



Leave
No
Trace™

Center for Outdoor Ethics | LNT.org

Leave No Trace Focused Research

Findings from 2011–2018





Leave No Trace-Focused Research

Findings from 2011–2018

The Leave No Trace Center for Outdoor Ethics (the Center) funds, designs, and undertakes research designed to inform new and effective ways to educate people about protecting our shared public lands. The Center develops groundbreaking research projects, and utilizes cutting-edge methods, blending different data collection techniques to gather important information. This research fuels the creation of specific education, messaging, and innovative programming that contributes to the long-term care and stewardship of parks and protected areas.

The following summaries of recent studies provide insight regarding the most salient findings from the studies, while also detailing the most meaningful management implications. Some of these studies examine behavioral intent and actual behaviors while others explore specific types of recreation, or recreation in specific settings. However, these studies generally are focused on recreation-related behaviors and identifying the educational and management leverage points for influencing the choices people make in the outdoors. Ideally, the aggregation of findings from these studies can be used to better align the actions of outdoor enthusiasts with Leave No Trace.

Leave No Trace Behaviors in National Parks

Factors Influencing Behavioral Intentions for Leave No Trace Behavior in National Parks

Abstract

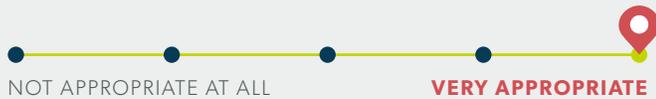
Resource degradation resulting from visitor behavior continues to be a significant concern for land managers, and effective educational messages such as those promoted through Leave No Trace, which target deprecative behaviors, are imperative. This study examined psychological and knowledge variables that were hypothesized to influence future Leave No Trace behavioral intent of visitors in Rocky Mountain National Park. Data were obtained from an on-site survey

administered to individuals ($n = 390$, response rate 74%) in the Bear Lake corridor of the park. Results of a multiple regression analysis revealed that perceived effectiveness of Leave No Trace practices is a significant predictor of future behavioral intent ($> .21$, $p < .001$, in all cases). Frontcountry visitors like those at Bear Lake are more likely to practice Leave No Trace if they perceive the practices to be effective at reducing impacts.

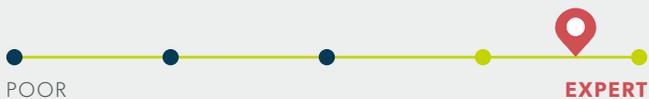




55% of visitors responded that it was **“very appropriate”** to leave food scraps behind as a food source for animals, indicating that many visitors are either unfamiliar with or misunderstand some Leave No Trace practices.



Almost 60% of visitors reported their knowledge of Leave No Trace as **above average to expert**.



The majority of visitors responded that they were **“extremely likely”** to practice Leave No Trace in the future for all survey items except **“taking breaks away from the trail and other visitors,”** for which visitors responded that they were **“moderately likely”** to follow this recommendation.



Management Implications

1. Park visitors need to better understand why certain Leave No Trace practices are recommended, and why those practices are effective at reducing impacts.
2. Education efforts specifically focused on the perceived effectiveness of Leave No Trace practices may prove more effective at modifying visitor behavior in order to minimize recreation-related impact in parks.

Leave No Trace Behaviors in State Parks

Understanding and Influencing State Park Visitors' Leave No Trace Behavioral Intent

Abstract

Impact to protected area resources due to uninformed or deprecative visitor behavior continues to be a principal concern for managers. Leave No Trace is a prevalent educational strategy for mitigating such impacts. Through on-site surveys, this study examined frontcountry visitor attitudes toward Leave No Trace practices, and self-reported knowledge concerning Leave No Trace in three Wyoming state parks to determine factors that influenced

their behavioral intent to practice Leave No Trace. Results suggest that attitudes toward perceived effectiveness of Leave No Trace practices and appropriateness of Leave No Trace practices are significant predictors of behavioral intent. If education-based communication efforts focus on why Leave No Trace practices are appropriate and effective, there is an increased likelihood of meaningfully influencing behavioral intent.



