Investigating visitor behavior in relation to leave no trace practices

by

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Abstract

Leave No Trace (LNT) has existed since the 1990’s and has been a topic of many studies that examine its effectiveness for influencing visitor behaviors to use minimum impact practices while visiting parks and protected areas (PPAs). Many of those studies rely on visitors reporting their behaviors via surveys but do not utilize observed behavioral data. This study analyzed reported and observed behaviors of visitors using informal social trails. Trail cameras collected observed data which was compared to self-reported survey data. The study area was Tuttle Creek State Park because State Parks are understudied areas within LNT research compared to other types of PPAs. Moreover, this research examined various types of social trails and their usage to gain a robust understanding of how LNT principles influence visitor behaviors. Preliminary results show approximately 40% of visitors who self-reported that they did not use a social trail were photographed by cameras while using non-designated trails. There is the potential that future research on LNT should rely more on observed visitor behaviors or to use that data in collaboration with self-reported behaviors.

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Chapter 1 - Introduction

Background

The park and recreation field is a diverse area of research that often overlaps with other fields. This means that there is a myriad of literature about problems and questions that park professionals face. Many of these questions relate to visitors, their behaviors and impacts (Ancin-Murguzur et al., 2019; Esfandiar et al., 2021; Gungor et al., 2018), while others examine phenomena like place attachment and how it influences behaviors (Eder & Arnberger, 2012; Groshong et al., 2020). Additionally, many researchers focus on the actions that park managers take (Engen et al., 2019; Sisneros-Kidd et al., 2021). Over the past few decades, a new area of exploration has emerged that examines the effects of Leave No Trace practices and how it relates to the previous research questions (visitor behaviors, impacts, place attachment, and management actions, among others).

Leave No Trace (LNT) is a set of outdoor ethics that is taught worldwide, and it aims to reduce the environmental impacts of visitors, while enhancing the visitor experience. It is a form of outdoor education that educates visitors about their impacts and how to reduce them without taking away from the experience. LNT has been taught in over 90 countries to different non-profits and government agencies ("History of LNT - Leave No Trace Center for Outdoor Ethics," n.d.). This means that the principles are broad to relate to all parks and natural areas. LNT programs have also been created that target children or specific recreation activities such as climbing (Jones et al., 2003). The question often asked is what level of effectiveness does LNT have on protecting the environment and how does it vary acro management agencies (City, State, Federal, etc.) (Settina et al., 2020; Vagias, 2009). LNT is often presented as part of interpretive signs or interpretive programs at the natural areas. To look at the effectiveness of the program, one must look at the behaviors of the visitors and how they change based on LNT exposure.

The other major area of Leave No Trace research is the effect it has on visitors behaviors (B. Lawhon et al., 2017, 2019; J. B. Lawhon, 2013) and the effectiveness of LNT to change behaviors to be more pro-environmental. This would require the use of visitor behavioral data and seeing how it compares with the preferred behaviors. Even with all this research done on visitor behaviors and Leave No Trace, there is still a gap in the research that is not being accounted for.

Statement of Problem

For many LNT reported behavior studies, post experience surveys are used to access visitors at parks or protected areas. By doing so, the researchers are able to ask the visitors what behaviors they exhibited and often what their intention were (F. G. Schwartz, 2017; Vagias et al., 2014). There are many deficiencies of self-reported data, such as the wording, administration method, and the potentially stigmatizing of undesirable aspects. The wording of the survey questions can lead to some misunderstanding of what the questions is asking or what the principles mean (B. Lawhon et al., 2017). Face-to-face surveys can lead to bias responses to sensitive questions as well as lack of inclusion of certain populations, compared to online surveys (Ramo et al., 2011). Similarly, visitors may underreport behaviors that are considered undesirable behaviors (Norwood et al., 2016). Thus what can be done to get more accurate behavioral data? One strategy is to collect observed behavioral data of the visitors. This has its own challenges because observed behavior data are harder to collect and because these data aren't used as often, there are not standardized methods or means of collection. Past studies have placed researchers at different locations to record the observed behaviors (Heberlein &

Dunwiddie, 1979). However, visitors might act differently if they see the researchers observing them. An alternative strategy is to use inconspicuous trail cameras. Trail cameras can be set up at specific areas to capture visitors' real-time behavior and to understand where and when impactful behaviors, such as the creation and propagation of social trails. The use of trail cameras is not new, however the use of cameras to observe visitors LNT behaviors is a new concept.

Significance

This study begins to fill the previously mentioned gap by introducing a novel approach for collecting observational data. Along with trails cameras, this study utilized a survey to collect self-reported behaviors that can be compared to observed data. The methods used in this study can help researchers by giving a starting point for future projects that aim to examine visitor behaviors. This project also contributes to the testing of different methods of collecting observed behavioral data. Another contribution is that the results show that there are discrepancies between self-reported and actual behaviors of visitors.

The other benefit that is gained from this research is the examination of two understudied areas of the field, front country and State Parks, which are not as commonly studied as backcountry federal sites (e.g., National Park Service). The importance of this is the level at which LNT is stressed at the different locations. LNT is typically communicated more frequently at backcountry areas or federal sites that might have more funds to spend on educational messaging. This research identifies the user groups that use social trails and examines their LNT knowledge and perceived behaviors. This information can help the park managers enhance/create an LNT program at the park.

Future research should examine different methods for collecting observed data and compare the effectiveness of different LNT principles for enhancing conservation ethic. Finally, this research should be conducted at a National Park to examine how behaviors differ depending on the environmental setting (e.g., wilderness).

Chapter 2 - Manuscript

Introduction

When visitors participate in outdoor recreation activities at parks and protected areas (PPAs), they are likely to leave an impact to an extent that can range from small in magnitude to large. Visitor behaviors can impact wildlife, vegetation, water quality, other visitors and often show cumulative effects (Lawhon et al., 2017). PPA managers aim to mitigate severe impacts through conservation efforts. Conservation endeavors attempt to protect the environment to keep it unimpaired for future generations and typically can be achieved by changing visitor behavior.(Sandbrook, 2015; Schultz, 2011). Understanding visitor behaviors is important for conservation because PPA managers have the ability to influence behaviors by employing direct and indirect strategies that mitigate environmental impacts. Examples of direct management are the use of laws or regulations to alter visitor behaviors. These techniques often cost more to implement and limit visitor autonomy. Alternately, the use of indirect management techniques utilize educational strategies and are favored for attempting to minimize recreation impacts, which have resulted in several programs such as Woodsy Owl, Smokey Bear, and Leave No Trace (Lawhon et al., 2019). Indirect techniques have limitations such as visitors not taking the time to read signs and typically require voluntary implementation by the visitor (Lawhon et al., 2019). The behaviors and intention of visitors is what determines the effectiveness of these interpretive signs and will vary based on location.

Visitors' behaviors are a culmination of environmental awareness, intentions, and perceptions (Hasebrook et al., 2022). Human understanding and awareness of environmental crises are increasing and research shows increased support for conservation (Halpenny, 2010). Research also reveals heightened support for conservation can be achieved by increasing social media presence about conservation programs (Ferreira-Rodríguez, 2022). Conservation initiatives can influence visitor attitudes and level of support (Bennett et al., 2019). Yet, most PPA visitors can adopt stronger conservation ethic that helps minimize environmental impacts (Halpenny, 2010). Similarly, Schultz (2011) identified a greater awareness of some issues like crowding or noise factors, but research participants were less aware of ecological impacts they caused. Thus, it is necessary to better understand actual behaviors (not just reported or intended) of outdoor recreationists.

Visitor behaviors at PPAs have a direct effect on the environment. For example, social trails (i.e. visitor created trails or unofficial trails) are formed by visitors either casually or deliberately going off trail creating social trails in areas where this type of behavior isn't allowed (Primack & Terry, 2021). Typically, visitors go off-trail to avoid overcrowded areas or to explore other areas that the trail does not reach (Primack & Terry, 2021). This type of behavior is inappropriate in areas where off-trail exploration isn't permitted and can result in the formation of social trails after multiple visitors follow suit. Social trails have been shown to compact soil, increase erosion, and disturb vegetation (Ancin-Murguzur et al., 2019). The more a social trail is used, the more compaction and erosion is likely to occur along with vegetation trampling. Additionally, social trails could be mis-interpreted as a formal trail resulting in more use and impact. Knowing the impacts of social trails can help with the identifying of thresholds and preventative measures such as Leave No Trace. An ecological threshold is defined as the minimum acceptable conditions (Manning et al., 2022). In essence this means that there is a level of impact that is acceptable as long as it does not surpass its threshold.

History of Leave No Trace

In 1994, the Leave No Trace (LNT) nonprofit was founded and features seven principles for ethical recreation in the outdoors. However, environmental stewardship educational programs had been around for many years prior. One of the first was the “No Trace” program formed in 1987, which influenced the formation of the LNT program. During the No Trace program, The United States Forest Service, Bureau of Land Management, and the National Park Service were distributing “Leave No Trace Land Ethics” pamphlets. In 1993, at the Outdoor Recreation Summit, where federal agencies, NGOs, and members of the outdoor industry convened, a decision was made to formally establish Leave No Trace (Lnt.org, para. 2). Since then, four federal agencies have adopted the program (United States Forest Service, National Park Service, United States Fish and Wildlife Service, Bureau of Land Management) and recently the United States Army Corps of Engineers joined. In 2007, there was a meeting with the National Association of State Park Directors to discuss how LNT could be used in the State Parks around the country. Today LNT reaches 15 million Americans and several countries each year with trainings, education, and outreach (Lnt.org, para. 5).

PPA managers understand that impacts will happen regardless if appropriate visitor behaviors are utilized (Manning, 2009). However. the issue that most PPA managers face is a guiding dual mandate of the agency. Dual mandates are part of many state and federal agencies that have played a major role in the management strategies of PPAs. The U.S National Park Service is guided by a dual mandate to conserve the natural heritage while allowing universal access to the natural heritage areas (Haskin, 2011). The dual mandate can be problematic for PPA managers because they are charged with conserving resources while accommodating for visitor access. Visitor access is important so that people can benefit from PPAs and research shows that when visitors have a quality experience they are more likely to adopt conservation ethics (Pollastri et al., 2022). However, visitation always has a degree of impact and can counteract conservation efforts.

Most PPAs allow a wide variety of recreation opportunities, including hiking, biking, hunting, and fishing (KDWP, n.d.). Some of these recreation activities have a bigger impact per visitor, while others have impacts due to sheer volume of visitors partaking in that type of activity (Lawhon et al., 2019). Recreation sites have also gained popularity in recent decades and that has led to an increase in environmental degradation (Vagias, 2009). A study by Kays et al. (2017) examined how recreational activities impact wildlife and how this can be mitigated with LNT education. The researchers found that the impact of recreational use on wildlife communities in public areas is relatively minor and that habitat disturbances are of greater importance (Kays et al., 2017). Another study also looked at impacts of wildlife and how LNT is potentially able to improve the coastal species management for turtles (Ware & Fuentes, 2020). The LNT program has proven effective for educating visitors (especially youth) and have a positive impact on the attitudes and behaviors (Schwartz, 2017).

