2017 Public Lands Service Coalition Trail Evaluation Report: Year 2

NC STATE UNIVERSITY

Executive Summary

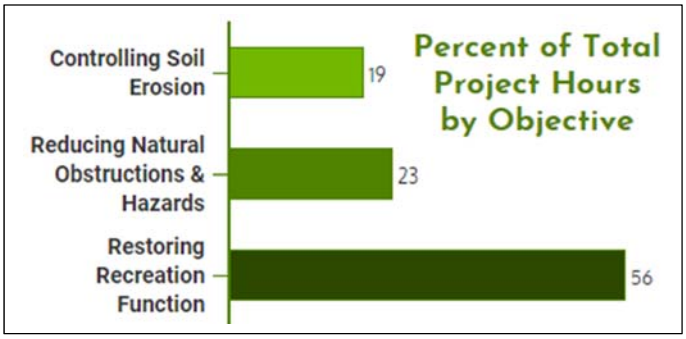
INTRODUCTION: In order to evaluate the impact of Conservation Corps trail improvement projects, the Public Lands Service Coalition (PLSC) and North Carolina State University developed and implemented standard protocols for assessing the value of corps work for indicators related to three overall management goals (see box). This evaluation involved pre- and post-work assessment measures of short-term outcomes using a comprehensive and standard approach for documenting environmental conditions.

Purposes of trail improvement projects

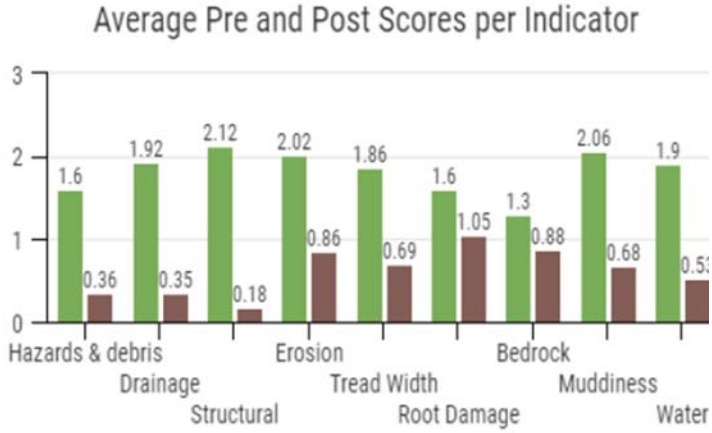
PROCEDURES: Trail improvement projects focused on three objectives: 1. Restoring recreation function, 2. Reducing natural obstructions and hazards, and 3. Controlling soil erosion. Trained crew members established plots and systematically evaluated conditions linked to nine indicators using rapid, visual assessments. Indicators were ranked in one of five categories: NA (not applicable), NLE (no longer exists), minimal, moderate, and major. Analysis evaluated changes in condition from pre- to post-work.

Project-Level Findings

Project-level findings are based on 75 projects, incorporating 471 crew members from 4 corps, almost 20,000 hours, and 160 miles of trail work. Projects were located in 8 states across the country, and nearly 60% took place in State Parks and Nationals Forests.



Plot-Level Findings



At the **plot level**, **average conditions improved across all nine indicators.** Eight of nine indicators were found to have statistically significant changes between pre-and post-work scores, with six of those eight exhibiting large effect sizes, meaning the difference is meaningful in practice. **Results indicate that corps contributed positively to trail improvement objectives.**

PUBLIC LANDS SERVICE COALITION

NC STATE UNIVERSITY

The CorpsNetwork
Strengthening America through service and conservation

2017 Public Lands Service Coalition Trails Evaluation Report February 7, 2018

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Acknowledgements

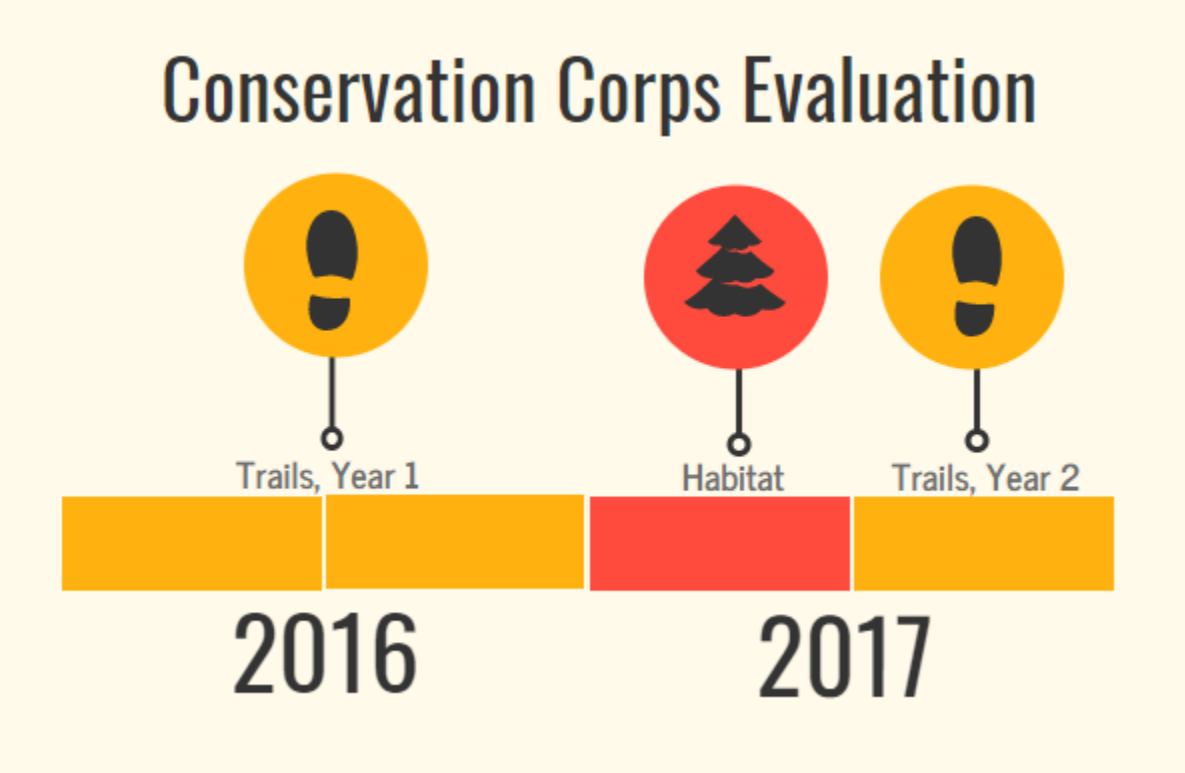
Participating Public Lands Service Coalition corps and The Corps Network funded this evaluation, with leadership from Conservation Legacy. We also thank all corps and crew members for their time and dedicated efforts in developing, testing, refining, and implementing this evaluation.

