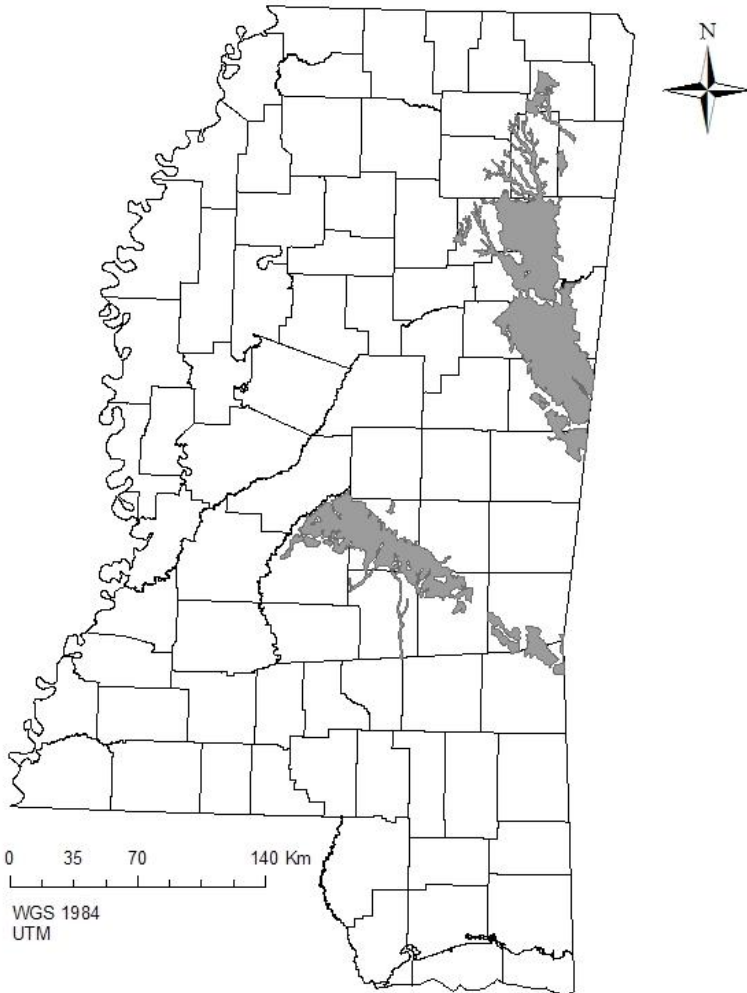


# The Blackland Prairie of Mississippi: Conservation needs, practices, and development of a predictive model

Steven Hughes

# Mississippi Prairie



- Jackson
  - 250 km<sup>2</sup>
- Blackland
  - Over 10,000 km<sup>2</sup> in MS and AL
  - Calcareous soil
  - Soil attributed to diverse flora (Jones and Patton 1966)
  - 196 plant species (Barone and Hill 2007)
  - “Grainery of Confederacy”

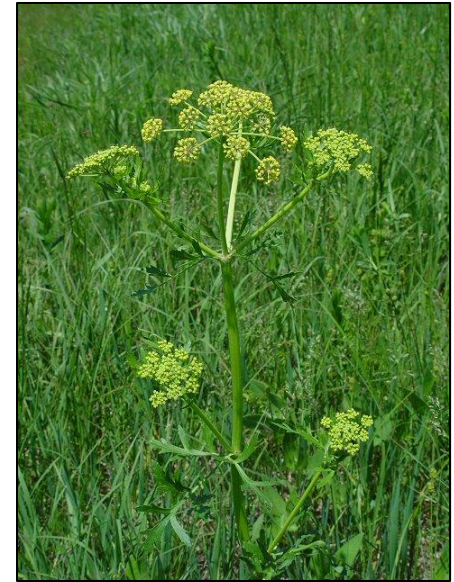


# Cause for Concern

- Listed as an Endangered Ecosystem with less than 1% of pre-Columbian coverage remaining (Noss et al. 1995)
- Continued degradation of remaining patches (Barone and Hill 2007)
- Home to state-listed plant species



*Echinacea purpurea*



*Polytaenia nuttallii*



*Linum sulcatum*

# Conservation Efforts

- Conservation Reserve Program (CP33)
  - Primary goal restoration of upland bird habitat
- State Acres for Wildlife Enhancement (CP38)
  - Primary goal is wildlife habitat restoration
- Grassland Reserve Program
  - Enhancement of grazing land using native vegetation





# Hypothesis 1

Mississippi Blackland Prairie remnant sites will have **different plant species assemblages** than restored sites.