Because most recreation results in impacts, it is the magnitude of the impacts that often is more concerning. LNT principles were designed for minimizing visitor impacts regardless of if impacts are intentional or not. There are seven LNT principles, which are: Plan Ahead and Prepare, Travel and Camp on Durable Surfaces, Dispose of Waste Properly, Leave What You Find, Minimize Campfire Impacts, Respect Wildlife, Be Considerate to Other Visitors (LNT.org) These principles have been taught to generations of people (15 million Americans a year) (LNT.org, History, Para 5), yet so many still do not know them or do not fully understand how to implement them. Two challenges of LNT principles are that people often interpret them differently and they are guiding principles not regulations. There are PPA visitors who might not follow specific LNT principles because they don't feel they are effective or that the principle is too difficult to perform (Backman et al., 2018; Lawhon et al., 2013). Other visitors will not follow LNT because they are not experienced and know little about LNT(Lawhon et al., 2017). To educate visitors about LNT, interpretive signs are often used. Interpretive signs are a form on indirect management actions that are used to attempt to educate visitors. They often take the form of signs near trail heads or around the PPA that talk about the historical/cultural/natural significance of the area. Messaging on interpretive signs is important to deliver a concise message to reduce undesirable behaviors, but the effectiveness of messaging should also be examined (Peterson et al., 2020). However, the challenge remains that many of these studies rely on reported behaviors from visitor surveys, which may not be a true reflection of actual behaviors. Therefore, it is important to study exhibited visitor behaviors at PPAs.

The LNT principles are often referred to as outdoor ethics because they rely on visitors to act ethically as PPA stewards even when nobody is watching. Before LNT there were many actions that were thought of as acceptable while recreating (washing pans in the river, burning waste, feeding wildlife, etc.). However, advancements in educational strategies have helped prevent visitors from exhibiting undesirable behaviors that result in environmental impacts. Every piece of trash or visitor-built fire ring that you don't find supports LNTs impact of visitor recreation. Gorman (Gorman, 1998, p. 1) stated that it is now just as frowned upon to wash dished in a lake as it is to wash yourself in public. Since Gorman's work, much has changed, but the idea that there are fewer impacts because of LNT is supported by research findings (Settina et al., 2020; Ware & Fuentes, 2020).

Today there is a separation emerging that has started to increase impacts and could challenge the ethics of LNT. According to Schultz (2010), there is a general tendency for humans to perceive themselves as separate from nature and in doing so it manifests certain actions that might not align with conservation ethic. Many contemporary societies view nature as a commodity that is great for recreation and health purposes. If humans perform the bare minimum to gain the benefits provided by nature, then there is a risk of creating a watered-down version of nature that is less biodiverse with fewer ecosystem services provided (van Heezik & Brymer, 2018, p. 3). This was evident in 2020, with the emergence of the Coronavirus (COVID-19). COVID-19 continues to have a huge impact on PPAs since the beginning of 2020, mainly by increasing the number of visitors to PPAs. For example, New Jersey State Park visitation increased by 63.4% with the onset of the pandemic (Volenec et al., 2021). Not all PPAs experienced higher visitation numbers. In Heath County, Texas, for instance had lower PPA visitation that varied depending how green the PPA is, proximity, size, etc. (Ding et al., 2022). Many countries started 2020 with a decrease in park visitation before increasing back to baseline or above visitation (Geng et al., 2021). Around 96% of outdoor space in the National Park system remained open, allowing more public visitation (Taff et al., 2022). Arches National Park closed for two months during the pandemic and when it reopened in May of 2020, it quickly was receiving visitation numbers similar to that of the pre-COVID-19 years (Miller et al., 2021). Research shows that National Parks had an increased visitation if they were within 347 km of the individuals home of residence (Alba et al., 2022). With an increase in visitation there is likely an increase in impacts. Additionally, impacts could be of higher magnitude if new visitors are unaware of LNT practices.

Visitors at PPAs are bound to leave some level of impact and that is why LNT was formed to help educate visitors about their impacts and how to minimize them when possible. LNT has also been helpful for managers of PPAs to create indirect management practices for education and awareness purposes. With an increase in visitor use at these areas it is important to understand how visitors recreate and behave. Though it is common to only ask for reported behaviors of visitors, little research has been conducted to understand exhibited visitor behaviors and if those behaviors are congruent with self-reported behaviors.

Previous LNT Behavior Research

Visitor motivation research has been influential for understanding how to manage visitor behaviors and subsequent impacts (Sisneros-Kidd et al., 2021). Sisneros-Kidd et al. (2021) states that scarce research has been conducted that examines how visitors' spatial behavior and their motivations relate to impacts at PPAs. Past research has focused on where visitors travel within PPAs but not their observed behaviors. Research has examined how visitor knowledge of the PPA influences their behavior (Gungor et al., 2018; Sisneros-Kidd et al., 2021) and how place attachment cognitively influences behaviors (Eder & Arnberger, 2012; Groshong et al., 2020; Halpenny, 2010; Skibins & Powell, 2013). However, observed behaviors have rarely been included to further understand visitor behavior, instead work has mostly focused on visitors' reported behaviors.

Many studies have examined visitors' behavioral intentions (Lawhon et al., 2013; Lawhon, 2013; Vagias et al., 2014), but intention to act does not always correlate to behaving in a certain way and other factors, like social norms, can affect behavior (Hasebrook et al., 2022). Research done in Australia further supports that claim. Esfandiar et al. (2021) examined factors influencing behaviors by conducting a study at Yanchep National Park and their study revealed personal norms among visitors are a key driver of behaviors related to throwing trash away. Hasebrook et al. (2022) states that other research should be conducted to examine how certain measures affect conservation ethic and compare behavioral intention to actual behavior. A study conducted in Canada explored the relationship between personal interpretation events and how effective are they at influencing visitors to preform pro-environmental behaviors(Blye et al., 2023). They found that future environmental interpretation should focus on affective communication, personal meaning, responsibility to act, and transmission of knowledge (Blye et al., 2023). These studies focus on intentions, but how do the actual behaviors relate?

Few studies have been conducted to understand how visitor intentions and perceptions relate to actual behavior. Esfander et al. (2021) transitioned from measuring visitors' intentions and instead gathered data about exhibited behaviors related to the proper disposal of waste (littering). Another study examined visitor compliance with trail closures and visitor knowledge about why areas and trails are closed for restoration (F. Schwartz et al., 2018). These studies typically examine how visitor behaviors play a role in undesignated trail creation and use. In order to create lasting sustainability, it is critical to understand the relationship between management intervention and visitor behaviors (F. Schwartz et al., 2018, p. 459). By understanding this relationship, managers can understand the effectiveness of their strategies and how these relate with visitor intentions. LNT is a strategy that can be implemented by managers to help with specific impacts of visitors.

LNT education is comprised of two primary areas focusing on ecological and experiential impacts of outdoor recreationists. The base seven principles are broad and might not relate to a variety of outdoor recreation activities. To help expand the reach of the LNT organization, they published principles pertaining to climbing that focused on how to decrease impacts (ecological and experiential) on the natural resources, the impacts on others, and protecting access (Jones et al., 2003). When there is expansion made to a program, it is important to examine the effectiveness of the additions to show justification. To this point many studies examine the effectiveness of LNT at reducing the impacts at PPAs (Backman et al., 2018; Settina et al., 2020; Ware & Fuentes, 2020). A specific study wanted to observe the effectiveness of LNT using the theory of planned behavior (Vagias et al., 2014). This study found that visitors are less likely to perform a LNT behavior if they believe that it is too difficult or how much effort the visitor must employ to comply (Vagias et al., 2014). The location of the studies conducted might also play a role in how effective LNT is based on visitor perceptions of the PPA.

LNT research has been conducted at many PPAs including National Parks (Backman et al., 2018; Lawhon et al., 2013; Schafer, 2022; Taff et al., 2011; Vagias, 2009), National Forests (Backman et al., 2018), and State Parks (Backman et al., 2018; Lawhon et al., 2017, 2019; Lawhon, 2013). Yet, State Parks remain a location where there is limited information about visitors in the context of LNT (Lawhon et al., 2017). According to the National Association of State Park Directors (NASPD), there are over 6,500 State Parks in the US. By comparison there are just over 400 National Park Service sites and 154 National Forests in the US. This means that even though there are studies done in State Parks, the percentage of study locations is much less than that of the Federal sites. Most of the past research regarding Leave No Trace has focused on backcountry-overnight visitors (B. Lawhon et al., 2017; F. Schwartz et al., 2018). However, by sheer numbers alone, day-users are by far the largest user group of protected area users and research regarding this user-group is insufficient (Taff et al., 2014). There are still very few studies of backcountry visitor attitudes or behaviors that use both survey and observational methods and the few studies that use observational methods are not comparable to survey-based research (Manning, 2022). This means that there is a gap between the survey-based research and the observational information collected that needs to be filled.

Purpose

The purpose of this research is to examine visitor behaviors in relation to LNT principles and to compare self-reported and observed visitor behavior. This will be accomplished by surveying visitors at Tuttle Creek State Park in Kansas to understand perceptions of self-reported-behavior and compare it with trail camera data at two locations to capture observed behaviors. This research will fill two gaps in the literature. First, by incorporating observational research (rather than relying on reported behaviors). Secondly, by focusing on front country visitors at a state park, both of which are understudied areas.

Research Questions

1. What behaviors are observed by visitors in relation to LNT principles?
2. What behaviors are self-reported by visitors in relation to LNT principles?
3. What types of social trails are more likely to be used?
4. What visitor types are most likely to use social trails?

Methods

Site Selection

Tuttle Creek State Park is situated just outside the city of Manhattan, Kansas. There are roughly 24.5 miles of trails maintained by the park staff and there are some unmaintained trails that have arisen from visitors traveling off trails. There are two main examples of this, Western Heritage Social trail and Cedar Ridge Social Trail. As stated earlier, Tuttle Creek State Park was selected because, in general, State Parks and front country areas are an understudied area within LNT research. In 2022, roughly 600,000 people visited areas within Tuttle Creek State Park (L. Gantenbein, personal communication, February 21, 2023), and with over 6,000 State Parks across the U. S.(cjrw.com, n.d.), the visitation numbers far exceed that of National Parks. In fact, in 2019, State Parks had over twice as many visitors as National Parks (813 million, 327 million respectively, (cjrw.com, n.d.).

There were specific qualities that were desirable for the research site. First, due to limited funding resources a local state park was preferable. Second, the study area needed formal trails and social trails to examine. The researcher considered using a rating scale of tread durability to help with site selection, however formal rating systems of designated trails lacked transferability. Instead, there were two types of trails that were chosen based on the creation of the trails. The first is a designated trail that has a social trail branching off of it. The second is a trail that was made entirely by visitors and has not been designated as a formal trail. The other type that was unable to be tested was a shortcut trail that connected either two trails or the same trail together. There was no trail that met this description in the study area, so it was excluded. There were locations that met the needs of the other trail types at Tuttle Creek State Park.

Western Heritage trail is a paved trail at Tuttle Creek State Park, and it connects Rocky Ford Camping area to Rocky Ford Fishing area. It is a high-use trail due to its proximity to the city of Manhattan (KS) and the accessibility of the trail. Near the mouth of the trail at Rocky Ford Camping Area, there is a short social trail that leads down to the water. This trail has been used by many visitors and is now just as wide, if not wider, as the designated trail and exhibits high levels of eroded and exposed bare soil. Though it is a short trail, it is a high-use trail that leads directly to a water source. A camera facing the social trail mouth was placed in late on July 28th, 2022, and remained active until November 6th, 2022.