Title page photos Top: New boardwalk construction, Wompatuck State Park, Cohasset, MA, Student Conservation Association (SCA); Bottom left: New bridge construction (see pre-work photo on report page 2), Northwest Youth Corps (NYC) ; Bottom right: New picnic area completed and connected to existing trail, Wilmington, NY, Student Conservation Corps.

Executive Summary

Commissioned by member organizations of the Public Lands Service Coalition (PLSC) and completed by North Carolina State University (NCSU) in collaboration with corps and crew members, this evaluation, part of a multi-year study, assessed outputs of trail improvement projects conducted by Conservation Corps. The evaluation also involved pre- and post-work assessment measures of short-term outcomes using a comprehensive and standard approach for documenting environmental conditions. Specifically, trail indicators related to ecosystem health, accessibility and usage of public lands, and enhanced visitor experience were selected. Data were then collected by trained crew members to systematically evaluate conditions linked to each indicator within sample plots using rapid, visual assessments.

Findings in this report are based on **75 trail projects** conducted by **4 corps** between April 1 and November 15, 2017. These projects involved over **160 miles of trail** and **471 crew members** working **nearly 20,000 hours**. In 2017, year two of the study, participating corps were asked to report data on habitat as well as trail work, resulting in a shared effort between the two evaluations and a reduction in overall trails focus.



Pre-work photo of location for new bridge, Northwest Youth Corps. (See post-work photo on cover)

As in the 2016 trails evaluation, crew members established plots within work areas and conducted rapid assessments of conditions, ranking them in one of five categories: NA (not applicable, or not a problem), NLE (no longer exists; only for post-assessments), minimal, moderate, and major. Analysis focused on evaluating the changes in trail condition toward achieving overall objectives for trail improvement.

In 2017, the most commonly reported trail work objective was **restoring recreation function (RRF)**, which is consistent with findings for 2016. **Significant changes to trail conditions were documented in 158 plots for eight of the nine indicators** (i.e., natural hazards and debris, drainage feature damage, structural damage, erosion, increased tread width, root exposure or damage, muddiness, and standing water). Bedrock exposure was the only indicator with a change that was not statistically significant.

Changes in condition score between pre- and post-work assessments all documented average scores moving toward desired conditions. Across all indicators, average post-scores were 1.05 or less, placing them within categories reporting no to minimal visual evidence of the trail issue. Reductions in **natural hazards and debris** and **muddiness**, along with repairs to **drainage feature damage**, ranked among the indicators with the **largest effect sizes**, indicating the practical significance in the condition score change (Figure 1).

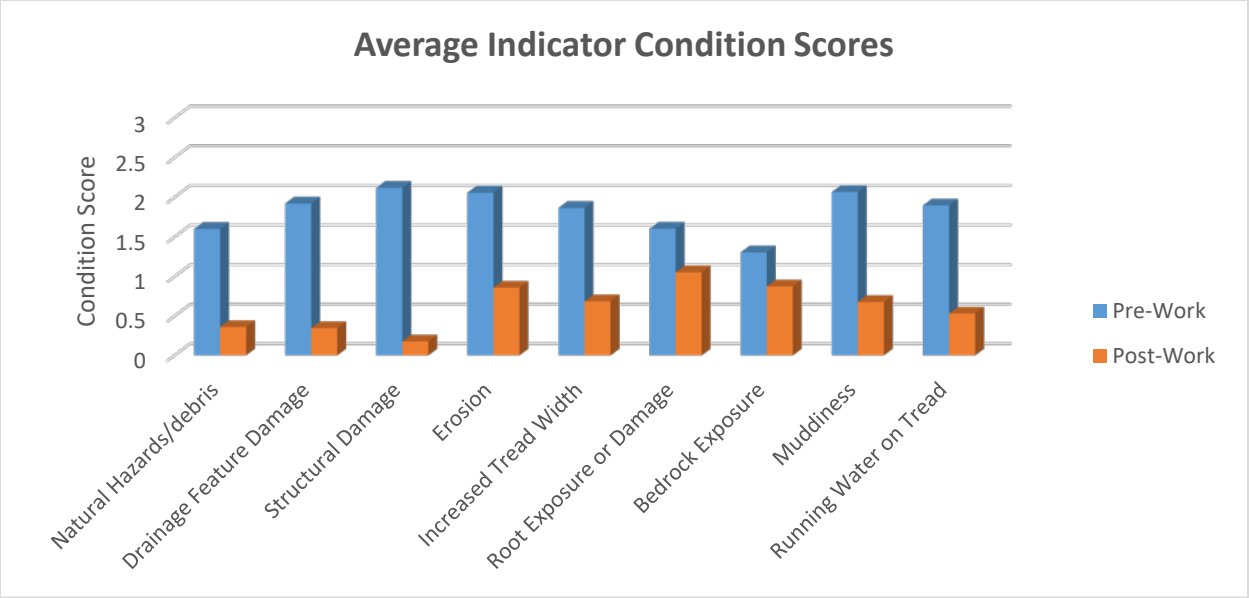


Figure 1. Average pre- and post-work indicator scores reported by corps for 2017 trail evaluation

