)	(30.4)
Sanitation and/or cleanliness	(5)	(7.2)
Parking and/or traffic	(5)	(7.2)
Ancillary recreation facility closures	(4)	(5.7)
Total Behavioral Adaptation Impacts	52	17.9
Avoidance	(23)	(44.2)
Resource substitution	(16)	(30.8)
Displacement	(6)	(11.5)
Activity Substitution	(4)	(7.7)
Temporal Substitution	(3)	(5.8)
Total Unclear/Unrelated	7	2.4
TOTAL	290	100

*Note. Percentages may not equal 100 because of rounding.

key themes into coherent coding categories (Dorsch et al., 2016). Based on the results from both the open and axial coding methods, the researchers then created their own individual codebooks (Lincoln & Guba, 1985) which were then used to independently code each of the qualitative responses. Based on the constant comparative method, the codebooks were independently altered as needed to accommodate data (Patton, 2014). Upon completion of coding, the researchers then independently re-assessed their own codebooks and created their own primary and secondary themes. Finally, the researchers compared their codebooks. This constant comparative procedure was applied four separate times in order to refine the 223 independent comments and ultimately produce a consensus agreement of 5 total themes and 15 total sub-themes (Table 5). This process yielded an acceptable inter-rater reliability statistic representing 86.5% agreement amongst the four independent researchers (Miles and Huberman, 1994). Moreover, the constant comparative method and subsequent presentations of the presence of absence of dichotomous themes and sub-themes via frequency reporting is common, widely accepted, and an appropriate methodological data analysis approach in the social sciences (Bobilya et al., 2005; Ferguson et al., 2022; Krippendorff, 2018).

Overall, respondents identified and incorporated both broad and specific social, ecological, situational, and behavioral impacts from the pandemic upon their WMNF experience. Respondents' qualitative comments were categorized under the primary themes of social impacts (29.3%), general recreation impacts (26.5%), situational and ecological impacts (23.8%), and behavioral adaptation impacts (17.9%). The vast majority of comments and associated pandemic impacts were negative (96%), however, a limited number of positive impacts (4%) were also noted. These qualitative themes, sub-themes, and associated comments are explored in further detail in the following sections.

The *social impacts* theme received the most comments ($n=85$ or 29.3%). The social impact theme contained the sub-themes of crowding impacts ($n=43$) and conflict-related impacts ($n=42$). Respondents within the crowding impact sub-theme suggested the overall volume of visitation on the WMNF was "overwhelming", "overcrowded", and may have "detracted" from the overall outdoor recreation experience. For example, one respondent noted, "During the COVID quarantine I thought it would be good to seek outdoor recreation and exercise on WMNF trails, but I have found them incredibly overcrowded." Several respondents also suggested that the sheer volume of visitation has directly impacted their satisfaction and enjoyment. For example, one respondent elaborated, "Because there are so many people [on the WMNF] the trails have been very crowded, so it has really deterred me from enjoying my typical summer hikes."

The majority of comments within the conflict impacts sub-theme revolved around pandemic related interactions, particularly with out-of-state or non-local populations. Numerous respondents suggested "too many non-locals" using the area and concerns about "out-of-state virus transmission". For example, one visitor noted, "I have been reluctant to hike in my normal areas because of higher visitation by non-compliant out-of-staters" while another mentioned, "too many non-locals from COVID hot spots using the trails". Numerous respondents also suggested various COVID protocol and associated norm violations resulted in conflict. For example, one visitor noted, "When I do try to hike, I pass so many people on the trails that I feel unsafe. Many people believe that if you are outdoors, you are completely safe from any virus no matter how you behave. Almost all of them (mostly folks from other states) aren't wearing masks and none are social distancing."

The theme of *general recreation impacts* ($n=77$ or 26.4%) received a considerable number of responses. General recreation impact sub-themes included decreased visitation ($n=53$), negatively impacted recreation experiences ($n=15$), positively impacted recreation experiences ($n=6$), and increased visitation ($n=5$). Many respondents noted the pandemic caused them to take "fewer trips" and make "less visits" to the WMNF. For example, one respondent noted, "I am using the WMNF significantly less than I normally would be due to COVID", while another

commented, "We've avoided the WMNF in general during the pandemic." Respondents also noted impacts associated with "vacation cancellations". One visitor explained, "Our annual family camping trip to the WMNF was cancelled". The few positive and/or increased visitation impact anecdotes related to "spending more time outside", "social distancing opportunities", and other various enhancement to the recreation experience.