Cedar Ridge is an extension of Tuttle Creek State Park on the reservoir side of a dam that hosts a marina. This park has many primitive sites (tent camping) that have shelters and open areas. There is a trail that traverses about 0.7 miles through the park and is Americans with Disabilities Act (ADA) accessible. That, however, is not the trail that will be used for this study. The trailhead of the trail being studied is located at one of the first primitive campsites as you enter the park. It is situated facing the dam and has a nice vista for lake viewing. This trail is located about 15 minutes north of Manhattan, making it an easy drive for locals. This trail was selected because it fits a unique category of social trails as there is no designated trail that the trail branches from, instead it is purely a social trail. This “trail” is also marked on google maps as being the “spillway trail” but the administrative personnel at Tuttle Creek State Park say it was never meant to be a trail. This potentially could lead to visitors believing that this trail is a designated trail though there are clear signs that it is not (i.e. overgrown trailhead, server erosion, no trail sign). The trail was formed by visitors as a way to get closer to the water to swim, fish, or watch the sunset. The trail is visible from satellite imagery due to continued use exposing the bare white rock beneath (Figure 1). What is also interesting about this location is that there is a trail at Cedar Ridge that is ADA accessible, but it is not marked on google maps as existing.

Figure 1: An image of the Cedar Ridge Social trail. Photo taken from google maps.
(Google, n.d.)

Pilot Study

In the spring of 2022, a pilot study was conducted to test the methods used for this research with some minor alterations. Instead of testing one LNT principle, three principles (travel and camp on durable surface, leave what you find, and dispose of waste properly) were tested to examine which of these principles would be viable for this research. There were three locations that were selected at Tuttle Creek State Park (Western Heritage Trail, Eagle Pass Trail, and Willow Lake). The trail cameras were set up on February 9th, 2022, and remained active until April 10th, 2022. The first two used similar settings (motion detect, 10-sec delay) and the Willow Lake camera was set on timelapse taking a photo ever minute from 7am – 7pm. The 10-

second delay was used to test if that was enough time between shots to eliminate repetitive photos but still allow to see all visitors.

During those 3-months of data collection, over 40,000 photos (approx. 2,000 at Western Heritage, 100 at Eagle Pass, 37,000 at Willow) were collected from the cameras and 17 surveys administered after receiving IRB exempt status. Western Heritage trail camera caught 294 visitors traveling off trail. The Willow Lake trail camera found one photo of a visitor not disposing of waste properly out of 40,000 photos. The last camera at Eagle Pass trail failed to operate properly and captured no photos of visitors. However, there was one photo at Western Heritage of someone taking a rock. This was the one observed behavior of someone taking something from the park. Of the 17 visitors surveyed, 11 of them said that they stayed on trail. Nine out of the 11 were seen, either by camera or in-person, going off trail.

This pilot study was used to then narrow down the focus of the research to focus solely on the use of social trail because it was shown to the most observable behavior using these methods. From there the new research questions and edits to the survey were made to better fit the new aim of the study. The last thing that changed was the addition of the Cedar Ridge social trail as a study site.

Data Collection

There are two data collection methods used for this research: surveys and trail cameras. A survey was drafted and exempted by the Internal Review Board (IRB) at Kansas State University (IRB-11119 – Appendix A). Following the exempt status, the survey was then transcribed into the survey software Qualtrics. Qualtrics Offline App allows for the survey to be downloaded and used on tablets. Surveys were administered electronically and upon completion, uploaded to Qualtrics once the devices regained Wi-Fi signal. The survey began with general LNT questions (do you know what LNT is, when did you learn about it, etc.). Questions about visitor knowledge of LNT followed (Lawhon et al., 2013). The next section of questions asked about their visit and type of activities they participated in. This was used to help identify recreational activity groups. A question asked for visitors' motivation for participating in outdoor recreation that day (Sisneros-Kidd et al., 2021). There were two matrix questions that were included to ask visitors about how appropriate different activities are and do they agree or disagree with specific claims about LNT (Lawhon et al., 2013) Finally, general demographic questions were asked. In total there were 23 questions in the survey. Surveys were administered during the months of August through November of 2022 on ten weekends with a few weekdays as well in order to attempt to capture a representative sample of those using the respective trails. To prevent from altering the behaviors of the visitors, the survey was administered after the visitors passed the social trail at least once.

Trail cameras were set-up at both locations during the last week of July 2022. Both cameras were set on motion detection with a 10-second delay between photos (Fairfax et al., 2014). Throughout the four-month period the cameras where checked every two weeks for battery life and memory space. The SD cards and batteries were replaced as needed. There was however one 2-week period when the Cedar Ridge trail camera did not take a single photo resulting in lost data. The cameras were taken down during the first part of November to conduct the data analysis.

Materials

Moultrie trail cameras were used at both locations (Figure 2) as these have been recommended by previous researchers to capture visitor use due to their long battery life (Cribbs et al., 2022). They were stored in a lock box with a Python chain lock and zip ties holding them against the trees to avoid unwanted tampering. The photos were transferred to a USB drive that was kept in a locked drawer. A backup of the photos was also saved to Microsoft OneDrive accessible by the PI.

Figure 2: Image of the trail camera set up at Cedar Ridge.

Data Analysis

The photos were examined every time an SD card was replaced (Figure 3). The total number of photos for each timeframe were recorded as well as the location as to ensure data integrity. The photos were examined and only photos that captured visitors off trail were then used for analysis. The number of visitors caught on camera were counted and added to the running total for that location. After the picture were counted, they were saved to the USB and cleared off the SD card so it could be used again. This was done every two weeks throughout the study period. The photos were then combed through using a slideshow and all photos with visitors in them were moved to a flash drive folder labeled by the location and the timeframe of the picture. A total count of all visitors in the photos was taken at this time also. The next step was to match the photos to the survey responses.

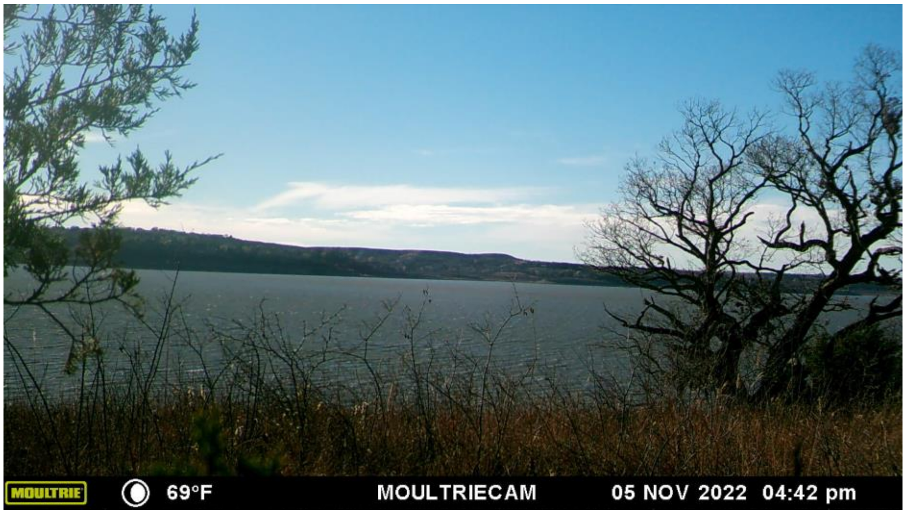

Figure 3: Example photos taken by the cameras. Western Heritage (top) and Cedar Ridge (bottom).

Pairing the survey to the people caught on camera is a unique challenge this study faced because of relative novelty of the study. Before starting the research, the team worked on devising ideas on how to solve the problem. The solution was to record general outfit or appearance of the visitors and number of people in the group and was noted when the survey was administered. This made it easier to identify visitors when examining photos afterwards. The contact forms from the survey dates were consolidated into a spreadsheet with all the information plus some additional sections that aided in the analysis (Survey Answers, Camera Findings, Time of Completion). Once the forms were in the spreadsheet, the matching process began. First by listing how they answered the question relating to if they stayed on trail (Yes or No), then noting that in the table. After that was completed the description of the party was used to examine the photos for a group that matches. The final step was to see if people who said they stayed on trail (Y) were seen off trail (Y) and noting that in another column. Basic frequencies and descriptive statistics were used examine the research questions.

Results

Out of the 154 visitors approached, 128 agreed to participate in the survey for a response rate of 83% (124 at Western Heritage and 4 at Cedar Ridge). The majority (88%) of respondents self-reported their race as White. The other 13% was represented by American Indian (.75%), Asian (1.5%), Black or African American (3.01%) and Hispanic (2.26%). Another 4.5% answered other or prefer not to say. The gender of visitors was more evenly distributed with 52% of respondents listening female and 45% as male. There was also one non-binary response and three did not answer. The majority of respondents fell between the ages of 21 and 70 (81%) with most visitors reporting between the ages of 41-50 (21%). There were two visitors over the age of 81 and six that were between 18 and 21. These demographics align with the general demographics of Manhattan where 80% of residence are White, 49% are female, and 76% fall between the ages of 18 and 65 (*U.S. Census Bureau QuickFacts*, n.d.).

Most visitors (83%) had an average or below knowledge of LNT (Figure 4). Of those visitors, 40 had no knowledge about LNT (31%). Only 16 had above average understanding (13%) and six visitors had extensive knowledge (5%). No visitors said that they were experts of LNT. Over 50% of visitors also had no idea what a social trail was (Figure 5). Only six visitors were able to correctly define what social trail was (5%).

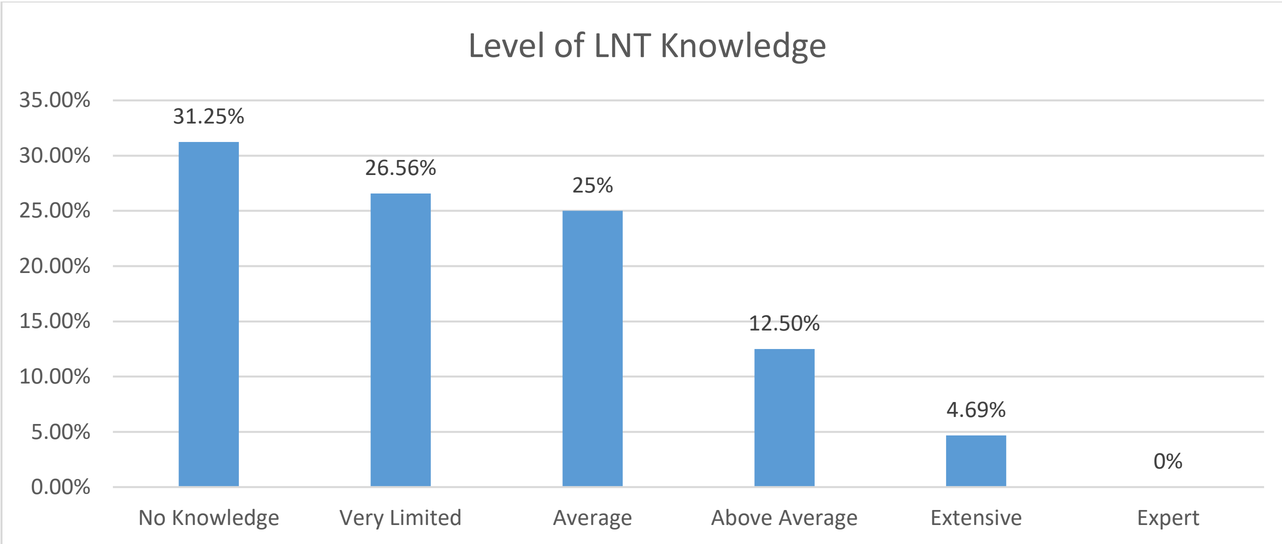

Figure 4: Level of Leave No Trace Knowledge of all respondents.

