





**The Efficiency of Thinning, Fire, and Herbicides in Restoring Oak Savannas and Woodlands in the Mid South**

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University of Tennessee

Wednesday, April 20, 2010, 12:20 pm Room 160, Plant Biotech Building

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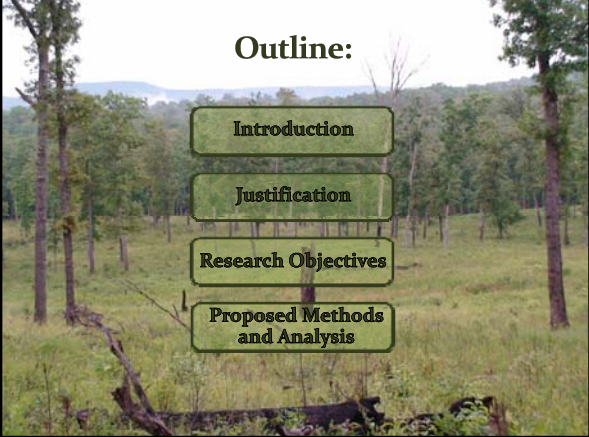
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**Outline:**

- Introduction
- Justification
- Research Objectives
- Proposed Methods and Analysis



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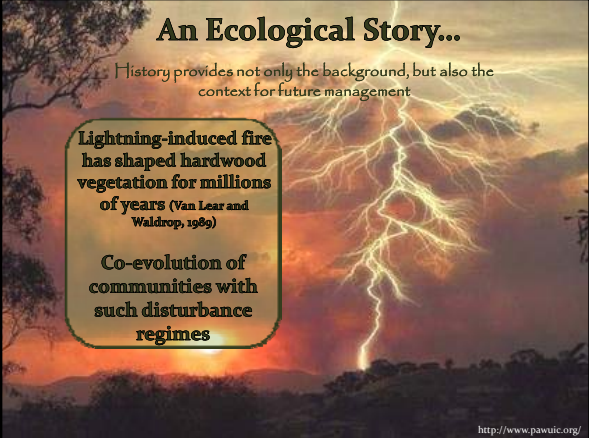
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**An Ecological Story..**

History provides not only the background, but also the context for future management

**Lightning-induced fire has shaped hardwood vegetation for millions of years (Van Lear and Waldrop, 1989)**

**Co-evolution of communities with such disturbance regimes**



<http://www.pawuic.org/>

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### An Ecological Story..

**Native Americans dramatically increased the prevalence of fire  
Cliff Palace Pond, Jackson Co KY**  
(Delcourt et al., 1998)



**"The top of the mountain is described as being then a vast upland prairie covered with the most luxuriant growth of native grasses , pastured over as far as the eye could see, with numerous herds of deer, elk, and buffalo ...."**  
(Ramsey, 1893)

**Dendrochronology-  
1-12 year fire intervals**  
(Frost, 1998)  
**Gross Under-estimation**  
(Baker and Ehle, 2001)

<http://illinois.edu/ib/111et/98>  
Artist Rex Robinson, © 2000, Kentucky Heritage Council

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### The Greater Evidence...



Nuzzo, 1986

**Pre-Settlement Extent:  
11-13 million ha**



Legend:  
 ■ Tallgrass prairie—intermixed with Savanna and woodland, except along the western edge.  
 ■ Tallgrass savanna and woodland—intermixed with prairie and forest.

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### The Story Continues...



- Presently 0.02% (2,607 ha) of the original extent of oak savanna remains (Nuzzo, 1986)
- One of the most imperiled ecosystems in N.A. (Noon and Peters, 1999)
- <500 acres with similar plant assemblages as original oak savanna (Henderson, 1995)
- Remnants limited to poor sites (Peterson and Reich, 2001)

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### Associated Community Declines... Herbaceous Plants

- Highly diverse herbaceous layer (Kirkman et al. 2001)
- Light reductions and resource gradient loss due to successional advance has led to widespread plant diversity losses (Walker and Silletti, 2006)

