
Midstory Herbicide Treatments as a Useful Tool in the Restoration of Oak Savannas and Woodlands in the Mid-South
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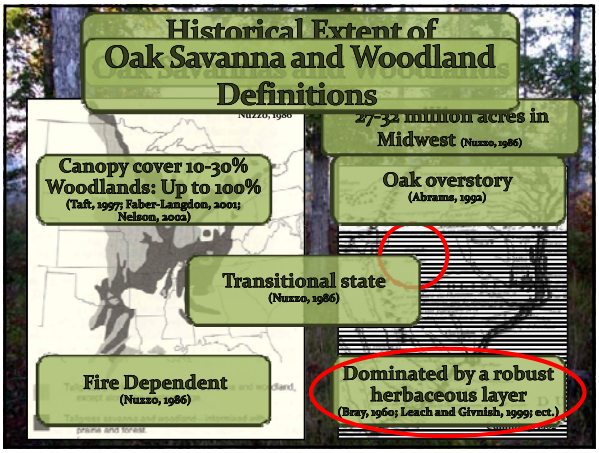
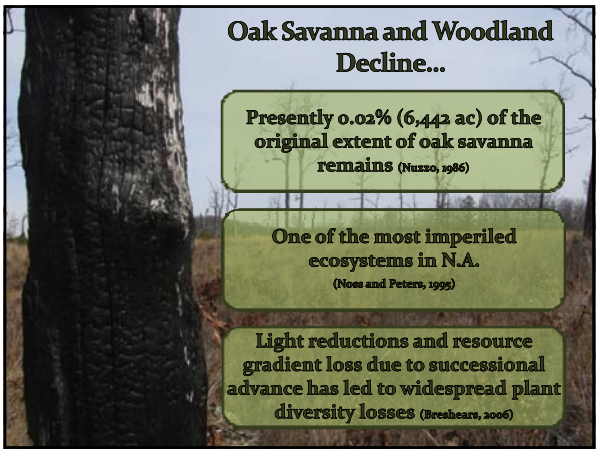
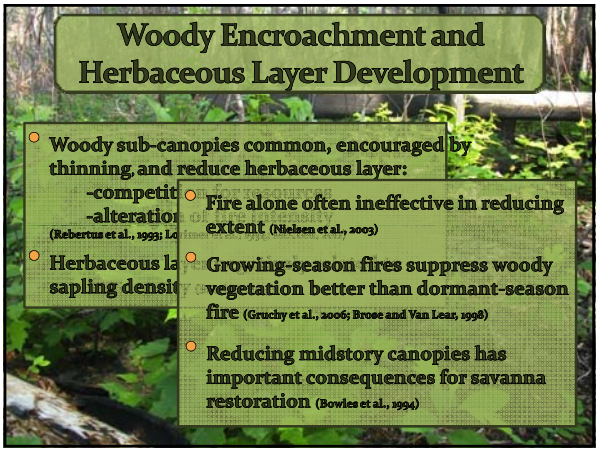
12:20 pm, Oct. 17, 2012, Room 160 PBB
UT FWF Departmental Seminar

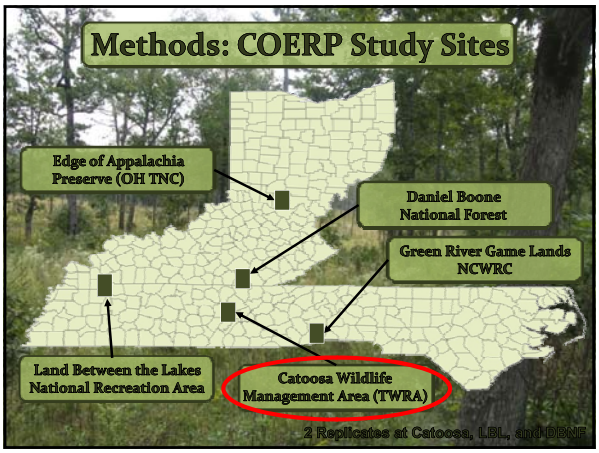

Outline:
Introduction and Justification for Research
Research Objectives
Methods
Results and Discussion
Management Implications

