

A photograph of a person climbing a large, light-colored rock face. The climber is wearing a red shirt and dark pants, and is positioned on the left side of the frame. The rock face is vertical and has some texture. Below the rock face, there is a dense forest of evergreen trees. The sky is blue with some white clouds. The text is overlaid on the right side of the image.

Leave No Trace
Knowledge among
Climbers in Lander,
Wyoming

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Executive Summary

The Division of Regional Economic Assessment and Modeling (DREAM) conducted a study of Leave No Trace knowledge in Lander, Wyoming, using the Leave No Trace Rock Climbing Measure (LNTRCM). Researchers found that:

1. Climbers in Lander scored well on the LNTRCM overall, indicating they know the steps needed to minimize their environmental impacts.
2. The LNTRCM identified four areas for future work: reducing chalk use, removing chalk after use, minimizing vegetation removal from the climbing area, and packing out toilet paper.
3. Climbers in Lander indicated they most often learned about LNT before the age of eighteen and have learned more about LNT and minimal impact practices from friends (55%), learning from other climbers while climbing (41%), learning from National Park or Forest Service literature (41%) and their parents (41%).
4. In all, 69% signed the Climber's Pact. Those who did sign indicated statistically higher scores on the LNTRCM.
5. Climbers in Lander are well-educated, with over half holding a bachelor's degree and another 33% holding a graduate degree.

Photo: Yasmeen Fowler in Lander, photo by Rick Bost

Literature Review

Rock climbing represents an increasingly popular form of public land use with its own unique impacts that must be managed to make climbing sustainable. Whereas hikers may be concerned with compacting soil on trails and not creating switchbacks, climbers must *also* consider a second dimension: climbers' impacts on the vertical rock walls they climb. Impacts there include chalk use (and overuse), removing vegetation, disturbing nesting birds, and addressing loose rocks or trees that may pose safety issues ([Covy et al., 2019](#); [Lorite et al., 2017](#); [Clark & Hessel, 2015](#)).

Climbers are not strangers to understanding how impacts can shape access to climbing. For example, in Kentucky's Red River Gorge, the unpredictable surge of sport climbing in the region also led to a rapid increase in the number of climbers found there ([Maples, 2021](#)). This exacerbated existing issues like soil compaction at the bottom of crags and the use of unofficial trails to get to the crag while also bringing out an entire generation of new climbers, many of whom had not ever climbed outside before. This resulted in several closures in the Red, leading climbers and local climbing organizations to reassess past approaches to LNT and set clearer expectations for climbers going forward to minimize future closures. This also supported a need for further studies of LNT among climbers.

Recent studies have examined the idea of LNT knowledge specifically among climbers. Evan Coulson's ([2016](#)) dissertation set the tone for examining climbers' awareness of LNT principles as well as their feelings about the applications of those ideas. Coulson's work examined climbers in the Shawnee National Forest in Southern Illinois. The results were important: climbers who felt minimizing their impacts mattered were more apt to report performing these activities. Moreover, Coulson argued that these results could be shaped by other ideas like climbing specializations and attachments to place. [Sharp and associates \(2020\)](#) build upon this idea in applying Wade Vagias and associates' ([2012](#)) Leave No Trace Attitudinal Inventory and Measure (LNTAIM) to explore what climbers knew about LNT alongside their corresponding self-reported behaviors in Kentucky's Red River Gorge. The results set precedent: climbers who knew more about LNT reported acting upon that knowledge in the backcountry. This result was then replicated with a second field survey and published under [Clark and associates \(2020\)](#). Notably, both studies found that at least one demographic variable (income) shaped this relationship between knowing more about LNT and acting upon it in the backcountry.

One problem present in both Clark's and Sharps' studies was that respondents indicated the LNTAIM was not an ideal measure of climbing knowledge. For example, the LNTAIM was largely built around camping and hiking applications. While relevant and important, the measure's focus on ideas like camping on durable surfaces and using fire rings was not immediately applicable to climbing. To resolve this issue, [Maples and](#)

[associates' \(2022\)](#) study of LNT knowledge among climbers in West Virginia's New River Gorge established a new measure called the Leave No Trace Rock Climbing Measure (LNTRCM), a 29-item scale which explored specific impact issues climbers experience while in the backcountry in relation to climbing. For example, the measure included ideas like not climbing in areas that would stress nesting birds, minimizing chalk use, and not leaving tic marks on the wall. The scale covers all seven LNT Principles (whereas the LNTAIM covered only six) and provided an opportunity to study climbers' knowledge, identify areas for improvement, and hopefully minimize impacts over time.

