

## THE IMPACT OF AMERICORPS MEMBERS IN INVASIVE SPECIES AND WILDFIRE FUELS MITIGATION

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### Abstract

*Millions of acres of public lands in Montana, Idaho, North Dakota, South Dakota, and Wyoming are imperiled by invasive species and wildfires, which reduce ecosystem health, decrease the productivity of public lands for wildlife, diminish recreation assets, and threaten the safety for communities. There is a need to manage public lands to sustain ecosystem services and enhances human safety. Agencies responsible for managing these lands, including the Forest Service, National Park Service, BLM, State Parks, and others, lack the capacity to complete such work and rely on the intervention of AmeriCorps members to mitigate the spread of invasive weeds and reduce wildfire fuel loads that threaten communities and habitat. For this evaluation, Montana Conservation Corps (MCC) is collaborating with a cohort of conservation corps (Public Lands Service Coalition (PLSC)) to conduct a national evaluation. This study is led by Dr. Allie McCreary and Dr. Lily Popova Zhuhadar from Western Kentucky University. This research aims to assess the impact AmeriCorps members may have in reducing invasive species and minimizing wildfire fuel loads on public lands. In this research, we introduce preliminary results of the evaluation method used to assess the impact of AmeriCorps members on natural and recreation resource enhancement.*

**Keywords:** *Ecosystem Health, Public Lands, Ecosystem Service, AmeriCorps, Before-After-Control-Impact (BACI) quasi-experimental design*

## 1. INTRODUCTION

Existing studies have demonstrated that invasive species reduce biological diversity and have negative impacts on human well-being (Rai & Singh, 2020; Pysek & Richardson, 2010) and wildfire fuels reduction can positively benefit wildlife (Fontaine & Kennedy, 2012; Pilliod et al., 2008) as well as enhance the safety of built environments in the wildland-urban interface (Stevens et al., 2014). When removing invasive species, ‘aggressive suppression’ (i.e., removal of 90% of invasive vegetative cover) is as beneficial as complete eradication for long-term ecosystem health (Prior et al., 2018) and overall success of invasive species management depends on target species and the ratio of invasive and native cover (Adams et al., 2008).

Often, public land management personnel partner with external entities to complete such tasks (McCreary et al., 2012). Understanding how corps partnerships contribute to these objectives through collaborative management with public land management agency sponsors, will establish the role of AmeriCorps members in contributing to positive environmental outcomes on public lands (e.g., Conner, 2016, Davis, 2015).

## 2. RESEARCH METHODS

### 2.1. Past Research and Existing Evidence

For this evaluation, **Montana Conservation Corps (MCC)** will collaborate with a cohort of conservation corps (**Public Lands Service Coalition (PLSC)**) to conduct a national evaluation to assess the impact AmeriCorps members may have in reducing invasive species and minimizing wildfire fuel loads on public lands.

MCC participated in a previous evaluation (2015-17) with the PLSC to measure the impact of AmeriCorps members on natural and recreation resource enhancement. Preliminary results were shown statistically significant evidence demonstrating the efficacy of members in improving trails and habitats on public lands, resulting in enhanced recreational access and experiences, reduced fire risk, and decreased invasive plant cover resulting in improved ecological conditions for native species. This evaluation utilized a pre/post visual assessment design to show statistically significant results that were accepted as “preliminary” evidence meeting criteria for an **Alternative Evaluation Approach**.

Building on this previous evaluation, MCC and the PLSC propose a **Before-After-Control-Impact (BACI) quasi-experimental design** to strengthen evidence of environmental stewardship. The evaluation will measure outcomes on project sites treated by AmeriCorps members and assess ecosystem indicators for comparison sites. Assessment of treatment, or impact, plots and control plots will be performed before and after treatment.

### 2.2. Theory of Change

MCC partners with federal, state, local government agencies and with nonprofit organizations to improve public lands. This evaluation will focus on the ability of AmeriCorps members to reduce invasive species populations and reduce wildfire risk through canopy thinning practices.

MCC’s theory of change addresses outcomes related to the AmeriCorps focus area of environmental stewardship, and strategic plan objective for at risk ecosystems. MCC members complete projects to remove invasive species and reduce wildfire risks. Both activities are measured in acres of habitat treated (output) and improved (outcomes). The inputs necessary to deliver these interventions include the AmeriCorps members. An external evaluation team will be providing protocols to assess habitat treatment and improvements.