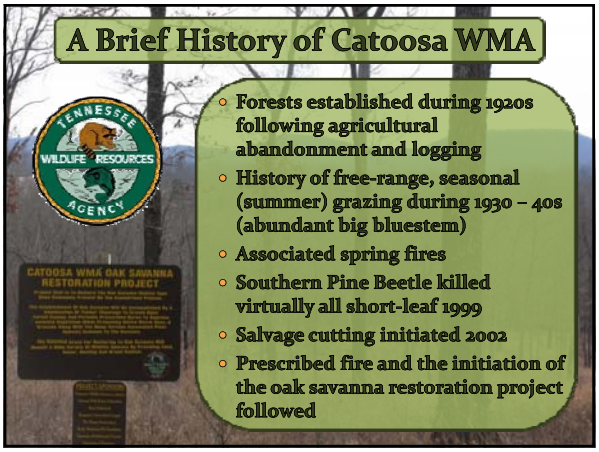

Historical Extent of Oak Savanna and Woodland Definitions
27-32 million acres in Midwest (Nuzzo, 1986)
Canopy cover 10-30%
Woodlands: Up to 100%
(Taft, 1997; Faber-Langdon, 2001; Nelson, 2002)
Oak overstory
(Abrams, 1992)
Transitional state
(Nuzzo, 1986)
Fire Dependent
(Nuzzo, 1986)
Dominated by a robust herbaceous layer
(Bray, 1960; Leach and Givnish, 1999; ect.)

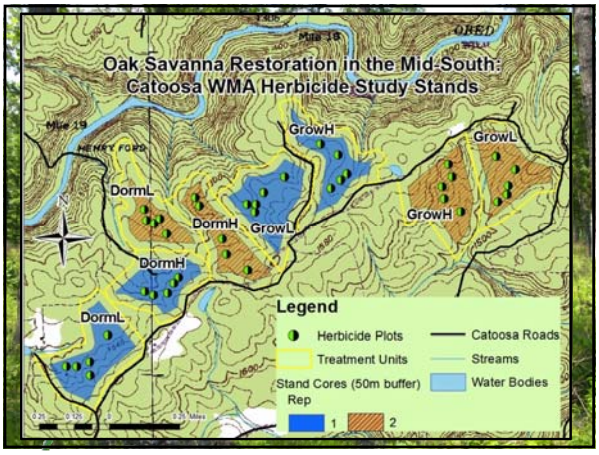

Oak Savanna and Woodland Decline...
Presently 0.02% (6,442 ac) of the original extent of oak savanna remains (Nuzzo, 1986)
One of the most imperiled ecosystems in N.A. (Noss and Peters, 1995)
Light reductions and resource gradient loss due to successional advance has led to widespread plant diversity losses (Breshears, 2006)

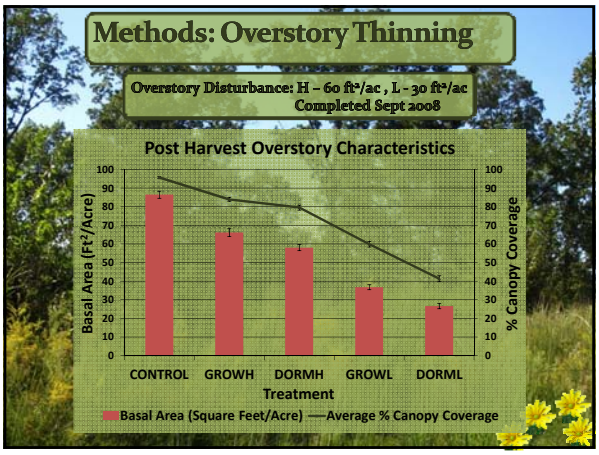

Woody Encroachment and Herbaceous Layer Development
Woody sub-canopies common, encouraged by thinning, and reduce herbaceous layer:
-competit
-alteratio
(Rebertus et al., 1993; Lo
Herbaceous la
sapling densit
Fire alone often ineffective in reducing extent (Nielsen et al., 2003)
Growing-season fires suppress woody vegetation better than dormant-season fire (Gruchy et al., 2006; Brose and Van Lear, 1998)
Reducing midstory canopies has important consequences for savanna restoration (Bowles et al., 1994)

