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

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## **Abstract**

Impact to protected area resources due to uninformed or deprecative visitor behavior continues to be a principal concern for managers. Leave No Trace (LNT) is a prevalent educational strategy for mitigating such impacts. Through on-site surveys, this study

examined frontcountry visitor attitudes toward Leave No Trace (LNT) practices, and self-reported knowledge concerning LNT in three Wyoming state parks to determine factors that influenced their behavioral intent to practice LNT. Results suggest that attitudes toward perceived effectiveness of LNT practices and appropriateness of LNT practices are significant predictors of behavioral intent. If education-based communication efforts focus on why LNT practices are appropriate and effective, there is an increased likelihood of meaningfully influencing behavioral intent.

## **Keywords**

Leave No Trace, minimum-impact behaviors, parks, communication, visitor management

## **Introduction**

A particularly complicated challenge for park and protected area managers is influencing visitor behavior to minimize the environmental and social impacts of recreation. Land managers attempt to strike a balance between protecting resources and providing diverse recreational opportunities, yet degradation of resources and values due to inappropriate behavior continues to be a significant issue. Park and protected area visitor behaviors can impact wildlife, vegetation, water quality, and other visitors. Many of these impacts are cumulative over time, and have been shown to occur at relatively low levels of use (Hammitt, Cole, & Monz, 2015; Leung & Marion, 2000; Marion, Leung, Eagleston, & Burroughs, 2016).

Land managers often use one of two primary strategies for dealing with visitor impacts: indirect management actions such as visitor education and interpretation, or direct management actions such as rules, or restrictions on use or access (Hendee & Dawson, 2002; Martin, Marsolais, & Rolloff, 2009). Indirect management approaches are viewed as “light-handed” and are favored by both the public and land managers. As a result, indirect strategies have become a primary tool to minimize recreation-related impacts (Bullock & Lawson, 2007; Manning, 1999; 2003; Marion & Reid, 2001; Marion & Reid, 2007). Yet, despite the preference for an educational approach, the job of effectively educating the recreating public about appropriate outdoor behavior is challenging. Managers must contend with limited timeframes, non-captive audiences, and frequent distractions (Orams, 1997). To better meet these challenges, protected area managers have developed a wide variety of educational campaigns. Of these educational approaches, LNT is the most frequently used approach to inform visitors about minimizing recreation-related impacts (Marion, 2014). The original focus of LNT was on minimizing recreation-related impacts in large, remote, and often fragile wilderness areas. At the time of its inception, little thought was given to the application of LNT in other areas such as state parks, which differ substantially from wilderness in many cases (Swain, 1996).

Contemporary social science research has advanced understanding of wilderness-based visitors' knowledge, attitudes, and behaviors related to LNT (Vagias & Powell, 2010; Vagias, Powell, Moore, & Wright, 2012; 2014). However, there is limited information about visitors to other types of protected areas, such as state parks, in the context of LNT (Lawhon et al., 2013; Taff, Newman, Bright, & Vagias, 2011; Taff, Newman, Vagias, & Lawhon, 2014). Furthermore, the vast majority of outdoor recreationists commonly visit non-wilderness destinations, creating a knowledge gap regarding this type of visitor and their perceptions of LNT (Marion, 2014). The purpose

of this study was to explore state park visitor attitudes and knowledge concerning LNT practices in three Wyoming state parks to determine factors that significantly influenced their behavioral intent to practice LNT. The findings provide a unique contribution to the literature regarding frontcountry visitor attitudes and perceptions. This understanding can inform the development of effective education-based communication strategies aimed at mitigating depreciative frontcountry visitor behaviors.

### *Study Context*

Nearly 90 percent of outdoor recreation in the U.S. occurs in frontcountry settings (Marion, 2014). Frontcountry is defined as areas that are easy to access by vehicle and predominantly visited by day users (Leave No Trace Center for Outdoor Ethics, 2016a). These areas include designated sites used for vehicle-accessible overnight camping, which often include amenities such as picnic tables, fire rings, and toilet facilities. The vast network of over 6,600 state parks in the U.S. provides extensive recreational opportunities in such frontcountry settings. According to the National Association of State Park Directors (NASPD), annual visitation to state parks is approximately 730 million, and is projected to significantly increase over time (NASPD, 2015). In comparison, U.S. National Park units received approximately 307 million visits in 2015 (National Park Service, n.d.). Though LNT has been fully adopted by federally managed parks and protected areas, it is not as common in state parks (Marion, 2014). While there have been recent advances, to date there have been no studies specifically focused on state park visitors' attitudes and perceptions related to LNT.

