



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

The nature of the pandemic

Citation for published version:

Ferguson, MD, Lynch, ML, Evensen, D, Ferguson, LA, Barcelona, R, Giles, G & Leberman, M 2022, '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', *Journal of Outdoor Recreation and Tourism*.
<https://doi.org/10.1016/j.jort.2022.100498>

Digital Object Identifier (DOI):

[10.1016/j.jort.2022.100498](https://doi.org/10.1016/j.jort.2022.100498)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Journal of Outdoor Recreation and Tourism

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



1 Abstract

2 The COVID-19 pandemic dramatically affected parks and protected areas and overall recreation
3 visitation across the United States. While outdoor recreation has been demonstrated to be beneficial,
4 especially during a pandemic, the resulting increase in recreation visitation raises concerns regarding the
5 broader influence of social, situational, ecological, and behavioral factors upon overall visitor
6 experiences. This study investigated the extent to which recreation visitors' behaviors and experiences
7 have been impacted by the COVID-19 pandemic within the White Mountain National Forest (WMNF). A
8 modified drop-off pick-up survey method was employed to collect population-level data from WMNF
9 visitors from June to August of 2020 ($n=317$), at the height of the pandemic. Results from this mixed-
10 method study suggest social factors (e.g., crowding and conflict), situational factors (e.g., access and
11 closures), ecological factors (e.g., vegetation damage), behavioral factors (e.g., substitution), and
12 sociodemographic factors (e.g., gender and income) significantly influenced overall visitor decision-
13 making and experience quality within the WMNF. For example, more than one-third of visitors indicated
14 the pandemic had either a *major* or *severe* impact upon their WMNF recreation experience. A more
15 nuanced investigation of qualitative data determined that the majority of pandemic-related recreation
16 impacts revolved around the themes of social impacts, general negative recreation impacts, situational and
17 ecological impacts, and behavioral adaptation impacts. Moreover, historically marginalized populations
18 (e.g., low-income households and females) within the sample reported significantly higher recreation
19 experience impacts during the pandemic. This study demonstrates the influence of the pandemic upon
20 outdoor recreation visitor experiences and behaviors and considers outdoor recreation as a central
21 component within the broader social-ecological systems framework. This study demonstrates the
22 influence of the pandemic upon outdoor recreation visitor experiences and behaviors and considers
23 resource users a central component within the broader social-ecological systems conceptual framework.
24

25 **Keywords:** Outdoor Recreation; Visitor Management; COVID-19 Pandemic; Social-Ecological Systems;
26 Visitor Behaviors; Visitor Decision-Making; Parks and Protected Areas
27

28 1.0 Introduction

29 In March 2020, the World Health Organization officially declared the COVID-19 outbreak a
30 global pandemic. This declaration forced the sudden closure of schools, businesses, and recreation
31 facilities worldwide (Dolesh, 2020; Rice et al., 2020). During challenging and unprecedented times
32 individuals often turn to outdoor recreation within parks and protected areas (PPAs) for escape and
33 solitude as well as the mental and physical health benefits provided by nature (CDC, 2020; OIA, 2021;
34 Rice et al., 2020). As a result, the overall volume of recreation visitation amongst both experienced and
35 inexperienced visitors increased dramatically during the pandemic within PPAs worldwide (Brassil, 2020;
36 Ferguson et al., 2022; Hale 2020). In the United States, local, state, and federal PPAs have witnessed
37 consistent and incremental visitation growth over the past several decades which have caused significant
38 strains within the overall public lands system (Ferguson et al., 2022; NPS, 2020). For example, National
39 Park Service visitation has grown steadily over the past 50 years with 26 million visitors in 1974, 101
40 million visitors in 1989, 276 million visitors in 2004, and 327 million visitors in 2019 (NPS, 2020).
41 Adding fuel to this fire, the pandemic rapidly and exponentially increased recreation visitation within an
42 already overwhelmed PPA system (Ferguson et al., 2022). This sudden and unprecedented visitation
43 spike caused an increase in the presence and severity of various social, ecological, and situational impacts
44 upon visitor experiences, natural resources, and local communities (Carr, 2020; Freeman & Eykelbosh,
45 2020). Moreover, many of these impacts forced visitors to engage in various behavioral adaptations to
46 make the best of their recreation experiences (Ferguson et al., 2021)

47 This research examined the impact of the COVID-19 pandemic upon recreation visitors'
48 behaviors and experiences within the White Mountain National Forest (WMNF). Population-level mixed-
49 method data were collected from WMNF visitors at the height of the pandemic, from June to August of
50 2020 ($n=317$). Findings suggest social, ecological, behavioral, and sociodemographic factors significantly
51

52 influenced visitor decision-making and experience quality within the WMNF. A deeper assessment of
53 qualitative data determined the majority of pandemic-related recreation impacts revolved around the
54 themes of social impacts, general recreation impacts, situational and ecological impacts, and behavioral
55 adaptation impacts. Moreover, study findings suggest various historically marginalized populations
56 reported significantly higher recreation experience impacts during the pandemic. This research showcases
57 the impact of the COVID-19 pandemic upon outdoor recreation visitor experiences and behaviors and
58 suggests the relationship between resource users and public infrastructure providers is critical within the
59 broader social-ecological systems conceptual framework.

60 61 **2.0 Literature Review**

62 ***2.1 Social-Ecological Systems Framework related to PPA during the COVID-19 Pandemic***

63 The recent increase in demand for outdoor recreation has been demonstrated to strain the natural
64 resources, infrastructure, communities, and visitors' experiences which rely upon PPAs (Cole, 2021;
65 Hauslohner & Thebault, 2020). Oftentimes, PPAs are researched and managed within a narrow scope,
66 concerned with only specific issues at unique locations or time periods (Ferguson et al., 2021; Morse,
67 2020). This narrow scope can be problematic as recreation does not take place in a vacuum; rather, each
68 component of the recreation experience is interconnected, like a ripple in a pond. This recognition led to
69 the development of an adaptive social-ecological systems (SES) framework which considers the complex,
70 dynamic, and integrated relationships within entire systems (Morse, 2020). Thus, the SES conceptual
71 framework considers the multiple scales and associated feedback loops between and within social and
72 ecological sub-systems (Anderies, et al., 2004; Walker, et al., 2006). For example, SES considers the
73 preexisting interaction and connections between visitors, resources, managers, communities, stakeholders,
74 and external environments (e.g., the COVID-19 pandemic) and recognizes the interconnected impacts
75 stemming from increasing PPA visitation (Ferguson et al., 2021; Morse, 2020). In addition, SES provides
76 an ideal conceptual framework to explore the complex human-nature connection that is vital for
77 informing equitable social, environmental, and economic policy (Anderies, et al., 2004; Cole & Hall,
78 1992; Marion & Cole, 1996; Outdoor Foundation, 2021).