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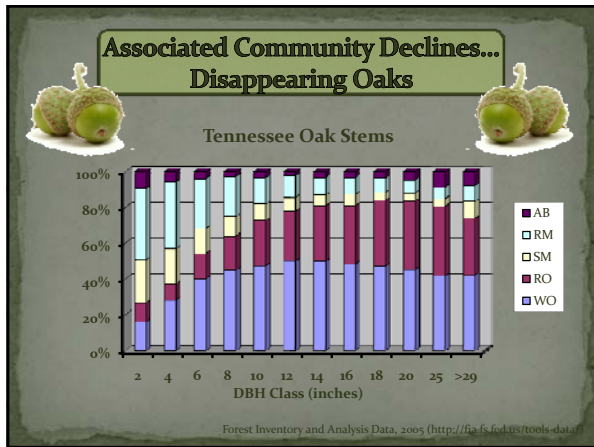
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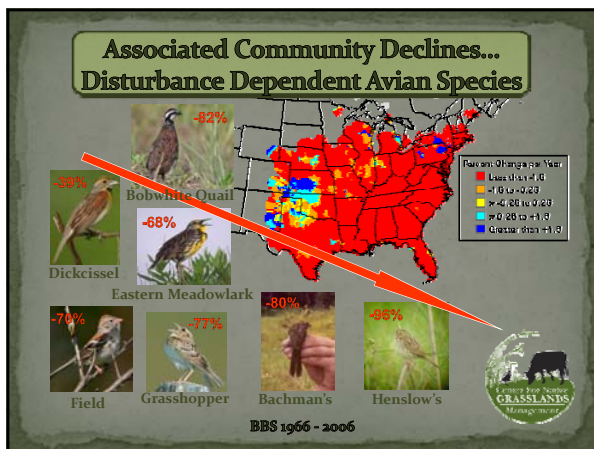
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### Cause? Disappearing Fire

- Other causes mentioned...but fire suppression most influential
- Disturbance normal for the maintenance of oak ecosystems
- Fire-influenced components completely gone

**Fire importance**

Pre-1900: Fire suppression, canopy closure, increased shade

Mid-1900s: Dramatic increase of shade-tolerant, mesophytic trees

Early 2000s: Decreased flammability due to mesophytic fire and oak, humid microclimate

Present: Fire regimes change

**Mesophication**

**Change in magnitude**

Less fire: -4, -3, -2, -1, 0, 1, 2, 3, 4: More fire

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### COERP Goal

Monitor Community Level Responses

- Woody Vegetation
- Herbaceous Vegetation
- Songbirds

Determine the efficiency of management techniques in the restoration of open oak ecosystems

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### Fire

- Fire is essential (Nielsen et al., 2003)
- Positive effects on:
  - herbaceous vegetation (Appelbaum and Haney, 1990)
  - oak regeneration (Broose and Van Leeu, 1998)
  - avian diversity (Davis et al., 2002)
- Dormant-season vs. Growing-season (Broose and Van Leeu, 1998)
- Slow to alter the overstory (Peterson and Reich, 2001; Nielsen et al., 2003)

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### Overstory Thinning

- Acceleration of restoration from decades to years (Abella et al., 2003; Peterson and Reich, 2003; Nielson et al., 2003)
- The shelterwood-burn technique (Brose et al., 1999)
- Positive effects on:
  - herbaceous vegetation (Peterson et al., 2007)
  - oak regeneration (Loftis, 1990)
  - avian diversity (Annand and Thompson, 1997)
- Revenue generated off-sets restoration costs (Laubach, 2000)

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### Herbicides

- Dense sub-canopies of oak competitors (Abrams, 1998)
- Further accelerate restoration timeframe (Walker and Silletti, 2006)
- Positive effects on:
  - Herbaceous vegetation (Bowles et al., 1994)
  - Oak regeneration (Lorimer et al., 1994)
  - Avian species (Welch et al., 2004)

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## COERP Management Experiment



		Fire		
		None	Dormant Season	Growing Season
Canopy Disturbance	None/Minimal	IMPAIRED FOREST		WOODLAND/FOREST
	Partial		MIXED/OAK FOREST	OAK WOODLAND
	Heavy		FOREST/WOODLAND	OAK SAVANNA

