

# Monitoring changes to plant communities and soils during oak savanna restoration in Iowa



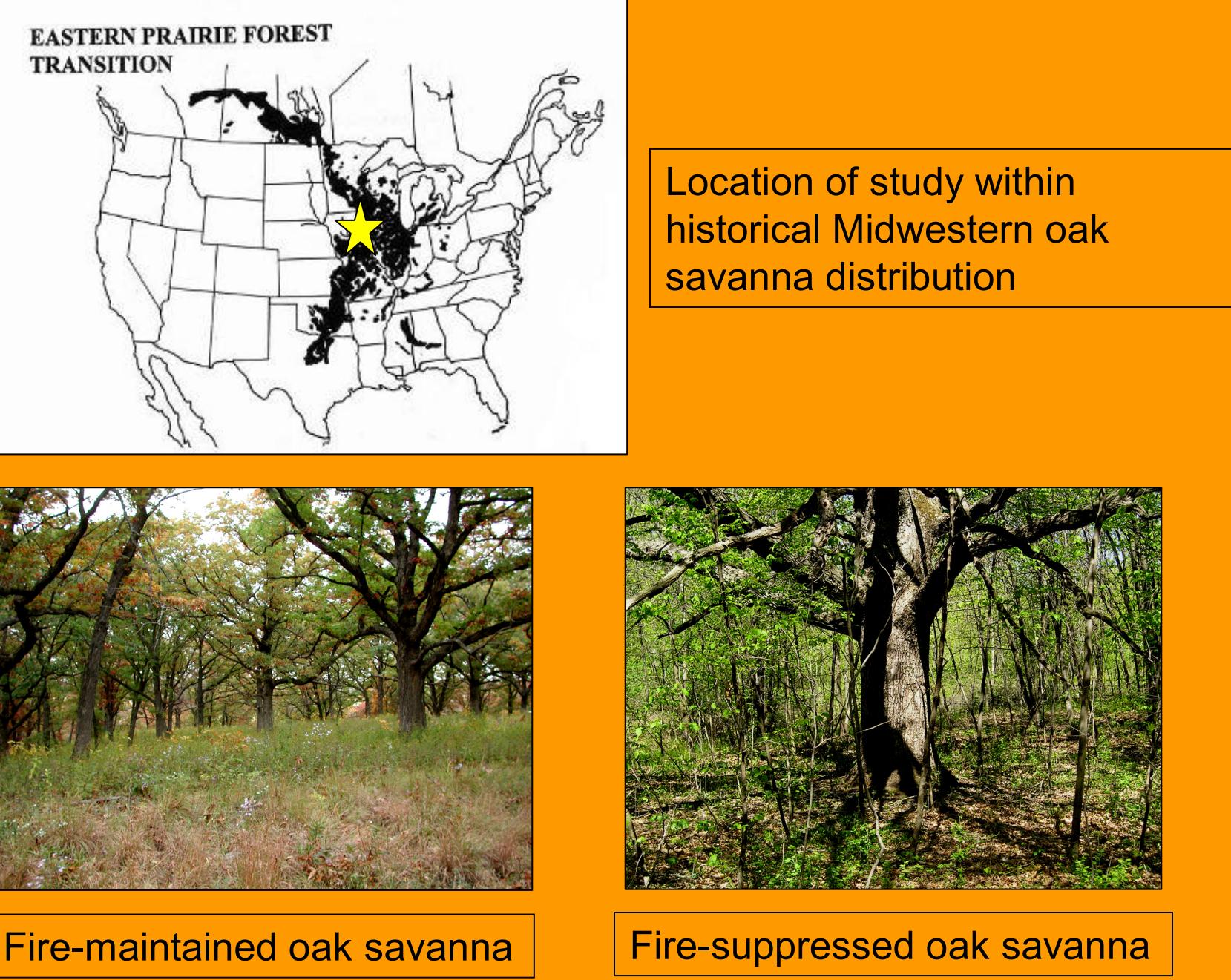
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## Background – Midwestern oak savannas

- Historically formed the >10M ha fire-maintained ecotone between prairies and Eastern deciduous forest
- Characterized by broken oak overstory and species rich, dense understory
- <1% remains following agricultural conversion and fire suppression
- Fire suppression converts savanna to woodland
- Fire suppressed savannas hold potential for restoration



