Slow-Change in Iowa (& Midwestern?) Grasslands: Has the 'Green Glacier' Arrived?

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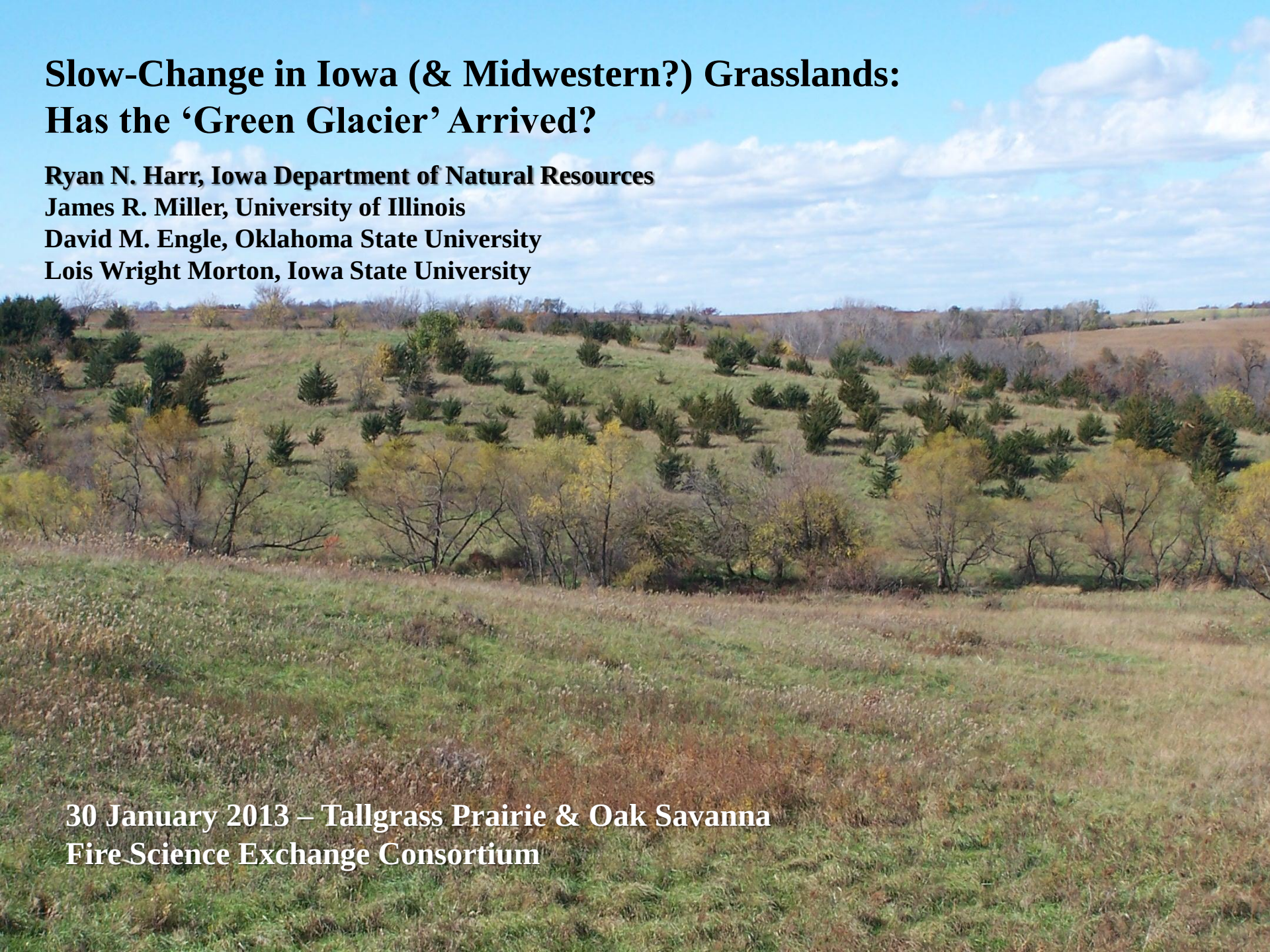

30 January 2013 – Tallgrass Prairie & Oak Savanna
Fire Science Exchange Consortium

Background

- Extant, frequent fires coupled with grazing historically maintained Great Plains grasslands
- Woody species limited to river-bottom gallery forests and areas of limited fire spread

George Caitlin's *Prairie Bluffs Burning* (1832)

Background

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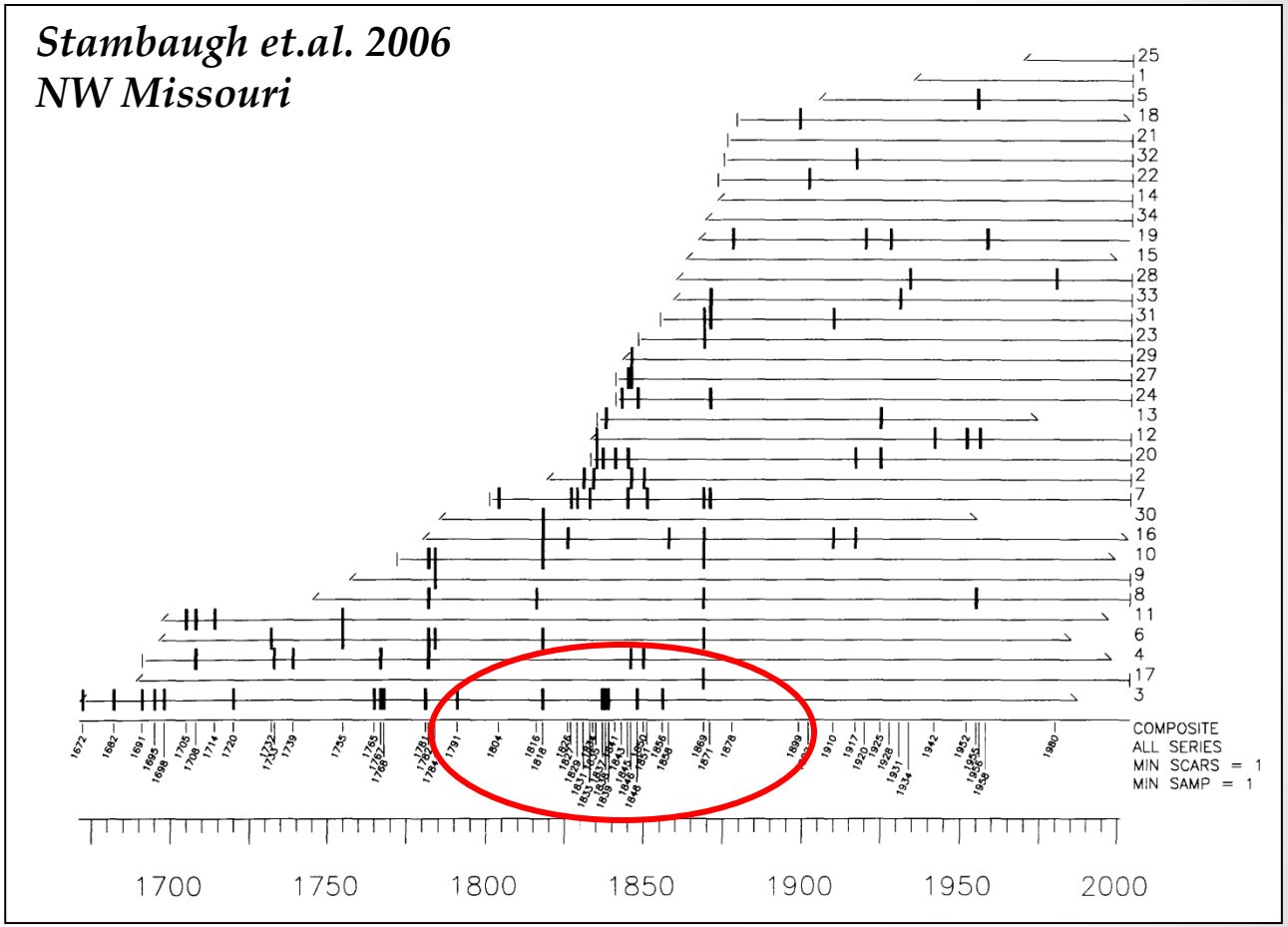
- Dendrochronology data indicate historical FRI of 2.5-10 years