- 1<sup>st</sup> known attempt at assessment of restoration practices

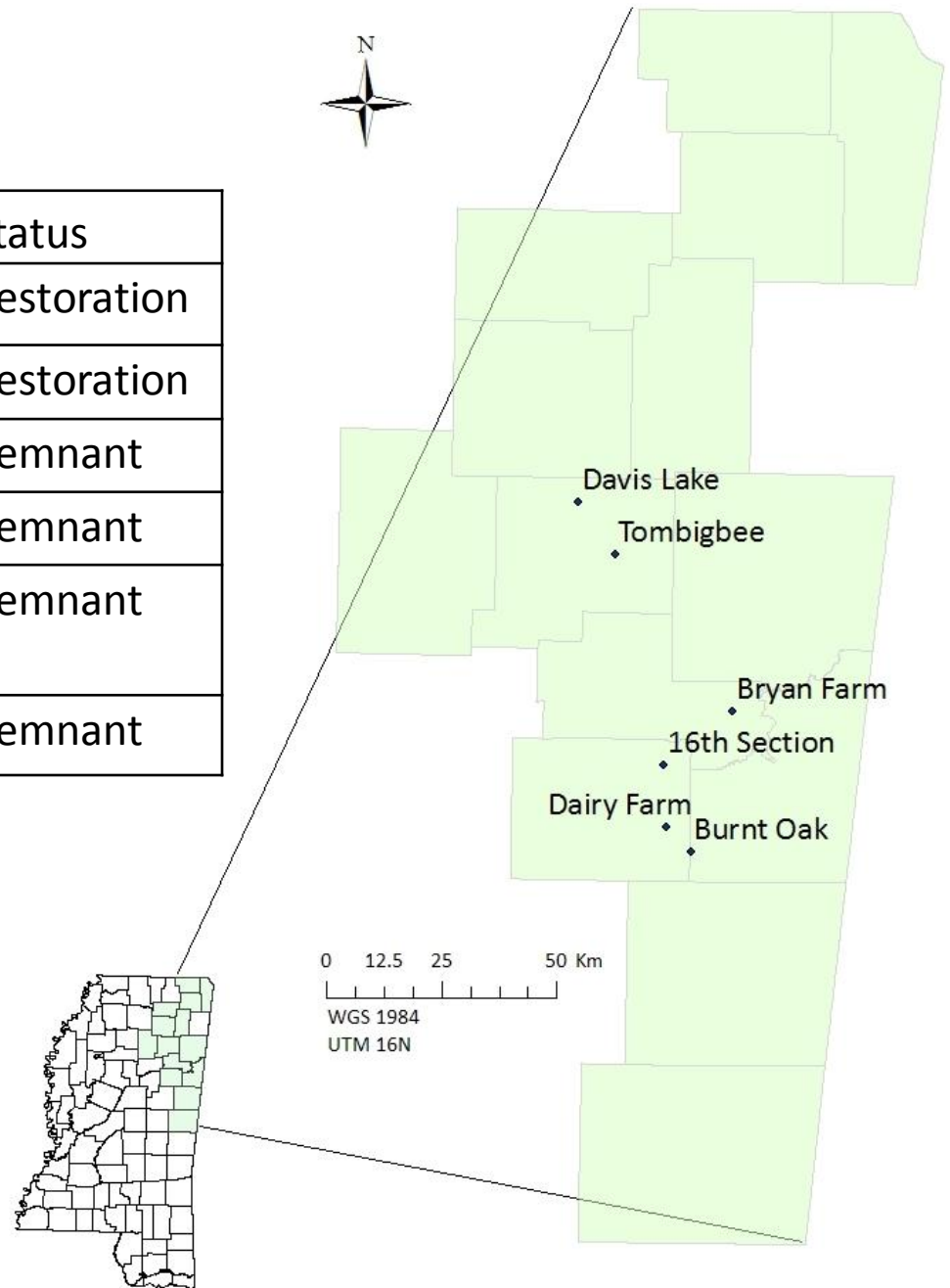


# Prairie Survey

Site	Ownership	Status
Burnt Oak	Private	Restoration
Bryan Farm	Private	Restoration
Davis Lake	National Forest	Remnant
Tombigbee	National Forest	Remnant
Dairy Farm	Mississippi State University	Remnant
16 <sup>th</sup> Section	Private	Remnant

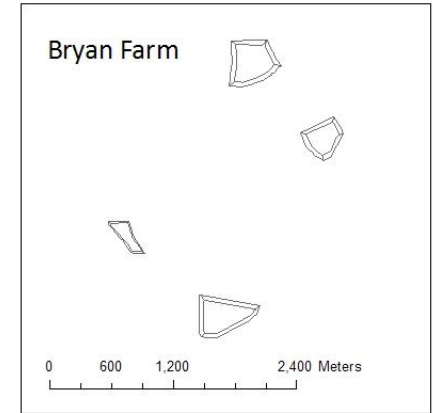
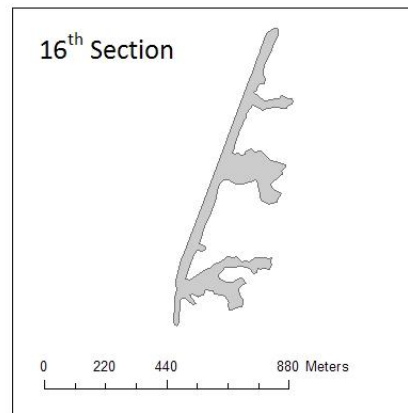
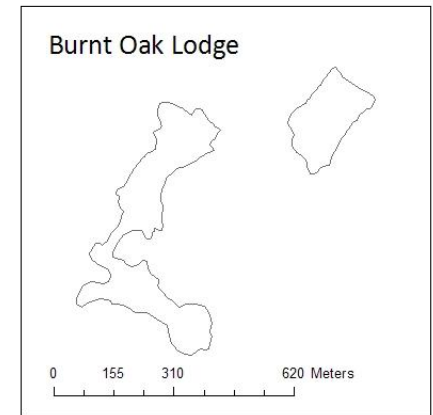
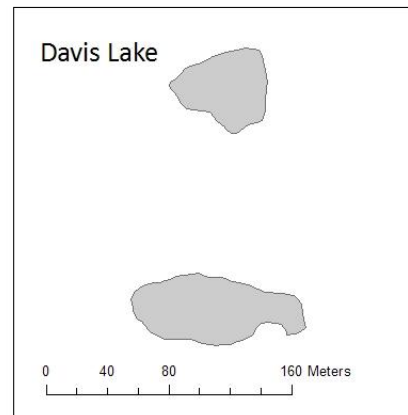
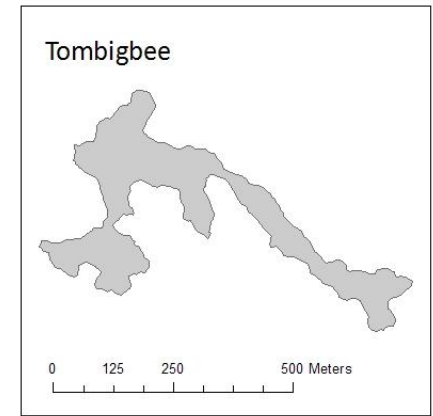
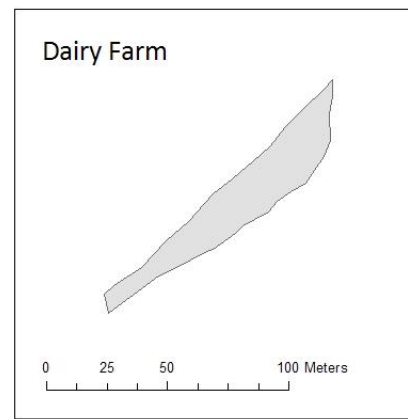