Key Findings: Trail Report

75 Trail Projects

159 plots recorded

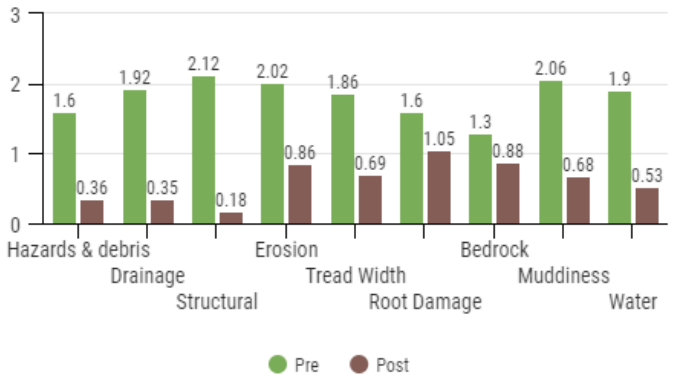
160 miles of trails

471 Crew Members from 4 Corps

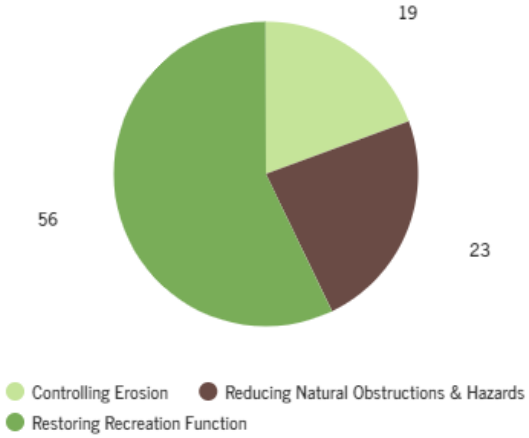
8 **Indicators showed** statistically SIGNIFICANT improvements

Statistically significant changes to trail conditions were documented for 8 of the 9 indicators, with 6 of the 8 significant indicators reporting large effect sizes.

Average Pre and Post Scores per Indicator



Percent of Project Hours by Objective



Evaluation Procedures

The nature of environmental corps programs presents unique conditions for evaluation and monitoring. Partner agencies set priorities and methods for accomplishing project goals based on their best practices and work objectives. Identification of work sites often precludes any incorporation of control sites in project evaluation design: Crews conduct work in diverse locations under dynamic conditions, complicating standardization and comparison.

To address these challenges, a collaboration between The Corps Network, member organizations of the Public Lands Service Coalition (PLSC), and North Carolina State University (NCSU) developed and implemented standardized measures of trail improvement projects on public and private lands that provide rigorous evaluation of corps programs. Management goals identified through interviews and surveys with corps and partner agencies directed measurement selection. Specifically, this evaluation focused on improving ecosystem health and visitor experience through three objectives:

1. Restoring recreation function
2. Reducing natural obstructions and hazards
3. Controlling soil erosion

Overall project outputs (i.e., miles of trail repaired, hours worked), as well as activities contributing to each objective were collected at the project level. For detailed information about short-term outcomes of trail work, systematic assessments of trail and environmental conditions were also collected at the plot level. A review of the literature from land management agencies (e.g., US Forest Service, US National Park Service) and peer-reviewed journals identified salient trail indicators (i.e., measureable and manageable proxies for objectives) for in-depth evaluation of condition changes (see Appendix 1 for an annotated bibliography of select references).

Indicators were categorized into condition classes using rapid, visual assessments both before and after work to evaluate the impact of corps' activities. Indicator descriptions, along with the relevant reference(s), are outlined in Table 1.

Table 1. Trail indicators selected for evaluation of corps projects.

Indicator	Description	Reference
Natural hazard or debris	Trail corridor obstruction by organic material such as loose rocks, trailside fuels, attached or fallen limbs hanging over trail, encroaching vegetation.	Verlič, Arnberger, Japelj, Simončič and Pirnat, 2015
Drainage feature damage	Structures designed to divert water away from trail tread, including culverts, water bars or other drainage features that require maintenance or exhibit noticeable damage.	Hammitt, Cole and Monz, 2015
Structural damage	Built structure, including raised platforms, pavement, steps, signage, bridges, stone retaining walls, that has incurred noticeable damage.	Verlič, Arnberger, Japelj, Simončič and Pirnat, 2015
Erosion features	Soil displacement such as deposition, ruts, gullies, trail incision or deepening on or immediately adjacent to the trail corridor.	Moore, Leung, Matisoff, Dorwart and Parker, 2012; Marion and Leung, 2001
Increased tread width	Widened, social/informal or multiple treads present.	Eagan, Newman, Fritzke and Johnson, 2004; Marion and Leung, 2001
Root exposure and/or damage	Roots exposed due to soil loss or compaction and present a hazard to tree health or visitor safety.	Moore, Leung, Matisoff, Dorwart and Parker, 2012; Marion and Leung, 2001
Bedrock exposure	Exposure of rock layer in location where it should naturally be covered by soil and other organic material.	Hammitt, Cole and Monz, 2015
Muddiness or standing water	Areas of wet, saturated soil (mud) or standing water (puddles) on or immediately adjacent to trail tread.	Moore, Leung, Matisoff, Dorwart and Parker, 2012
Running water on trail tread	Water running any direction along or across trail tread.	Marion and Leung, 2001

Crew members established plots within work areas (‘trail events’) and conducted rapid assessments of conditions, ranking them in one of five categories: NA (not applicable, or not a problem), NLE (no longer exists; only for post-assessments), minimal, moderate, and major. Analysis focused on evaluating the changes in trail condition toward achieving overall objectives for trail improvement.