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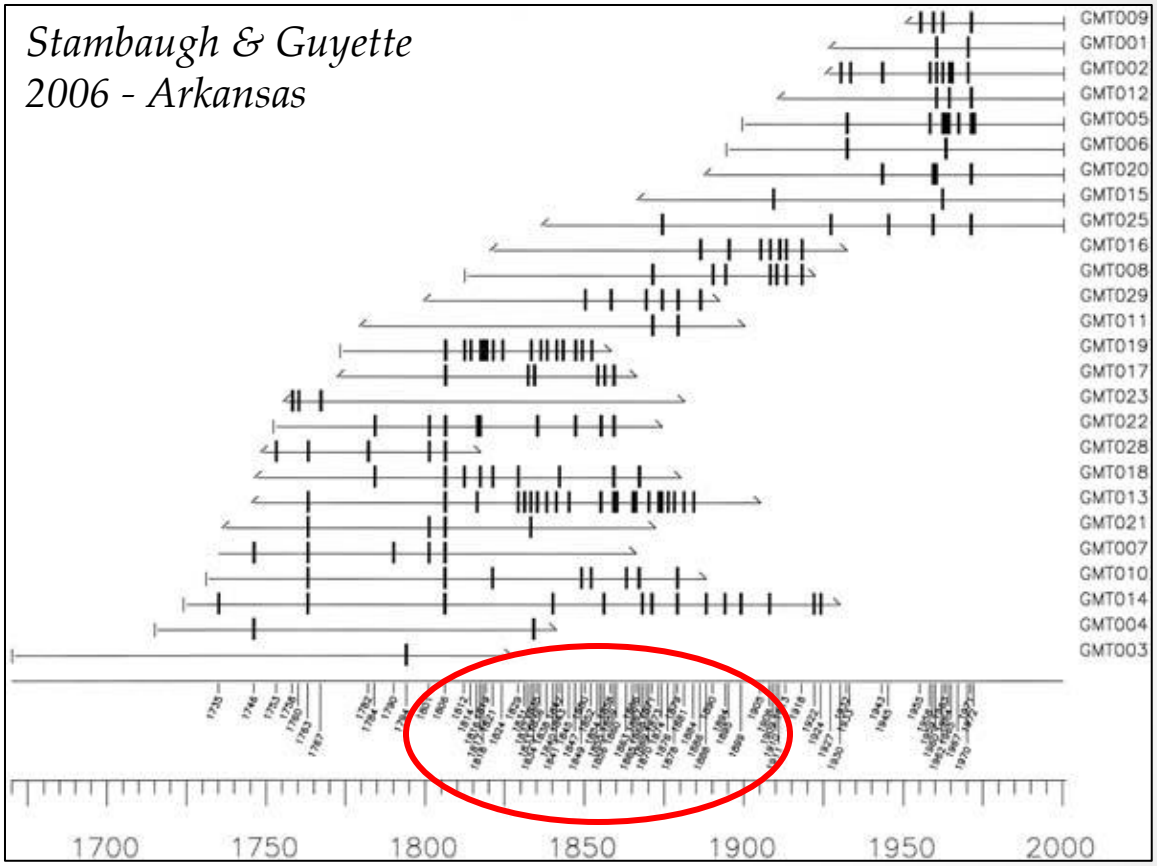
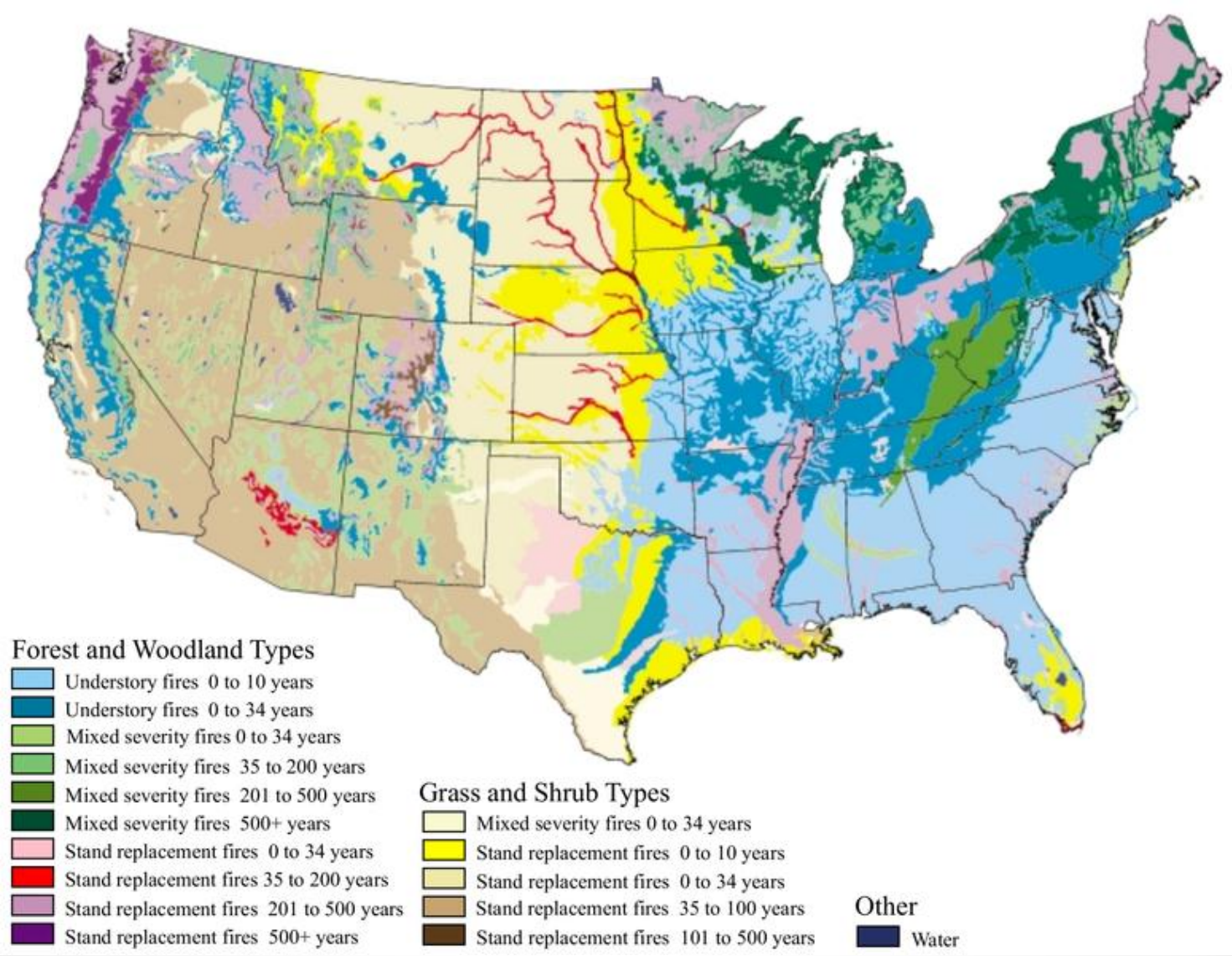


Background



- *Brown and Smith 2000. Wildland fire in ecosystem: effects of fire on flora. Gen. Tech. rep. RMRS-GTR-42-vol. 2 40, 56-68. USDA, Forest Service*

Background

- Agricultural conversion, cultural shifts eliminated fire from much of the Great Plains by 1900s
  - Droughts of 1930s reverted many semi-arid cropped lands of the plains to rangelands
  - Cultural shift in how fire was viewed: from ally to antagonist

Smokey


CCC Fire Crew

Propaganda

  - Persistent suppression of fire allowed escape of woody species (*Juniperus* spp.)

Background

- Concerns over threats posed by redcedar conversion to grazing lands were recognized as early as 1950s (e.g., Martin and Crosby 1955)

- Soil Conservation Service (present-NRCS) estimated 1.5 million acres redcedar in Oklahoma 1950s
  - Estimated at over 9.0 million acres today

- Eastern redcedar (*Juniperus virginiana*) has long been realized as a threat to grasslands
  - Rapidly colonizes in most environments of the North American continent
  - Tends to be drought tolerant once established
  - Once established, has rapid growth potential (>0.5m/yr)

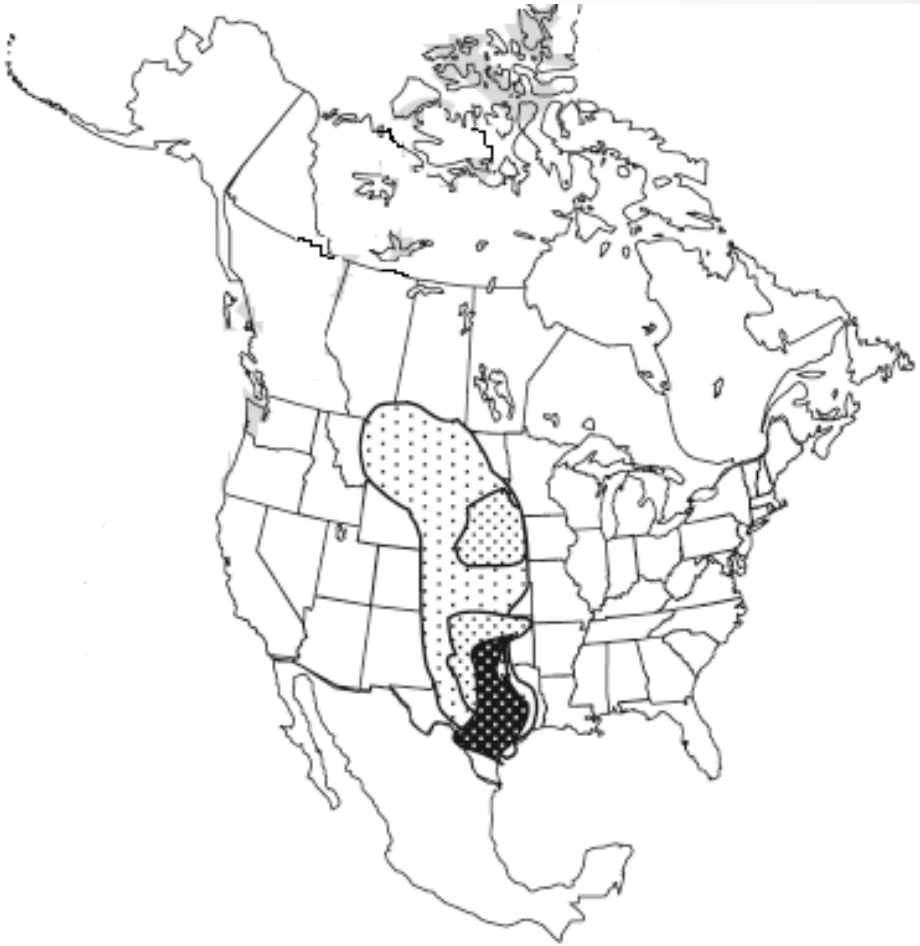
Background

- Numerous ecological shifts associated with conversion of grassland to *Juniperus* dominated woodlands

  - Hydrologic
  - Chemical
  - Biomass productivity
  - Soil erosion
  - Increased risk of severe, catastrophic fire
  - Shift in wildlife community