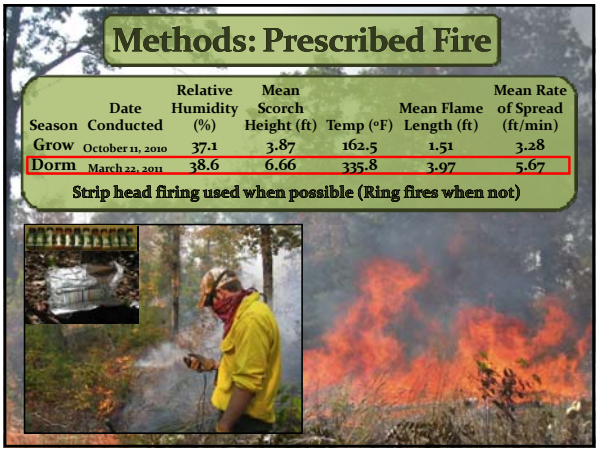

Cooperative Oak Ecosystem Restoration Project
Monitor Community Level Responses
Woody Plants
Herbaceous Plants
Songbirds
Determine the efficiency of management techniques in restoring open oak ecosystems
Objectives:
To determine any differential effects of woody midstory herbicide treatments applied after late growing-season vs. dormant-season fire on:
1. Woody Plant Community
-Stem Densities (stems/acre)
-Species Groups:
Oaks, Comp, and Others
-Size Class Groups
2. Herbaceous Ground Layer
-Richness and Diversity
-% Cover Classes:
Graminoids, Forbs, and Legumes

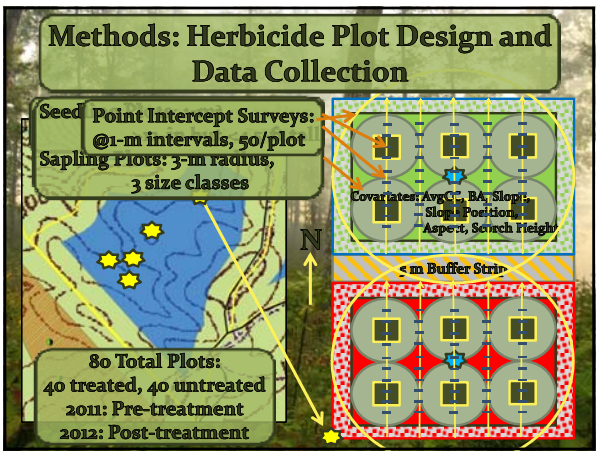

Methods: COERP Study Sites
Edge of Appalachia Preserve (OH TNC)
Daniel Boone National Forest
Green River Game Lands NCWRC
Land Between the Lakes National Recreation Area
Catoosa Wildlife Management Area (TWRA)
2 Replicates at Catoosa, LBL, and DBNF


A Brief History of Catoosa WMA
Forests established during 1920s following agricultural abandonment and logging
History of free-range, seasonal (summer) grazing during 1930 – 40s (abundant big bluestem)
Associated spring fires
Southern Pine Beetle killed virtually all short-leaf 1999
Salvage cutting initiated 2002
Prescribed fire and the initiation of the oak savanna restoration project followed
TENNESSEE WILDLIFE RESOURCES AGENCY
CATOOSA WMA OAK SAVANNA RESTORATION PROJECT

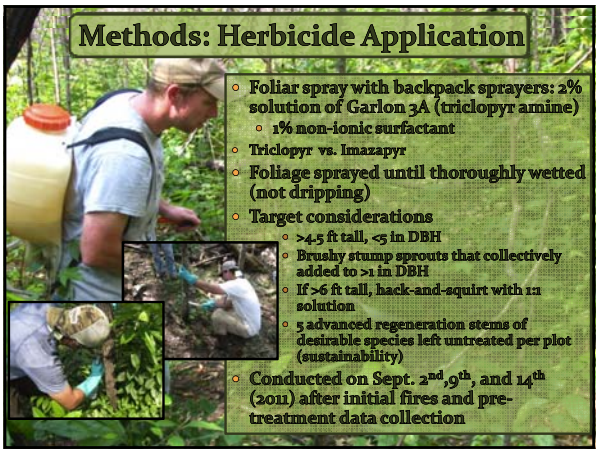

Oak Savanna Restoration in the Mid-South:
Catoosa WMA Herbicide Study Stands
GrowH
GrowL
DormL
DormH
Legend
Herbicide Plots
Treatment Units
Stand Cores (50m buffer)
Rep
Catoosa Roads
Streams
Water Bodies


