
Informing Visitor Use Management and Outfitter Guide Permitting in the Lye Brook Wilderness of the Green Mountain & Finger Lakes National Forests: Final Report



Submitted to the
USDA Forest Service Green Mountain &
Finger Lakes National Forests



Submitted by the Department of
Recreation Management and Policy
The University of New Hampshire

June 01, 2022

Informing Visitor Use Management and Outfitter Guide Permitting in the Lye Brook Wilderness of the Green Mountain & Finger Lakes National Forests: Final Report

by:

Michael D. Ferguson, Ph.D.¹
Alexander R. Caraynoff, M.S.²
Lauren A. Ferguson, Ph.D.³
Robert J. Barcelona Ph.D.⁴

¹Assistant Professor, Recreation Management and Policy, 193 Hewitt Hall, University of New Hampshire, Durham, NH 03823, USA, (603) 862-1644, Michael.Ferguson@unh.edu.

*Project Principal Investigator

²Graduate Research Assistant, Recreation Management and Policy, 193 Hewitt Hall, University of New Hampshire, Durham, NH 03824, (603) 862-1644, arc1189@unh.edu.

³Assistant Professor, Recreation Management and Policy, 306 Hewitt Hall, University of New Hampshire, Durham, NH 03824, (603) 862-2429, Lauren.Ferguson@unh.edu.

⁴Associate Professor and Department Chair, Recreation Management and Policy, 191 Hewitt Hall, University of New Hampshire, Durham, NH 03824, (603) 862-1442, Bob.Barcelona@unh.edu.

Project Period: 09/01/2020 – 06/01/2022

Acknowledgements

The cooperation provided by USDA Forest Service Green Mountain & Finger Lakes National Forests was instrumental in the successful completion of this study. The Green Mountain & Finger Lakes National Forests natural resource managers were extremely helpful in identifying appropriate sampling locations, discussing site-specific management issues, and generously providing study funding. The organization, technical assistance, interviewing, and data processing provided by the University of New Hampshire Department of Recreation Management and Policy graduate students and project staff were extremely helpful in the completion of this project. The authors also wish to thank the study participants who took the time to share information concerning their use and evaluation of the Green Mountain & Finger Lakes National Forests. Additionally, the authors would like to acknowledge the original peoples who inhabited the Green Mountain & Finger Lakes National Forests including the Abenaki, Mohican, and Wabanaki peoples.

Table of Contents

Executive Summary	1
Overall key observations and findings:	1
Outfitter guide key observations and findings:.....	3
Section 1-0. Introduction	4
Section 1-1. Study Background and Objectives	4
Section 1-2. Methods.....	6
Section 2-0. Overall Results	8
Section 2-1. Respondent Profile	8
Section 2-2. Activity Participation	10
Section 2-3. Satisfaction and Intention-to-return	12
Section 2-4. Perceptions of Social Impacts	13
Section 2-5. Perceptions of Situational Impacts	14
Section 2-6. Perceptions of Ecological Impacts	16
Section 2-7. Coping and Substitution Behaviors.....	17
Section 2-8. Perceptions of Visitor Encounters & Outfitter Guides.....	18
Section 2-9. Management Preferences	21
Section 3-0. Advanced Statistical Data Analyses	22
Section 3-1. Structural Equation Modeling	22
Section 3-2. Binary Logistic Regression	23
Section 4-0. Summary and Conclusions	26
Section 4-1. Contextual Variables Summary and Conclusions	26
Section 4-2. Overall Summary and Conclusions.....	28
Section 5-0. Management Recommendations.....	29
Section 5-1. Specific Management Recommendations	29
Section 5-2. Management Recommendations Conclusions	34
Section 6-0. References	35
Appendix A. Staff, Students Supported, and Outreach/Extension.....	36
Appendix B. Survey Instrument.....	37

Table of Tables

Table 1. LBW visitors' respondent profile	8
Table 2. LBW visitors' activity participation profile.....	10
Table 3. Percentage of LBW visitors using each entrance and exit.....	11
Table 4. LBW visitors' overall satisfaction rating.....	12
Table 5. LBW visitors' satisfaction rating.....	12
Table 6. LBW visitors' intention-to-return rating.....	12
Table 7. LBW visitors' perceptions of social impacts.....	13
Table 8. LBW visitors' perceptions of situational impacts.....	14
Table 9. LBW visitors' perceptions of COVID-19 impacts.....	15
Table 10. LBW visitors' impacts due to COVID-19 – recreation usage.....	15
Table 11. LBW visitors' impacts due to COVID-19 – positive or negative.....	15
Table 12. LBW visitors' perceptions of ecological impacts.....	16
Table 13. LBW visitors' substitution responses.....	17
Table 14. LBW visitors' acceptability of visitors encountered at one time.....	19
Table 15. LBW visitors' maximum visitor encounters at one time before they would no longer visit.....	19
Table 16. Percentage of LBW visitors on a guided or non-guided trip.....	19
Table 17. LBW visitors' awareness of existing group limitation policy.....	20
Table 18. LBW visitors' support or opposition for management actions.....	21
Table 19. Logistic regression models predicting LBW experiential impacts.....	24
Table 20. Binary logistic regression models - extrapolations predicting LBW visitor impacts.....	25

Table of Figures

Figure 1. LBW outfitter guide infographic	3
Figure 2. LBW map and survey locations.....	7
Figure 3. Percentage of LBW visitors' indicating each overall level of crowding	13
Figure 4. LBW number of visitors encountered at one time	18
Figure 5. LBW visitors' perceptions of a group size limitation policy	20
Figure 6. Structural Equation Model.....	22

Executive Summary

The overarching goal of this study was to assess Lye Brook Wilderness (LBW) outdoor recreation visitors' perceptions, preferences, behaviors, and decision-making. The secondary goal of this study was to assess perceptions of outfitter guides and threshold of tolerance for both visitor encounters and outfitters guide group sizes within the LBW. An on-site exit-use intercept survey method was utilized to collect data from LBW visitors within the Green Mountain and Finger Lakes National Forests (GMNF) in the summer of 2021. For a guiding framework, this study utilized a systematic sampling plan and a mixed-method survey methodology, which resulted in 576 completed surveys and a 93% response rate. Readers are encouraged to review these findings as reflective of LBW visitors only, and *not* representative of *all* GMNF visitors. Study results and analyses are further detailed throughout the various sections of this report. Readers are encouraged to skip ahead to section 2-8 (pages 18-20) for specific information regarding outfitter guide perceptions.

Overall key observations and findings:

- The majority of LBW visitors in the sample were young adult white males from out-of-state who were politically moderate, yet slightly liberal leaning, who reported earning high levels of both household income and education (Section 2-1).
 - These findings suggest the LBW may be a *destination wilderness* as the vast majority of respondents were out-of-state (88%) and first-time (80%) visitors at the LBW, yet highly experienced.
- The sample largely consisted of highly experienced yet first-time visitors at the LBW who participated in a multitude of recreation activities such as *hiking, backpacking, and through hiking the Appalachian/Long Trail* (Sections 2-1 and 2-2).
- Respondents indicated very high levels of satisfaction with their overall LBW recreation experiences as well as high levels of intention-to-return (Section 2-3).
- Visitors perceived low to moderate levels of various impacts at the LBW (Sections 2-4 to 2-6).
 - *Crowding* was noted to be the most impactful social condition.
 - *Visible litter, garbage, and/or waste* was noted to be the most impactful situational condition.
 - *Trail muddiness* was noted to be the most impactful trail condition.
 - *Rain* was noted to be the most impactful weather condition.
- Visitors rarely found the need to employ behavioral adaptations or substitution behaviors at the LBW (Section 2-7).
 - The most commonly employed substitution behaviors were *strategic substitution* (e.g., changing gear) and *temporal substitution* (e.g., changing time of day).
 - The least commonly employed substitution behaviors were *activity substitution* (e.g., hiking instead of fishing) and *displacement* (e.g., no longer recreating at the LBW).
- It should be noted that the reported impacts (Sections 2-4 to 2-6) and behavioral adaptations (Section 2-7) in this study may have been artificially low as the sample consisted largely of first-time LBW visitors.
 - Research suggests first-time visitors often do not perceive impacts nor behaviorally adapt as much as repeat visitors (Arnberger & Brandenburg, 2007).

- Respondents largely agreed that the number of other visitors they encountered at the LBW was acceptable (Section 2-8).
 - Respondents reported encountering an *average/mean* of 6 visitors at one time and a *median* of 5 visitors at one time during their LBW recreation experiences.
 - The majority of visitors (83%) reported they were unaware of the current group size limitation policy of no more than 10 people per group at the LBW.

- Visitors indicated varying levels of support for management actions (Section 2-9).
 - *Require visitors to carry-out all litter, trash, and/or waste* received the highest level of support, followed closely by *prohibit illegal campfires*, and *increase signage about proper visitor behavior/recreation impacts*.
 - *Implement an entrance fee* had the least support.

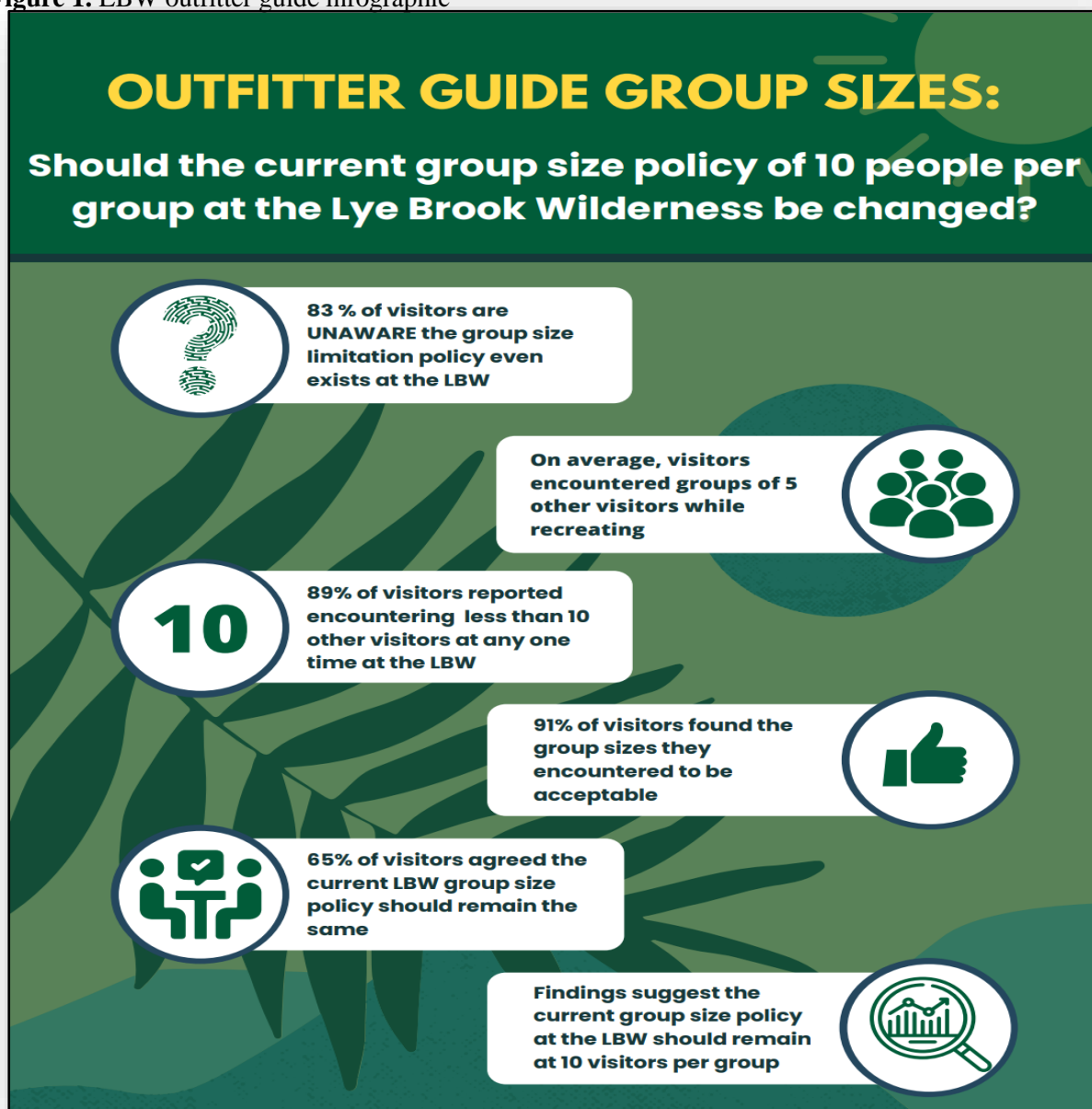
- Structural equation modeling indicated visitors were *partially able* to cope/adapt to social, situational, and ecological conditions at the LBW (Section 3-1).
 - Visitors were largely *able* to cope with social/situational impacts (e.g., conflict, accessibility).
 - Visitors were largely *unable* to cope with trail impacts (e.g., trail muddiness, erosion).
 - *Trail impacts led directly to significant decreases in visitor intention-to-return.
 - Findings suggest combatting ecological factors, particularly trail impacts, should be a top priority for LBW resource managers.