Background

- Current distribution of eastern redcedar in Great Plains grasslands
  - Area densely stippled has largely been converted to woodland
  - Medium-density stippled areas under threat of conversion to juniper woodlands within 10 to 20 years



From Engle et. al. 2008

The Green Glacier

- In the 1990s, Oklahoma lost an estimated 1 million acres of grazing lands to redcedar conversion
  - Grassland conversion peaked at an equivalent of 325 ha/day (804 acres/day)
- Kansas has experienced conversion of open, native tallgrass prairie to closed canopy cedar woodlands within 40 years
  - Equivalent to **2.3% increase** in forested acres per year

Photo courtesy Susan Aber

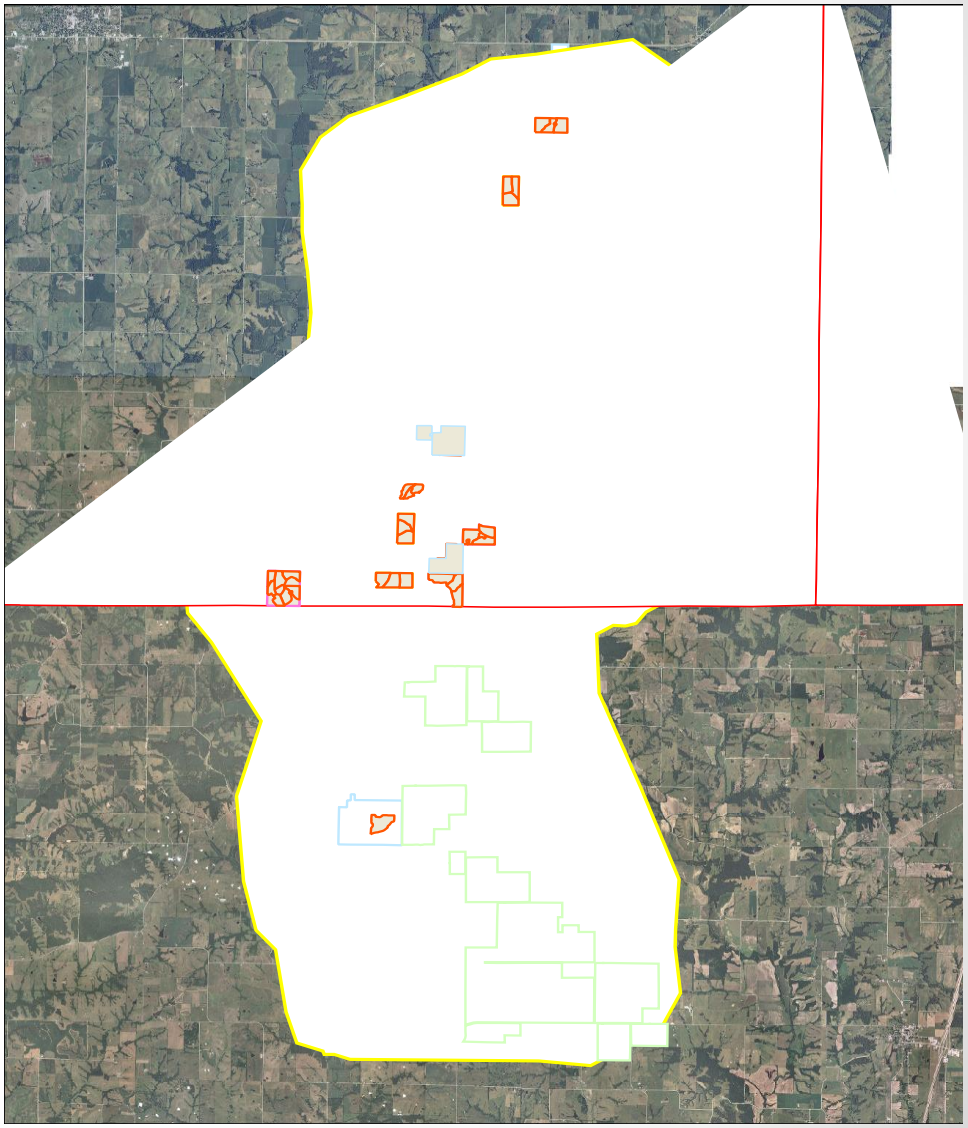
The Green Glacier

- Does the threat translate to Iowa and the upper Midwest?
- Landscape management different than that of rangelands
- Many natural resource professionals have noticed increase in redcedar over the years
- Easily visible on color-infrared imagery (e.g., DNR 2002)

Photo: Devan McGranahan

Research in Grand River Grasslands

- Research into fire-grazing management began in 2006
  - 12 pastures allocated to three treatments, representing remnants and restorations
  - Burn-only (burn every 3 years)
  - Graze & Burn (burn every 3 yrs+ cattle)
  - Patch-Burn Graze (burn 1/3 each year + cattle)
- Examining soil, plant, invertebrate, bird responses to patch-burn grazing
- Socio-economic factors of land use decisions



Research in Grand River Grasslands

- Early in the project, we began to think about redcedar encroachment in and around research pastures
- In 2007, conducted a small investigation of redcedar expansion 1997-2002 within 1-km of study pastures
- Documented an 8.3% increase in acreage
  - 1.7% per year

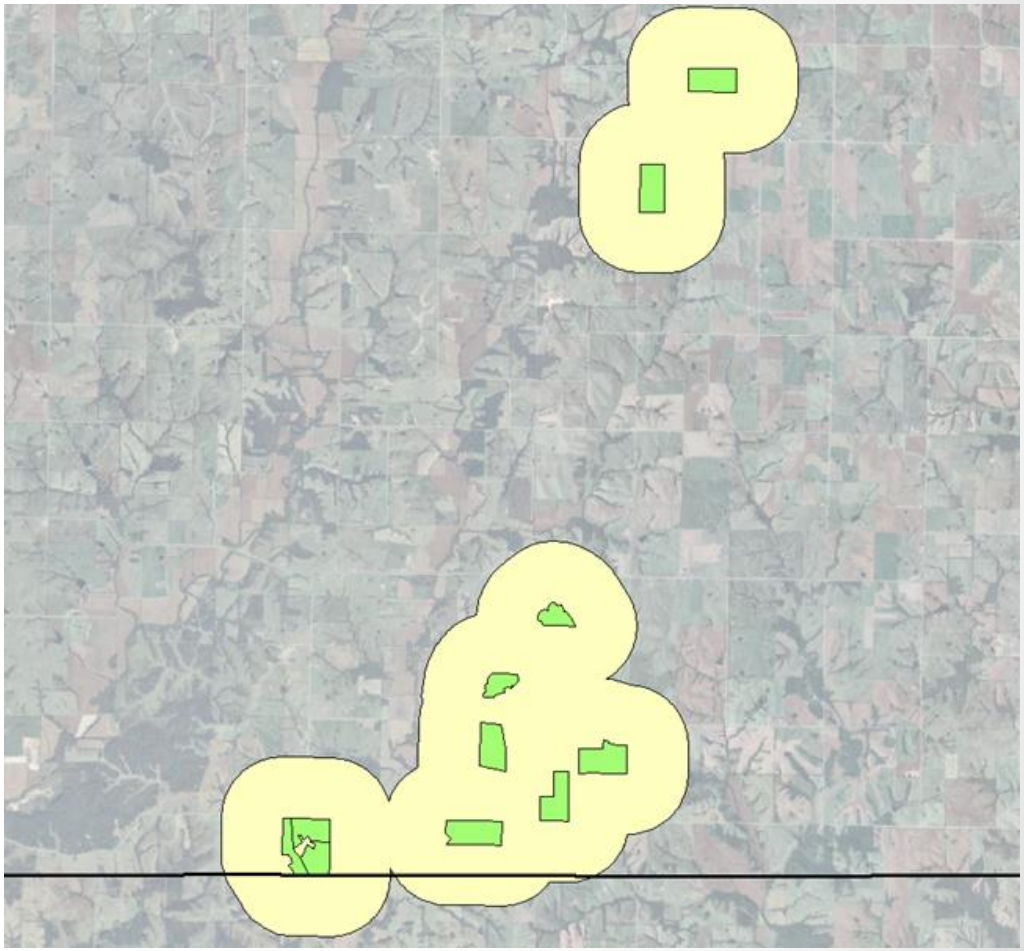


Image: Pete Lovell

Research in Grand River Grasslands

- This earlier study, coupled with investigations into the land-management decisions of local landowners, led to proposed investigation of redcedar encroachment over time in the Grand River Grasslands

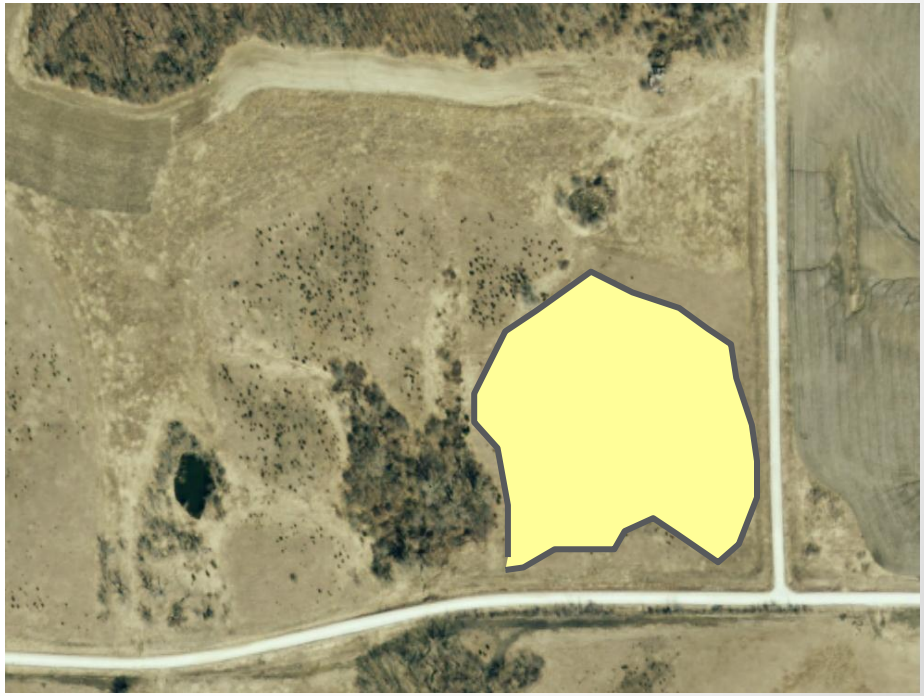
- Funding provided by Leopold Center for Sustainable Agriculture allowed us to partner with Saint Mary's University (Minnesota) Geospatial Services Laboratory