Management Implications

1. Communication efforts should highlight the effectiveness and ease of practicing Leave No Trace behaviors, as visitor attitudes towards perceived effectiveness and difficulty are meaningful predictors of Leave No Trace behavioral intent.
2. A more uniform approach to Leave No Trace education and communication could lead to greater adoption and use of Leave No Trace by state parks, thereby lessening the burden on agencies in terms of program development and implementation.



50% of visitors responded that it was **“very appropriate”** to carry out all litter, leaving only food scraps.

NOT APPROPRIATE AT ALL

VERY APPROPRIATE



While respondents perceived the majority of Leave No Trace practices to be effective, the recommended practice of taking breaks away from the trail and other visitors was perceived to **only reduce impact sometimes**.

NEVER

ALWAYS



55% of respondents rated their knowledge of Leave No Trace practices as **above average, extensive, or expert**.

POOR

EXPERT



Minimizing the Use of Undesignated Trails

Mitigating Undesignated Trail Use: The Efficacy of Messaging and Direct Site Management Actions in an Urban-Proximate Open Space Context

Abstract

The use and creation of undesignated recreational trails can lead to erosion, vegetation damage, unsafe trail conditions, and impacts to local wildlife. The mitigation of undesignated trail use is typically addressed indirectly through minimum impact visitor education programs such as Leave No Trace, or directly through closures or sanctions. In this study, researchers collaborated with City of Boulder, Colorado Open Space and Mountain Parks (OSMP) staff to develop a quasi-experimental field study that examined the effectiveness of indirect (messaging)

and direct (barriers) management approaches to mitigating undesignated trail use. The study applied a theory of planned behavior framework, utilized Leave No Trace messaging, and employed a method to pair survey and direct observation data. A total of 2,232 visitor parties were observed, and 147 surveys were collected. The combined direct (barrier) and indirect (messaging) intervention was the most effective at mitigating undesignated trail use. Implications for management and future research are discussed.

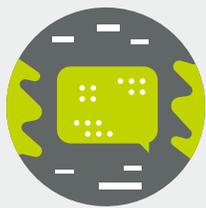
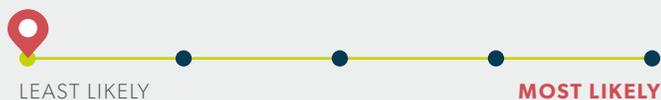




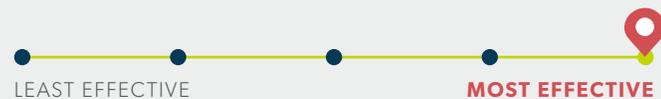
42% of survey respondents were **unaware** that undesignated trails existed on the OSMP system.



Frequent visitors reported being the **least likely** to stay on designated trails.



A combined barrier and Leave No Trace education message was the **most effective** method for reducing undesignated trail use.



Management Implications

1. Survey results suggested that there is a need to better clarify which existing OSMP trails are designated and undesignated trails. It would be valuable to maintain consistent dissemination of information, signage, and management interventions throughout the trail system that signify which trails are designated trails.
2. Consider the use of attributional-based Leave No Trace messages, such as "Stay on designated trails: Even when wet and muddy, to protect trailside plants and minimize erosion. This is Not a Designated Trail," in the design of future information and education campaigns.
3. Education and outreach efforts regarding the impacts related to undesignated trail use should be strategically designed to reach local user communities and frequent visitors.