- Binary logistic regression indicated that weather impacts increased visitor perceptions of social, situational, and ecological impacts (Section 3-2).
 - In the presence of weather impacts at the LBW:
 - *Visitors were 94% more likely to be negatively impacted by *trail conditions*.
 - *Visitors were 50% more likely to be negatively impacted by *crowding*.
 - Visitors were 39% more likely to be negatively impacted by *litter*.
 - Visitors were 37% more likely to be negatively impacted by *access*.
 - Visitors were 30% more likely to be negatively impacted by *conflict*.
 - These findings suggest the impact of social, situational, and ecological conditions on the visitors, ecosystems, and communities surrounding the LBW is likely to worsen as weather conditions become increasingly adverse and atypical.

Outfitter guide key observations and findings:

- The vast majority of LBW visitors (89%) reported encountering no more than 10 other visitors at one time while recreating at the LBW.
 - The majority of respondents (63%) indicated they preferred the current group size limitation policy, of a maximum of 10 visitors per group, remain unchanged.
 - Respondents indicated they would no longer recreate at the LBW if they encountered an *average/mean* of 18 other visitors at one time or a *median* of 15 other visitors at one time.
- Findings suggest the current outfitter guide group size limitation policy, of a maximum of 10 visitors per group, is appropriate and acceptable amongst LBW visitors.
 - Findings also suggest *15 visitors* is the maximum acceptable outfitter guide group size limitation threshold of tolerance for LBW visitors.

Figure 1. LBW outfitter guide infographic



Section 1-0. Introduction

Section 1-1. Study Background and Objectives

During the 21st century, outdoor recreation visitation within parks and protected areas (PPAs) in the United States has grown exponentially, with more than half the country participating annually as of 2018 (OFR, 2021). In 2020-2021, outdoor recreation visitation to PPAs reached unprecedented levels due largely to the COVID-19 pandemic (Ferguson et al., 2022; OFR, 2021). This surge in visitation has become increasingly difficult for PPA managers who are presented with the dual mandate of providing both high-quality outdoor recreation experiences while simultaneously protecting these important natural resources. As a result, resource managers are growing increasingly concerned regarding the impacts of social (e.g., crowding, conflict), situational (e.g., litter, access), and ecological (e.g., site degradation, weather) factors upon visitor behaviors, decision-making, experience quality, and intention-to-return. These impacts are particularly concerning in congressionally designated wilderness areas where opportunities for solitude (i.e., minimal evidence of human habitation) are a core tenet of the visitor experience (Wilderness Act, 1964). The coping framework suggests that in the presence of impacts, visitors may utilize a variety of behavioral coping mechanisms (e.g., substitution behaviors) to preserve their desired outcome (Ferguson et al., 2018; 2021; Miller & McCool, 2003). Yet, assessing and understanding the complex interplay between visitor behaviors, decision-making, experience quality, and natural resource quality remains challenging.

This study explored outdoor recreation visitor perceptions, preferences, behaviors, and decision-making at the Lye Brook Wilderness (LBW) within the GMNF. The LBW is the third largest Congressionally Designated Wilderness area in the GMNF as well as a vital recreation resource for the state of Vermont and the larger New England region (Anderson, 2016). The LBW encompasses 20 miles of hiking trails, including 4.5 miles of the popular Appalachian/Long trail, one historic camping shelter, multiple backcountry campsites, two major ponds, and the third largest waterfall in Vermont—the Lye Book Falls (Anderson, 2016). The LBW is also rich in historical, cultural, ecological, and biological value as a landscape recovering from heavy logging and mining. It has since become a popular recreation destination for myriad local, regional, and international visitors. The LBW is conveniently located within one day's drive of an estimated 74 million people and surrounded by major roadways on three sides, making it a highly accessible recreation destination (Anderson, 2016).

Broadly speaking, the Green Mountain & Finger Lakes National Forests (GMNF) Land and Resource Management Plan aims to maximize benefits for recreation visitors while achieving and maintaining desired experiences and conditions within the LBW (USDA FS, 2006). The combination of ecological and geological diversity, in addition to an abundance of public access, has made the LBW extremely attractive and popular amongst a wide range of local, regional, and international outdoor recreationists. To protect these resources, it is essential that the LBW proactively, continuously, and sustainably manages outdoor recreation visitation and experiences. Of particular concern is the need to assess visitor perceptions of group size and outfitter-guiding policies. Managers also need information related to visitors' satisfaction and socio-demographics, as well as their perceptions of use levels, crowding, conflict, and management preferences. Moreover, resource managers require empirically validated and 3rd party non-biased data to establish a firmer basis for policy and regulatory decisions. In response to these gaps, the GMNF commissioned the University of New Hampshire to collect data on the LBW from June to August of 2021.

The purpose of this study was to collect, analyze, and interpret the following information:

- LBW visitors' perceptions of group size and outfitter-guiding policies
- LBW visitors' demographic and trip visitation information
- LBW visitors' satisfaction
- LBW visitors' perceptions of impacts
- LBW visitors' employment of substitution behaviors
- LBW visitors' perception of visitor use levels
- LBW visitors' management preferences
- LBW visitors' decision-making process



Section 1-2. Methods

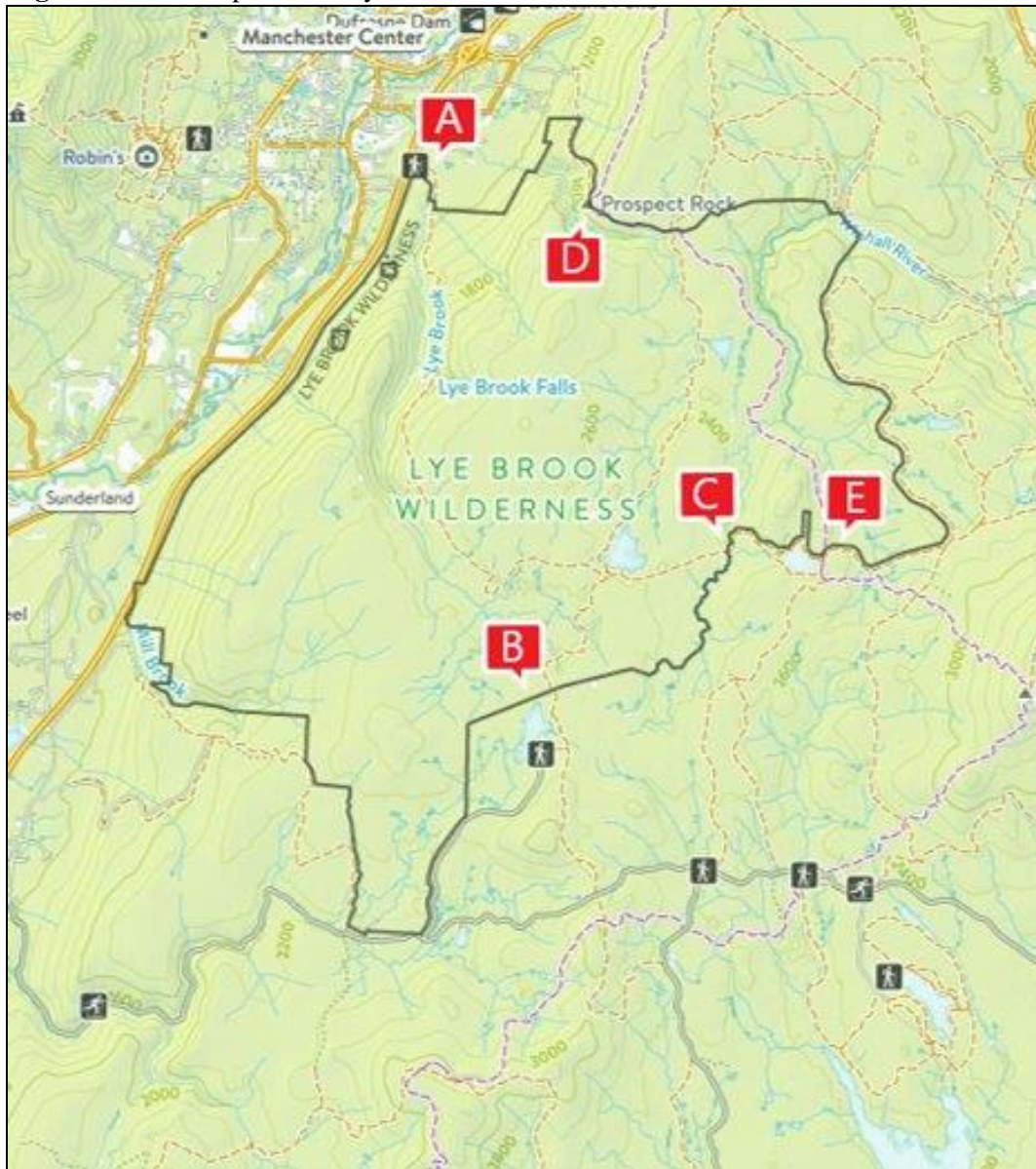
This study employed an on-site exit-use intercept survey of LBW visitors from June to August of 2021. To obtain a diverse and representative sample, researchers established a systematic sampling plan coinciding with peak recreation visitation periods (Vaske, 2008). To ensure representative data collection across a broad and diverse spatial scale, numerous survey locations within the LBW were selected for sampling based on conversations with natural resource managers (Morse, 2020; Perry et al., 2020). These survey locations included front-country and back-country hiking trails, thru-hiking and/or long-distance hiking sites, undeveloped campgrounds, and water-based recreation sites (Figure 2). As potential respondents exited the LBW boundary, they were approached by a trained research assistant and asked if they would be willing to participate in a brief 10 to 15-minute survey regarding their experience *that day*, via a tablet computer using Qualtrics data collection software. Informed consent was obtained from each respondent prior to commencing the survey.

To qualify for the study, potential respondents were shown a map of the LBW and asked a prerequisite screen-out question, “Did you specifically enter the LBW during this trip?” If respondents answered ‘no’ to this question, they were excluded from the survey. If respondents answered ‘yes’ to this question, but were unwilling to participate in the survey, they were asked to complete a separate non-respondent survey. Study respondents were instructed to only consider “this trip to the LBW” while completing the survey. Section one of the survey asked questions regarding visitors’ general recreation experience. The next section evaluated visitors’ perceptions of various social, situational, and ecological impacts. The ensuing survey section evaluated how often visitors employed various coping/substitution behaviors as well as their intention-to-return to the LBW. The fourth section had respondents assess various management preferences. The topics within the final portion of the survey included sociodemographic characteristics. The LBW survey instrument can be found in Appendix B.

Upon completion of the survey, respondents were thanked for their time. This process resulted in a 93% response rate, with 618 respondents being approached and 576 respondents completing the survey. This survey method response rate was consistent with similar research methods and settings. Finally, non-response bias was examined by comparing socio-demographic data between respondents and non-respondents. A lack of non-response bias was determined as a series of chi-square analyses found no significant differences between respondents and non-respondents within any variables.



Figure 2. LBW map and survey locations



*Note: A = Lye Brook Falls Trailhead; B = Bourn/Branch Pond Access; C = Stratton Pond Access; D = AT/LT North; E = AT/LT South

Section 2-0. Overall Results

Section 2-1. Respondent Profile

To develop a respondent profile, the study sample was asked to identify their gender, age, ethnic background, earned income level, highest education level obtained, political affiliation, and residency status (Table 1). The second column in Table 1 indicates the valid percentages and means for each category.

- Sex/gender within the sample indicated that just over half of the visitors were male (51%) and 47% were female (Table 1).
- The average age of respondents was 39 years with approximately 48% representing the 18-35-year age group, 28% representing the 36-50-year age group, and 21% representing the 51-65-year age group.
- A large majority of the visitors surveyed (91%) reported their race/ethnicity as White. Other ethnicities reported included Spanish/Hispanic/Latino, African American, and Asian.
- Approximately one-third (35%) of the visitors surveyed reported earning household incomes of \$150,000 or more, while 47% reported earning household incomes of less than \$100,000.
- Nearly three-quarters (76%) of the sample reported earning a four-year college or graduate/professional degree, while approximately 20% of the sample earned either a two-year college degree or had some college or completed high school.
- The political ideology within the sample was moderate and slightly liberal leaning, with approximately 58% of respondents identifying as liberal, approximately 22% of respondents identifying as moderate, and approximately 16% of respondents identifying as conservative.
 - The mean for political ideology was 3.32, suggesting the sample was fairly moderate, although leaning toward the liberal side of moderate.
- The majority of respondents (88%) noted they were not Vermont residents.
 - Respondents most often indicated coming from New York (17%), Massachusetts (11%), or Pennsylvania (7%).
- Visitors at the LBW reported being moderately to highly experienced.
 - On average, visitors noted they spent approximately 2 days per month, 3 days per year, and 6 total years engaged in recreation at the LBW as of 2021.