Methodology

- Imagery from 4 time-steps over the last ~30 years used to map eastern redcedar in 70,000-acre GRG
- Four days of ground-truthing of redcedar ID differentiate signatures from other evergreen species, osage orange
  - Also defined canopy coverage classes, pinpointed reference stands
- SMU-GSL analysts used photo-interpretation, color & shadow signature models, and other GIS tools with to identify redcedar, working backwards from 2009 to 1983
- Classified redcedar as individual trees, or into one of three stand-density categories

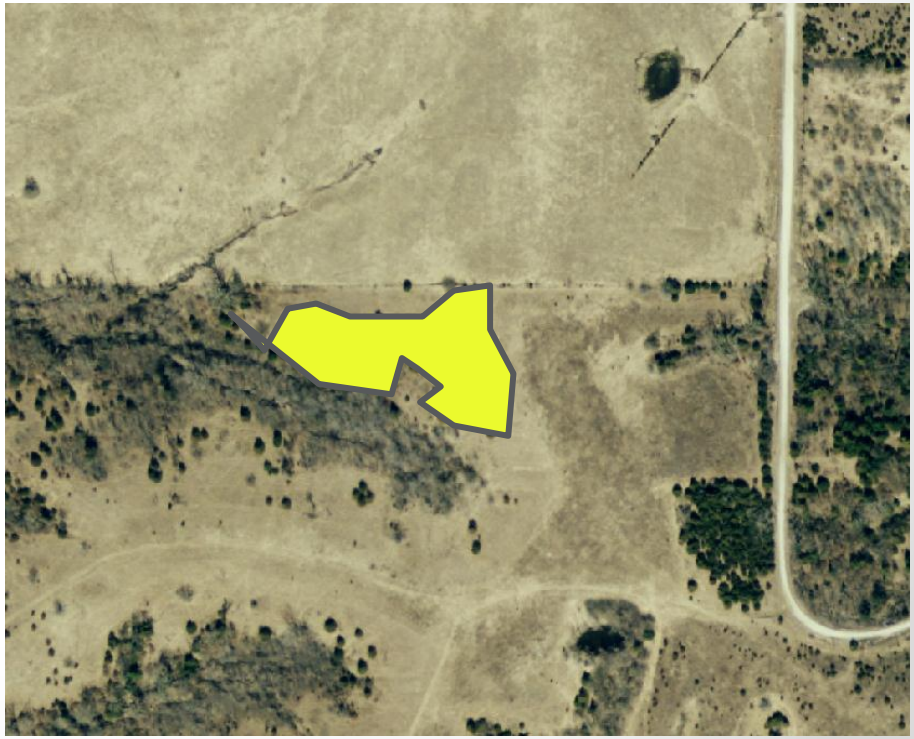
Methodology

- 10-30% canopy (open, still usable by grassland wildlife)



Methodology

- 30-70% canopy (shrub, past grassland obligate threshold)



Methodology

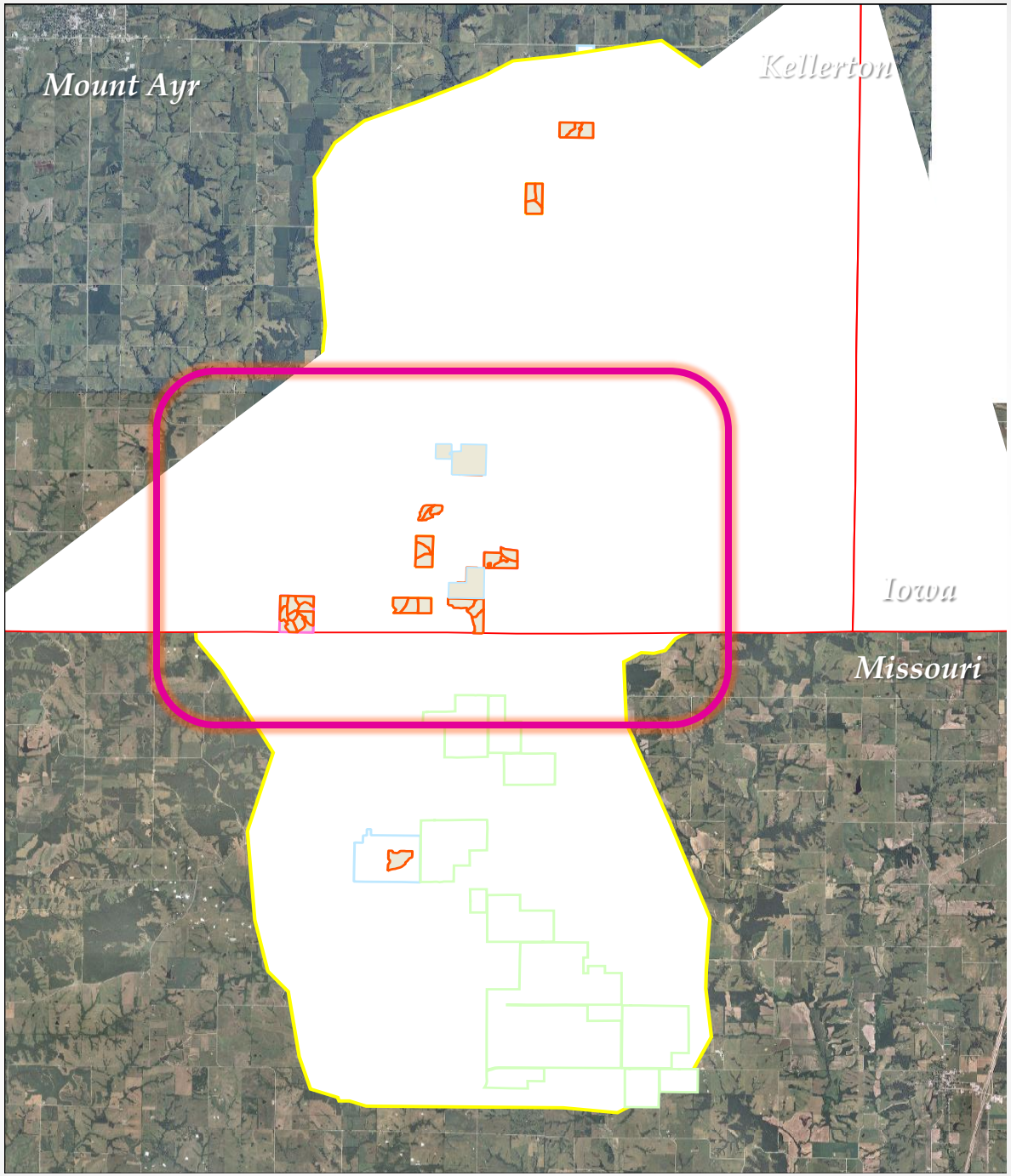
- 70-100% canopy (closed canopy redcedar woodland)