The theme of *situational and ecological impacts* ($n=69$ or 23.8%) was also prominent amongst the sample. Situational and ecological impact sub-themes included closures and/or restricted access ($n=35$), litter/trash, vegetation damage, and/or water pollution ($n=21$), sanitation and/or cleanliness ($n=5$), parking and/or traffic ($n=5$), and ancillary recreation facility closures ($n=4$). The dominant sub-theme in this category being closures and/or restricted access, with visitors noting "trailhead closures", "ski area closures", and "a lack of access". One respondent explained, "Various AMC [Appalachian Mountain Club] and White Mountain National Forest huts and trails are constantly closing and opening, it's frustrating". A secondary and important sub-theme in this category referred to ecological impacts, with respondents indicating various impacts in the form of "trash", "trampling plants and vegetation", and "water pollution from inadequate restroom availability". One visitor wrote, "The litter and plant damage was so awful in some places, so I asked people to walk around sensitive areas and I picked up a small bag full of trash today as I hiked."

The theme of *behavioral adaptation impacts* ($n=52$ or 17.9%) was the least frequently mentioned theme, but remained relatively common. The sub-themes within behavioral adaptations included avoidance ($n=23$), resource substitution ($n=16$), displacement ($n=6$), activity substitution ($n=4$), and temporal substitution ($n=3$). Avoidance behaviors were commonly associated with "not visiting certain areas" and "avoiding other visitors on-trail". One visitor noted, "I completely avoided places where I thought other people would be most likely to visit, especially if there were more than 10 cars in the parking lot". Resource substitution behaviors mostly revolved around the concepts of "choosing different trails" and "finding more remote trails". For example, one respondent noted, "I have young kids and we normally hit the popular easy trails, but we searched out lesser used trails during COVID". Instances of displacement, activity, and temporal substitution behaviors were less frequent. One visitor explained, "I haven't been back to the WMNF because of COVID", while another noted, "I stopped hiking on weekends in the WMNF."

4.4. Research question three

Finally, to assess the extent to which historically marginalized visitor populations have altered their recreation behaviors and experiences as a result of the COVID-19 pandemic on the WMNF, a series of cross-tabulation procedures in conjunction with Pearson's Chi-Square analyses were utilized to examine the associations between open-ended responses to the ways in which COVID-19 impacted recreation experiences and both reported annual household income and gender. Open-ended responses were coded for the presence or absence (e.g., 1 or 0) of the aforementioned thematic codes developed in research questions two (Table 5). This method is common and widely accepted in the social sciences (Krippendorff, 2018) as it allows for statistical comparison between dichotomously coded open-ended response data and other quantitative study variables. Additionally, study authors feel this statistical process actually makes study findings more robust. Due to the dichotomous data, the theme was either present or not, masking some variance in importance of the theme to each respondent, thus inferring that any statistically significant and meaningful relationships with other variables represents the existence of a meaningful relationship.

Results revealed significant differences for behavioral adaptations by reported annual household income. Results suggest upper middle-income respondents (making \$75,000–100,000 annually) were decidedly most likely to engage in various substitution behaviors on the

WMNF (Table 6). Results also revealed significant differences for both conflict interactions and overall negative recreation experiences, by reported gender (Table 7). During the pandemic, women reported higher levels of both conflict and overall negative recreation experiences on the WMNF, relative to men.