## Experimental restoration methods

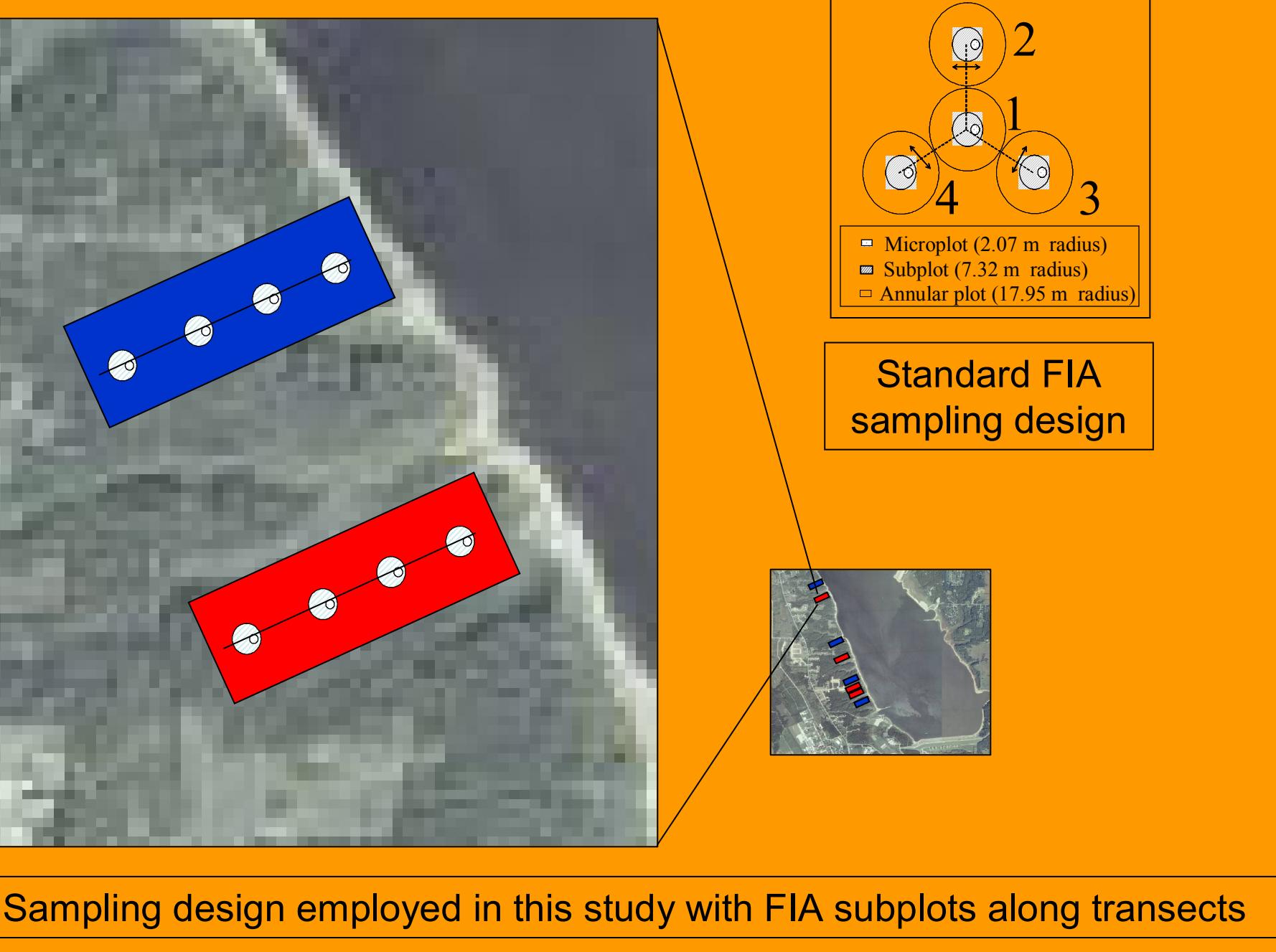
- 8 *Quercus alba* savanna remnants along Saylorville Lake in central Iowa
  - Remnants 3-8 ha
  - 40+ years of fire suppression
    - Encroached by fire intolerant trees (e.g., *Fraxinus americana*, *Ostrya virginiana*, *Ulmus* sp.)
  - Encroachment mechanically removed in 4/8 remnants during 2002-2003
  - Remaining 4 remnants serve as encroached control sites