79 80 ***2.2 General PPA Impacts during the COVID-19 Pandemic***

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

97 98 ***2.3 Social PPA Impacts during the COVID-19 Pandemic***

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

103 simultaneously closing PPAs, sending mixed signals to visitors (CDC, 2020; VOREC, 2020). Visitor
104 conflict is commonly framed around goal interference and is defined as any interference in a visitor's goal
105 caused by other visitors' behaviors (Jacob & Schreyer, 1980). Visitor conflicts quickly emerged during
106 the pandemic, largely driven by differences stemming from conflicting national, state, and local pandemic
107 protocols (Rice et al., 2020). These inconsistencies often led to a lack of mask compliance, improper
108 social distancing, unruly visitor behavior (i.e., illegal parking and arguments), out-of-state visitors being
109 perceived as 'non-local', and a general lack of adherence to CDC protocols (Ramer, 2020; Rice et al.,
110 2020; Siler, 2020). Other forms of visitor conflict centered on strains placed upon often underfunded rural
111 gateway community infrastructure, as these communities attempted to accommodate increasing visitor
112 demands (Erwin, 2020). As a result, gateway communities were often subjected to increased litter,
113 vandalism, illegal dumping, dispersed camping, trail degradation, general trail erosion, and healthcare
114 system overburden (Brassil, 2020; Chow, 2020; Cole, 2021).

115 Visitor perceptions of crowding commonly refers to any negative evaluation of the volume of
116 visitors within a defined area (Manning et al., 2000). Instances of crowding also emerged due to a
117 combination of site closures and a renewed interest in outdoor recreation (Siler, 2020; Venter et al.,
118 2020). As a result of these accessibility restrictions, visitors often flocked to the few PPAs which
119 remained open, leading to inevitable instances of overcrowding and associated pandemic protocol
120 violations (CDC, 2020; Siler, 2020; Venter et al., 2020). Moreover, these social impacts combined with a
121 rapid increase in visitation often resulted in a multitude of PPA infrastructure and management challenges
122 such as visitor adaptations and site degradation (Beery et al. 2021; Landry et al., 2021).

123

124 ***2.4 Situational PPA Impacts during the COVID-19 Pandemic***

125 In many cases, the pandemic and associated political pressures led to closures and loss of access
126 within many PPAs across the United States which impacted both local and international visitation
127 worldwide (Colman & Dolesh, 2020; Will, 2020). Furthermore, widespread travel restrictions halted park
128 visitation among international travelers which in turn hurt local businesses and may have long-term
129 consequences associated with the global tourism industry (Spenceley et al., 2021; Will, 2020). Within
130 New England, pandemic protocols often varied by state, leading to access issues within their respective
131 PPAs. For instance, certain states imposing laxer protocols (e.g., New Hampshire) while other states
132 enforced more stringent protocols (e.g., Massachusetts, Maine, and Vermont) (Mawson, 2020; MOT,
133 2020; VOREC, 2020). As a result, states with stricter pandemic policies often experienced significant
134 recreation displacement and overall visitation decreases. For example, Maine saw a 27% recreation
135 visitation decrease from 2019 to 2020 (MOT, 2020; Valigra, 2021). Alternatively, states with more
136 lenient protocols often experienced visitation spikes due to the abundant availability of PPA access
137 (Ferguson et al., 2022). For instance, the WMNF saw record-breaking visitation amongst both in-state
138 and out-of-state visitors resulting in unprecedented impacts (Callery, 2020; Ferguson et al., 2021; Ramer,
139 2020). Recreation sites and parking areas across New Hampshire often far exceeded capacity, resulting in
140 pervasive instances of congestion, illegal parking, and overall non-compliance with pandemic protocols
141 (Callery, 2020). Further, as the pandemic progresses and new variants such as Omicron emerged,
142 travelers often altered their behaviors and locations as they either canceled plans or sought more solitude
143 in remote and dispersed recreation settings such as Congressionally Designated Wilderness (Associated
144 Press, 2021; Chow, 2020; Ferguson et al., 2021a; LNT, 2020; Ramer, 2020). Sudden restricted access to
145 PPAs worldwide also has broader implications such as negative economic impacts, decreased ; 116-
146 118tional visitation, and unpredictable visitor behaviors (Hockings et al., 2020).

147

148 ***2.5 Behavioral Adaptation and Substitution Behaviors in PPA during the COVID-19 Pandemic***

149 Substitution refers to behavioral changes or adaptations among recreationists in response to
150 social, situational, or ecological impacts (Brunson & Shelby, 1993). In response to the pandemic and
151 related impacts, visitors often found the need to modify, change, or substitute their behaviors and
152 decision-making within PPAs (OIA, 2021; Rice et al., 2020). The WMNF experienced unprecedented
153 levels of visitation during the pandemic which often led to the pervasive employment of various

154 behavioral adaptations (Ferguson et al., 2021). Unsurprisingly, many local visitors were often in conflict
155 with non-local visitors who were not as accustomed to traditional recreation etiquette and knowledge of
156 the area (Brassil, 2020; Chow, 2020; Cole, 2021; Hautamaki, 2020; Hale, 2020; LNT, 2020). Research
157 suggests non-local visitors may sometimes lack awareness and experience related to recreation safety,
158 norms, and procedures (Brassil, 2020; LNT, 2020). Alternatively, local visitors often quickly adapt their
159 behaviors, especially during the pandemic where in some instances they were able to take advantage of
160 various pandemic protocols and loopholes (Chow, 2020). For example, local visitors within Rocky
161 Mountain National Park often began recreating earlier in the morning to avoid the enforcement of timed
162 entry systems and trail closures (Chow, 2020). Ultimately, the pandemic seems to have forced both local
163 and non-local visitors alike to employ various behavioral adaptations in an effort to maintain their overall
164 experience quality.

165 **2.6 Impacts upon Historically Marginalized Populations in PPA during the COVID-19 Pandemic**

166 While there have been substantial efforts, the outdoor industry continues to lack significant
167 diversity. Approximately 40% of the U.S. population identified as non-White in 2020, yet nearly 75% of
168 outdoor recreation visitors identified as White in the same year (OIA, 2021). For example, women and
169 individuals from lower socio-economic backgrounds often face significant constraints in outdoor
170 recreation, due in part to implicit prejudice and biases which frequently result in negative experiences
171 (Mitten et al., 2018; More & Stevens, 2000; Powers et al., 2020; Rosa, et al., 2020). For example,
172 research indicates the cost of user entry fees often prevents participation and access for lower socio-
173 economic visitors (More & Stevens, 2000; Trawalter et al., 2021). Recent research also suggests women
174 are typically underrepresented and often marginalized in the outdoor recreation realm (Mitten et al.,
175 2018). Yet, visitation to PPAs among certain historically marginalized populations was shown to increase
176 during the pandemic (OIA, 2021). Specifically, a notable increase was observed amongst female visitors
177 who sought out recreation opportunities in PPAs (OIA, 2021). Although this is a positive development,
178 the long-term challenges of accessibility, engagement, and equity faced by marginalized populations
179 continue to prevail in PPAs (OIA, 2021). Ultimately, the impact of the pandemic upon historically
180 marginalized populations within outdoor recreation may have lasting and long-term positive effects upon
181 diversity and equity related to public health, environmental stewardship, and economic prosperity (Derks
182 et al., 2020; Hautamaki, 2020; Rice et al., 2020; Powers et al., 2020).