*Eryngium yuccifolium*



# Prairie Survey

- Map study sites
  - GPS to record perimeter using tree line as limit
- Sample points
  - Randomly generated points within each prairie site

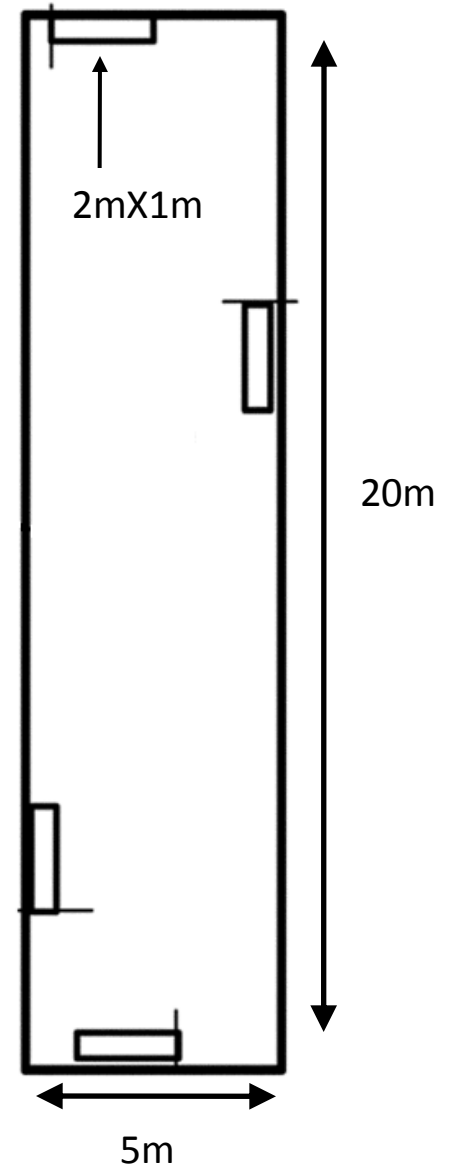


Grey=Remnant; White=Restoration

WGS 1984 UTM 16N

# Prairie Survey

- Sampling method
  - Nested plot sampling design
  - May and August, 2009
  - One point per sample period
- Data collected
  - Plant species coverage
  - Ground cover variables
  - Plant species presence
  - Disturbance features





# Prairie Survey

- Remnant vs. Restored
  - Ordination

Non-metric Multidimensional Scaling (Pc-Ord 5.10)

$\gamma=126$

$r^2=0.78$

Site	Species Richness (Cover/Presence)	Evenness	Shannon Index
Bryan Farm	11/13	.67	1.6
Burnt Oak Lodge	35/38	.89	3.1
Davis Lake	51/66	.75	2.9
Tombigbee	47/56	.77	3.0
Dairy Farm	47/60	.85	3.3
16 <sup>th</sup> Section	40/47	.73	2.7

# Hypothesis 2

Presence of prairie *Indicator Species* will be correlated with soil attributes, topography, and/or canopy cover.



# Model Building

- **1<sup>st</sup> known attempt to model in the Blackland Prairie**
- Predict locations where remnant prairie habitat or suitable prairie restoration sites may be found
  - Based on *Indicator Species* from Hypothesis 1
  - Locate sample points
  - Environmental variables expected to be important correlates of prairie habitat