## 3. OUTCOMES AND RESEARCH QUESTIONS

The overall aim of the proposed evaluation is to examine the outcomes of AmeriCorps members on at-risk ecosystems, specifically those in need of invasive species or wildfire fuels management. This will be assessed via a quasi-experimental design (QED), before-after control-impact (BACI) evaluation approach comparing treated plots (managed by AmeriCorps members in partnership with a public land management agency) to comparison control plots for two habitat management project types: invasive species management and wildfire fuel management.

The long-term outcomes of these types of habitat management projects include enhancing biodiversity including native flora and fauna, and promoting community safety through less frequent and/or less intense wildfires. Evaluating long-term outcomes would require an evaluation approach spanning several years as these outcomes are not evident until many years after treatment and, with wildfire, only in the unfortunate context that uncontrolled fire spread through the study area. Instead, this evaluation will focus on assessing the short-term outcomes of habitat management by AmeriCorps members.

The primary research questions of this evaluation are:

- Do areas of land treated for invasive species removal by AmeriCorps members demonstrate less invasive species cover in near-term (e.g., three month) evaluations compared to similar plots of untreated land?
- Do areas of land treated for invasive species removal by AmeriCorps members demonstrate more native plant growth in near-term evaluations compared to similar plots of untreated land?
- Do areas of land treated for fuels removal by AmeriCorps members demonstrate reduced fuel load indicators (e.g., number of trees, canopy closure) in near-term evaluations compared to similar plots of untreated land?
- Do areas of land treated for invasive species removal by AmeriCorps members demonstrate less invasive species cover in longer-term (e.g., one year) evaluations compared to similar plots of untreated land?

- Do areas of land treated for invasive species removal by AmeriCorps members demonstrate more native plant growth in longer-term evaluations compared to similar plots of untreated land?
- Do areas of land treated for fuels removal by AmeriCorps members demonstrate less density (and therefore reduced wildfire risk) in longer-term evaluations compared to similar plots of untreated land?

Invasive species management improvement will be assessed by comparing the change in priority, target invasive species vegetative cover on treatment and control plots. Fuels management improvement will be assessed by comparing the change in stand density and canopy cover on treatment and control plots.

#### 4. EVALUATION DESIGN AND RATIONALE

This evaluation is being conducted as part of a larger evaluation by multiple conservation corps organizations from across the country. Participating corps utilize similar program models and partner with public land management agencies on habitat management tasks such as invasive species management and wildfire fuel load reductions. Invasive species treatments vary depending on target species and may include chemical spraying, mechanical removal, and/or utilization of bio-control methods, but share a common objective to decrease the presence of invasive species on the landscape. Prescriptions for wildfire fuels treatments also may vary depending on management objectives but share common objectives to reduce the severity of wildfires by removing biomass fuels (removing trees and/or low growing limbs). Each of the corps participating in this evaluation will have planned projects with public land management agency sponsors related to either fuel and/or invasive species management during the sampling timeframe. Generating data from multiple corps will allow for program-specific data to be collected and analyzed for MCC (and other, individual, participating corps) while allowing for aggregation of multi-state data and a more robust examination of how the nationwide community of PLSC conservation corps environmental stewardship AmeriCorps programs may be improving at-risk ecosystems through habitat management tasks.

Each participating Corps will identify one land management agency sponsor (state park or national forest) with whom they are partnering in the summer of 2022 to complete projects related to either invasive species management (removal: mechanical or chemical) or fuels management (thinning). Together, the Corps, the agency sponsor, and the evaluation team, will identify project areas (i.e., “treatment” areas) and comparable “control” areas within the state park or national forest. Control areas will be similar in slope, aspect, and vegetation composition and density --and for invasive species projects, in the presence and density of the target species to be removed -- to the treatment areas on which Corps have planned projects with the land management agency. Within each control and treatment area the evaluation team will work with Corps to designate 30x30 meter plots. Two, paired plots within each treatment and control area will be established. Corps members, with direction from the evaluation team, will then establish three thirty-meter transects per plot, running horizontally and spaced 7.5 meters apart vertically (see Fig.1. Sampling design illustration, below).

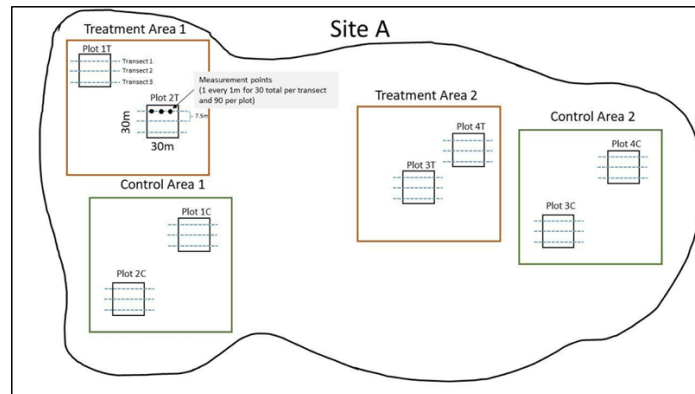


Fig. 1. Illustration of sample site, treatment area pairs, and transect lines.