5. Discussion

The COVID-19 pandemic fundamentally altered outdoor recreation visitation and experiences within PPAs across the United States. These impacts may have significant influences upon the visitors, resources, communities, and economies which rely upon PPAs. The literature has largely examined this phenomenon within a narrow scope, often focusing on a single issue at a single site. This research, however, is one of the first mixed-method studies to examine visitor impacts, behaviors, and decision-making related to the pandemic, across an entire National Forest system in New England. This study found that nearly three-quarters (70%) of WMNF visitors perceived the pandemic impacted their recreation experience, with more than one-third (35%) of visitors indicating the pandemic had either a *major* or *severe* impact upon their recreation experience. Amongst those impacted respondents, various historically marginalized populations (e.g., low-income households and females) reported significantly higher levels of perceived impacts. Further, study findings suggest that nearly one-fifth of respondents (18%) changed their outdoor recreation behaviors or experiences because of social, situational, and/or ecological pandemic related impacts. These findings corroborate the influence of the pandemic upon parks and protected areas and raise important theoretical and managerial questions.

5.1. Theoretical implications

This study examined the prominent theory-in-use that outdoor recreation visitor experiences, behaviors, and decision-making have been altered during the COVID-19 pandemic (Ferguson et al., 2022; Zeithaml et al., 2020). Study findings investigated this premise and determined that visitor experiences, behaviors, and decision-making were significantly impacted during the pandemic, across an entire National Forest system. Results revealed that as the pandemic progressed, not only were social impacts prevalent, but instances of situational and ecological impacts also became more pronounced, often necessitating the employment of various behavioral adaptation techniques in an effort to preserve the overall recreation experience and natural resource (Brassil, 2020; Ferguson et al., 2021; Rice et al., 2020; Siler, 2020). The context of this study is also important as this theory-in-use was examined not just at one site or location, but across an entire National Forest system. Thus, while this study did not explicitly examine and test an SES model, study findings lend themselves to certain components of the SES conceptual framework, which serves to explore interconnected systems and their adaptive functions within the broader recreation ecosystem (Anderies et al., 2004; Morse, 2020).

The concept of resiliency has become central to understanding and managing complex SES systems (Walker et al., 2006). Study findings

Table 6
Associations between WMNF visitors' income and behavioral adaptations in response to COVID-19.

Annual Household Income	Reported Behavioral Adaptations ^a (Valid %)
Under \$75,000	10.6% ²
\$75,000-\$99,999	29.3% ¹
\$100,000 or more	12.9% ²
Overall Sample	15.3%

^{1&2}Bonferroni post-hoc analysis determined that the \$75,000-\$100,000 group significantly differed (p: 0.001) from the other two groups.

^a Chi-Square: 11.2, df: 2, p: .004, Phi: 0.20.

Table 7
Associations between WMNF visitors' gender and conflict in response to COVID-19.

Gender	Reported Conflict ^a (Valid %)	Reported Negative Recreation Experiences ^b (Valid %)
Male	5.7%	4.0%
Female	19.3%	13.6%
Overall Sample	11.7%	8.3%

^a Chi-Square: 9.4, df: 1, p: .002, Phi: 0.17.

^b Chi-Square: 13.8, df: 1, p: .001, Phi: 0.21.

suggest the WMNF system may be resilient as inferred by the overall systems' ability to seemingly change and adapt during the pandemic (Janssen et al., 2007). However, inferences regarding overall WMNF system resilience must be interpreted with caution as study findings suggest ecological resilience may have increased (e.g., reduced visitation), yet social resilience may have decreased (e.g., negative impacts upon historically marginalized populations). Moreover, results suggest that continuous spatial and temporal adaptations have and may continue to manifest across the four interconnected feedback components of the WMNF SES conceptual framework (Fig. 1). For instance, as visitors employ behavioral adaptations as a result of encountering pandemic induced impacts, spatial adaptations such as visitor site selection and movements have and may continue to occur at the site, district, and even forest level. An example from this study is the reported visitor avoidance of crowded WMNF sites in pursuit of less densely populated areas. Further, the pandemic presents unique short- and long-term temporal adaptations. For instance, daily, monthly, and annual visitation rates have and may continue to fluctuate dramatically, based largely on the complex relationship between the pandemic and outdoor recreation visitation (Ferguson et al., 2022). For example, study respondents reported a decrease in recreation visitation during the pandemic.