### *Leave No Trace*

Leave No Trace is the most prevalent minimum-impact educational communication program currently used in U.S. parks and protected areas (Marion, 2014). The overarching purpose of the program is to educate outdoor enthusiasts about the nature of their recreation-related impact as well as teach them techniques for minimizing the impact (Harmon, 1997; Leave No Trace Center for Outdoor Ethics, 2016b; Marion & Reid, 2007). LNT is particularly appealing to land managers because it offers a more light-handed approach to visitor management as opposed to more heavy-handed management strategies (Vagias, 2009). The foundation of the program includes the seven principles (Figure 1), which are used on signage, maps, websites, and other interpretive information.

Leave No Trace concepts date back to the 1960s when the USDA Forest Service began encouraging visitors to "pack it in, pack it out." These early efforts were modeled

### **Seven Principles of Leave No Trace**

1. Plan Ahead and Prepare
2. Travel and Camp on Durable Surfaces
3. Dispose of Waste Properly
4. Leave What You Find
5. Minimize Campfire Impacts\*
6. Respect Wildlife
7. Be Considerate of Other Visitors

Figure 1. The Leave No Trace Principles (Leave No Trace Center for Outdoor Ethics, 2016c).

\*The fifth LNT principle Minimize Campfire Impacts was not under investigation in this study. See Methods section.

on the successful Smokey the Bear anti-forest fire campaign. Eventually, it morphed into what are now considered the initial minimum impact camping messages. As outdoor recreation continued to increase throughout the 1970s and 1980s, it became clear that a comprehensive educational approach to managing visitor impacts in the backcountry was necessary. As such, the USDA Forest Service created numerous partnerships in the 1990s to cooperatively promote a science-based approach to minimum-impact recreation. This effort resulted in the development of several publications focused on responsible outdoor recreation practices, and ultimately led to the creation of the 501(c)(3) Leave No Trace Center for Outdoor Ethics (the Center). The initial focus of LNT was on impacts in wilderness areas but has expanded to include other types of parks and protected areas (Marion, 2014; Marion & Reid, 2001).

For over two decades the Center has been under a Memorandum of Understanding (MOU) with the primary U.S. land management agencies, including the National Park Service, USDA Forest Service, Bureau of Land Management, and the US Fish and Wildlife Service, to promote LNT on federal lands. In 2007 the Center entered into an MOU with the NASPD to create a stronger link between state parks and national LNT efforts. Currently, the Center has a primary focus on frontcountry area visitors, and has created numerous LNT educational resources addressing common recreational pursuits such as day hiking, picnicking, camping in developed campsites, and dog walking (Leave No Trace Center for Outdoor Ethics, 2015; Marion, 2014).

#### *Previous Leave No Trace Research*

Existing LNT literature largely aligns with the disciplines of recreation ecology and human dimensions of natural resources (HDNR). Recreation ecology is a field of study that examines the impact of visitors to protected areas. Since it focuses on recreation-related impacts, recreation ecology has provided the underpinning for LNT messaging (Cole, 2004; Hampton & Cole, 2003; Leung & Marion, 2000; Marion, Leung, Eagleston, & Burroughs, 2016). However, one of the most important causes of visitor-created impacts is improper visitor behavior (Leung & Marion, 2000; Marion, Leung, Eagleston, & Burroughs, 2016; Marion & Reid, 2007), which more closely aligns with human dimensions. HDNR research seeks to interpret humans' attitudes toward, perceptions of, and interactions with natural ecosystems (Bright, Cordell, Hoover, & Tarrant, 2003; Ewert, 1996; Manfredo, Teel, & Bright, 2004). LNT-focused research of this kind is limited but increasing (Taff et al., 2014).

The preponderance of LNT related HDNR research has evaluated educational efficacy by examining communication strategies aimed at increasing knowledge to influence the behavior of recreationists (Marion & Reid, 2007). Such studies have evaluated strategies to diminish litter (Cialdini, 1996), minimize human and wildlife conflict (Hockett & Hall, 2007), discourage off-trail hiking (Winter, 2006), and curtail removal of natural objects (Widner-Ward & Roggenbuck, 2003). However, few studies have explicitly addressed LNT and have otherwise focused on generic minimum impact behaviors. An even smaller subset of HDNR studies has explored LNT in the context of visitors to frontcountry areas (see Jones & Bruyere, 2004; Jones & Lowry, 2004; Leung & Attarian, 2003; Mertz, 2002).

Some previous investigations have utilized knowledge of minimum-impact practices as a measure of LNT efficacy. While some relationship does exist, a primary shortcoming of focusing on knowledge is that the assumption of a linear relationship

between environmental knowledge and pro-environmental behavior is questionable (Hungerford & Volk, 1990; Hwang, 2000; Manning, 2003; Petty, McMichael, & Brannon, 1992). In other words, increasing knowledge about environmental impact does not necessarily equate to a change in an individual's behavior.

