

Introduction

This summer we worked as Stewardship Liaisons for the Northwest Indiana Restoration Monitoring Inventory (NIRMI) monitoring 29 plots in 12 ecological restoration sites in the southern Lake Michigan rim. NIRMI provides the in-depth and comprehensive data needed to track success in ecological restoration and the information is freely available on the web at nirmi.org. We utilized skills of field ecology, plant and fungal identification, photo documentation, GPS and GIS software, data entry, and basic data analysis.

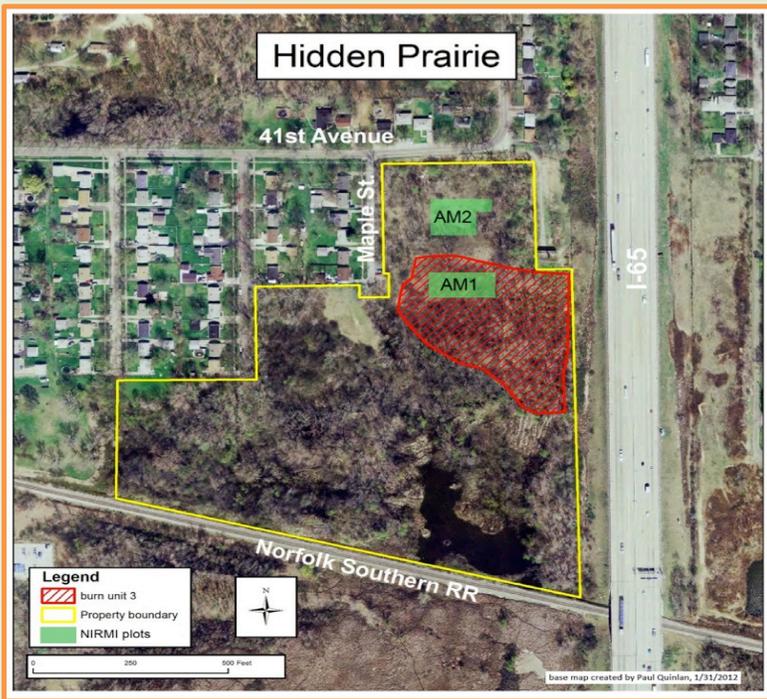
This study focuses on how two plots at a single site, Hidden Prairie, changed over a three year period. From 2011 to 2013 active restoration management activities took place. The positive changes to the habitats are obvious in our data.

Site Description

Owned and managed by the Shirley Heinze Land Trust, Hidden Prairie Nature Preserve is located in the city of Hobart in Lake County, Indiana. The 17 acre preserve is part of the Hobart Marsh complex and is characterized as an ecotone which includes wet-mesic prairie, marsh, swamp, and open water. Despite a history of agriculture and grazing, the site includes a high-quality remnant prairie supporting at least 10 state-listed plants and 5 threatened insect species.

NIRMI has two permanent 0.1 ha plots in the northern wet-mesic prairie area (Figure 1). Plot 1 is a standard 20m x 50m layout located within "burn unit 3". Plot 2 is located to the north of Plot 1 in a wetter area inside a roughly square-shaped clearing which required a modified layout to fit that area.

Figure 1: Map of site with NIRMI plots shaded in green, burn area in red, and preserve boundaries in yellow.



Management Summary

Hidden Prairie has had significant management activity since at least 2006. Controlled burns were conducted in 2007, 2009, 2011, 2012, and 2013. Pulling and/or cutting of garlic mustard, buckthorn, honeysuckle, dogwood, cottonwood, viburnum, and multiflora rose has occurred in most years, and various target species have been treated with herbicides. Native plugs were planted each year from 2006 to 2009, and seeding took place in 2010 and 2012.

While it is difficult to determine exactly which management activities took place within the boundaries of our plots prior to 2011, between the period of our surveys in 2011 and 2013 cutting, herbiciding, and burning activities took place. Numerous shrubs were cut and treated with herbicide in both Plots 1 and 2 in January and February 2012 with re-sprouts of certain species being re-treated with herbicide in July. The brush piles of cut material were burned in March and April. Selected seeds were hand-broadcast in April 2012. A controlled burn in part of the prairie (red highlighted area in Figure 1) was done on April 3, 2013.

Methods

Typically a 50m x 20m rectangular plot (0.1 ha) is set up in a homogenous habitat within a restoration area. A plot is subdivided into ten, 10m x 10m modules, four of which are intensively surveyed for vascular plants and macrofungi at five spatial scales (from 0.01m² to 100m²). Soil samples are collected from the center of these four intensive modules. The cover of each plant taxon recorded within the plot is estimated and used to determine relative species abundance. These data then provide statistics for predictive variables (e.g. species diversity, floristic quality, community composition). Repeated surveys at the same plots over the long-term (decades) project a trajectory for a given restoration. Plots for this study were surveyed in June and August 2011, and then again in June and August 2013.