Table 1. LBW visitors’ respondent profile

Variable	Valid Percentage or Mean
<i>Gender</i>	
Male	50.6%
Female	47.0%
<i>Age</i>	
Average age	39 Years
18-35	48.4%
36-50	28.0%

51-65	21.1%
<i>Race/Ethnic Background</i>	
White	90.6%
Other	9.4%
<i>Income</i>	
\$150,000 or more	34.8%
\$100,000 to \$149,999	16.8%
\$75,000 to \$99,999	14.4%
\$50,000 to \$74,999	12.5%
\$50,000 to \$74,999	12.5%
\$25,000 or less	7.5%
<i>Education</i>	
Graduate or Professional Degree	39.2%
Four Year College	37.1%
Some College	9.9%
Two Year College	5.3%
High School Graduate	5.1%
Some High School	<1.0%
Less than High School	<1.0%
<i>Political Affiliation</i>	
Mean	3.34
Liberal	58.1%
Moderate	21.7%
Conservative	16.2%
<i>Residency Status</i>	
New York Resident	17.0%
Vermont Resident	12.0%
Massachusetts Resident	11.0%
Pennsylvania Resident	7.0%
<i>Experience Use History</i>	
First time visitors	80.1%
Returning visitors - Average total years recreating	6.4 years
Returning Visitors - Average days per year recreating	3.1 days
Returning Visitors - Average days per month recreating	1.5 days
<i>Group Size</i>	
Average number of adults per group	2 adults
Average number of children per group	0 children
<i>Trip Characteristics</i>	
Private day trip	76.5%
Private overnight trip	23.1%
Guided overnight trip	<1.0%

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

Section 2-2. Activity Participation

Due to the abundance of recreation resources available within the LBW, visitors may participate in a wide variety of recreation activities. In this study, visitors were asked to indicate which activities they participated in, which one recreation activity was their primary activity at the LBW, as well as which location they used to enter and exit the LBW (Tables 2 and 3).

- Of the entire sample, the four most common primary activities were: *hiking or walking* (52%), *through hiking the Appalachian/Long Trail* (23%), *backpacking* (10%), and *section hiking the Appalachian/Long Trail* (5%) (Table 2).
 - The most common primary activity by far was *hiking or walking*, with 52% of visitors noting it as their primary activity.
 - The next most common activity, *through hiking the Appalachian/Long Trail*, was significantly less common than *hiking or walking*.
 - The least common primary recreation activities were: *picnicking or family day gatherings*, *swimming*, *foraging*, *trail running*, *fishing*, *canoeing or kayaking* and *hunting* (all activities were <1%).

Table 2. LBW visitors’ activity participation profile

Activity Type	Valid Percentage Participating in Activity Type	Valid Percentage as Primary Activity
Hiking or walking	88.9%	52.4%
Sightseeing or viewing natural features and/or wildlife	39.6%	2.3%
Backpacking	37.6%	10.2%
Relaxing and hanging out	35.2%	<1.0%
Through hiking the Appalachian/Long Trail	25.1%	22.8%
Camping	20.1%	2.0%
Section hiking the Appalachian/Long Trail	11.8%	5.0%
Dog walking	11.8%	2.1%
Picnicking or family day gatherings	6.5%	<1.0%
Swimming	6.4%	<1.0%
Foraging	3.4%	<1.0%
Trail running	2.3%	<1.0%
Fishing	2.3%	<1.0%
Canoeing or Kayaking	1.6%	<1.0%
Hunting	<1.0%	<1.0%

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

- Results indicated that the Lye Brook Falls Trailhead was used the *most often* by respondents (54%) to enter the LBW while the Stratton Pond Access was used *least often* by respondents (4.2%) to enter the LBW (Table 3).
- Results indicated that the Lye Brook Falls Trailhead was used the *most often* by respondents (53%) to exit the LBW while the Stratton Pond Access was used *least often* by respondents (<1.0%) to exit the LBW (Table 3).

Table 3. Percentage of LBW visitors using each entrance and exit

Location	Valid Percentage
<i>Entrance Used</i>	
Lye Brook Falls Trailhead	53.8%
Appalachian/Long Trail South	30.2%
Bourn/Branch Pond Access	7.5%
Stratton Pond Access	4.2%
Appalachian/Long Trail North	4.3%
<i>Exit Used</i>	
Lye Brook Falls Trailhead	53.0%
Appalachian/Long Trail North	36.7%
Bourn/Branch Pond Access	8.2%
Appalachian/Long Trail South	1.0%
Stratton Pond Access	<1.0%

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



Section 2-3. Satisfaction and Intention-to-return

Overall trip satisfaction and intention-to-return are often used as a primary management criterion for evaluating the quality of an outdoor recreation experience. This study asked visitors to evaluate their overall level of satisfaction with the LBW as well as their intention-to-return at the LBW on both single-item and multi-item scales (Tables 4, 5, and 6).

- The single-item measurement of overall satisfaction was measured on a seven-point scale where one represented ‘*poor*’ and seven represented ‘*perfect*’ (Table 4).
 - Overall satisfaction was very high amongst respondents; with the majority of visitors (88%) indicating their overall trip that day at the LBW was either excellent or perfect.

Table 4. LBW visitors’ overall satisfaction rating

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.85	<1.0%	<1.0%	2.5%	8.0%	15.6%	42.8%	29.9%

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

*Note. Response Code: 1 = Poor and 7 = Perfect

- The multi-item measurement of LBW visitors’ satisfaction was measured on a seven-point scale where one represented ‘*completely disagree*’ and seven represented ‘*completely agree*’ (Table 5).
 - The vast majority of respondents (94%) agreed they thoroughly enjoyed their trip to the LBW, with an average of 6.26 on a 7-point scale.
 - 90% of the sample agreed that they could not imagine a better trip to the LBW, with an average of 6.21 on a 7-point scale.
 - Approximately 72% of the sample agreed that their trip was well worth the time and money spent to take it, with an average of 5.25 on a 7-point scale.

Table 5. LBW visitors’ satisfaction rating

Variable	Mean	Disagree (%)	Neutral (%)	Agree (%)
I have thoroughly enjoyed this trip to the LBW	6.26	2.5%	3.5%	94.0%
This trip to the LBW has been well worth the time and money I spent to take it	6.21	2.8%	7.4%	89.7%
I cannot imagine this trip to the LBW being better	5.25	14.9%	13.1%	72.0%

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

*Note. Response Code: 1 = Completely Disagree and 7 = Completely Agree

- The single-item measurement of intention-to-return was measured on a seven-point scale where one represented ‘*definitely not*’ and seven represented ‘*without a doubt*’ (Table 6).
 - Overall intention-to-return was high amongst respondents; with a majority of visitors (65%) indicating they would *without a doubt return to the LBW*, and an average of 5.17 on a 7-point scale.

Table 6. LBW visitors’ intention-to-return rating

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.17	3.1%	4.9%	5.9%	20.7%	19.2%	15.6%	30.6%

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

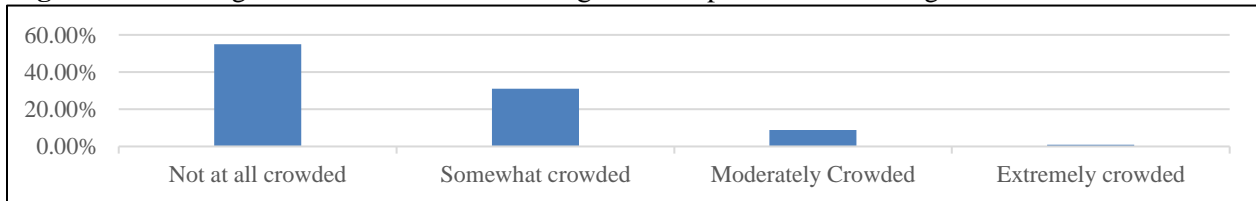
*Note. Response Code: 1 = Definitely not and 7 = Without a doubt

Section 2-4. Perceptions of Social Impacts

Perceptions towards impacts can vary greatly among visitors. The term *impact* refers to any condition or situation that may negatively affect a visitor’s overall recreation experience. To assess LBW visitors’ perceptions of impacts, respondents were asked to indicate how various social, situational, and ecological conditions impacted their recreation experience at the LBW. The following section focuses on LBW visitors’ perceptions of *social conditions* (Table 7 and Figure 3). Social impacts refer to visitor interactions with *other humans* (e.g., other visitors, non-visitors, landowners), such as crowding and conflict, that may influence the visitor experience.

- The single-item measurement of overall crowding was measured on a seven-point scale where one represented ‘*not at all crowded*’ and seven represented ‘*extremely crowded*’ (Figure 3).
 - Overall crowding was low amongst respondents; with the majority of visitors (86%) indicating they were *not at all crowded* or minimally crowded, with an average of 2.70 on a 9-point scale.

Figure 3. Percentage of LBW visitors’ indicating levels of perceived crowding



- The multi-item measurement of visitors’ perception of social impacts was measured on a seven-point scale where one represented ‘*no impact*’ and seven represented ‘*major impact*’ (Table 7).
- Overall social impacts were low at the LBW; crowding had the highest overall mean (2.05) and conflict had the lowest mean (1.53) suggesting that crowding was most impactful social condition upon the visitor experience at the LBW (Table 7).
 - Within the crowding scale, *crowding* (2.10) was the highest rated item followed closely by *too many other visitors* (2.00).
 - Within the conflict scale, *the actions and behaviors of other visitors* (1.60) was the highest rated item and *conflict with other visitors* (2.02) was the lowest rated item.
- It should be noted that the reported perceived social impacts in this study may have been artificially low as the sample consisted largely of first-time visitors to the LBW, and first-time visitors often do not perceive impacts as much as repeat visitors (Arnberger & Brandenburg, 2007).

Table 7. LBW visitors’ perceptions of social impacts

Variable	Item Mean	Scale Mean
<i>“To what extent have the following impacted your recreation experience at the LBW on this trip?”</i>		
Social Impacts - Crowding		
Crowding	2.10	2.05
Too many other visitors	2.00	
Social Impacts - Conflict		
The actions or behaviors of other visitors	1.60	1.53
The way other visitors are behaving	1.58	
Conflict with other visitors	1.40	

*Note. Response Code: 1 = No impact and 7 = Major impact

Section 2-5. Perceptions of Situational Impacts

Perceptions towards impacts can vary greatly among visitors. The term *impact* refers to any condition or situation that may negatively affect a visitor’s overall recreation experience. To assess LBW visitors’ perceptions of impacts, respondents were asked to indicate how various social, situational, and ecological conditions impacted their recreation experience. The following section focuses on LBW visitors’ perceptions of *situational conditions* (Tables 8, 9, 10, and 11). Situational impacts refer to *contextual* interactions, often with the built environment, such as access (e.g., sites, parking, traffic) and litter (e.g., waste, garbage) that may influence the visitor experience.

- The multi-item measurement of visitors’ perception of *situational* impacts was measured on a seven-point scale where one represented ‘*no impact*’ and seven represented ‘*major impact*’ (Table 8).
- Within the impacts assessed in this study, *situational* conditions were generally the *least* impactful to visitor experiences at the LBW.
- Overall situational impacts were low; access had the highest overall scale mean (1.73) and litter had the lowest scale mean (1.63) suggesting that access was most impactful situational condition upon the visitor experience at the LBW (Table 8).
 - Within the access scale, *parking accessibility* (1.74) was the highest rated item followed closely by *trail accessibility* (1.72).
 - Within the litter scale, *visible litter, garbage, or waste* (1.77) was the highest rated item and *domestic animal waste* (1.48) was the lowest rated item.
- It should be noted that the reported perceived social impacts in this study may have been artificially low as the sample consisted largely of first-time visitors to the LBW, and first-time visitors often do not perceive impacts as much as repeat visitors (Arnberger & Brandenburg, 2007).

Table 8. LBW visitors’ perceptions of situational impacts

Variable	Item Mean	Scale Mean
<i>“To what extent have the following impacted your recreation experience at the LBW on this trip?”</i>		
<i>Situational Impacts - Litter</i>		
Visible litter, garbage, or waste	1.77	1.63
Domestic animal waste	1.48	
<i>Situational Impacts - Access</i>		
Parking accessibility	1.74	1.73
Trail accessibility	1.72	

*Note. Response Code: 1 = No impact and 7 = Major impact

- The single-item measurement of *situational impacts – COVID-19* was measured on a seven-point scale where one represented ‘no impact’ and seven represented ‘major impact’ (Table 9).
 - The vast majority of respondents (81%) reported that COVID-19 had *no impact* upon their recreation experience at the LBW with a mean of 1.42.

Table 9. LBW visitors’ perceptions of COVID-19 impacts

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.42	81.1%	8.5%	3.0%	4.1%	<1.0%	1.4%	1.1%

*Note. Percentages may not equal 100 because of rounding.
 *Note. Response Code: 1 = No impact and 7 = Major impact

- The single-item measurement of *COVID-19 impacts – usage* was measured on a seven-point scale where one represented ‘decreased usage’ and seven represented ‘increased usage’ (Table 10).
 - Overall, respondents indicated that the COVID-19 pandemic had little impact on the frequency of their recreation usage at the LBW; with the majority of visitors (70%) indicating their usage of the LBW stayed the same.