Locations of 8 savanna remnants (red = treatment sites), with ground-level view of one remnant before and after mechanical restoration treatment

## Vegetation and soil monitoring

- Vegetation and soil monitoring initiated in 2002
- Vegetation monitored via nested transect and FIA methodologies
  - FIA Methodology: Phase 2 subplots arranged linearly to fit within sites
- Soils monitored via transect-based methodology
- Transect based-sampling in 2002-2006
- FIA sampling in 2002, 2004, 2006, 2008 at four sites; 2006, 2008 at all sites

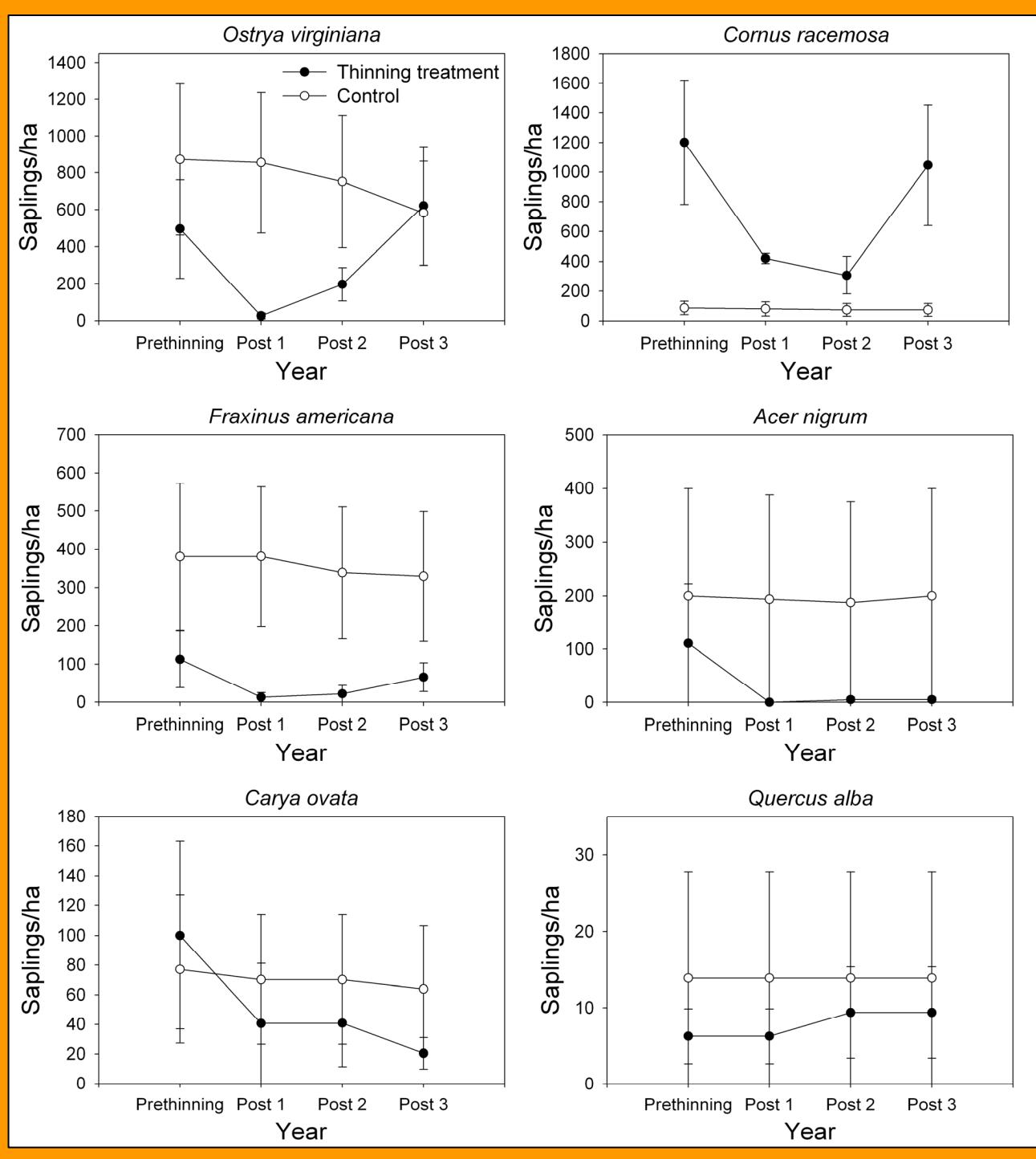
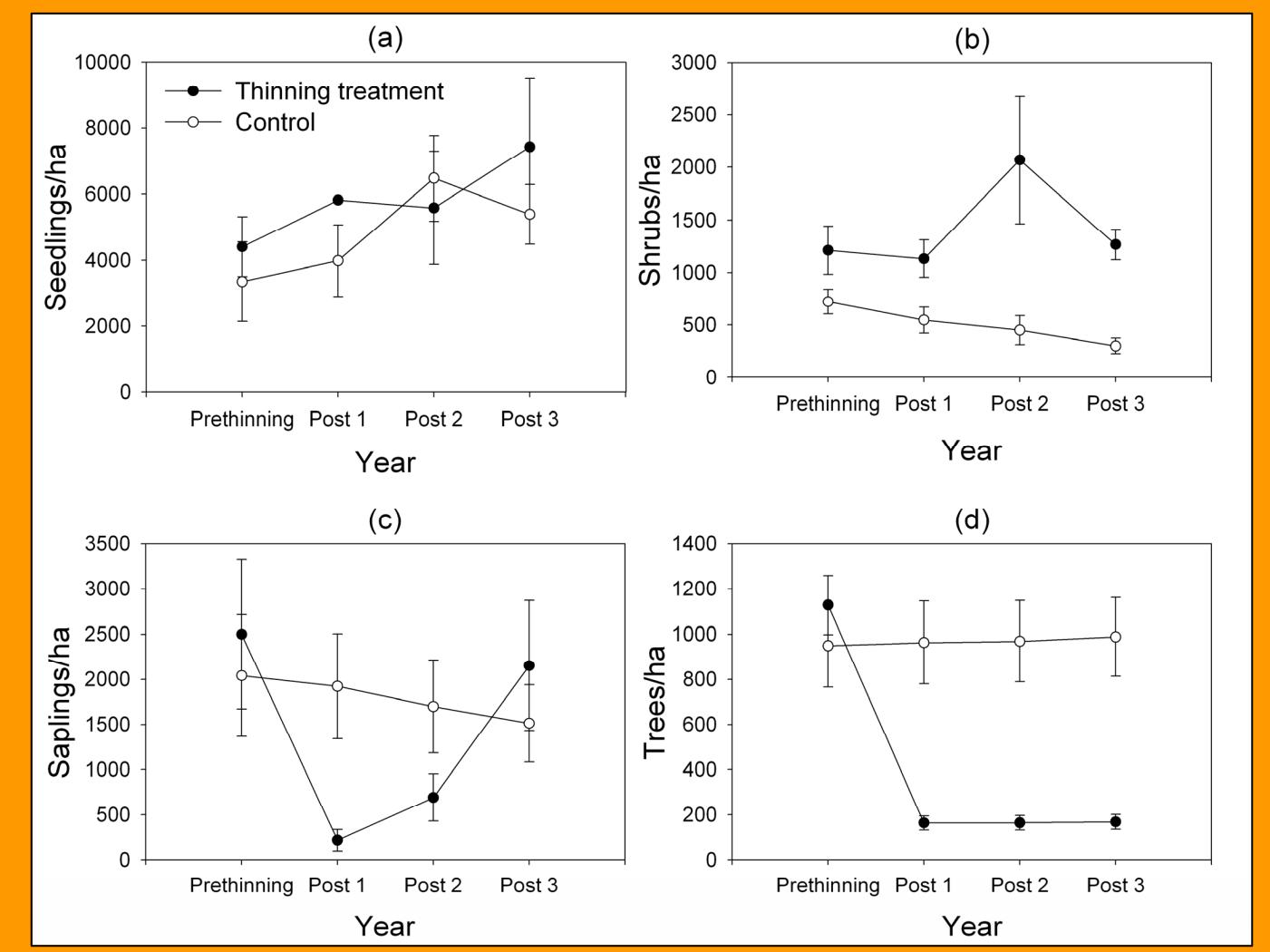