183 **2.7 Summary and Research Questions**

184 Policymakers and PPA managers must remain vigilant and continue to evolve their practices in
185 response to increased visitation and impacts resulting from the pandemic. Previous studies have explored
186 recreation related impacts and behavioral adaptations within a narrow scope, often focusing on a single
187 issue (e.g., conflict) at a single site (e.g., a wilderness area). This research, however, is one of the first
188 mixed-method studies to examine visitor impacts, behaviors, and decision-making related to the
189 pandemic, across an entire National Forest system in New England. This study serves to explore the
190 impact of the COVID-19 pandemic upon recreation visitors' behaviors and experiences within the White
191 Mountain National Forest. Study findings lend themselves to an SES conceptual framework which serves
192 to comprehensively explore the interconnection sub-systems and their adaptive functions within the
193 broader recreation ecosystem. It should be noted that study data was intentionally not weighted and
194 should be interpreted with caution as it is not representative of and/or generalizable to *all* WMNF
195 visitors. The following research questions were examined to directly address these phenomena:

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

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

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

201

202

203

204

205 **3.0 Methods**

206 **3.1 Study Context- The White Mountain National Forest**

207 The White Mountain National Forest (WMNF) is managed by the USDA Forest Service and is
208 located in New Hampshire and Western Maine. The WMNF spans approximately 800,000 acres, hosts
209 more than 6 million annual outdoor recreation visitors, and is located within one day’s drive of more than
210 70 million people (NFF, 2020; USDA FS, 2020). The forest serves as a major recreation destination,
211 boasting more than 1,200 miles of hiking trails, 400 miles of snowmobile trails, 160 miles of the
212 Appalachian Trail, 23 developed campgrounds, 6 ski touring areas, and 4 alpine ski areas (USDA FS,
213 2020). The WMNF and adjacent communities serve as a crucial components of the state and regional
214 outdoor industry and economy, supporting more than 5,000 jobs and generating more than \$193 million
215 in labor income (USDA FS, 2016).

216
217 **3.2 Data Collection**

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

233
234 **Table 1.** WMNF visitation and survey response information

Community Name	% of WMNF Visitation ¹	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%

235 *Note. Percentages may not equal 100 because of rounding.
236 Note¹: 2015 National Visitor Use Monitoring data - White Mountain National Forest

237
238 As a qualifying screening question, potential respondents were asked if they had recreated on the
239 WMNF within the past year. A response of ‘yes’ to this question qualified respondents to begin the
240 survey. A response of ‘no’ to this question disqualified respondents from the survey. Disqualified
241 individuals were then asked to complete a discrete non-respondent socio-demographic survey. Once the

242 survey was completed, respondents were thanked for their participation and offered a voluntary
243 opportunity to enter into a prize raffle. Of the 1,482 surveys distributed in total, 317 were completed,
244 representing a 21% response rate (Table 1). In terms of modality, approximately two-thirds of surveys
245 were completed online, and one-third were completed via mail-back. These survey methods and
246 associated response rate metrics are consistent with comparable research (Ferguson et al., 2021; Stedman
247 et al., 2019; Wallen et al., 2016). Amongst the disqualified respondents, non-response and survey
248 modality bias were both examined via a series of chi-square analyses. Results determined no significant
249 differences between respondents and non-respondents; thus, a lack of non-response bias was presumed.
250

251 **3.3 Survey Instrumentation**

252 For the entirety of the survey, respondents were asked to reference their “most recent trip to the
253 WMNF”. The entire 6-page survey instrument included a number of outdoor recreation variables
254 regarding trip visitation patterns and socio-demographic information, perceptions of impacts, the COVID-
255 19 pandemic, coping behaviors, use levels, management preferences, and beliefs and attitudes towards the
256 environment. It is important to note that only specific and applicable quantitative and qualitative variables
257 from the larger survey instrument were used in this study. First, respondents were asked questions
258 pertaining to socio-demographic characteristics and trip visitation patterns. Next, respondents assessed the
259 overall extent they had been impacted by the pandemic on the WMNF. Respondents were asked, “To
260 what extent has Coronavirus (COVID-19) impacted your recreation experience at the WMNF”. This
261 previously validated single-item impact variable was evaluated on a seven-point Likert scale of 1-7; 1=no
262 impact and 7=severe impact (Table 3) (Ferguson et al., 2018; White et al., 2008).

263 Respondents were then asked a dichotomous yes/no question, “Has your recreation experience on
264 the WMNF been impacted by Coronavirus (COVID-19)?” (Table 4). This dichotomous single-item
265 impact variable was created based on previously validated literature and conversations with WMNF
266 natural resource managers (Rice et al., 2020). The respondents who answered ‘yes’ to this question,
267 inferring their recreation experience on the WMNF had indeed been impacted by Coronavirus (COVID-
268 19), were the primary focus of the qualitative portion of this study ($n=223$ or 70.3%). Finally, these
269 respondents were then asked, “You have indicated that your recreation experience on the WMNF has
270 been impacted by Coronavirus (COVID-19). Please tell us more about that experience.” This open-ended
271 qualitative follow-up question was created based on previously validated literature and conversations with
272 WMNF natural resource managers (Rice et al., 2020).
273

274 **3.4 Data Analyses**

275 All data were analyzed using Statistical Package for the Social Sciences (SPSS) version 24.0. To
276 address research question R1, frequencies, percentages, and measure of central tendency were used. To
277 address research question R2, open-ended qualitative responses were analyzed and thematically coded
278 using the constant comparative method (Corbin et al., 2014). Finally, to address research question R3,
279 frequencies, valid percentages, and cross-tabulation procedures in conjunction with Pearson’s Chi-Square
280 analysis was applied.
281

282 **4.0 Results**

283 **4.1 Descriptive Statistics**

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

293 homes to the WMNF. These largely local and highly experienced visitors reported recreating on the
 294 WMNF an average of approximately 5 days per month, 37 days per year, and 30 total years.

295 **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

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

298

299 **4.2 Research Question One**

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

308

309 **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%

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

311 ^aNote. Response Code: 1 = No impact and 7 = Severe impact

312

313 **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

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

315

316 **4.3 Research Question Two**

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

323 Qualitative responses were independently analyzed and thematically coded by four independent
 324 researchers using the constant comparative method (Corbin et al., 2014). This iterative process involved a
 325 combination of inductive, deductive, and abductive reasoning, which is common in mixed-method
 326 research (Charmaz, 2006; Chun et al, 2019). First, the researchers independently applied open coding

327 methods to identify key themes in the data (Corbin et al., 2014). Next, axial coding methods were
 328 independently applied to organize the key themes into coherent coding categories (Dorsch et al., 2016).
 329 Based on the results from both the open and axial coding methods, the researchers then created their own
 330 individual codebooks (Lincoln & Guba, 1985) which were then used to independently code each of the
 331 qualitative responses. Based on the constant comparative method, the codebooks were independently
 332 altered as needed to accommodate data (Patton, 2014). Upon completion of coding, the researchers then
 333 independently re-assessed their own codebooks and created their own primary and secondary themes.
 334 Finally, the researchers compared their codebooks. This constant comparative procedure was applied four
 335 separate times in order to refine the 223 independent comments and ultimately produce a consensus
 336 agreement of 5 total themes and 15 total sub-themes (Table 5). This process yielded an acceptable inter-
 337 rater reliability statistic representing 86.5% agreement amongst the four independent researchers (Miles &
 338 Huberman, 1994). Moreover, the constant comparative method and subsequent presentations of the
 339 presence of absence of dichotomous themes and sub-themes via frequency reporting is common, widely
 340 accepted, and an appropriate methodological data analysis approach in the social sciences (Bobilya et al.,
 341 2005; Ferguson et al., 2019; Krippendorff, 2018).

