AmeriCorps St. Louis
Impact Evaluation Report

Program Name:
Partnership for Youth, Inc dba AmeriCorps St. Louis

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Summary

Having been in operation since the inception of the AmeriCorps National Service program in 1994, AmeriCorps St. Louis has continuously provided disaster response and environmental stewardship while exemplifying the highest value of national service for the last 27 years. The organization has learned from evaluations of National Civilian Community Corps as well as two internal evaluations about the benefits and effects of our work. For the first time, we conducted an impact evaluation to gather some rigorous quantitative data to measure the effects of our environmental stewardship efforts by examining the treatment of invasive species at the Greenwood Cemetery in St. Louis, the region's first non-sectarian commercial cemetery for African Americans. This impact evaluation sought to answer the following three questions:

1. Is a homemade solution effective for reducing wintercreeper coverage compared to a no treatment comparison group?
2. Is a commercial solution (Contact Organics) effective for reducing wintercreeper coverage compared to a no treatment comparison group?
3. Is a homemade or a commercial solution more cost-effective for reducing wintercreeper coverage considering both the relative impact and cost?

ACSTL members measured out 120 plots of land, divided them into three groups, and applied one of two solutions (along with a 'no-treatment' control group) once every month for six months. **The results of this quasi-experimental design study show that a homemade solution was more effective and cost effective than both a 'no treatment' comparison group and a commercial solution at reducing wintercreeper coverage.** The commercial solution was more effective than a no-treatment comparison group. Both the homemade solution and the commercial solutions reflected a statistically significant decrease in average invasive species coverage between the two time points. The results of this evaluation provide promising results to greatly reduce the costs and labor associated with invasive species removal at this site. Findings from the evaluation will be used to expand treatment to the remaining untreated acreage at the cemetery and have implications beyond this site for the ability to be recreated and modified to continue expanding the impact of AmeriCorps St. Louis' impact on the environment and benefit to our partners.

Introduction

AmeriCorps St. Louis (ACSTL) serves to protect people and places through service to local, state, and national communities through two program areas: Emergency Response and Environmental Stewardship. This evaluation will focus in the Environmental Stewardship program area, and specifically on the program activity of invasive species removal. ACSTL worked with the Brown School Evaluation Center at Washington University in St. Louis on this evaluation (Evaluation Team). The Brown School Evaluation Center's mission is to help organizations create lasting social impact through strategic learning and evaluation.

The Evaluation Team identified one of the long-term outcomes as articulated in their program's logic model to further examine. The long-term outcome for the Environmental Stewardship program is as follows: Ecosystems and wildlife habitats will be better suited for natural diversification through long-term effects of invasive species eradication, native habitat restoration, prescribed fire controls, and timber stand improvements. This evaluation will support ACSTL's theory of change by measuring the impact of invasive species removal on the surrounding ecosystems and habitats. The site upon which the null hypothesis will be tested is Greenwood Cemetery in Saint Louis, Missouri.

Established in 1874, Greenwood Cemetery is the first commercial burial ground for African Americans in the city of Saint Louis. Based on advocacy efforts from the Greenwood Cemetery Preservation Association and Friends of Greenwood, the Cemetery was listed on the National Register of Historic Places in 2004 (National Park Service, 2004). The property is 31.85 acres and contains approximately 50,000 graves of African Americans whose deaths range in date from 1874 to 1993. Greenwood Cemetery's historian and archivist said of the cemetery: "Greenwood is almost a picture, a window into the early history of African Americans in the city of St. Louis" (Woodbury, 2020). Left largely unmonitored since 1993, ACSTL is partnering with the Greenwood Cemetery Preservation Association to support efforts to clear cemetery brush, reveal existing grave markers, and restore the property for the purposes of cultural and ecological restoration. See Appendix A for reference photos. This evaluation compared the effectiveness of two methods of land management employed by ACSTL at the Greenwood Cemetery to inform its practices in maintaining the effects of its invasive species removal.