Boulderers Attitudes and Beliefs about Leave No Trace

Boulderers' Attitudes and Beliefs Regarding Leave No Trace in Rocky Mountain National Park

Abstract

Bouldering is a growing recreational activity, frequently occurring in fragile wilderness areas. As bouldering use increases, so too does the potential for ecological and social impacts. Leave No Trace–based educational strategies are the most prominent form of indirect management used to influence wilderness visitor behaviors. Given the growth of bouldering in wilderness and the lack of understanding regarding boulderers' perceptions of minimum impact practices, the purpose of this study was to examine boulderers' attitudes and perceptions of Leave No Trace in Rocky Mountain National Park. Results suggest that boulderers' attitudes

generally align with Leave No Trace recommended practices, although attitudes are less congruent with practices that are perceived as limiting to safety, access, and maintaining bouldering opportunities in the park. Findings indicate that global perceptions of Leave No Trace are positive and that educational communication strategies that target specific bouldering behaviors could minimize ecological and social impacts associated with bouldering. Results provide wilderness managers with baseline attitudinal data, which can be reevaluated in the future and monitored in conjunction with ecological data, after educational communication and outreach strategies have been deployed.





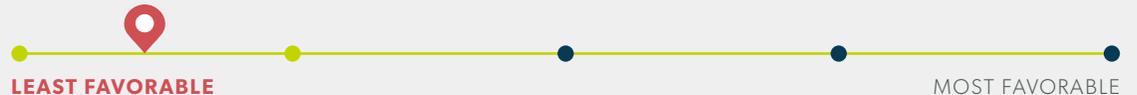
Over 90% of respondents indicated **very strong agreement** with the statements “practicing Leave No Trace protects the environment” and “it is important that all visitors practice Leave No Trace.”



The item “scheduling a visit to avoid times of high use” was perceived to be the **least effective** of the Leave No Trace behaviors (techniques) for reducing impacts.



Attitudes towards some bouldering-specific Leave No Trace behaviors were **less favorable**: items such as “moving rocks or trees at the base of a boulder to develop a safer landing zone” and “removing lichen, moss, or plants from a boulder to establish a new route” received greater support relative to the other Leave No Trace practices being evaluated.



Management Implications

1. Nearly 70% of respondents in this survey indicated they first learned to climb in a gym. This research suggests that national park staff should focus on education and outreach efforts within the climbing gym industry.
2. Education and messaging efforts should focus on the effectiveness and lack of difficulty associated with the Leave No Trace practices currently perceived by some as limiting to bouldering opportunities.
3. Education and messaging efforts are being initiated in ROMO via signage, website, and direct ranger and park volunteer contact.
4. Park staff have also begun, and continue, to collaborate with external agencies and constituent groups in outreach efforts.

Efficacy of Leave No Trace Youth Education

Will They Leave What They Find? The Efficacy of a Leave No Trace Education Program for Youth.

Abstract

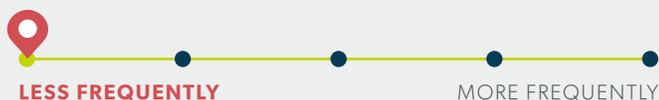
The authors explored the influences of a youth-focused Leave No Trace educational program on participants' attitudes, behaviors, and nature connectedness. The study employed an experimental, equivalent control-group design and included survey and direct observation measures. Pretest and posttest surveys provided self-report measures of attitudes and nature

connectedness, while direct observations examined participants' behavior toward keeping or leaving objects found in nature. Participants who received the PEAK educational program reported positive attitude changes above and beyond participants who did not receive the program and left found objects more often than those in the control group.





Participants who received the Leave No Trace Leave What You Find (LWYF) education removed objects found in nature 11% **less frequently** (60% removal rate) than participants who did not receive LWYF education (71% removal rate). This was statistically significant.



LWYF program participants were **significantly more likely** than those who did not receive the education program to evaluate the behavior of taking natural objects home as unimportant, and the majority disagreed further that bringing natural objects home helped them feel connected to nature.



Management Implications

1. Because a 30-minute program that broadly covered the LWYF concept caused significant differences in attitudes and behaviors among participants, it stands to reason that a more intensive (e.g., longer, more elaborate) outdoor ethics curriculum might have even greater positive influence on outdoor behavior.
2. Leave No Trace may serve as a bridge for meaningfully connecting youth with the natural world.