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

349 **Table 5.** Frequency of COVID-19 pandemic impact themes and sub-themes
 350

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

351 *Note. Percentages may not equal 100 because of rounding.
 352

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

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

373 The theme of *general recreation impacts* ($n= 77$ or 26.4%) received a considerable number of
374 responses. General recreation impact sub-themes included decreased visitation ($n=53$), negatively
375 impacted recreation experiences ($n=15$), positively impacted recreation experiences ($n=6$), and increased
376 visitation ($n=5$). Many respondents noted the pandemic caused them to take “fewer trips” and make “less
377 visits” to the WMNF. For example, one respondent noted, “I am using the WMNF significantly less than
378 I normally would be due to COVID”, while another commented, “We’ve avoided the WMNF in general
379 during the pandemic.” Respondents also noted impacts associated with “vacation cancelations”. One
380 visitor explained, “Our annual family camping trip to the WMNF was cancelled”. The few positive and/or
381 increased visitation impact anecdotes related to “spending more time outside”, “social distancing
382 opportunities”, and other various enhancement to the recreation experience.

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

395 The theme of *behavioral adaption impacts* ($n =52$ or 17.9%) was the least frequently mentioned
396 theme, but remained relatively common. The sub-themes within behavioral adaptations included avoidance
397 ($n=23$), resource substitution ($n=16$), displacement ($n=6$), activity substitution ($n=4$), and temporal
398 substitution ($n=3$). Avoidance behaviors were commonly associated with “not visiting certain areas” and
399 “avoiding other visitors on-trail”. One visitor noted, “I completely avoided places where I thought other
400 people would be most likely to visit, especially if there were more than 10 cars in the parking lot”.
401 Resource substitution behaviors mostly revolved around the concepts of “choosing different trails” and
402 “finding more remote trails”. For example, one respondent noted, “I have young kids and we normally hit
403 the popular easy trails, but we searched out lesser used trails during COVID”. Instances of displacement,

404 activity, and temporal substitution behaviors were less frequent. One visitor explained, “I haven’t been
 405 back to the WMNF because of COVID”, while another noted, “I stopped hiking on weekends in the
 406 WMNF.”

407
 408 **4.4 Research Question Three**

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

422 Results revealed significant differences for behavioral adaptations by reported annual household
 423 income. Results suggest upper middle-income respondents (making \$75,000-100,000 annually) were
 424 decidedly most likely to engage in various substitution behaviors on the WMNF (Table 6). Results also
 425 revealed significant differences for both conflict interactions and overall negative recreation experiences,
 426 by reported gender (Table 7). During the pandemic, women reported higher levels of both conflict and
 427 overall negative recreation experiences on the WMNF, relative to men.

428
 429 **Table 6.** Associations between WMNF visitors’ income and behavioral adaptations in response to
 430 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%

431 ^aChi-Square: 11.2, df: 2, p: .004, Phi: 0.20

432 ^{1&2}Bonferroni post-hoc analysis determined that the \$75,000-\$100,000 group significantly differed (p: .001) from
 433 the other two groups.

434
 435 **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%

436 ^aChi-Square: 9.4, df: 1, p: .002, Phi: 0.17

437 ^bChi-Square: 13.8, df: 1, p: .001, Phi: 0.21

438
 439 **5.0 Discussion**

440 The COVID-19 pandemic fundamentally altered outdoor recreation visitation and experiences
 441 within PPAs across the United States. These impacts may have significant influences upon the visitors,
 442 resources, communities, and economies which rely upon PPAs. The literature has largely examined this

443 phenomenon within a narrow scope, often focusing on a single issue at a single site. This research,
444 however, is one of the first mixed-method studies to examine visitor impacts, behaviors, and decision-
445 making related to the pandemic, across an entire National Forest system in New England. This study
446 found that nearly three-quarters (70%) of WMNF visitors perceived the pandemic impacted their
447 recreation experience, with more than one-third (35%) of visitors indicating the pandemic had either a
448 *major* or *severe* impact upon their recreation experience. Amongst those impacted respondents, various
449 historically marginalized populations (e.g., low-income households and females) reported significantly
450 higher levels of perceived impacts. Further, study findings suggest that nearly one-fifth of respondents
451 (18%) changed their outdoor recreation behaviors or experiences because of social, situational, and/or
452 ecological pandemic related impacts. These findings corroborate the influence of the pandemic upon
453 parks and protected areas and raise important theoretical and managerial questions.

454

455 **5.1 Theoretical Implications**

456 This study examined the prominent theory-in-use that outdoor recreation visitor experiences,
457 behaviors, and decision-making have been altered during the COVID-19 pandemic (Ferguson et al., 2022,
458 2021b; Zeithaml et al., 2020). Study findings investigated this premise and determined that visitor
459 experiences, behaviors, and decision-making were significantly impacted during the pandemic, across an
460 entire National Forest system. Results revealed that as the pandemic progressed, not only were social
461 impacts prevalent, but instances of situational and ecological impacts also became more pronounced,
462 often necessitating the employment of various behavioral adaptation techniques in an effort to preserve
463 the overall recreation experience and natural resource (Brassil, 2020; Ferguson et al., 2021; Rice et al.,
464 2020; Siler, 2020). The context of this study is also important as this theory-in-use was examined not just
465 at one site or location, but across an entire National Forest system. Thus, while this study did not
466 explicitly examine and test an SES model, study findings lend themselves to certain components of the
467 SES conceptual framework, which serves to explore interconnected systems and their adaptive functions
468 within the broader recreation ecosystem (Anderies, et al., 2004; Morse, 2020).

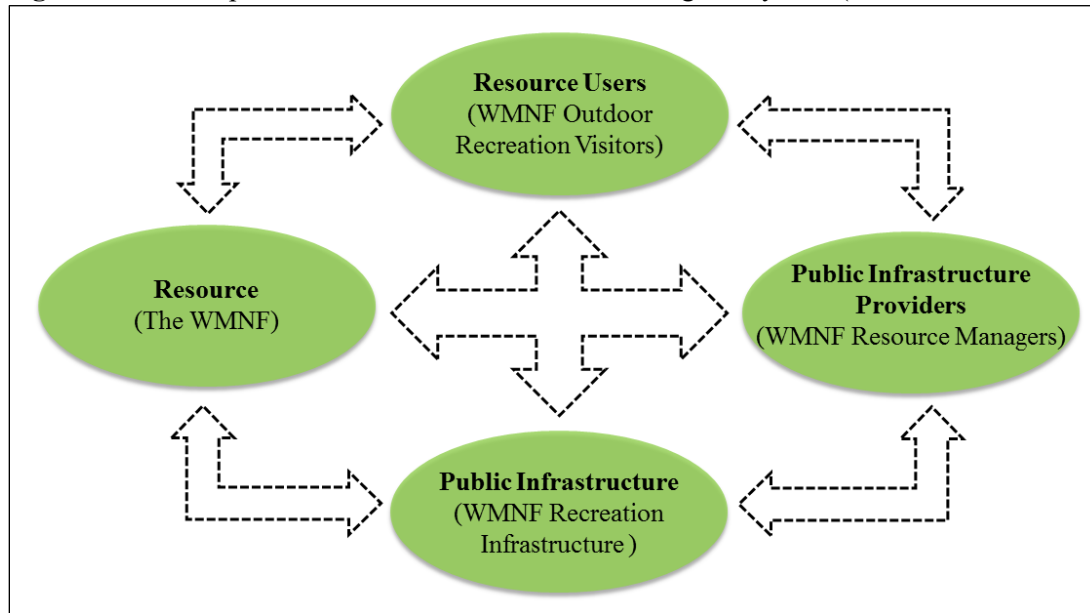
469 The concept of resiliency has become central to understanding and managing complex SES
470 systems (Walker et al., 2006). Study findings suggest the WMNF system may be resilient as inferred by
471 the overall systems' ability to seemingly change and adapt during the pandemic (Janssen et al., 2007).
472 However, inferences regarding overall WMNF system resilience must be interpreted with caution as study
473 findings suggest ecological resilience may have increased (e.g., reduced visitation), yet social resilience
474 may have decreased (e.g., negative impacts upon historically marginalized populations). Moreover,
475 results suggest that continuous spatial and temporal adaptations have and may continue to manifest across
476 the four interconnected feedback components of the WMNF SES conceptual framework (Fig 1). For
477 instance, as visitors employ behavioral adaptations as a result of encountering pandemic induced impacts,
478 spatial adaptations such as visitor site selection and movements have and may continue to occur at the
479 site, district, and even forest level. An example from this study is the reported visitor avoidance of
480 crowded WMNF sites in pursuit of less densely populated areas. Further, the pandemic presents unique
481 short- and long-term temporal adaptations. For instance, daily, monthly, and annual visitation rates have
482 and may continue to fluctuate dramatically, based largely on the complex relationship between the
483 pandemic and outdoor recreation visitation (Ferguson et al., 2022). For example, study respondents
484 reported a decrease in recreation visitation during the pandemic.

