Economic Impact of Select Rock Climbing Destinations in Tennessee

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Executive Summary

This study explores the economic expenditures of climbers in four Tennessee climbing destinations: Chattanooga, Obed Wild and Scenic River, Kings Bluff, and Big South Fork National River and Recreation Area. Using an online survey (n=652 with 76% completing the survey), the researchers established the following major findings:

1. An estimated 113,000 outdoor climbing-related visits occur each year in Tennessee across the four study areas covered in this report.
2. Climbers annually spend $14.31 million across the four study areas, which supports $4.15 million in wages and 126 jobs in Tennessee.
3. The majority of climbers (between 62% and 69%, depending on study area) choose to stay overnight while visiting climbing areas in Tennessee.
4. Over 80% of climbers in the sample held at least a Bachelor's degree and 30% report incomes over $100,000 per year.
5. Respondents indicated understanding key ways to limit their environmental impacts while climbing, such as packing out trash, avoiding trampling endangered plants, and using only designated trails.

Cover image: Woodcock Cove. Image courtesy of Caleb Timmerman.

Study Summary

This study examines the economic impact of rock climbing in four Tennessee climbing areas: Chattanooga, Obed Wild and Scenic River, Kings Bluff, and Big South Fork National River and Recreation Area. The study results include economic impacts, visitation estimates, use patterns, and measures of Leave No Trace knowledge among climbers.

Study Area

This study examined four climbing destinations in Tennessee: Chattanooga, Obed Wild and Scenic River, Kings Bluff, and Big South Fork National River and Recreation Area. Study areas are designed to encompass both the area where recreation occurs and the likely places where recreation users would generate expenditures for lodging, food, and other expenses. Study areas are defined as follows using counties as the core building block:

- Chattanooga: Hamilton (TN), Marion (TN), Sequatchie (TN), Rhea (TN); Catoosa (GA, Dade (GA), Walker (GA)
- Obed Wild and Scenic River: Morgan (TN)
- Kings Bluff: Montgomery (TN)
- Big South Fork National River and Recreation Area: Fentress, Scott (TN), McCreary (KY)

Survey and Data Collection

The researchers collected data for this study via an online survey. The survey (which is available upon request) was constructed from previous published studies on rock climbing (Maples and Bradley, 2021;[1] Maples et al., 2019;[2] Bailey and Hungenberg, 2018[3]) and includes questions on use and visitation patterns, expenditure patterns, Leave No Trace knowledge, and demographics. Questions are summarized through each section in the report.

The survey was administered via Qualtrics October 20, 2022 through June 1, 2023. Access Fund and Southeastern Climbers Coalition distributed the survey through their known email lists and social media accounts. In all, 652 respondents consented to and initiated the survey. Responses are included up to the point that the respondent discontinued the survey, with 439 respondents completing the survey.

Data Cleaning

After extracting the data from Qualtrics, the researchers cleaned the dataset for analysis. This largely included recoding categorical variables into dichotomous measures (where 1=presence of category and 0=absence of category) for easy interpretation as percentages. Questions answered with "prefer not to respond" or "unsure" were recoded as missing data.

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[1] Maples, James N. and Michael J. Bradley. 2021. "Outdoor Recreation and Rural Transitions in Central Appalachia: Revisiting the Economic Impact of Rock Climbing in Kentucky's Red River Gorge." *Journal of Economic Impact* 3(3): 186-195.

[2] Maples, James N., Michael J. Bradley, Sadie Giles, Rhiannon Leebrick, and Brian Clark. 2019. "Climbing Out of Poverty: The Economic Impact of Climbing in West Virginia's New River Gorge." *Journal of Appalachian Studies* 25(2): 184-201.

[3] Bailey, Andrew W. and Eric Hungenberg. 2018. "Managing the Rock-Climbing Economy: A Case from Chattanooga." *Annals of Leisure Research* 23(2):165-183.

For economic impact questions, additional methodological revisions were required to prevent unusual responses or expenditures from overestimating results. First, respondents were divided into two categories: *residents* (persons who indicated living in a study area where they recently climbed) and *visitors* (persons who indicated living outside of the study area where they recently climbed). This delineation is important, as only visitors represent new economic expenditures in a study area. Methodologically, resident expenditures should be considered redirected expenditures (expenditures that could be spent on anything , such as other services or retail purchases), and as these expenditures already exist in the study area would not qualify as economic impact (White, 2017).[4] Accordingly, a possible limitation of this study is, for example, that expenditures by a climber from Atlanta who visits Chattanooga on the weekend will count as economic impact, but expenditures by a climber from Atlanta who moves to Chattanooga for climbing would not count. Visitors and residents were also asked different sets of economic expenditure questions which are summarized later in the study.

Next, in accordance with United States Forest Service economic impact methodology, responses were coded as missing data when the group size was equal to eight or more persons (n=1) and visitors who indicated an unusually long stay (more than 30 days in this study, n=7) (White, 2017).[5] All retail expenditures are capped at $500 to prevent overestimation, and both retail purchases and gear purchases are margined for accurate estimation in the analysis.

The expenditure measures are also adjusted to discourage overestimation. This includes the previous steps of capping retail at $500 and removing any expenditures more than three standard deviations above (and therefore outside the assumption of a normal distribution) the initial mean statistic. For example, if the initial mean of gas purchases was $10 and the standard deviation was 5, any gas expenditure over $25 (or (3*5)+$10) would be recoded as missing data. Additionally, zero values (where no expenditure occurs) are included in the results and are not subject to any of the above adjustments. In cases 0)where visitor respondents provided expenditure measures but no group size, the group size would be adjusted to one person.

Two study areas (Kings Bluff and Big South Fork) experienced lower response rates. Here, the researchers elected to replace the mean expenditures for these two locations using comparable areas within the study. As Kings Bluff is near the Nashville metro area, the researchers utilized mean expenditures from Chattanooga for the Kings Bluff analysis. Next, as the Obed and Big South Fork are comparable rural areas, the mean expenditures from the Obed will be used to represent Big South Fork. While imperfect, this allows an analysis to occur, though

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[4] White, Eric .M. 2017. *Spending Patterns of Outdoor Recreation Visitors to National Forests* (Gen. Tech. Rep. PNW-GTR-961). Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Available at https://www.fs.usda.gov/treesearch/pubs/55244

[5] Ibid

the findings should be treated with caution for these two study areas.

Respondent Use Patterns

Tennessee offers diverse climbing opportunities. Table One examines respondents' climbing interests. Respondents could check all that apply, so the percentages will not total 100%. Nearly 70% of respondents indicated their climbing interests focused on sport climbing and/or bouldering. Sport climbing utilizes permanent anchors installed in the rock face to create safe fall and lowering points. Bouldering, in comparison, uses no rope and focuses on shorter routes on large rocks (e.g., boulders) separated from the rock face. As the routes are shorter, climbers can safely fall onto movable crash pads. The next most popular option (at 36%) is trad (or traditional) climbing. In contrast to the permanent anchors used in sport climbing, trad climbing utilizes removable protection which can be installed in cracks and features in the rock face. Around one percent of respondents indicated engaging in other forms of climbing. These include competition climbing (which is often sport or bouldering-oriented), deep water soloing (climbing routes above a body of water and without rope), rappelling, and winter/ice climbing.

Note that climbing interests often influence why a climber visits one location over another. For example, when exploring climbing interests only at the Obed, sport climbing (at 93%) is the most popular climbing interest. Chattanooga's respondents lean slightly in favor of bouldering over sport climbing. Use patterns were relatively balanced among trad, sport, and climbing at Big South Fork, and overwhelmingly in favor of sport climbing at Kings Bluff, but these findings should be treated with caution due to low responses.

