A Comparison of Buckthorn Control Methods

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ABSTRACT

The purpose of this project was to evaluate and compare several different buckthorn control methods both for their efficacy in reducing buckthorn and for their effects on non-target native vegetation. The study compared four different buckthorn control methods in a degraded oak forest, where buckthorn formed a virtual shrub-layer monoculture of dense stems. Earthworm invasion was high throughout the study area, with all plots rating a 5 (highest level of invasion) using the Invasive Earthworm Rapid Assessment Tool (IERAT) scale. Native shrub and ground laver vegetation was sparse. While removing buckthorn was a primary focus of the treatments, minimizing negative impacts to regenerating native vegetation was of equal importance.

The four treatments were:
1) Dormant season forestry mow and stump treat for large diameter stems, followed by a fall foliar spray.
2). Dormant season forestry mow, no stump treatment, followed by a fall foliar spray.
3) Dormant season forestry mow and a second mow the following fall (no foliar spray).
4). Hand-cut and stump treat stems in dormant season, with no additional follow-up.

Buckthorn abundance was measured before and after treatment using coverage estimates within each $10m^2$ plot and by stem counts within $1m^2$ subplots.

Overall, Method 2 had the best results for buckthorn control, with the fewest buckthorn seedlings and the fewest stems (both resprouts and small saplings) in the second year. Method 3 had the least negative impact to the number and coverage of native species, but also the highest abundance of buckthorn seedlings. Methods 2 and 4 had the next lowest impacts to the native species, while Method 1 had the greatest negative impact.

METHODS

Study Site

Hampton Woods Wildlife Management Area (WMA) is a 200-acre forested natural area in Dakota County, roughly two miles east of Hampton, MN. The entire forested area is over 400 acres and is predominately surrounded by agricultural land. The primary plant community at the site is southern mesic oak-basswood forest (MHs38).

This study took place in the most degraded part of the WMA in terms of invasive species presence. Although oak trees have been harvested from the site in past decades, the tree canopy was largely intact, dominated by bitternut hickory, red oak and black cherry, with lesser amounts of American basswood, hackberry, bur oak and quaking aspen. The shrub layer

consisted of very dense young and mature buckthorn. About 70 percent of the stems were 1 to 2 cm dbh, and 30 percent were 3 to 7 cm dbh (up to 3 inches). The ground layer was mostly bare soil with sparse native plants such as Jack-in-the-pulpit, wild geranium, early meadowrue, and white avens. The earthworm population was classified as a 5 (highest invasion) on the IERAT scale.

Treatments

We established four treatment units (labeled 1, 2, 3, 4) of about five-acres each (Figure 1). Units 1, 2, and 3 all received an initial forestry mow treatment in March 2018 (Table 1). The ground was frozen with a fairly deep snow cover - over a foot. Results of the mowing in units 1 and 2 were poor, with numerous tall "punji sticks" left behind, and large chunks of woody debris that were not shredded. We were able to hire another contractor who specializes in forestry mowing to re-mow unit 2. That was completed on April 6, with still 6-8 inches of snow on the ground, and temperatures in the teens. Results of the second mow were excellent. The mower cut down to the soil surface, more effectively reaching the root collar of the buckthorn and shredding the mulch. Unit 1 could not be re-mowed because it had a secondary treatment of herbicide application to large stumps after the mowing. This was completed two to three weeks after mowing. While that timing is within the label specifications, our intention had been for immediate treatment after mowing.