485 Moreover, spatial and temporal variations will likely influence the interconnected feedback
486 components of the SES including WMNF outdoor recreation visitors (e.g., resource users), WMNF
487 resource managers (e.g., public infrastructure providers), the National Forest itself (e.g., the resource), as
488 well as the developed and undeveloped WMNF recreation infrastructure (e.g., public infrastructure) (Fig
489 1) (Anderies, et al., 2004). Previous research suggests the robustness and subsequent resiliency of an
490 entire system can hinge largely on the key linkage and working relationship between resource users (e.g.,
491 WMNF visitors) and public infrastructure providers (e.g., WMNF resource managers) (Anderies, et al.,
492 2004). This essential relationship is built on pillars of repeated interactions, reciprocity, reputation, and
493 ultimately trust (Anderies, et al., 2004; Ostrom, 1998). This relationship is even more critical when

494 considering the inequality of impacts found in this study amongst historically marginalized populations.
495 Thus, the robustness of the overall system is paramount, especially when system performance is
496 susceptible to unpredictable external perturbations such as a global pandemic (Anderies, et al., 2004;
497 Carlson & Doyle, 2002).

498
499

Figure 1. A Conceptual Model of a WMNF Social-Ecological System (Anderies et al., 2004)



500
501

5.2 Management Implications

502 For PPA managers and policymakers, study results suggest a series of unique challenges and
503 opportunities, especially as the pandemic continues. While it is important to quantitatively assess
504 pandemic-related recreation impacts, the deeper discussion may revolve around a more nuanced
505 interpretation of qualitative impact data. Qualitative responses not only explicitly identified various
506 social, situational, ecological, and behavioral impacts, but they also spoke to the interconnectivity of
507 impacts within the broader social-ecological system. For instance, one visitor noted, “The sheer volume
508 and overuse by what seemed like mostly new hikers was wreaking havoc on the forest, people, and
509 communities who love this area.” While another commented, “The crowding and litter, mainly from out-
510 of-staters, was so intense at many of our favorite [WMNF] trails that my family and I had to cut our stay
511 short and leave the area to find a less popular trail.” Many of these interconnected impacts seem to have
512 stemmed from instances of crowding and conflict associated with out-of-state visitation, corroborating
513 previous research which determined both above average visitation and non-local visitation during the
514 pandemic on the WMNF (Ferguson et al., 2021, 2022). More concerning, however, is the inequity of
515 these impacts amongst historically marginalized populations, namely female and lower income visitors.
516

517 Study findings suggest visitor crowding and conflict, followed closely by visitor access and
518 equity, should be a top priority for management and policymakers. This focus is even more important
519 when considering the projected longevity of the pandemic as well as global trends towards diversity,
520 equity, and inclusion (DEI) in parks and protected areas (CDC, 2020; Derks et al., 2020; Hautamaki,
521 2020; Rice et al., 2020; Powers et al., 2020). To that end, study results infer that high- and middle-income
522 visitors can adapt to pandemic related impacts, yet low-income visitors are largely unable to adapt and
523 respond to said impacts, effectively forcing them to live with their current situation. Further, female
524 visitors were significantly more susceptible to negative experiences and impacts. Resource managers
525 might consider implementing a multi-tiered approach (e.g., before, during, and after a recreation
526 experience) to messaging and communication primarily focusing on educating visitors (with a focus on

527 out-of-state visitors) and adjacent communities in recreation norms, trail etiquette, DEI, and Leave No
528 Trace principles. Specifically, managers may consider focusing on recreation sites and communities
529 particularly susceptible to crowding and conflict and make concerted efforts to establish rapport amongst
530 both local and non-local visitor populations. This strategy could benefit from working with various non-
531 profit partners such as Outdoors for All and Women Outdoors to further promote equity and access in the
532 outdoors and destigmatize the impacts faced by historically marginalized populations. Moreover, resource
533 managers must also be cognizant of the influence of these management strategies, coupled with visitors'
534 behavioral adaptations and inequities, upon the larger social-ecological system.
535

536 **5.3 Implications for Future Research**

537 There were various study limitations and implications for future research as a result of this
538 research such as augmenting the study sample and including more diversity, the employment of cross-
539 sectional data, a more thorough investigation of SES, the potential limitations associated with the constant
540 comparative method, the representativeness and generalizability of study finding, and a more nuanced
541 investigation of crowding and conflict. Due to pandemic-related safety protocols and funding limitation,
542 the study sample was rather homogenous, consisting largely of in-state and white visitors. Future research
543 should consider broadening the study sample to include out-of-state, regional, and more diverse
544 populations. This study examined visitor perceptions arguably at the peak of the pandemic, during the
545 summer months of 2020 on the WMNF. Future research should consider assessing visitor impacts,
546 behaviors, and decision-making on a larger temporal scale to account for the ebbs and flows of the
547 pandemic. Next, study findings lend themselves to certain components of the SES framework, however,
548 this study did not explicitly examine and test SES theory. Future research may consider specifically
549 examining the multiple interconnected subsystems associated with SES such as social, ecological,
550 economic, and community impacts. Future research might also consider the potential benefits, limitations,
551 and subjectivity associated with the constant comparison method and dichotomous thematic coding. It is
552 important to note that the constant comparison method, when combined with open and axial coding,
553 applies the relative same importance equally to each theme/sub-theme; thus, making it impossible to
554 assess the relative importance or emphasis of each theme/sub-theme. Future research might consider
555 employing rank-order scaling to open-ended comments to provide respondents the ability to express
556 importance; especially for study questions of importance to resource managers. It is also important to
557 note that study data were not weighted as the goal of this research was to maximize the number of
558 respondents who were frequent users of the WMNF. Thus, study data should be interpreted with caution
559 as it is not representative of and/or generalizable to *all* WMNF visitors. Finally, future research should
560 consider including additional questions about visitor expectations and outcomes regarding crowding and
561 conflict, specifically seeking more nuanced information regarding the source, meaning, expectations, and
562 standards.
563

564 **6.0 Conclusion**

565 Results from this mixed-method study suggest that during the peak of the COVID-19 pandemic,
566 the vast majority of WMNF visitors perceived significant experiential and behavioral impacts.
567 Specifically, social, situational, ecological, behavioral, and sociodemographic factors were found to
568 significantly influence overall visitor decision-making and experience quality on the WMNF. Study
569 findings also serve to highlight the inequality of impacts amongst historically marginalized populations,
570 as low-income and female visitors were particularly susceptible to impacts. Results suggest that as the
571 pandemic progressed, and impacts become more pronounced, the employment of various behavioral
572 adaptations were often necessary. These impacts and associated behavioral and experiential
573 modifications, combined with various inequities, may present unique downstream SES influences upon
574 the visitors, resources, communities, and economies which rely upon the parks and protected areas. This

575 study demonstrates the influence of the pandemic upon parks and protected areas and considers outdoor
576 recreation as a central component when exploring the complex human-nature connection.