Recently, social scientists have begun exploring the influence that values, beliefs, attitudes, and other factors play in determining the behavior of outdoor enthusiasts within the context of LNT. These studies have been based largely upon behavioral theory such as Theory of Planned Behavior (Vagias et al., 2012; 2014). Recent research has also examined the perceptions of frontcountry visitors with respect to behavioral theory and LNT (Taff et al., 2011; Taff et al., 2014). This is an important consideration in LNT-related research given the theoretical foundations that suggest attitudes are one of the important influences on behavior (Ajzen, 1991).

### *Theoretical Foundation*

The Theory of Planned Behavior (TPB) is a general theory of social psychology that strives to explain human behavior. The overarching assertions of the TPB are that individuals make behavioral decisions based on beliefs, and the most accurate predictor of their behavior is the intention to engage in a particular behavior. According to the TPB, intention (how much effort an individual is willing to put toward performing a behavior) is a function of attitude toward a behavior and subjective norms (how others feel about the behavior). Additionally, behavioral intentions are based on behavioral beliefs (an attitude about the consequences of a particular behavior), normative beliefs (social pressure to engage in a particular behavior) and control beliefs (the belief that one has the knowledge, skill, resources, etc. to engage in a particular behavior). The TPB posits that attitudes, subjective norms, and perceived behavioral control can accurately predict the behavioral intentions of an individual and his or her eventual behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Though the TPB was used to orient this research it is worth noting that the theory has continued to undergo modifications. Continued evolution of TPB has led to the Reasoned Action Approach, which posits a more integrated framework for understanding social behavior by including potential determinants of behavior such as actual control (Fishbein & Ajzen, 2010), which may prove useful for future studies of LNT.

The TPB has been generally useful to human dimensions of natural resources research (Fishbein & Manfredo, 1992; Manfredo, Teel, & Bright, 2004; Vagias & Powell, 2010), and has been applied to inform LNT studies specifically (Lawhon et al., 2013; Taff et al., 2014; Vagias & Powell, 2010; Vagias et al., 2012; 2014). Furthermore, the TPB has the specific function to "predict and explain human behavior in specific context" (Ajzen, 1991, p. 181). This is perhaps the primary reason that the TPB is so useful for orienting evaluations of the efficacy of visitor education programs such as LNT (Vagias, 2009).

Previous research has established that attitudes often have a significant influence on a specific behavior (Ajzen, 2001; Fishbein & Manfredo, 1992; Ham & Krumpe, 1996). Attitudes are generally described as an individual's evaluation of and dispositional response to a particular object such as behavior. Once an evaluation of an object has occurred, an associative attitude about that object can be retained in memory and influence future behavior (Ajzen & Fishbein, 2000). LNT behavior is therefore theoretically influenced in part by attitudes toward specific LNT guidelines and recommended practices. If attitudes directly influence behavioral intention, and attitudes can be changed, then

park managers may alter visitor behavior by specifically targeting the salient attitude that is determining human behavior (Ham, 2007; Ham & Krumpe, 1996). Understanding visitor attitudes related to LNT is critical to craft effective educational messages that can potentially reduce depreciative behavior in park and protected areas.

Based on TPB and previous research, we hypothesized the behavioral intent of frontcountry state park visitors to practice LNT would be influenced by: 1) attitudes toward LNT; 2) attitudes regarding the perceived effectiveness of LNT practices 3) attitudes regarding the perceived difficulty of LNT practices; and 4) self-reported knowledge of LNT practices. Though self-reported knowledge has some linkage with the TPB construct of perceived behavioral control, this variable was not operationalized in this study to measure the construct in terms of the TPB. This item was selected because knowledge, to a degree, has been found to influence behavior regarding minimum impact practices (Manning, 2003; Marion & Reid, 2007), and aids in extending and improving the predictive capabilities of TPB (Vagias et al., 2014).

## Methods

The Wyoming State Parks, Historic Sites and Trails Agency manages 30 state parks and historic sites, which are primarily frontcountry areas. As such, these parks and historic sites do not offer wilderness-type experiences for visitors. Annual visitation to these areas is nearly 3.1 million, which represents a 68% increase over the past 25 years (Wyoming State Parks, 2014). To provide a representative sample of parks and historic sites, three units were selected for inclusion in this research: Glendo State Park (Glendo), Glendo, WY; Curt Gowdy State Park (Gowdy), Laramie, WY; and Wyoming Territorial Prison Historic Site (Prison), Laramie, WY. The three study locations were selected because a) they represent varying frontcountry state park visitor experiences, b) all receive significant annual visitation based on their size, location, and amenities, c) all locations receive both resident and non-resident visitors, and d) all three locations have existing visitor education programs. Glendo State Park offers motor boating, car camping, and angling. Curt Gowdy State Park offers motor boating, angling, car camping, horseback riding, hiking, and mountain biking. Wyoming Territorial Prison offers historic sites and displays, interpretive programs, living history exhibits, and limited hiking and cycling opportunities; camping is not allowed at the Prison.