Goals & Objectives

This impact evaluation examined the land management intermediate outcomes identified in one of two Environmental Stewardship logic models developed by ACSTL. The intermediate outcome on the logic model is: "Lands improved to agency standards will allow for more efficient and effective maintenance with limited land management resources" (See Appendix B). This also supports the latter half of ACSTL's theory of change that AmeriCorps St. Louis' services 1) caused disaster response partners to experience positive change in both knowledge/skill and service delivery of disaster response and recovery operations; and 2) assisted environmental stewardship partners to meet their land management targets/goals. The selected indicator for determining land improvement as a result of ACSTL AmeriCorps Member activities is a decrease in the density of invasive species after treatment compared to baseline as a result of ACSTL's interventions. Specifically, this evaluation aims to identify which treatment regime (homemade vinegar-based solution or commercial product Contact Organics) was most effective at decreasing the density of wintercreeper at one identified site, Greenwood Cemetery. The intermediate outcome was chosen to best suit the timeline of the evaluation, and because our Greenwood Cemetery partners prioritized the removal of invasive species as a necessary intervention as a means to restore the property.

Due to the introduction of non-native plants by humans in the service of landscape restoration, biological pest control, food processing, and more, many invasive species have been introduced to and overtaken new regions in the United States at a rapid rate, causing negative impacts on both ecosystems and human welfare (Pimentel et al., 2005). Wintercreeper (*Euonymus fortune*) is an invasive, non-native plant species introduced from Asia that can be found throughout the Midwest (Rounsaville, 2017). The trailing, fast growing vines create dense mats of ground cover that smother other plants and suck the nutrients and moisture from the soil, changing soil chemistry and bacterial composition (Bray et al., 2017). Wintercreeper also has the ability to grow vertically, and when a vertical structural host (tree) is found, it grows even larger as it parasites off the tree (Rounsaville, 2017). Severity (density and % cover) of wintercreeper invasions may be positively related with proximity to human development. While ACSTL has extensive experience with invasive species removal through its Environmental Stewardship activities, wintercreeper removal is a new endeavor. Greenwood Cemetery is located in Saint Louis, a major urban area, which is prime ground for wintercreeper invasion, as it has been shown to be a greater problem in urban woodlands (Zouhar, 2009).

Biological invasions, such as those in urban woodlands, are one of the most prominent ecological disturbances that threaten native biodiversity (Mollot et al., 2017; Homoya, 2011). It has been shown that a wide variety of invasive species removal processes can lead to an increased chance of success for native plant restoration (Reid, et al., 2009). The first phase of ACSTL's engagement with Greenwood Cemetery will be to remove the invasive species using multiple methods of removal, with subsequent phases aimed at re-introducing native plant species to the property. Successful native plant restoration facilitates the conservation of species through interactions between native plants, their consumers, and their pollinators, which provides the foundation of the ecosystem upon which humans and wildlife depend (Baughman et al., 2022). In order to maintain the Greenwood Cemetery property, ACSTL will seek to remove the invasive species (i.e. wintercreeper) and determine the most efficient treatment by which to do so through comparing two treatment types to a no treatment group.

ACSTL and their partners at Greenwood Cemetery are committed to using organic herbicides for invasive species removal for both economic and environmental reasons. Studies on common non-organic herbicides, such as glyphosate (i.e. RoundUp), show increased evidence of harmful impacts on humans and the environment. A 2016 World Health Organization Report concluded that glyphosate is "probably carcinogenic to humans," among other harmful health impacts. Knowing Greenwood Cemetery sits adjacent to a residential area, ACSTL did not want to introduce glyphosate to the area. Environmentally, glyphosate usage has been linked to disruption of soil biology, habitat destruction, and ground water contamination (Ho & Sirinathsinghji, 2012). Without AmeriCorps support, the cemetery is maintained by one volunteer, so cost efficiency was a significant factor as well. Economically, glyphosate is much more costly than natural homemade solutions. One gallon of commercial glyphosate concentrate costs $53 from a typical home improvement retailer, compared to one gallon of a homemade solution (dish soap, vinegar, and water) costing approximately $15 (Home Depot, 2022). If natural homemade solutions are not as effective as invasive species removal, then a commercial organic solution is preferable for use, though it is the most expensive option for treatment. The selected organic commercial solution for this evaluation, Contact Organics, costs $150 per gallon (Contact Organics, 2022). See the table below for a comparison of these common herbicidal treatments. While ultimately it would be more fiscally prudent to utilize a homemade solution, a commercial organic solution would be more efficient to reduce the coverage of invasive species while also using a natural solution.