Other issues still remain in studying LNT among climbers. One big gap in the existing literature is where climbers are learning about LNT and how that might shape their knowledge of LNT. The purpose of this study is to establish to what degree climbers in Lander, Wyoming can accurately apply Leave No Trace (LNT) principles to common climbing behaviors. The study also explores how specific sources of knowledge and behaviors (such as taking an LNT course) may shape what climbers know.

Methods

An online survey was used to collect data for this study. This study was nested as an optional section of a larger economic impact survey conducted in the Lander region in 2020 and 2021. The survey was distributed in 2021 using a convenience sample approach. The online survey link was released nationally using the Access Fund's social media blasts and regionally through the Central Wyoming Climbers' Alliance social media. A convenience sample is appropriate for this scenario, as the exact size of the climbing population visiting this region is, prior to this study, unknown. In all, 409 persons acknowledged the survey by clicking the provided link and giving consent to continue. Of these individuals, 238 persons opted to take the LNT survey section. Six cases were excluded as analysis of their LNTRCM responses indicated they had not read the instructions (e.g. answering everything with a five). All remaining responses are reported up until the moment they either completed the survey or discontinued the survey.

The survey included variables in four categories: the Leave No Trace Rock Climbing Measure (LNTRCM), sources of LNT knowledge, behaviors shaping LNT knowledge, and demographics. The LNTRCM is a 29-item scale established by [Maples and associates \(2022\)](#) to explicitly study LNT issues as they related to climbing examples. The scale asks respondents to indicate if a climbing behavior (such as carving names into a rock wall or packing out one's trash after climbing) is appropriate or inappropriate using a five-point Likert measure. The scale functions as a measure to explore problem areas in crags while also giving a useful tool for understanding how knowledge is shaped by other variables.

The survey also includes questions about twenty sources of knowledge where climbers might learn about minimizing their impacts. Climbers are asked to check any category that they felt was important to their learning about LNT behaviors. The survey includes seven questions about behaviors (such as taking a LNT course) that could shape a climber's knowledge of minimizing their impacts. Finally, the survey includes common demographic measures on age, sex, race, education, income as well as climbing-specific measures examining the types of climbing the respondent engages in in Lander, how often they climb each year in Lander, and if they bring a dog to the crag with them on a typical trip.

Analysis

What do climbers in Lander know about LNT?

Table One individually explores the 28 items from the LNTRCS. Recall these items are measured on a five-point Likert measure which examined if the items was very appropriate (5), appropriate (4), neither appropriate nor inappropriate (3), inappropriate (2), or very inappropriate (1). To interpret the means in the tables, look for means closer to 5 or, on items marked with an asterisk, closer to one. Note that many items in the scale (marked with an *) are reverse coded, meaning that the question was phrased such that the behavior would be very inappropriate.

Table One indicates that, overall, climbers accurately knew if a behavior was appropriate or not. For example, nearly every respondent indicated that carving names into the climbing wall was inappropriate (mean=1.01, which indicates very inappropriate). Similarly, all respondents knew that they should pack out their own trash (mean= 5.00, or very appropriate). In all, the scale items indicate climbers know the ideas needed to minimize their impacts in the crags.

Where do climbers learn about LNT?

Table Two lists sources of LNT knowledge reported by respondents. Note these categories are coded dichotomously (0 and 1), where 1 equals the presences of the category and 0 equals the absence. If the respondent indicated the category was a source of LNT knowledge for them, it would be coded as a 1. If they did not indicate that category, it would be coded as a 0. The advantage to this approach is that the means can be interpreted as percentages of cases indicating a 1. For example, 29% (mean=.29) of respondents indicated that the Climber's Pact was a source of LNT knowledge for their experiences.