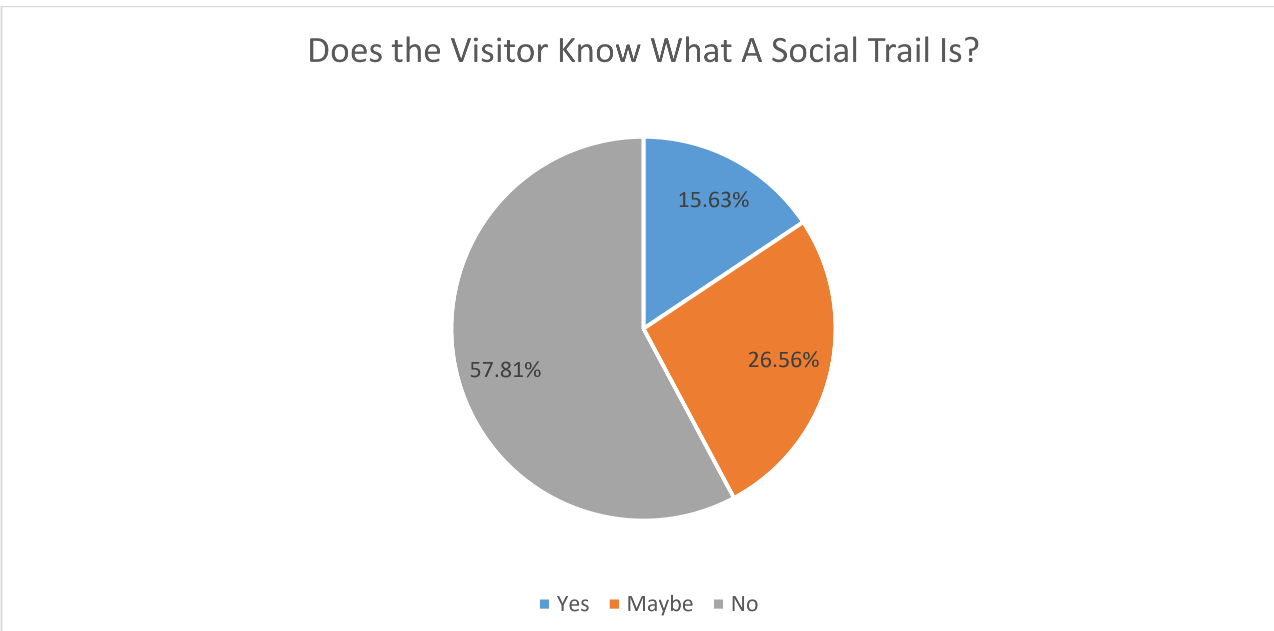

Figure 5: Social trail awareness.

The most common motivations for using the trail were for physical well-being (61%) and love of nature (55%) (Figure 6). There were 32 visitors that stated their motivations were purely recreational (25%). Other motivations such as religious, escapism, self-reflection, self-development, and other; all received between 10-20 responses (8%-16%).

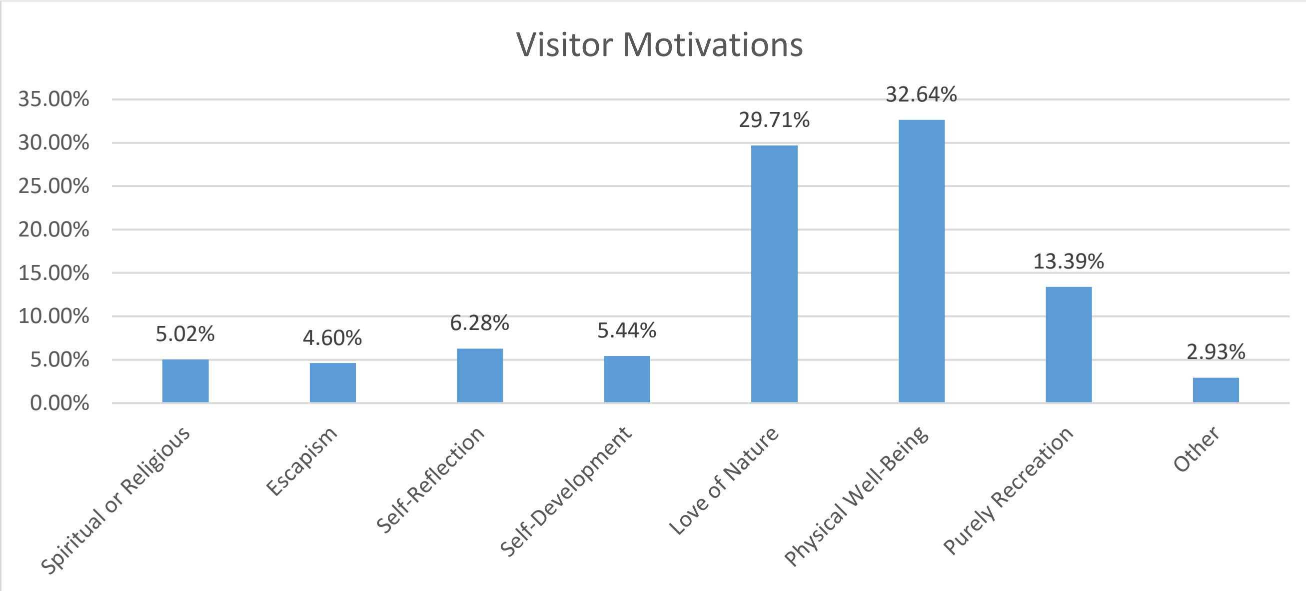

Figure 6: Visitor motivations when surveyed.

The quality of the designated trail was rated by the visitors and had a mean of 4.21 (on a Likert-type scale from 1-5) with 51 people giving the trail a 5 (40%) and 56 giving a 4 (44%) (Table 1). There were some complaints that I received about graffiti on the sidewalk as well as trees falling on the path that hadn't been cleared.

Visitors Rating of Trail Quality

	Min	Max	Mean	Median	Standard Deviation	Variance
Trail Quality	1.00	5.00	4.21	4.00	0.78	0.60

Table 1: Visitor rating of trail quality (1-5 scale).

Research Q1 and Q2

Over the three months of data collection there were over 60,000 photos taken (6,000 Western Heritage and 55,000 Cedar Ridge) and of that roughly 2,200 were photos of visitors off trail (800 Cedar Ridge and 1,400 Western Heritage). The reason why Cedar Ridge camera capture roughly 10 times more photos was due to placement rather than visitation. That camera was aiming at water leading to the movement of the water to trigger the camera. Of the 128 surveys, 117 visitors said that they did not go off trail during their visit (91%). After conducting the matching of the surveys to the photos it was found that of the 117 there were 46 visitors who were seen on the trail cameras going off trail (Figure 8). That shows that 40% of visitors reported behaviors did not align with the observed behaviors. This indicates that most visitors reported their actual behavior, but a significant number also did not.

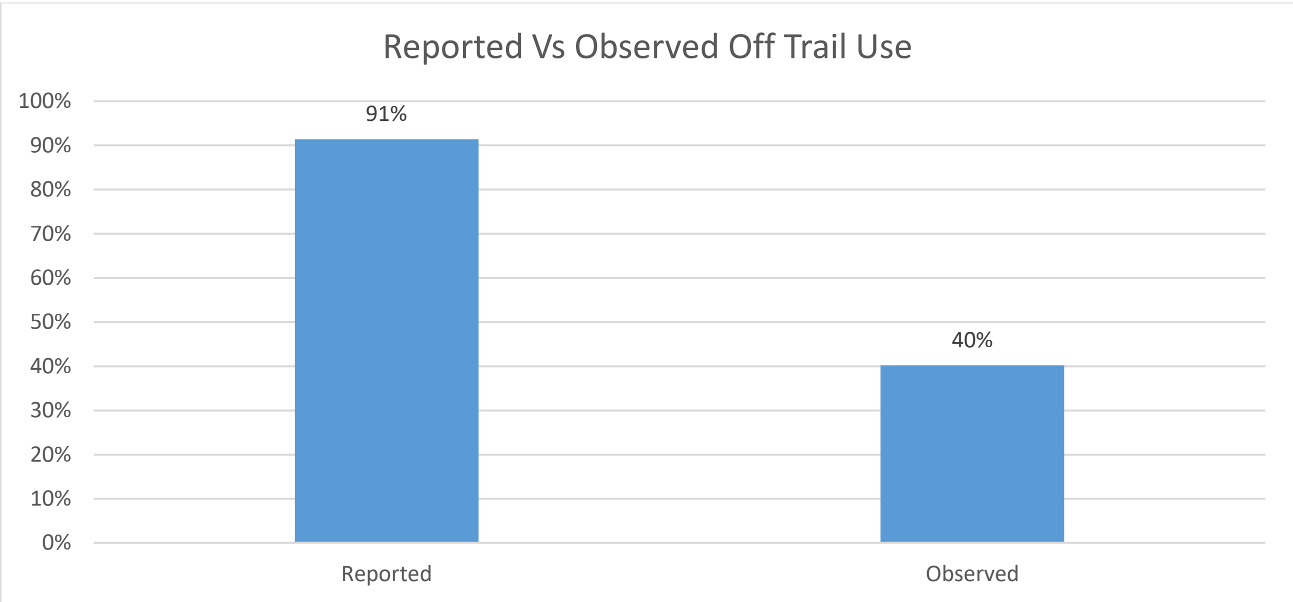

Figure 7: Observed versus reported behaviors

Research Q3

Most visitors also responded that they would be more likely to travel off trail in a backcountry setting (59) rather than a more developed setting (15) (Figure 9). Including the surveyed visitors, a total of 1,199 people were seen off trail (805 at Western Heritage and 394 at Cedar Ridge). The majority of the usage of social trails still came from the Western Heritage trail though Cedar Ridge still receives significant use.