Sampling design employed in this study with FIA subplots along transects

## Transect-based sampling results

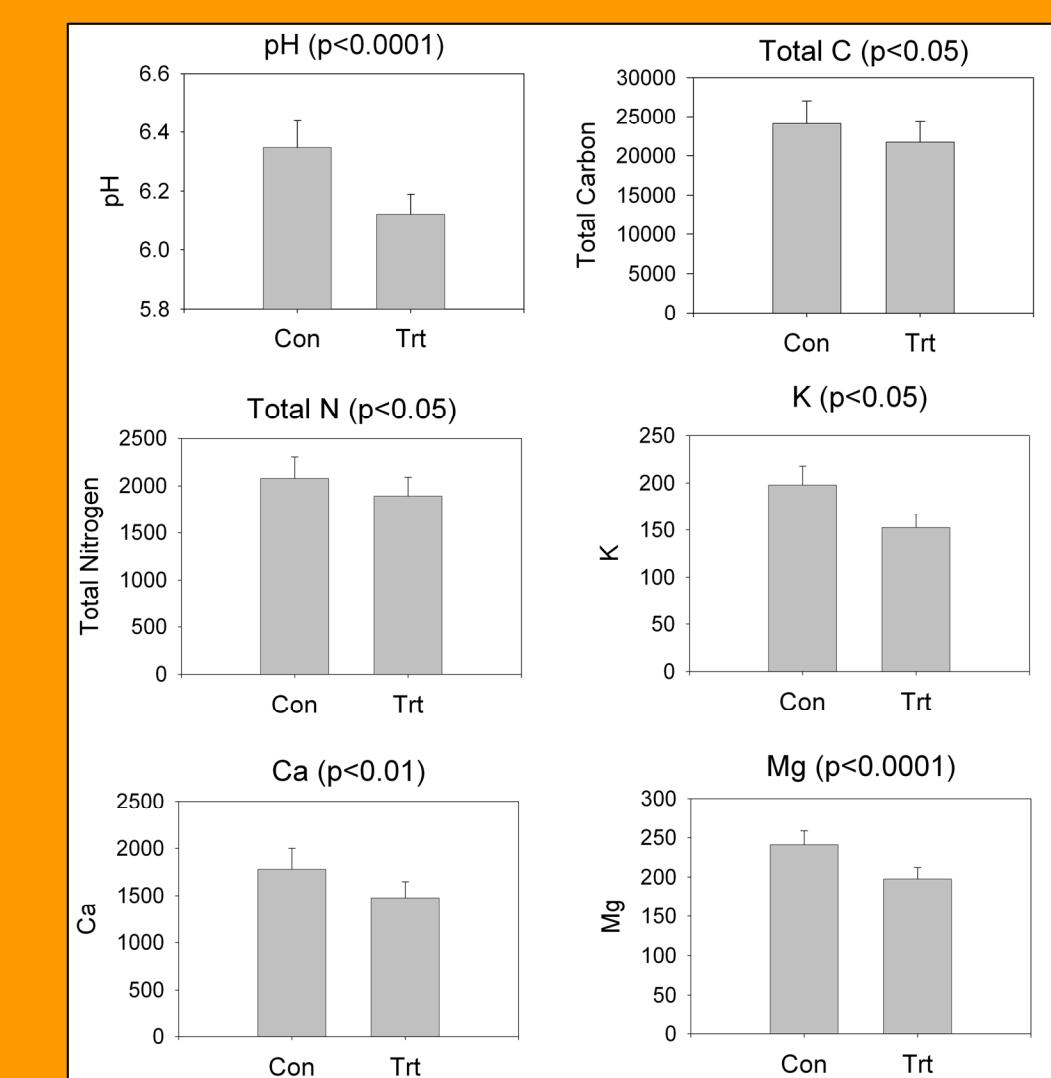
### A. Vegetation

- No impact of thinning on tree seedlings
- Regeneration pulse evident over time, dominated by encroaching species *Ostrya virginiana* and *Cornus racemosa*