Results

Between the 2011 and 2013 surveys there was an obvious decrease in woody shrubs in both plots (Figures 2 and 3). The desirable herbaceous species recorded in our "ground level" strata increased measurably in both plots with a dramatic increase in Plot 2 (Figure 3). In 2011 we encountered several of the target invasive taxa, especially woody shrubs of dogwood (*Cornus* spp.), multiflora rose (*Rosa multiflora*), honeysuckle (*Lonicera*), hawthorn (*Crataegus* spp.), viburnum (*Viburnum opulus*), and pussy willow (*Salix discolor*). Several undesirable herbaceous plants were seen as well, namely ox-eye daisy (*Chrysanthemum leucanthemum*), teasel (*Dipsacus sylvestris*), sweet clover (*Melilotus alba*), poison ivy (*Toxicodendron radicans*), and tall goldenrod (*Solidago altissima*). In the 2013 surveys the presence and estimated cover of many of these target invasive species declined (Figure 4).

We recorded several desirable species in 2011, but none of the species planted in 2009, most notably big bluestem (*Andropogon gerardii*). In 2013 we recorded increased coverage of desirable species and even many new high quality species, including big bluestem (Figure 4). Overall, from 2011 to 2013 we saw increases in several factors indicative of higher quality floristic composition (Figure 5).

Figure 2: Visual changes in plant composition in Plot 2 from 2011 to 2013. Note large tree on left in 2011 is dead in 2013.



Figure 3: Changes in average cover of all species combined at three strata from 2011 to 2013; darker colors indicate higher percentages of cover.

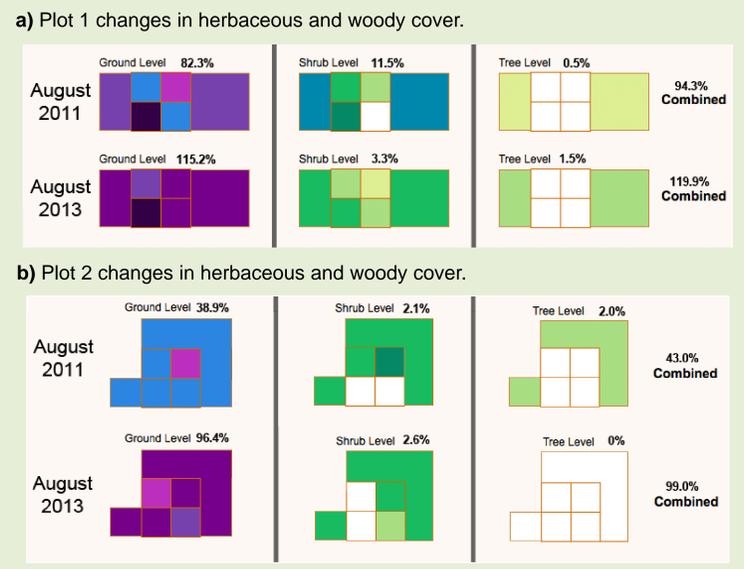


Figure 4: Comparison of surveys from 2011 to 2013 (post restoration work) for both plots shows an increase of selected "good" quality species [minimum C-value of 4], and a decrease of selected undesirable species [non-natives, invasives, shrubby species, and those with C-values <4]. Percentages are maximum values from a single module.

a) Plot 1 increase of selected "good" quality species					b) Plot 2 increase of selected "good" quality species				
Taxon Name	2011		2013		Taxon Name	2011		2013	
	# of modules	max. cover	# of modules	max. cover		# of modules	max. cover	# of modules	max. cover
<i>Liatris spicata</i>	3	1.0%	3	2.0%	<i>Anemone virginiana</i>	1	0.1%	3	1.0%
<i>Monarda fistulosa</i>	4	1.0%	4	5.0%	<i>Eleocharis elliptica</i>	4	2.0%	4	50.0%
<i>Ratibida pinnata</i>	1	1.0%	2	2.0%	<i>Gentiana andrewsii</i>	1	1.0%	4	2.0%
<i>Rosa carolina</i>	2	5.0%	4	10.0%	<i>Juncus torreyi</i>	1	1.0%	4	2.0%
<i>Scirpus pendulus</i>	1	0.1%	3	1.0%	<i>Monarda fistulosa</i>	residual	0.1%	1	1.0%
<i>Sisyrinchium albidum</i>	residual	0.1%	1	1.0%	<i>Pycnanthemum virginianum</i>	4	2.0%	4	25.0%
<i>Vernonia gigantea</i> ssp. <i>gigantea</i>	4	5.0%	4	10.0%	<i>Ratibida pinnata</i>	residual	0.1%	3	1.0%
<i>Veronicastrum virginicum</i>	1	1.0%	2	5.0%	<i>Schizachyrium scoparium</i>	2	5.0%	4	25.0%
<i>Andropogon gerardii</i>			residual	1.0%	<i>Scirpus pendulus</i>	4	25.0%	4	50.0%
<i>Gentiana andrewsii</i>			4	2.0%	<i>Sisyrinchium albidum</i>	3	1.0%	4	2.0%
<i>Juncus torreyi</i>			3	1.0%	<i>Solidago rigida</i>	2	1.0%	4	1.0%
<i>Liatris aspera</i>			residual	0.1%	<i>Sorghastrum nutans</i>	4	2.0%	4	50.0%
<i>Mentha arvensis</i>			1	1.0%	<i>Andropogon gerardii</i>			1	1.0%
<i>Carex conoidea</i>			4	2.0%	<i>Carex conoidea</i>			2	1.0%
<i>Elymus canadensis</i>			residual	0.1%	<i>Elymus canadensis</i>			residual	0.1%
<i>Elymus trachycaulus</i>			residual	0.1%	<i>Elymus trachycaulus</i>			residual	0.1%
<i>Juncus marginatus</i>			1	1.0%	<i>Juncus marginatus</i>			1	1.0%
<i>Panicum amphibium</i> var. <i>stipulacea</i>			residual	0.1%	<i>Panicum amphibium</i> var. <i>stipulacea</i>			residual	0.1%
<i>Solidago juncea</i>			residual	0.1%	<i>Solidago juncea</i>			residual	0.1%
<i>Spartina pectinata</i>			1	1.0%	<i>Spartina pectinata</i>			residual	0.1%