## Methods

- Logistic regression
- GIS modeling



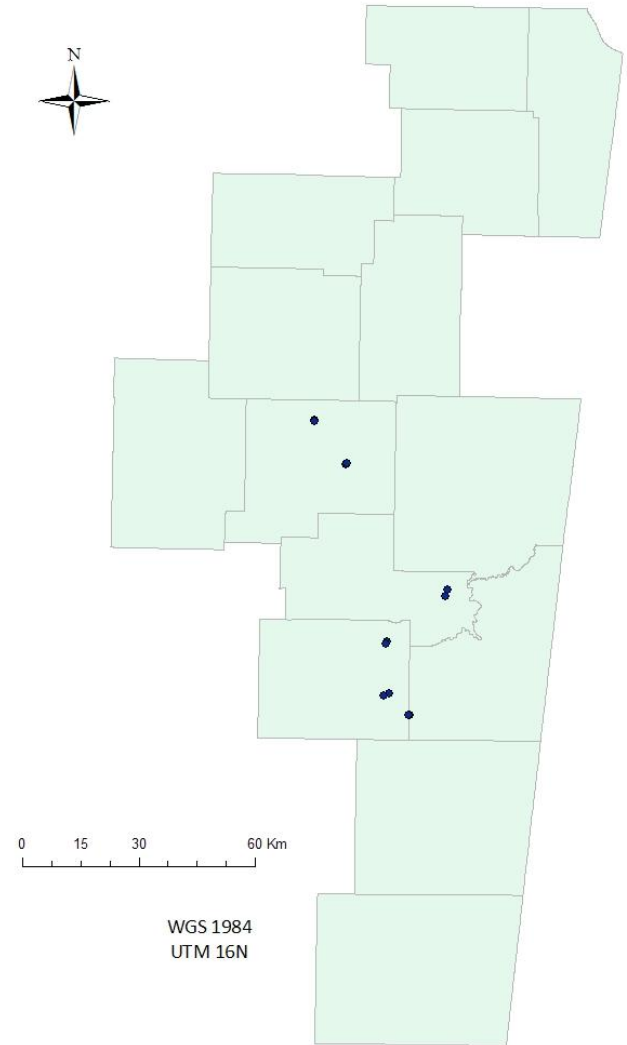
# *Indicator Species*

- Most common species by presence or coverage

Presence	Coverage
Salvia lyrata	Schizachyrium scoparium
Schizachyrium scoparium	Sorghastrum nutans
Andropogon virginicus	Andropogon virginicus
Chamaecrista fasciculata	Ratibida pinnata
Dalea candida	Aristida purpurascens
Desmanthus illinoensis	Ambrosia artemesifolia
Ratibida pinnata	Salvia lyrata
Solidago nemoralis	Solidago nemoralis
Ambrosia artemesifolia	Desmanthus illinoensis
Cornus drumundii	Dalea candida

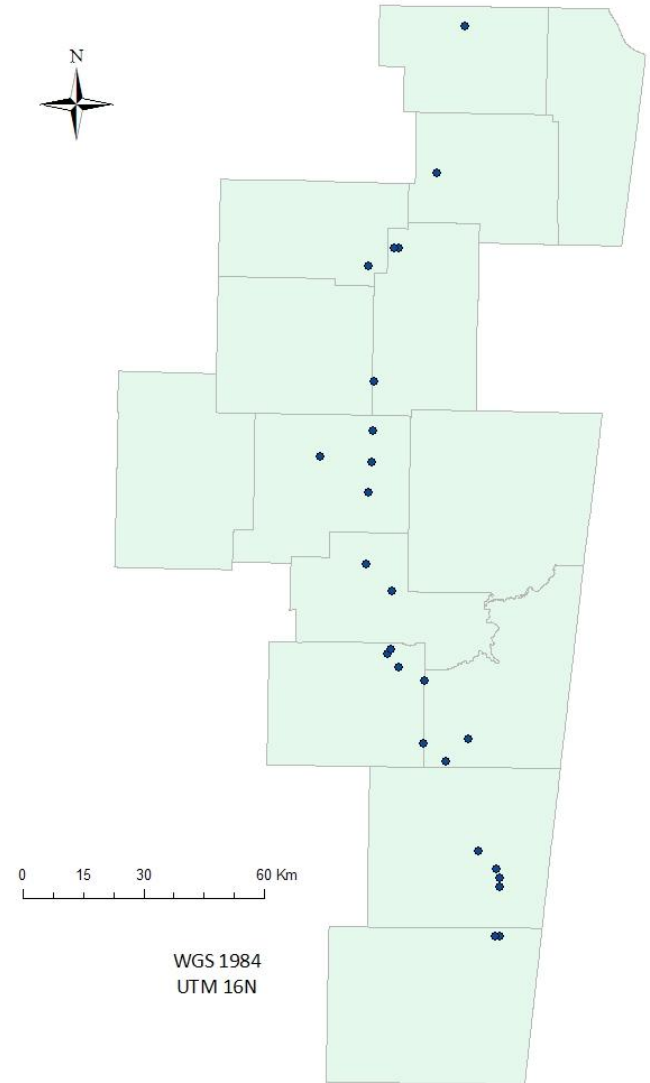
# Model Building

- Sample points
  - Initial survey sites (n=12)
    - Presence points
    - List of indicator species
  - Mississippi Museum of Natural Science (n=25)
    - Presence points based on indicator species
  - Statewide floristic survey
    - Presence points based on indicator species (n=3)
    - Absence points (n=30)