577

578 **7.0 Acknowledgements**

579 Study funding was provided by the USDA Forest Service – WMNF. The participation from
580 community residents and WMNF visitors was invaluable for the completion of this research.

581 Additionally, the authors would like to acknowledge the original peoples who inhabited the WMNF
582 including the Abenaki, Malecite, Passamaquoddy, and Penacook peoples.

583 **8.0 References**

- 584 Anderies, J. M., Janssen, M. A., & Ostrom, E. (2004). A framework to analyze the robustness of social-
585 ecological systems from an institutional perspective. *Ecology and society*, 9(1).
- 586 Associated Press. (2021) Omicron Unravels Travel Industry's Plan for a Comeback. U.S. News. Accessed
587 on January 12, 2022. [https://www.usnews.com/news/business/articles/2021-12-01/omicron-](https://www.usnews.com/news/business/articles/2021-12-01/omicron-unravels-travel-industrys-plans-for-a-comeback)
588 [unravels-travel-industrys-plans-for-a-comeback](https://www.usnews.com/news/business/articles/2021-12-01/omicron-unravels-travel-industrys-plans-for-a-comeback).
- 589 Beery, T., Olsson, M. R., & Vitestam, M. (2021). Covid-19 and outdoor recreation management:
590 Increased participation, connection to nature, and a look to climate adaptation. *Journal of*
591 *Outdoor Recreation and Tourism*, 36, 100457.
- 592 Bobilya, A. J., McAvoy, L. H., & Kalisch, K. R. (2005). A Mixed-Method Investigation of the
593 Wilderness Solo and FLOW (Leisure & Recreation).
- 594 Brassil, G. (2020). As hiking surges during the pandemic, so do injuries. *New York Times*. Accessed
595 November 28, 2020: <https://www.nytimes.com/2020/11/28/sports/covid-hiking-parks-trails.html>.
- 596 Brunson, M. W., & Shelby, B. (1993). Recreation substitutability: A research agenda. *Leisure Sciences*,
597 15(1), 67–74.
- 598 Carlson, J. M., & Doyle, J. (2002). Complexity and robustness. *Proceedings of the national academy of*
599 *sciences*, 99(suppl 1), 2538-2545.
- 600 Carr, C. (2020). Outdoor Renaissance: Industry growth and enhanced programming provide opportunities
601 for UNH students. *University of New Hampshire*. Accessed October 20, 2020:
602 <https://www.unh.edu/unhtoday/2020/10/outdoor-renaissance>.
- 603 Center for Disease Control [CDC]. (2020). Coronavirus Disease 2019 (COVID-19) – Prevention &
604 Treatment. Centers for Disease Control and Prevention. *CDC*. Accessed September 20, 2020:
605 <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>.
- 606 Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Sage.
- 607 Chow, A. (2020). National parks are getting trashed during COVID-19, endangering surrounding
608 communities. *Time Magazine*. Accessed July 25, 2020: [https://time.com/5869788/national-parks-](https://time.com/5869788/national-parks-covid-19/)
609 [covid-19/](https://time.com/5869788/national-parks-covid-19/).
- 610 Chun Tie, Y., Birks, M., & Francis, K. (2019). Grounded theory research: A design framework for novice
611 researchers. *SAGE open medicine*, 7, 2050312118822927.
- 612 Cole (2021). Parks experience visitor boom in last year, officials advocate Leave No Trace ethics.
613 *Watauga Democrat*. Accessed April 15, 2020: [https://www.wataugademocrat.com/news/parks-](https://www.wataugademocrat.com/news/parks-experience-visitor-boom-in-last-year-officials-advocate-leave-no-trace-ethics/article_7eb9b523-e4ff-5b5b-80bb-878fdeaaf167.html)
614 [experience-visitor-boom-in-last-year-officials-advocate-leave-no-trace-ethics/article_7eb9b523-](https://www.wataugademocrat.com/news/parks-experience-visitor-boom-in-last-year-officials-advocate-leave-no-trace-ethics/article_7eb9b523-e4ff-5b5b-80bb-878fdeaaf167.html)
615 [e4ff-5b5b-80bb-878fdeaaf167.html](https://www.wataugademocrat.com/news/parks-experience-visitor-boom-in-last-year-officials-advocate-leave-no-trace-ethics/article_7eb9b523-e4ff-5b5b-80bb-878fdeaaf167.html).
- 616 Colman, A., & Dolesh, R. (2020). Coronavirus: What impact will COVID-19 have on parks and
617 recreation? *New Hampshire Public Radio*. Accessed March 15, 2020:
618 [https://www.nrpa.org/blog/coronavirus-what-impact-will-covid-19-have-on-parks-and-](https://www.nrpa.org/blog/coronavirus-what-impact-will-covid-19-have-on-parks-and-recreation/)
619 [recreation/](https://www.nrpa.org/blog/coronavirus-what-impact-will-covid-19-have-on-parks-and-recreation/).
- 620 Corbin, J. & Strauss, A. L. (2014). *Basics of qualitative research*. Thousand Oaks, CA: Sage Publishing.
- 621 Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed).
622 Thousand Oaks, CA: Sage.
- 623 Derks, J., Giessen, L., & Winkel, G. (2020). COVID-19-induced visitor boom reveals the importance of
624 forests as critical infrastructure. *Forest Policy and Economics*, 118, 102253.
- 625 Dolesh, R. J. (2020). How Parks and Recreation Will Change Forever. *Parks & Recreation Magazine*,
626 55(8), 38-43.
- 627 Dorsch, T. E., Richards, K. A. R., Swain, J., & Maxey, M. (2016). The effect of an outdoor recreation
628 program on individuals with disabilities and their family members: A case study. *Therapeutic*
629 *Recreation Journal*, 50(2), 155.
- 630 Erwin, C., Aultman, J., Harter, T., Illes, J., & Kogan, R. C. J. (2020). Rural and Remote Communities:
631 Unique Ethical Issues in the COVID-19 Pandemic. *The American Journal of Bioethics*, 1-4.

632 Ferguson, M. D., Mueller, J. T., Graefe, A. R., & Mowen, A. J. (2018). Coping with climate change: a
633 study of Great Lakes water-based recreationists. *Journal of Park and Recreation Administration*,
634 36(2). <https://doi.org/10.18666/JPRA-2018-V36-I2-8296>.

635 Ferguson, M. D., McIntosh, K., English, D. K., Ferguson, L. A., Barcelona, R., Giles, G., Fraser, O., &
636 Leberman, M. (In press- 2022). The Outdoor Renaissance: Assessing the Impact of the COVID-
637 19 Pandemic upon Recreation Visitation in New England's National Forests. *Society of Natural*
638 *Resources*.