c) Plot 1 decrease of selected undesirable species					d) Plot 2 decrease of selected undesirable species				
Taxon Name	2011		2013		Taxon Name	2011		2013	
	# of modules	max. cover	# of modules	max. cover		# of modules	max. cover	# of modules	max. cover
<i>Chrysanthemum leucanthemum</i>	4	5.0%	4	2.0%	<i>Cornus obliqua</i>	4	10.0%	4	5.0%
<i>Cornus obliqua</i>	4	25.0%	4	5.0%	<i>Populus deltoides</i>	2	2.0%	2	1.0%
<i>Crataegus mollis</i>	2	10.0%	4	1.0%	<i>Salix discolor</i>	4	5.0%	4	1.0%
<i>Melilotus alba</i>	2	1.0%	residual	0.1%	<i>Solidago altissima</i>	4	10.0%	4	1.0%
<i>Rosa multiflora</i>	4	10.0%	3	2.0%	<i>Cornus stolonifera</i>	1	1.0%		
<i>Rubus occidentalis</i>	4	10.0%	4	5.0%	<i>Pastinaca sativa</i>	1	1.0%		
<i>Salix discolor</i>	4	10.0%	4	5.0%					
<i>Toxicodendron radicans</i>	4	10.0%	4	5.0%					
<i>Viburnum opulus</i> var. <i>opulus</i>	3	10.0%	2	1.0%					
<i>Cornus racemosa</i>	2	2.0%							
<i>Cornus stolonifera</i>	1	25.0%							
<i>Dipsacus sylvestris</i>	1	1.0%							
<i>Robinia pseudoacacia</i>	1	0.1%							

Figure 5: Restoration management activities between August 2011 and June 2013 resulted in increased species richness (number of species) and Floristic Quality Index rating (FQI) for both plots.

	Plot 1		Plot 2	
	2011	2013	2011	2013
Species Count	110	123	91	116
Average C-value	2.789	2.582	2.767	2.820
FQI	27.188	30.586	25.664	29.709

Discussion

With management from 2011 to 2013, Plot 1 showed a significant decrease (over 8%) in average shrub cover and an increase of almost 33% in average herbaceous ground level cover (Figure 3a). Eight of the selected good quality species recorded in 2011 were more common in 2013. In addition, eight new quality species were found in 2013 (Figure 4a). Our data also show thirteen undesirable species decreased in cover or presence (Figure 4c). Along with these factors, an increase in FQI from 2011 to 2013 indicates a positive trajectory for the restoration of the prairie habitat in and around Plot 1 (Figure 5).

Management activities in Plot 2 after August 2011 resulted in a measurable decrease in average shrub cover for the intensively surveyed modules even though average cover remained about the same for the whole plot. All tree level cover was removed as part of the restoration work. The average herbaceous ground level cover increased dramatically with a nearly 60% jump (Figure 3b). Twelve of the selected good quality species recorded in 2011 were more common in 2013. In addition, eight new quality species were found in 2013 (Figure 4b). Our data also show six undesirable species have decreased in cover or presence (Figure 4d). An increase in FQI from 2011 to 2013 also supports a positive trajectory for the restoration of the habitat in Plot 2 (Figure 5).

In conclusion, our data indicate that management activities positively affected the quality of the wet-mesic prairie habitat in and around the NIRMI plots. We would expect that ongoing management of Hidden Prairie will stabilize the overall quality of this remnant habitat. We also recommend continued long-term monitoring of this site in order to adequately assess future management directions.

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