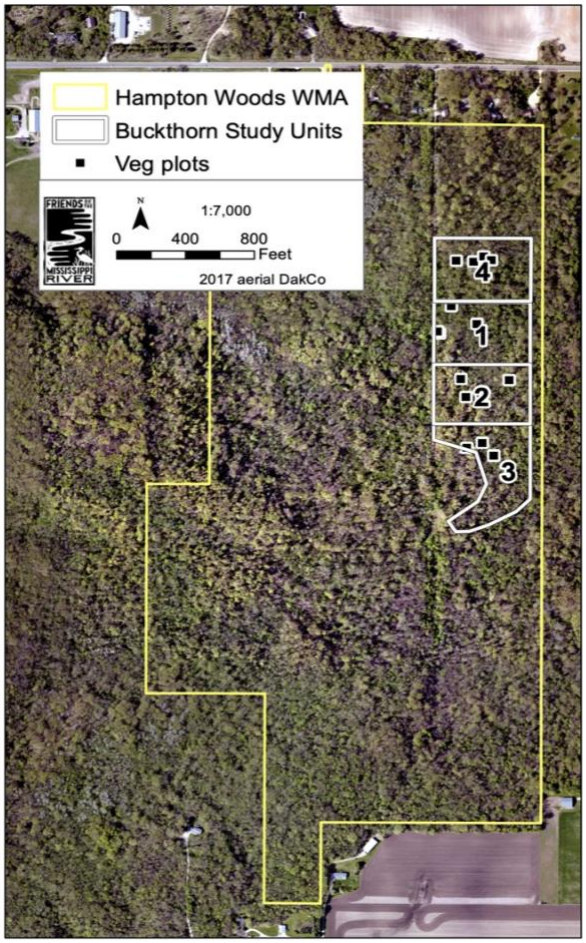

Figure 1. Study units at Hampton Woods WMA

Table 1. Treatments

		Treatment Units			
Timeframe	**Treatment**	**1**	**2**	**3**	**4**
2018 Jan	Hand-cut and stump treat				x
2018 March	Forestry mow, frozen ground.	x	x	x	
2018 Aprill	Re-mow to get flush, frozen ground		x		
2018 May	Stump-treated May 2018	x			
2018 June	Survey	x	x	x	x
2018 Aug	Survey	x	x	x	x
2018 Sept	Foliar treat resprouts/seedlings	x	x		
2018 Nov	Forestry Mow			x	
2019 June	Survey	x	x	x	x
2019 Aug	Survey	x	x	x	x

Unit 4's treatment consisted of hand-cutting in January 2018. Buckthorn stems were cut and stumps were treated with Garlon 4. The brush was stacked and later burned or forestry mowed. This unit did not receive further treatment during the study period, but has since been foliar sprayed to control resprouts and seedlings.

The foliar herbicide application treatment for units 1 and 2 was completed September 27, 2018, using Garlon 3a. The second forestry mow of unit 3 was completed November 29, 2018.

Evaluation

Prior to the initial treatments, we established vegetation survey plots in each of the units and inventoried the buckthorn. Within each unit we set up three or four large plots, about 10m x 10m, for vegetation surveys. Within each plot we established a one-meter radius subplot for stem counts.

The project began in February so we were unable to survey the herbaceous layer prior to management treatments. Instead, we used results of the study to compare the plots with each other, with the assumption that starting conditions were fairly similar among the units given their invasion history and current canopy cover.

The plots were surveyed twice in 2018 (June 21, August 28) after the initial treatment, and twice in 2019 (June 17, August 26) after the follow-up treatment. We focused on the ground layer and shrub layer vegetation to best reflect the vegetative changes. We surveyed the vegetation in each plot according to standard releve methods, identifying species and recording relative coverages.

To calculate the total coverage of each species in each of the units for each year, we took the maximum coverage of the two surveys in each plot. We then averaged the coverages of the three plots in each unit to provide the total coverage for each species. In each subplot, we also counted all buckthorn stems, with separate counts for seedlings and resprouts.

Data evaluation consisted of before and after comparisons of the ground layer vegetation. We looked at species richness, total native vegetative cover, number of buckthorn seedlings and number of buckthorn resprouts.

RESULTS

While the project site had appeared to be very degraded, once the buckthorn was removed there was a flush of native plant regeneration, especially in the second year. There were very few non-native herbaceous plants that colonized post-buckthorn removal, and none that are considered invasive species. With such a response we were especially interested to minimize non-target impacts of the herbicides.