Table One: Respondent Climbing Interests, All Locations
(Check all that apply; % will not add to 100%)

Variable	n	Percent	SD	Min	Max
Trad	652	36.50%	0.48	0	1
Sport	652	69.48%	0.46	0	1
Bouldering	652	69.48%	0.46	0	1
Gym	652	27.76%	0.45	0	1
Top rope	652	16.56%	0.37	0	1
Other	652	1.07%	0.10	0	1

Table Two examines respondent use patterns inside Tennessee and also in the report's study areas. Respondents indicated spending an average of 35 days per year climbing outdoors at any location in Tennessee. Respondents who indicated living inside any of the report's study areas climbed 62 days per year outdoors in the report's study areas. Respondents indicated spending an average of 35 days per year climbing outdoors at any location in Tennessee. Respondents who indicated living inside any of the report's study areas climbed 62 days per year outdoors in Tennessee, while those living outside the study areas climbed 23 days per year outdoors in Tennessee. Respondents indicated climbing around 45 days per year inside any climbing gym located in Tennessee. Again, respondents living in study areas climbed more often inside gyms in the state than those living outside the study areas (84 compared to 29). On average, respondents began climbing (in any form) around 2010 with values ranging from 1968 to 2023. Although not examined in the table, the median was 2013 and the mode was 2019 (which included nearly 10% of the cases). Figure One adds further context to this finding, noting that over half of respondents indicated starting climbing indoors in a gym setting. The average age at the time when respondents began climbing was 33 with a range of 18 to 73. Note this statistic is impacted by the survey being limited to those 18 and older.

Figure One: Where did you first begin climbing?

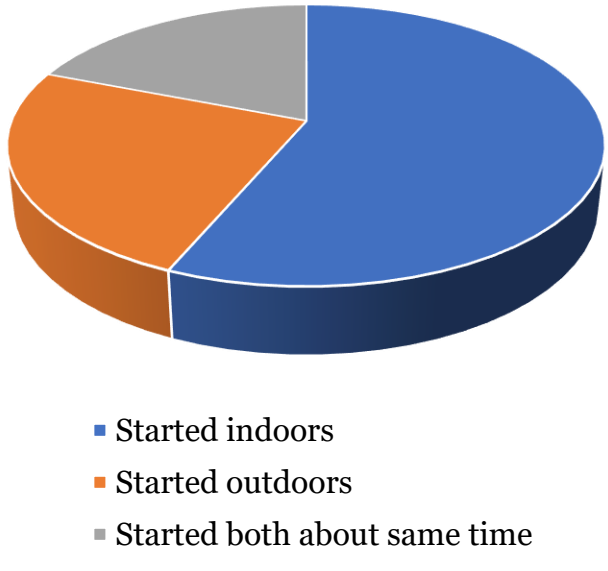


Table Two includes several questions which begin investigating the details of respondents' most recent visit. In all, 94% of respondents indicated their most current trip to any of the report's study areas was to climb, with ten percent indicating this was their first climbing trip in Tennessee. Roughly one in three respondents lived inside one of the study areas. Sixty-three percent of respondents indicated they stayed overnight, with 70% of visitors (persons living outside the study areas) staying overnight. On average, respondents reported spending 24 nights during their trip, but this statistic is misleading, as several residents reported their length of stay as 365 days because they live in the study area. A more accurate measure would be to examine visitors only, who spent, on average, five nights in Tennessee per trip. This number is further skewed by five cases where the respondent stayed for over one month. Excluding these, the average length of stay is closer to four days. The average group size was 1.60, with visitor group sizes averaging 1.72. Note these group size means are created prior to any adjustments to group sizes (eliminating groups of eight or larger) required by economic impact

methodology.[6]

Select statistics in Table Two can also be attached to specific study areas for further analysis. For example, higher percentages of visiting climbers stayed overnight when climbing in Chattanooga (70%) versus the Obed (62%). Visiting climbers were also more apt to stay longer in Chattanooga (six nights average) versus the Obed (about 3 nights).

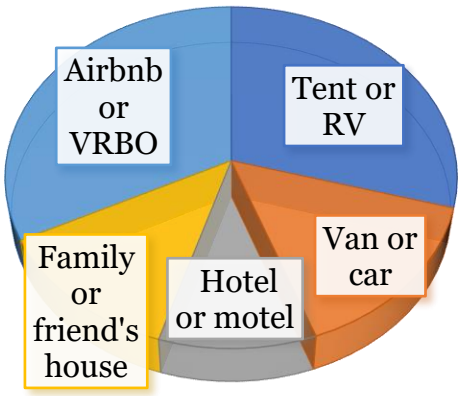
Table Two: Use Patterns

Variable	n	Mean	SD	Min	Max
Days spent climbing outside in TN	587	35.13	39.98	0	302
Days spent climbing in a gym in TN	587	45.82	65.10	0	350
Year started climbing	575	2010	9.07	1968	2023
Age, in years	396	33.43	9.57	18	73
Trip purpose is to climb	544	0.94	0.23	0	1
First time climbing in TN	543	0.10	0.30	0	1
Live inside a study area	544	0.32	0.46	0	1
Stayed overnight, residents only	175	0.52	0.50	0	1
Stayed overnight, visitors only	369	0.69	0.42	0	1
Stayed overnight, all cases	545	0.63	0.48	0	1
Nights spent in area, residents only	82	83.01	149.72	0	365
Nights spent in area, visitors only	249	5.54	9.72	0	100
Nights spent in area, all cases	331	24.73	81.82	0	365
Group size, residents only	155	1.34	0.65	1	5
Group size, visitors only	343	1.72	1.04	1	9
Group size, all cases	499	1.60	0.95	1	9

[6] Note that group sizes here refer to expenditure groups, not necessarily social groups, as have been examined in previous studies on Chattanooga (see Bailey and Hungenberg, 2018). Social groups can include anyone coming along on the trip whereas expenditure groups focus centrally on spending patterns.

Figure Two explores overnight lodging use patterns for respondents in all areas. Roughly one third of respondents indicated using a rental cabin or house during their stay, while 29% utilized a tent or RV setup. Only 10% of respondents noted staying in hotels as a result of their trip, more often staying with family or friends in the area (13%) or in a van or car (15%). These results are consistent when examining Chattanooga individually, but for the Obed, respondents were more likely to stay in tents or RVs, likely due to fewer lodging options. Table Three explores user demographics. Several of these measures indicate a diverse climbing community in Tennessee. For example, 34% of respondents indicated they were female. When examining gender, 33% identified as a cis-gender woman while one percent indicated they identified as non-binary. Six percent of respondents identified as Asian while 5% identified as Latino/Hispanic. In all, 15% of respondents indicated having at least one racial identity other than White.

Figure Two: Lodging Use Patterns



Respondents indicated they are typically college-educated. Forty-four percent of respondents held a Bachelor's degree with another 8% enrolled to complete a Bachelor's degree. Another 30% held a graduate degree while another 5 percent are currently in graduate school. Incomes are most concentrated in six figure incomes. Although not summarized in the tables, a survey question also asked about the respondent's profession. Common responses included scientist (multiple fields), engineer, teacher/professor/coach, accountant, software work, medicine (nurse, physician, physician assistant, physical therapy), data science, information technology, and human resources. Table Two also notes that roughly one in five respondents had a career related to outdoor recreation (such as climbing guide, climbing gym careers, coaching sports, and sports therapy). Sixteen percent of respondents own a business, with 22% of those respondents owning a business in outdoor recreation. The findings in this table matches the findings from previous studies which have similarly shown climbers to be well-educated professionals with concomitantly higher incomes.