Pet Waste Disposal

Dog Owners' Perceptions and Behaviors Related to the Disposal of Pet Waste in City of Boulder Open Space and Mountain Parks

Abstract

Leaving pet waste on public open space is a depreciative behavior, with the potential to harm social and ecological wellbeing. Managers often implement direct and indirect management actions to mitigate depreciative behaviors like this. The purpose of this study was to explore dog owner behaviors and self-reported perceptions regarding the disposal of dog waste in Open Space and Mountain Parks (OSMP) in Boulder, Colorado, in an effort to increase compliance with proper disposal practices. This study utilized direct observations of dog owners and

their behaviors regarding pet waste, and separate self-reported surveys to examine dog owner's perceptions of pet waste disposal in OSMP. The Theory of Planned Behavior served as a framework to explore how dog owners' attitudes, norms, and perceived behavioral control might influence behavioral intentions, as well as self-reported current behavior, regarding the disposal of pet waste in OSMP. Finally, this study explored potential management techniques that may influence dog owners' to properly dispose of pet waste in OSMP in the future.





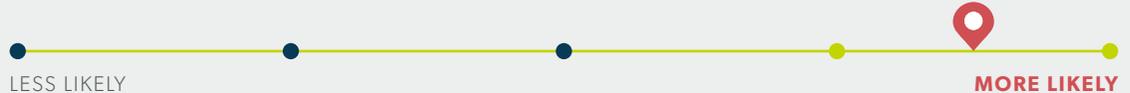
73.5% of dog guardians properly (i.e., bag waste and immediately take all bags) disposed of waste.



Guardians with dogs on-leash were **significantly more likely** to bag their pet's waste than guardians with dogs off-leash, and they were **~11% more likely** to bag and immediately take pet waste for disposal (i.e., compliance) than guardians with dogs off-leash.



Many survey respondents stated that additional trash/compost bins and/or bag dispensers would make them **more likely** to properly dispose of their dog's waste during their next visit.



Management Implications

1. The following direct actions should be considered: designating more on-leash only sites because compliance is significantly higher when dogs are on-leash; establishing longer on-leash segments at off-leash areas/trailheads; installing additional, more frequent trash and/or compost receptacles and bag dispensers at the end of existing on-leash segments and at off-leash areas/trailheads.
2. Pairing direct actions with indirect actions such as Leave No Trace education strategies that inform pet owners that it is inappropriate to leave bagged pet waste for later disposal, while highlighting the ease of immediately bagging waste and carrying it to a trash or compost receptacle may further increase compliance.

Waste and Recycling Behavior in National Parks

Exploring Visitor Attitudes, Values, and Behaviors Regarding Waste in National Parks

Abstract

For most park and protected area managers, balancing resource protection with the provision of recreational opportunities is an ongoing challenge. Given the recent substantial increase in national park visitation in the United States, impacts on visitor experience and ecological conditions have correspondingly increased. A specific concern for many park and protected area managers is waste management and/or generation of waste by visitors, park operations, and concessionaires, and the impact it has on both protected areas and adjacent communities. Each year, over 100 million pounds of waste is generated in national parks through a variety of means including park operations, by visitors to parks, and other sources (Pierno, 2017). This is not entirely representative of all waste

generating activities in parks and does not completely account for waste generated in gateway communities or by park concessions. Though the NPS promotes visitation and enjoyment of parks, the agency must provide sustainable parks now and for future generations. The primary goal of this study was to explore specific visitor attitudes and behaviors towards waste disposal and recycling in select national parks. This was done through direct visitor observations paired with visitor surveys at Grand Teton National Park (GRTE), Yosemite National Park (YOSE), and Denali National Park and Preserve (DENA) to better understand how park managers can achieve waste management goals through effective educational and management strategies.



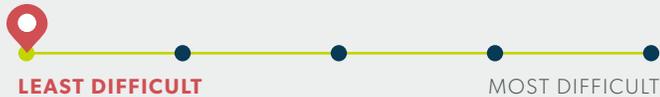


74% of visitors observed properly disposed of their waste and recycling in park receptacles.