Methods: Overstory Thinning
Overstory Disturbance: H – 60 ft²/ac , L - 30 ft²/ac
Completed Sept 2008
Post Harvest Overstory Characteristics
Basal Area (Ft²/Acre)
% Canopy Coverage
CONTROL
GROWH
DORMH
GROWL
DORML
Treatment
Basal Area (Square Feet/Acre) —Average % Canopy Coverage


Methods: Prescribed Fire
Season | Date Conducted | Relative Humidity (%) | Mean Scorch Height (ft) | Temp (°F) | Mean Flame Length (ft) | Mean Rate of Spread (ft/min)
Grow | October 11, 2010 | 37.1 | 3.87 | 162.5 | 1.51 | 3.28
Dorm | March 22, 2011 | 38.6 | 6.66 | 335.8 | 3.97 | 5.67
Strip head firing used when possible (Ring fires when not)


Methods: Herbicide Plot Design and Data Collection
Seed
Point Intercept Surveys: @1-m intervals, 50/plot
Sapling Plots: 3-m radius, 3 size classes
Covariates: Avg Cᵀ, BA, Slope, Slope Position, Aspect, Scorch Height
N
≤ m Buffer Strip
80 Total Plots:
40 treated, 40 untreated
2011: Pre-treatment
2012: Post-treatment

Methods: Herbicide Application



- Foliar spray with backpack sprayers: 2% solution of Garlon 3A (triclopyr amine)
  - 1% non-ionic surfactant
- Triclopyr vs. Imazapyr
- Foliage sprayed until thoroughly wetted (not dripping)
- Target considerations
  - >4.5 ft tall, <5 in DBH
  - Brushy stump sprouts that collectively added to >1 in DBH
  - If >6 ft tall, hack-and-squirt with 1:1 solution
  - 5 advanced regeneration stems of desirable species left untreated per plot (sustainability)
- Conducted on Sept. 2nd, 9th, and 14th (2011) after initial fires and pre-treatment data collection

Statistical Analysis

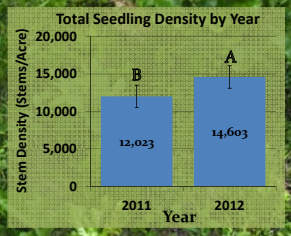
- CRD Split-Split Plot Design with covariates
  - Whole Plot: Fire/Overstory Trt Sub Plot: Herbicide Trt
  - Blocking on Sub Plot Pairs
- ANCOVA Models for each dependent-compare treatment means (α=0.05)
- Covariates:
  - Slope, Slope Position, Aspect
  - Canopy Coverage, Live Basal Area
  - Scorch Height
- Shapiro Wilk Test for normality: √ Trans
- SAS 9.3 PROC MIXED (SAS Ins., Cary, N.C)
- LSD Mean Separation

Results: Seedling Stem Density

>12 in and <4.5 ft tall Oaks, Comp, and NONC

No herbicide or burn/canopy effects

Consistent year effect



ANCOVA P-Value Table: Highlighted Effects

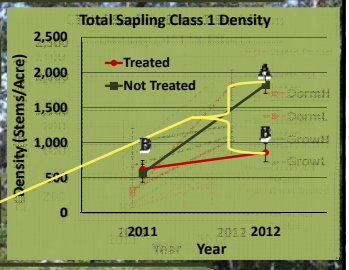
Dependent	Covariates	H*Y	Trmnt	Year
Total	Slope Position (0.0295)	0.210	0.310	0.0004
Oaks	Scorch Height (0.008)	0.105	0.998	0.0026
Oak Competitors	None	0.912	0.946	<0.0001
Other Species	Slope Position (0.009)	0.309	0.082	0.7993

Results: Sapling Stem Density

>4.5 ft tall, < 1 in DBH
Oaks, Comp, NONC

Both Burn/Canopy and Herbicide effects

A difference of 1,034 stems/acre



ANCOVA P-Value Table: Highlighted Effects

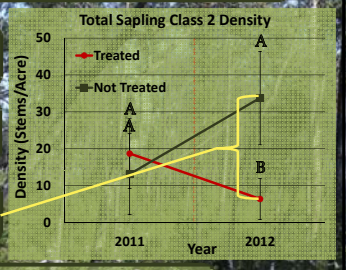
Dependent	Covariates	H*Y	T*Y	H*T*Y
Total	AvgCC	<0.0001	<0.0001	0.5122
Oaks	None	0.4768	<0.0001	0.9739
Oak Competitors	None	<0.0001	<0.0001	0.0145
Other Species	AvgCC, Aspect	<0.0001	<0.0001	0.6843

Results: Sapling Stem Density

>4.5 ft tall, 1-3 in DBH
Oaks, Comp, NONC

Only Herbicide effects!