### B. Soils (2006 data)

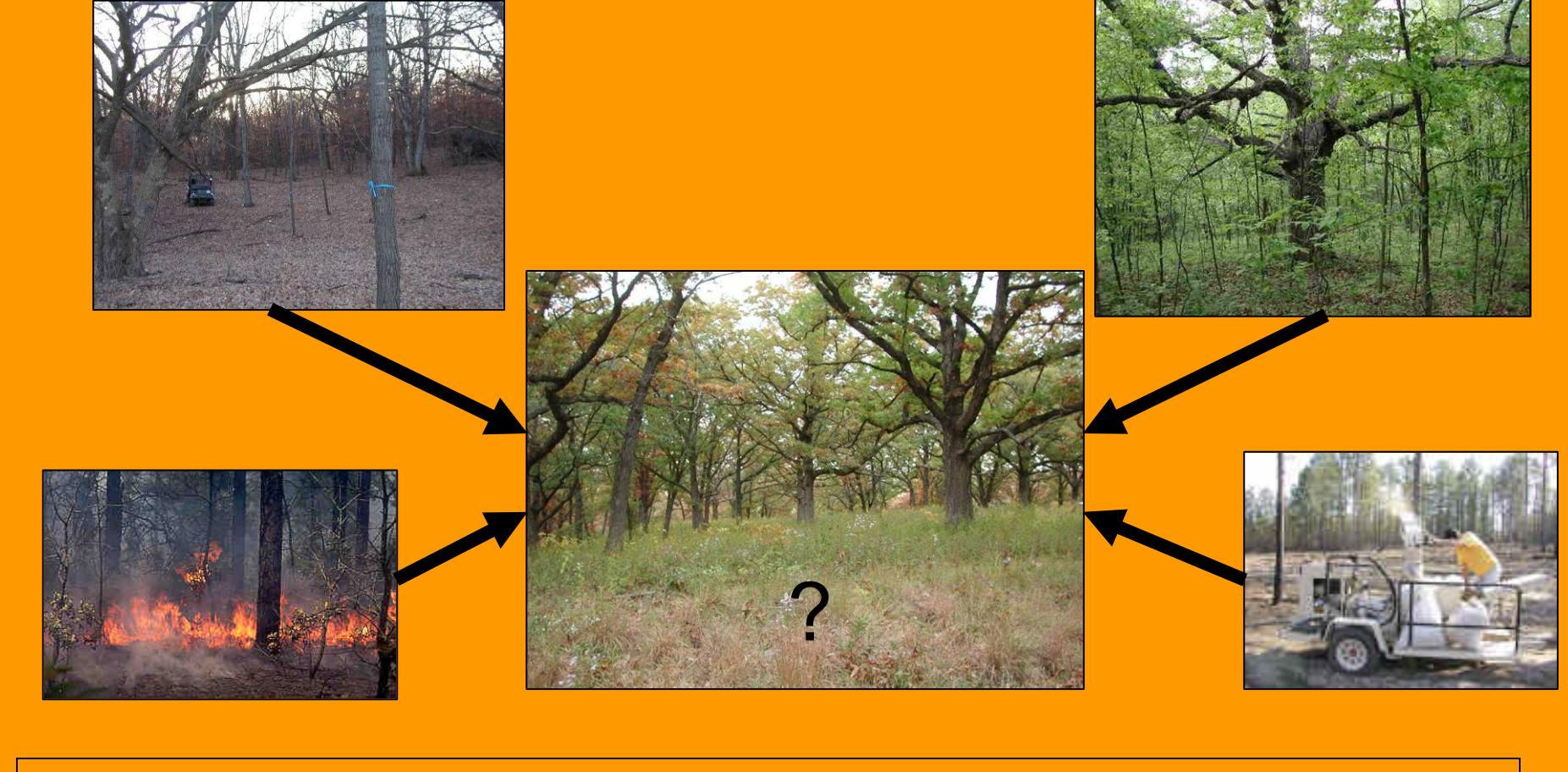
- Thinning had no effect on percent moisture, bulk density, or Bray P concentration
- Thinning reduced total C and N
- Thinning lowered pH and reduced basic cation concentrations: K, Ca, Mg
- pH and cation effects likely interrelated:
  - Cations replaced by H on CEC sites → reduction in pH once CEC sites are saturated



## Conclusions (to-date)

- Restoration thinning:
  - Modified vegetation structure by reducing mid- and overstory density
  - Promoted regeneration of encroaching species, not oaks
  - Altered soils by lowering pH and reducing K, Mg, and Ca
- Modified FIA sampling methods robustly documented vegetation changes only when replicated across all sites (n=8)
  - FIA data may be useful for monitoring site-level responses to disturbance
- Standard FIA plot layout was not useful for our study, as sites were not wide enough for all subplots to fall within study areas
  - Rearranged subplots fit within treatment areas

## Current research – restoration by thinning, prescribed fire, and seed additions



What is the best way to restore fire suppressed oak savannas? Common methods include mechanical thinning, prescribed fire, and seed additions.