Table 1. Comparison of common herbicide treatments

	Commercial Glyphosate	**Homemade Organic Solution**	**Organic Commercial Solution (Contact Organics)**
Cost for 1 gallon	$53	$15	$150
Net environmental impact	Negative	Positive	Positive

This impact evaluation sought to assess whether AmeriCorps Members' invasive species removal activities had a positive impact on the land management and restoration activities in Missouri. Specifically, the evaluation addressed the efficiency of invasive species maintenance through the following research questions when using organic herbicides for invasive species removal:

1. Is a homemade solution effective for reducing wintercreeper coverage compared to a no treatment comparison group?
2. Is a commercial solution (Contact Organics) effective for reducing wintercreeper coverage compared to a no treatment comparison group?
3. Is a homemade or a commercial solution more cost-effective for reducing wintercreeper coverage considering both the relative impact and cost?

Data was collected at two different time points throughout a six-month period:

- Immediately prior to invasive species treatment in June 2022
- Approximately six months after invasive species treatment in November 2022

As the growing season for wintercreeper is year-round, a six-month window during the program year was chosen to examine effects based on the availability of the ACSTL team. This impact evaluation utilized comparison data from monitoring plots that were not treated with any herbicides.

Methods

This independent impact evaluation includes a quasi-experimental design (QED) and was conducted primarily by ACSTL Members in partnership with external evaluators at the Brown School Evaluation Center and with the Greenwood Cemetery Preservation Association.

ACSTL's staff sought to gain answers on which treatment regimen is more or most effective, thus comparison and control for application requires a quasi-experimental design approach.

Comparison Group

This research examined the impact of various organic herbicides on the removal of invasive species. Greenwood Cemetery was the selected site for this evaluation, given the timeline of planned activities, as well as the autonomy ACSTL has as the only group contracted to collaborate with the Greenwood Cemetery Preservation Association on the removal of invasive species.

This quasi-experimental design examined two treatment groups based on monthly applications of two types of organic herbicide applications: a homemade organic solution and a natural commercial solution. The amount

of wintercreeper reduction on plots of land in each treatment group was compared to the change in coverage of wintercreeper on plots in a comparison group that receives no treatment. The first treatment is a homemade herbicide that is a homemade solution comprised of dish soap, vinegar, and salt (Carreiro et al., 2020). The second treatment is a commercial natural solution, Contact Organics, was chosen because of its proven efficacy while also using non-toxic and environmentally friendly ingredients (Contact Organics, 2022). These topical solutions were chosen because of their low-cost and feasibility compared to AmeriCorps Members' typical treatment of invasive species via hand pulling, given that without AmeriCorps engagement one volunteer manages the property. In this experiment, applications were applied by AmeriCorps Members using a spray applicator, which took about 20 minutes to cover each plot area. This application was sprayed onto the two treatment plot areas once per month six months, from June through November 2022. The hope is for either solution to be sustainable for this volunteer to maintain beyond AmeriCorps' engagement and the initial treatment. Since multiple applications will be necessary to work on these resilient species, the primary goal of this evaluation is to understand which solution should be applied to most efficiently reduce wintercreeper coverage.

Sampling Methods

Greenwood Cemetery sits on 32 acres, 14 acres of which have been treated previously with manual removal techniques. ACSTL has a planned engagement to support the clearing of the remaining 18 acres in collaboration with ACSTL staff, AmeriCorps Members and volunteers. The designated area for treatments is a 10-acre subset of the untreated acres. This area was chosen because it has minimal foot traffic and will not overlap with other planned activities so as not to invalidate study findings.

Figure 1. Satellite view of Greenwood Cemetery and designated treatment area

In this case, sites could not be randomly selected within the cemetery because some areas had already been treated, and other areas include unmarked graves that will be worked on during the time period of the evaluation. One prominent example is the grave of Harriet Robinson Scott, 19th-century freedom fighter and

wife of Dred Scott, whose grave remains undiscovered but is known to be located within a particular subsect of the cemetery. A volunteer group is going to erect a monument to honor her life and legacy.