Overall we had somewhat mixed results, with no single unit showing both the best buckthorn control and the least impact to native species. This is not surprising as we would expect that the herbicide-treated units would show some impact to non-target species. Notably, it appeared that these impacts occurred even though the herbicide was applied when most native plants were dormant.

Based on our results, Unit 2 (forestry mow, fall foliar) had the best buckthorn control, with the fewest seedlings and the fewest resprouts in the second year (Figures 1 and 2). Unit 2 also had good native forb richness and cover (Figures 3 and 4). Unit 1 (forestry mow and stump treat, fall foliar) was second best in terms of buckthorn control (seedlings and resprouts) but had the greatest negative impact on native forb richness and cover. Units 3 and 4 had only slightly more forb species than Unit 2, and both had considerably more buckthorn coverage.

Unit 4 (cut and treat) had the best native forb coverage, which is important in buckthorn suppression. Conversely, however, it also had the highest number of buckthorn resprouts. That may have been due to inadequate stump-treatment and missed stems, common for hand work over a large area.

Unit 3 (double forestry mow) had the most seedling buckthorn and Unit 4 (cut and treat) had the most resprouted buckthorn. Unit 1 (forestry mow and stump treat, fall foliar) had the least number and the lowest cover of forbs. This seemed to be a clear result of the two herbicide applications.

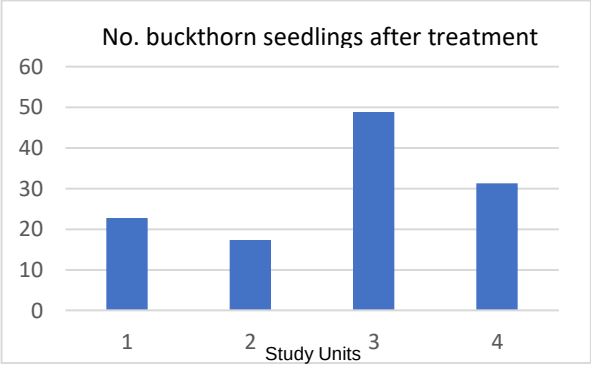

Figure 3. Unit 2 had the fewest buckthorn seedlings after treatment, Unit 3 had the most.

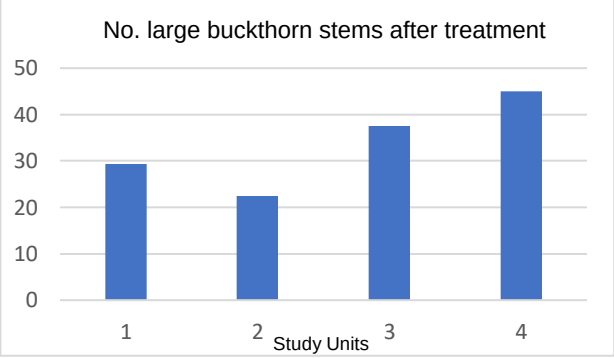

Figure 2. Unit 2 had the fewest resprouts of large stems, Unit 4 had the most.

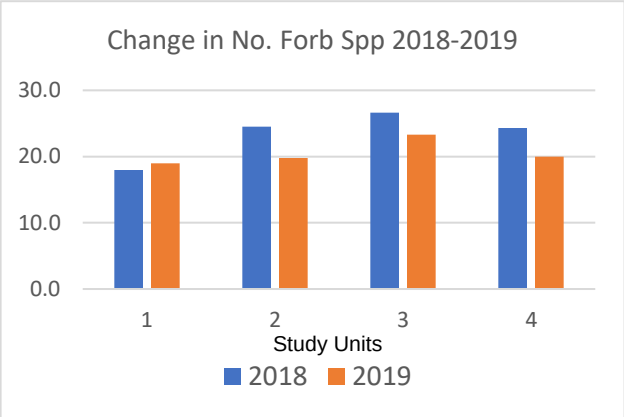

Figure 4. Unit 3, no herbicide treatment, had the most forb species in both years. Units 2, 3, and 4 all had fewer forbs the second year than the first. Unit 1 had fewest forbs both years, and the highest herbicide use.