Table Three: User Demographics

Variable	n	%
Sex (n=437)		
Female	149	34.10%
Male	288	65.90%
Gender (n=439)		
Cis-gender Man	145	65.60%
Cis-gender Woman	288	33.03%
Non-binary	6	1.37%
Race/ethnicity (n=458)		
(check all that apply)		
American Indian/Alaskan Native	4	0.87%
Asian	29	6.33%
Black or African American	2	0.44%
Latino/Hispanic	25	5.46%
Middle Eastern/North African	4	0.87%
Native Hawaiian/Pacific Islander	1	0.22%
White	388	84.72%
Another race/ethnicity not listed	5	1.09%
Education (n=436)		
HS/GED	11	2.52%
Some college	27	6.19%
Associate	14	3.21%
BA/BS	192	44.04%
MA/MS	81	18.58%
Doctorate	51	11.7%
Enrolled, BA/BS	35	8.03%
Enrolled, MA/MS	10	2.29%
Enrolled, Doctorate	15	3.44%
Income (n=425)		
$0-$19,999	55	12.94%
$20,000-$29,000	24	5.65%
$30,000-$49,000	62	14.59%
$50,000-$74,999	86	20.24%
$75,000-$99,999	67	15.76%
Greater than $99,999	131	30.82%
Summary of Other Measures		
Has career in outdoor recreation	82	19.34%
Owns a business	69	16.01%

Economic Impact Terminology
In the coming pages, the research team utilizes Regional Input–Output Modeling System (RIMS II) to create economic impact estimates for what visiting climbers contributed to the study areas region during a typical year. RIMS II, created by the Bureau of Economic Analysis in the 1980s, utilizes multipliers to explore how expenditures create changes in study areas. RIMS modifiers are change ratios examining how initial changes in spending in a particular industry/sector relate to total changes in jobs, income, value added, and output.

RIMS modifiers come in two forms (Type 1 and Type 2) to address different economic impact scenarios. The former includes all changes while the latter excludes expenditures by workers living in the study area. For this study's purpose the authors chose Type II modifiers as the survey instrument intentionally excluded persons living (and presumably working) within 100 miles of the study area from expenditures.

The researchers utilized RIMS final modifiers for each study area to estimate the economic impact of jobs and labor income by multiplying total expenditures in each spending area by its provided modifier. However, retail sales (which cover general retail and gear purchases) must be treated differently for accurate results by margining the results to prevent overestimation of impacts. A margin addresses the wholesale markup in the cost of goods sold to retailers. As a result, both retail spending categories were margined at 20% to prevent overestimation.

Recall the analysis follows approaches used in prior peer-reviewed research and Forest Service studies. Cases with disproportionately long stays or large group sizes (greater than eight) have been excluded and instances of unusually high expenditures have been listed as missing data as previously outlined in the methodology.

Later tables in this report use common economic impact terms: wages, jobs, value added, and output. **Wages** represent funds paid to persons working (and often living) in the study area. These include part-time, full-time, and proprietor income. **Jobs** includes both full and part-time jobs and can be considered a sum of percentages of jobs addressing the expenditures studied in this report. **Value added** is treated as the total value of income generated from production and includes labor wages as well as taxes on production and imports as well as gross operating surplus. **Output** is the sum of value added and intermediate inputs (which are goods and services used by an industry to produce output). Of the four, wages represent the most conservative approach to understanding economic impact and is the central approach used throughout this report.

Visitation Patterns

Table Four summarizes climber visitation patterns in this study. In sum, an estimated 113,000 outdoor climbing-related visits occur each year in Tennessee across the four study areas covered in this report. The bulk of these visits are from persons living outside the four study areas. Note the table results are uses (or visits) per year and one person can account for more than one visit per year. The researchers estimate 94,000 total visits to the Chattanooga study area with 66,740 attributed to persons visiting the area. Similarly, 12,000 annual visits occur at the Obed with 8,520 being visitors, 5,000 visits occur at Kings Bluff with 3,550 being from persons living outside the study area, and 2,000 visits occur annually at Big South Fork with 1,420 being visitors to the study area. Ideally, visitation estimates are determined using parking monitors and trail counters, but as a satisfactory alternative the researchers used a mixed method approach to create the estimates in Table Four and these methods are described below. Throughout, each estimate was cross-checked with local climbers who know these areas and could evaluate their veracity.

An estimated 94,000 climbing related visits occur each year near Chattanooga. For Chattanooga, researchers created a spreadsheet of 19 climbing areas and used multiple methods to determine visitation for each site. For Stone Fort, researchers had extremely solid data based on sales of day use passes. Annual visitation data from Stone Fort also provided a baseline for local climbing popularity growth patterns. Total visitation was 12,037 in 2015-2016 and 17,085 in 2022-2023, a 42% increase. For Foster Falls, Tennessee State Parks shared data from its permitting system and estimates about how many climbers utilize permits. Researchers also used previous visitation estimates for Foster Falls and applied popularity growth patterns to determine a conservative estimate of 15,000 visits. Both strategies produced similar numbers, thus increasing confidence. For Rocktown, Georgia Department of Natural Resources provided a visitation estimate of 10,000. This number was in-line with estimates derived from previous research and applied growth patterns. Boulders at Old Wauhatchie Pike had high visitation relative to the quantity and quality of routes (conservatively 10,000 visits) due to its extreme accessibility as an urban boulder field located in the St. Elmo neighborhood just minutes from downtown Chattanooga. The total would be significantly higher (19,500 visits) had researchers counted numerous school groups that utilize this urban resource. To further increase reliability, the authors shared an annotated spreadsheet with local expert climbers and stakeholders and adjusted estimates based on expert feedback and intimate knowledge of climbing areas.

An estimated 12,000 climbing relat”d vi’Its occur each year at the Obed. For the Obed, the authors primarily utilized a parking lot estimate approach. An excel file with the available Obed parking lots was created and included the percentage of cars filling each lot for every day throughout the year. The researchers then worked with local climbers from the Obed to estimate what percent of the lot would be filled throughout the day based on their knowledge of the lots and the climbing season. As climbers frequently plan trips around intimate knowledge of which areas will be full, their perspectives provide a unique opportunity to apply this

knowledge to parking lot visitation. Researchers also utilized existing parking lot counts published by the National Park Service as a baseline for estimates. The resulting file was then reviewed by other climbers in the community for accuracy and adjusted for consensus.

An estimated 5,000 climbing related visits occur each year at Kings Bluff and 2,000 at Big South Fork. For Kings Bluff and Big South Fork, the researchers worked with local climbers to estimate visitation due to the limited use of these areas and with Access Fund to confirm these results. This was done in reference to visitation estimates to other climbing areas for comparison purposes.

Table Four: Visitation Estimates in Uses Per Year

Location	Total estimated uses per year	Uses by persons living in nearby study area	Uses by persons visiting the study area
Chattanooga	94,000	27,260	66,740
Obed	12,000	3,480	8,520
Kings Bluff	5,000	1,450	3,550
Big South Fork	2,000	580	1,420

Mean Visitor Expenditure Patterns: Chattanooga Study Area

Table Five explores mean expenditures created when visitors come to the Chattanooga study area to climb. The table is divided into two sections: spending inside the Chattanooga study area and spending outside of the study area, but still in Tennessee. Each section includes common spending categories (lodging, food services, travel, retail, and services) and sub-categories within each (for example, lodging includes hotels, camping/RV, and Cabin/rental houses). Note that the lodging category represents only cases engaging that type of lodging, while all other categories represent all cases. Sub-categories include mean expenditures which are modeled to represent a typical climbing visit to Chattanooga. Mean expenditures have been adjusted for group size and outliers as outlined in the methods section.

