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Measuring Restoration Success in Cedar Glades after *Ligustrum sinense* Removal

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What is a cedar glade?

- Rare ecosystem found primarily in middle TN
- Globally unique habitat
- Open, rocky natural areas characterized by thin soil and limestone bedrock
- Supports highly specialized plant species



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Stones River National Battlefield Cedar Glades

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- Federally and state protected
- Home to twenty-one endemic plant species
- *Astragalus bibullatus* (Pyne's Ground Plum) and *Echinacea tennesseensis* (Tennessee Coneflower) are Federally Listed Endangered Species



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Invasive Exotic Plants

- Numerous exotic invasive species have invaded the glade complex
- Threaten integrity of the park and the organisms that rely on it
- Can facilitate soil accumulation (leaf litter & capture eroded soil)
- Creates conditions that allow invasives to move farther into glades
- Open habitat is lost



Troy Evans, Eastern Kentucky University, Bugwood.org

UGA5079012

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Project

- Determine effectiveness of exotic removal along cedar glade edges
- Establish 3 sites (Untreated, Treated, and Infested)
- Use Untreated area as a reference

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Methods & Materials

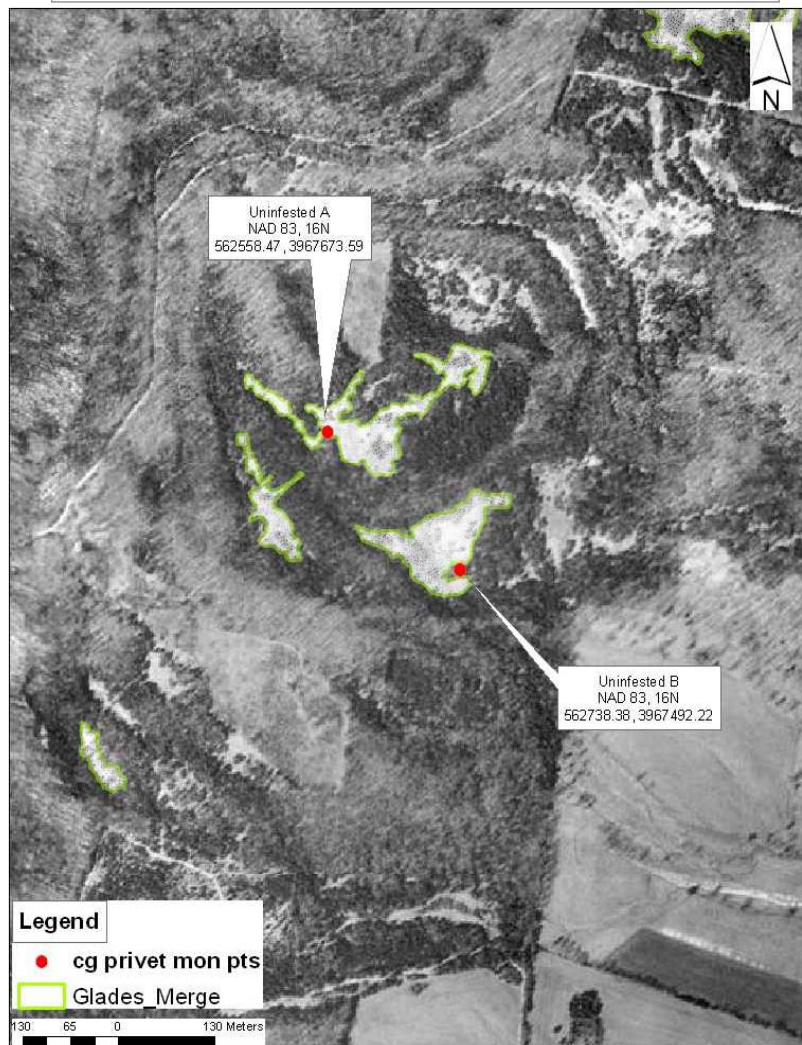
- Establish six randomly selected transects (2 per site)
- Plots consist of ten 1m² quadrants located at 10-meter intervals along 100 meter transects
- Transects run parallel to glade edges
- Remove privet in the Treated site prior to monitoring