Eligibility criteria for inclusion in the sample plots included the following:

- Located within the 10 acres of designated treatment area
- Safe to navigate (e.g. topography is even, safe distance from power line on property)
- No planned gravestone recovery on the impacted gravestones and markers
- Not previously cleared
- No highly shaded areas with heavy tree coverage

To determine locations of sample plots, volunteers staked out three plot areas, each 40 square meters that meet the eligibility criteria outlined above, each assigned to a study group (no treatment comparison, homemade application, or commercial application). Each plot area was several meters apart so as to mitigate any effect of wind, application spray, or runoff. Within those plot areas, volunteers staked out 1x1 meter plots and assigned each plot a number for subsequent monitoring using survey flags. A map was then constructed of the location and condition assignment of all staked out plots within the area (see Appendix D). Due to the homogeneity of the landscape, it was determined that random sampling of each plot to a treatment type was not necessary.

Sample Size

A power analysis was conducted using G*Power for a repeated measures, between factors ANOVA that had three total groups (conditions, in this case, the two different herbicide application schedules and a control comparison group that received no treatment). Alpha was set to .05 and power to .80 as is standard practice, and the benchmark for an anticipated medium effect size of d=.25 was used. A medium effect size was predicted based on the critical importance of application schedules in successful use of herbicide for plant management, and the use of two very different methods of application (homemade vs. organic). Power analyses using these parameters yielded a minimum sample size estimate of 120 plots needed to detect the predicted difference between groups, 40 in each condition.

Data Collection Procedures

As all of these herbicide methods are non-specific, meaning they will affect any plants they contact, applicators were spot sprayed, holding nozzles no more than 5 or 6 inches from target-wintercreeper in the plots, avoiding other plants if possible, when they are present in the plots.

Twice throughout the evaluation (immediately prior to and six months after intervention), data were collected about the plots being monitored and percent coverage was estimated (see Appendix C). The data and photos of each plot collected into a spreadsheet for comparisons at the end of data collection. The information collected at each timepoint was:

- The plot being sampled
- The estimated percent coverage of live wintercreeper
- A photo of the plot

Percent coverage within each plot was measured by using the plot photos and super-imposing a 10x10 grid using Google Draw to visually estimate percent coverage (see Appendix E). Photos were taken using the same parameters (e.g. angle, distance above ground, distance from plot, etc.) at each time point. The same two team members estimated percent coverage at each time point and for each plot by reviewing the photos of each of the 120 plot areas and then summing the measure of the percent coverage within each one of the 100 squares created by the grid; their estimations were averaged to produce a more objective percent coverage

per plot. The members who measured this percent coverage were not the ones who conducted maintenance at Greenwood Cemetery, so as to eliminate the potential incentive to overestimate the efficacy of the treatment. The photos of the groups were labelled “A, B, and C” so as to mask the identity of the treatment group. It is possible, however, that the team members viewing the photos could have ascertained which treatment group they were viewing, as the original files were labelled by their treatment group and not in a way that was blind.

The data collected was then compared across treatment groups and to the control group in order to assess the efficacy of each application schedule at eliminating wintercreeper and to assess the effects on other preferred groundcover species.

Statistical Approach

For addressing research questions 1 and 2, a mixed methods ANOVA was used to compare differences between the two treatment groups and a non-treated control (1 categorical condition, 3 levels) on wintercreeper cover over time (continuous measure of ground cover by invasive plant 0-100%) with outcome measures taken at two time points, before treatment application and six months post treatment. Post-hoc comparison of means between conditions were utilized to determine direction of any significant differences identified. Post hoc analyses of ANOVA compared means between two groups at a time to see where the significant differences were emerging— e.g., is the significance being driven by differences in control vs. treatment 1 or control vs. treatment 2, or is there also significant differences between treatment 1 and 2 when comparing group means. Data were analyzed in SPSS v27. This approach tested the null hypothesis that there was no difference between wintercreeper coverage before and after treatments.

For addressing the third research question, both the magnitude in the difference in the effectiveness of the two treatment groups and the relative cost of each treatment type were considered in determining which treatment is most cost-effective for use in future applications and maintenance of the plots.