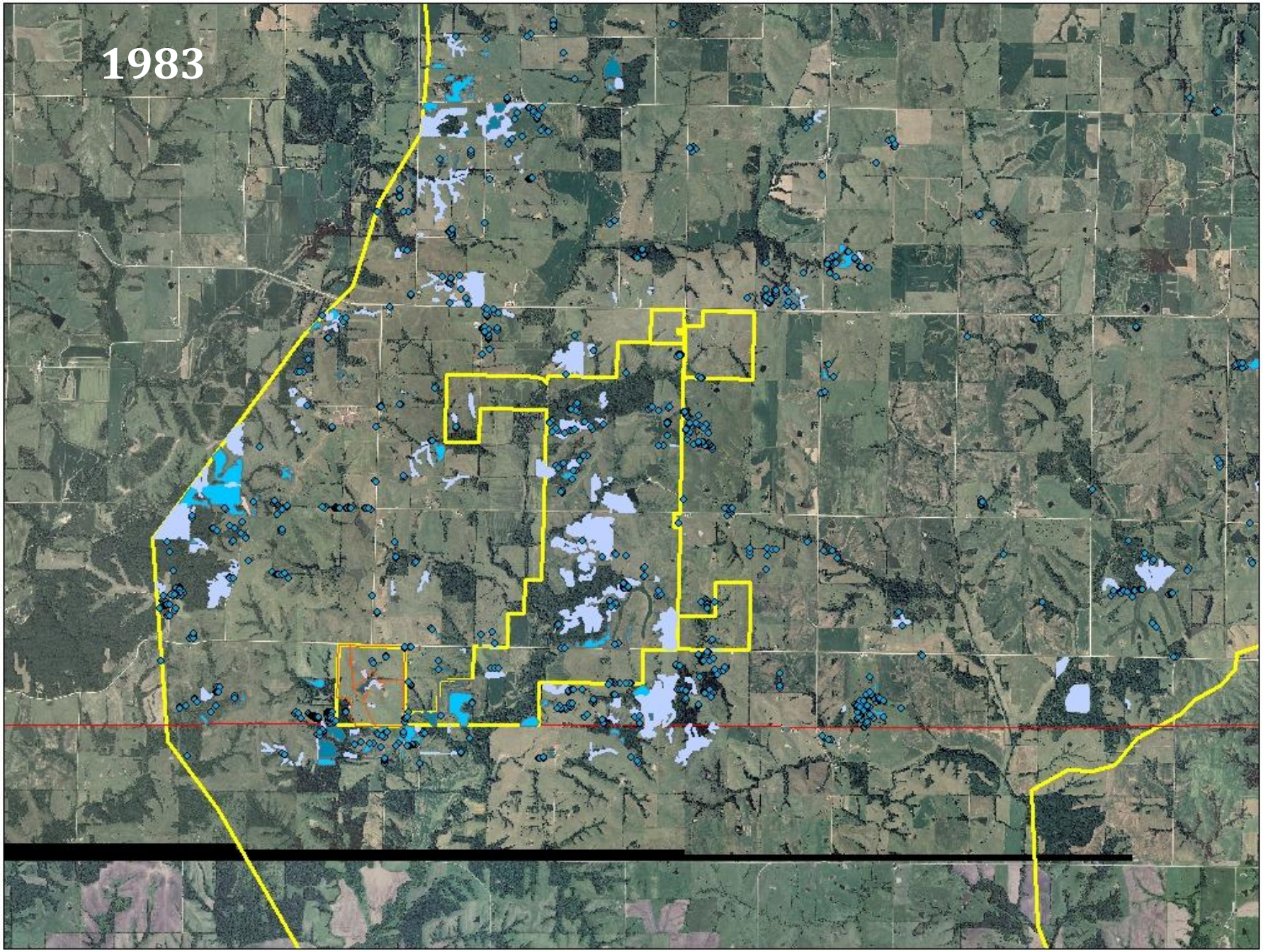
Methodology

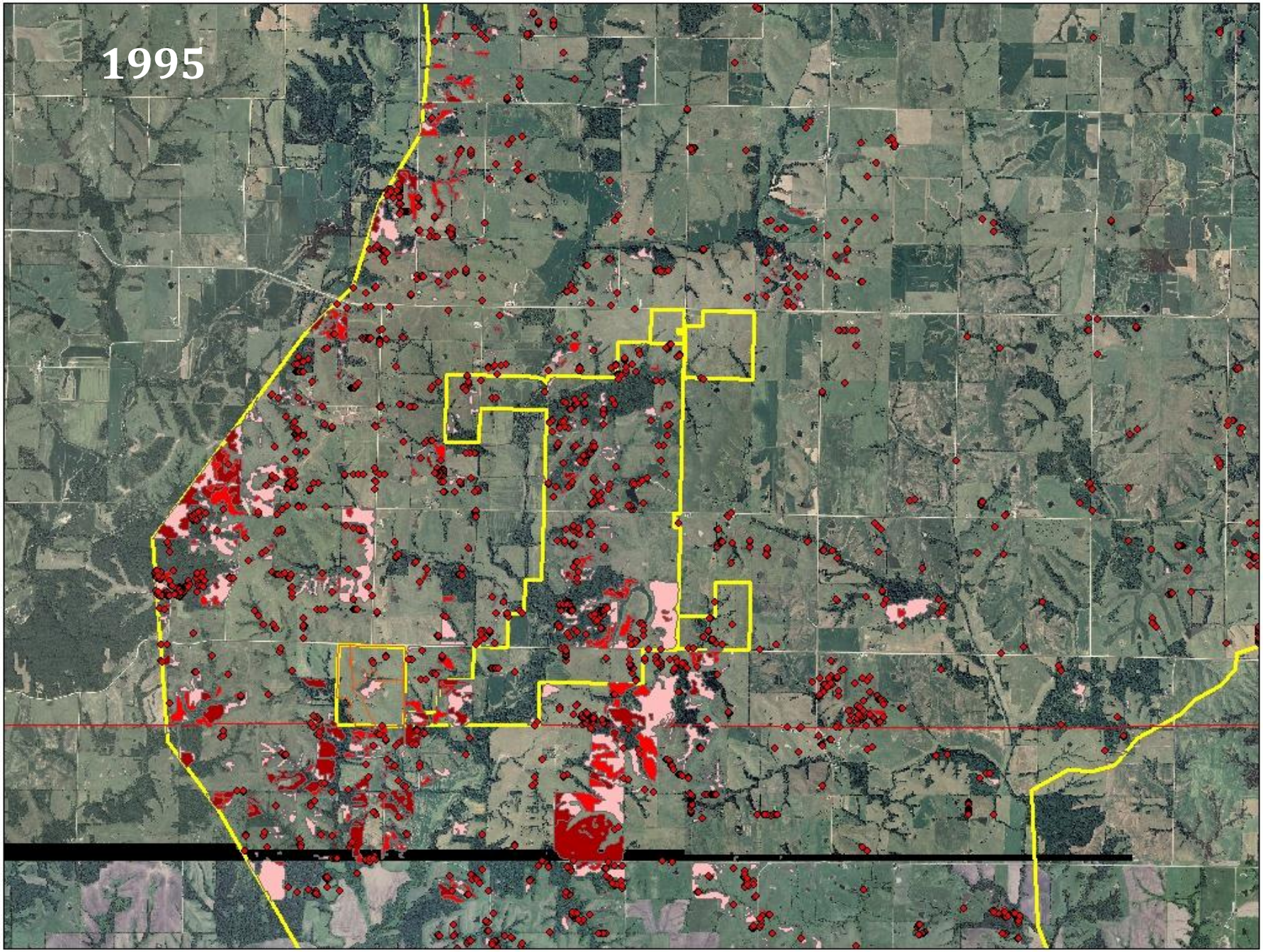
- Individual trees mapped along fencerows, drainages, and where no canopy could be constituted/defined