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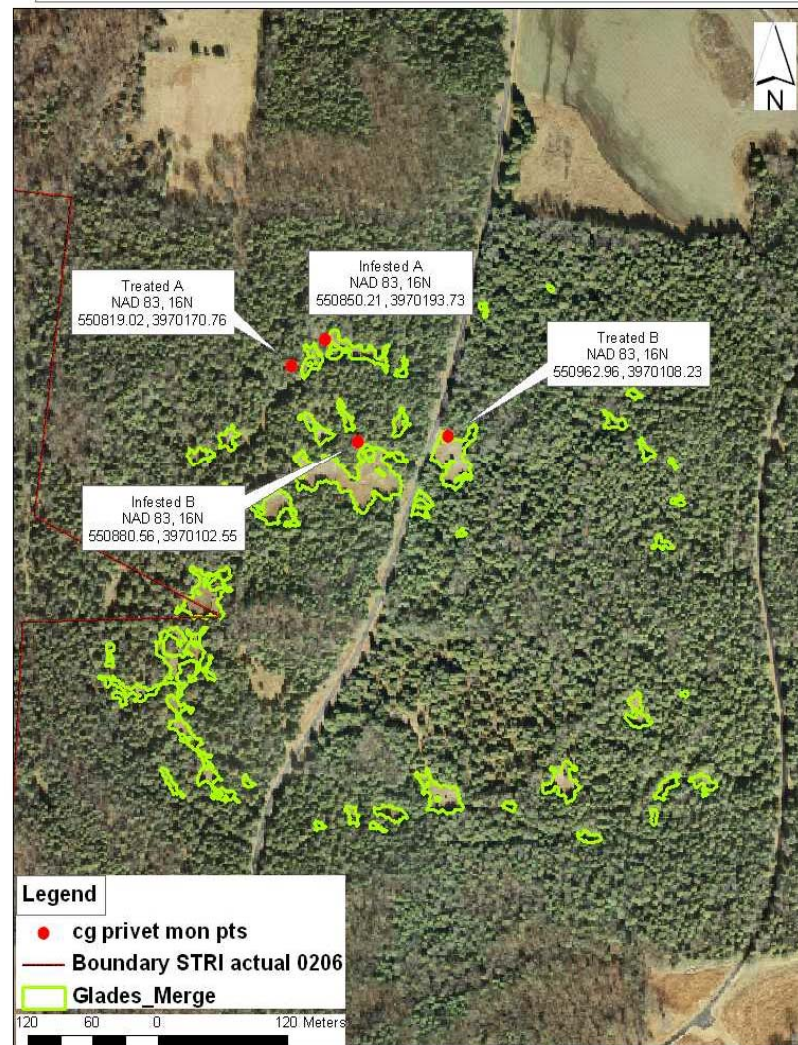
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Flat Rock State Natural Area-Limestone Glade Monitoring Plots



Stones River National Battlefield-Limestone Glade Monitoring Plots



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The Unexpected

- F4 Tornado hits cedar glades on April 10, 2009



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Table 1. Mean Cover Class by Site and Cover

Cover	Site	<i>N</i>	<i>M</i>	<i>SD</i>
Lichen	Untreated	40	2.20	0.99
	Infested	18	1.44	0.71
	Treated	33	1.39	0.66
Moss	Untreated	51	2.57	1.38
	Infested	50	2.50	1.21
	Treated	58	2.36	1.33
Leaf Litter	Untreated	59	4.51	0.97
	Infested	59	4.32	1.22
	Treated	60	4.85	1.18
Dead Wood	Untreated	39	2.10	0.88
	Infested	44	2.25	0.84
	Treated	49	2.00	0.77
Soil	Untreated	26	1.92	0.85
	Infested	38	1.87	1.07
	Treated	25	1.76	1.05
Gravel	Untreated	19	1.26	0.56
	Infested	35	2.09	1.25
	Treated	20	1.35	0.59