All treatment areas within a project site will be managed similarly, e.g., mechanical removal of invasive species will be used across all treatment areas within a single site OR chemical removal of invasive species will be used across all treatment areas within a single site OR a combination of chemical and mechanical removal of invasive species will be used across all treatment areas within a single site. Multiple project sites may exist for each participating Corps depending on the capacity (size, duration of working season, etc.) of the Corps members (Sher et al., 2018).

This evaluation will include the sampling of plots within habitat management projects by AmeriCorps members (i.e., treatment plots) and within areas of similar environmental and geographic conditions (i.e., control plots). The work season, and therefore sampling timeframe, will vary depending on the agency-determined ideal timeframe for treatment of target species. Sampling and treatment may occur in the spring, summer and fall when corps have AmeriCorps members engaged in the intervention. A power analysis to determine the number of transects, and subsequently number of plots, will be determined in summer-fall 2021, when corps' 2022 season projects are defined with agency partners as power is influenced by the inherent spatial and temporal variance of the species and ecosystems under investigation. The power analysis will use the R package Emon and function power BACI (e.g., Barry et al., 2017). An initial assessment using the percent changes observed in invasive species percent cover and total number of trees within plots evaluated by MCC in 2017 suggest that approximately 9-14 transects would be required to detect large effect sizes ( $>0.8$ ) with 80% power.

Using the QED, BACI approach, plot areas will not be randomly assigned within corps' habitat management projects. That is, Corps program staff will coordinate with the evaluators and public land management agency sponsors to determine the location of both treatment and control plots. Participating corps will assess invasive species management plots and/or fuels management plots as determined by a final sampling frame that will be based upon participating corps and their planned projects with land management agency sponsors for the 2022 season. While a single participating corps may assess a combination of plot types (e.g., three wildfire reduction/canopy thinning plots and three invasive species removal plots), any single, unique plot site will only be assessed in terms of either wildfire risk reduction (canopy thinning) OR invasive species removal.

The location of the plots will be distributed throughout the project area based on the following goals: spatially distributed throughout the area; spatially coincide with work being done to capture efforts; located in an area in which it is safe and efficient to collect data. Plots will be defined as 30-meter by 30-meter areas in which measurements of specific indicators (see bulleted measures, below) will be evaluated.

Control plots will be selected in a similar manner. For each project area plot (e.g., treatment plot) a control/comparison plot will be selected that is similar in environmental and geographic conditions (e.g., aspect, elevation, vegetation cover and/or density). Control areas will be matched to treatment areas based on 3-4 variables depending on the project type. For fuels management projects, control areas will be matched based on slope, aspect, and vegetation composition, including species type and density. For

invasive species management projects, control areas will be matched based on slope, aspect, vegetation composition, including species type and density, and in terms of the target species to be removed from the area. Additionally, data collected during the assessment of control plots will be taken at the same time as the data collected on treatment plots. Control plots will include areas not scheduled for any management/maintenance tasks during the 2022-2023 sampling period by either the AmeriCorps members or their sponsoring agency partner.

## 5. DISCUSSION

Assessment protocols for both invasive species and fuels management plots will be designed by an external evaluation team who will train corps staff in protocol application. Professional corps employees will manage the data collection to ensure consistent application of sampling protocols and data collection. While protocols will differ by plot type (invasive species vs fuels reduction), assessment protocols will be identical for both the before and after assessment phases within each plot type, and for both the treatment and control plots. The external evaluators will monitor data collection and ensure rigor in data management and analysis.

Habitat treatment and improvements will be evaluated through the absence/presence of multiple indicators for two plot-types among the participating corps: fuel management plots and invasive species management plots. Primary measures, to be evaluated before and after treatment for both treatment and control plots, include:

- *For invasive species management plots:*
  - Invasive species cover
  - Invasive species life cycle
  - Beneficial vegetation cover
  - Bare ground cover
- *For fuels management plots:*
  - Forest type
  - Dead and declining trees
  - Litter depth
  - Canopy cover
  - Average lowest live branch height
  - Average circumference at breast height

Corps members will collect data at designated points along each transect. Each unique treatment area (based on slope, aspect, and vegetation composition and density (and target invasive species presence and density, if applicable) will be matched with a unique control area of similar characteristics (i.e., a 'paired design, e.g., Tubbesing et al., 2019).