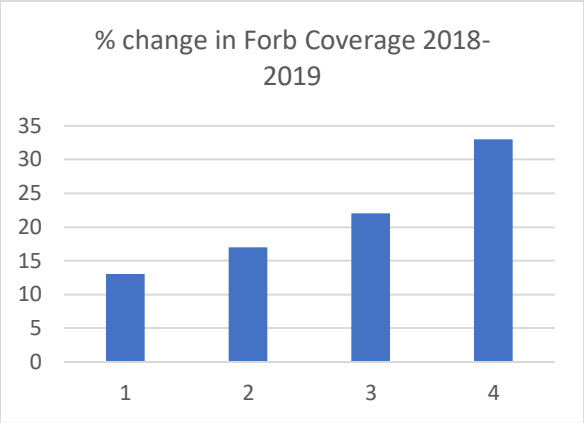

Figure 5. Unit 1 had the lowest percent increase in forb coverage, Unit 4 had the highest. All units started with very sparse herbaceous cover.

DISCUSSION

There are several things we learned from this study. First, when forestry mowing, it is critically important to have a very good operator and/or the right kind of mower. The mowing should be flush to the ground as much as possible, or lightly scuffing the soil to help destroy the root collar of the buckthorn. Good operators will typically go back and forth over each spot to achieve a good result.

Second, we do not recommend trying to do stump-treatment *after* forestry mowing. It is very difficult to locate large stumps within the debris field. In fact, if mowed properly, remains of any large stumps should not be very visible. Since this study, we have changed methods to cut and stump-treat very large stems (2-inches dbh or more) prior to mowing. Our observations have been that large stems have a lot of reserves and are more likely to persist after mowing and can be difficult to kill with foliar treatment. However, this method of pre-cutting large stems should be further studied to determine if it really is worth the effort.

Third, detailed communication is important. When doing the second mowing, although we instructed the contractor to re-mow the entire unit, they selectively mowed only areas they thought needed it – where buckthorn regrowth was evident. In doing so they failed to mow many areas where buckthorn seedlings were abundant, so we were not able to get reliable data on the effectiveness of mowing on seedling plants.

We also have some caveats – the control methods used here may not be suitable at other sites, and additional steps may be needed to get full control. This site surprised us with an amazing flush of diverse, native oak forest species after the mows, which helped to suppress buckthorn seedlings to some extent. This was not anticipated and is hardly ever the case, in our

experience, to have an intact native seedbank. Overseeding with native seed is typically needed to reestablish the native community. However, most native plants take time to establish so it is difficult to achieve the quick cover needed to suppress buckthorn seedlings. Prescribed burns may also be an important step at other sites. We also did not have many invasive weed species like garlic mustard, which could impact the methodology or impede native species recovery.

Minimizing herbicide application is important due to the negative impacts to both native vegetation and soil microorganisms. In most cases it is not feasible to eradicate invasive woody plants without the use of herbicides. So we need to understand how to maximize the effectiveness of herbicides when we do use them. We also do not have reliable information on how long it takes for the native plants and/or soil microorganisms to recover after herbicide.

If herbicides are heavily used to accomplish buckthorn control, it may also result in widespread eradication of native plants, as we have seen at some sites. While that seems to be an undesirable result, we do not have enough information about how long it may take for native vegetation to re-establish, or if it can recover, and what that composition may look like. Could the short-term "kill-all" approach be worth it if it removes the invasive species, allowing the natives species to re-establish? Maybe, but there are also multiple reasons why this would not likely be true - eradicating most of the vegetative cover is likely to create good conditions for more invasive non-native species, while the desirable native species are less likely to readily re-establish. However, long-term studies to evaluate this in multiple habitat types and conditions would be valuable.

Further study is also needed to determine better methods of controlling buckthorn seedlings and small saplings – the resurgence that happens after initial large-stem removal. One method to explore is whether wick applicators could be used effectively, which would minimize the amount of herbicide on non-target species.

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