Table One: Description of Items and Responses in the Leave No Trace Rock Climbing Measure (LNTRCM): Alpha: .738, *=reverse coded items

<i>Variable</i>	<i>LNT Area</i>	<i>Obs</i>	<i>Mean</i>	<i>StDev</i>	<i>Min</i>	<i>Max</i>
Knowing the climbing regulations where I'll climb in advance.	1	222	4.82	0.46	2	5
Limiting my group size to protect the climbing area.	1	222	4.50	0.59	3	5
Carpooling to the climbing area whenever possible.	1	222	4.54	0.65	1	5
Using only designated trails in and around climbing areas.	2	222	4.86	0.43	1	5
Travelling in a single file whenever walking with others on the trail.	2	222	4.55	0.66	2	5
Creating trail shortcuts when trails do not go straight to the climbing area.*	2	222	1.15	0.49	1	5
Packing out all the trash I create while climbing.	3	222	5.00	0.00	5	5
Minimizing the amount of chalk I used.	3	222	3.88	0.86	2	5
Packing out any forgotten or discarded gear I find.	3	222	4.62	0.65	1	5
Leaving my feces on top of the ground so it will biodegrade.*	3	222	1.18	0.59	1	5
Urinating at least seventy steps from the trail.	3	222	4.10	1.00	1	5
Burying my toilet paper.*	3	222	2.58	1.57	1	5
Pooping close to the trail.*	3	222	1.09	0.49	1	5
Brushing off excess chalk on the route when I am done climbing it.	3	222	4.01	0.95	1	5
Taking small rocks home with me as mementos.*	4	222	1.84	0.77	1	4
Dislocating rocks that make it hard to climb.*	4	222	1.82	1.15	1	5
Cleaning vegetation off the wall while climbing.*	4	222	2.50	1.08	1	5
Using a portable stove rather than start a campfire should I need to cook something at the crag.	5	222	4.55	0.85	1	5
Making a campfire at the climbing area to cook or keep warm.*	5	222	1.55	0.84	1	5
Cutting down trees that are in the way of the route.*	6	222	1.45	0.86	1	5
Using tree-safe straps or a protective cloth to protect tree bark if using a hammock.	6	222	4.43	0.87	1	5
Keeping a dog on a leash or tethered at all times when I bring it to the crag.	6	222	4.43	0.82	1	5
Packing out my dog's feces when I bring it to the crag.	6	222	4.82	0.55	1	5
Feeding my food scraps to the local wildlife.*	6	222	1.07	0.40	1	5
Not climbing a route if I knew it would stress out nesting birds.	6	222	4.66	0.97	1	5
Making sure everyone can hear music if I listen to it while climbing.*	7	222	1.11	0.38	1	4
Carving names into the climbing wall.*	7	222	1.01	0.09	1	2
Leaving tic marks to help climbers that are not in my group.*	7	222	1.55	0.80	1	5
LNTRCM Scores	all	222	.00	.35	-1.27	.62

Overall, respondents indicated several important sources of LNT knowledge. Overall, the most popular source of knowledge was from one's friends, with 55% of respondents indicating this was an important source of LNT knowledge for them. The next most common source of knowledge was a three-way tie. In all, 41% of respondents indicated learning about LNT via info from another climber while climbing, National Park/Forest Service literature, and/or one's parents. (Note the similarities in means and standard deviations here are the result of rounding.) Next was websites and the Internet (40%) followed by watching other climbers (38%), local climbing organizations (32%), popular media (32%), and National Park/Forest Service personnel (30%). Although not summarized in the table, 87% of respondents noted at least one climbing source as an important source of LNT knowledge.

Table Two: Respondent Sources of LNT Knowledge					
*significant predictor of LNTRCM (p=.01)					
<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>St Dev</i>	<i>Min</i>	<i>Max</i>
Climbing sources					
Climber's Pact	232	0.29	0.45	0	1
Access Fund Conservation Team	232	0.09	0.29	0	1
Access Fund website	232	0.25	0.44	0	1
Local climbing organization programs	232	0.32	0.47	0	1
AAC conservation programs	232	0.06	0.25	0	1
AAI website*	232	0.11	0.31	0	1
Gym kiosks	232	0.09	0.28	0	1
Watching other climbers	232	0.38	0.49	0	1
Info from another climber while climbing	232	0.41	0.49	0	1
Family and friend sources					
My parents	232	0.41	0.49	0	1
My grandparents	232	0.06	0.23	0	1
Other family members	232	0.09	0.29	0	1
My friends	232	0.55	0.50	0	1
Public lands sources					
Park/Forest Service personnel	232	0.30	0.46	0	1
Park/Forest Service literature	232	0.41	0.49	0	1
LNT-related sources					
LNT info kiosks	232	0.22	0.42	0	1
Classes/Courses on LNT	232	0.24	0.43	0	1
Other Sources					
Boy/Girl Scouts or similar organizations	232	0.21	0.41	0	1
Website/Internet sources	232	0.40	0.49	0	1
Popular media (including magazines and books)	232	0.32	0.47	0	1

The researchers utilized a bivariate regression to explore any relationships between sources of knowledge and the respondent's score on the LNTRCM. Only one proved statistically significant: The American Alpine Institute's website. The relationship is positive, with persons indicating this was an important source of LNT knowledge scoring slightly higher on the LNTRCM. This [website](#) includes extensive material on LNT.