Data were collected via an on-site researcher-administered survey over a five-week period during June–July 2012. A stratified random sampling procedure was used to ensure representativeness (Babbie, 2015; Vaske, 2008). Sampling was stratified between weekday/weekend, A.M./P.M., and location. Respondents were randomly targeted at a variety of park sites (campground, boat ramp, visitor center, trailhead, etc.) within each unit based on consultation with each unit manager. The majority of respondents (54%) were surveyed in campgrounds, while 30% of respondents were surveyed at a visitor center. The remaining respondents were surveyed at trailheads (9%), boat ramps (5%), and along a greenway trail (1%). Trained surveyors asked visitors if they would be willing to participate in a “visitor opinion study.” If a potential respondent declined, researchers recorded the time at which they encountered the individual and asked a single non-response question, “What is the primary purpose of your visit today?” All surveys were completed by a single individual regardless of group size, and were completed on site. Survey respondents were randomly selected using an nth sampling strategy. To reduce survey instrument-induced bias, the phrase “Leave No Trace” was not mentioned nor

Table 1. Attitudes toward frontcountry Leave No Trace practices

How APPROPRIATE or INAPPROPRIATE do you think the following activities are for a visitor to do in Wyoming State Parks and Historic Sites?	<i>N</i>	Mean	S.D.	Percentage <sup>a</sup>						
				Very Inappropriate			Neutral		Very Appropriate	
				1	2	3	4	5	6	7
Experiencing parks by not preparing for weather/hazards	342	2.20	1.84	59	14	7	7	5	3	6
Traveling off trail to experience the natural environment	345	3.21	2.09	34	13	9	16	9	10	9
Carrying out all litter, leaving only food scraps	344	4.35	2.67	30	9	4	5	3	8	42
Keeping a single item like a rock, plant, stick or feather as a souvenir	345	2.94	1.84	35	15	8	24	8	6	5
Dropping food on the ground to provide wildlife a food source	345	1.68	1.32	68	17	5	6	1	1	2
Taking a break along the edge of a trail	345	5.34	1.63	4	4	4	19	13	25	31

a. Percentages may not equal exactly 100% due to rounding.

Table 2. Perceived level of effectiveness of Leave No Trace practices

Participating in the following activities in Wyoming State Parks and Historic Sites would reduce impact...	<i>N</i>	Mean	S.D.	Percentage <sup>a</sup>						
				Never			Sometimes		Every time	
				1	2	3	4	5	6	7
Preparing for all types of weather, hazards and emergencies before getting on trail	346	6.17	1.14	0	0	1	11	11	21	56
Staying on designated or established trails	329	6.26	1.04	0	0	2	8	9	24	57
Carrying out all litter, even crumbs, peels or cores	340	6.53	1.00	0	1	2	4	5	12	76
Never removing objects from the area, not even a small item like a rock, plant or stick	344	5.26	1.79	6	3	6	21	11	16	37
Never approaching, feeding or following wildlife	343	5.60	2.02	9	3	4	9	4	14	55
Taking breaks away from the trail and other visitors	342	4.25	1.90	15	6	6	29	16	12	16

a. Percentages may not equal exactly 100% due to rounding.

Table 3. Perceived difficulty of practicing Leave No Trace

Please indicate how DIFFICULT you think each of the following would be for a visitor to do in Wyoming State Parks and Historic Sites...	<i>N</i>	Mean	S.D.	Percentage <sup>a</sup>							
				Not at all Difficult		Moderately Difficult			Extremely Difficult		
				1	2	3	4	5	6	7	
Preparing for all types of weather, hazards and emergencies before getting on trail	341	2.23	1.40	40	21	11	17	4	2	.3	
Staying on designated or established trails	314	1.72	1.22	62	22	5	7	2	1	1	
Carrying out all litter, even crumbs, peels or cores	340	1.65	1.33	71	15	5	5	1	1	3	
Never removing objects from the area, not even a small item like a rock, plant or stick	340	1.92	1.44	60	17	8	11	2	2	2	
Never approaching, feeding or following wildlife	337	1.64	1.22	68	17	5	6	1	1	1	
Taking breaks away from the trail and other visitors	339	2.15	1.42	45	24	11	13	3	1	2	

a. Percentages may not equal exactly 100% due to rounding.