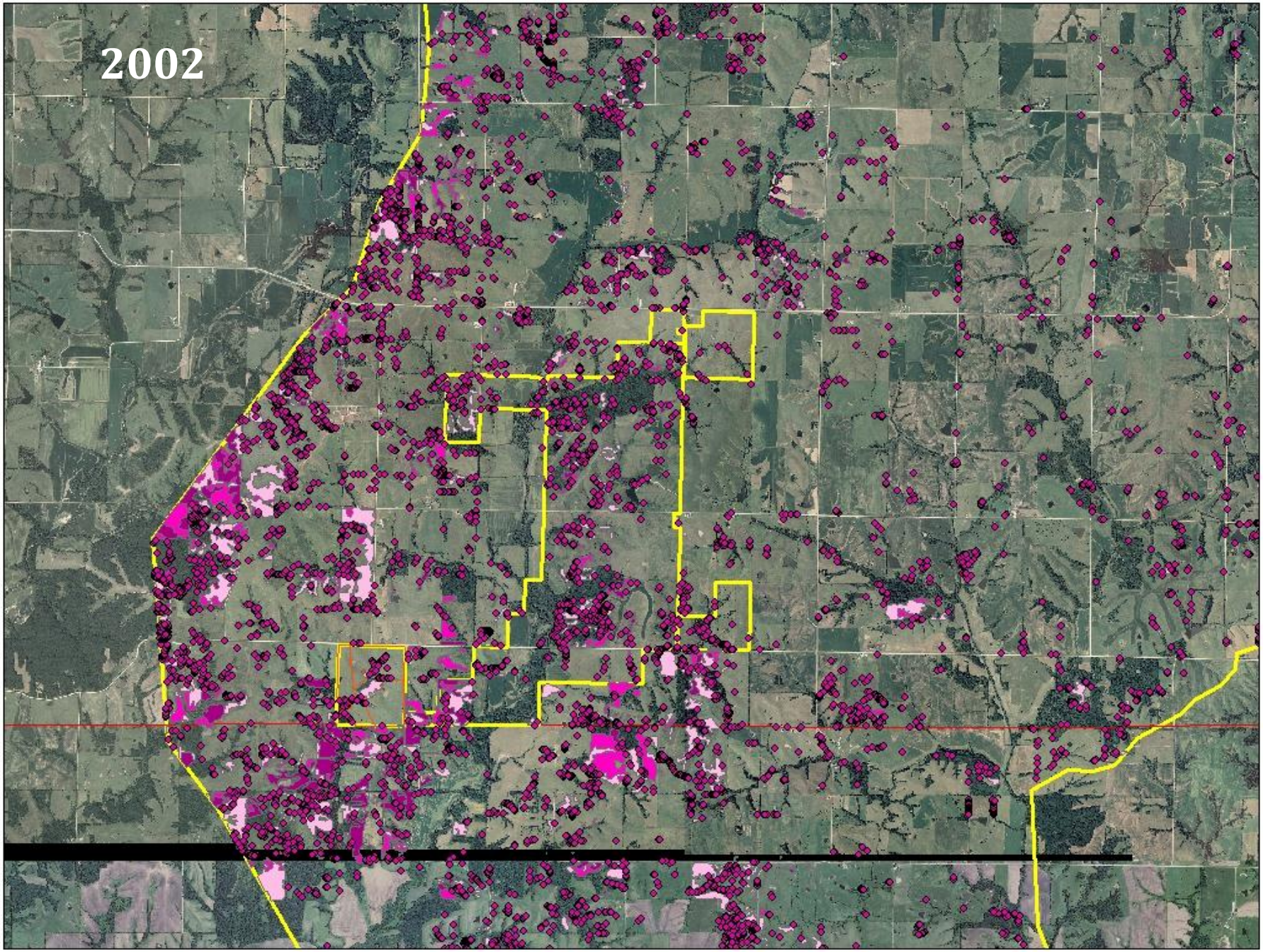
Methodology

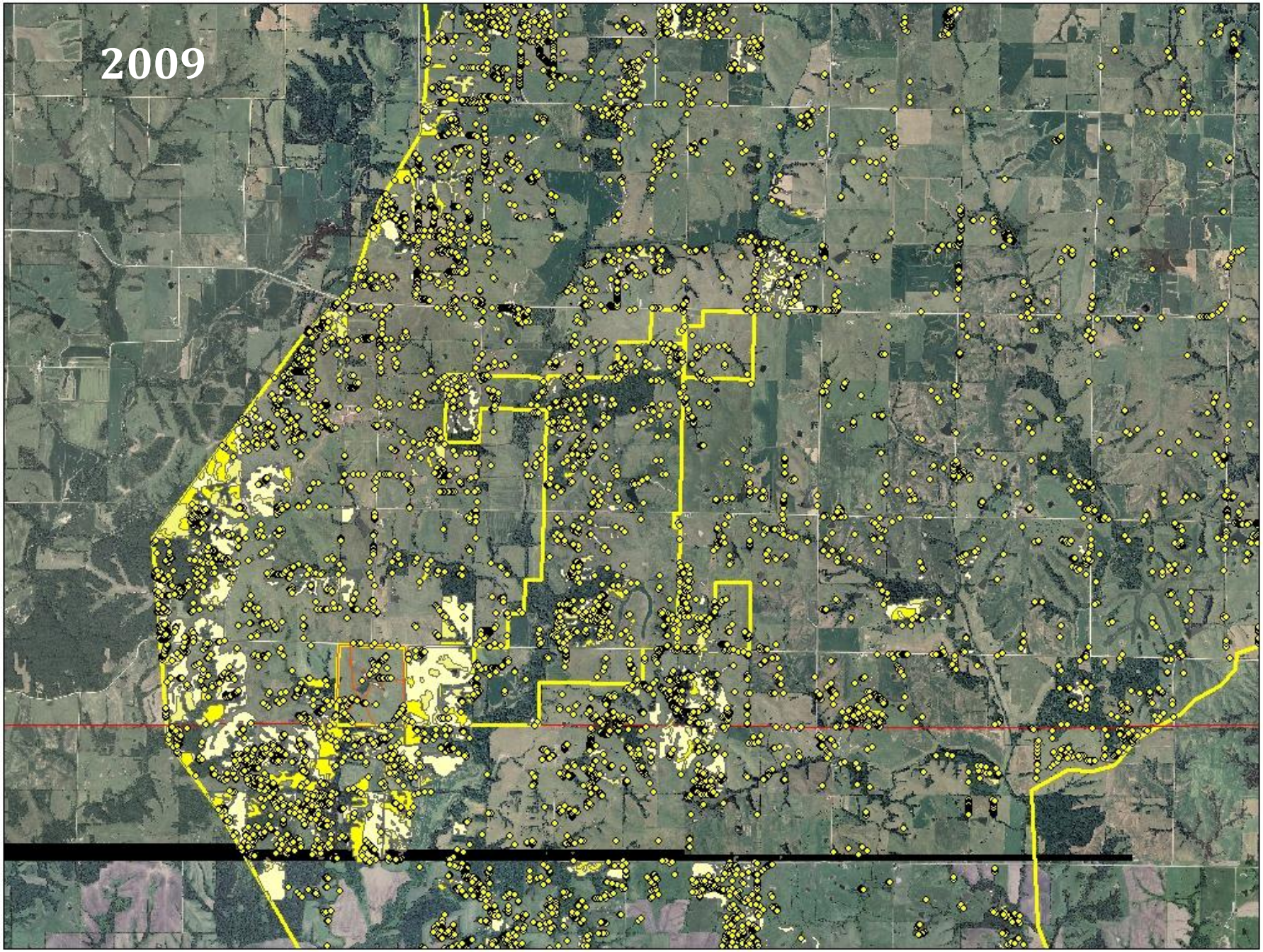
- Limitations to analysis:
  - Imagery correction factors (minimal)
  - Minimum size for capture was likely basal area of ~2 meter^2
  - Errors of omission likely greater than errors of commission