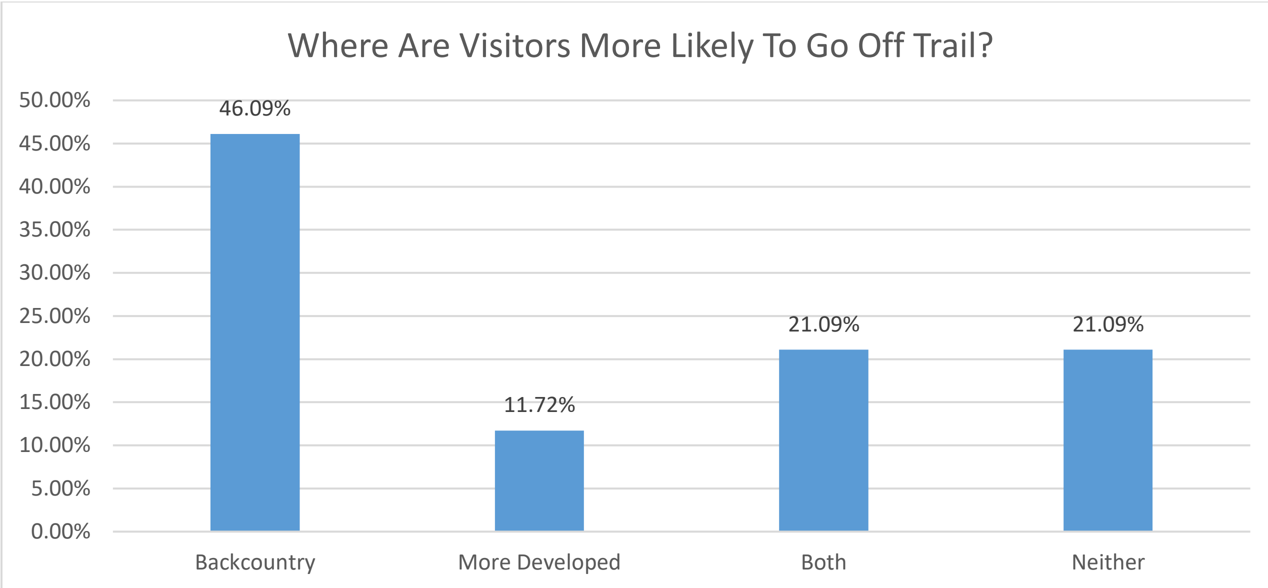

Figure 8: Visitor likelihood to travel off trail at different areas.

Research Q4

The main recreation activities that visitors participated in were hiking (95%), camping (60%), fishing (53%), and canoeing/kayaking (51%). The recreation activities that had the lowest response included horseback riding (14%), ATV or off-roading (17%), climbing (23%), and hunting (27%). This shows a wide range of activities that visitors participate in (Figure 10). The main recreation activities for those observed traveling off trails were hiking (36%), camping (26%), fishing (25%), and canoeing/kayaking/rafting (21%). The activities with lower participation were bird watching (9%), climbing (9%), ATV or off-roading (7%) and horseback riding (6%) (Figure 11). The activities that the visitors reported as actively doing when surveyed were counted and the activities of those who went off-trail were combined. This shows the comparison between the total number of activities and the activities of those who went off trail (Figure 12).

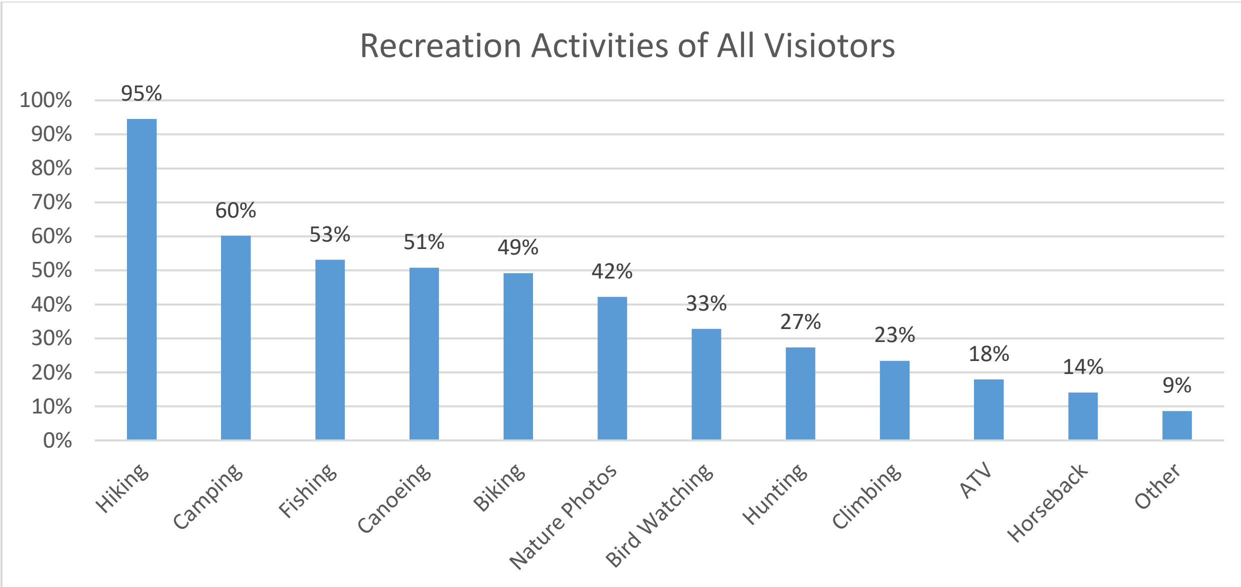

Figure 9: Recreation activities that all visitors reported as participating in at any time in the past. ((Activity #/128) *100)

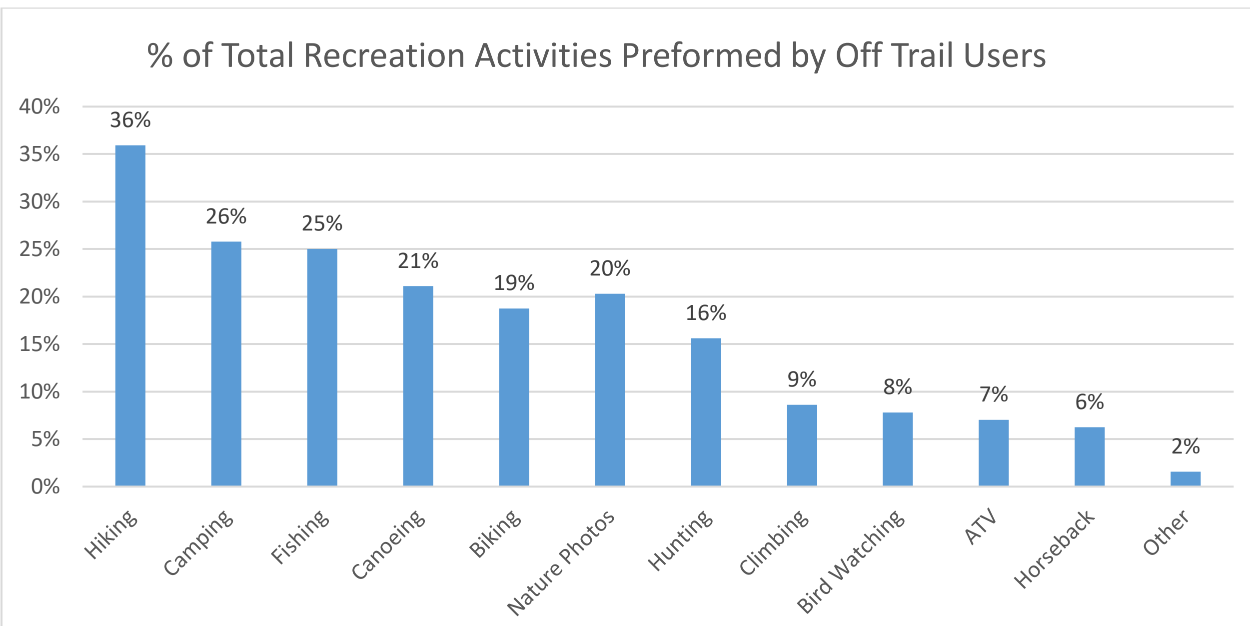

Figure 10: Percentage of total reported activities that the off-trail visitors have participate at any time in the past. ((Activity #/128) *100)

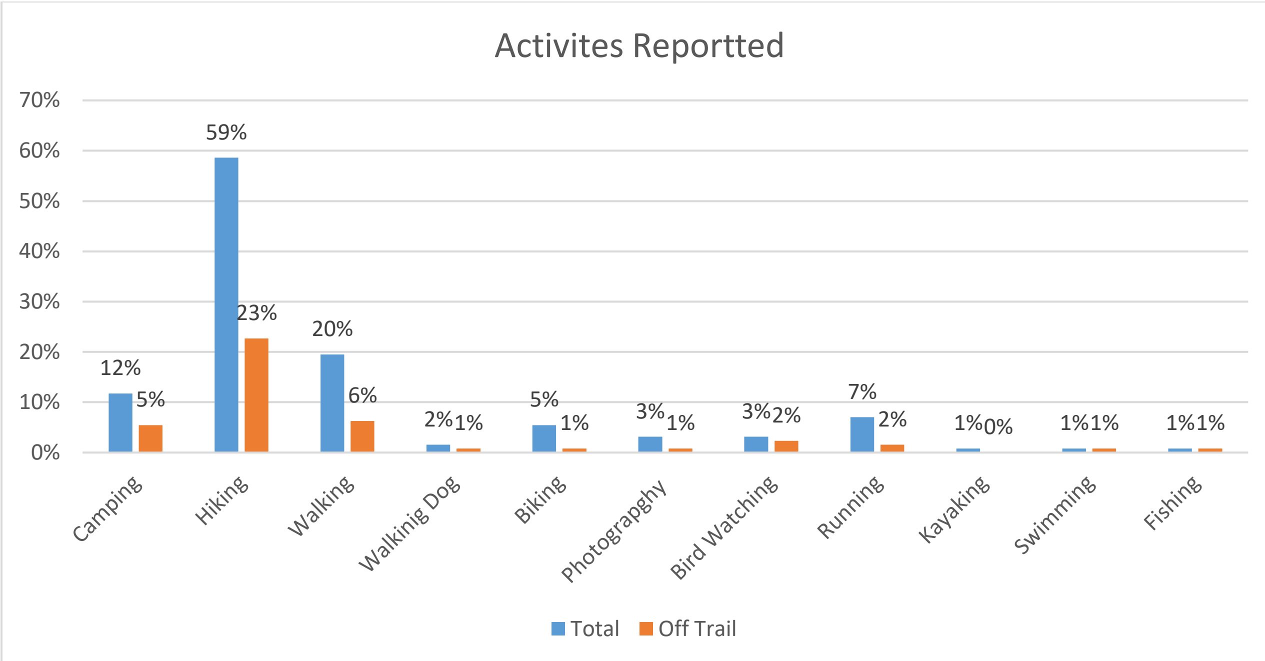

Figure 11: Comparison of activities reported as participating in at time of survey.

Two tables were created that categorized behaviors into reported (Table 2) and observed (Table 3). The tables were then segmented using the results of three demographic questions (Age, Race, Gender) and by level of LNT knowledge. These tables show what level of knowledge the visitors who stayed on the trail or went off-trail have as well as what demographics they fall into as a way to identify user groups in relation to off trail usage. These tables can be used to examine how different age groups, race, and gender affect the level of LNT knowledge and make assumptions about social trail usage. Most age ranges showed about 50% off-trail usage (21-60) with three age ranges showing higher percentages (61-81+). 91% of visitors who reported traveling off trail were White. 62% of white respondents were observed off-trail. Even though there were more female respondents to the survey, the percentage of male and female off-trail usage was very similar (61% and 62% respectively).