# Model Building

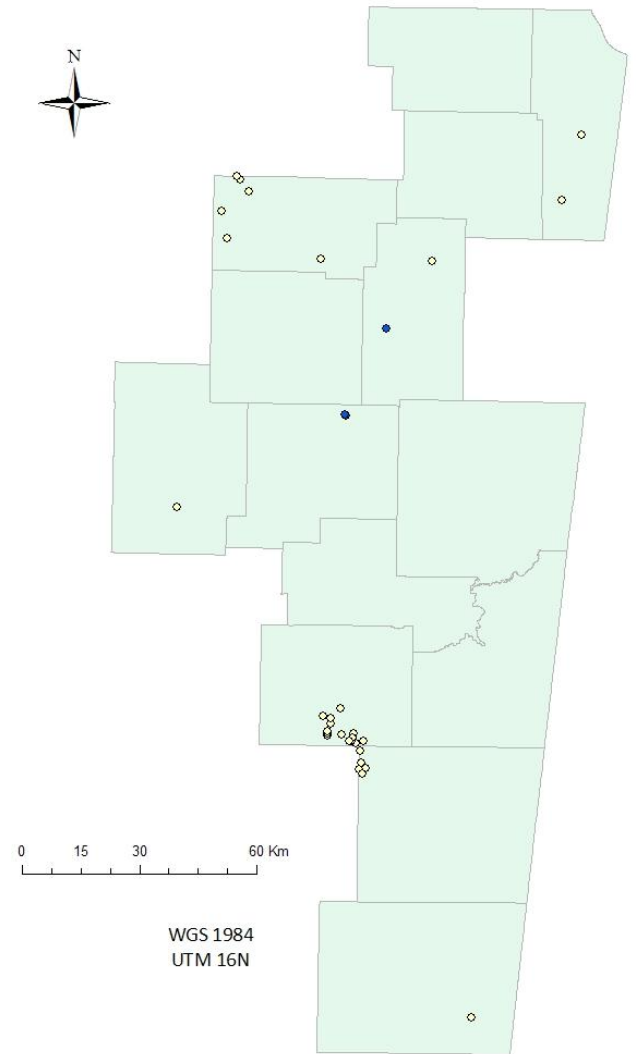
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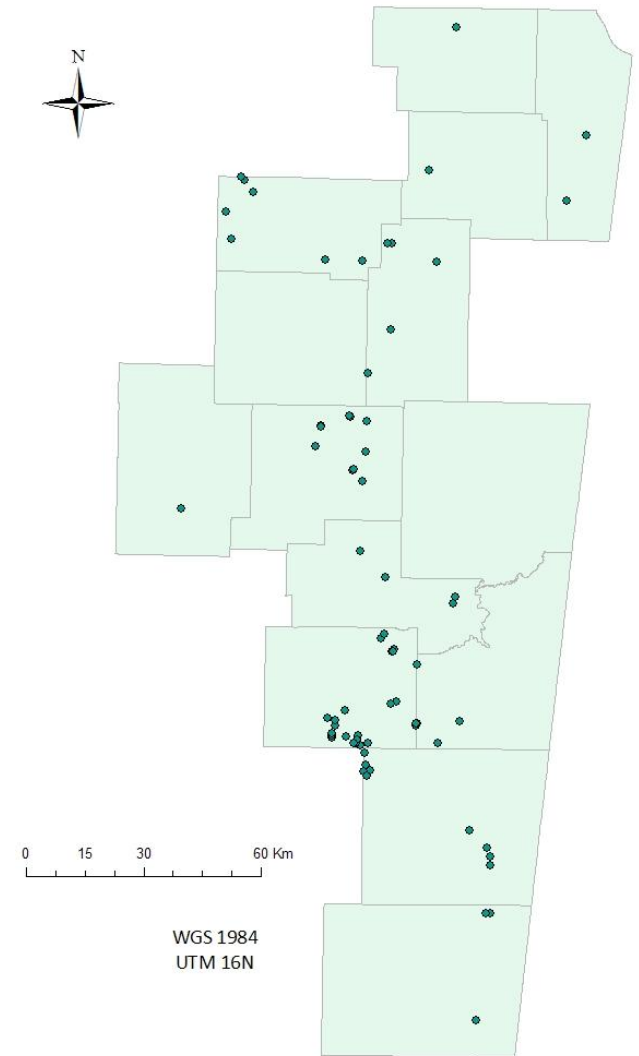
# Model Building

- Sample points
  - Initial survey sites (n=12)
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    - Absence points (n=30)



# Model Building

- Sample points
  - Initial survey sites (n=12)
    - Presence points
    - List of indicator species
  - Mississippi Museum of Natural Science (n=25)
    - Presence points based on indicator species
  - Statewide floristic survey
    - Presence points based on indicator species (n=3)
    - Absence points (n=30)
  - **Total: N=70**  
**(40 presence, 30 absence)**
- All points used  $\geq 140\text{m}$  to nearest neighbor



# Model Building

- Environmental Data
- Publicly accessible GIS databases
  - Mississippi Automated Resource Information System (MARIS)
    - 10m DEM
      - Topography: curvature
    - Soil
  - USDA NRCS SSURGO/Soil Data Viewer
    - Soil characteristics
      - % clay, % silt, % sand
  - USGS Southeast Gap Analysis Project (SEGAP)
    - Canopy



# Model Building

## Methods

- Forward Stepwise Logistic Regression (SPSS 16.0)
  - GIS
    - Mahalanobis distance
- (Jenness Enterprise, ArcView 3.3)