How do climber behaviors shape what they know about LNT?

Table Three lists several behaviors which have been raised in past studies and in climbing anecdotes as being potential behaviors shaping one's knowledge of LNT practices. First, the survey included a question asking respondents to self-rank their LNT knowledge, with a ten indicating excellent knowledge and 1 effectively equaling no knowledge about LNT principles. The mean score was 7.90, which indicates the respondents believe they know LNT principles well. Note that 68% scored themselves an 8 or greater. Second, 64% of respondents indicated learning about LNT before the age of 18. Third, 69% of respondents indicated they had signed the Climber's Pact. That said, note there was a high instance of missing data here where respondents could not recall if they had signed it. Fourth, the table includes three LNT training opportunities, with 12% of respondents completing the Master Educator course, 19% completing the trainer course, and 36% taking part in an LNT awareness workshop. Finally, 37% noted they began climbing indoors.

The researchers again conducted additional bivariate regression analysis on the variables in Table Three. Although no results were significant, one was marginally significant: signing the Climber's Pact. There, respondents who signed scored slightly higher than those who had not ($p=.08$).

Table Three: Behaviors Shaping LNT Knowledge					
^ indicates marginally significant predictor of LNTRCM ($p=.08$)					
Variable	Obs	Mean	St Dev	Min	Max
Self-ranking on LNT Knowledge (10=Expert and 1=novice)	229	7.90	1.62	2	10
Self-ranked LNT Knowledge score 8 or higher	232	.68	.46	0	1
Was taught LNT before Age 18	221	0.64	0.48	0	1
Signed Climber's Pact [^]	184	0.69	0.46	0	1
Completed LNT Master Educator Course	225	0.12	0.33	0	1
Completed LNT Trainer Course	220	0.19	0.39	0	1
Completed LNT Awareness Workshop	219	0.36	0.48	0	1
Started climbing indoors	232	0.37	0.48	0	1

Who are the climbers of Lander, Wyoming?

Table Four explores the demographics of the sample. Roughly 41% of respondents engaged in trad climbing in Lander, while 94% sport climbs and 24% boulders in Lander. Note these categories are not mutually exclusive. On average, respondents spent 26 days climbing in Lander. About one in four bring dogs with them to the crag on a typical visit. In all, 35% indicated being female. The average age was 36, although this would be impacted by limiting the survey to persons 18 and older; roughly one in nine respondents were over 55. Roughly half of respondents had a Bachelor’s (four year) degree, while another 33% held graduate degrees. Nearly 60% had annual personal incomes over \$50,000, while one in five reported six figure annual personal incomes. Although not summarized in the table, the bulk of respondents identified as white.

The researchers again conducted a bivariate analysis of Table Four’s variables. Three variables statistically predicted the respondent’s score on the LNTRCM. First, sport climbers scored slightly higher than non-sport climbers on the LNTRCM ($p=.05$). Second, females similarly scored higher than non-females ($p=.01$). Third, climbers who climbed more days in Lander each year had a slightly lower LNTRCM score than those who climbed less. Finally, the table also included a marginally significant finding: persons who boulder in Lander had a slightly higher LNTRCM score.

Table Four: Demographics					
*indicates significant predictor of LNTRCM ($p=.05$)					
**indicates significant predictor of LNTRCM ($p=.01$)					
^ indicates marginally significant predictor of LNTRCM ($p=.06$)					
Variable	Obs	Mean	St Dev	Min	Max
Climbs trad in Lander	232	0.41	0.49	0	1
Climbs sport in Lander*	232	0.94	0.25	0	1
Boulders in Lander^	232	0.24	0.43	0	1
Days per year typically spent climbing (any kind) in Lander*	232	26.88	42.07	0	340
Typically brings dog with them while climbing	219	0.23	0.42	0	1
Respondent is female**	217	0.35	0.48	0	1
Age, in years	220	36.14	11.93	18	75
Respondent is over 55	220	.09	.29	0	1
Respondent has Bachelor’s degree	221	0.50	0.50	0	1
Respondent has Graduate degree	221	0.33	0.47	0	1
Respondent annual personal income >\$50K	214	0.59	0.49	0	1
Respondent annual personal income >\$99K	214	0.21	0.41	0	1