Demographic Breakdown of Self-Reported Trail Usage

	Reported Stayed on Trail						Total
LNT Knowledge	No Knowledge	Very Limited	Average	Above Average	Extensive	Expert	
Total	39	32	27	14	5	0	117
Age							
18-20	2	2	1	1			6
21-30	5	4	7				16
31-40	8	5	2	1			16
41-50	6	9	5	6	1		27
51-60	5	6	4	1	1		17
61-70	8	4	4	3	3		22
71-80	2	1	1	2			6
81+			2				2
Race							
American Indian or Alaskan Native			1				1
Asian	1			1			2
Black or African America	1	1	2				4
Native Hawaiian or other Pacific Islander							0
White	35	29	26	12	5		107
Hispanic		1					1
Other	1	1					2
Prefer Not to Say	2	1					3
Gender							
Male	21	10	10	8	1		50
Female	16	21	16	6	4		63
Non-Binary							0
Prefer Not to Say	2	1					3

	Reported Traveling Off Trail						Total
LNT Knowledge	No Knowledge	Very Limited	Average	Above Average	Extensive	Expert	
Total	1	2	5	2	1		11
Age							
18-20							0
21-30		1	1	1	1		4
31-40		1	1				2

41-50							0
51-60				1			1
61-70							0
71-80			2				2
81+							0
Race							0
American Indian or Alaskan Native							0
Asian							0
Black or African America							0
Native Hawaiian or other Pacific Islander							0
White	1	2	4	2	1		10
Hispanic			2				2
Other			1				1
Prefer Not to Say							0
Gender							
Male		2	3	1	1		7
Female	1		1	1			3
Non-Binary			1				1
Prefer Not to Say							0

Table 2: Visitor breakdown based on demographics and reported behaviors.

Demographic Breakdown of Observed Trail Usage

			Stayed on Trail				Total
LNT Knowledge	No Knowledge	Very Limited	Average	Above Average	Extensive	Expert	
Total	16	18	9	4	2	0	49
Age							0
18-20	1	2		1			4

21-30	2	3	4				9
31-40	4	4	1				9
41-50	3	5	2	2	1		13
51-60	1	3	1	1	1		7
61-70	2	1			1		4
71-80			1				1
81+							0
							0
Race							0
American Indian or Alaskan Native							0
Asian	1						1
Black or African America		1					1
Native Hawaiian or other Pacific Islander							0
White	14	16	8	4	2		44
Hispanic			1				1
Other		1					1
Prefer Not to Say	1	1					2
Gender							
Male	10	6	4	1	1		22
Female	5	11	5	3	1		25
Non-Binary							0
Prefer Not to Say	1	1					2

			Observed Off Trail				**Total**
LNT Knowledge	No Knowledge	Very Limited	Average	Above Average	Extensive	Expert	
Total	24	16	22	11	4	0	77
Age							0
18-20	1		1				2
21-30	3	2	4	1	1		11
31-40	4	2	2	1			9
41-50	3	4	4	3			14

51-60	4	3	1	1		9
	7	3	4	3	2	19
71-80	2	1	2	2		7
81+			2			2
						0
Race						0
American Indian or Alaskan Native			1			1
Asian				1		1
Black or African America	1		2			3
Native Hawaiian or other Pacific Islander						0
White	22	15	22	9	4	72
Hispanic		1	1			2
Other	1		1			2
Prefer Not to Say	1					1
Gender						
Male	11	6	9	8	1	35
Female	12	10	12	3	3	40
Non-Binary			1			1
Prefer Not to Say	1					1

Table 3: Visitor breakdown based on demographics and observed behaviors.

Discussion

The purpose of this study was to examine the use of cameras to capture observational data of visitors behaviors and compare them to visitors' reported behaviors. This is significant because it questions how valid self-reported data is and provides a method to capture observed data. As Manning (2022) stated, very little if any observational data is used for behaviors and rarely is it compared to survey data. By combining the two data collections it is possible to see that roughly 40% of the time, visitors do not accurately report their behaviors at Tuttle Creek

State Park. This does not mean that they are intentionally doing so because it was also revealed that a portion of visitors do not know about LNT or what a social trail is. Misunderstanding has also been shown to play a role in LNT research (Lawhon et al., 2013). If visitors are unaware what a social trail is, then it is likely that they will not report their behaviors correctly. This helps show that the visitors are not well enough informed to be able to minimize their own impact. The question then becomes how to educate the public because Tuttle has very little, if any, LNT education practices for visitors. This also brings into questions past research about LNT that relied on reported behaviors. With this study showing 40% of visitors' behaviors not aligning, it begs the question of how effective is LNT or how effective are the educational methods? The internal validity of LNT research must be examined.

With most visitors reporting that they would use a social trail in the backcountry it raises the question about why so many people are ok with traveling off trail in a less developed area. This could be because that in backcountry locations, LNT may require more effort and skill to accomplish (B. Lawhon et al., 2017). This is contradictory to the results that show that more visitors traveled off trail at the more developed location of the two sites. A wide range of activities that visitors participate in plays a role because over half of the visitors who participated in hunting and fishing were see off trail. Those two recreation activities usually require traveling off trail to reach hunting or fishing areas.

With most visitors agreeing upon most of the LNT principles it uncovers a question about LNT understanding. Previous research suggests that understanding the principles is an important factor influencing visitor compliance (Lawhon et al., 2013). This suggests that the visitors not only should know the principles but understand them if they want to have acceptable behaviors. An example of this is that most people said that building a campfire pit and having a large fire is acceptable, even those with LNT knowledge. People who knew LNT said that a non-acceptable behavior (in many parks) was acceptable because of lack of understanding. Along those same lines, social trail can often be confused for formal trails because of how many visitors use them. This can lead to managers adopting new trails where these social trails are as a way to limit future impacts. As stated earlier, a reason social trails form is because the formal trail does not meet the needs of the visitors. By selecting specific social trail to make into formal trails, managers can attempt to better suit the needs of the visitors.

During the survey period, a few visitors stated that they thought that the social trail was part of the actual trail because of how well used it is. This is an interesting point when it comes to past research. If a study asks if users used only the designated trail, how are the visitors going to know what is or is not a designated trail, especially when some social trails can look like part of the maintained trail. With everyone being able to interpret the principles differently it poses some challenges for researchers who have their own way of interpreting them and therefore researching the principles.

What surprised me was that roughly 8 surveyed visitors who honestly stated that they walked off trail while on their visit. Some visitors understand what they are doing and yet continue to walk off trail. It is also possible that some visitors chose to go off trail to avoid crowded areas and to enjoy the solitude nature. Overcrowding on PPAs can play a role on visitor satisfaction of their visit as well increase impacts (Rathnayake, 2015). It brings up the question about what to do for those visitors who do know and understand the principles, yet do not follow them? This could be done be emphasizing the importance of practicing LNT to minimize impacts in order for future generations can enjoy these natural areas. That being said, it is possible that the visitors understand the principles yet chose to ignore them because may not think highly of them (Lawhon et al., 2017). Manning (2022) also states that it is almost impossible to change depreciative behavior (Manning, 2022).

Limitations

This study was limited on time and funding. This project was completed within one semester of college for use as a thesis. Weather also limited the number of surveys and the closing of some of the park for winter months. This project also did not have any additional funding meaning that a site location had to be within driving distance to minimize the cost. Both of those lead to only having 128 surveys completed. Future research would hopefully have more surveys completed to provide for more population generalization.

There was also a limiting factor of having two locations but not always having the help to be able to survey at both locations. Therefore, the vast majority of the surveys came from one location. The other reason is because though there were 400 visitors at Cedar Ridge, the majority of the visitors used the trail after the survey collection time and some after dark. Cedar Ridge had the only camera problem, and it is unclear if that was human or camera error, but it still limited the photos taken by failing to collect any for a two-week period.

Future Research

Future research would be able to expand upon this study by examining other LNT or visitors' behaviors at PPAs. As mentioned, there are six other LNT principles that research could investigate. Research could also look at other types of social trails and have more sample sites for a longer time. Since this was a newer idea of how to collect observed data, other research could be done to compare different ways of collecting data. Another idea that could be explored is having 2 trail cameras at each location that has a designated trail and social trail. This way one camera could face the social trail to count how many visitors use it and have the other camera facing the designated trail to count visitation. This would then give a percentage of how many visitors who walk the trail use the social trail.

It is also possible to examine if there are any differences between different times of the year and how the visitor group vary across time. This could be done by having the project go for 12 months and line it up with the season change by grouping data into three-month periods.

Future studies should explore the relationship between reported and observed behaviors because if the results of this study are valid at other locations, then the question needs to be asked. Do we still use reported behaviors for research and if so, what level of variability with reality is there? That question depends on what the scope and purpose of the study is. Some principles are difficult to use observed behaviors and the resources available can limit how viable observed methods. Should camera data or another method of collecting observed behaviors become the accepted method if examining visitor behaviors? The most effective approach likely uses several types of data collection that can be used to triangulate the findings.

Chapter 3 - Future Implications

What good are the results from research if it doesn't get utilized by others? It's kind of like the saying if a tree falls in the forest does it make a sound. If research is done but nobody knows about it, does it matter? The purpose of research is to find answers and then report those findings, it is a two-part process. For this project there are a few areas that will benefit from the results. The first being the park manager at Tuttle Creek. The second benefit resulting from this project is that additional research and literature were produced. The final benefit goes to the researchers who worked on this project.

Management

Tuttle Creek is a front country State Park close to the city. This means that for most visitors LNT knowledge is not a huge priority, as shown by the data. That being said, LNT education is still needed due to the varying levels of emphasis other parks might have on it. It is also a way to help keep the park clean and take some stress off the staff to have to go clean-up trashed campsites because park resources are limited. To conduct any form of education it is important to understand your audience so that you can cater to them. The results from this study can inform the park administration about their visitors/audience. Specifically, they gain information about the demographics of trail users and information about the number and type of users that travel off trail. Considering most visitors using the trail are also camping, the park could provide an educational LNT brochure when they arrive for them to better understand the principles and properly practice them. Additionally, managers can create a menu of messaging strategies that can be used at a PPA that is frequented by a diversity of recreation visitor types.

When managers implement new management practices, it is important to check for effectiveness because there might be another way to complete the same task but more effectively. To do this, park staff could put out interpretive signs or hand out brochures. After a few months they could re-conduct this study to see if level of LNT knowledge among visitors had been affected by the action(s). Or, managers could test effectiveness at pairs of trails or pairs of trailheads by treating one location and using the other location as the control. This would allow the manager to know whether it is worth continuing this action(s), attempting other ideas, or abandoning the project.

Literature

Every year thousands of research papers are written and published and then cited by other papers. It is hard to imagine how researchers stay on top of all the new methods or ideas. With so many papers coming out, the literature on a certain topic can change so quickly if one paper finds something different than all the rest. That paper's methods and ideas has to be tested again and again to see if the results are valid. Then there are comparison studies looking at the new methods versus the old. After the field is stirred up, it either settles back to the old ways or adopts the new. I believe that this project has the potential to make waves in the field of LNT research and park visitor behaviors as a whole.