*Ophioglossum engelmannii*

## Results

- Generated 11 prediction models
  - 2 Logistic Regression
  - 9 GIS



*Lithospermum canescens*

# Model Building

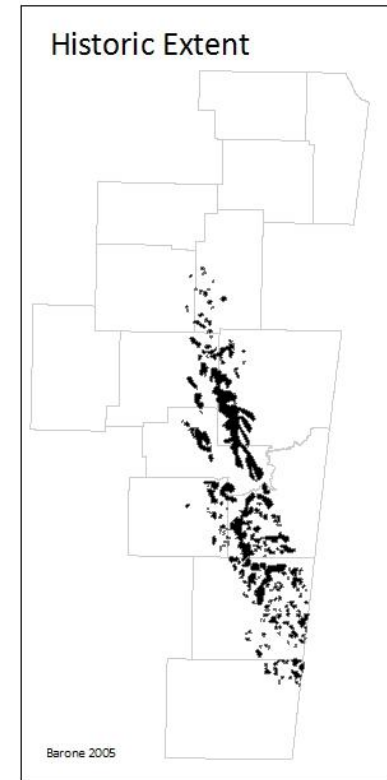
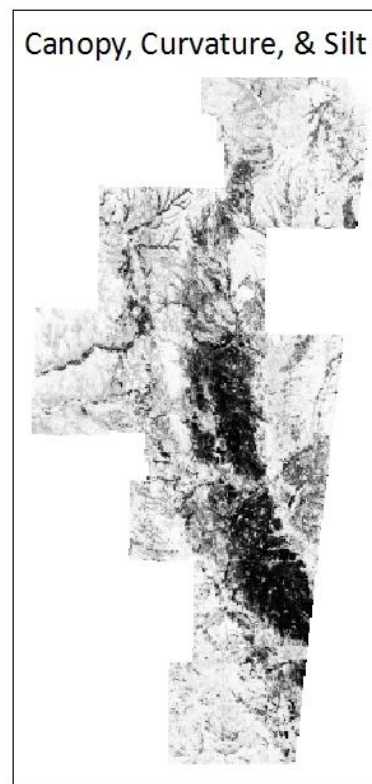
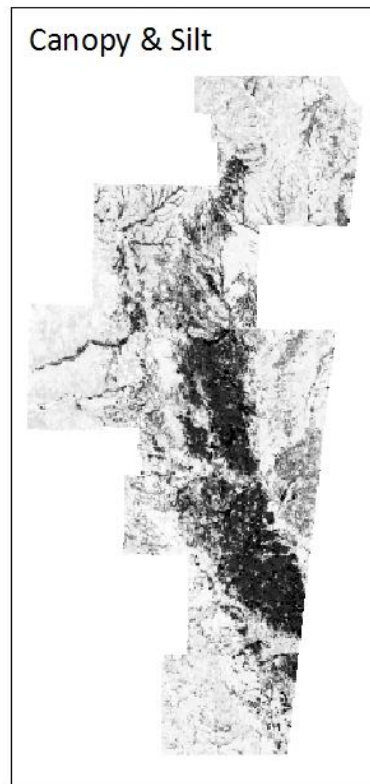
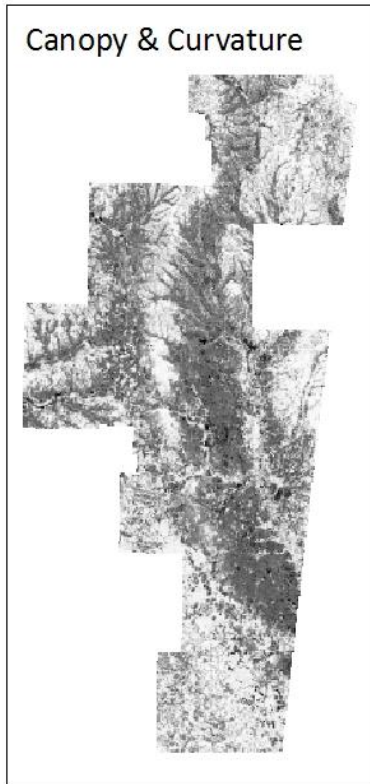
## Top models?

- Assessment metrics
  - ROC curve
    - Represents model ability to correctly identify presence against false presence
    - $> 0.8$  considered good model
  - Reduce false presence for conservation (Fielding and Bell 1997)
  - 5 Good models
    - All from Mahalanobis method



*Blephilia ciliata*

# How do they look?



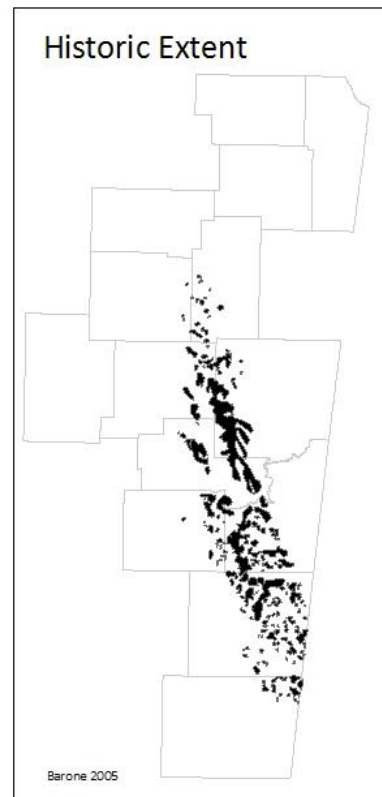
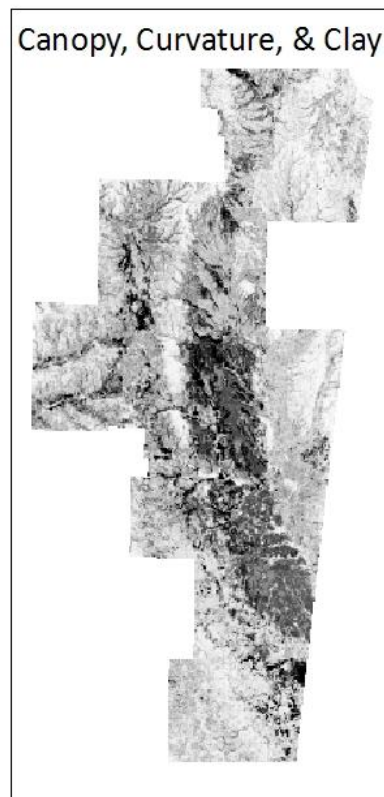
0 45 90 180 Km