Also included: Herbicide treatment of the woody midstory

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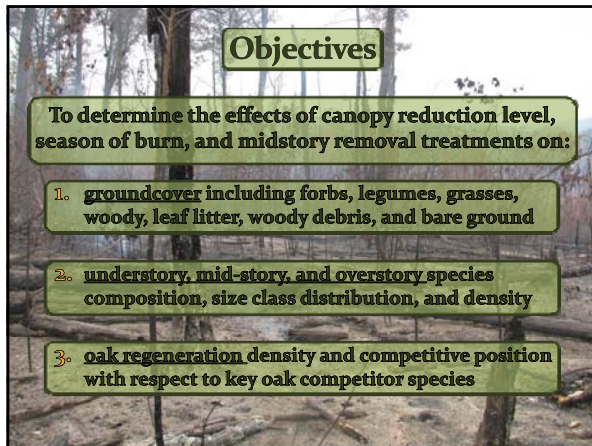
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**Objectives**

To determine the effects of canopy reduction level, season of burn, and midstory removal treatments on:

1. **groundcover** including forbs, legumes, grasses, woody, leaf litter, woody debris, and bare ground
2. **understory, mid-story, and overstory species composition, size class distribution, and density**
3. **oak regeneration density and competitive position with respect to key oak competitor species**

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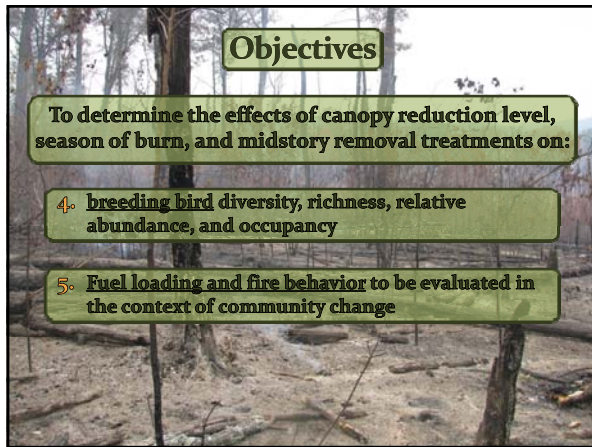
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**Objectives**

To determine the effects of canopy reduction level, season of burn, and midstory removal treatments on:

4. **breeding bird diversity, richness, relative abundance, and occupancy**
5. **Fuel loading and fire behavior to be evaluated in the context of community change**

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**Justification**

- **Open-oak ecosystems highly imperiled**
- **Few studies on vegetation and avian community response to fire and canopy removal**  
(Abella et al. 2001, Nielsen 2003)
- **Restoration using herbicides**
- **Degraded savannas vs. closed canopy start**
- **Research in the Mid-South limited and retrospective only**(Barrios, 2009)
- **Our understanding of how restoration is best accomplished remains limited**(Leach and Ross, 1995)

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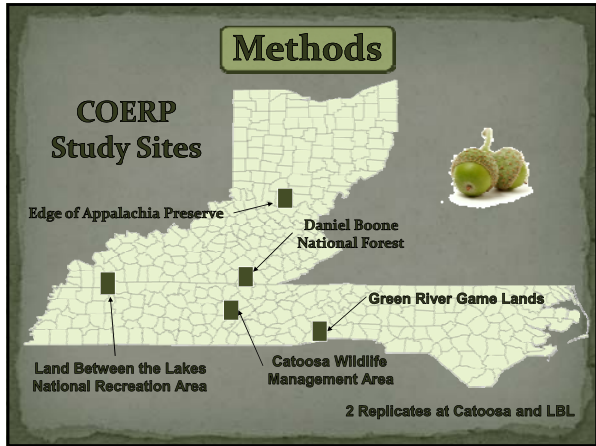
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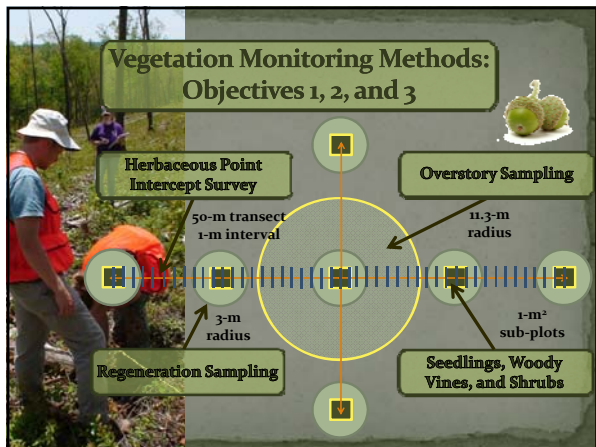
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### Objective 4- Methods

Standard point counts (n=4/20 ha unit)  
(Ralph et al., 1993)