Table 10. LBW visitors’ impacts due to COVID-19 – recreation usage

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.23	4.3%	2.7%	2.3%	69.7%	6.0%	7.0%	7.9%

*Note. Percentages may not equal 100 because of rounding.
 *Note. Response Code: 1 = Decreased usage and 7 = Increased usage

- The single-item measurement of *COVID-19 impacts – positive/negative* was measured on a seven-point scale where one represented ‘negatively impacted’ and seven represented ‘positively impacted’ (Table 11).
 - Overall, respondents indicated the quality of their recreation usage at the LBW was largely unaffected by COVID-19; with the majority of visitors (77%) indicating they were neither positively nor negatively affected.

Table 11. LBW visitors’ impacts due to COVID-19 – positive or negative

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.20	2.3%	2.7%	2.2%	76.5%	4.7%	4.7%	6.9%

*Note. Percentages may not equal 100 because of rounding.
 *Note. Response Code: 1 = Negatively impacted and 7 = Positively impacted

Section 2-6. Perceptions of Ecological Impacts

Perceptions towards impacts can vary greatly among visitors. The term *impact* refers to any condition or situation that may negatively affect a visitor’s overall recreation experience. To assess LBW visitors’ perceptions of impacts, respondents were asked to indicate how various social, situational, and ecological conditions impacted their recreation experience. The following section focuses on LBW visitors’ perceptions of *ecological conditions* (Table 12). Ecological impacts refer to interactions with the *natural environment*, such as biophysical features (e.g., water quality, weather) and resource degradation (e.g., trail, site degradation), that may influence the visitor experience.

- The multi-item measurement of visitors’ perception of *ecological* impacts was measured on a seven-point scale where one represented ‘*no impact*’ and seven represented ‘*major impact*’ (Table 12).
- Overall ecological impacts were low; trail conditions had the highest overall scale mean (2.49) and weather had the lowest scale mean (2.03) suggesting that trail conditions were the most impactful ecological conditions upon the visitor experience at the LBW (Table 12).
 - Within the trail conditions scale, *trail muddiness* (4.18) and *trail erosion* (2.79) were the highest rated items; *trail litter* (1.51) was the lowest rated item.
 - Within the campsite conditions scale, *campsite erosion* (2.37) and *damaged trees* (2.13) were the highest rated items; *unofficial campsite development* (1.96) was the lowest rated item.
 - Within the weather conditions scale, *rain* (2.55) and *humidity* (2.51) were the highest rated items; *strong winds* (1.44) was the lowest rated item.
- It should be noted that the reported perceived social impacts in this study may have been artificially low as the sample consisted largely of first-time visitors to the LBW, and first-time visitors often do not perceive impacts as much as repeat visitors (Arnberger & Brandenburg, 2007).

Table 12. LBW visitors’ perceptions of ecological impacts

Variable	Item Mean	Scale Mean
<i>“To what extent have the following impacted your recreation experience at the LBW on this trip?”</i>		
<i>Ecological Impacts - Trail conditions</i>		
Trail muddiness	4.18	
Trail erosion	2.79	
Trail widening	2.11	2.49
Informal trails	1.87	
Trail litter	1.51	
<i>Ecological Impacts - Campsite conditions</i>		
Campsite erosion	2.37	
Damaged trees	2.13	
Campsite area increasing	1.98	2.08
Campsite litter	1.97	
Unofficial campsite development	1.96	
<i>Ecological Impacts - Weather conditions</i>		
Rain	2.55	
Humidity	2.51	
Temperature	2.29	2.03
Cloudiness	1.75	
Visibility	1.68	
Strong Winds	1.44	

*Note. Response Code: 1 = No impact and 7 = Major impact

Section 2-7. Coping and Substitution Behaviors

Visitors have the ability to cope or behaviorally adapt with impacts that negatively affect their experiences by changing or altering their behaviors and decision-making. Substitution behaviors involve changing where one recreates, at what time one recreates, the activity that one engages in, the gear one uses while recreating, or simply deciding to not return to the LBW. To assess visitors' coping and substitution behaviors, respondents were asked to report the frequency in which they utilized various substitution behaviors (Table 13).

- The multi-item measurement of visitors' substitution behaviors was measured on a seven-point scale where one represented 'never' and seven represented 'always' (Table 13).
- Overall substitution behaviors were low; however, respondents indicated the most utilized substitution behaviors at the LBW were *strategic substitution* (1.79) and *temporal substitution* (1.77).
 - Within strategic substitution, the most common behavior was *considered purchasing new gear for future trips to the LBW* (1.92), followed by *changed the gear I use while recreating in the LBW* (1.66).
 - Within temporal substitution, the most common behavior was *visited the LBW earlier or later in the day* (1.87). The least common temporal substitution behavior was *visited the LBW during a different season* (1.62).
 - The least common substitution behaviors at the LBW were *displacement* (1.61) and *activity substitution* (1.38).
- It should be noted that the reported perceived social impacts in this study may have been artificially low as the sample consisted largely of first-time visitors to the LBW, and first-time visitors often do not perceive impacts as much as repeat visitors (Arnberger & Brandenburg, 2007).

Table 13. LBW visitors' substitution behaviors

Variable "In response to various conditions at the LBW on this trip, I have..."	Item Mean	Scale Mean
<i>Strategic Substitution</i>		
Considered purchasing new gear for future trips to the LBW	1.92	1.79
Changed the gear I use while recreating in the LBW	1.66	
<i>Temporal Substitution</i>		
Visited the LBW earlier or later in the day	1.87	1.77
Avoided visiting the LBW on holidays	1.81	
Visited the LBW on a different day of the week	1.76	
Visited the LBW during a different season	1.62	
<i>Resource Substitution</i>		
Visited different areas of the LBW	1.78	1.71
Visited a different location within the LBW	1.73	
Avoided certain areas of the LBW	1.63	
<i>Absolute Displacement</i>		
Considered visiting a different location outside of the LBW	1.90	1.61
Considered abandoning my recreation experience entirely	1.37	
<i>Activity Substitution</i>		
Began a new recreation activity at the LBW	1.46	1.38
Changed my Recreation activity at the LBW	1.36	
Stopped engaging in my main recreation activity at the LBW	1.33	

*Note. Response Code: 1 = Never and 7 = Always

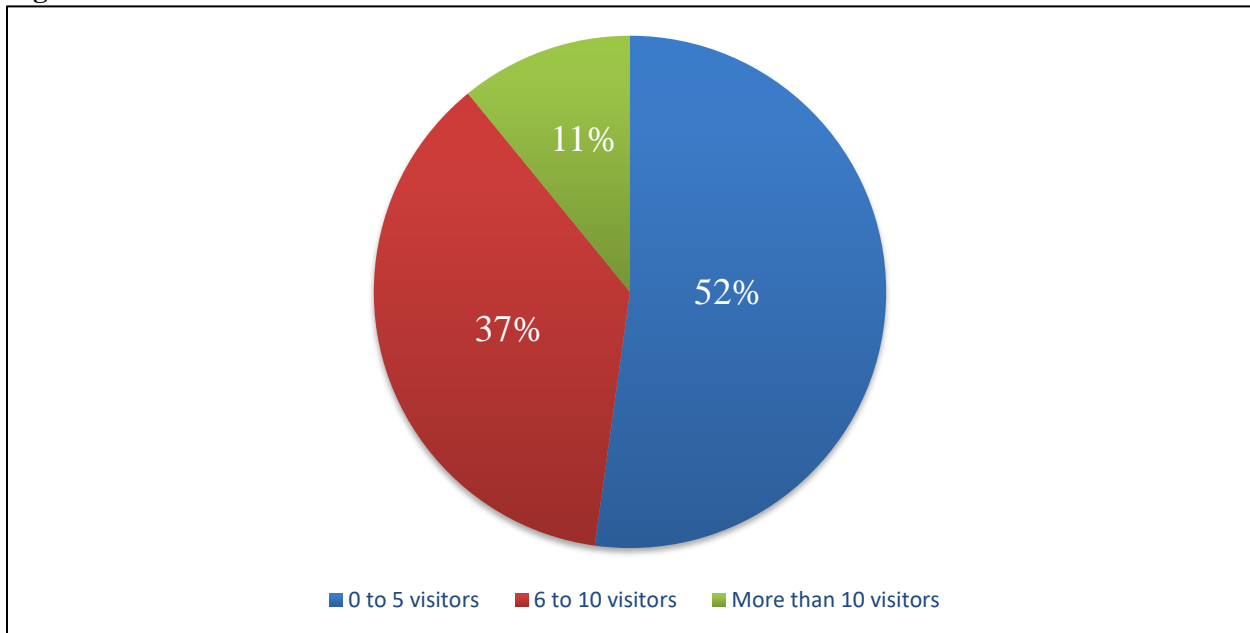
Section 2-8. Perceptions of Visitor Encounters & Outfitter Guides

LBW visitors have the opportunity to experience solitude and utilize wilderness in its most natural state. As National Forest visitation continues to grow, there is a need to assess visitors' perceptions of use levels. Currently, the LBW of the GMNF allows a maximum of 10 people per group while recreating within the wilderness. A primary interest in this study was to assess perceptions of outfitter guides and establish a threshold of tolerance for both visitor encounters and outfitter guide group sizes.

To that end, this study asked LBW visitors to report the number of visitors they encountered at one time, the acceptability of those encounters, and how many visitors they could encounter before no longer visiting the LBW (Tables 14 and 15; Figure 4). Visitors were also asked whether they were on a guided trip, if they were aware of the current group size policy at the LBW, and their preferences for amending the policy in the future (Table 16 and 17; Figure 5).

- The single-item measurement of *visitor encounters at one time* was measured as an open-ended question: “About how many other visitors did you encounter at any one time at the LBW on this trip?” (Figure 4).
 - Overall, the majority of respondents (52%) reported encountering 0-5 visitors at one time and approximately one-tenth (11%) of respondents encountered more than 10 other visitors at one time at the LBW(Figure 4).
 - Respondents reported encountering an *average/mean* of 6 visitors at one time and a *median* of 5 visitors at one time during their recreation experiences.
 - Respondents reported seeing a minimum of 0 visitors at one time and a maximum of 17 visitors at one time during their recreation experiences at the LBW

Figure 4. LBW number of visitors encountered at one time



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

- The single-item measurement of *acceptability of visitor encounters* was measured on a seven-point scale where one represented ‘*very unacceptable*’ and seven represented ‘*very acceptable*’ (Table 14).
 - Overall, the vast majority of respondents (91%) indicated the number of other visitors they encountered at one time to be acceptable or very acceptable.

Table 14. LBW visitors’ acceptability of visitors encountered at one time

Mean	Valid Percentages						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.20	6.0%	<1.0%	<1.0%	1.8%	2.5%	29.8%	59.1%

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

*Note. Response Code: 1 = Very unacceptable and 7 = Very Acceptable

- The single-item measurement of *maximum visitor encounters* was measured as an open-ended question: “*What is the maximum number of visitors you could encounter at any one time at the LBW before you would no longer visit here?*” (Table 15).
 - Approximately one-third of respondents (36%) indicated they would continue to visit the LBW regardless of use.
 - Approximately one out of three respondents (37%) indicated they would stop visiting the LBW if they encountered more than 10 other visitors at one time.
 - Respondents indicated they would no longer recreate at the LBW if they encountered an *average/mean* of 18 other visitors at one time and a *median* of 15 other visitors at one time.

Table 15. LBW visitors’ maximum visitor encounters at one time before they would no longer visit

Variable	Valid Percentage
“ <i>What is the maximum number of visitors you could encounter at any one time at the LBW before you would no longer visit here?</i> ”	
More than 10	37.1%
Would visit regardless of use	35.9%
0-10	26.9%

*Note. Percentages may not equal 100 because of rounding

- The vast majority of respondents (77%) reported being on a private day trip to the LBW (Table 16).
 - Less than 1% of respondents reported being on a guided trip to the LBW.

Table 16. Percentage of LBW visitors on a guided or non-guided trip

Variable	Valid Percentage
“ <i>Is your trip today...</i> ”	
Private day trip	76.5%
Private overnight trip	23.1%
Guided overnight trip	<1.0%
Guided day trip	0.0%

*Note. Percentages may not equal 100 because of rounding

- Results indicated the majority of LBW visitors (83%) were unaware of the current group size limitation policy (Table 17).

