

Above and below ground interactions during prairie restoration after common buckthorn invasion



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Introduction:

Rhamnus cathartica (Common Buckthorn) is a shrub native to Eurasia. It was introduced in North America during the late 19th century as an ornamental shrub (Heneghan et al. 2006). Buckthorn has many characteristics that enable it to dominate many urban areas of the United States (Heneghan et al. 2006):

- Rapid decomposition of leaf litter
- Altering soil to high N, pH and water content
- Shallow and expansive root structure
- High fecundity in dense thickets

Mettawa Open Lands Association has taken the initiative to restore a seven acre site, Whipponwill Farm, from buckthorn to a native oak and hickory savanna ecosystem (Mettawa 2008). DePaul University is one of three teams that have collaborated to work on this restoration project, and is restoring approximately 2500 square meters in an effort to evaluate buckthorn restoration techniques.



Plants:

- Walk 3 transects through each plot
- Identify and record cover for plants using Braun-Blanquet Ordinal Cover Estimate system (Fig. 3) (Poore 1955)
- Calculate coefficient of conservation (C) and floristic quality index (FQI) of each plot (Swink & Wilhelm 1994)

Tukey's Studentized Range (HSD) Test and ANOVA was run using the SAS system to find significant differences within both sets of data.



Figure 2. Dried worms

Number	% Cover
0	0
1	<1
2	1-4
3	5-24
4	25-49
5	50-74
6	>74

Figure 3. Braun-Blanquet Ordinal Cover Estimate System

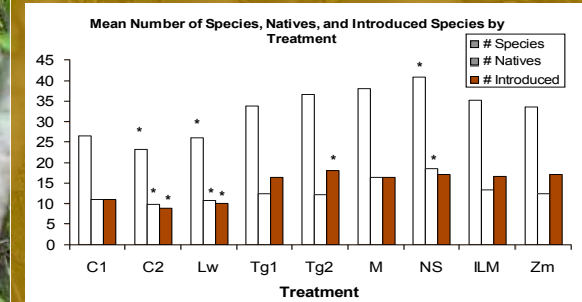


Figure 4. Graph of mean number of plant species, natives, and introduced by treatment
 * Significantly different treatments

Objectives:

1. Examine earthworm populations between treatments and control plots: A greater population of earthworms is associated with buckthorn
2. Examine plant diversity and compare the cover of plant species between treatments and control plots

Study Site:

- 7 acres in Mettawa, IL; Horse pasture in 1930s; Abandoned in the 1990s
- Monoculture of European buckthorn colonized the site (Mettawa 2008)
- Divided into 45 52 meter square hexagon plots (Fig. 1)
- There are nine treatments with five replicates each
 - C1 & C2: buckthorn not cut
 - ILM: buckthorn cut & sprayed; pasture seed mix
 - NS: buckthorn cut & sprayed; native seed mix
 - Tg1 & Tg2 buckthorn cut & sprayed; buckthorn mulch tilled, native or pasture seed mix
 - Zm: buckthorn cut & sprayed; Hybrid Corn
 - M: buckthorn cut & sprayed; store mulch tilled, native seed mix
 - LW: buckthorn not cut, leaf litter removed

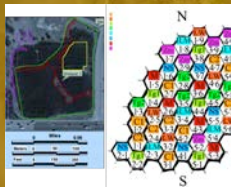


Figure 1. Aerial photograph of Whipponwill Farm with a map of DePaul's plots

Results:

Difference between treatments was examined using analysis of variance, where effects were significant differences between individual treatments and compared using Tukey's HSD post-hoc at 95% confidence for both sets of data.

Earthworms (Table 1):

- Abundance of worms is significant; differs by two groups of treatments
- C1, C2, Tg1, Tg2 (buckthorn source) > ILM, NS, Zm (seed mix or corn)
- No significance in the dry weight of the worms, but trend of higher biomass in Control and Tg2

Table 1. Summary of earthworm data averaged by treatment
 * Significant treatment group 1; * Significant treatment group 2

Treatment	Species Number		Avg Abundance (#)		Avg Dry Weight (g)		Avg Juveniles	
	SE	SE	SE	SE	SE	SE	SE	
C1	3	0.1	26 ¹	41	4.265	3.353	17	
C2	3	0.2	24 ¹	48	5.025	4.994	17	
LW	3	0.1	17	11	3.791	0.365	11	
Tg1	3	0.0	31 ¹	14	3.482	0.922	21	
Tg2	3	0.0	26 ¹	71	3.443	0.662	14	
M	3	0.1	17	13	1.662	0.117	10	
NS	3	0.0	14 ²	11	2.661	0.053	9	
ILM	3	0.3	11 ²	11	1.599	0.613	7	
ZM	2	0.0	11 ²	6	2.659	0.596	8	

Plants:

- Total number of species, number of native species, and number of introduced species are affected by treatments (Fig. 4)
- Species: NS = C2 > LW; Natives: NS > C2 = LW; Introduced: Tg2 > C2 > LW
- C values and FQI values not significant
- Most frequent species: buckthorn (1), oxeye daisy (0.97), goldenrod (0.95), strawberry (0.93), red clover (0.91)

Conclusion:

Because this is the first year after buckthorn removal on the Whipponwill Farm property, definitive conclusions can not be made; however, trends can be seen in both sets of data.

Earthworms:

- Greater abundance of earthworms under treatments with buckthorn
- Due to the high N inputs from buckthorn leaves and mulched stems (Heneghan et al. 2006).
- LW has no significant difference even though the buckthorn was not cut
- Probably because the litter layer was removed from the plot, removing the buckthorn litter and N source

Plants:

- Significant difference in the number of plant species, native plant species, and introduced plant species found between treatments C2, LW, Tg2 and NS
- No significant difference in the C and FQI values
- 1st year after removal; the area is supporting pioneer species and an early successional population
- Plants found will be weedy and of a low conservation status
- Trend seen: NS does appear to have the highest FQI of all the treatments
- C2 and LW different because only a small portion of the plants found are growing in those plots due to buckthorn thicket
- Number of introduced species in Tg2 is significantly different because it is seeded with Eurasian seed mix and has greatest number of introduced species
- NS has the greatest number of species and native species because it has been seeded with native plants

References:

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