Table Five includes three forms of lodging: camping in tents/RVs/cars/vans, staying in hotel/motels/resorts, and staying in rental cabins/rental houses. Sixty three percent of respondents indicated staying at least one night during their visit to the study area. All lodging expenditures in Chattanooga were spent inside the study area, which likely implies that lodging opportunities are plentiful and there is little need to explore options beyond the study area. Analysis of survey results indicated that 27% of respondents stayed in rental cabins/houses at a mean trip expenditure of $247. Nine percent of respondents stayed in hotels and motels at a mean trip expenditure of $222. Camping in its various forms represented 34% of respondent lodging expenditures at a mean of $15. This notably includes potentially free camping opportunities such as boondocking in parking lots. Finally, 28% of respondents stayed with friends, family, or at a vacation home and are treated as having no expenditures for lodging.

Turning to other visitation expenditures, climber spending is most focused on procuring food and gasoline. For example, climbers spent $34 on gasoline during their visit and $33 at dine-in restaurants (which include waitstaff). Previous studies indicate climbers do not prefer fast food and snacks at gas stations, and this finding holds true in Chattanooga ($7 for fast food and $5 on snacks). Retail expenditures are also relatively low, with gear purchases averaging nearly $3 per trip and general retail averaging $4 per trip. Although services such as guides and transportation are utilized by visiting climbers in some places, the expenditures for these categories were low in this study area. In all, non-lodging expenditures averaged $111 per trip.

The second half of Table Five summarizes visitor expenditures beyond the study area, but still in Tennessee, when travelling to climb in Chattanooga. Results indicate that expenditures were nearly entirely spent inside the study area, with gas (at $2) being the only sizable expenditure. This likely indicates that the services desired by visitors are routinely available inside the study area.

Table Five: Mean Per Person Expenditure Patterns, Inside and Outside Chattanooga Study Area, Visitors Only

Variable	n	Mean	SD	Min	Max
Expenditures Inside Study Area					
Lodging					
Hotel/Motel	16	$222.60	219.08	100	1000
Camping/RV	64	$15.86	19.25	0	90
Cabin/Rental house	55	$247.51	239.17	0	1000
Food services					
Fast food restaurant	245	$7.57	11.20	0	50
Dine-in restaurants	242	$33.83	37.63	0	175
Grocery	241	$23.34	31.20	0	150
Gas station food	247	$5.60	7.76	0	30
Travel					
Gas	244	$34.26	33.27	0	160
Retail					
General retail	243	$4.05	14.21	0	100
Gear purchases	243	$2.80	9.79	0	60
Services					
Rental Gear	248	$0.03	0.35	0	5
Guide	247	$0.15	1.83	0	27
Taxi/Uber/transportation	247	$0.04	0.70	0	11
Outside of study area					
Lodging					
Hotel/Motel	17	$0.00	0.00	0	0
Camping/RV	65	$0.00	0.00	0	0
Cabin/Rental house	56	$0.00	0.00	0	0
Food services					
Fast food restaurant	239	$0.23	1.55	0	15
Dine-in restaurants	243	$0.04	0.64	0	10
Grocery	245	$0.37	2.54	0	25
Gas station food	244	$0.17	1.14	0	10
Travel					
Gas	238	$2.23	7.65	0	40
Retail					
Gear Purchases	249	$0.00	0.00	0	0
General Retail	247	$0.00	0.00	0	0
Services					
Rental Gear	249	$0.00	0.00	0	0
Guide	249	$0.00	0.00	0	0
Taxi/Uber/transportation	247	$0.00	0.00	0	0

Mean Visitor Expenditure Patterns: Obed Study Area

Table Six summarizes per person expenditure patterns for the Obed study area. The Obed is located in a more rural area compared to the Chattanooga metro in the previous study area, and services are more limited as a result. This is generally reflected in the spending patterns. Looking at lodging, respondents indicated spending $150 on cabin and house rentals, $10 on camping/RVs, and $37 on hotels/motels. Note that all three have low response rates and results should be treated with caution, particularly the lodging figures. When examining the lodging selection, 57% selected tent and other camping options, 30% selected hotel/motels, 17% used rental cabins and houses, and 15% stayed with friends and family or in their second/vacation homes.

Turning to other expenditures while visiting the Obed, respondents indicated spending $48 per trip on things like food, retail, travel, and services. The largest expenditure was on gas ($18) and dine-in restaurants with waitstaff ($16). As previously mentioned, fast-food and snack purchases are generally less popular among climbing communities and averaged $4 and $2 respectively. However, the grocery expenditure mean (at just under $3) is lower than expected and likely indicates climbers either prefer bringing groceries with them from home or not finding desirable grocery offerings in the area. Looking at expenditure patterns beyond the study area provides further evidence of the latter.

Expenditures outside the study area for the Obed totaled $36 before lodging, nearly as much as within the study area. This reiterates that climbers are looking beyond the study area for their needs. This includes spending $8 on gas and $6 on dine-in food. Additionally, groceries averaged nearly $6 which indicates climbers are stopping at a regional grocery on the way into climb. This pattern has been demonstrated in past studies, such as the Red River Gorge where climbers coming from Ohio stopped in Lexington for groceries while climbers coming from the south stopped in Lexington or Richmond, outside the study area (Maples, 2021)[7].

Expenditure Patterns for Kings Bluff and Big South Fork

Due to low response rates (likely due to the limited climbing visitation occurring in these two areas), it was not possible to craft mean expenditure patterns for Kings Bluff and Big South Fork. Instead, the researchers utilized the Benefit-Transfer Method to apply similar expenditure patterns from another location. Conveniently, the best replacement values come from the other study areas within this report. As Kings Bluff's expenditures would likely include the Clarksville metro (the fifth largest metro in Tennessee after Chattanooga), using Chattanooga's expenditure patterns is a useful alternative. Similarly, the Obed's expenditure patterns are a good fit for the Big South Fork: both areas are rural and comparable in the services offered. One potential issue in this approach is understating grocery purchasing purchases in the Big South Fork due to a bigger study area and having somewhat more grocery store purchase options. This is a limitation of the study and should be reexamined in the future.

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[7] Maples, James N. 2021. *Rock Climbing in Kentucky's Red River Gorge: An Oral History of Community, Resources, and Tourism*. West Virginia University Press.

Table Six: Mean Per Person Expenditure Patterns, Inside and Outside Obed Study Area, Visitors Only

Variable	n	Mean	SD	Min	Max
Expenditures Inside Study Area					
Lodging					
Hotel/Motel	2	$37.50	53.03	0	75
Camping/RV	17	$10.12	8.66	0	30
Cabin/Rental house	6	$150.33	160.22	0	350
Food services					
Fast food restaurant	44	$4.03	7.09	0	20
Dine-in restaurants	43	$16.58	16.86	0	60
Grocery	42	$2.97	8.26	0	40
Gas station food	43	$2.22	4.20	0	15
Travel					
Gas	44	$18.65	20.42	0	75
Retail					
Gear Purchases	44	$0.00	0.00	0	0
General Retail	43	$0.00	0.00	0	0
Services		$0.00	0.00	0	0
Rental Gear	44	$0.00	0.00	0	0
Guide	44	$0.00	0.00	0	0
Taxi/Uber/transportation	44	$0.00	0.00	0	0
Outside of study area					
Lodging					
Hotel/Motel	2	$55.00	77.78	0	110
Camping/RV	17	$0.00	0.00	0	0
Cabin/Rental house	5	$20.00	44.72	0	100
Food services					
Fast food restaurant	43	$2.79	6.50	0	25
Dine-in restaurants	43	$6.04	19.80	0	100
Grocery	43	$5.81	11.74	0	50
Gas station food	43	$1.37	3.06	0	10
Travel					
Gas	43	$8.83	15.45	0	60
Retail					
Gear Purchases	43	$0.00	0.00	0	0
General Retail	44	$0.00	0.00	0	0
Services					
Rental Gear	44	$0.00	0.00	0	0
Guide	44	$0.00	0.00	0	0
Taxi/Uber/transportation	44	$0.00	0.00	0	0