Table 4. Level of Self-described Leave No Trace Knowledge

	<i>N</i>	Mean	S.D.	Percentage <sup>a</sup>							
				No Knowledge	Very Limited	Limited	Average	Above Average	Extensive	Expert	
				0	1	2	3	4	5	6	
339	3.40	1.77		14%	4%	4%	23%	28%	18%	9%	

a. Percentages may not equal exactly 100% due to rounding.

**Table 5. Behavioral intentions to practice Leave No Trace in the future**

Please indicate how LIKELY you are to do the following activity in the future...	N	Mean	S.D.	Percentage <sup>a</sup>						
				Not at all Likely		Moderately Likely			Extremely Likely	
				1	2	3	4	5	6	7
Prepare for all types of weather, hazards and emergencies before getting on trail	336	6.10	1.3	1	1	1	15	10	12	60
Stay on designated or established trails	329	6.09	1.30	1	0	1	13	11	16	57
Carry out all litter, even crumbs, peels or cores	335	6.51	1.12	1	1	1	5	4	11	77
Remove objects from the area, not even a small item like a rock, plant or stick	336	2.95	2.12	44	10	6	18	6	7	10
Approach, feed or follow wildlife	334	2.59	2.23	56	11	5	8	2	4	14
Take breaks away from the trail and other visitors	335	3.94	1.98	18	8	10	30	8	9	16

a. Percentages may not equal exactly 100% due to rounding.

**Table 6. Predicting Leave No Trace behavioral intent<sup>a</sup>**

Behavioral Intent	Appropriateness	Effectiveness	Difficulty	Knowledge	R <sup>2</sup>
Preparing for all types of weather, hazards and emergencies	.02	.24**	-.19**	.14*	.15
Staying on designated or established trails	-.21**	.31**	-.13*	.05	.24
Carrying out all litter, including food scraps	-.004	.44**	-.22**	.08	.31
Not removing natural objects from the area	.25**	.10	.18*	-.10	.10
Not feeding, following or approaching wildlife	.12	.10	.17*	.02	.10
Taking breaks away from trails and other visitors	.11	.34**	.004	-.003	.13

a. Cell entries are standardized regression coefficients — \* p < .05, \*\* p < .001

seen until the third page of the survey. The survey addressed only six of the seven LNT principles. The fifth principle of LNT, “Minimize Campfire Impacts,” was not included because fires are not allowed at all Wyoming state parks and historic sites.

There were a total of 346 completed surveys with an overall response rate of 93%. The individual unit response rates were: 92% for Glendo (N = 114), 95% for Gowdy (N = 125) and 93% for the Prison (N = 107). Based on sample size and visitation to the three units, there is 95% confidence that these findings are accurate to +/- five percentage points (Vaske, 2008).

### *Variable Measurement*

The items used in this study were modeled after pre-existing, validated, and pre-tested variables utilized in previous peer-reviewed studies designed to explore attitudes regarding LNT (see Lawhon et al., 2013; Taff et al., 2011; Taff et al., 2014; Vagias et al., 2012; 2014). Items were slightly modified to fit the study objectives, population sampled, and the specific state park settings. All variables were measured on a seven-point Likert-type scale. Independent variables included attitudes toward recommended LNT practices (how appropriate or inappropriate practices are perceived; Table 1), attitudes toward perceived effectiveness of recommended LNT practices (Table 2), attitudes toward perceived difficulty of recommended LNT practices (Table 3), and self-described knowledge of LNT (Table 4). The dependent variable was respondents’ behavioral intent to perform recommended LNT practices in the future. This variable was operationalized as how likely or unlikely visitors were to engage in LNT behavior in the future for each of the following: planning ahead, staying on designated trails, packing out all waste, leaving natural objects in place, not feeding wildlife, and taking breaks away from trails and other visitors (Table 5).

### *Analyses*

Frequencies were conducted to provide percentages, mean values, and standard deviations. A one-way analysis of variance (ANOVA) for all variables revealed no substantive differences between responses from the three units, thus results were combined for subsequent analysis purposes. Six separate linear regression models were analyzed to best explain LNT-related behavioral intent. For each model, one item from Table 5 (i.e., likelihood of engaging in LNT behaviors in the future) functioned as the dependent variable. The independent variables included attitudes toward recommended LNT practices (Table 1), attitudes toward perceived effectiveness of recommended LNT practices (Table 2), attitudes toward perceived difficulty of recommended LNT practices (Table 3), and self-described knowledge of LNT (Table 4).