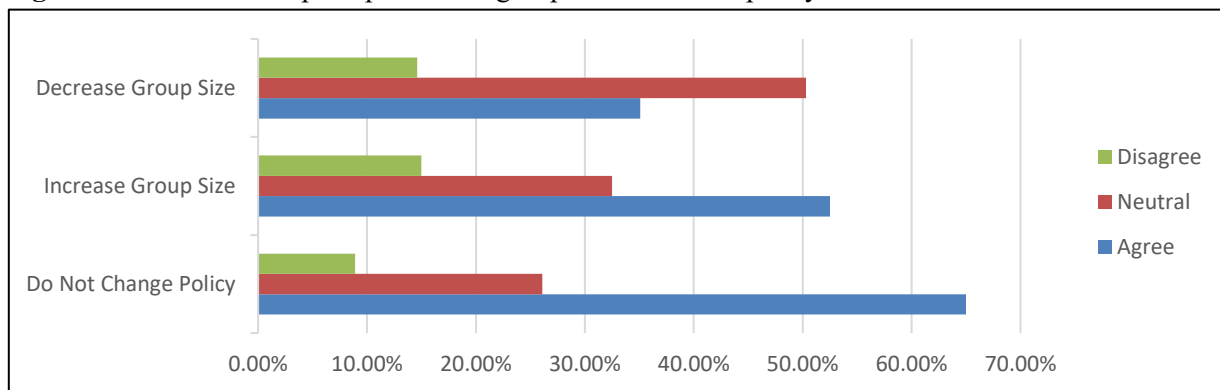
Table 17. LBW visitors’ awareness of existing group limitation policy

Variable	Valid Percentage
“Are you aware of the current group size limitation policy in the LBW?”	
No	83.1%
Yes	16.9%

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

- The multi-item measurement of visitors’ perception of the current group size limitation policy was measured on a seven-point scale where one represented ‘*completely disagree*’ and seven represented ‘*completely agree*’ (Figure 5).
 - The majority of respondents (65%) agreed the current group size policy of 10 people per group maximum at the LBW should remain the same.
 - Results indicate nearly half of respondents (52%) disagreed with increasing the size of groups allowed at the LBW.

Figure 5. LBW visitors’ perceptions of a group size limitation policy



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

Section 2-9. Management Preferences

LBW visitors have varying levels of support and opposition towards various management strategies. In this study, visitors were asked to indicate their level of support or opposition towards a variety of management strategies. These management strategies had to do with fee implementation, overall use level restrictions, rules and regulations, accessibility, ranger presence, and signage (Table 18).

- Management preferences were measured on a seven-point scale, with one representing ‘*strongly oppose*’ and seven representing ‘*strongly support*’ (Table 18).
- The most supported management strategy was *require visitors to carry-out all litter, trash, and/or waste*, with approximately 86% of respondents indicating they supported this management strategy.
- The top three most supported management strategies were *require visitors to carry-out all litter, trash, and/or waste* (86%), *prohibit illegal campfires* (64%), and *increase signage about proper visitor behavior* (57%).
- Respondents reported moderate support for *require visitors to stay on designated trails* (49%), *increase educational ranger presence* (48%), and *require camping at designated sites* (44%).
- The least supported management strategies were *limit the number of day users*, *implement a permit system for day use areas*, and *implement an entrance fee*, with only 17%, 9%, and 8% of visitors supporting these actions, respectively.

Table 18. LBW visitors’ support or opposition for management strategies

Variable “The LBW should...”	Mean	Oppose (%)	Neutral (%)	Support (%)
Require visitors to carry-out all litter, trash, and/or waste	6.30	5.5%	8.6%	85.9%
Prohibit illegal campfires	5.23	15.5%	20.5%	64.0%
Increase signage about proper visitor behavior	4.79	14.4%	28.3%	57.3%
Increase signage about recreation impacts	4.70	15.3%	30.8%	53.8%
Increase educational ranger presence	4.53	17.2%	34.9%	47.9%
Require visitors to stay on designated trails	4.52	24.7%	25.6%	49.7%
Require camping at designated sites	4.41	23.7%	32.7%	43.6%
Expand parking availability	4.20	22.3%	43.4%	34.3%
Expand public shuttle transportation services	4.11	25.4%	37.8%	36.9%
Place limitations on the overall number of visitors	3.36	44.3%	32.6%	23.1%
Limit the number of overnight users	3.29	44.1%	37.5%	18.4%
Implement a permit system for overnight use areas	3.27	45.4%	31.2%	23.4%
Increase law enforcement presence	3.16	47.1%	38.1%	14.8%
Limit the number of day users	3.07	50.5%	32.7%	16.9%
Implement a permit system for day use areas	2.65	61.2%	29.7%	9.2%
Implement an entrance fee	2.26	71.2%	21.2%	7.6%

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

*Note. Response Code: 1 = Strongly Oppose and 7 = Strongly Support

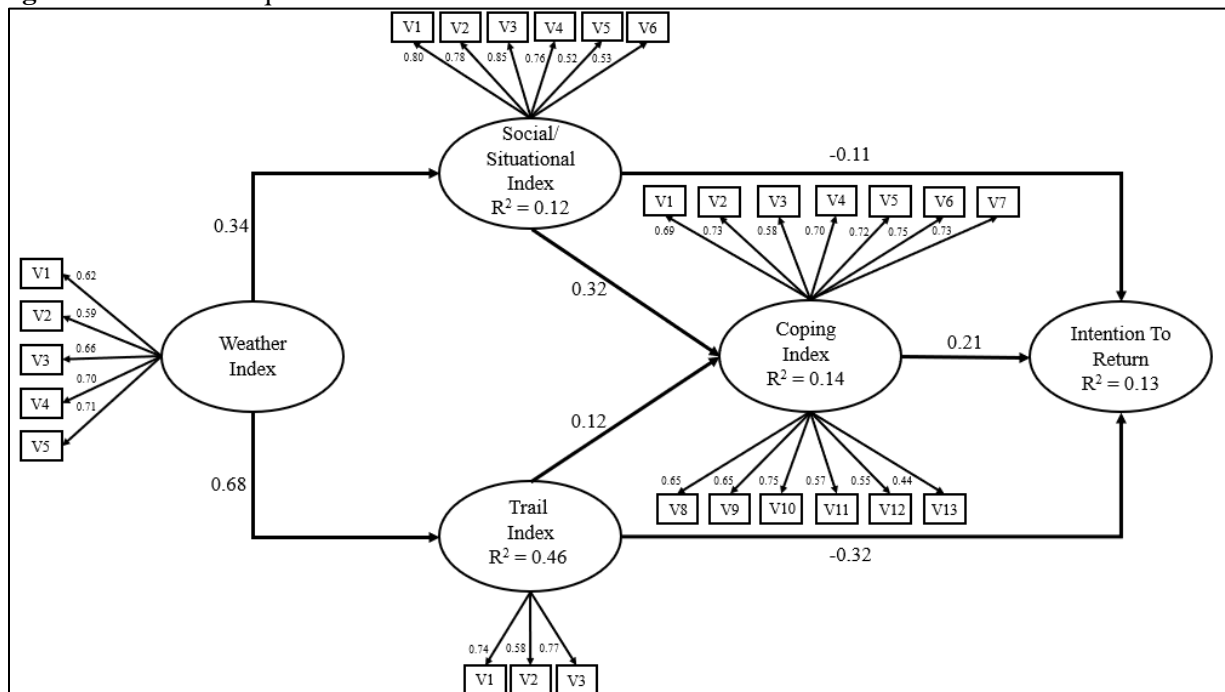
Section 3-0. Advanced Statistical Data Analyses

Section 3-1. Structural Equation Modeling

To better understand the interactions between impacts, substitution behaviors, and intention-to-return, structural equation modeling (SEM) procedures were utilized. SEM was selected as it is the gold standard in predictive modeling (Figure 6). SEM accounts for the relationships between all measured and latent variables and limits the possibility of human error by running multiple simultaneous regression analyses at once. The results can be used to visually depict the relationship between concepts within a research study. In the context of this study, the SEM depicts the influence of social, situational, and ecological impacts upon visitor behaviors and decision-making.

- Structural equation modeling indicated visitors were *partially able* to cope with social, situational, and ecological conditions at the LBW (Figure 6).
 - Visitors were largely *able* to cope with social/situational impacts (e.g., conflict, accessibility).
 - *Visitors were largely *unable* to cope with trail impacts (e.g., trail muddiness, erosion).
- Modeling suggested trail impacts had a major influence on visitors' intention-to-return while social and situational impacts had only a marginal influence upon visitors' intention-to-return.
- Visitors were also *completely unable* to cope with weather conditions, and weather conditions dramatically influenced visitor perceptions of trail impacts (Figure 6).
- *In other words, as weather conditions worsen, trail impacts also become much worse; both of which, when combined, lead to a significant number of visitors deciding *not* to return to the LBW.

Figure 6. Structural Equation Model



^aNote: $\chi^2:494.3$; $df=327$; $p<.001$; $CFI=0.97$; $TLI=0.96$; $RMSEA=0.03$; $SRMR=.05$

^{*}Note: All relationships and error covariances were significant at $p<.05$

Section 3-2. Binary Logistic Regression

Binary logistic regression analyses were utilized to better understand how weather impacts were influencing perceptions of other experiential impacts. Binary logistic regression was selected as it shows which specific impacts are being influenced by perceptions of weather. It is also a powerful statistic for resource managers, as it produces an odds ratio, or the likelihood of perceiving an impact under specific circumstances. Five separate binary logistic regression models were analyzed to examine the influence of *weather* upon LBW visitor perceptions of *social*, *situational*, and *ecological* impacts (Tables 19 and 20). Secondary weather data was then used to determine the average *real-world* weather conditions associated with the mean reported weather impacts utilized in the binary logistic regression models.

- In the first model, weather impacts were associated with a higher likelihood that visitors would perceive *trail* impacts (Table 19).
 - This model suggests that at the reported mean levels for weather impacts, there is a 94% likelihood of visitors perceiving trail impacts (Table 20).
 - *In other words, when average weather conditions are present in the LBW, approximately 9 out of 10 LBW visitors perceived trail impacts.
- In the second model, weather impacts were associated with a higher likelihood that visitors would perceive *crowding* impacts (Table 19).
 - This model suggests that at the reported mean levels for weather impacts, there is a 50% likelihood of visitors perceiving crowding impacts (Table 20).
 - *In other words, when average weather conditions are present in the LBW, approximately half of all LBW visitors perceived crowding impacts.
- In the third model, weather impacts were associated with a higher likelihood that visitors would perceive *litter* impacts (Table 19).
 - This model suggests that at the reported mean levels for weather impacts, there is a 39% likelihood of visitors perceiving litter impacts (Table 20).
- In the fourth model, weather impacts were associated with a higher likelihood that visitors would perceive *access* impacts (Table 19).
 - This model suggests that at the reported mean levels for weather impacts, there is a 37% likelihood of visitors perceiving access impacts (Table 20).
- In the final model, weather impacts were associated with a higher likelihood that visitors would perceive *conflict* impacts (Table 19).
 - This model suggests that at the reported mean levels for weather impacts, there is a 30% likelihood of visitors experiencing conflict impacts (Table 20).
- These findings suggest the impact of social, situational, and ecological conditions on the visitors, ecosystems, and communities surrounding the LBW is likely to worsen as weather conditions become increasingly adverse and atypical, especially in the presence of global climate change.

Table 19. Logistic regression models predicting LBW experiential impacts

	<i>Nagelkerke R Square</i>	β	<i>Wald</i>	<i>Odds Ratio</i>
Social factors - Crowding Model^a				
Weather factors	0.078	0.438	29.463***	1.550
<i>Constant</i>		-0.896	24.873***	0.408
Social factors - Conflict Model^b				
Weather factors	0.082	0.431	31.398***	1.539
<i>Constant</i>		-1.747	82.227***	0.174
Situational factors - Litter Model^c				
Weather factors	0.034	0.271	13.902***	1.311
<i>Constant</i>		-1.011	33.545***	0.364
Situational factors - Access Model^d				
Weather factors	0.028	0.246	11.564***	1.279
<i>Constant</i>		-1.025	34.382***	0.359
Ecological factors - Trail Conditions Model^e				
Weather factors	0.135	1.235	21.056***	3.437
<i>Constant</i>		0.158	0.168	1.172

*Significant at .05 level, **significant at .01 level, ***significant at .001 level
 *Note. W = reported mean for latent weather factor

^a $Ln(odds) = -0.896 + 0.438(W)$

^b $Ln(odds) = -1.747 + 0.431(W)$

^c $Ln(odds) = -1.011 + 0.271(W)$

^d $Ln(odds) = -1.025 + 0.246(W)$

^e $Ln(odds) = 0.158 + 1.235(W)$



- The binary logistic regression models were then used to extrapolate the likelihood of visitors perceiving social, situational, and ecological impacts under a 1-point increase and decrease to perceived average weather impacts (Table 20).
 - A 1-point increase in weather impacts increased the likelihood of perceiving *crowding* impacts by 11%.
 - A 1-point increase in weather impacts increased the likelihood of perceiving *conflict* impacts by 10%.
 - A 1-point increase in weather impacts increased the likelihood of perceiving *litter* impacts by 7%.
 - A 1-point increase in weather impacts increased the likelihood perceiving *access* impacts by 6%.
 - A 1-point increase in weather impacts increased the likelihood of perceiving *trail* impacts by 4%.

Table 20. Binary logistic regression models - extrapolations predicting LBW visitor impacts

	Likelihood of Visitor Impact (%)		
	Reported Mean -1	Reported Mean	Reported Mean +1
Social factors - Crowding Model ^a	39.1%	50.0%	60.7%
Social factors - Conflict Model ^b	21.4%	29.6%	39.2%
Situational factors - Litter Model ^c	32.5%	38.7%	45.3%
Situational factors - Access Model ^d	31.6%	37.2%	43.1%
Ecological factors - Trail Conditions Model ^e	80.8%	93.6%	98.0%

^{a-e}Note: Variable model refers to BLR models in Table 3.