639 Ferguson, M. D., Giles, G., Ferguson, L. A., Barcelona, R., Evensen, D., & Barrows, C. (In press- 2021).
640 Seeing the Forest for the Trees: A Social-Ecological Systems Approach to Managing Outdoor
641 Recreation Visitation in Parks and Protected Area. *Journal of Outdoor Recreation and Tourism*.

642 Freeman, S. & Eykelbosh, A. (2020). COVID-19 and outdoor safety: Considerations for use of outdoor
643 recreational spaces. *National Collaborating Centre for Environmental Health*, 829.

644 Hale, J. (2020). Rise of the rookie hikers: The pandemic pushed a new wave of people outside, for better
645 or worse. *The Oregonian*. Accessed January 10, 2020:
646 [https://www.oregonlive.com/travel/2020/12/rise-of-the-rookie-hikers-the-pandemic-pushed-a-](https://www.oregonlive.com/travel/2020/12/rise-of-the-rookie-hikers-the-pandemic-pushed-a-new-wave-of-people-outside-for-better-or-worse.html)
647 [new-wave-of-people-outside-for-better-or-worse.html](https://www.oregonlive.com/travel/2020/12/rise-of-the-rookie-hikers-the-pandemic-pushed-a-new-wave-of-people-outside-for-better-or-worse.html).

648 Hauslohner, A. & Thebault, R. (2020). A deadly 'checkerboard': Covid-19's new surge across rural
649 America. *The Washington Post*. Accessed June 10, 2020:
650 [https://www.washingtonpost.com/nation/2020/05/24/coronavirus-rural-america-](https://www.washingtonpost.com/nation/2020/05/24/coronavirus-rural-america-outbreaks/?arc404=true)
651 [outbreaks/?arc404=true](https://www.washingtonpost.com/nation/2020/05/24/coronavirus-rural-america-outbreaks/?arc404=true).

652 Hautamaki, A. (2020) As crowds swell on public lands, visitors learn how to minimize their impact.
653 *National Geographic Magazine*. Accessed November 11, 2020:
654 [https://www.nationalgeographic.com/travel/2020/11/how-to-care-for-national-lands-despite-](https://www.nationalgeographic.com/travel/2020/11/how-to-care-for-national-lands-despite-coronavirus-wildfire-pressures/)
655 [coronavirus-wildfire-pressures/](https://www.nationalgeographic.com/travel/2020/11/how-to-care-for-national-lands-despite-coronavirus-wildfire-pressures/).

656 Hockings, M., Dudley, N., Elliott, W., Rao, M., Redford, K., & Robinson, J. (2020). COVID-19 and
657 protected and conserved areas. *Parks: The International Journal of Protected Areas and*
658 *Conservation*.

659 Jackson-Smith, D., Flint, C. G., Dolan, M., Trentelman, C. K., Holyoak, G., Thomas, B., & Ma, G.
660 (2016). Effectiveness of the drop-off/pick-up survey methodology in different neighborhood
661 types. *Journal of Rural Social Sciences*, 31(3), 3.

662 Janssen, M. A., Anderies, J. M., & Ostrom, E. (2007). Robustness of social-ecological systems to spatial
663 and temporal variability. *Society and Natural Resources*, 20(4), 307-322.

664 Krippendorff, K. (2018). *Content analysis: An introduction to its methodology*. Sage publications.

665 Landry, C. E., Bergstrom, J., Salazar, J., & Turner, D. (2021). How Has the COVID-19 Pandemic
666 Affected Outdoor Recreation in the US? A Revealed Preference Approach. *Applied Economic*
667 *Perspectives and Policy*, 43(1), 443-457.

668 Langlois, K. (2020). Summer at America's national parks kicks off with long lines and crowded trails.
669 *National Geographic Magazine*. Accessed June 14, 2020:
670 [https://www.nationalgeographic.com/travel/2020/05/national-parks-reopen-to-hectic-crowds-but-](https://www.nationalgeographic.com/travel/2020/05/national-parks-reopen-to-hectic-crowds-but-what-happens-next/)
671 [what-happens-next/](https://www.nationalgeographic.com/travel/2020/05/national-parks-reopen-to-hectic-crowds-but-what-happens-next/).

672 Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage publications.

673 Maine Office of Tourism [MOT] (2020). State Visitation Highlights. *Maine Office of Tourism*. Accessed
674 October 10, 2020: [https://motpartners.com/wp-](https://motpartners.com/wp-content/uploads/2021/05/2020_Maine_Tourism_Highlight.pdf)
675 [content/uploads/2021/05/2020_Maine_Tourism_Highlight.pdf](https://motpartners.com/wp-content/uploads/2021/05/2020_Maine_Tourism_Highlight.pdf).

676 Mawson, M. (2020). Green mountain national forest limits site access. *Manchester Journal*. Accessed
677 November 15, 2020: [https://www.manchesterjournal.com/news/local/green-mountain-national-](https://www.manchesterjournal.com/news/local/green-mountain-national-forest-limits-site-access/article_ded2e671-5814-52ef-b2c3-1472bfbbaf0b.html)
678 [forest-limits-site-access/article_ded2e671-5814-52ef-b2c3-1472bfbbaf0b.html](https://www.manchesterjournal.com/news/local/green-mountain-national-forest-limits-site-access/article_ded2e671-5814-52ef-b2c3-1472bfbbaf0b.html).

679 Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed).
680 Thousand Oaks, CA: Sage.

681 Mitten, D., Gray, T., Allen-Craig, S., Loeffler, T. A., & Carpenter, C. (2018). The invisibility cloak:
682 Women's contributions to outdoor and environmental education. *The Journal of Environmental*
683 *Education*, 49(4), 318-327.

684 More, T., & Stevens, T. (2000). Do user fees exclude low-income people from resource-based recreation?
685 *Journal of Leisure Research*, 32(3), 341-357.

686 Morse, W. (2020). Recreation as a social-ecological complex adaptive system. *Sustainability*,
687 12(753), 1-16. <https://doi.org/10.3390/su12030753>.

688 National Forest Foundation [NFF]. (2020). White Mountain National Forest. nationalforests.org.
689 Accessed April 20, 2020: [https://www.nationalforests.org/our-forests/find-a-forest/white-](https://www.nationalforests.org/our-forests/find-a-forest/white-mountain-national-forest)
690 [mountain-national-forest](https://www.nationalforests.org/our-forests/find-a-forest/white-mountain-national-forest).

691 National Park Service [NPS]. (2020). About us: Visitation Numbers. Accessed November 6, 2020:
692 <https://www.nps.gov/aboutus/visitation-numbers.htm>.

693 Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action: Presidential
694 address, American Political Science Association, 1997. *American political science review*, 92(1),
695 1-22.

696 Outdoor Industry Association [OIA]. (2021). Outdoor Participation Trends Report. *Outdoor Industry*
697 *Association*. Accessed September 10, 2021: [https://outdoorindustry.org/resource/2021-outdoor-](https://outdoorindustry.org/resource/2021-outdoor-participation-trends-report/)
698 [participation-trends-report/](https://outdoorindustry.org/resource/2021-outdoor-participation-trends-report/).

699 Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage
700 publications.

701 Powers, S. L., Lee, K. J., Pitas, N. A., Graefe, A. R., & Mowen, A. J. (2020). Understanding access and
702 use of municipal parks and recreation through an intersectionality perspective. *Journal of Leisure*
703 *Research*, 51(4), 377-396.

704 Ramer (2020). COVID Saturday update: National Forest Service shuts down trailheads in White
705 Mountains. *The Concord Monitor*. Accessed May 25, 2020:
706 <https://www.concordmonitor.com/NH-COVID-19-update-for-Saturday-April-25-34054695>.