## **Results**

### *Demographics*

The median age of survey respondents was 48 years. Over half of the respondents (58%) were male. A plurality of individuals sampled (46%) were from Wyoming, with the remaining 54% coming from over a dozen different states. The highest percentage of visitors indicated that the primary purpose of their visit was for camping in developed campsites (29%). Just over one fifth (21%) of respondents indicated that fishing was the primary purpose of their visit. A smaller portion of respondents (16%) indicated

that visiting historical exhibits was the primary reason for their visit. Other reasons indicated included sightseeing (11%), mountain biking (10%), boating (4.5%), hiking (4%), picnicking (2%), and other (2.5%). Nearly 29% of respondents indicated this was their first visit to the park or historic site in the past twelve months, while 35% indicated they had visited this park or site between one and two times in the same timeframe. Nearly one quarter of visitors (23%) reported having visited the park or historic site between three and ten times in the past twelve months.

#### *Attitudes Toward Appropriateness of Leave No Trace Practices*

Attitudinal statements were used to determine how park visitors viewed the appropriateness of six specific recommended LNT practices. The results (Table 1) suggest that some visitors either misunderstand or are unfamiliar with some LNT practices. It is also possible that the particular wording of these items was unclear to respondents. Specifically, 50% of respondents felt that *Carrying out all litter, leaving only food scraps* was Very Appropriate ( $M = 4.35$ ), yet LNT recommends removing all litter including food scraps and other biodegradable items. Likewise, the majority of respondents (56%) indicated that *Taking breaks along the edge of the trail* was Very Appropriate ( $M = 5.34$ ) however, this too is counter to LNT recommendations, which instructs people to move away from trails for breaks to allow other trail users unrestrained passage. Mean scores for all other attitudinal measures were less than  $M = 3.21$ , indicating that respondents had a better understanding of these principles, and had an attitudinal orientation more in line with LNT recommendations regarding these practices.

#### *Attitudes Toward Perceived Effectiveness of Leave No Trace Practices*

Survey respondents were asked to indicate whether or not they thought recommended LNT practices were effective at reducing impacts. A majority of practices (Table 2) were perceived to be effective at reducing impact Every Time ( $M \geq 5.26$ ). However, one recommended practice, Taking breaks away from the trail and other visitors, had a lower mean score ( $M = 4.25$ ), suggesting that respondents felt this practice would only reduce impact Sometimes. It is conceivable that respondents were unaware of the potential impact taking breaks in the middle of a trail could have on other trail users.

#### *Attitudes Toward Perceived Difficulty of Leave No Trace Practices*

Respondents were asked to indicate how difficult they thought a variety of LNT practices would be to perform. None of the items received a mean score higher than  $M = 2.23$ , suggesting that the majority of respondents did not view the recommended practices as being anything greater than moderately difficult to do (Table 3). It is possible that if specific practices are viewed as too difficult to perform, park visitors may not follow them.

#### *Self-reported Leave No Trace Knowledge*

Respondents were asked to describe their current knowledge of LNT practices. This variable was measured on a seven-point scale ranging from (0) No Knowledge to (6) Expert. The majority of respondents (55%) rated their knowledge as Above Average, Extensive, or Expert (Table 4). Nearly one quarter of respondents (23%) rated their knowledge as average, with the remaining 22% of respondents rating their knowledge from Limited to No Knowledge.

### *Likelihood of Practicing Leave No Trace in the Future (Behavioral Intent)*

Respondents were asked how likely they were to perform six recommended LNT practices in the future (Table 5). The majority of respondents indicated they were Extremely Likely to perform all recommended LNT practices with the exception of Taking breaks away from the trail and other visitors ( $M = 3.94$ ). This finding suggests that respondents are only Moderately Likely to follow this LNT recommendation in the future.

### *Regression Analysis*

The regression analyses revealed that LNT behavioral intent was influenced to varying degrees by attitudes, perceptions, and self-reported LNT knowledge (Table 6). The most variance ( $R^2 = .31$ ) was explained in respondents' future likelihood of *Carrying out all litter, including food scraps*. The analysis explained the next highest level of variance ( $R^2 = .24$ ) for respondents' likelihood of *Staying on designated or established trails*. The least amount of explained variance ( $R^2 = .10$  in both cases) was for both *Not feeding, following or approaching wildlife* and *Not removing natural objects from the area*. It should be noted that LNT recommends leaving natural objects (e.g. fossil, feather, seashell, etc.) where found unless collection of such objects is allowed by land managers. Furthermore, this LNT recommendation does not address or pertain to legal harvest of fish or game.