WGS 1984  
UTM 16N

Darker = Higher probability



# How do they look?



0 45 90 180 Km

WGS 1984  
UTM 16N

Darker = Higher probability

# Model Evaluation

## Validate model predictions

- Ground truth predicted presence of *Indicator Species* based on environmental attributes



# Model Evaluation

## How?

- Create validation points
  - Public land
- Survey validation points
- Top model?
  - Assess models with:
    - metrics
    - validation points



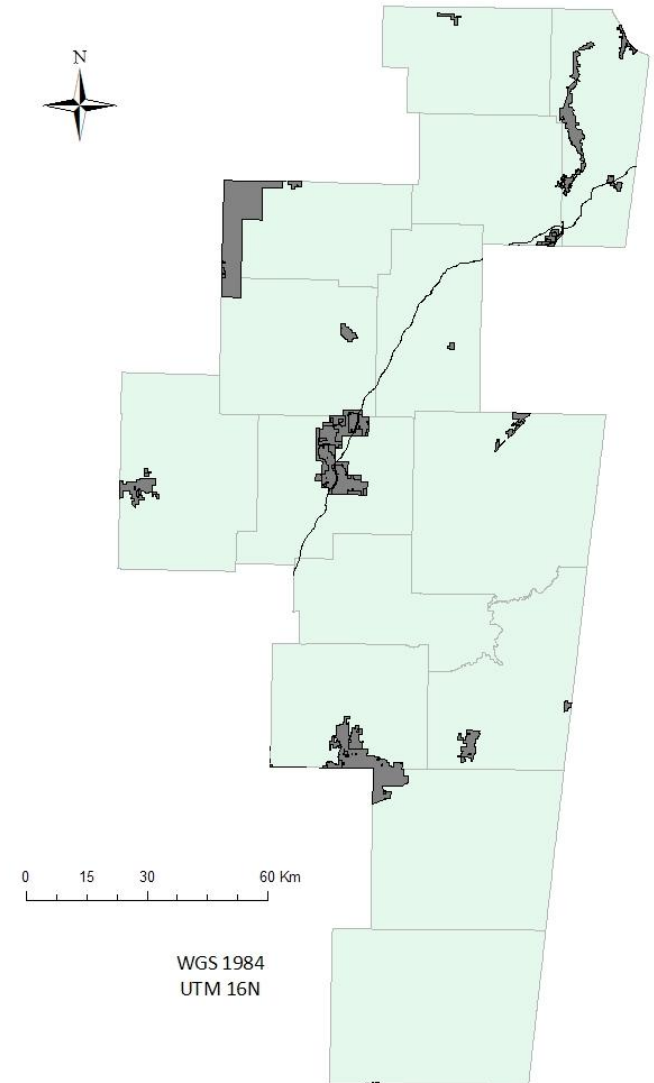
*Liatrix aspera*



*Apis* sp

# Model Evaluation

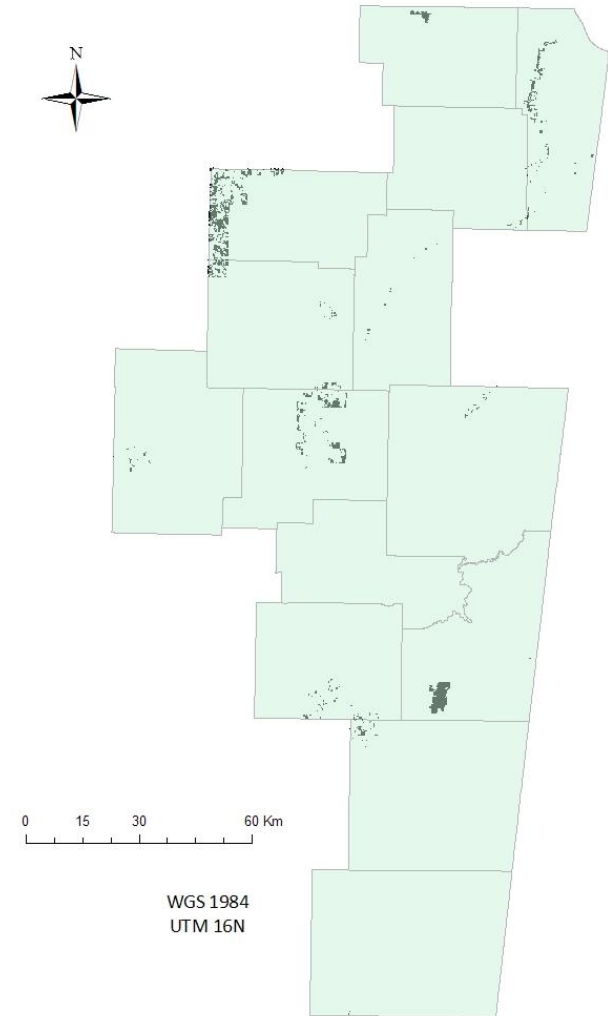
- Public Land
  - MARIS
    - National Forest
    - National Parks
    - National Wildlife Refuges
    - Mississippi State Wildlife Management Areas
    - Mississippi State Parks