- Current experimental design employs factorial experiment with mechanical thinning, prescribed fire, and seed additions
- Vegetation monitored annually in seed addition plots
- ISU graduate student Anthony Beringer (insert) examining soil carbon dynamics after thinning and prescribed fire

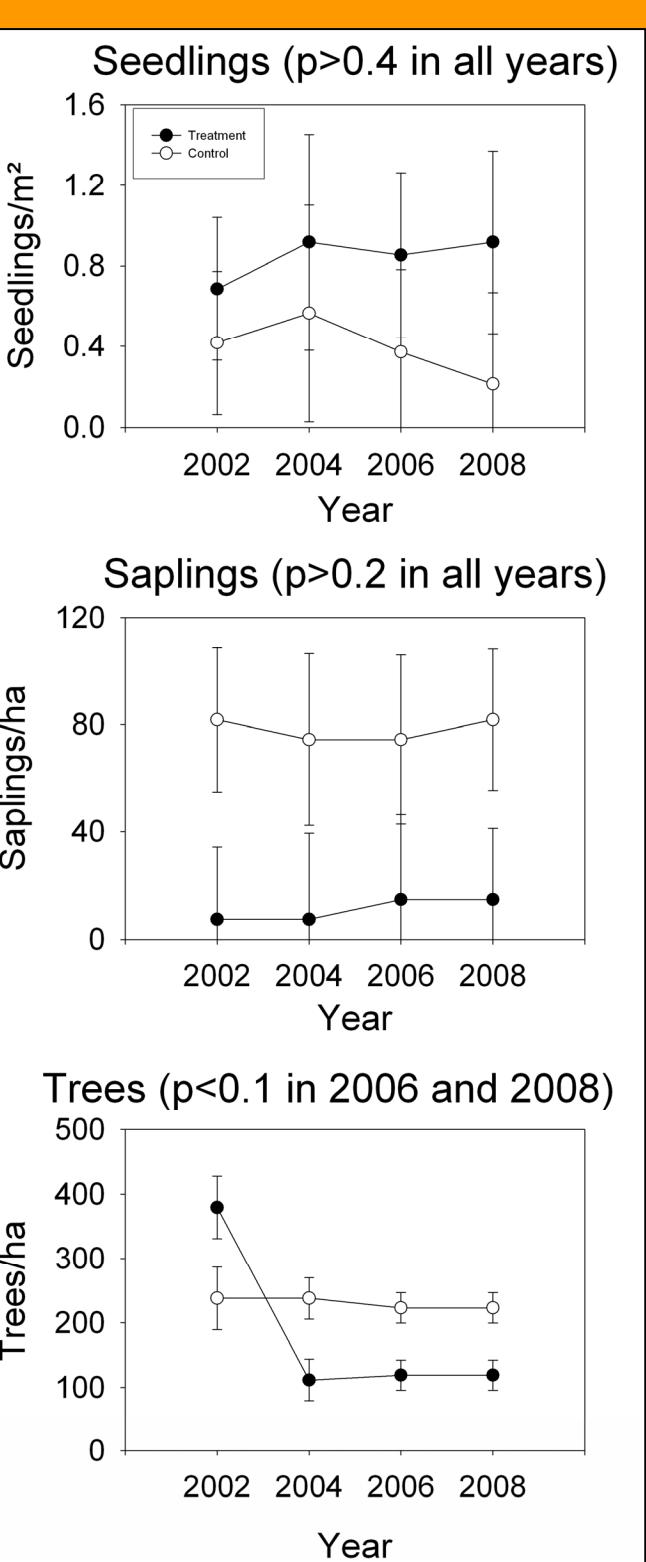
## Acknowledgments

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## FIA sampling results

### A. All years (4 sites)

- Reduction of sapling and tree density evident following restoration treatment
- Replication of n=2/treatment was generally too low to statistically resolve these effects



### B. All sites (2 years)

- Restoration treatment increased seedling densities and decreased sapling and tree densities
- Changes robust through six years of regrowth following treatment
- Replication with all sites sufficient for resolving differences between treatments across all size classes