Attitudes toward perceived effectiveness of LNT practices was the strongest predictor ( $\beta \geq .24$ ,  $p < .001$ ) in four cases: *Preparing for all types of weather, hazards and emergencies*, *Staying on designated or established trails*, *Carrying out all litter including food scraps*, and *Taking breaks away from trails and other visitors*. However, in the case of *Not removing natural objects from the area* ( $\beta = .25$ ,  $p < .001$ ), attitudes toward appropriateness of the practice was the strongest predictor of behavioral intent to follow this LNT recommendation. Lastly, in the case of *Not feeding, following or approaching wildlife*, attitudes toward perceived difficulty ( $\beta = .17$ ,  $p < .05$ ) was shown to be the most significant predictor of behavioral intent to follow this practice. Despite the high level of self-reported LNT knowledge, it was not shown to be a significant predictor of behavioral intent ( $\beta < .14$ ,  $p \geq .05$ , in all cases). Overall, these results indicate, based on a TPB model of action, there is a need to focus visitor education efforts on the effectiveness of recommended LNT practices and the appropriateness of the practices, in addition to providing information for visitors regarding the perceived difficulty of practicing LNT.

## **Discussion**

The majority of respondents indicated that they were moderately to extremely likely to practice LNT in the future. By understanding significant influences on LNT behavioral intent, state park and other frontcountry-based managers can craft more effective messages to visitors about minimizing recreational impacts in parks and reducing depreciative behaviors.

Respondents indicated a high level of LNT knowledge; nearly 55% self-reported Above Average to Expert LNT knowledge. Despite similar findings in previous LNT research using the same variables (Lawhon et al., 2013; Taff et al., 2014; Vagias et al. 2014), this construct was not found to be a strong predictor of behavioral intent. Though respondents indicated a high level of self-reported knowledge, the results of the attitudinal measures (Table 1) suggest that some park visitors do not understand, are confused about, or are simply unfamiliar with certain LNT recommended practices.

It is also possible that the results may have been influenced by ambiguous wording

of some items. Specifically, visitors may not entirely understand the LNT principles *Dispose of waste properly* and *Be considerate of other visitors*, or may not have understood what the item was actually attempting to measure. Respectively, these principles recommend packing out all waste including food scraps, and taking breaks away from trails on durable surfaces such as rock, sand, gravel, or snow when available so as not to unnecessarily impact the experience of other visitors. Previous investigations of LNT found similar deficiencies in visitors' understanding of these LNT principles (Lawhon et al., 2013; Taff et al., 2014; Vagias & Powell, 2010). Additionally, the recommendation to stay on designated trails to minimize erosion may be perceived as inconsistent with the recommendation to move off trail to take breaks to minimize potential social impact with other trail users. Recommendations such as these may appear to park visitors to be in conflict and should be targeted in future studies. It is also possible that LNT information for frontcountry settings may simply be too generic to apply broadly and accurately for this particular setting. These results suggest that the Center should consider adding additional detail in the existing LNT literature to better explain the rationale underpinning these recommendations, and should potentially consider site-specific factors. Finally, since an attitude is an evaluation of a particular object or recommendation, it is possible that visitors may be fully aware of LNT practices but may simply hold negative views toward certain recommended practices.

Respondents' attitudes toward the perceived difficulty of carrying out recommended practices may have some influence on their behavioral intent as shown in the regression results in Table 6. It is plausible that if recommended LNT practices are perceived as being too difficult, there is the potential that park visitors will not adhere to those recommended practices. However, the low mean scores for attitudes toward perceived difficulty of the LNT practices (Table 3) addressed in this study indicate that visitors feel that these practices are generally easy to follow when recreating in the parks. Many state parks offer amenities such as toilets, picnic tables, food storage facilities, hardened trails, and trash cans. It is conceivable that visitors find it easier to minimize their overall impact due to these amenities. Conversely, in backcountry situations where such amenities are often not available, practicing LNT may require more skills and effort.

### **Management Implications**

Results from this study support the notion that knowledge does not directly translate to a change in behavioral intent. However, state park visitors need to be made aware of how impacts occur, how those impacts can be minimized, and how recommended LNT practices are effective at minimizing those impacts. It should be noted that recreation-related impacts may vary widely by place, time, and use. Such factors should be taken into consideration when implementing LNT educational efforts. The results suggest that focusing on the effectiveness of recommended LNT practices as well as the appropriateness of those practices through education-based communication strategies may positively influence the behavioral intent of state park visitors to practice LNT. While effectiveness and appropriateness are related, these are two distinct concepts with respect to LNT. Effectiveness refers to how specific LNT practices can prevent or minimize impacts, whereas appropriateness pertains to causes of impacts and why those impacts are unacceptable. Attitudes toward perceived effectiveness of recommended LNT practices are important because it is possible that practices perceived as ineffective are less likely to be performed than those perceived as effective. Data from this study

and previous LNT investigations suggest that attitudes toward perceived effectiveness and difficulty are meaningful predictors of LNT behavioral intent (Vagias et al., 2014). Therefore, park managers might consider implementing communication efforts that highlight the effectiveness and ease of practicing LNT behaviors. Furthermore, visitors do need to be made aware of why impacts should be minimized or prevented, as efforts focused solely on effectiveness may not be successful. These strategies could result in less depreciative behaviors, thus helping preserve resource and social conditions in parks and protected areas.