Results

Trail Project-Level Findings

During the 2017 evaluation period, four* corps assessed trail conditions within **75 projects**, representing **160.88 miles of trail** work involving **463 crew members** contributing **19,679.5 hours** of work (Table 2).

Table 2. Number of projects sampled between April 1 and November 15, 2017, including miles of trail improved or created, hours worked, and crew members involved by corps.

Corps	Number of Projects Sampled	Miles of Trail Improved or Created	Hours to Complete Project	Number of Crew Members
Conservation Legacy	14	24	4,349	121
Student Conservation Association	50	107	14,016	294
Utah Conservation Corps	11	30	1,316	48
Grand Total	**75**	**161**	**19,681**	**463**

*Northwest Youth Corps provided data at the plot level

Project Locations

Projects were implemented on a variety of public and private lands in 8 states across the country (Figure 2). Several regions were represented in the evaluation, including the Northeast (New York, Massachusetts), West/Southwest (Arizona, Utah, Colorado), and South/Southeast (Texas, Alabama, Georgia). Of projects included in the evaluation, State Parks (n=25, 33%) and National Forests (n=19, 25%) comprised nearly 60% of the total sample (Figure 3).

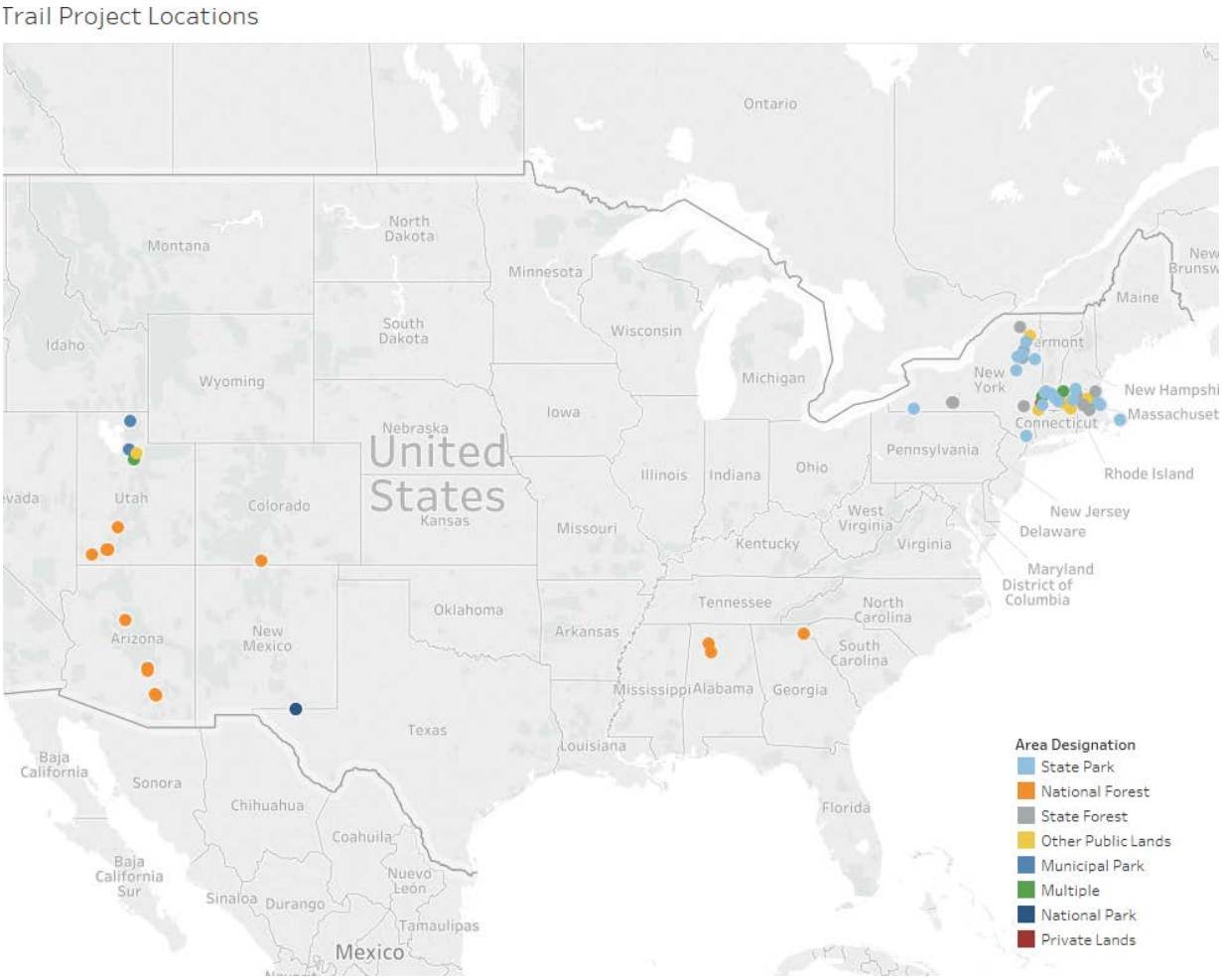