"Before" data will be collected in spring, summer or fall 2022 depending on the site characteristics, project timeline for Corps members, and for invasive projects, the type of species and control method being used. "After" data will be collected at two-time intervals. A more 'near term' "after" data collection will occur in 2022, for example, three months after treatment has occurred on 'intervention' or treatment areas. For example, for knapweed removal in Montana, a previous study collected "before" data in June and "after" data in September (Naiman-Session & Shteir, 2019). Another "after" data collection, to determine 'longer term' impacts of the intervention, will occur one year later in 2023. The 'longer term' "after" data will be collected during the same month as the 'near term' "after" data collection the year prior. This two-step "after" data collection is preferred as a similar evaluation found

that “power was consistently lower when only a single ‘after’ survey was carried out, and increased with both two and three ‘after’ surveys” (Fisher et al., 2019).

Immediate outputs (acres treated) and short-term outcomes (acres improved) for fuels plots, will be assessed immediately following the intervention. Short-term outcomes (acres improved) for invasive species plots will be assessed on a timeline corresponding to the target species managed by each participating corps. Depending on the target species and the method of invasive species removal (e.g., chemical, mechanical, mixed), assessing ecosystem improvements for invasive species plots may be scheduled for one to twelve months from the time of treatment.

## 6. CONCLUSIONS

Analysis of variance (ANOVA) statistical testing will be used to determine equivalency of groups at baseline. Repeated measures ANOVA (with between/within factor interactions) will be used to examine changes between plots of the same type (invasive species or fuels) between baseline and post-treatment assessments. Additionally, comparisons of different invasive species treatments will be made to explore which may be more effective in the short- and longer-term, to inform future habitat management practices. ANOVA testing determines statistically significant differences between the means of two or more groups. In this evaluation we are exploring differences in mean vegetation cover (A) before and after treatment and (B) between control and treated plots.

For invasive species projects, ANOVA testing will be used to accept or reject the following hypotheses:

- Treatment did not affect invasive species cover.
- Treatment did not affect native/non-invasive cover.

For fuels projects, ANOVA testing will be used to accept or reject the following hypothesis:

- Treatment did not affect stand density measures (i.e., CBH, LBB, canopy coverage, dead or declining trees).

To examine if the changes in percent of (1) invasive species cover (invasive species management plots); and (2) canopy cover, LLB, and DBH (fuel management plots) are statistically significant, values will be compared using the Wilcoxon Signed Rank test. Analyses will also establish the threshold levels for target invasive species cover (i.e., the percent reduction in invasive vegetation cover) and stand density (i.e., the percent reduction in canopy cover, LBB, and DBH) for treatment and control plots. Using a modified approach established by Niaman-Session and Shteir (2019), “alpha level of .05 [will be] utilized to determine statistical significance. The power to detect a 25 percent difference in cover [will be] .94, given a deviation of 25 percent” (p. 7).

By establishing multiple control/treatment paired areas within each site, and multiple plots within each area, statistical analyses may examine if differences between control and treatment areas are significantly different than before/after conditions in areas due to natural variations in ecosystems (Fisher et al., 2019b). Using a technique published by Fisher and others (2019b), a pilot phase of the project is currently being conducted (June-September 2021) to ascertain the necessary number of control and treatment areas, and transects within, for statistical power during the full evaluation in 2022.

Typically, each Corps participating in this evaluation has a defined service area, although some overlap may occur in the minority of instances. For this evaluation, there will be no duplication of data (no participating Corps working on same plot of land). Because each participating Corps serves a unique region (and even unique eco-types within their region) there will be multiple scales to this evaluation project. First, analyses will be conducted on the transect level (e.g., Naiman-Session & Shteir, 2019). Results from transect-level analyses will allow the research team to answer research questions for each participating Corps at the site level. Additional analysis may be performed to evaluate the combined impact of multiple Corps where there is overall in target species and/or similarity in site characteristics allowing for between-group comparison (i.e., multi-site scale).

The evaluation team will conduct a training session with AmeriCorps staff, who will be supervising Corps members collecting data in the field, prior to data measurement point collection in the 2022 season. This training will occur via a video-conferencing platform. Data collection protocols will be supplied, in advance, along with a user-friendly guide summarizing the main points of the training and answering frequently asked questions, for easy reference throughout the evaluation. The training manual will include example photos (similar to a previous PLSC evaluation [2.0]), videos will be organized for training purposes, and periodic checks of data by evaluators for completeness and outliers (to be confirmed with corps) will be performed. Quality will be further assured by requiring crew members to take photographs as part of the data collection process, by having two individuals collect data concurrently and compare their findings, and by conducting periodic reviews with crew leaders.

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