- Secondary weather data was also used to determine the average *real-world* weather conditions associated with the mean reported impacts for *rain*, *humidity*, *temperature*, and *strong winds*.
 - At the mean reported impact for *temperature* (M = 2.29), the average temperature at the LBW was 75.6 degrees.
 - At the mean reported impact for *humidity* (M = 2.51), the average humidity at the LBW was 66.6%.
 - At the mean reported impact for *rain* (M = 2.55), the average rainfall at the LBW was 0.21 inches.
 - At the mean reported impact for *strong winds* (M = 1.44), the average wind speed at the LBW was 5.4 miles per hour.

Section 4-0. Summary and Conclusions

The overarching goal of the study was to assess Lye Brook Wilderness (LBW) outdoor recreation visitors' perceptions, preferences, behaviors, and decision-making. The secondary goal of this study was to assess perceptions of outfitter guides and threshold of tolerance for both visitor encounters and outfitters guide group sizes within the LBW. An on-site exit-use intercept survey method was utilized to collect data from LBW visitors in the Green Mountain & Finger Lakes National Forests (GMNF). For a guiding framework, this study utilized a systematic sampling plan and a quantitative survey methodology, which resulted in 576 completed surveys and a 93% response rate. Readers are encouraged to review these findings as reflective of LBW visitors, and *not* representative of *all* northeastern National Forest visitors. A detailed account of LBW visitors' characteristics, behaviors, attitudes, and perceptions was provided in the main body of this report. This summary and conclusion section provides a brief highlight of key findings that may be of interest to natural resource managers, partner organizations, and stakeholders.

Section 4-1. Contextual Variables Summary and Conclusions

In terms of the visitor profile, data suggests LBW visitors were likely to be young adults, white (91%), males (51%), who reported earning high levels of education and household income. The average age across all visitors was 39 years old; while 48% of respondents indicated they were under 35 years old. When combining the household income categories, approximately half of visitors (47%) reported household incomes less than \$100,000, while 35% reported household incomes greater than \$150,000. More than two-thirds of the sample (76%) indicated earning either a four-year college or professional degree. The political ideology distribution demonstrated approximately 58% of respondents identified as liberal, 22% as moderate, and 16% as conservative. The mean for political ideology was 3.32 (out of 7.0) suggesting the sample was leaning toward the liberal side of moderate.

When evaluating trip visitation patterns, the vast majority of LBW visitors in the study indicated they were from out-of-state (88%). Out-of-state visitors most often reported coming from New York (17%), followed by Massachusetts (11%) and Pennsylvania (7%). While LBW visitors reported being highly experienced, repeat visitation frequency was relatively low amongst the sample, with the majority of respondents noting they were highly experienced yet first-time visitors (80%) to the LBW. This suggested that the LBW may be a *destination wilderness*. Returning visitors reported an average of 2 days per month, 3 days per year, and 6 total years engaged in recreation at the LBW. The visitors in this study indicated various forms of recreation as their primary recreation activities at the LBW. The top primary recreation activities at the LBW were: hiking or walking (52%), through hiking the Appalachian/Long Trail (23%), backpacking (10%), and section hiking the Appalachian/Long Trail (5%).

The recreation experience questions provided data and insights regarding trip satisfaction and intention-to-return. Overall satisfaction was high among respondents, with approximately 88% of visitors indicating their trips to the LBW were either excellent or perfect. Moreover, nearly all the respondents in the sample agreed they thoroughly enjoyed their trips to the LBW (94%) and that their trip was well worth the time and money spent to take it (90%). The data also clearly showed that LBW visitors had high intention-to-return at the LBW; the mean for intention-to-return was 5.17 (out of 7.0) with the majority of visitors (65%) reporting they were likely to visit the LBW again in the future.

This study assessed visitor behaviors and decision-making in response to various impacts at the LBW. Overall, findings indicated that visitors perceived low levels of impact from social, situational, and ecological factors. Of the social impacts, crowding was perceived to have the largest impact upon the visitor experience (2.1/7.0). Of the situational impacts, visible litter, garbage, or waste was perceived to have the largest impact upon the visitor experience (1.77/7.0). Of the trail conditions, trail muddiness had the largest impact upon the visitor experience (4.18/7.0). Of the weather conditions, rain had the largest impact upon the visitor experience (2.55/7.0).

Further, visitors reported generally having low engagement in coping behaviors. When coping was utilized, visitors reported they were most likely to employ either strategic substitution (1.79/7.0), temporal substitution (1.77/7.0), or resource substitution (1.71/7.0) when encountering impacts. Visitors had the lowest engagement in displacement behaviors (2.23/7.0) and activity substitution (1.31/7.0). The individual coping behaviors most frequently reported by LBW visitors were: 1) considered purchasing new gear for future trips to the LBW (1.92/7.0), 2) considered visiting a different location outside the LBW (1.90/7.0), and 3) visited the LBW earlier or later in the day (1.87/7.0). Together, these findings suggest LBW visitors are changing their use patterns and gear to avoid conditions they perceive as being impactful or negative.

A primary goal of this study was to assess visitors' perceptions of use levels and group encounters at the LBW. Nearly all respondents (89%) reported encountering no more than 10 other visitors at one time. Additionally, the vast majority of visitors (89%) reported the number of other visitors they encountered at one time to be acceptable or very acceptable, with the mean of acceptability of encounters being 6.2 (out of 7.0). When asked about the maximum number of visitors that could be encountered at one time before no longer visiting the LBW, approximately one-third (36%) of respondents reported they would visit regardless of use. One-third of respondents (37%) also reported the maximum number of people they could see at one time before no longer recreating to be more than 10 visitors. Regarding current USDA Forest Service policy within the LBW, most of the sample (83%) was unaware of the current group size limitation policy of no more than 10 people per group. Finally, the majority of respondents (65%) indicated they would prefer the current group size limitation policy to remain the same.

Visitors were also asked about their levels of support or opposition towards a variety of management actions. The most popular management action was to enforce regulations requiring visitors to carry out all litter, trash, and/or waste, with approximately 86% of respondents indicating they agreed. Increasing signage about proper visitor behavior and increasing signage about recreation impacts were also largely supported. The least popular management action was implementing an entrance fee at the LBW, with approximately 71% of respondents indicating opposition to that action. Finally, placing limitations on the overall number of visitors and implementing a permit system for day users both had more opposition than support.



Section 4-2. Overall Summary and Conclusions

The overarching goal of the study was to assess LBW outdoor recreation visitors' perceptions, preferences, behaviors, and decision-making. The secondary goal of this study was to assess perceptions of outfitter guides and threshold of tolerance for both visitor encounters and outfitters guide group sizes within the LBW. This report offers data and insights concerning LBW visitors' socio-demographic characteristics, trip visitation and activity patterns, overall satisfaction and intention-to-return, perceptions of impacts, behaviors and decision-making, perceptions of visitor use levels and group encounters, and management preferences. Additional advanced statistical data analyses in the forms of structural equation modeling and binary logistic regression were provided for further elaboration. Study results determined the majority of LBW visitors in the sample noted being young adult white males, from out-of-state, who were politically moderate but slightly liberal leaning, and reported earning high levels of education and household income. The sample consisted of highly experienced yet first-time visitors at the LBW who participated in a multitude of outdoor recreation activities including hiking and walking, backpacking, and through/section hiking the Appalachian/Long Trails. The overall sample indicated very high levels of overall satisfaction with their experiences at the LBW and noted high intention-to-return in the future.

Study results suggest various social, situational, and ecological impacts within the LBW were low. It should be noted, however, that the reported impacts and coping behaviors in this study may be artificially low as first-time visitors often do not perceive impacts nor cope as much as repeat visitors (Arnberger & Brandenburg, 2007). Overall, the ecological factors relating to trail conditions (e.g., trail muddiness, erosion) had the largest impact on the visitor experience. Ecological factors pertaining to weather conditions (e.g., rain, humidity) were similarly impactful. Social factors (e.g., crowding, conflict) had a lesser impact on the visitor experience when compared to ecological factors, while situational factors (e.g., litter, access) had the smallest overall impacts on the visitor experience. Moreover, binary logistic regression analyses demonstrate that at the current reported levels of weather impacts at the LBW, there is an approximate 50%, 30%, 39%, 37%, and 94% likelihood that visitors perceive impacts due to crowding, conflict, litter, access, and trail conditions, respectively. A 1-point increase in weather impacts further increases the likelihood that visitors perceive social, situational, and ecological impacts.

Study results further suggest that when faced with various sub-optimal conditions, LBW visitors are most likely to employ strategic, temporal, and resource substitution behaviors in an effort to preserve their overall experience quality (i.e., intention-to-return). Thus, the pervasive application of these substitution behaviors is likely to impact the visitors, ecosystems, and communities both within and surrounding the LBW. For example, as a result of resource substitution, visitation often spreads from high- to low-use areas, leading to significant social and ecological impacts. With temporal substitution, visitation may shift to different times of the day, week, month, or year; potentially alleviating conventional high-use periods (e.g., summers, holiday weekends), while increasing overall visitation, especially during off-peak periods (e.g., shoulder seasons, weekdays). Finally, in the instances of strategic substitution, visitors may use additional gear to recreate when they normally would not (e.g., during inclement weather), which may lead to further resource degradation.

Findings also demonstrate that LBW visitors, through coping behaviors, are only able to partially mediate the impacts associated with social/situational and ecological factors. Further, visitors are largely able to cope with social/situational impacts and largely unable to cope with ecological impacts, with ecological impacts likely decreasing future intentions-to-return for recreation. However, these findings are advantageous for resource managers as social impacts can be more difficult and resource intensive to address (e.g., ranger patrol to combat crowding), whereas ecological impacts are comparatively simpler and often more time and cost effective to fix (e.g., installing water-bars, trail communication). These findings are also vital to wilderness managers entrusted with maintaining resources in their most natural state to fulfill visitor expectations of solitude. Thus, from a management perspective, ecological impacts should be a primary focus as they most severely detract from visitor experiences, especially as use-levels and associated impacts intensify amidst the COVID-19 pandemic (Beery et al., 2021; Derks et al., 2020).

Section 5-0. Management Recommendations

Section 5-1. Specific Management Recommendations

This section provides recommendations for management policies and facility/natural resource capital investments at the LBW. These recommendations are based upon insights from the data gathered throughout this project as well as the most up-to-date peer-reviewed parks and protected areas management research. Each management recommendation is broken down into two categories: 1) *primary recommendations* and 2) *secondary recommendations*.

Primary management recommendations largely revolve around indirect management techniques (e.g., educating the visitor). Secondary management recommendations largely revolve around direct management techniques (e.g., law enforcement). It should be noted that indirect management techniques are empirically demonstrated to be more effective and preferred by visitors in parks and protected areas over direct management techniques, especially in wilderness settings. However, support for direct management techniques typically increases when implemented to specifically combat worsening conditions.

Some management recommendations are ambitious and long-term, while others represent minor adjustments to policies/procedures. Further, the LBW is encouraged to work cooperatively with local stakeholder groups to consider these recommendations and develop potential alternatives for implementation as various direct and indirect visitor management approaches may have distinct downstream influences upon the visitors, communities, and economies who rely upon the LBW.



- **Issue: Trail Conditions**

- **Resource management plan:** “Restoration efforts should be site-specific and small scale, such as rehabilitating campsites or other sites impacted by recreation” (GMNF, 2006, p. 51). “Trails should be constructed, relocated, and maintained to a minimum standard necessary for protection of the soil, water, vegetation, visual quality, user safety, and long-term maintenance. Emphasis should be placed on trails that appear to be part of the wilderness environment and not an intrusion upon it” (GMNF, 2005, p. 52). “Trails may be added or eliminated to protect wilderness values” (GMNF, 2005, p. 52).
- **Survey respondent preferences:** Respondents perceived trail conditions to have a significant negative impact upon the recreation experience; particularly trail muddiness. Respondents were largely supportive of increasing signage about recreation impacts as well as requiring visitors to stay on designated trails. Advanced data analyses suggested LBW visitors were mostly *unable* to cope/deal/behaviorally adapt with issues related to trail conditions; and that the presence of impactful trail conditions led *directly* to decreased intention-to-return. Moreover, the presence of impactful weather conditions also led to a significant *increase* in the likelihood that LBW visitors would perceive negative trail condition impacts.
- **Primary Recommendations:** We suggest resource managers consider a two-tiered communication approach to engage stakeholders and visitors, particularly in areas of intensive trail impacts (e.g., Lye Brook Falls, Bourn Pond, Appalachian/Long Trail). The first aspect of messaging could focus on how trail degradation impacts specific recreation behaviors and experiences. The second aspect of messaging could focus on how trail degradation impacts the broader natural resources, communities, states, and regions which rely upon high-quality outdoor recreation opportunities. For example, informational campaigns (e.g., press releases, signage, websites, social media) could focus on educating visitors and communities regarding proper trail etiquette and the seven primary principles of Leave No Trace (LNT). These LNT principles could be integrated and applied not only at trailheads, but also reiterated to visitors via stakeholders and partners repeatedly throughout the visitor experience (e.g., hotels, restaurants, attractions). Campaigns could also convey specific conditions and locations where trail impacts are likely to occur (e.g., in large groups, after severe weather).
- **Secondary Recommendations:** Additionally, resource managers may consider implementing greater enforcement towards behaviors that lead to trail impacts (e.g., ticketing, fines, three-strike rule, enforcing current group-size limitation), especially during traditional peak visitation seasons (e.g., summer, early fall). Managers might also consider various trail infrastructure improvements (e.g., installing water bars, hardening trails) and require visitors to stay on designated trails to minimize future site degradation. We also suggest resource managers consider further educating visitors regarding Leave No Trace principles and increasing the presence of volunteers throughout the National Forest to simultaneously educate visitors and serve as informal and indirect authority figures.