Figure 2. Location of trail projects conducted by corps in 2017

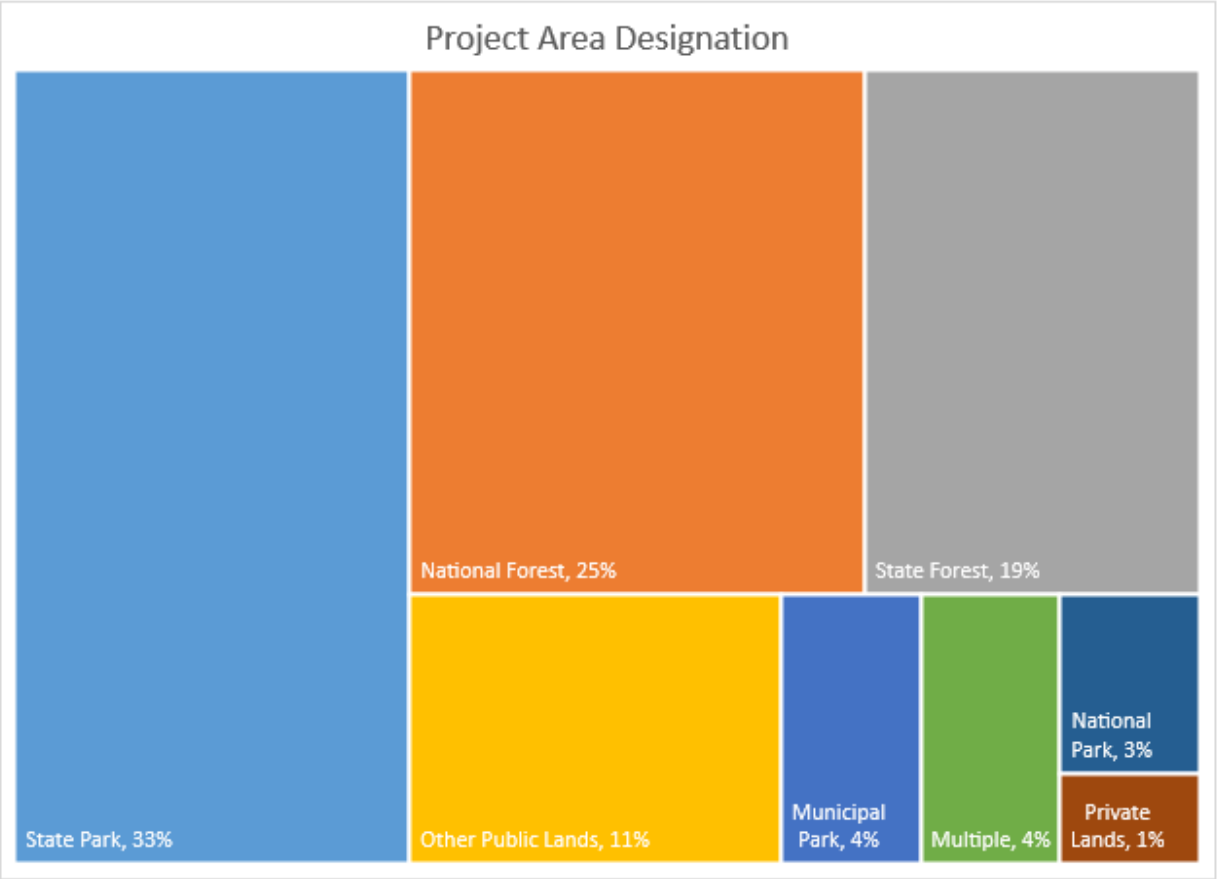


Figure 3. Treemap illustrating the percentage of projects by area designation (n=75)

Project Objectives and Activities

Trail projects were categorized by three objectives, with one or more objectives possible within the same project. Objectives included *(1) restoring recreation function, (2) reducing natural obstructions and hazards*, and (3) *controlling soil erosion*. The objective with the greatest average percent of overall project effort was *restoring recreation function*, with 56% of total hours (Figure 4). The total percent of project hours could add to fewer than 100% if work also achieved objectives not covered in this evaluation, or more than 100% if two or more were concurrently achieved during corps work.

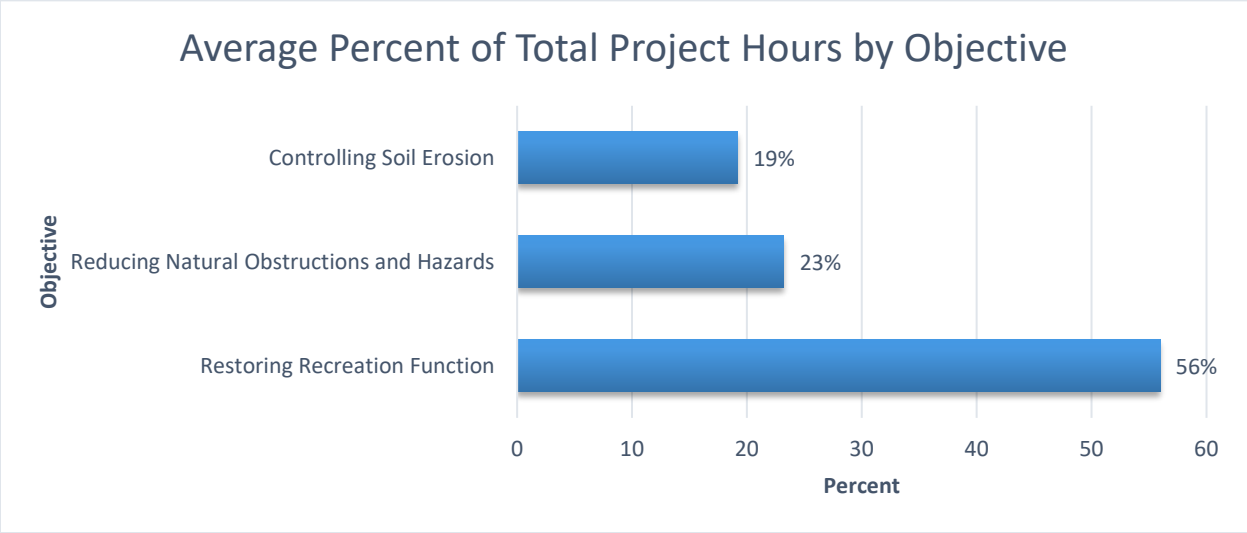


Figure 4. Average percent of project hours by objective (n=74)

The majority of project hours focused on **restoring recreation function.** This was most often achieved through **repairing or enhancing existing trail treads,** which accounted for work on **75% of all trail miles for this objective.**

One or more activities could contribute to each objective. Table 3 details the activities, along with the corresponding number of projects and totals.