Results

A mixed-effects ANOVA was conducted in SPSS using time (pre-treatment and 6 months post-treatment) as a within-subjects factor and treatment group (control, contact organics commercial solution, and homemade vinegar solution) as a between-subjects variable. There was a very strong, statistically significant effect of treatment group on percent of wintercreeper present over time ($F=1172.82$, $p<.001$, $\eta_p^2=.91$). Following this up with post-host testing via the Tukey HSD, it was found that each treatment group was significantly different from one another ($p<.001$) with the greatest difference being between the control group (M=73.01%) and the homemade vinegar solution treatment (M=44.16%, $p<.001$), which was found to be more effective than the commercial organic solution (M=52.74%, $p<.001$). A paired samples t-test was then conducted to analyze change over time for each condition individually. There was no significant change in wintercreeper coverage of the untreated control plots over the 6-month time period, ($t=-1.674$, $p=.10$). Though not significant, it should be noted that coverage seemed to increase over time in the control plots, which would make sense considering the natural, year-round growth cycle of wintercreeper. The use of a commercial organic pesticide resulted in a significant (37.45%) decrease in wintercreeper coverage ($t=20.38$, $p<.001$). The largest difference between time points was seen for the vinegar solution: plots that were treated with it saw a 69.29% decrease in coverage ($t=46.64$, $p<.001$). See Table 2 below for side-by-side comparisons of percent coverage for each condition and a graph of the interaction between time and treatment condition below.

Table 2. Comparison of Average Invasive Coverage Over Time

Treatment	***Average Invasive Coverage: Time 1***	***Average Invasive Coverage: Time 2***	***Average Change in Coverage***
Control	*71.43%*	*74.59%*	***+3.16%***
Contact Organics	*71.47%*	*34.02%**	***-37.45%***
Vinegar Solution	*78.81%*	*9.52%**	***-69.29%***

**Statistically significant decrease in invasive species coverage*

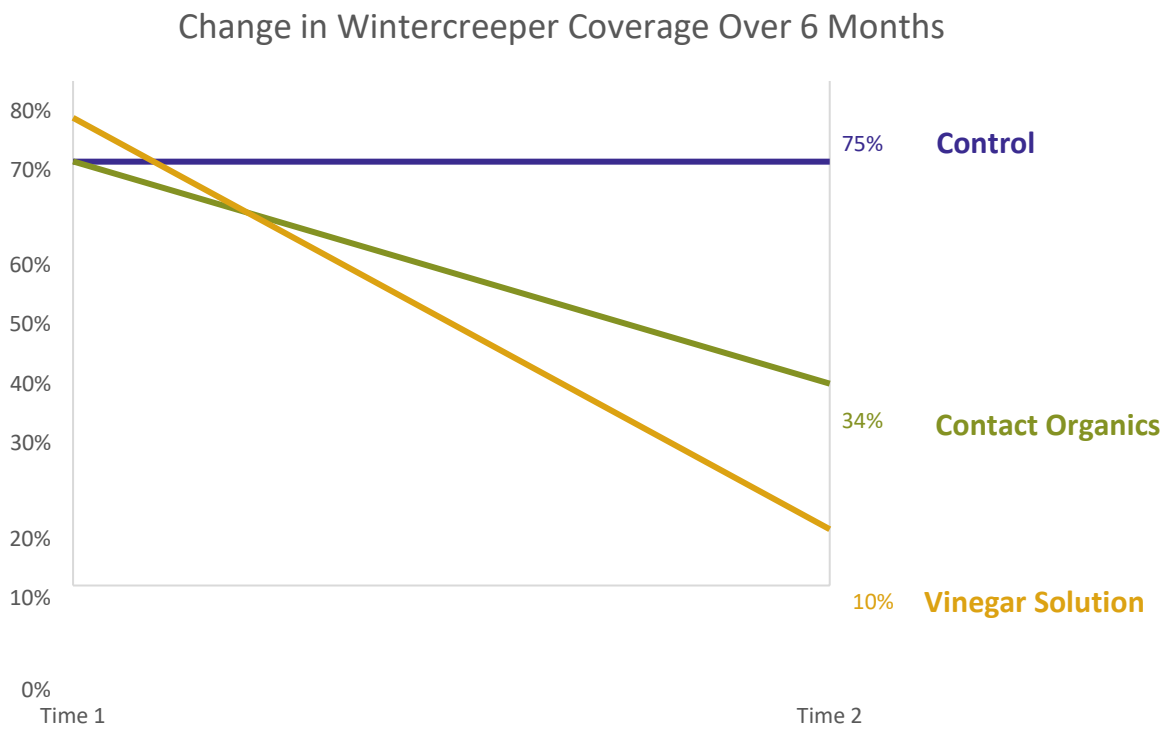


Figure 2. Change in coverage over time

Figure 3. A side-by-side comparison of a plot (#39) that received the homemade vinegar solution before (left) and post (right) treatment. Example images were chosen by using a random number generator and before and after pictures from the corresponding plot number.