707 Randall, C. (2020). Why Going Outside is Good for your Health, Especially Right Now. *Forbes*
708 *Magazine*. Accessed September 10, 2021:
709 [https://www.forbes.com/sites/cassidyrandall/2020/04/09/why-going-outside-is-good-for-your-](https://www.forbes.com/sites/cassidyrandall/2020/04/09/why-going-outside-is-good-for-your-health-especially-right-now/?sh=413369032de9)
710 [health-especially-right-now/?sh=413369032de9](https://www.forbes.com/sites/cassidyrandall/2020/04/09/why-going-outside-is-good-for-your-health-especially-right-now/?sh=413369032de9).

711 Rice, W. L., Mateer, T. J., Reigner, N., Newman, P., Lawhon, B., & Taff, B. D. (2020). Changes in
712 recreational behaviors of outdoor enthusiasts during the COVID-19 pandemic: Analysis across
713 urban and rural communities. *Journal of Urban Ecology*, 6(1).
714 <https://doi.org/10.1093/jue/juaa020>.

715 Rosa, C. D., Larson, L. R., Collado, S., Cloutier, S., & Profice, C. C. (2020). Gender differences in
716 connection to nature, outdoor preferences, and nature-based recreation among college students in
717 Brazil and the United States. *Leisure Sciences*, 1-21.

718 Siler, W. (2020). Inconsistent Mask Regulations in Parks Risk Lives: The National Park Service has
719 abdicated responsibility for visitor safety, compromising local mandates and leaving staff and
720 vendors to fend for themselves. *Outside Magazine*. Accessed September 15, 2021:
721 <https://www.outsideonline.com/2415603/national-parks-mask-rules-inconsistent>.

722 Spenceley, A., McCool, S., Newsome, D., Báez, A., Barborak, J. R., Blye, C. J., & Zschiegner, A. K.
723 (2021). Tourism in protected and conserved areas amid the COVID-19 pandemic. *Parks*, (27),
724 103-118.

725 Stedman, R. C., Connelly, N. A., Heberlein, T. A., Decker, D. J., & Allred, S. B. (2019). The end of the
726 (research) world as we know it? Understanding and coping with declining response rates to mail
727 surveys. *Society & Natural Resources*, 32(10), 1139-1154.

728 Trawalter, S., Hoffman, K., & Palmer, L. (2021). Out of place: Socioeconomic status, use of public space,
729 and belonging in higher education. *Journal of Personality and Social Psychology*, 120(1), 131.

730 United States Department of Agriculture Forest Service [USDA FS]. (2005). Visitor use report White
731 Mountain NF. Accessed April 20, 2020:
732 https://apps.fs.usda.gov/nvum/results/ReportCache/2005_A09022_Master_Report.pdf.
733 United States Department of Agriculture Forest Service [USDA FS]. (2015). Visitor use report White
734 Mountain NF. Accessed April 20, 2020:
735 https://apps.fs.usda.gov/nvum/results/ReportCache/2015_A09022_Master_Report.pdf.
736 United States Department of Agriculture Forest Service [USDA FS]. (2016.) Jobs and income: Economic
737 contributions in 2016 at a glance. Accessed April 20, 2020:
738 [https://www.fs.fed.us/emc/economics/contributions/documents/at-a-](https://www.fs.fed.us/emc/economics/contributions/documents/at-a-glance/published/eastern/AtaGlance-WhiteMountain.pdf)
739 [glance/published/eastern/AtaGlance-WhiteMountain.pdf](https://www.fs.fed.us/emc/economics/contributions/documents/at-a-glance/published/eastern/AtaGlance-WhiteMountain.pdf).
740 United States Department of Agriculture Forest Service [USDA FS]. (2020). White Mountain National
741 Forest: Facts about the forest. fs.usda.gov. [https://www.fs.usda.gov/detail/whitemountain/about-](https://www.fs.usda.gov/detail/whitemountain/about-forest/?cid=FSEPRD580336)
742 [forest/?cid=FSEPRD580336](https://www.fs.usda.gov/detail/whitemountain/about-forest/?cid=FSEPRD580336).
743 Valigra, L. (2021). Maine's tourism industry sees signs of recovery after decline in 2020 visitors. *Bangor*
744 *Daily News*. Accessed May 15, 2021: [https://bangordailynews.com/2021/05/05/business/maines-](https://bangordailynews.com/2021/05/05/business/maines-tourism-industry-sees-signs-of-recovery-after-decline-in-2020-visitors/)
745 [tourism-industry-sees-signs-of-recovery-after-decline-in-2020-visitors/](https://bangordailynews.com/2021/05/05/business/maines-tourism-industry-sees-signs-of-recovery-after-decline-in-2020-visitors/).
746 Venter, Z., Barton, D., Gundersen, V., Figari, H., & Nowell, M. (2020). Urban nature in a time of crisis:
747 Recreational use of green space increases during the COVID-19 outbreak in Oslo, Norway.
748 *Environmental Research Letters*. <https://doi.org/10.1088/1748-9326/abb396>.
749 Vermont Outdoor Recreation Economic Collaborative [VOREC] (2020). VOREC Response to COVID-
750 19. *Stay Home Stay Safe Executive Order*. Accessed September 1, 2021:
751 [https://governor.vermont.gov/sites/scott/files/documents/ADDENDUM%206%20TO%20EXEC-](https://governor.vermont.gov/sites/scott/files/documents/ADDENDUM%206%20TO%20EXECUTIVE%20ORDER%2001-20.pdf)
752 [UTIVE%20ORDER%2001-20.pdf](https://governor.vermont.gov/sites/scott/files/documents/ADDENDUM%206%20TO%20EXECUTIVE%20ORDER%2001-20.pdf).
753 Wallen, K. E., Landon, A. C., Kyle, G. T., Schuett, M. A., Leitz, J., & Kurzawski, K. (2016). Mode effect
754 and response rate issues in mixed-mode survey research: implications for recreational fisheries
755 management. *North American Journal of Fisheries Management*, 36(4), 852-863.
756 <https://doi.org/10.1080/02755947.2016.1165764>.
757 Wang, J. (2020). Why time outdoors is crucial to your health, even during the coronavirus pandemic.
758 *University of Chicago News*. Accessed April 20, 2020: [https://news.uchicago.edu/story/why-time-](https://news.uchicago.edu/story/why-time-outdoors-crucial-your-health-even-during-coronavirus-pandemic)
759 [outdoors-crucial-your-health-even-during-coronavirus-pandemic](https://news.uchicago.edu/story/why-time-outdoors-crucial-your-health-even-during-coronavirus-pandemic).
760 Walker, B. H., Anderies, J. M., Kinzig, A. P., & Ryan, P. (2006). Exploring resilience in social-ecological
761 systems through comparative studies and theory development: introduction to the special
762 issue. *Ecology and society*, 11(1).
763 White, D. D., Virden, R. J., & Riper, C. J. (2008). Effects of place identity, place dependence, and
764 experience-use history on perceptions of recreation impacts in a natural setting. *Ecological*
765 *Management*, 42, 647-657. DOI 10.1007/s00267-008-9143-1.
766 Zeithaml, V. A., Jaworski, B. J., Kohli, A. K., Tuli, K. R., Ulaga, W., & Zaltman, G. 2020. A theories-in-
767 use approach to building marketing theory. *Journal of Marketing*, 84(1), 32-51.
768