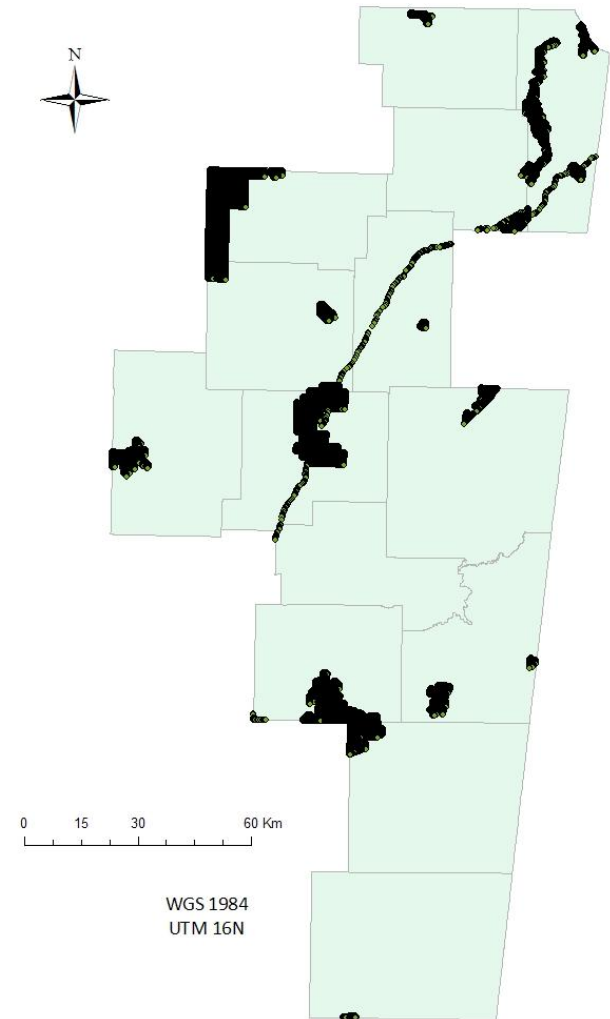
# Model Evaluation

- Generate validation points
  - Extract model surfaces to public land
  - Convert to points
  - Select random subset of 40 points for each model (N=200)



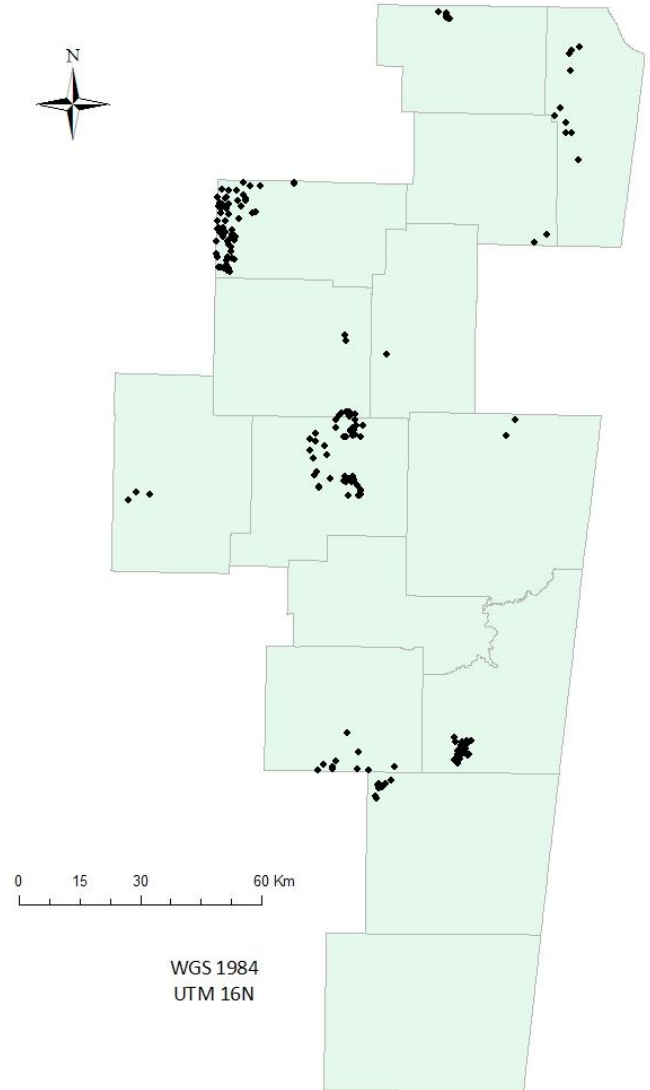
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# Model Evaluation

- Generate validation points
  - Extract model surfaces to public land
  - Convert to points
  - Select random subset of 40 points for each model (N=200)





# Model Evaluation



- Survey validation points
  - Presence of *Indicator Species*
  - Topographic position
  - Disturbance features



# Model Evaluation

A landscape photograph showing a grassy field in the foreground, a line of trees in the middle ground, and a blue sky with scattered white clouds in the background. The trees are a mix of green and bare, suggesting a transitional season. The overall scene is bright and clear.

In Progress...

- Assess models with validation data
- Determine Top model



# Prairie Roundup

- Mississippi Blackland Prairie needs:
  - Exploration
  - Conservation
- Evaluate conservation efforts
- Develop and test prediction model for:
  - More thorough investigation of region for remnant sites
  - Aid selection for future conservation



# Acknowledgements



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Ecology and Evolutionary Biology

Reading Group

Department of Biological Sciences

Parents: **Jim and Carol Hughes**



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