Discussion

Based on the results of this impact evaluation, the invasive species removal methods of both a commercial organic pesticide and a homemade vinegar solution utilized by AmeriCorps St. Louis proved to be an effective way to decrease wintercreeper coverage, with the homemade vinegar solution proving to be even more effective than its store-bought counterpart at decreasing invasive wintercreeper in treatment areas. In addition to coverage, this study also identified that this homemade vinegar solution method was also the most cost-effective method when compared to the price of commercial organic pesticide ($15 vs. $150 per gallon). The results of this evaluation provide promising results to greatly reduce the costs and labor associated with invasive species removal at this site.

Limitations may be present in the short time frame evaluated (ground cover over a 6-month time span while receiving active treatment). It is unclear from the current evaluation what the sustainability of both treatments are at keeping wintercreeper at bay over the long term, post any active treatment. If replicated, the study could be improved in its validity by having the team members be completely blind to the treatment group when estimating the percent coverage within each plot area; it was feasible during this study that the team members who estimated the percent coverage during this study could have known the treatment groups they were viewing, as the original photos were labelled by treatment group and not in a de-identified way (e.g., “A, B,C”). Additional opportunities for inquiry remain, both for longer-term results and for broader geographical contexts outside of urban wooded cemeteries.

Findings from the evaluation will be used to expand treatment to the remaining untreated acreage at the cemetery. While the schedule of a monthly application can be maintained for now, further inquiry remains around additional time points using the homemade solution (e.g., one month compared to three months). Additionally, findings from this evaluation could be replicated in other contexts and on other invasive species, and could readily be replicated in other invasive species removal work in future program years to further refine ACSTL’s approach.

Appendix A: Photos of Greenwood Cemetery

Figure 4. Pre-intervention photo of ground cover, Greenwood Cemetery

Figure 5. Eastern side of cemetery, Time 1

Figure 6. Unattended grave marker in Greenwood Cemetery

Figure 7. Time 2 photo of treatment plot 2, Contact Organics solution

Figure 8. Time 2 photo of treatment plot 3, vinegar solution

Figure 9. Time 2 photo of cemetery

Appendix B: Program Logic Model

AmeriCorps

LOGIC MODEL CHART - EN4.1

NAME OF APPLICANT ORGANIZATION: Partnership For Youth, Inc, d.b.a. AmeriCorps St. Louis