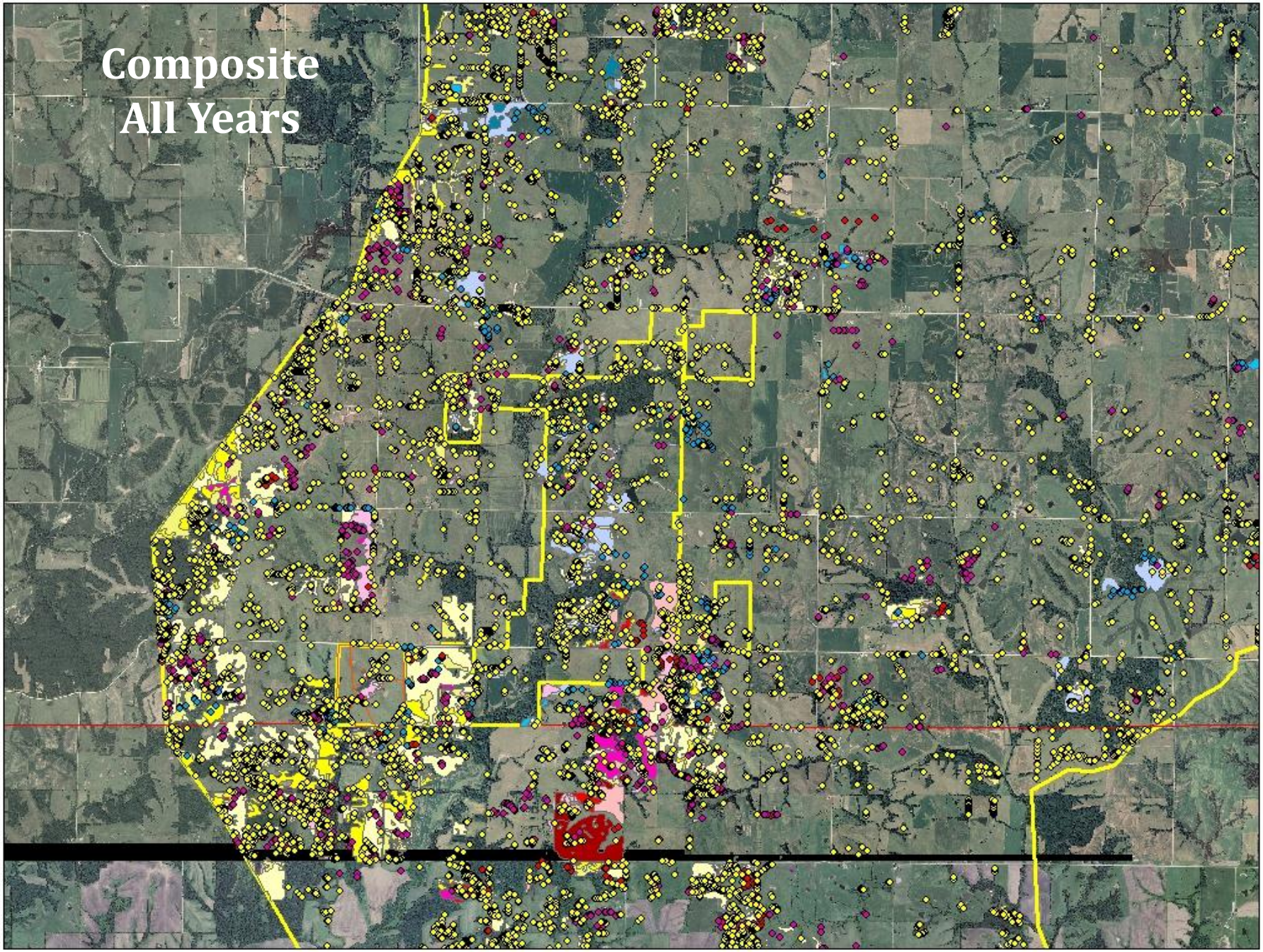

Mount Ayr
Kellerton
Iowa
Missouri


1983


1995

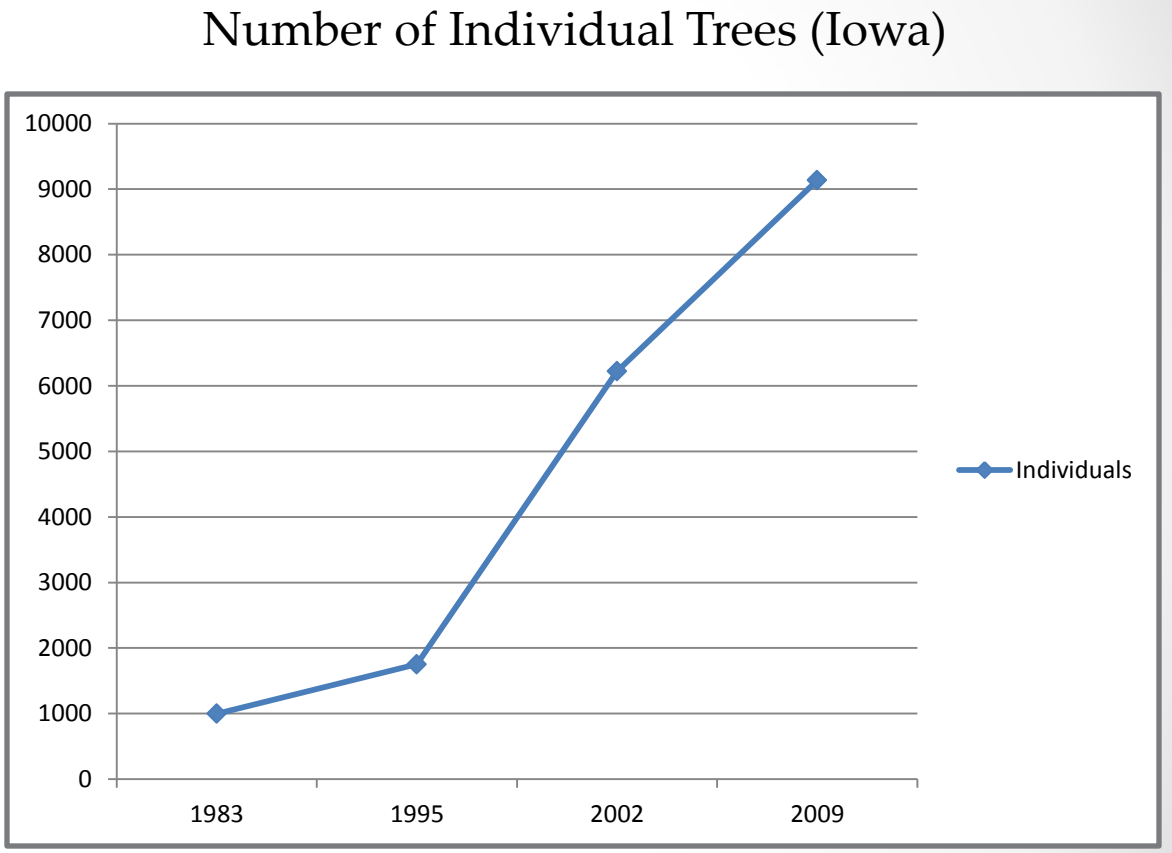

2002


2009


Composite
All Years

Results

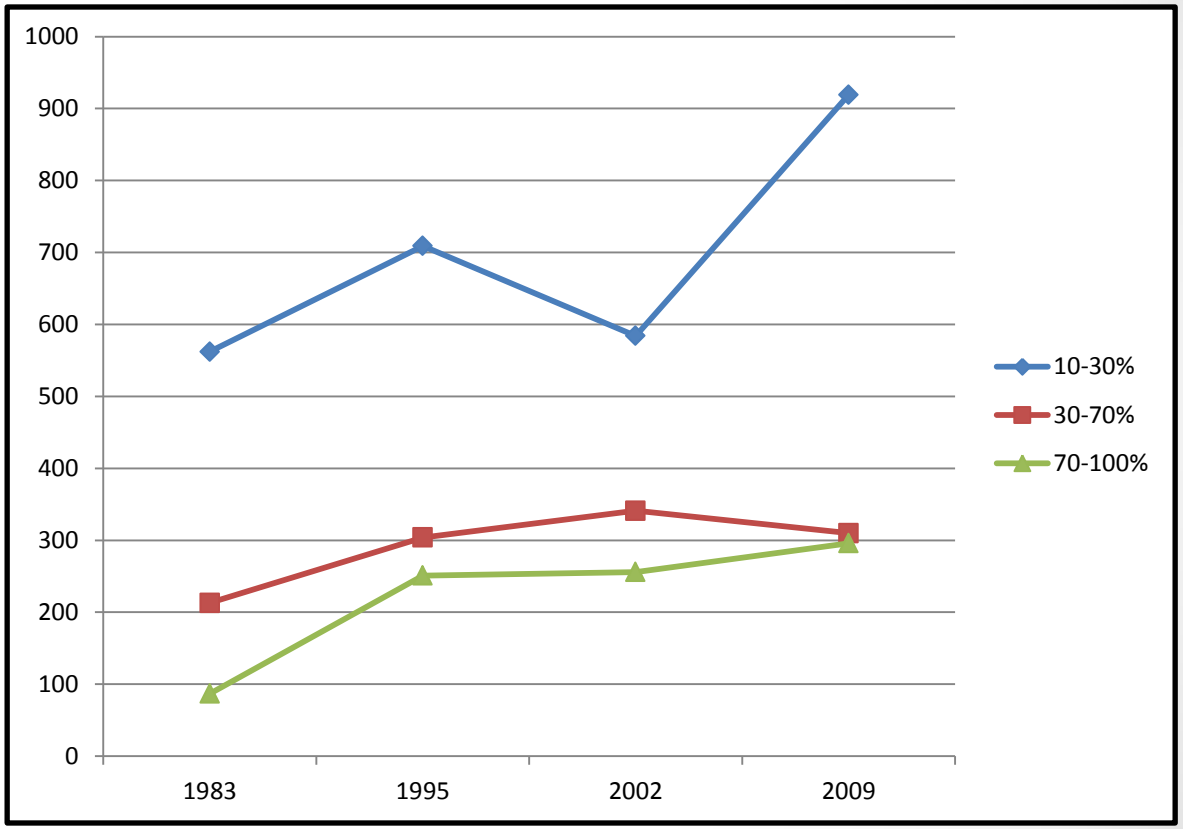
- Individual trees increased from 997 in 1983 to 9,136 in 2009 (~850+%)
- Tend to spread linearly along fencerows, drainages
- Spread to idled lands easily



Results

- 77% increase in total stand *acreage*
  - 862 to 1525
  - ~3.0%/year
- A 200% increase in *number* of stands
  - 266 to 767
- Temporary reduction in acreage likely due to control on reserved lands; CRP reenrollment

Area (acres) of Canopy Coverage Classes (Iowa)



What are the implications?

- Literature suggests a canopy threshold of 25-30% for grassland obligate species across taxa
  - GRSP, BOBO, UPSA, SAVS, WEME, SEWR,
  - Small mammals
  - Specialist prairie forbs

- Some specialists (prairie grouse) are far less tolerant than the identified threshold (5% or less)

- Increased opportunities for nest predators such as snakes and mesopredators

What are the implications?

- Sociological data would indicate that private landowners do notice redcedar, but see little risk ("slow change")

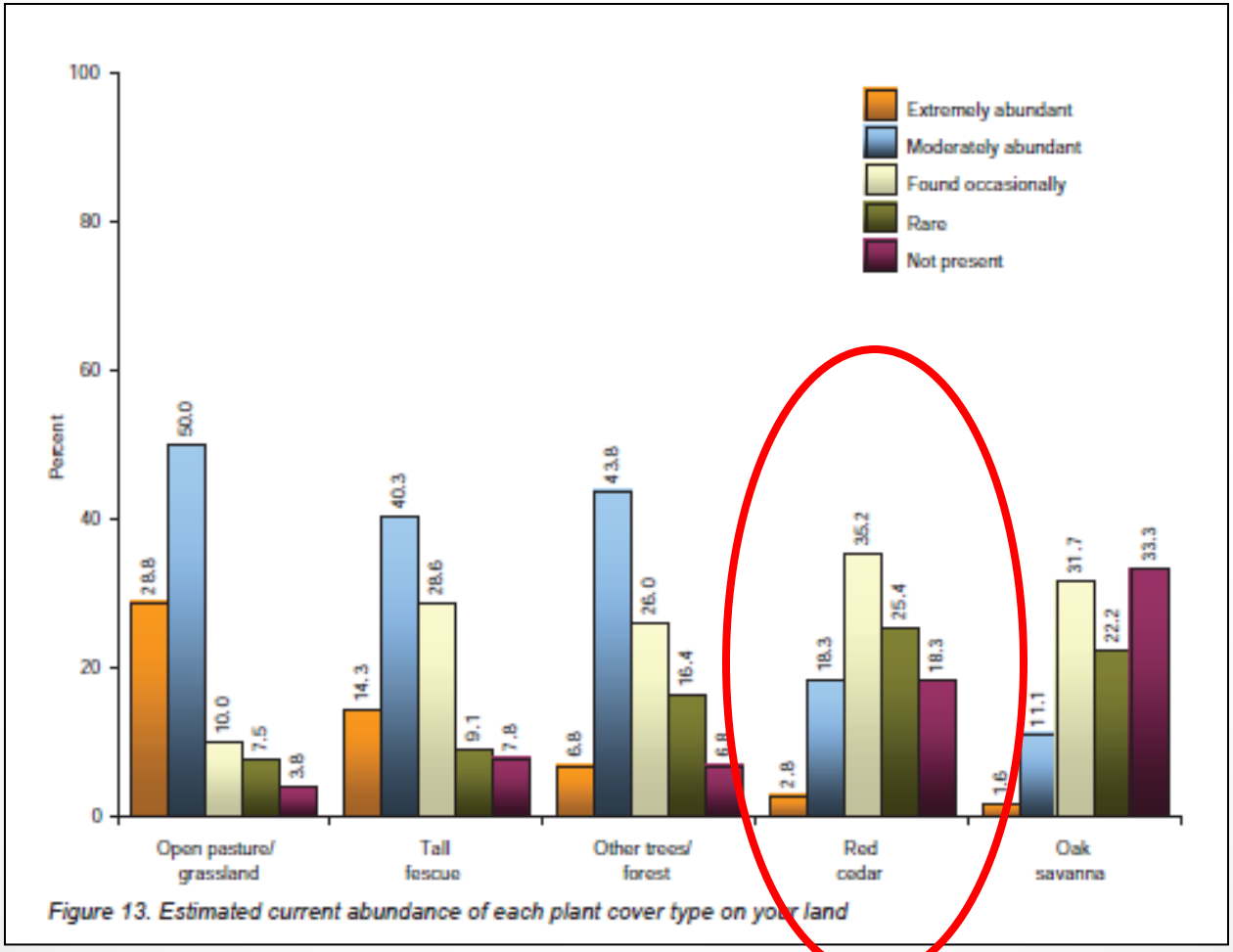
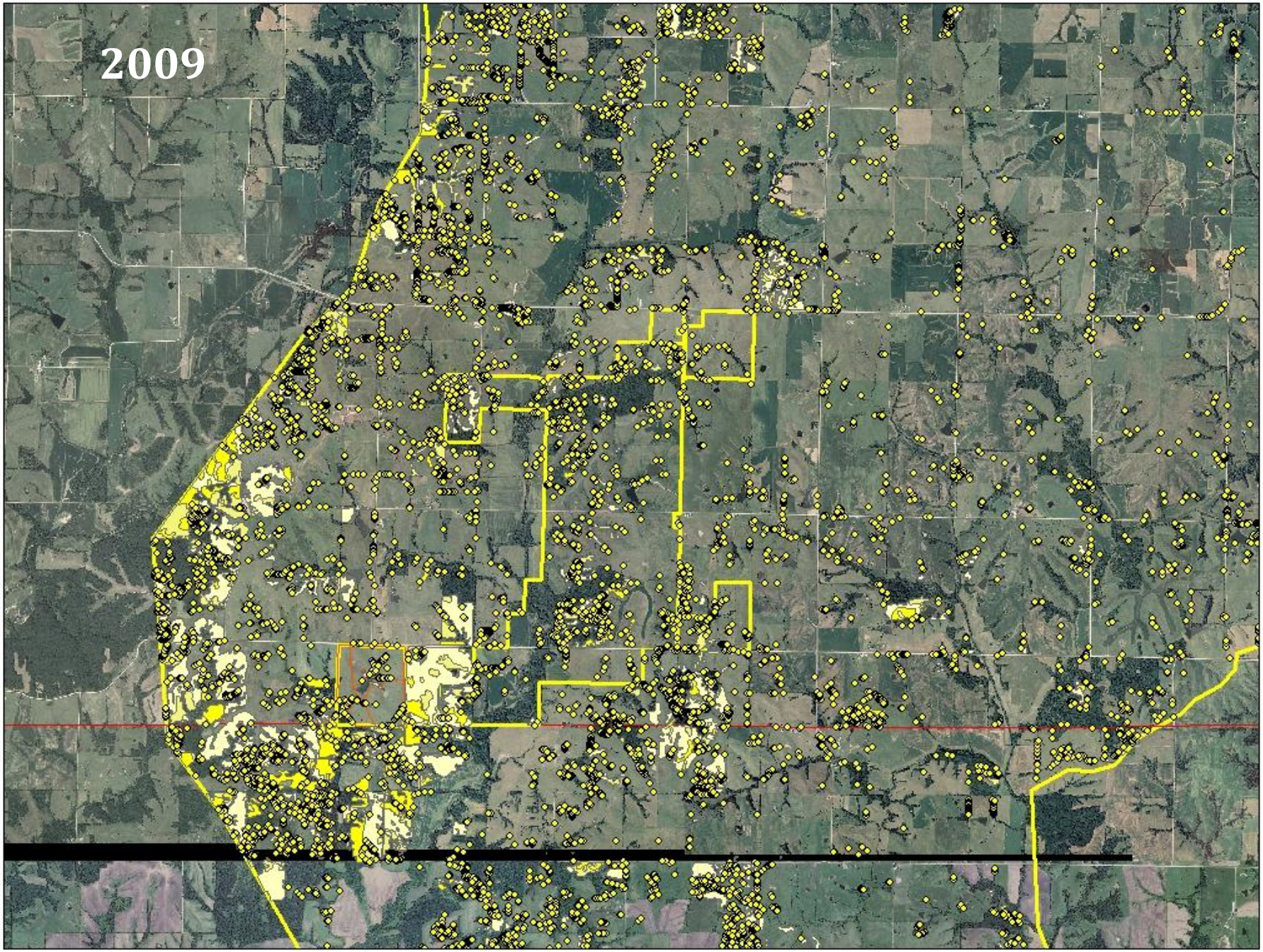