Moreover, spatial and temporal variations will likely influence the interconnected feedback components of the SES including WMNF outdoor recreation visitors (e.g., resource users), WMNF resource managers (e.g., public infrastructure providers), the National Forest itself (e.g., the resource), as well as the developed and undeveloped WMNF recreation infrastructure (e.g., public infrastructure) (Fig. 1) (Anderies et al., 2004). Previous research suggests the robustness and subsequent resiliency of an entire system can hinge largely on the key linkage and working relationship between resource users (e.g., WMNF visitors) and public infrastructure providers (e.g., WMNF resource managers) (Anderies et al., 2004). This essential relationship is built on pillars of repeated interactions, reciprocity, reputation, and ultimately trust (Anderies et al., 2004; Ostrom, 1998). This relationship is even more critical when considering the inequality of impacts found in this study amongst historically marginalized populations. Thus, the robustness of the overall system is paramount, especially when system performance is susceptible to unpredictable external perturbations such as a global pandemic (Anderies et al., 2004; Carlson & Doyle, 2002).

5.2. Management implications

For PPA managers and policymakers, study results suggest a series of unique challenges and opportunities, especially as the pandemic continues. While it is important to quantitatively assess pandemic-related recreation impacts, the deeper discussion may revolve around a more nuanced interpretation of qualitative impact data. Qualitative responses not only explicitly identified various social, situational, ecological, and behavioral impacts, but they also spoke to the interconnectivity of impacts within the broader social-ecological system. For instance, one visitor noted, "The sheer volume and overuse by what seemed like mostly new hikers was wreaking havoc on the forest, people, and communities who love this area." While another commented, "The

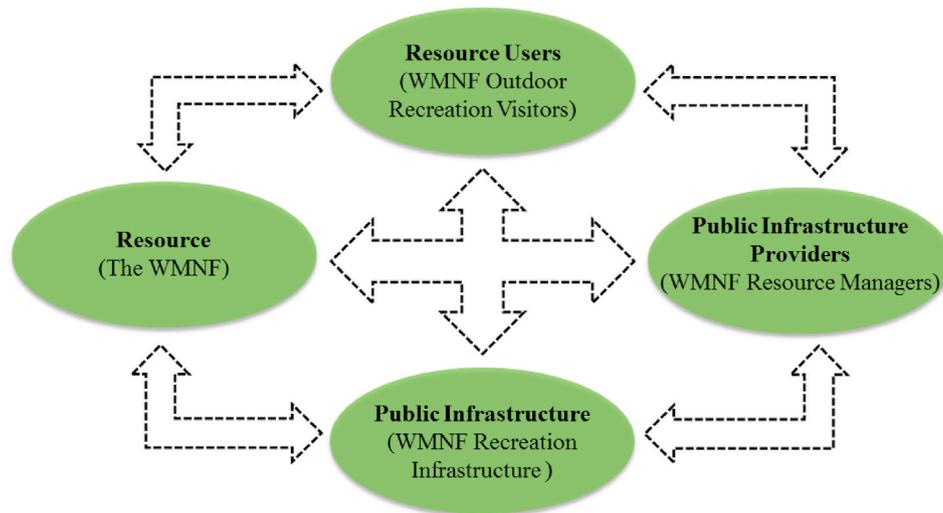


Fig. 1. A conceptual model of a WMNF social-ecological system (Anderies et al., 2004).

crowding and litter, mainly from out-of-staters, was so intense at many of our favorite [WMNF] trails that my family and I had to cut our stay short and leave the area to find a less popular trail.” Many of these interconnected impacts seem to have stemmed from instances of crowding and conflict associated with out-of-state visitation, corroborating previous research which determined both above average visitation and non-local visitation during the pandemic on the WMNF (Ferguson et al., 2021; 2022). More concerning, however, is the inequity of these impacts amongst historically marginalized populations, namely female and lower income visitors.