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- For lichen cover class, the Infested site ($t(71)=-3.99$, $p < .001$) and Treated site ($t(56)=-2.91$, $p = .005$) were significantly different from the Untreated site
- For gravel cover class, the Treated site ($t(52)=2.72$, $p = .009$) was significantly different from the Untreated site

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Table 2 . Average number of Native and Non-Native Species by Site

Nativity	Site	N	<u>M</u>	<u>SD</u>
Native Species	Untreated	1072	6.19	8.06
	Infested	716	5.71	11.65
	Treated	799	6.12	12.17
Non-Native Species	Untreated	1	-	-
	Infested	174	12.72	19.45
	Treated	141	9.45	13.09

- Untreated site had the highest average of native species and lowest average of non-native species
- Infested site had highest average of non-native species and lowest average of native species
- One specimen of Chinese privet was found in the untreated site

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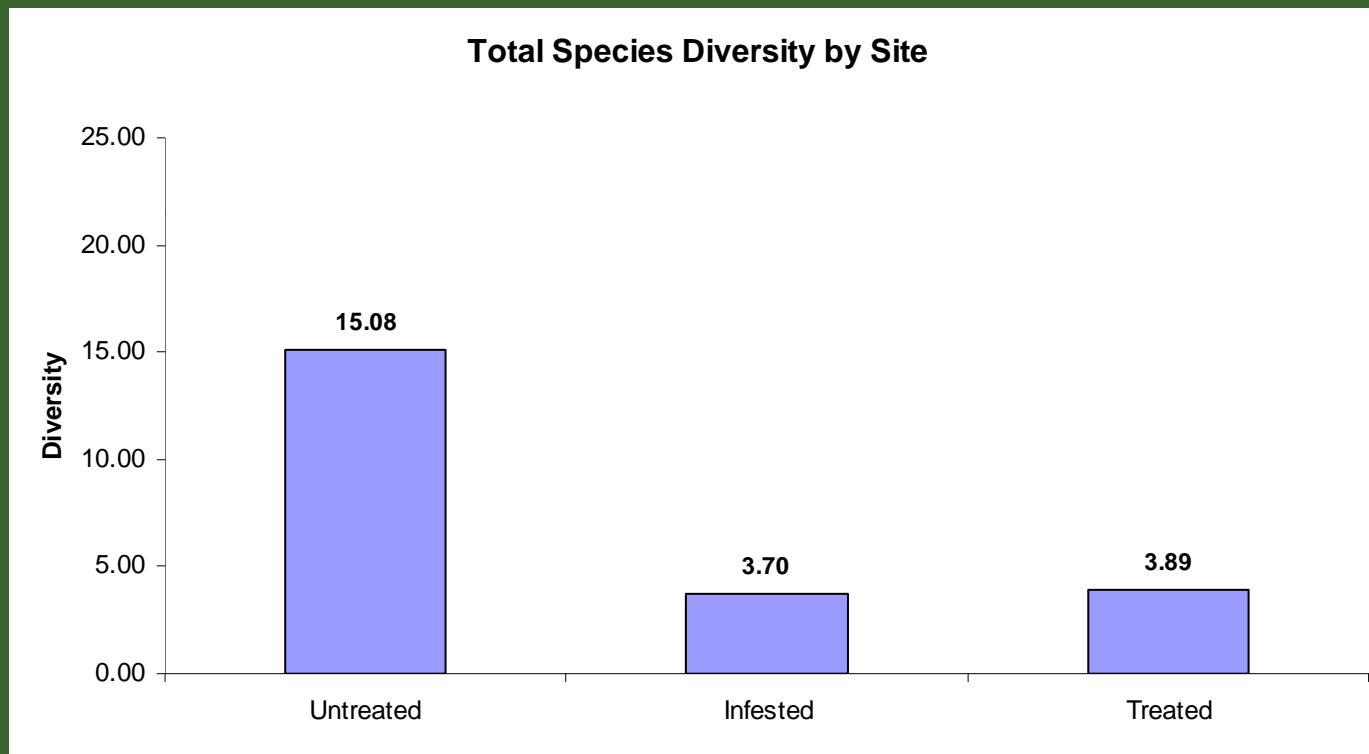