Table 3. Summary of trail project activities by objective (n=74)

Restoring Recreation Function	Number of Projects (59)	Total	Unit of Measure
Repairing or enhancing existing trail treads	33	57	miles
Constructing or creating new trails	23	6	miles
Constructing or repairing bridges or boardwalks	12	0.38	miles
Rehabilitating social trails or multiple treads	12	12	miles
Other	19		see Appendix 2
Reducing Natural Obstructions and Hazards	**Number of Projects (41)**	**Total**	**Unit of Measure**
General brushing and sweeping	25	52	miles
Clearing vegetation obstructions on, near, or over trails	21	27	miles
Rock or sediment obstructions removed from on or near trails	5	43	# 39-gal bags
Reducing fire hazards	0	0	miles
Other	9		see Appendix 2
Controlling Soil Erosion	**Number of Projects (35)**	**Total**	**Unit of Measure**
Water control or drainage features installed	23	287	number
Water control or drainage features repaired or cleaned	13	56	number
Stabilization of side slope	11	4	miles

Trail Plot-Level Findings

Detailed data on key indicators of trail conditions were collected within sample plots (i.e., areas extending 20 feet along the trail and the trail tread plus five feet to either side of the trail) to further quantify and assess changes resulting from crew work. Table 4 describes the number of plots evaluated by each corps.

Table 4. Number of plots sampled by corps

Corps	Number of Plots Sampled
Conservation Legacy	62
Northwest Youth Corps	3
Student Conservation Association	86
Utah Conservation Corps	8
Grand Total	**159**

Average Plot Condition Scores

For analysis, indicator categories were assigned a numeric value: 0 for No Longer Exists, 1 for Minimal, 2 for Moderate, and 3 for Major. A 'no data' value was included for NA. Average scores were calculated for each indicator across all plots where an indicator was assigned a category.

A radar chart of average before and after scores by indicator (Figure 5) illustrates that indicators associated with feature damage (i.e., structural damage and drainage feature damage), and with soil-

related issues (i.e., erosion, muddiness) exhibited the highest average condition scores before work. Following corps work, those same indicators ranked among the lowest scores, indicating values associated with improved conditions. The smaller overall shape for post-work scores indicates a positive condition change in all indicators.

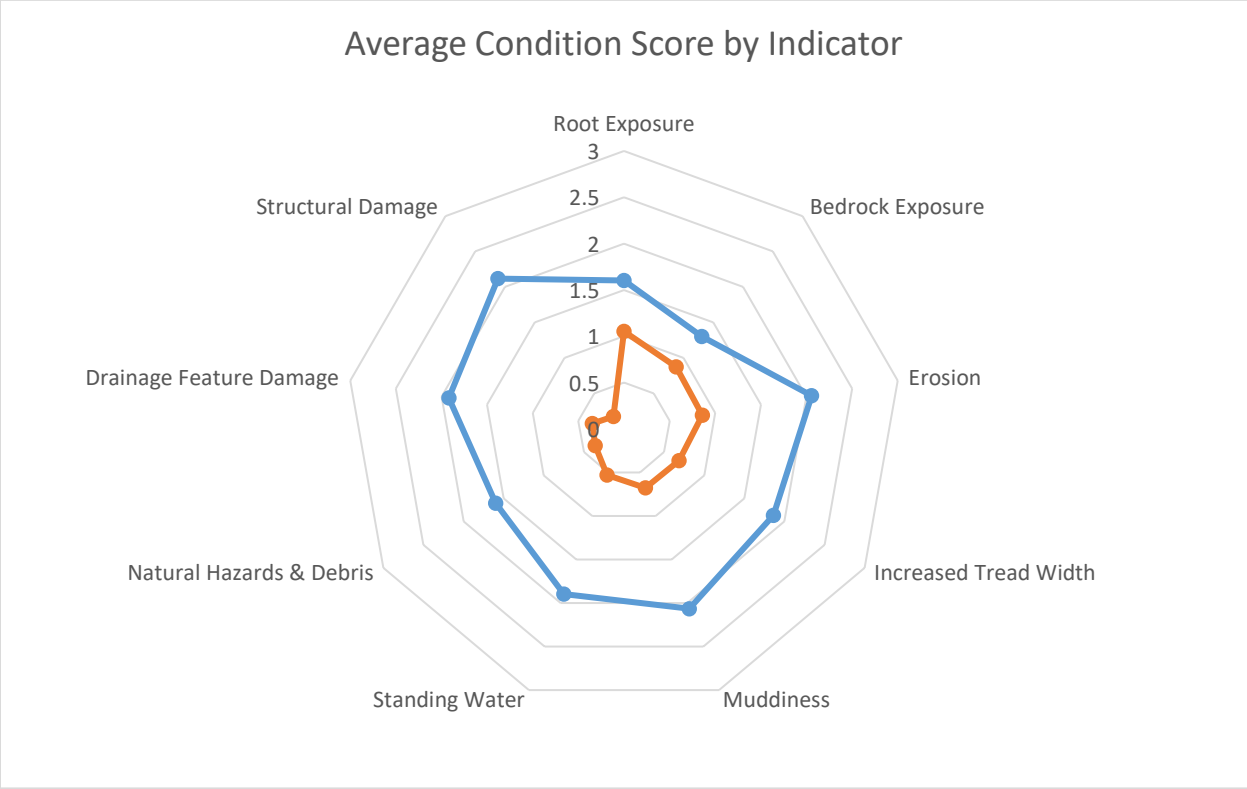


Figure 5. Radar chart of average condition scores by indicator for all plots

Changes in Average Plot Condition Scores

To determine if the changes in indicator scores were statistically significant, the difference between the value for the paired pre- and post-work plot scores were compared using the Wilcoxon Signed Rank Test (Table 5). Eight of the nine indicators were found to have statistically significant changes between pre- and post-work scores, with six of those eight exhibiting large effect sizes (i.e., natural hazards and debris, drainage feature damage, structural damage, erosion, muddiness and running water on tread). Bedrock exposure was the only indicator that was not statistically significant at the p = 0.05 level, though it was also an indicator with the fewest observations (n=23) and lowest pre-work score (1.3).