Economic Impact of Climbing in Chattanooga Study Area
Tables Seven and Eight summarize the economic impact of rock climber visitation to the Chattanooga study area. Table Seven summarizes the mean expenditures from Table Four alongside detailed visitor use counts from Table Six. The table also includes study area multipliers provided by RIMS. The multipliers are broken down across four categories (output, value added, wages, and job counts), defined earlier in the report. Table Eight then uses the figures in Table Seven to estimate output, value added, wages, and job counts for each spending category. Recall that our study will focus on wages as the most conservative estimate of economic impact of the values provided. Based on the results of these two tables, the researchers estimate climbers visiting the Chattanooga study area annually spend $12.6 million dollars. These expenditures support $3.6 million in local/proprietor wages and 113 full and part time jobs in the study area.

Economic Impact of Climbing in Obed Study Area
Tables Nine and Ten summarize the economic impact of rock climber visitation to the Obed study area. As with Chattanooga, Table Nine summarizes mean expenditures alongside visitor counts and multipliers from RIMS while Table Ten examines the impact results. The findings of Table Nine indicate climbers spent an estimated $767,462 each year. The findings from Table Ten indicate these expenditures support $208,238 in wages each year.

Economic Impact of Climbing in Kings Bluff Study Area
Tables Eleven and Twelve summarize the economic impact of rock climber visitation to the Kings Bluff study area. Recall that due to low survey responses in this area mean expenditures from the Chattanooga study area are used alongside Kings Bluff visitation and multipliers in Table Eleven. The results of Table Eleven indicate that climbers annually spend $795,269 in this study area. These expenditures (modeled in Table Twelve) represent $204,334 in worker wages each year.

Economic Impact of Climbing in Big South Fork Study Area
Tables Thirteen and Fourteen summarize the final study area in this report, Big South Fork. Again, due to low survey responses, mean expenditures from the Obed were used to represent this study area. Summarizing Table Thirteen, climbers spend an estimated $127,910 each year in this study area. Based on estimations in Table Fourteen, these expenditures support $33,501 in local wages each year.

Total Estimates for Climbing Economic Impact in Tennessee
When summarizing the expenditures for the four study areas in this report, climbers annually spend $14.31 million dollars in Tennessee, supporting $4.15 million in wages and the presence of 126 jobs.

Table Seven: Study Area Multipliers, Visitor Uses, and Total Spending by Sector, Chattanooga Only

Sector	Output	Job wages	Jobs per million spent	Value added	Total visitor uses	Per visit mean	Total spending
Camping Use*	1.009	0.2569	7.4762	0.6038	17959.70	$15.86	$284,841.38
Hotel Use*	1.009	0.2569	7.4762	0.6038	5065.57	$222.60	$1,127,594.99
Cabin Use*	1.009	0.2569	7.4762	0.6038	15196.70	$247.51	$3,761,334.72
Dine-in Restaurant	1.0265	0.2946	10.7188	0.5376	66,740.00	$33.83	$2,257,814.20
Fast food	1.0265	0.2946	10.7188	0.5376	66,740.00	$7.57	$505,221.80
Groceries	1.0524	0.3581	11.4129	0.6688	66,740.00	$23.34	$1,557,711.60
Snacks	1.05	0.3482	10.5883	0.6645	66,740.00	$5.60	$373,744.00
Gasoline	1.05	0.3482	10.5883	0.6645	66,740.00	$34.26	$2,286,512.40
General Retail^	1.0451	0.3122	10.8312	0.6622	66,740.00	$4.05	$270,297.00
Gear Purchases^	1.05	0.3482	10.5883	0.6645	66,740.00	$2.80	$186,872.00
Gear Rental	1.05	0.3482	10.5883	0.6645	66,740.00	$0.03	$2,002.20
Guide Services	1.038	0.3482	10.5883	0.6645	66,740.00	$0.15	$10,011.00
Taxi Services	1.0381	0.3231	23.2339	0.3867	66,740.00	$0.04	$2,669.60
Total	-	-	-	-	-	-	**$12,626,626.89**

*Adjusted; 69% of total visitor uses stayed overnight, with 39% camping, 11% staying in hotels, and 33% staying in rental cabins/rental houses. The remaining overnight visits stayed for free with friends/family, in secondary homes, or in other free accommodations.
^This figure is later margined to 20% of its initial value for modelling.

Table Eight: Economic Impact of Visitors in Study Area, Chattanooga Only

Sector	Output	Value Added	Wages	Jobs^
Camping Use	$287,404.95	$171,987.23	$73,175.75	2.13
Hotel Use	$1,137,743.35	$680,841.86	$289,679.15	8.43
Cabin Use	$3,795,186.73	$2,271,093.91	$966,286.89	28.12
Dine-in Restaurants	$2,317,646.28	$1,213,800.91	$665,152.06	24.20
Fast food	$518,610.18	$271,607.24	$148,838.34	5.42
Groceries	$1,639,335.69	$1,041,797.52	$557,816.52	17.78
Snacks	$392,431.20	$248,352.89	$130,137.66	3.96
Gasoline	$2,400,838.02	$1,519,387.49	$796,163.62	24.21
General Retail*	$56,497.48	$16,877.34	$35,798.13	0.59
Gear Purchases*	$39,243.12	$13,013.77	$24,835.29	0.40
Gear Rental	$2,102.31	$1,330.46	$697.17	0.02
Guide Services	$10,391.42	$6,652.31	$3,485.83	0.11
Taxi Services	$2,771.31	$1,032.33	$862.55	0.06
Totals	**$12,600,283.79**	**$7,488,555.94**	**113.28**	**$3,662,787.32**

*These expenditures are margined to 20% of the initial value.
^This figure is adjusted from the prior table where the job multiplier is per million spent in that sector.

Table Nine: Study Area Multipliers, Visitor Uses, and Total Spending by Sector, Obed Only

Sector	Output	Job wages	Jobs per million spent	Value added	Total visitor uses	Per visit mean	Total spending
Camping Use *+	1.0014	0.2703	8.2288	0.5992	2,982.00	$10.12	$30,177.84
Hotel Use *+	1.0014	0.2703	8.2288	0.5992	681.60	$37.50	$25,560.00
Cabin Use *+	1.0014	0.2703	8.2288	0.5992	2,215.20	$150.33	$333,011.02
Dine-in Restaurants	1.0111	0.1969	6.4746	0.0099	8,520.00	$16.58	$141,261.60
Fast food	1.0111	0.1969	6.4746	0.0099	8,520.00	$4.03	$34,335.60
Groceries	1.0174	0.3423	9.95	0.6458	8,520.00	$2.97	$25,304.40
Snacks	1.0176	0.337	9.5695	0.6431	8,520.00	$2.22	$18,914.40
Gasoline	1.0176	0.337	9.5695	0.6431	8,520.00	$18.65	$158,898.00
General Retail	na^	na^	na^	na^	8,520.00	$0.00	$0.00
Gear Purchases	na^	na^	na^	na^	8,520.00	$0.00	$0.00
Gear Rental	na^	na^	na^	na^	8,520.00	$0.00	$0.00
Guide Services+	na^	na^	na^	na^	8,520.00	$0.00	$0.00
Taxi Services+	na^	na^	na^	na^	8,520.00	$0.00	$0.00
Total	-	-	-	-	-	-	**$767,462.86**

*Adjusted; 62% of total visitor uses stayed overnight, with 35% camping, 8% staying in hotels, and 26% staying in rental cabins/rental houses. The remaining overnight visits stayed for free with friends/family, in secondary homes, or in other free accommodations.
+No multipliers were available for these industries in the study area, so means were used from the comparable Big South Fork study area.
^As no mean expenditures are analyzed in this sector, no multipliers are listed.