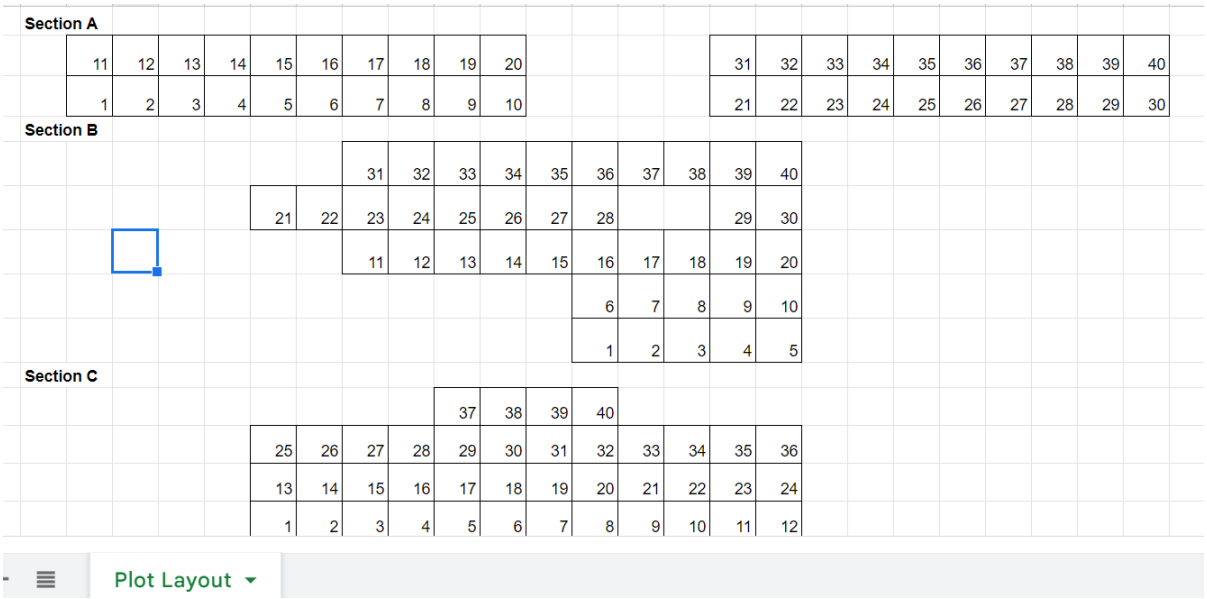
PROBLEM STATEMENT:	Natural resource and conservation agencies -- federal, state and nonprofit -- are underfunded and understaffed and thus have inadequate resources to effectively support the conservation and preservation of public lands for ecological sustainability and recreational enjoyment.				
INPUTS	**ACTIVITIES**	**OUTPUTS**	**OUTCOMES**		
			Short-term	**Medium-term**	**Long-term**
What we will invest, including # of ACMs and # of service site locations	*What we propose to do*	*Direct products from program activities (e.g. # of beneficiaries / participants)*	*Changes in knowledge, skills, attitudes, opinions*	*Changes in behavior or action that result from participants' new knowledge*	*Meaningful changes, often in participants' condition or status in life*
- 10 full-time MSY for an 11-month term - 7 Staff Members - AmeriCorps funding, in-kind donations, earned income, and other program funds - Training & Certifications in wildland fire chainsaw operations, Missouri ecology and forestry, hand tool use, herbicide application, etc - Program tools, equipment, PPE, and vehicles - Over 20 years of organizational expertise and background - ACMs will complete service interventions at the local, nonprofit, state and federal level in Missouri, with limited projects in Illinois and Montana	Teams of skilled ACMs will serve on weekly service projects, partnered with 21 different public land agencies and/or subsidiaries across multiple levels of public lands. ACM service interventions will range seasonally and include invasive species eradication, prescribed fire support, timber stand improvement, native glade restoration, riparian area improvements, native habitat restoration, public access facility improvements, and recreation area improvement.	9,500 Acres of Parks or Public Lands Treated	9,000 Acres of Parks or Public Lands Improved to agency standards. Land Managers will be surveyed to attest to improved public lands attributed to partnering with AmeriCorps St. Louis in the efforts to support public lands	Lands improved to agency standards will allow for more efficient and effective maintenance with limited land management resources. Land managers will be assessed on changes to their future implemented actions due to AmeriCorps St. Louis interventions.	Ecosystems and wildlife habitats will be better suited for natural diversification through long-term effects of invasive species eradication, native habitat restoration, prescribed fire controls and timber stand improvements. Long-term outcomes will be assessed with public agency data attributed to public land ecology.

Appendix C: Wintercreeper Plot Coverage Analysis

Solution	Plot Number	Estimated % Coverage - LV	Estimated % Coverage - LD	Average % Coverage
Control	A1	95.11%	95.03%	95.07%
Control	A2	90.16%	88.74%	89.45%
Control	A3	86.67%	88.25%	87.46%
Control	A4	84.21%	82.89%	83.55%
Control	A5	82.26%	78.95%	80.60%
Control	A6	84.10%	80.93%	82.52%
Control	A7	90.22%	84.14%	87.18%
Control	A8	87.15%	86.26%	86.71%
Control	A9	76.04%	74.23%	75.13%
Control	A10	64.25%	63.84%	64.04%
Control	A11	84.13%	82.80%	83.46%
Control	A12	78.16%	80.23%	79.20%
Control	A13	78.44%	73.46%	75.95%
Control	A14	73.86%	77.01%	75.44%
Control	A15	75.82%	74.74%	75.28%
Control	A16	82.14%	77.65%	79.89%