- Separated by >250 m
- Identified species by sight and sound (10 min)
- Each point visited 3 times from May-June

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### Objective 5- Methods

- Fuel loading surveys (NPS FMH 2003)
- Fuel moisture content (1, 10, 100, 1000 HR Fuels)
- Weather (temp, relative humidity, wind speed, wind direction, cloud cover)
- Pyrometers
- Rate of spread and flame length
- Scorch height measurements

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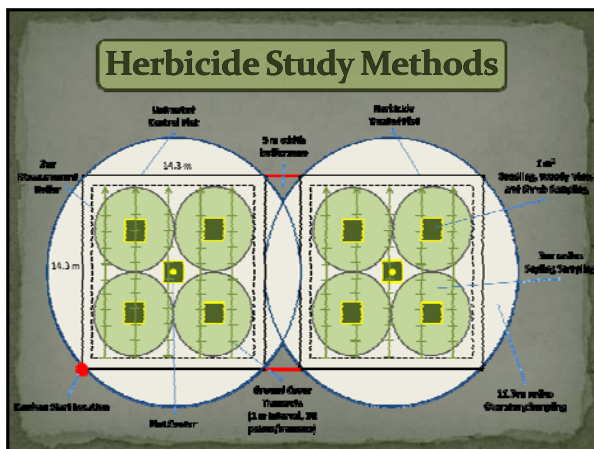
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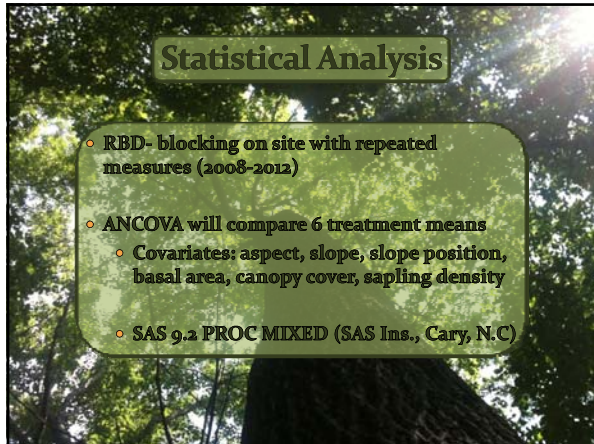
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**Statistical Analysis**

- RBD- blocking on site with repeated measures (2008-2012)
- ANCOVA will compare 6 treatment means
  - Covariates: aspect, slope, slope position, basal area, canopy cover, sapling density
- SAS 9.2 PROC MIXED (SAS Ins., Cary, N.C)

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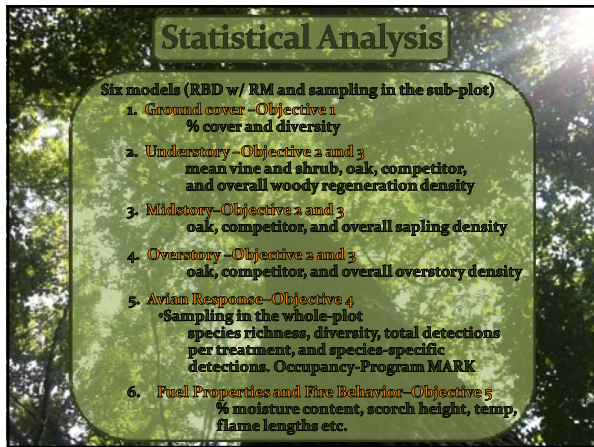
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**Statistical Analysis**

Six models (RBD w/ RM and sampling in the sub-plot)

1. **Ground cover -Objective 1**  
% cover and diversity
2. **Understory -Objective 2 and 3**  
mean vine and shrub, oak, competitor, and overall woody regeneration density
3. **Midstory -Objective 2 and 3**  
oak, competitor, and overall sapling density
4. **Overstory -Objective 2 and 3**  
oak, competitor, and overall overstory density
5. **Avian Response -Objective 4**  
•Sampling in the whole-plot  
species richness, diversity, total detections per treatment, and species-specific detections. Occupancy-Program MARK
6. **Fuel Properties and Fire Behavior -Objective 5**  
% moisture content, scorch height, temp, flame lengths etc.

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**Conclusion**

Oak savannas were once a dominant ecosystem type and their restoration is crucial for preserving a highly diverse and valuable piece our natural heritage

My research will determine the best management for restoration goals

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