Previous research has rarely examined the observed behaviors of park visitors, specifically in regard to LNT principles. This means that there are not many if any, methods that are accepted for that type of data collection and study. That suggests that the results and methods from this project are going to help with the creation of a new set of methods to examine behavior at PPAs. This does not mean these methods are without flaws, but that the beginning stages of advancement has begun. There is the potential for comparison studies looking at different methods for observed data (trail counters, observers on site, video vs photos, etc.). Since this research was done at a local scale, another avenue of study could examine LNT at the City, State, Federal, and international levels to see if recreation areas effect observed visitor behaviors. Along those lines, a study could be conducted to look at how different levels of backcountry affect the behaviors. This study found a gap within LNT research, and by examining that gap, a door has opened for future projects to fill it.

Personal

I was unsure what I was getting myself into when I started this project. I had an idea of what I wanted to look at and explore but wasn't sure how to get there or what I'd find. Thankfully my adviser was extremely supportive and helped me hammer out the details for this study. As stated earlier, there were not any guiding for data collection, so I had to creatively formulate a solution. When I started data collection, I was excited but nervous that I would not get enough responses or that my results would not line up with what I thought would happen. I came to realize, thanks to my advisor's help, that even if I didn't find what I wanted, it would still be beneficial. That kept me going and got me excited to see what I found. When data analysis began, it was a relief to discover that the results aligned with what I expected. Now that I am coming to the end, I look back at all I did and learned. It makes me proud to be able to say that I did this. I saw a question that I was passionate about and I found the answer.

Even though I might not end up doing more research projects like this, I gained knowledge I can use in my future career path. This experience taught me to question things more than normal and to apply logic to solving problems. I now find myself asking questions to coworkers about things around the office or presenting ideas to a boss to help the production. Not only am I asking more questions, but I am presenting more ideas of how to make things work better. I also have a better understanding of how the research process works if I do more research in the future. Overall, I have gained considerable knowledge about how to structurally solve challenging problems that use logical methods.

References

Alba, C., Pan, B., Yin, J., Rice, W. L., Mitra, P., Lin, M. S., & Liang, Y. (2022). COVID-19's impact on visitation behavior to US national parks from communities of color: Evidence from mobile phone data. *Scientific Reports*, *12*(1), Article 1. https://doi.org/10.1038/s41598-022-16330-z

Ancin-Murguzur, F. J., Munoz, L., Monz, C., & Hausner, V. H. (2019). *Drones as a tool to monitor human impacts and vegetation changes in parks and protected areas—Ancin-Murguzur—2020—Remote Sensing in Ecology and Conservation—Wiley Online Library*. https://zslpublications.onlinelibrary.wiley.com/doi/full/10.1002/rse2.127

Backman, C. L., Vaske, J. J., Lawhon, B., Vagias, W. M., Newman, P., Coulson, E., & Taff, B. D. (2018). Visitors' Views of Leave No Trace Principles across a National Park, a National Forest, and Three State Parks. *Journal of Park and Recreation Administration*, *36*(4), 41–55. https://doi.org/10.18666/JPRA-2018-V36-I4-8841

Bennett, N. J., Di Franco, A., Calò, A., Nethery, E., Niccolini, F., Milazzo, M., & Guidetti, P. (2019). Local support for conservation is associated with perceptions of good governance, social impacts, and ecological effectiveness. *Conservation Letters*, *12*(4), e12640. https://doi.org/10.1111/conl.12640

Blye, C.-J., Hvenegaard, G., & Halpenny, E. (2023). Are We Creatures of Logic or Emotions? Investigating the Role of Attitudes, Worldviews, Emotions, and Knowledge Gain From Environmental Interpretation on Behavioural Intentions of Park Visitors. *Journal of Outdoor Recreation, Education and Leadership*, *15*(1), 9–29. https://doi.org/10.18666/JOREL-2022-11654 cjrw.com, C.-. (n.d.). *About Us*. National Association of State Park Directors. Retrieved February 24, 2023, from https://www.stateparks.org/about-us/

Cribbs, T. W., Sharp, R. L., & Brownlee, M. T. J. (2022). Evaluating the Influence of Photo Order on Park Visitors' Perceptions of Crowding at Buffalo National River. *Leisure Sciences*, *44*(5), 634–652. https://doi.org/10.1080/01490400.2019.1655685

Ding, Y., Li, D., & Sang, H. (2022). Park Characteristics and Changes in Park Visitation before, during, and after COVID-19 Shelter-in-Place Order. *Sustainability*, *14*(6), Article 6. https://doi.org/10.3390/su14063579

Eder, R., & Arnberger, A. (2012). *The influence of green space on community attachment of urban and suburban residents—ScienceDirect*. https://www.sciencedirect.com/science/article/pii/S1618866711000963

Engen, S., Fauchald, P., & Hausner, V. (2019). Stakeholders' perceptions of protected area management following a nationwide community-based conservation reform. *PLoS ONE*, *14*(4), e0215437–e0215437. https://doi.org/10.1371/journal.pone.0215437

Esfandiar, K., Dowling, R., Pearce, J., & Goh, E. (2021). What a load of rubbish! The efficacy of theory of planned behaviour and norm activation model in predicting visitors' binning behaviour in national parks. *Journal of Hospitality and Tourism Management*, *46*, 304–315. https://doi.org/10.1016/j.jhtm.2021.01.001

Fairfax, R. J., Dowling, R. M., & Neldner, V. J. (2014). The use of infrared sensors and digital cameras for documenting visitor use patterns: A case study from D'Aguilar National Park, south-east Queensland, Australia. *Current Issues in Tourism*, *17*(1), 72–83. https://doi.org/10.1080/13683500.2012.714749

Ferreira-Rodríguez, N. (2022). *Spread the word about freshwater mussels' conservation: Increasing awareness and willingness to support conservation-oriented policies through social media* [Preprint]. Scientific Communication and Education. https://doi.org/10.1101/2022.09.09.507251

Geng, D. (Christina), Innes, J., Wu, W., & Wang, G. (2021). Impacts of COVID-19 pandemic on urban park visitation: A global analysis. *Journal of Forestry Research*, *32*(2), 553–568. https://doi.org/10.1007/s11676-020-01249-w

Gorman, J. (1998, April). Leave no trace: A new wilderness ethic. *Backpacker*, *26*(3), 68.

Groshong, L., Link to external site, this link will open in a new window, Stanis, S. W., Morgan, M., & Li, C. J. (2020). Place Attachment, Climate Friendly Behavior, and Support for Climate Friendly Management Action among State Park Visitors. *Environmental Management*, *65*(1), 98–110. https://doi.org/10.1007/s00267-019-01229-9

Gungor, B. S., Chen, J., Wu, S. R., Zhou, P., & Shirkey, G. (2018). Does Plant Knowledge within Urban Forests and Parks Directly Influence Visitor Pro-Environmental Behaviors. *Forests*, *9*(4). https://doi.org/10.3390/f9040171

Halpenny, E. A. (2010). *Pro-environmental behaviours and park visitors: The effect of place attachment—ScienceDirect*. https://www-sciencedirect-com.er.lib.k-state.edu/science/article/pii/S0272494410000514?via%3Dihub

Hasebrook, J. P., Link to external site, this link will open in a new window, Michalak, L., Link to external site, this link will open in a new window, Wessels, A., Koenig, S., Spierling, S., & Kirmsse, S. (2022). Green Behavior: Factors Influencing Behavioral Intention and Actual Environmental Behavior of Employees in the Financial Service Sector. *Sustainability*, *14*(17), 10814. https://doi.org/10.3390/su141710814

Haskin, J. (2011). *A Complex Situation: The Tension Between Access and Conservation in the U.S. and U.K. National Parks* [M.A., Tufts University]. https://www.proquest.com/docview/911792258/abstract/8208C83E871245CAPQ/1

Heberlein, T., & Dunwiddie, P. (1979). Systematic Observation of Use Levels, Campsite Selection and Visitor Characteristics at a High Mountain Lake. *Journal of Leisure Research*, *11*, 307–316. https://doi.org/10.1080/00222216.1979.11969408

History of LNT - Leave No Trace Center for Outdoor Ethics. (n.d.). *Leave No Trace*. Retrieved October 5, 2022, from https://lnt.org/about/history/

Jones, C. D., Hollenhorst, S., & Tino, G. (2003). Relationships between climbing specialization, Leave No Trace ethics and visual impacts: An empirical study in Rock Canyon Park, Utah. *The Journal of Experiential Education*, *25*(3), 348.

Lawhon, B., Newman, P., Taff, D., Vaske, J., Vagias, W., Lawson, S., & Monz, C. (2013). Factors Influencing Behavioral Intentions for Leave No Trace Behavior in National Parks. *Journal of Interpretation Research*, *18*(1), 23–38. https://doi.org/10.1177/109258721301800103

Lawhon, B., Taff, B. D., Newman, P., Vagias, W. M., & Miller, Z. D. (2019). Understanding Attitudes and Support for Leave No Trace: Informing Communication Strategies With Frontcountry State Park Visitors. *Journal of Outdoor Recreation, Education and Leadership*, *11*(1), 37–53. https://doi.org/10.18666/JOREL-2019-V11-11-9290

Lawhon, B., Taff, B. D., Newman, P., Vagias, W. M., & Newton, J. (2017). Understanding and Influencing State Park Visitors' Leave No Trace Behavioral Intent. *Journal of Interpretation Research*, *22*(1), 53–72.

Lawhon, J. B. (2013). *Influencing Leave No Trace behavioral intentions in frontcountry visitors to national and state park* [M.S., Colorado State University]. htt*ps://www.proquest.com/docview/1496772978/abstract/6D803BE96229496CPQ/1*

MANNING, R. O. B. E. R. T. E. (2022). Studies in outdoor recreation: Search and research for satisfaction. OREGON STATE UNIV PRESS.

*Manning, R. E. (2009). Parks and People: Managing Outdoor Recreation at Acadia National Park. University Press of New England. http://ebookcentral.proquest.com/lib/ksu/d*etail.action?docID=1084884

Miller, Z. D., Freimund, W., Dalenberg, D., & Vega, M. (2021). Observing COVID-19 related behaviors in a high visitor use area of Arches National Park. *PLOS ONE*, *16*(2), e0247315. https://doi.org/10.1371/journal.pone.0247315

Norwood, M. S., Hughes, J. P., & Amico, K. R. (2016). The validity of self-reported behaviors: Methods for estimating underreporting of risk behaviors. *Annals of Epidemiology*, *26*(9), 612-618.e2. https://doi.org/10.1016/j.annepidem.2016.07.011

Parks, K. D. of W. &. (n.d.). *KDWP Home*. Retrieved March 31, 2023, from https://ksoutdoors.com/

Peterson, B. A., Sharp, R. L., Fefer, J. P., & Brunson, M. A. (2020). The Utility of GIS for Identifying Areas of Recreation Conflict for Targeted Interpretive Messaging. *Journal of Interpretation Research*, *25*(2), 118–131. https://doi.org/10.1177/10925872211019731

Pollastri, I., Normando, S., Florio, D., Ferrante, L., Bandoli, F., Macchi, E., Muzzo, A., & Mori, B. de. (2022). The Animal-Visitor Interaction Protocol (AVIP) for the assessment of Lemur catta walk-in enclosure in zoos. *PLOS ONE*, *17*(7), e0271409. https://doi.org/10.1371/journal.pone.0271409

Primack, R. B., & Terry, C. (2021). New social trails made during the pandemic increase fragmentation of an urban protected area. *Biological Conservation*, *255*, 108993. https://doi.org/10.1016/j.biocon.2021.108993

Ramo, D. E., Hall, S. M., & Prochaska, J. J. (2011). Reliability and validity of self-reported smoking in an anonymous online survey with young adults. *Health Psychology*, *30*(6), 693–701. https://doi.org/10.1037/a0023443

Rathnayake, R. M. W. (2015). How does 'crowding' affect visitor satisfaction at the Horton Plains National Park in Sri Lanka? *Tourism Management Perspectives*, *16*, 129–138. https://doi.org/10.1016/j.tmp.2015.07.018

Sandbrook, C. (2015). What is conservation? *Oryx*, *49*(4), 565–566. https://doi.org/10.1017/S0030605315000952

Schafer, D. M. (2022). *Understanding Hikers' Behavioral Intent towards Leave No Trace in Great Smoky Mountains National Park* [M.S., Western Carolina University]. http://www.proquest.com/docview/2664861752/abstract/DDD339ECF48E443BPQ/1

Schultz, P. W. (2011). Conservation Means Behavior. *Conservation Biology*, *25*(6), 1080–1083.