Table 5. Summary of average condition scores by indicator for plots before and after work, statistical significance of difference, and effect sizes.

Indicator	n	Average Pre-Score	Average Post-Score	p-value[1]	Effect Size[2]
Natural Hazards & Debris	100	1.6	0.36	<0.01	-0.56
Drainage Feature Damage	25	1.92	0.35	<0.01	-0.57
Structural Damage	34	2.12	0.18	<0.01	-0.62
Erosion	88	2.02	0.86	<0.01	-0.51
Increased Tread Width	81	1.86	0.69	<0.01	-0.48
Root Exposure or Damage	68	1.6	1.05	<0.01	-0.38
Bedrock Exposure or Damage	23	1.3	0.88	0.06	
Muddiness	62	2.06	0.68	<0.01	-0.56
Running Water on Trail Tread	48	1.9	0.53	<0.01	-0.52

Natural hazards and debris was the most commonly occurring indicator, with 100 plots assessing this indicator out of 159 total plots (63% of plots).

Average observed **condition improved across all nine indicators** with **all but one indicator reporting statistically significant changes** indicating **more desirable ecological conditions** and **recreation function**.

[1] The p-value helps determine the statistical significance of the results. It is a measure of the likelihood of concluding that there is a statistically significant finding when one does not exist. For example, a p-value of less than or equal to 0.05 means that there is a 5% chance of concluding there is a significant difference when one does not exist. A value of less than or equal to 0.05 is commonly used as a threshold for determining statistical significance.

[2] Measures of effect size are standardized measures (between -1.0 and 1.0) that assess the magnitude of this difference. Effect size is often used to determine whether a statistically significant difference is meaningful in practice with effect sizes further from zero, either positive or negative, suggesting greater practical importance. For this statistical test, the criteria for interpreting the absolute value of the r value (or the effect size) are: Small ≥ .10, Medium ≥ .30, Large ≥ .50.

Conclusions

Trail evaluation results from 2017, which represent a reduced scope from the 2016 evaluation, indicate that corps contributed positively to the three objectives of *reducing natural obstructions and hazards, restoring recreation function*, and *controlling soil erosion* through their work on trails. The proportion of project hours recorded for each objective is comparable to the previous year's (2016) assessment, with the majority of project hours devoted to restoring recreation function. This suggests a consistent pattern of trail improvement needs in public lands, informing future project preparation and crew training needs.

Methodologically, several changes were introduced between year one and year two. These included moving to a new system of data collection through the KoBoToolbox data collection tool in year two. KoBoCollect allowed crews to download project forms to their devices for use in the field, even if no network connection was available. This system streamlined data collection, both simplifying the process in the field and decreasing potential input errors from transferring data from paper to the online form. Additional changes included adding another category of assessment, *No Longer Exists* (i.e., the issue does not exist in the plot post-work), beyond *Not Applicable* (i.e., the issue does not exist in the plot pre-work) to define additional conditions for indicators. Overall, the year two trail evaluation resulted in efficient and effective data collection, as corps that invested the resources to implement the protocols and train crews in the first year continued their evaluations. The front-end investment in learning and employing these evaluation protocols will benefit these corps for years to come.

This evaluation also provides evidence to support the value of corps activities by using pre- and post-work scores to measure changes in trail indicators. Natural hazards and debris was the most commonly occurring indicator, which was effectively addressed by the 75 PLSC projects as illustrated by the difference between pre- and post-work scores and the effect size. Except for bedrock exposure/damage, other indicators, most notably structural damage, drainage features, and muddiness, have also significantly improved based on the same metrics. These results reaffirm the findings from last year that the PLSC projects provide valuable service to public land partners by improving their trail infrastructure in multiple ways. Future implementation of this evaluation methodology is highly recommended. It will enable long-term, comprehensive evaluation of PLSC trail improvement projects, especially the tracking of efforts among corps members and the detection of temporal changes in trail improvement needs as influenced by environmental, use, and managerial factors. As this methodology is expanded to other corps working in different ecosystems, new trail indicators may be needed. The adaptive design of the evaluation protocols allows for efficient incorporation of new indicators or adjustments of current indicators.

Effective public lands management in the form of trail building and maintenance by environmental service learning corps supports the purpose and value of these natural spaces. Work by corps on the largest indicator changes recorded in this evaluation, for structural damage, drainage features, natural debris, and muddiness, enhanced recreation function and build upon the capacity to encourage visitation and associated benefits. Evaluation of such work provides a meaningful, measurable illustration of this important work, and its implication in parks and public lands across the country.

Appendices

Appendix 1 – Annotated Bibliography of Select References

The development of trail evaluation protocols was informed in collaboration with PLSC corps and through literature reviews. Project themes focused on erosion/water control, removal of natural debris, and improvement of ecological health, safety, and visitor experience. The following is a selection of the literature informing the evaluation protocols and assessment instruments.