Table Ten: Economic Impact of Visitors in Study Area, Obed Only

Sector	Output	Value Added	Wages	Jobs^
Camping Use	$30,220.09	$18,082.56	$8,157.07	0.25
Hotel Use	$25,595.78	$15,315.55	$6,908.87	0.21
Cabin Use	$333,477.23	$199,540.20	$90,012.88	2.74
Dine-in Restaurants	$142,829.60	$1,398.49	$27,814.41	0.91
Fast food	$34,716.73	$339.92	$6,760.68	0.22
Groceries	$25,744.70	$16,341.58	$8,661.70	0.25
Snacks	$19,247.29	$12,163.85	$6,374.15	0.18
Gasoline	$161,694.60	$102,187.30	$53,548.63	1.52
General Retail*	$0.00	$0.00	$0.00	0.00
Gear Purchases*	$0.00	$0.00	$0.00	0.00
Gear Rental	$0.00	$0.00	$0.00	0.00
Guide Services	$0.00	$0.00	$0.00	0.00
Taxi Services	$0.00	$0.00	$0.00	0.00
Totals	**$773,526.03**	**$365,369.46**	**$208,238.38**	**6.29**

*These expenditures are margined to 20% of the initial value.
^This figure is adjusted from the prior table where the job multiplier is per million spent in that sector.

Table Eleven: Study Area Multipliers, Visitor Uses, and Total Spending by Sector, Kings Bluff Only

Sector	Output	Job wages	Jobs per million spent	Value added	Total visitor uses	Per visit mean	Total spending
Camping*	1.0084	0.2402	7.0401	0.6034	1384.50	$15.86	$21,958.17
Hotel Use*	1.0084	0.2402	7.0401	0.6034	390.50	$222.60	$86,925.30
Cabin Use*	1.0084	0.2402	7.0401	0.6034	1171.50	$247.51	$289,957.97
Dine-in Restaurants	1.0225	0.2676	8.8011	0.5355	3,550.00	$33.83	$120,096.50
Fast food	1.0225	0.2676	8.8011	0.5355	3,550.00	$7.57	$26,873.50
Groceries	1.0434	0.308	8.9217	0.663	3,550.00	$23.34	$82,857.00
Snacks	1.0414	0.2972	8.4135	0.6588	3,550.00	$5.60	$19,880.00
Gasoline	1.0414	0.2972	8.4135	0.6588	3,550.00	$34.26	$121,623.00
General Retail^	1.0363	0.2682	9.3816	0.6564	3,550.00	$2.80	$9,940.00
Gear Purchases^	1.0414	0.2972	8.4135	0.6588	3,550.00	$4.05	$14,377.50
Gear Rental	1.0414	0.2972	8.4135	0.6588	3,550.00	$0.03	$106.50
Guide Services	1.0414	0.2972	8.4135	0.6588	3,550.00	$0.15	$532.50
Taxi Services	1.0202	0.3586	29.8895	0.3783	3,550.00	$0.04	$142.00
Total	-	-	-	-	-	-	**$795,269.94**

*Adjusted; 69% of total visitor uses stayed overnight, with 39% camping, 11% staying in hotels, and 33% staying in rental cabins/rental houses. The remaining overnight visits stayed for free with friends/family, in secondary homes, or in other free accommodations.
^This figure is later margined to 20% of its initial value for modelling.

Table Twelve: Economic Impact of Visitors in Study Area, Kings Bluff Only

Sector	Output	Value Added	Wages	Jobs^
Camping	$22,142.62	$13,249.56	$5,274.35	0.15
Hotel Use	$87,655.47	$52,450.73	$20,879.46	0.61
Cabin Use	$292,393.61	$174,960.64	$69,647.90	2.04
Dine-in Restaurants	$122,798.67	$64,311.68	$32,137.82	1.06
Fast food	$27,478.15	$14,390.76	$7,191.35	0.24
Groceries	$86,452.99	$54,934.19	$25,519.96	0.74
Snacks	$20,703.03	$13,096.94	$5,908.34	0.17
Gasoline	$126,658.19	$80,125.23	$36,146.36	1.02
General Retail*	$2,060.16	$6,524.62	$533.18	0.02
Gear Purchases*	$2,994.55	$9,471.90	$854.60	0.02
Gear Rental	$110.91	$70.16	$31.65	0.00
Guide Services	$554.55	$350.81	$158.26	0.00
Taxi Services	$144.87	$53.72	$50.92	0.00
Totals	**$792,147.78**	**$483,990.93**	**$204,334.14**	**6.08**

*These expenditures are margined to 20% of the initial value.
^This figure is adjusted from the prior table where the job multiplier is per million spent in that sector.

Table Thirteen: Study Area Multipliers, Visitor Uses, and Total Spending by Sector, Big South Fork Only

Sector	Output	Job wages	Jobs per million spent	Value added	total visitor uses	Per visit mean	Total spending
Camping Use *	1.0084	0.2402	7.0401	0.6034	497.00	$10.12	$5,029.64
Hotel Use *	1.0084	0.2402	7.0401	0.6034	113.60	$37.50	$4,260.00
Cabin Use *	1.0084	0.2402	7.0401	0.6034	369.20	$150.33	$55,501.84
Dine-in Restaurants	1.0225	0.2676	8.8011	0.5355	1,420	$16.58	$23,543.60
Fast food	1.0225	0.2676	8.8011	0.5355	1,420	$4.03	$5,722.60
Groceries	1.0434	0.308	8.9217	0.663	1,420	$2.97	$4,217.40
Snacks	1.0414	0.2972	8.4135	0.6588	1,420	$2.22	$3,152.40
Gasoline	1.0414	0.2972	8.4135	0.6588	1,420	$18.65	$26,483.00
General Retail	na^	na^	na^	na^	1,420	$0.00	$0.00
Gear Purchases	na^	na^	na^	na^	1,420	$0.00	$0.00
Gear Rental	na^	na^	na^	na^	1,420	$0.00	$0.00
Guide Services	na^	na^	na^	na^	1,420	$0.00	$0.00
Taxi Services	na^	na^	na^	na^	1,420	$0.00	$0.00
Total	-	-	-	-	-	-	**$127,910.48**

*Adjusted; 62% of total visitor uses stayed overnight, with 35% camping, 8% staying in hotels, and 26% staying in rental cabins/rental houses. The remaining overnight visits stayed for free with friends/family, in secondary homes, or in other free accommodations.
^This figure is adjusted from the prior table where the job multiplier is per million spent in that sector.

Table Fourteen: Economic Impact of Visitors in Study Area, Big South Fork Only

Sector	Output	Value Added	Wages	Jobs^
Camping Use	$5,071.89	$3,034.88	$1,208.12	0.04
Hotel Use	$4,295.78	$2,570.48	$1,023.25	0.03
Cabin Use	$55,968.05	$33,489.81	$13,331.54	0.39
Dine-in Restaurants	$24,073.33	$12,607.60	$6,300.27	0.21
Fast food	$5,851.36	$3,064.45	$1,531.37	0.05
Groceries	$4,400.44	$2,796.14	$1,298.96	0.04
Snacks	$3,282.91	$2,076.80	$936.89	0.03
Gasoline	$27,579.40	$17,447.00	$7,870.75	0.22
General Retail*	$0.00	$0.00	$0.00	0.00
Gear Purchases*	$0.00	$0.00	$0.00	0.00
Gear Rental	$0.00	$0.00	$0.00	0.00
Guide Services	$0.00	$0.00	$0.00	0.00
Taxi Services	$0.00	$0.00	$0.00	0.00
Totals	**$130,523.15**	**$77,087.16**	**$33,501.15**	**1.00**

*These expenditures are margined to 20% of the initial value.
^This figure is adjusted from the prior table where the job multiplier is per million spent in that sector.