Discussion

Table One provides a direction of focus towards areas for addressing impacts in the future. Problem areas are indicated where appropriate items score less than 4.00 or inappropriate items score greater than 2.00. For example, minimizing the amount of chalk used (mean 3.88) indicates that climbers are unsure what the correct behavior would be (which, in this case, would be to minimize the amount of chalk used). Similarly, brushing off excess chalk (mean=4.01) is very nearly in this same category. Cleaning vegetation off the wall while climbing (mean=2.50) indicates that climbers are not clear what the correct choice would be. The correct behavior would be to avoid removing vegetation. Admittedly, this is a tough one for the climbing community, as this is a fairly common practice. Recall these represent an area where climbers are also often cited by environmental researchers. Climbers also struggle with what to do with toilet paper (mean=0.258). This finding was also found in Maples and associates (2022).

This result is also a historical product: in the past, burying toilet paper was generally considered appropriate, except in arid areas as the toilet paper would degrade with time. However, now the more acceptable practice is to pack out the toilet paper in all circumstances. Alternatively, using stones, vegetation, or snow as toilet paper removes the necessity of packing out the toilet paper. Remember also in areas where decomposition is slow (such as high deserts or alpine areas) and/or burying feces is not possible (such as river canyons), packing out feces is also the correct decision.

Table Two also shares a few important ideas. First, it shows the importance of climbing-oriented LNT sources while focusing on the importance of interactions at the crag. Note that the most important climbing sources were watching other climbers and getting information from other climbers specifically while climbing. This reiterates the need for the climbing community to self-monitor LNT issues at the crag. This also shows the importance of the people around us being a source of LNT knowledge. Note that friends, parents, and NPS/USFS employees all represented important sources of information. As such, training climbers on current LNT knowledge will likely cascade into others' (even non-climbers) knowledge of minimizing impacts. In short, the people close to climbers are the people who have the most ability to shape a climber's LNT knowledge.

Second, the significant finding in this table reveals that, in at least this case, having clear LNT information available and focused through a climbing perspective can

help promote environmental consciousness. In this case, only a small percentage (about one in ten) respondents indicating using this particular source, so this may be something to consider for organizations.

Table Three is possibly most important for one of its non-statistical findings: that there is no correlation between a respondent's self-ranked LNT knowledge and the actual LNTRCM. This is important because it reflects a need for *all* respondents regardless of their perceived knowledge to update their LNT training. This table also provides some additional evidence that the Climber's Pact, a national program to encourage climbers to commit to minimal impact practices, may be working. Note a similar finding was reported in Maples and associates (2022).

Table Four continues in replicating findings from previous studies. First, females have been found to outscore non-females on the LNTRCM on specific items and here on the entire scale. Reasons for this may root back to recent inclusivity efforts in climbing to make the sport accessible to everyone. As part of many introductory climbing courses, LNT principles are part of that training. Hence, there could be an argument that females may represent a group within climbing who have more updated LNT information. Another repeated finding is that climbers who use areas more often report slightly lower scores on the LNTRCM. This finding in West Virginia was limited to just a few items, but here it applies to the entire scale. More work is needed to understand this finding, but ostensibly it may link back to a sense of place attachment that grows as one climbs more often which somehow shapes this relationship.

One interesting finding in Table Four is that sport climbers and boulder climbers reported a higher score overall on the LNTRCM. Again, this may be a story of time: sport climbers and boulder climbers more likely include newer climbers, and those newer climbers are more apt to be taking courses on climbing that would include LNT information. This should be investigated in future research.

Limitations

There are limitations to this study. First, the results cannot be adequately applied to all climbers. The results should be applied only to Lander climbers until a more expansive and inclusive sample can be conducted across the nation or numerous LNT studies using the LNTRCM continue to report similar findings. Another limitation to this study is understanding if knowledge truly transitions into behavior. This is one important flaw raised in nearly all climbing LNT studies, as it is very difficult to follow up with each individual and verify that they act as they

have indicated they should. Future studies should consider addressing this difficult issue.