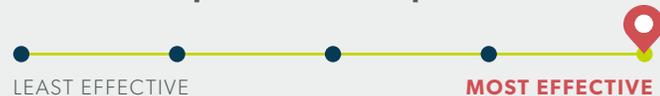
Visitors perceived the behavior “avoid the purchase of items in the park that cannot be reused or recycled” as most difficult to perform, and believed

the behavior “sort my waste items between recycling and trash while in the park” was the easiest to perform.



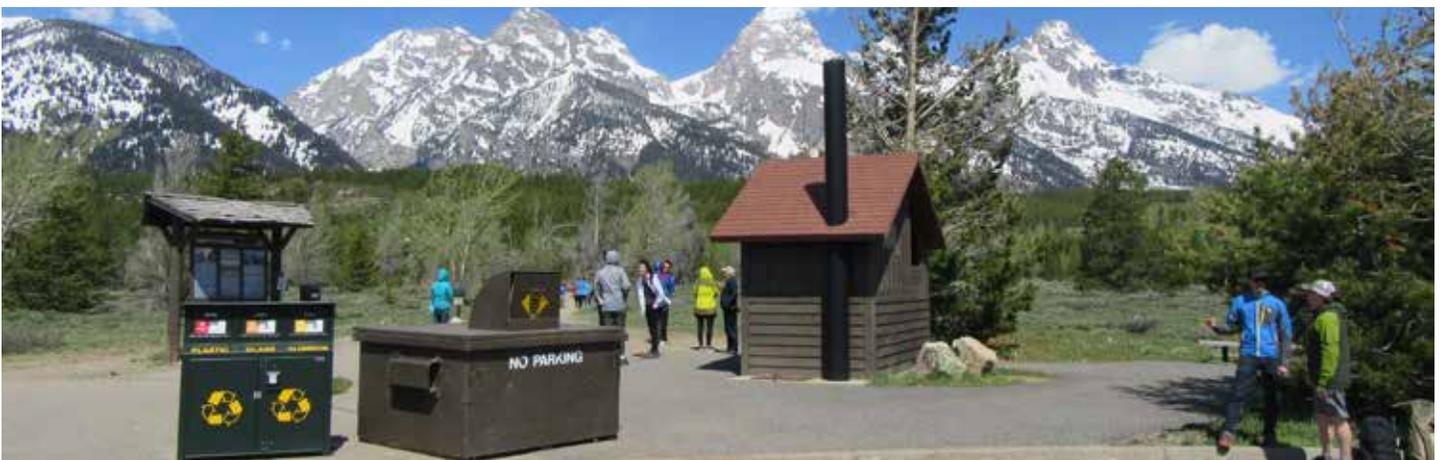
The attitudes, norms, and behaviors of visitors surveyed were largely aligned with proper disposal of waste and recyclable material in national parks. Despite

very low visitor awareness of the Zero Landfill Initiative (ZLI), the data suggests that visitors are predisposed to engage in environmentally responsible behaviors that benefit and protect national parks.



Management Implications

1. Effective messaging may include moral norms (eliciting a sense of responsibility, feelings of guilt, etc.) and focus on the ease of proper waste disposal/recycling.
2. Based on high levels of reported support for proper waste disposal/recycling, such positive attitudes should be leveraged in all ZLI messaging (e.g., “By properly recycling in Denali, you are helping to preserve this park.”)
3. Ensuring visitors are aware of recycling/trash locations and including visually engaging signage on and around disposal infrastructure could capture visitor attention and influence proper disposal.



Communication and Messaging Regarding Wilderness Camping

Conflicting Messages About Camping Near Waterbodies in Wilderness: A Review of the Scientific Basis and Need for Flexibility

Abstract

The preceding article by C. B. Griffin examines the differences in recommended camping distance from waterbodies from a perspective that there should be consistency between the guidance provided by land management agencies and low impact education and communication programs, such as Leave No Trace and Tread Lightly. We concur that regulatory and messaging

consistency is a beneficial mutual goal and suggest that it's time to reexamine the biophysical and social scientific basis for such guidance, historical precedents, alternative management options, and where there are needs for flexibility. We also identify possible additional research needs and suggest alternative actions based on the current body of research.