Figure 1. Total Species Diversity by Site

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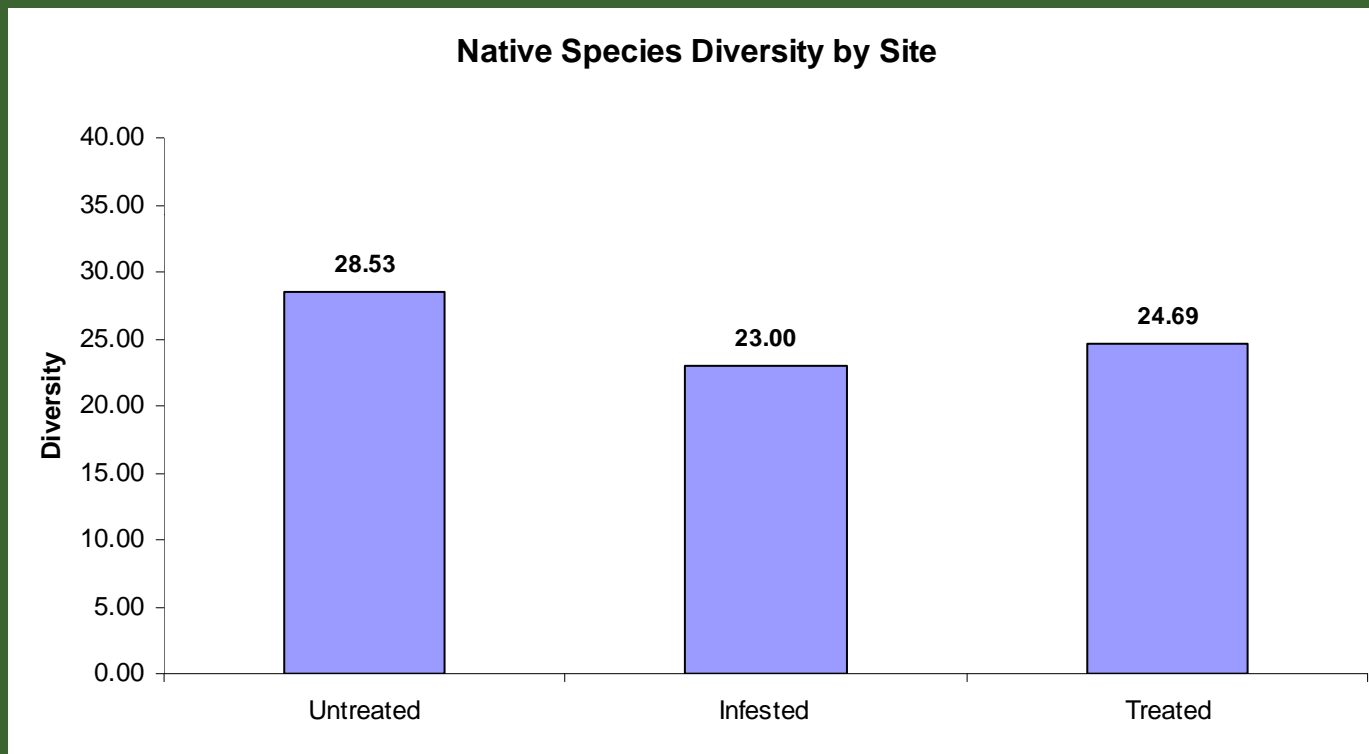


Figure 2. Native Species Diversity by Site

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Discussion

- Monitoring was conducted over a limited time period
- Treated site is in better condition ecologically than Infested site
- If the pattern continues, should see significant differences over time
- Research is important but management of resources is main goal

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Questions



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