- **Issue: Campsite Conditions**

- **Resource management plan:** “Facilities and designated campsites may be present when necessary to protect Wilderness values” (GMNF, 2006, p.49). “Recreation and other activities may be restricted or prohibited through area closures to protect the special ecological values of these areas” (GMNF, 2006, p. 51). “Whenever practical, campsites outside of the Appalachian Trail and Long Trail should be managed in ways to make them as unrecognizable as possible. Only minimal physical changes and structures should exist at most sites (simple rock fire rings)” (GMNF, 2006, p.51).
- **Survey respondent preference:** Respondents perceived current campsite conditions to have a negative impact upon the recreation experience; particularly campsite erosion and damaged trees. Respondents were very supportive of prohibiting illegal campfires and increasing signage about recreation impacts. Respondents were moderately supportive of requiring camping at designated sites within the LBW.
- **Primary Recommendations:** We suggest resource managers consider a two-tiered communication approach to engage stakeholders and visitors, particularly in areas of intensive campsite impacts (e.g., Bourn Pond). The first aspect of messaging could focus on how impactful campsite conditions impact specific recreation behaviors and experiences. The second aspect of messaging could focus on how impactful campsite conditions impact the broader natural resources, communities, states, and regions which rely upon high-quality outdoor recreation opportunities. For example, informational campaigns (e.g., press releases, signage, websites, social media) could convey and encourage sustainable use habits (e.g., Leave No Trace) at campsites (e.g., only using dead trees for campfires, camping on durable surfaces), and working with communities to increase education amongst proper behavior at wilderness campsites (e.g., proper campfire etiquette, social norms, consideration for other current/future campers).
- **Secondary Recommendations:** Additionally, resource managers may consider implementing greater enforcement towards behaviors that lead to campsite impacts (e.g., ticketing, fines, three-strike rule), especially during traditional peak visitation seasons (e.g., summer, early fall). Managers might also consider camping use-limitations (e.g., requiring visitors to camp at designated sites, a reservation system for popular camping locations) to further minimize site degradation. We also suggest resource managers consider further educating visitors regarding Leave No Trace principles and increasing the presence of volunteers throughout the National Forest to simultaneously educate visitors and serve as informal and indirect authority figures.

- **Issue: Litter**

- **Resource management plan:** “Nationally adopted I&E programs, such as Leave No Trace, should be promoted to Forest visitors to create a better understanding of the Forest environment and to reduce impacts to Forest resources” (GMNF, 2006, p. 41). “Management emphasizes the maintenance of wilderness values [...] A general appearance of being affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable” GMNF, 2005, p. 49).
- **Survey respondent preference:** Respondents perceived visible litter, garbage, and/or waste to have a significant negative impact upon the recreation experience. Respondents were very supportive of enforcement and regulations requiring visitors to carry-out all litter, trash, and/or waste at the LBW. Advanced data analyses suggested LBW visitors were *partially* able to cope/deal/behaviorally adapt with issues related to litter; and that the presence of litter lead to the employment of substitution behaviors and *directly* decreased visitor intention-to-return. Moreover, the presence of impactful weather conditions also led to a significant *increase* in the likelihood that LBW visitors would perceive negative impacts due to litter.
- **Primary Recommendations:** We suggest resource managers consider a two-tiered communication approach to engage stakeholders and visitors, particularly in areas prone to intensive litter, garbage, and/or waste (e.g., Bourn Pond, Lye Brook Falls). The first aspect of messaging could focus on how litter, garbage, and/or waste impacts specific recreation behaviors and experiences. The second aspect of messaging could focus on how litter, garbage, and/or waste impacts the broader natural resources, communities, states, and regions which rely upon high-quality outdoor recreation opportunities. For example, informational campaigns (e.g., press releases, signage, websites, social media) could focus on educating visitors and communities regarding the seven primary principles of LNT. These LNT principles could be integrated and applied not only at trailheads and campsites, but also reiterated to visitors via stakeholders and partners repeatedly throughout the visitor experience (e.g., local hotels, restaurants, attractions).
- **Secondary Recommendations:** Additionally, resource managers may consider implementing greater enforcement towards the presence of litter, garbage, and/or waste (e.g., ticketing, fines, three-strike rule), especially during traditional peak visitation seasons (e.g., summer, early fall). We also suggest resource managers consider further educating visitors regarding Leave No Trace (LNT) principles and increasing the presence of volunteers throughout the National Forest to simultaneously educate visitors and serve as informal and indirect authority figures.

- **Issue: Conflict**
 - **Resource management plan:** “Visitor use may be managed by informing visitors of alternative opportunities outside of wilderness, restricting access to the wilderness, limiting length of stay, limiting group size, and/or instituting a permit system” (GMNF, 2006, p. 51). “Interaction between users will vary by wilderness, specific places within each wilderness, and season of use. In general, use will be concentrated around trail corridors and other popular features. Away from trails and in low-use wildernesses, evidence of, and interaction with, other users will be low” (GMNF, 2006, p. 49).
 - **Survey respondent preference:** Respondents perceived conflict to have a significant negative impact upon the recreation experience; particularly the actions and behaviors of other visitors. Advanced data analyses suggested LBW visitors were able to *partially* cope/deal/behaviorally adapt with issues related to conflict; and that the presence of conflict lead to the employment of substitution behaviors and *directly* decreased visitor satisfaction. Further, the presence of impactful weather conditions also led to a significant *increase* in the likelihood that LBW visitors would perceive negative impacts due to conflict.
 - **Primary Recommendations:** We suggest resource managers consider a two-tiered communication approach to engage stakeholders and visitors, particularly in areas of intensive conflict. The first aspect of messaging could focus on how conflict impacts specific recreation behaviors and experiences. The second aspect of messaging could focus on how conflict impacts the broader natural resources, communities, states, and regions which rely upon high-quality outdoor recreation opportunities. For example, informational campaigns (e.g., press releases, signage, websites, and social media) could convey and encourage respectful recreation behaviors, specifically zoned recreation locations for certain user types, promote a “share the trails” program in which the needs and perspectives of various user groups are emphasized (e.g., providing hikers a buffer, informing hikers of intent to pass, appropriate behaviors of large hiking parties), and working with communities to increase education amongst traditionally oppositional user segments (e.g., trail etiquette, social norms, understanding one-way conflict).
 - **Secondary Recommendations:** Additionally, resource managers may consider implementing a zoned management approach, or segregating recreation activities, on the LBW to decrease conflict and limit physical interactions while providing recreation opportunities for all user groups. Resource managers might consider zoning certain areas or trails exclusively for a limited number of recreation activities (e.g., dog walking, trail running, extended quiet hours) to encourage and concentrate similar recreation activities and separate traditionally oppositional user groups. Resource managers might also consider implementing a temporally zoned management approach (e.g., segregating various user groups by time-of-day, day-of-week, month, or season).

Section 5-2. Management Recommendations Conclusions

The study researchers and authors acknowledge that many of these management preferences and recommendations may be related, overlapping, and/or conflicting. For example, to reduce instances of conflict, it is suggested that a zoned management approach be considered to concentrate similar user groups together. However, this may increase the prevalence of trail degradation at certain locations as implementing recreation zones may shift where visitors physically recreate. The researchers suggest LBW resource managers view each of these recommendations and suggestions from a holistic, interconnected, and triage lens to assure the most pressing management concerns are met first.

The overarching theme of this section is to address and mitigate worsening ecological conditions (i.e., site degradation) in one form or another. Management strategies that may be effective in controlling site degradation include, but are not limited to: visitor education, messaging, signage (e.g., LNT, reiterating proper etiquette/social norms), permitting systems (e.g., lottery permits, first-come first-serve permits, individual site access permits), implementing and enforcing policy around litter, enforcing and restricting use to designated trails and campsites, enforcing current group-size policy, infrastructure adjustments (e.g., trail hardening, maintenance, water bars), as well as implementing reservation systems (e.g., timed entry, reservations for high-use corridors).

These concepts of visitor education and maintenance to mitigate ecological impacts from recreation use within a parks and protected areas are not novel, and precedent has already been set by numerous parks and protected areas in the United States, especially as visitation intensifies. For example, the Caribou-Targhee National Forest in Idaho, Wyoming, and Utah has recently engaged visitors in an informational campaign to stay on designated trails and recreate responsibly. The campaign outlines the susceptibility of certain areas of the forest to ecological impacts from recreation and emphasizes visitors consider the current condition of the trails as to not damage any natural resources further (TVN, 2022). Moreover, the Pisgah National Forest has implemented bans on camping and campfires until 2024 in certain high-use areas of the forest along the Appalachian Trail to mitigate ecological impacts and allow the area to recover (Aldridge, 2022).

In conclusion, the LBW is an invaluable resource. A unique combination of ecological diversity and high-quality natural resource management, in addition to an abundance of public access, has made the LBW extremely popular amongst a variety of local, regional, and international visitors. As a social-ecological system, the visitor experience is intimately interconnected with the ecological functioning of the natural resource as well as local and regional economies and workforces. It is imperative that management actions are considered and implemented from a holistic perspective, and that these pervasive ecological, social, and situational impacts are addressed for the LBW to ensure the best outcomes for not only recreation visitors, but to preserve and sustain the long-term social, ecological, cultural, and economic integrity of the entire system.

Section 6-0. References

- Aldridge, B. (2022, July 1). Camping banned in popular area of Appalachian Trail in NC due to flood of visitors. *The Charlotte Observer*. <https://www.charlotteobserver.com/news/state/north-carolina/article252510523.html>
- Anderson, K. (2016). *Lye Brook Wilderness Character Narrative*. USDA Forest Service.
- Arnberger, A., & Brandenburg, C. (2007). Past on-site experience, crowding perceptions, and use displacement of visitor groups to a peri-urban national park. *Environmental management*, 40(1), 34.
- Beery, T., Olsson, M. R., & Vitestam, M. (2021). COVID-19 and outdoor recreation management: Increased participation, connection to nature, and a look to climate adaptation. *Journal of Outdoor Recreation and Tourism*, 36, 100457.
- Derks, J., Giessen, L., & Winkel, G. (2020). COVID-19-induced visitor boom reveals the importance of forests as critical infrastructure. *Forest Policy and Economics*, 118, 102253.
- Ferguson, M. D., Evensen, D., Ferguson, L. A., Bidwell, D., Firestone, J., Dooley, T. L., & Mitchell, C. R. (2021). Uncharted waters: Exploring coastal recreation impacts, coping behaviors, and attitudes towards offshore wind energy development in the United States. *Energy Research & Social Science*, 75, 102029.
- Ferguson, M. D., McIntosh, K., English, D. B., Ferguson, L. A., Barcelona, R., Giles, G., Fraser, O., & Leberman, M. (2022). The Outdoor Renaissance: Assessing the impact of the COVID-19 pandemic upon outdoor recreation visitation, behaviors, and decision-making in New England's national forests. *Society & Natural Resources*, 1–20.
- Ferguson, M. D., Mueller, J. T., Graefe, A. R., & Mowen, A. J. (2018). Coping with climate change: a study of Great Lakes water-based recreationists. *Journal of Park and Recreation Administration*, 36(2).
- Forest urges visitors to use caution and prevent resource damage as they venture out this spring. (2022, July 19). *Teton Valley News*. https://www.tetonvalleynews.net/freeaccess/forest-urges-visitors-to-use-caution-and-prevent-resource-damage-as-they-venture-out-this/article_644773f5-b92c-5966-b285-b3c9633e85d3.html
- Miller, T. A., & McCool, S. F. (2003). Coping with stress in outdoor recreational settings: An application of transactional stress theory. *Leisure Sciences*, 25(2), 257-275. DOI: [10.1080/01490400306562](https://doi.org/10.1080/01490400306562)
- Morse, W. C. (2020). Recreation as a social-ecological complex adaptive system. *Sustainability*, 12(3), 753.
- Outdoor Foundation. (2021). Outdoor Participation Trends Report. Outdoorindustry.org. <https://outdoorindustry.org/wp-content/uploads/2015/03/2021-Outdoor-Participation-Trends-Report.pdf>
- Perry, E. E., Thomsen, J. M., D'Antonio, A. L., Morse, W. C., Reigner, N. P., Leung, Y. F., ... & Taff, B. D. (2020). Toward an integrated model of topical, spatial, and temporal scales of research inquiry in park visitor use management. *Sustainability*, 12(15), 6183.
- United States Department of Agriculture Forest Service. (2006). *Green Mountain National Forest Land and Resource Management Plan*.
- Vaske, J. J. (2008). *Survey research and analysis: Applications in parks, recreation, and human dimensions*. Venture Publishing, Incorporated.