Camping activities frequently reduce or remove vegetation ground cover and organic litter, which are important in preventing soil erosion. Campsites along shorelines threaten water quality and can increase the potential for soil erosion during flooding events.



It is possible for riparian campsites to be carefully located and managed to avoid or substantially minimize the impact management concerns presented.



Where visitors retain the freedom to select campsites, problems arise including the proliferation of campsites to excessive numbers and poor compliance with regulations that establish camping setbacks from water.

Management Implications

1. Managers may not achieve the closure and recovery of restricted shoreline campsites due to popularity and continued use by visitors. All use must be eliminated for these campsites to achieve substantial or full recovery, and this is exceptionally difficult to achieve.
2. Camping setback regulations have been largely ineffective in achieving management objectives. Setback regulations can promote campsite creation in new areas that meet the requirements.
3. Shifting to a camping “containment” strategy with designated sites can help eliminate unnecessary campsites, shift use to the most sustainable campsites, and allow flexibility to incorporate alternative setback distances dependent on the specific setting and type of resource in need of protection. Designated site camping is a flexible and effective option for limiting campsite numbers and the areal extent of impact.

Visitors' Views of Leave No Trace on Public Lands

Visitors' Views of Leave No Trace Principles across a National Park, a National Forest, and Three State Parks

Abstract

There is rising concern that increases in visitor numbers could negatively affect natural resources within protected natural areas. This has raised questions regarding the effectiveness of indirect management strategies in reducing depreciative behaviors among visitors across different natural resource settings. Leave No Trace, which focuses on indirect management tactics, is an educational program adopted by parks and forests for reducing visitor impacts. Leave No Trace promotes stewardship using seven guiding principles: (a) plan ahead and prepare, (b) travel and camp on durable surfaces, (c) dispose of waste properly, (d) leave what you find, (e) minimize campfire impacts, (f) respect wildlife, and (g) be considerate of other visitors. These principles were developed for wilderness settings but have been revised to apply to backcountry and frontcountry areas. This article examined the use of Leave No Trace practices in three different natural resource settings and attempts to contribute to this knowledge gap. Data for this article were obtained from on-site surveys in a national park (Rocky Mountain National Park), a national forest (Shawnee National Forest) and three state parks in Wyoming (Glendo, Curt Gowdy, Wyoming Territorial Prison Historic Site).

Standardized questions were developed to examine the four topics: (a) appropriateness of Leave No Trace principles, (b) difficulty to perform Leave No Trace, (c) perceived control over Leave No Trace behaviors, and (d) behavioral intentions relative to Leave No Trace principles. Results revealed that across the three settings visitors' responses within each topic aligned with Leave No Trace principles. However, compared to national forest and state park visitors, national park visitors were the least likely to view Leave No Trace principles as appropriate yet most likely to indicate that they behave in accordance with Leave No Trace guidance. There were no differences among visitors to the three settings regarding perceived difficulty of performing Leave No Trace practices. It is unclear if these findings are applicable to other parks and forests—researchers are encouraged to replicate this work in a range of outdoor settings. By understanding differences between visitors to different natural settings, managers and educators can improve the efficacy of Leave No Trace messaging to individual natural resource settings, increase the adoption of Leave No Trace practices, and decrease depreciation of natural resources.





Regardless of the natural resource setting, visitors **do not find** recommended Leave No Trace practices **difficult** nor do they feel a lack of control for following recommended practices.