Study Area Resident Expenditures

Recent studies cited in this report collectively indicate climbers are an important form of economic impact in the nation's economy, but this overlooks climbers who live inside the study areas and often choose to move there solely to be closer to climbing. Recall the expenditures by persons living in the study area are not economic impact as they do not represent new expenditures in the economy (although, arguably, they do when residents are newly located there). Instead, it is argued that these expenditures are considered redirected climbing expenditures, as these funds could have been spent in any number of ways but already exist in the economy. The researchers recognize this methodological crux. Nonetheless, the authors believes these expenditures are important in understanding the expenditures of outdoor recreation users in the study area as outdoor recreation users often relocate to live close to the recreation areas they value. Persons living in the study area reported spending over $21,000 inside the study area each year as a result of living in the study area. Most of this consists of rents and mortgages ($10,713) and expenditures in the local economy for restaurants ($2,405) and retail ($2,707).

Leave No Trace Knowledge

As part of the economic impact study, respondents were asked to participate in a study of climbers' knowledge of their environmental impacts while climbing, if and how they learned about Leave No Trace principles, and their participation in Leave No Trace programming. The separate study was offered as an additional section before completing the demographics section. In all, 70% of respondents agreed to take the additional survey consisting of the Leave No Trace Rock Climbing Measure (LNTRCM) and three questions about when and how they learned about Leave No Trace. Additionally, the main survey included four questions about respondents' participation in Leave No Trace programming also summarized in this section.

Table Fifteen explores responses of when and how climbers learned about LNT as well as their participation in LNT programming. The first four questions examine participation in specific LNT-related courses. In all, 48% of respondents have signed Access Fund's Climber's Pact, a public pledge that they will adhere to LNT best practices while climbing. In comparison, only 6% had completed a Leave No Trace Master Educator course and/or Trainer course. However, 22% had completed a Leave No Trace Awareness Workshop. These workshops are notable as they are sometimes held in crags and are aimed directly at climbers.

Climbers next were asked two questions of interest to the research team for later studies. First, respondents were asked to self-rank their LNT knowledge, with higher scores indicating more knowledge. On average, respondents ranked themselves a 7.5, which indicates they have a good awareness of Leave No Trace. Respondents were also asked if they learned about Leave No Trace (or minimal impact principles for those who were children before the former existed as a formal idea) before the age of 18; 61% indicate they had learned about this prior to adulthood.

The last section of the table explores if the respondent found a particular common source of Leave No Trace knowledge was an important source for their knowledge on the topic. Respondents could check all that apply. The highest mean responses included their friends (65%), watching other climbers' behaviors (52%), info from another climber while at a crag (50%), their parents (40%), local climbing organization programs (40%), and Park Service/Forest Service literature (40%).

Table Sixteen explores responses to the Leave No Trace Rock Climbing Measure (LNTRCM) which asks respondents to rank (1= very inappropriate, 5=very appropriate) common climbing activities in relation to Leave No Trace principles. The measure, which presently includes 31 items, has an alpha of .84 and includes items addressing all seven LNT principles. Reverse coded items (where indicating a behavior is very in appropriate is in line with Leave No Trace principles) are noted with an asterisk. The research team also utilized reverse coded questions to check for cases where respondents indicated the same answer throughout (ie, marking everything as very appropriate) and no cases failed this test. Scores here can be used by climbing organizations to address shortcomings in climber knowledge and diagnose issues which may be happening in the field.

Overall, the LNTRCM here indicates respondents in this study understood how they should behave at the crag in relation to Leave No Trace principles. For example, nearly all respondents (mean of 4.97) understood it was very appropriate to pack out trash created while climbing. They also scored well on planning around climbing regulations in advance (4.85), using only designated trails (4.82), and (not) creating trail shortcuts (1.25, reverse coded). They also understood how to interact with the crag, such as not carving on the walls (1.01, reverse coded), not playing loud music (1.07), not climbing on/around/above Indigenous sites and/or petroglyphs (1.18), adhering to nesting bird closures (4.75), and not climbing inside/above a fenced area (1.21).

While results are overall desirable, there are still areas of concern. For example, climbers are ambivalent about what to do with toilet paper. The appropriate response in this geographic area would allow for burial, but climbers are unable to determine this based on the knowledge they have. This issue is easily solved by encouraging all climbers to pack out toilet paper regardless of crag geography without exception. Ideally, this would also include use of WAG bags or similar feces bags (or even a simple sealed sandwich bag) to back out all feces (including dog feces when bringing dogs to the crag). While not enjoyable, this would have a beneficial impact on the crag overall, most noted in arid conditions where feces and toiled paper will not biodegrade. Of note, respondents indicated it was very appropriate to pack out dog feces when bringing dogs, so they are likely more receptive to also packing out their own feces. Urine, however, would not need to be packed out and can be left so long as they adhere to local regulations and LNT principles (200 feet/80 steps from water sources and trails/camps and aiming pee at rocks versus vegetation to avoid animals seeking salt eating the vegetation). Responses indicate climbers understand where they should and should not defecate regarding trails, and that they should not leave feces on the surface.

Table Fifteen: Leave No Trace Knowledges Sources

Variable	n	Mean	SD	Min	Max
Have you signed Access Fund's Climber's Pact?	455	0.48	0.50	0	1
Have you ever completed a Leave No Trace Master Educator Course?	458	0.06	0.23	0	1
Have you ever completed a Leave No Trace Trainer Course?	458	0.06	0.24	0	1
Have you ever completed a Leave No Trace Awareness Workshop?	458	0.22	0.42	0	1
How would you self-rate your knowledge of Leave No Trace principles? (1=novice, 10=expert)	319	7.51	1.77	1	10
Would you say that you were taught minimal impact principles and/or Leave No Trace principles before the age of eighteen?	321	0.61	0.49	0	1
Sources of LNT knowledge	321	0.61	0.49	0	1
Access Fund Climber's Pact	324	0.28	0.45	0	1
Access Fund Conservation Team visits	324	0.08	0.27	0	1
Access Fund website	324	0.28	0.45	0	1
Local climbing organization programs	324	0.40	0.49	0	1
American Alpine Club conservation programs	324	0.09	0.28	0	1
American Alpine Club website	324	0.12	0.33	0	1
Other climbing websites	324	0.17	0.38	0	1
Popular media (magazines and books)	324	0.27	0.44	0	1
Watching other climbers' behaviors	324	0.52	0.50	0	1
Info from another climber while at a crag	324	0.50	0.50	0	1
LNT websites	324	0.17	0.38	0	1
My parent(s)	324	0.40	0.49	0	1
My grandparent(s)	324	0.08	0.28	0	1
Other family member(s)	324	0.11	0.32	0	1
My friend(s)	324	0.65	0.48	0	1
Gym info kiosks	324	0.08	0.27	0	1
LNT info kiosks	324	0.18	0.38	0	1
Classes/Courses on LNT	324	0.11	0.31	0	1
Park/Forest Service personnel	324	0.36	0.48	0	1
Park/Forest Service literature	324	0.40	0.49	0	1
Boy/Girl Scouts or similar organization	324	0.23	0.42	0	1
Other sources[8]	324	0.12	0.33	0	1

[8] Other responses included outdoor leadership programs and education, guide books, camps, festivals (such as Burning Man), social media, personal study, and other sport involvement.