A difference of 27.4 stems/acre



ANCOVA P-Value Table: Highlighted Effects

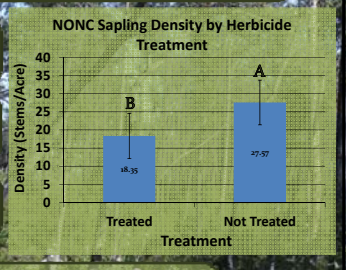
Dependent	Covariates	H*Y	T*Y	H*T*Y
Total	AvgCC, BA	0.0207	0.0828	0.4857
Oaks	-	-	-	-
Oak Competitors	AvgCC	0.0637	0.2906	0.3960
Other Species	AvgCC, BA	0.0120	0.1624	0.2148

Results: Sapling Stem Density

>4.5 ft tall, 3-5 in DBH
Oaks, Comp, NONC

Only Herbicide effects!

A difference of 9.23 stems/acre

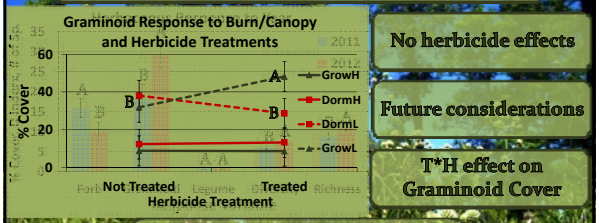


ANCOVA P-Value Table: Highlighted Effects

Dependent	Covariates	H	T*Y	H*T*Y
Total	AvgCC, BA	0.2381	0.7243	0.5875
Oaks	-			
Oak Competitors	AvgCC	0.4156	0.6860	0.5346
Other Species	AvgCC, BA	0.0361	0.1607	0.7829

Results: Herbaceous Response

Diversity, Richness, %Forb, %Graminoid, %Legume



No herbicide effects

Future considerations

T*H effect on Graminoid Cover

ANCOVA P-Value Table: Highlighted Effects

Dependent	Covariates	T*H	Y	T
Species Diversity	AvgCC, Slope Position	0.9834	<0.0001	<0.0001
Species Richness	BA, Slope Position	0.6642	<0.0001	<0.0001
Forb Cover	BA	0.0820	<0.0001	0.0927
Graminoid Cover	None	0.0192	<0.0001	0.0060
Legume Cover	Slope Position	0.5067	1.0000	0.0659

Cost Considerations

- Recorded time/plot and chemical use/plot
- Calculated Cost/Acre

Calculated Costs per Acre for Midstory Herbicide Treatments

Cost Type	Plot Averages	GrowL Averages
Labor	$48.80	$51.81
2% Spray Chemical	$25.32	$28.37
1:1 Hack-and-Squirt Chemical	$4.21	$3.95
Total	$78.33	$84.13

Discussion continued…with Literature?

- The use of herbicides is limited in oak woodland and savanna restoration…and so is research (Lashley et al., 2009; McCord, 2011; McCord and Harper, 2011)
- Effective in pine savanna management (Ansley and Castellano, 2006; Walker and Silletti, 2006; Freeman and Jose, 2009)
- Growing-season effects as late as October…most studies on spring or no later than September fires (Gruchy et al. 2006, Brose and Van Lear 1998, Waldrop and Lloyd 1991)
- Often used for oak regeneration release (Loftis, 1990; Lorimer et al., 1994)

Conclusions and Management Implications

- Midstory herbicide treatments reduced the cover and density of woody plants
  - Herbicide reductions > than fire alone
  - Most successful following late growing-season fire
  - Reduced larger size classes that fire did not affect
- Woody reductions occurred without harming desirable vegetation
  - No affect on diversity, richness, forb cover, and legume cover
  - Increased graminoid coverage, increasing fine fuels
  - Released brambles and greenbriars
- Affordable
- Future monitoring will determine if:
  - greater benefits to the herbaceous layer exist
  - the magnitude of the difference between treated and un-treated plots following subsequent fire warrants the added restoration costs

Acknowledgements

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