DIFFICULT

EASY



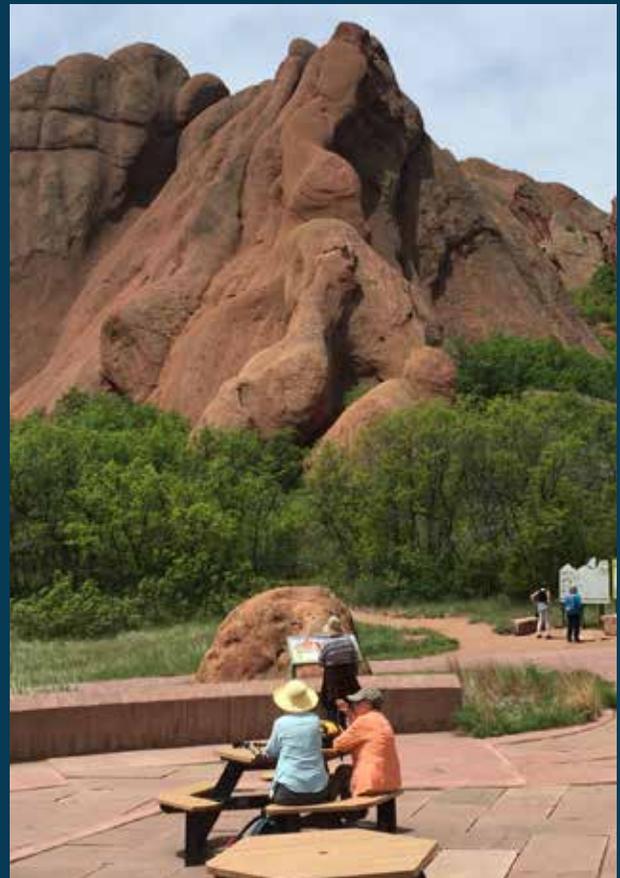
Practices deemed **easier** to adhere to are more likely to be followed by visitors.

DIFFICULT

EASY

Management Implications

1. A consistent, uniform Leave No Trace educational effort could be utilized across various natural resource settings to minimize or eliminate depreciative behaviors. This approach could minimize the burden on natural resource managers, eliminating the need for a one-off approach for each natural resource setting.
2. There is a potential need for managers to inform visitors why recommended Leave No Trace practices are appropriate and necessary, and to provide information on how the practices can effectively minimize recreation-related impact in a given setting.



3. Leave No Trace could be uniformly applied across a range of parks and protected area settings to minimize recreation-related impacts.

What's next on the Center's research agenda?

For 2019 – 2020, the Center is engaged in a handful of studies designed to further Leave No Trace. These studies include:

Exploring Visitor Attitudes and Behaviors Regarding Waste in National Parks – Testing the Efficacy of Data-Driven Messages – Leave No Trace Center for Outdoor Ethics in cooperation with Penn State Univ./Subaru of America/ National Park Service

Study of the Efficacy of Leave No Trace Youth Curriculum – Does Bigfoot's Playbook Work? – Leave No Trace Center for Outdoor Ethics in cooperation with Old Dominion University



Other potential research topics of interest:

- **The exploration of specific Leave No Trace-related behaviors through robust, multi-method, and/or experimental research designs**
- **Understanding contemporary perceptions and beliefs about outdoor ethics – we're in a rapidly changing world**
- **Examination of the Relationship Between Environmentally Responsible Behavior (ERB) and Leave No Trace**
- **Exploration of the decisions (behavior) recreationists make when outdoors – do they practice Leave No Trace? Why or why not? If yes, at what level are they putting it into action?**
- **Examining the potential effect social media is having on parks and protected areas– can social media be used to benefit parks and protected areas?**
- **Assessing efficacy of Leave No Trace efforts, training, and outreach – are we making a difference for youth?**

Conclusion

There are myriad benefits to continued Leave No Trace-focused research for both people and our shared lands. As the Leave No Trace program evolves, research investigating recreation-related impacts is critical for refining practices and recommendations. Continued human dimensions of natural resources research is

imperative for enhancing the efficacy of Leave No Trace outreach, education and training programs. Lastly, ensuring effective strategies for wide dissemination of research findings to land managers, educators, and the general public is critical.



**For more information on the Center's
research efforts, visit:
[LNT.org/our-work/research](https://lnt.org/our-work/research)**

**Contact Ben Lawhon, Education Director
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