The results highlight several important considerations for state park managers regarding LNT as a tool to minimize visitor impact. Despite the fact that three different types of state parks were included in this study, the finding of no substantive differences among the park visitors suggests that a single, consistent LNT-based educational effort could be implemented by the Wyoming State Parks, Historic Sites and Trails Agency. This type of educational strategy would likely resonate with visitors regardless of which park they visit. While it is clear that educational-based communication strategies need to highlight the kinds of behaviors that cause impact, the reasons for wanting or needing to avoid those impacts, and the techniques needed to reduce those impacts, results also indicate that a park-by-park approach may not be needed. Despite such promising findings, more data is likely necessary to definitively determine if a uniform approach would be effective on a system-wide scale. Although locally tailoring LNT information is warranted in certain situations to make the information ecologically and environmentally relevant (Marion, 2014), these data suggest that park managers may be able to implement an effective “one size fits all” approach with some local adjustments as needed. This is important for modern-day land management agencies as education and interpretation resources are often limited and messages are sometimes inconsistent. A more uniform approach to LNT education and communication could lead to greater adoption and use of LNT by state parks, thereby lessening the burden on agencies in terms of program development and implementation.

The findings suggest that LNT educational-based communication efforts in state parks that utilize this approach, regardless of park type, are likely to be effective at both educating visitors about LNT and minimizing recreation-related impacts through changing visitors’ behavioral intent. However, we suggest that a suite of management approaches, including LNT educational efforts in conjunction with direct management strategies, may be needed to effectively address specific issues such as off-trail travel.

### *Study Limitations*

This study has a number of limitations that merit further investigation in future LNT-focused studies. While it is becoming clear that many factors appear to influence the behavioral intent of park and protected area visitors to practice LNT (Vagias et al., 2014), this study only examined attitudes, perceptions, and self-reported knowledge as it relates to behavioral intent. This study did not measure actual behavior regarding LNT. Subsequent research should attempt to examine self-reported measures with unobtrusive observations of specific behaviors of interest. To date, much of the human dimensions LNT research, whether focused on frontcountry or backcountry wilderness visitors, has taken place in states in the western U.S. Additional research should examine whether visitor attitudes and perceptions regarding LNT are similar in visitors to other regions of the country, or even internationally. Attention should also be placed on other

types of frontcountry protected areas, such as city and county open space, which may accommodate visitors having differing behavioral intentions toward LNT. While this study did not explore normative influences on LNT behavioral intent, norms have been shown to be an important component of behavior and could be investigate further. Lastly, specific wording of some survey items may have been ambiguous. These items should be revised for future research. Measurement purity should be an overarching goal for any subsequent studies that aim to explore these concepts. Despite these limitations, the results of this study verify the importance attitudes toward appropriateness, perceived effectiveness, and perceived difficulty of recommended LNT practices in terms of influencing behavioral intent in state park visitors. We recommend that future studies incorporate these factors.

## **Conclusions and Future Research**

Resource and social impact due to deprecative visitor behavior continues to be a chief concern for many park and protected area managers. Educational communication messages and strategies such as those promoted through LNT, which often focus on uninformed and unskilled visitors, are essential for future protection of recreational resources from visitor-created impacts. Study results indicate that both attitudes toward perceived effectiveness and appropriateness of LNT practices are important predictors of behavioral intent in state park visitors. Education-based communication efforts have an increased likelihood of meaningfully influencing behavioral intent if they are tailored to state parks, focus on why LNT practices are appropriate, and address how those practices are effective at minimizing impacts. This study and previous research also signify the need to further investigate the influence attitudes, norms, perceptions, perceived behavioral control, and beliefs play in determining the intentions to practice LNT. Furthermore, results from this study indicate the need for a more targeted examination of the potential effectiveness of a uniform approach to LNT education for a park system such as Wyoming State Parks, Historic Sites and Trails. Recent trend data indicate that a continued increase in recreational use in frontcountry areas, such as those found in many state parks, is likely to occur over the coming years (Cordell, 2012; Outdoor Industry Foundation, 2014). Therefore, LNT studies in the frontcountry context may be the most useful for both the Leave No Trace Center for Outdoor Ethics and land managers across the country.

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