Schwartz, F. G. (2017). *Advancing the Social Science of Leave No Trace: Examining Attitudes, Efficacy, Intentions and Behaviors* [Ph.D., The Pennsylvania State University]. http://www.proquest.com/docview/1925920436/abstract/963944DA3CB24EB6PQ/1

Schwartz, F., Taff, B. D., Lawhon, B., & VanderWoude, D. (2018). Mitigating Undesignated Trail Use: The Efficacy of Messaging and Direct Site Management Actions in an Urban-Proximate Open Space Context. *Environmental Management*, *62*(3), 458–473. https://doi.org/10.1007/s00267-018-1054-1

Settina, N., Marion, J. L., & Schwartz, F. (2020). Leave No Trace Communication: Effectiveness Based on Assessments of Resource Conditions. *Journal of Interpretation Research*, *25*(1), 5–25. https://doi.org/10.1177/1092587220963523

Sisneros-Kidd, A. M., D'Antonio, A., Monz, C., & Mitrovich, M. (2021). Improving understanding and management of the complex relationship between visitor motivations and spatial behaviors in parks and protected areas. *Journal of Environmental Management*, *280*, 111841. https://doi.org/10.1016/j.jenvman.2020.111841

Skibins, J. C., & Powell, R. B. (2013). Conservation caring: Measuring the influence of zoo visitors' connection to wildlife on pro-conservation behaviors. *Zoo Biology*, *32*(5), 528–540. https://doi.org/10.1002/zoo.21086

Taff, B. D., Newman, P., Vagias, W. M., & Lawhon, B. (2014). Comparing day-users' and overnight visitors' attitudes concerning leave no trace. *Journal of Outdoor Recreation, Education and Leadership*, *6*(2), 133–147. https://doi.org/10.7768/1948-5123.1189

Taff, B. D., Thomsen, J., Rice, W. L., Miller, Z., Newton, J., Miller, L., Gibson, A., Riddle, M., Schaberl, J. P., & McCormick, M. (2022). US national park visitor experiences during COVID-19: Data from Acadia, Glacier, Grand Teton, Shenandoah, and Yellowstone National Parks. *Parks Stewardship Forum*, *38*(1). https://doi.org/10.5070/P538156128

Taff, D., Newman, P., Bright, A., & Vagias, W. (2011). Day-user beliefs regarding leave no trace in Rocky Mountain National Park. *Journal of Outdoor Recreation, Education and Leadership*, *3*(2), 112–116.

U.S. Census Bureau QuickFacts: Manhattan city, Kansas. (n.d.). Retrieved March 31, 2023, from https://www.census.gov/quickfacts/manhattancitykansas

Vagias, W. M. (2009). *An examination of the Leave No Trace visitor education program in two US National Park Service units* [Ph.D., Clemson University]. http://www.proquest.com/docview/304866155/abstract/E2A691A5AAB84C2EPQ/1

Vagias, W. M., Powell, R. B., Moore, D. D., & Wright, B. A. (2014). Predicting Behavioral Intentions to Comply with Recommended Leave No Trace Practices. *Leisure Sciences*, *36*(5), 439–457. https://doi.org/10.1080/01490400.2014.912168

van Heezik, Y., & Brymer, E. (2018). Nature as a Commodity: What's Good for Human Health Might Not Be Good for Ecosystem Health. *Frontiers in Psychology*, *9*. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.01673

Volenec, Z. M., Abraham, J. O., Becker, A. D., & Dobson, A. P. (2021). Public parks and the pandemic: How park usage has been affected by COVID-19 policies. *PLoS ONE*, *16*(5), e0251799–e0251799. https://doi.org/10.1371/journal.pone.0251799

Ware, M., & Fuentes, M. M. P. B. (2020). Leave No Trace ordinances for coastal species management: Influences on sea turtle nesting success. *Endangered Species Research*, *41*, 197–207. https://doi.org/10.3354/esr01020

Appendix A - IRB

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Ryan Sharp
Horticulture & Nat Resources
Manhattan, KS 66506

FROM: Lisa Rubin, Chair
Committee on Research Involving Human Subjects

DATE: 08/08/2022

RE: Proposal #IRB-11119, entitled "Investigating Visitor Behavior in Relation to Leave No Trace Practices."

MODIFICATION OF IRB PROTOCOL #IRB-11119, ENTITLED, "Investigating Visitor Behavior in Relation to Leave No Trace Practices"

EXPIRATION DATE: Exempt

The Committee on Research Involving Human Subjects (IRB) has reviewed and approved the request identified above as a modification of a previously approved protocol. **Please note that the original expiration remains the same.**

All approved IRB protocols are subject to continuing review at least annually, which may include the examination of records connected with the project. Announced in-progress reviews may also be performed during the course of this approval period by a member of the University Research Compliance Office staff. Unanticipated adverse events involving risk to subjects or to others must be reported immediately to the Chair of the IRB, and / or the URCO

It is important that your human subjects activity is consistent with submissions to funding / contract entities. It is your responsibility to initiate notification procedures to any funding / contract entity of any changes in your activity that affects the use of human subjects.

Electronic Signatures

Signed by Phill Vardiman (pvardiman@k-state.edu)

Reason: Chair
Signed at 08/08/2022 4:16 PM ET

Appendix B - Survey

Investigating Visitor Behavior in Relation to Leave No Trace Practices

This survey aims to understand how visitors like yourself are using park. There is a few generic questions that provides the researchers with some information about you followed by asking questions about your visit today. We ask that you please answer all questions honestly and base your answers on your own experiences. Thank you for your time.

SECTION 1: Experience

Have you heard about Leave No Trace prior to this survey?

- ❑ Yes
- ❑ No
- ❑ Maybe

If yes, are you a current **Leave no Trace** member?

- ❑ Yes
- ❑ No

If yes, where did you learn about Leave No Trace?

____

How would you describe your current knowledge of "**Leave No Trace**" practices?

❑ No knowledge	❑ Average	❑ Extensive
❑ Very limited	❑ Above average	❑ Expert

Do you know what a social trail is?

- ❑ Yes
- ❑ No

If yes, what is a social trail?

____

____

How often do you partake in an outdoor recreation activity?

_______________Days a Year

What recreation activities have you done in the past (please select all that apply)?

- ❑ Hiking
- ❑ Hunting
- ❑ Fishing
- ❑ Bird Watching
- ❑ Photography
- ❑ Climbing
- ❑ Biking
- ❑ Canoeing/Kayaking/Rafting
- ❑ Camping
- ❑ Horseback Riding
- ❑ ATV and Off-roading
- ❑ Other (please specify) ________________

From the list above, what activity are you primarily partaking in today?

____

How many years have you been doing your primary outdoor recreation activity?

____

Have you visited/recreated at Tuttle Creek State Park before?

- ❑ Yes
- ❑ No

How often do you walk this trail?

__________ Days per Year

SECTION 2: Your Visit

What is your motivation for hiking today?

- ❑ Spiritual or Religious
- ❑ Escapism
- ❑ Self-Reflection
- ❑ Self-Development
- ❑ Love of Nature
- ❑ Physical Well-Being
- ❑ Purely Recreation
- ❑ Other ________________

How would you rate the quality of the trail you are using is? (1 – Poor Quality, 5 – Excellent Quality)

1 2 3 4 5

Rank the following images based on the perceived durability of the trail.




Did everyone in your group stay on the designated trails?

- ❑ Yes
- ❑ No

Did you see someone else go off the trail?

- ❑ Yes
- ❑ No

Are you more likely to go off trail in a backcountry or a more developed setting?

- ❑ Backcountry
- ❑ More Developed
- ❑ Both
- ❑ Neither

SECTION 3: Situations

Please indicate your opinion about how acceptable the following situations are.

	Very Inappropriate	Inappropriate	Neutral	Appropriate	Very Appropriate
Playing music through external speakers	❑	❑	❑	❑	❑
Building a campfire ring at your campsite	❑	❑	❑	❑	❑
Seeing someone leave trash along the trail or at a campsite	❑	❑	❑	❑	❑
Having a big campfire in firepit	❑	❑	❑	❑	❑
Traveling off designated trails	❑	❑	❑	❑	❑
Feeding the Wildlife	❑	❑	❑	❑	❑
Having a loud party at the campsite	❑	❑	❑	❑	❑
Carving into a picnic table	❑	❑	❑	❑	❑
Keeping a single item like a rock, plant, stick, or feather as a souvenir	❑	❑	❑	❑	❑

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Sometimes it is too difficult to practice “Leave No Trace”	❑	❑	❑	❑	❑
Practicing “Leave No Trace” takes too much time	❑	❑	❑	❑	❑
Practicing “Leave No Trace” violates the rights of individuals to do as they please in the outdoors	❑	❑	❑	❑	❑
Practicing “Leave No Trace” does not reduce the environmental harm caused by recreation	❑	❑	❑	❑	❑
Practicing “Leave No Trace” effectively protects the environment for future generations to enjoy	❑	❑	❑	❑	❑
Practicing “Leave No Trace” enhances my outdoor experience	❑	❑	❑	❑	❑
The people I recreate with believe it is important to practice “Leave No Trace”	❑	❑	❑	❑	❑
In general, the opinions of others have little effect on my practicing “Leave No Trace”	❑	❑	❑	❑	❑
I practice “Leave No Trace” because the people I recreate with believe it is important	❑	❑	❑	❑	❑
I practice “Leave No Trace” because the park regulations state that I should do so	❑	❑	❑	❑	❑

SECTION 4: DEMOGRAPHICS

Which of these categories best indicates your race? Answer only for yourself. Please select **one or more.** *(select all that apply)*

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or other Pacific Islander
- ❑ White
- ❑ Other (please specify) ________________

What is your gender? (*select one*)

- ❑ Male
- ❑ Female
- ❑ Non-binary
- ❑ Other

What is your age?

____

Thank you for taking time to participate in this survey.