Study findings suggest visitor crowding and conflict, followed closely by visitor access and equity, should be a top priority for management and policymakers. This focus is even more important when considering the projected longevity of the pandemic as well as global trends towards diversity, equity, and inclusion (DEI) in parks and protected areas (Center for Disease Control CDC, 2020; Derks et al., 2020; Hautamaki, 2020; Rice et al., 2020; Powers et al., 2020). To that end, study results infer that high- and middle-income visitors can adapt to pandemic related impacts, yet low-income visitors are largely unable to adapt and respond to said impacts, effectively forcing them to live with their current situation. Further, female visitors were significantly more susceptible to negative experiences and impacts. Resource managers might consider implementing a multi-tiered approach (e.g., before, during, and after a recreation experience) to messaging and communication primarily focusing on educating visitors (with a focus on out-of-state visitors) and adjacent communities in recreation norms, trail etiquette, DEI, and Leave No Trace principles. Specifically, managers may consider focusing on recreation sites and communities particularly susceptible to crowding and conflict and make concerted efforts to establish rapport amongst both local and non-local visitor populations. This strategy could benefit from working with various non-profit partners such as Outdoors for All and Women Outdoors to further promote equity and access in the outdoors and destigmatize the impacts faced by historically marginalized populations. Moreover, resource managers must also be cognizant of the influence of these management strategies, coupled with visitors’ behavioral adaptations and inequities, upon the larger social-ecological system.

5.3. Implications for future research

There were various study limitations and implications for future research as a result of this research such as augmenting the study sample and including more diversity, the employment of cross-sectional data, a more thorough investigation of SES, the potential limitations associated

with the constant comparative method, the representativeness and generalizability of study finding, and a more nuanced investigation of crowding and conflict. Due to pandemic-related safety protocols and funding limitation, the study sample was rather homogenous, consisting largely of in-state and white visitors. Future research should consider broadening the study sample to include out-of-state, regional, and more diverse populations. This study examined visitor perceptions arguably at the peak of the pandemic, during the summer months of 2020 on the WMNF. Future research should consider assessing visitor impacts, behaviors, and decision-making on a larger temporal scale to account for the ebbs and flows of the pandemic. Next, study findings lend themselves to certain components of the SES framework, however, this study did not explicitly examine and test SES theory. Future research may consider specifically examining the multiple interconnected subsystems associated with SES such as social, ecological, economic, and community impacts. Future research might also consider the potential benefits, limitations, and subjectivity associated with the constant comparison method and dichotomous thematic coding. It is important to note that the constant comparison method, when combined with open and axial coding, applies the relative same importance equally to each theme/sub-theme; thus, making it impossible to assess the relative importance or emphasis of each theme/sub-theme. Future research might consider employing rank-order scaling to open-ended comments to provide respondents the ability to express importance; especially for study questions of importance to resource managers. It is also important to note that study data were not weighted as the goal of this research was to maximize the number of respondents who were frequent users of the WMNF. Thus, study data should be interpreted with caution as it is not representative of and/or generalizable to *all* WMNF visitors. Finally, future research should consider including additional questions about visitor expectations and outcomes regarding crowding and conflict, specifically seeking more nuanced information regarding the source, meaning, expectations, and standards.

6. Conclusion

Results from this mixed-method study suggest that during the peak of the COVID-19 pandemic, the vast majority of WMNF visitors perceived significant experiential and behavioral impacts. Specifically, social, situational, ecological, behavioral, and sociodemographic factors were found to significantly influence overall visitor decision-making and experience quality on the WMNF. Study findings also serve to highlight the inequality of impacts amongst historically marginalized populations, as low-income and female visitors were particularly susceptible to

impacts. Results suggest that as the pandemic progressed, and impacts become more pronounced, the employment of various behavioral adaptations were often necessary. These impacts and associated behavioral and experiential modifications, combined with various inequities, may present unique downstream SES influences upon the visitors, resources, communities, and economies which rely upon the parks and protected areas. This study demonstrates the influence of the pandemic upon parks and protected areas and considers outdoor recreation as a central component when exploring the complex human-nature connection.

CRedit authorship contribution statement

Michael D. Ferguson: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Myles L. Lynch:** Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Darrick Evensen:** Software, Formal analysis, Writing – original draft, Writing – review & editing. **Lauren A. Ferguson:** Validation, Writing – original draft, Writing – review & editing. **Robert Barcelona:** Investigation, Supervision. **Georgia Giles:** Investigation, Data curation, Writing – original draft. **Marianne Leberman:** Investigation, Supervision.

Declarations of competing interest

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