Table Sixteen: Leave No Trace Rock Climbing Measure (alpha=.84, 31 items. Reversed-coded items noted with *)

Measure	n	Mean	SD	Min	Max
Knowing the climbing regulations where I'll climb in advance.	307	4.85	0.57	1	5
Limiting my group size to protect the climbing area.	307	4.38	0.81	1	5
Carpooling to the climbing area whenever possible.	307	4.67	0.62	1	5
Using only designated trails in and around climbing areas.	307	4.82	0.55	1	5
Traveling in a single file whenever walking with others on the trail.	307	4.48	0.71	2	5
Creating trail shortcuts when trails do not go straight to the climbing area.*	307	1.25	0.59	1	5
Packing out all the trash I create while climbing.	307	4.97	0.33	1	5
Minimizing the amount of chalk I used.	307	4.06	0.85	1	5
Packing out any forgotten or discarded gear I find.	307	4.54	0.70	1	5
Leaving my feces on top of the ground so it will biodegrade.*	307	1.19	0.67	1	5
Urinating at least seventy steps from the trail.	307	4.19	0.91	1	5
Burying my toilet paper.	307	3.18	1.60	1	5
Pooping close to the trail.*	307	1.05	0.28	1	4
Brushing off excess chalk on the route when I am done climbing it.	307	4.24	0.93	1	5
Taking small rocks home with me as mementos.*	307	1.72	0.72	1	5
Dislocating rocks that make it hard to climb.*	307	1.69	1.01	1	5
Cleaning vegetation off the wall while climbing.*	307	2.52	1.01	1	5
Climbing in, above, or near rare or sensitive plants.*	307	1.35	0.73	1	5
Using a portable stove rather than start a campfire should I need to cook something at the crag.	307	4.37	0.84	1	5
Making a campfire at the climbing area to cook or keep warm.*	307	1.59	0.89	1	5
Cutting down trees that are in the way of the route.*	307	1.41	0.75	1	5
Using tree-safe straps or a protective cloth to protect tree bark if using a hammock.	307	4.43	0.91	1	5
Keeping a dog on a leash or tethered at all times when I bring it to the crag.	307	4.62	0.72	1	5
Packing out my dog's feces when I bring it to the crag.	307	4.81	0.53	2	5
Feeding my food scraps to the local wildlife.*	307	1.13	0.40	1	4
Not climbing a route if I knew it would stress out nesting birds.	307	4.75	0.64	1	5
Climbing inside or above an area fenced off to protect something important at the crag.*	307	1.21	0.77	1	5
Climbing on routes adjacent to or overlapping petroglyphs or culturally sensitive Indigenous sites. *	307	1.18	0.64	1	5
Making sure everyone can hear music if I listen to it while climbing.*	307	1.07	0.33	1	5
Carving names into the climbing wall.*	307	1.01	0.08	1	2
Leaving tic marks to help climbers that are not in my group.*	307	1.53	0.71	1	4

Climbers also struggle with how they interact with vegetation. It has been largely accepted in climbing communities that climbers may clean vegetation from cracks and the route wall to allow better grip. Unfortunately, this disrupts the natural space along the route. It also remains a common area in research where climbers are often denigrated for their environmental impacts. Moreover, this represents a concrete example of climbers altering the environment in a way that can lead to closures on public lands. This area deserves further conversation in the community. On a positive note, climbers do understand that they should adhere to protected plant populations at the crag and should avoid climbing in, above, or near sensitive plants (.35, reverse coded).

There are also improvements in respondent LNT knowledge compared to past studies. Climbers in this study indicated improved knowledge on the use of chalk. This includes brushing off chalk after use and avoiding the use of tic marks to alter how future climbers may understand the route. Although it is not possible to remove microscopic amounts of chalk from climbing areas, reducing the amount of chalk used and removing excess chalk can go a long way toward addressing this issue, particularly on dry routes where chalk will effectively never be washed away.

Limitations

All economic impact studies experience limitations in what they can and cannot accomplish along with unique issues that may occur during the research process. This study is no exception, and the authors have noted below several limitations to this study which could be reexamined in future work.

1. Economic impact studies are snapshot estimates of a particular activity at a single moment in time. As such, the economic impact of any outdoor recreation activity will certainly vary from year to year based on weather, spending patterns, local business availability, and other variables. As such, the results in this study can be best understood as a scientific estimate of what expenditures would generally look like in a typical year barring major changes to the study area economy and its related activities.
2. Economic impact studies are limited in their ability to demonstrate directly observable activities in the study area. For example, if IMPLAN estimates expenditures create $1,000 in induced expenditures, observing or pinpointing that sum in the economy is not possible. Rather, these models operate on predictions of what would happen given the data available.
3. Economic impact studies are not cost-benefit analyses and offer no assessment of whether the activity being studied is more profitable in comparison to other activities. That said, follow up cost-benefit studies can be conducted to address this limitation.
4. This study does not attempt to account for changes in visitation and spending patterns as a result of the recent Covid-19 pandemic. There is anecdotal evidence that outdoor recreation use increased during the pandemic, but services and expenditures were reduced due to closed businesses and concerns over interactions and risk of transmission. Future

studies, however, could address this limitation by considering visitation pattern changes as a result of the pandemic.

5. This study does not consider the economic impact of visitors who come to any study area to climb indoors. Indoor climbing represents a growing and important part of the climbing economy. Likewise, having climbers located near a study area supports the presence of adding climbing gyms to the local economy. This is beyond the scope of the present study, but deserves more research.
6. Visitation totals do not include visits by those considered to be non-climbers. Actual total visits may be higher, and this may have environmental impact and economic impact not captured in this model. At the Obed, for example, the monthly Coffee and Climb with a Ranger program regularly draws 200 visitors on a Saturday. Similarly, Boulders at Old Wauhatchie pike are utilized by multiple area schools, inviting thousands of visits from school children not counted in this study.
7. This study occurred during a time of high inflation which ostensibly caused expenditure patterns to be higher than they would have been a year earlier. However, increases in costs of activities may have also limited use patterns. Future studies can address this limitation.
8. This study had study areas with low response rates which required using mean expenditure patterns from similar, but never the same, study areas. Future research should explore this issue further.
9. This study examines four study areas across a single state. This is not exhaustive and indicates the four areas selected by Access Fund to be included in this study.
10. This study includes visitation estimates which should be verified in future studies.
11. This study includes an omission in that, in studying multiple areas, it could not determine if a climber lives in one study area but is climbing in another. This should be addressed in future studies.
12. LNT knowledge does not equate following through on these behaviors in the field. Online surveys cannot link knowledge to behaviors, so this is a limitation of the study that should be explored in future research.
13. Questions in the LNT knowledge section also may suffer from bias, as persons interested in LNT would be more likely to take the survey whereas those not interested in, or even opposing, LNT behaviors could choose to skip the survey.
14. Results of the LNT measures should not be applied to other user groups, such as hikers or cyclists, as the questions are focused specifically on climbing behaviors. Note that other researchers are welcome to use and adapt the scale. The researchers ask that you please cite the original study using the LNTRCM which is Maples and associates, 2022. This LNT study is available upon request from the first author of this report.[9]

[9] Maples, James N., Michael J. Bradley, Brian Clark, Sadie Giles, and Rhiannon Leebrick. 2022. "Leave no person behind: Exploring how demographic categories shape LNT principles among climbers in West Virginia's New River Gorge." *Journal of Outdoor and Environmental Education* 25, 219–245.