Appendix A. Staff, Students Supported, and Outreach/Extension

One graduate student was employed on this project. Major tasks completed by the graduate student included survey data collection, data input, and assistance with the data analysis and preparation of project reports and outreach materials. Study results informed the development of the graduate student research, scholarship, and thesis. The following is a description of the staff, support, and outreach.

a. Students Supported

- i. Number of Graduate Students = 1
 - Mr. Alexander Caraynoff
- ii. Degrees Awarded = 1 (M.S.)

b. Staff

- i. Number of full-time faculty = 3
 - Dr. Michael Ferguson
 - Dr. Robert Barcelona
 - Dr. Lauren Ferguson
- ii. Number of full-time employees = 0

c. Publications

- i. Total publication = 1
- ii. Total theses = 1

d. Volunteer Hours

- i. Total volunteer hours = 0

e. Outreach/Extension

- i. Number of meetings, workshops, or conferences, and number of attendees = 2; 200 attendees
- ii. Number of public or professional presentations, and number of attendees = 2; 200 attendees

Appendix B. Survey Instrument

Date: _____ Time: _____ Location: _____ Interviewer: _____

Hello, my name is _____. I am a researcher with UNH and my team and I are conducting a survey of Lye Brook Wilderness (LBW) visitors. The information collected will help natural resource managers better serve their visitors. Your participation is voluntary, and all information will be kept confidential.

1. May I have about 10-15 minutes of your time to complete this survey? ____ Yes ____ No
 - a. [If NO] Your information is really important, could you please just complete a 1 minute portion of the survey?
2. Which of you has had the most recent birthday and is at least 18 years of age? [Focus all questions towards that user]
3. [*FC*] Did you specifically enter the LBW during this trip? ____ Yes ____ No

Section 1: Your Recreation Experience at the Lye Brook Wilderness
 Please tell us about your recreation experience during this trip to the Lye Brook Wilderness (LBW).
 Please report all answers referring only to your personal experiences at the LBW.

4. [*FC*] Which *entrance* did you use to access the LBW on this trip? [Select ONE entrance]

Lye Brook	Bourn/Branch	Stratton Pond	AT/LT	AT/LT
____ Falls TH (A)	____ Pond Access (B)	____ Access (C)	____ North (D)	____ South (E)
____ Other [Please specify]: _____				
5. [*FC*] Which *exit* did you use when leaving LBW on this trip? [Select ONE exit]

Lye Brook	Bourn/Branch	Stratton Pond	AT/LT	AT/LT
____ Falls TH (A)	____ Pond Access (B)	____ Access (C)	____ North (D)	____ South (E)
____ Other [Please specify]: _____				
6. Please indicate the level of crowding you experienced at the LBW on this trip on a scale from 1 to 9; 1= *not at all crowded* and 9= *extremely crowded*. [Select ONE option].

Not at All Crowded	Slightly Crowded	Moderately Crowded			Extremely Crowded
(1)	(2)	(3)	(4)	(5)	(6)
(7)	(8)	(9)			
7. About how many other visitors *did you encounter at any one time* at the LBW on this trip?
 ____ Visitors encountered at the LBW ____ No visitor encounters at the LBW ____ Don't know/Not sure
8. Previously, you noted how many visitors you encountered *at any one time* at the LBW on this trip. Please rate the acceptability of those encounters on a scale from 1 to 7; 1= *very unacceptable* and 7= *very acceptable*.

Very Unacceptable	Unacceptable	Slightly Unacceptable	Neither	Slightly Acceptable	Acceptable	Very Acceptable
(1)	(2)	(3)	(4)	(5)	(6)	(7)
9. What is the *maximum* number of visitors you could encounter *at any one time* at the LBW before you would no longer visit here? ____ Max # of visitors at any one time ____ I would visit regardless of use
10. The LBW currently allows a maximum of 10 visitors per group when recreating within the wilderness boundary. Are you aware of this group size limitation policy? ____ Yes ____ No
11. Please indicate the extent to which you support or oppose each of the following on a scale from 1 to 7; 1= *strongly oppose* and 7= *strongly support* [Select ONE option for each row].

“The LBW should...”	Strongly Oppose	←	Neutral	→	Strongly Support		
Continue to allow a maximum of 10 visitors per group at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Increase the size of groups allowed at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Decrease the size of groups allowed at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Limit the overall number of groups allowed at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)

12. Please indicate how satisfied you are with your overall recreation experience at the LBW on this trip on a scale from 1 to 7; 1= *poor* and 7= *perfect*. [Select ONE option].

Poor	Fair	Good	Excellent	Perfect		
(1)	(2)	(3)	(4)	(5)	(6)	(7)

13. [*FC*] Please indicate the extent to which you agree or disagree with each of the following statements on a scale from 1 to 7; 1= *completely disagree* and 7= *completely agree*. [Select ONE option for each row].

	Completely Disagree	←	Neither	→	Completely Agree		
I thoroughly enjoyed this trip to the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I could not imagine this trip to the LBW being better	(1)	(2)	(3)	(4)	(5)	(6)	(7)
This trip to the LBW has been well worth the time and money I spent to take it	(1)	(2)	(3)	(4)	(5)	(6)	(7)

14. [*FC*] Which of the following activities have you participated in at the LBW on this trip? [Select ALL that apply].

15. [*FC*] Which one of those activities was your *primary activity* at the LBW on this trip? [Select ONE option].

Q14 Answer [Select ALL that apply]	Q15 Answer [Select ONE option]
Hiking or walking	
Backpacking	
Through hiking the Appalachian/Long Trail	
Section hiking the Appalachian/Long Trail	
Dog walking	
Trail running	
Sightseeing or viewing natural features and/or wildlife	
Picnicking or family day gatherings	
Relaxing and hanging out	
Camping	
Fishing	
Canoeing or kayaking	
Swimming	
Hunting	
Foraging	
Other:	

Section 2: Perceptions of Conditions at the LBW

The purpose of these next questions is to understand your perceptions of various *conditions* at the LBW during this trip. *Conditions* refer to any condition or situation that may impact your overall recreation experience.

16. [*FC*] To what extent have the following *social and situational conditions* impacted your recreation experience at the LBW on this trip on a scale from 1 to 7; 1= *no impact* and 7= *major impact*. [Select ONE option for each row].

"To what extent have the following impacted your recreation experience at the LBW on this trip?"	No Impact						Major Impact
Crowding	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Too many other visitors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Conflict with other visitors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
The way other visitors are behaving	(1)	(2)	(3)	(4)	(5)	(6)	(7)
The actions or behaviors of other visitors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visible litter, garbage, or waste	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Domestic animal waste	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Parking accessibility	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trail accessibility	(1)	(2)	(3)	(4)	(5)	(6)	(7)
The COVID-19 pandemic	(1)	(2)	(3)	(4)	(5)	(6)	(7)

17. [*FC*] To what extent have the following *weather conditions* impacted your recreation experience at the LBW on this trip on a scale from 1 to 7; 1= *no impact* and 7= *major impact*. [Select ONE option for each row].

"To what extent have the following impacted your	No						Major
--	----	--	--	--	--	--	-------

<i>recreation experience at the LBW on this trip?</i>	Impact						Impact
Temperature	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Humidity	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rain	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Strong winds	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cloudiness	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visibility	(1)	(2)	(3)	(4)	(5)	(6)	(7)

18. [*FC*] To what extent have the following *trail conditions* impacted your recreation experience at the LBW on this trip on a scale from 1 to 7; 1= *no impact* and 7= *major impact*. [Select ONE option for each row].

<i>"To what extent have the following impacted your recreation experience at the LBW on this trip?"</i>	No Impact						Major Impact
Trail widening (e.g., excessive width)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Informal trails (e.g., social trails)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trail erosion (e.g., bare soil)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trail muddiness (e.g., wet soil)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trail litter (e.g., trash, toilet paper)	(1)	(2)	(3)	(4)	(5)	(6)	(7)

19. Did you camp in the LBW on this trip? ____ Yes ____ No

20. [*FC*] To what extent have the following *campsite conditions* impacted your recreation experience at the LBW on this trip on a scale from 1 to 7; 1= *no impact* and 7= *major impact*. [Select ONE option for each row].

<i>"To what extent have the following impacted your recreation experience at the LBW on this trip?"</i>	No Impact						Major Impact
Campsite erosion (e.g., bare soil, excessive root exposure)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Damaged trees (e.g., tree vandalism, cut limbs, bark removal, etc.)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Campsite area increasing (e.g., excessive site widening)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unofficial campsite development (e.g., informal campsites + fire rings)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Campsite litter (e.g., trash, toilet paper)	(1)	(2)	(3)	(4)	(5)	(6)	(7)

21. Please indicate whether you intend to return to the LBW in the future on a scale from 1 to 7; 1= *definitely not* and 7= *without a doubt*.

Definitely Not							Without a Doubt
(1)	(2)	(3)	(4)	(5)	(6)	(7)	

22. [*FC*] To what extent have the following conditions on this trip influenced your intention to return to the LBW on a scale from 1 to 7; 1= *no influence* and 7= *major influence* [Select ONE option for each row].

	No Influence						Major Influence
Social conditions (crowding and conflict)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Situational conditions (access, litter, cleanliness)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Weather conditions (temperature, rain, visibility)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trail conditions (erosion, widening, social trails)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Campsite conditions (erosion, expansion, tree damage)	(1)	(2)	(3)	(4)	(5)	(6)	(7)

[*FC*] The following are some strategies people use to deal with various *conditions*. Please indicate whether you have done any of the following in response to various *conditions* at the LBW on this trip on a scale from 1 to 7; 1= *never* and 7= *always*. [Select ONE option for each row].

<i>"In response to various conditions at the LBW on this trip, I have..."</i>	Never						Always
Avoided certain areas of the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visited different areas of the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visited a different location <i>within</i> the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Stopped engaging in my main recreation activity at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Began a new recreation activity at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Changed my recreation activity at the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Visited the LBW during a different season	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visited the LBW on a different day of the week	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Visited the LBW earlier or later in the day	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Avoided visiting the LBW on holidays	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Considered visiting different location <i>outside</i> of the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Considered abandoning my recreation experience entirely	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Changed the gear I use while recreating in the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Considered purchasing new gear for future trips to the LBW	(1)	(2)	(3)	(4)	(5)	(6)	(7)

23. Please tell us more about any *conditions or situations* that changed the way you recreate at the LBW (e.g., what happened, when/why it occurred, what/why you changed, where you went instead, potential solutions, etc.)

Section 3: Health Outcomes at the LBW

The purpose of these next questions is to understand your perceived health outcomes related to the LBW on **this trip**.

24. [*FC*] The following are some physical and mental health outcomes visitors derive from outdoor recreation. Please indicate the extent to which you visited the LBW for the following reasons on **this trip** on a scale of 1 to 7; 1= *not like me* and 7= *very much like me*. [Select ONE option for each row].

<i>"I recreate at the LBW because it..."</i>	Not Like Me → Very Much Like Me						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Improves my overall health	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Improves my overall fitness	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Improves my muscle strength	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Causes me to appreciate life more	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Makes me more aware of who I am	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Is connected to other positive aspects of my life	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Causes me to be more satisfied with my life	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reduces my chances of having a heart attack	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reduces my chances of premature death	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reduces my number of illnesses	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reduces my stress	(1)	(2)	(3)	(4)	(5)	(6)	(7)

25. To what extent has the COVID-19 pandemic changed your **recreation use** of the LBW on a scale from 1 to 7; 1= *decreased usage* and 7= *increased usage*?

Decreased Usage	←	Usage Stayed the Same	→	Increased Usage		
(1)	(2)	(3)	(4)	(5)	(6)	(7)

26. To what extent has the COVID-19 pandemic negatively or positively impacted your **recreation use** of the LBW on a scale from 1 to 7; 1= *negatively impacted* and 7= *positively impacted*?

Negatively Impacted	←	Neither	→	Positively Impacted		
(1)	(2)	(3)	(4)	(5)	(6)	(7)

27. Please tell us more about how the COVID-19 pandemic has impacted your recreation use of the LBW (e.g., what happened, where/when it happened, annoyances, conflict with other visitors, etc.).

Section 4: Management Preferences

The purpose of these next questions is to understand your preferences towards management actions at the LBW.

28. [*FC*] Please indicate the extent to which you support or oppose each of the following management actions at the LBW on a scale from 1 to 7; 1= *strongly oppose* and 7= *strongly support* [Select ONE option for each row].

(3) \$50,000-\$74,999 (6) \$150,000 or more

39. [*FC*] What is the highest level of formal schooling you have completed? [Select ONE option].

(1) Less than high school (4) Some college (7) Graduate/professional degree
(2) Some high school (5) 2 year college
(3) High school graduate (6) 4 year college

40. If you could ask management to improve the operation of the LBW, what might you ask them to do?

**Thank you for taking the time to complete this survey.
This information will be used to improve the management of the LBW and the overall visitor experience.**