Trail Work:

- Kaplan, R., Kaplan, S., & Ryan, R. (1998). W*ith people in mind: Design and management of everyday nature*. Washington, DC: Island Press.
    - The book, leveraging theory and practice in environmental psychology, focuses on the design of natural areas and how to improve design for visitor experience and compatibility with nature. A relevant discussion point for this evaluation is that trail width and surface can influence visitor experience. Visitors prefer trails that are compatible with their natural surroundings, with erosion and water control issues negatively detracting from visitor experience.
- Moore, R. L., Leung, Y.-F., Matisoff, C., Dorwart, C., & Parker, A. (2012). Understanding users' perceptions of trail resource impacts and how they affect experiences: An integrated approach. *Landscape and Urban Planning*, *107*(4), 343–350.
    - Results from a questionnaire of study participants (convenience sample) show all but one type of trail impact were found to have negative effects on user experience. Mud, standing water, and litter (man-made) were found to have the greatest negative impact.
- Verlič, A., Arnberger, A., Japelj, A., Simončič, P., & Pirnat, J. (2015). Perceptions of recreational trail impacts on an urban forest walk: A controlled field experiment. *Urban Forestry & Urban Greening*, *14*(1), 89–98.
    - Survey of trail users (convenience sample to test age and educational levels) assessed the extent to which users noticed visual trail impacts -- erosion, litter, exposed roots, vandalism, muddy trail sections, divergent and parallel trails, excessive trail width, domestic animal waste, and sporting activity impacts -- and the degree of influence the impacts had on their experience. The study also compared the perceptions of impact to objective measures of actual impact occurrence. Results indicated visitors positively perceived maintained trails, however scattered deadwood, erosion, and lack of management were perceived negatively. Reported perceived extent was also comparable to assessed impacts, though muddy trail sections, parallel tread, and sporting activity impacts were perceived to a greater extent than actual occurrence.
- Eagan, S., Newman, P., Fritzke, S., & Johnson, L. (2004). Subalpine meadow restoration in Yosemite national park. *Ecological Restoration*, *22*(1), 24–29.

- The article discusses the use of volunteers and Conservation Corps to conduct ecological restoration of a subalpine meadow impacted by multiple sections of deeply rutted, multiple-tread trails and evaluates the success of native species restoration. The percent cover and species richness within the restored trails and adjacent meadow were evaluated five years after the conclusion of the restoration efforts and found the restored area had not lost any soil and experienced high levels of species recovery for the elevation (e.g., mean percent cover of 43% and 56% in disturbed and undisturbed areas, respectively).

Assessment Techniques:

- Hammitt, W., Cole, D., & Monz, C. (2015). *Wildland recreation: Ecology and management*. Hoboken, NJ: John Wiley & Sons, Ltd.
  - The book provides a comprehensive overview of recreation impact to various environmental components (e.g., soil, vegetation, water, wildlife) and a review of visitor impact research and management strategies. This resource was consulted to leverage best assessment practices (e.g., condition classes, multiple parameter rating systems, quantitative measurements, visual assessments), research discussing assessment and impact considerations in different habitats, and ensure resulting indicators met the seven characteristics of desirable indicators: measurable, reliable, cost-effective, significant, sensitive, efficient, and responsive (p. 187).
- Marion, J.L., & Leung, Y.-F. (2001). Trail resource impacts and an examination of alternative assessment techniques. *Journal of Park and Recreation Administration, 19*(3), 17-37.
  - The article provides a review of trail impact and assessment methodologies for inventory, maintenance, and condition assessment following problem or point sampling methodologies. The benefits and limitations to each are discussed in the context of management and information needs. Findings suggest the problem assessment method, where data are recorded whenever an issue is identified and for the entire length of that issue, provides accurate information for problems that are easily predefined or infrequent. Collecting data at systematically determined locations (i.e., point sampling), as opposed to problem assessment where data are collected each time a problem is identified along a trail, is a more accurate assessment of trail characteristics that are continuous for frequent. For this evaluation, observations will be conducted in a hybrid fashion - non-random point locations as determined by the identification of a problem, but not for the length of the entire problem.

Appendix 2 – Other Activities Conducted to Achieve Project Objectives

Other Activities to Restore Recreation Function*	Number of Projects
130 feet of cribbing and 55 steps installed, 20-foot rock retaining wall installed	1
5 Carsonite trail signs installed	1
Blazing - 11.28 miles	1
Blazing - 2.2 miles	1
Built 4 puncheons	1
Existing trail brought into ADA compliance, new ADA trail made to Marsh/Whiteface overlooks	1
GPS trails - 27.3 miles	1
Installed 21 trail signs throughout forest	1
Installed trail signs and Kiosk to serve the entire park - 20.25 miles	1
Marking trails - 2.25 miles	1
Planting trees along the trail for recreational use	1
Removing damaged bridge - 20 feet	1
Removing old bridge - 30 feet	1
Restored Historic Shelter - 1 shelter and associated foundation	1
Restored Historic Shelter - 1 shelter, 240 square feet	1
Stepping stones - 52 feet	1
Removed trash from surrounding area, enough to fill one 50-gallon trash bag	1
Grand Total	**17**

Other Activities to Reduce Natural Obstructions & Hazards*	Number of Projects
Chain sawing	1
Cleared 3 trees that were blown down into the trail with chainsaws	1
Cleared 4 fallen trees	1
Invasive Species Removal - 0.5 acres	1
Removed concrete blocks that were in place to act as stairs	1
Cleared about 12 trees that were laying across the trail	1
Cleared about 15 trees that were laying across the trail creating obstructions	1
Worked 11 miles of trails, clearing 60 or more fallen trees and numerous clusters of downed trees (“widow makers”)	1
Removed several large boulders, roots, and other minor tripping hazards, and 3 boulders, roughly 200-300 pounds each, were adjusted to fit into the rock crib wall trail retention structure	1
Grand Total	**9**

*Responses are as reported by corps