Baseline | Endline

Appendix D: Plot Layout



Appendix E: Estimating Percent Coverage via Plot Photos

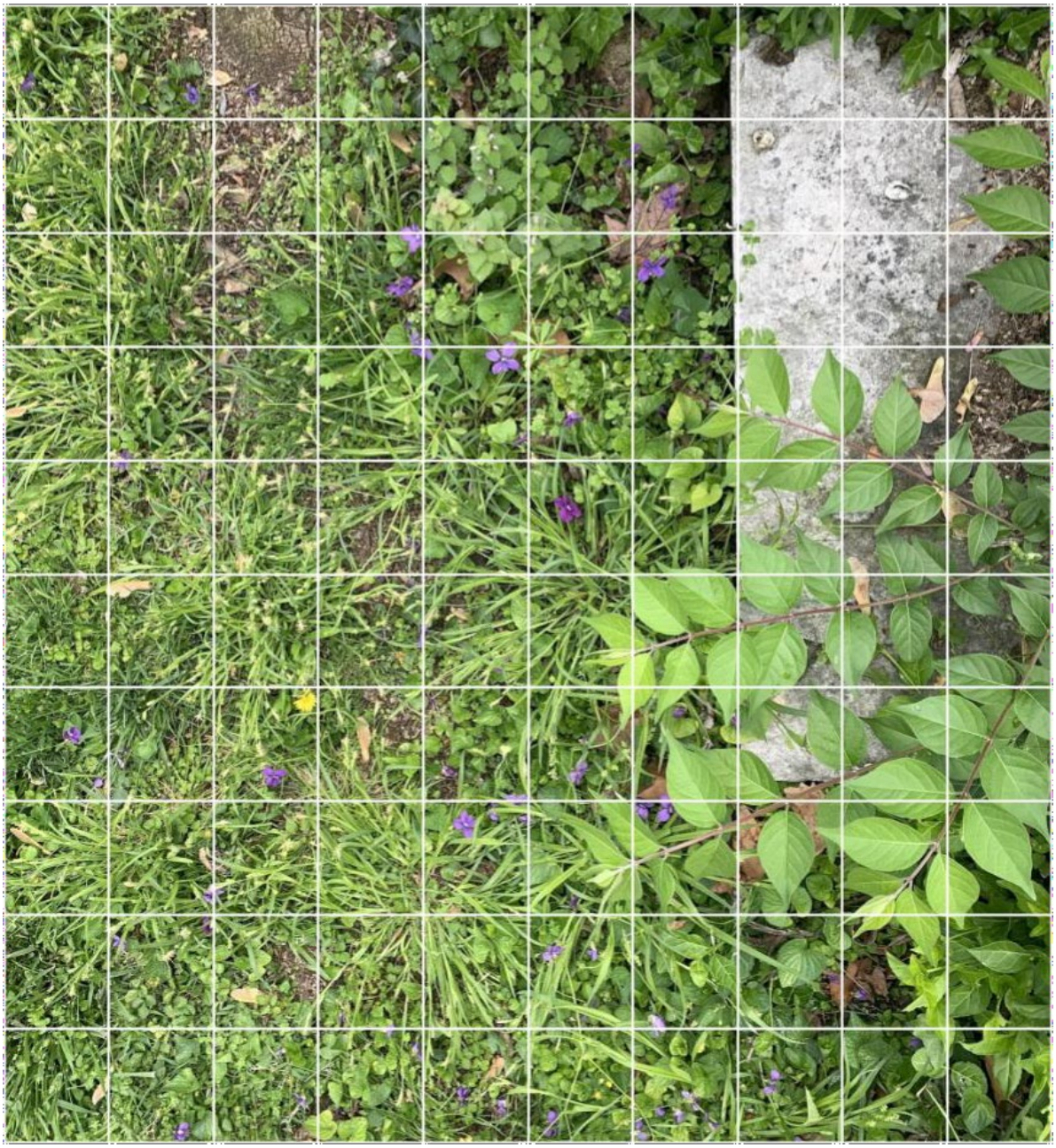


Figure 10. Superimposed grid on top of photo to estimate invasive species coverage

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