Figure 13. Estimated current abundance of each plant cover type on your land


2009

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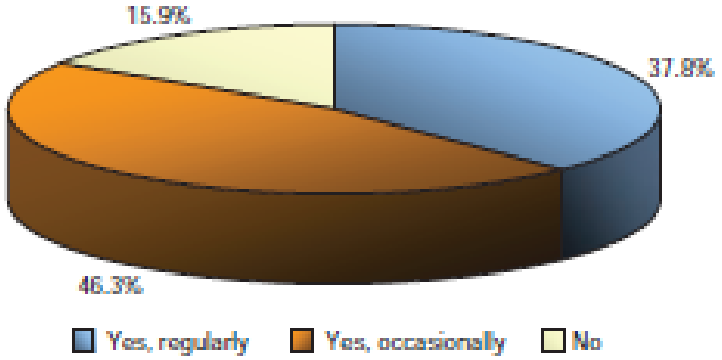


Figure 22. Have you ever taken action to control red cedar or other trees on your pastures/grasslands?

Nearly 85% of landowners note taking action to control ERC

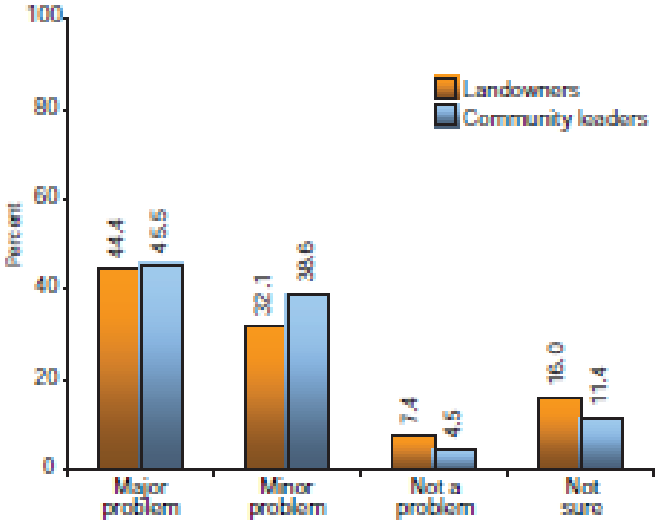


Figure 19. Do you think the increase in red cedar and other trees in grasslands is a problem?

But only 44% suggest it is a serious problem for them

What are the implications?

- Sociological data would indicate that private landowners do notice redcedar, but see little risk ("slow change")
  - Perception by local versus non-resident owners

- Interventions:
  - Increase communication with landowners
  - Use images to convey message, as well as new tools such as forage loss calculator

- From an operator's viewpoint redcedar poses a significant loss of forage / prairie biomass

What are the implications?

Redcedar Forage Loss Calculator

Each year, hundreds of acres of native prairie are lost to redcedar encroachment. Acres covered with redcedar will produce substantially less forage for livestock. This calculator will allow you to estimate the forage loss from redcedar encroachment on your land.

Percent of trees of each diameter

60	**5-10 ft.**
30	**10-15ft.**
10	**15-20 ft.**
0	**20-30 ft.**
0	**>30 ft.**

120	**Estimated total number of trees/acre**
8000	**Estimated forage biomass production (lbs.)**
80	**Total acres in paddock**

Calculate

A southern Iowa example, using Kansas State's forage loss tool

What are the implications?

Redcedar Forage Loss Calculator

Below you will see how much forage you are losing due to redcedar encroachment. Each year redcedar is left untreated, your forage losses will increase.

8000	**Estimated Potential Biomass/acre (lbs.)**	1.97	**Estimated Potential AUMs/acre**
929	**Estimated Loss of Biomass/acre (lbs.)**	0.23	**Estimated Loss of AUMs/acre**
74,329	**Estimated Loss of Biomass/paddock**	18.34	**Estimated Loss of AUMs/paddock**

Forage Loss Evaluation:

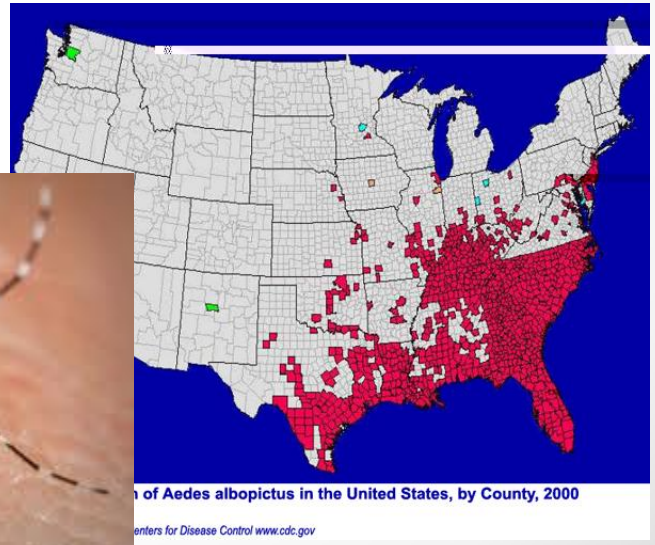
You have lost approximately 12 % of your biomass production.

This would have supported an additional 2.4 cow/calf pairs for a 6-month grazing season.

A southern Iowa example, using Kansas State's forage loss tool

What are the implications?

- Eventually a risk to public safety
  - Wildfire
- Public health
  - Pollen
  - Disease/insect vector
- Potential economic disruptions, and altered land-use decisions



Some thoughts to take home…

- Has the green glacier arrived?
  - Evidence suggests yes
- Increasing at a rate equal to or greater than that seen in Great Plains examples
  - Landscape, climate, soils likely contributing factors
- Missing "sense of urgency" may lead to serious environmental issues in near future

Some thoughts to take home…

- Problem is not just in southern Iowa & northern Missouri; rather spreading across the state & region
- Interventions are needed soon before we pass a tipping point
- Broad-scale efforts may require increased use of prescribed fire vs. alternative controls – to a point
- Rx Fire Cooperatives

Complications to effective management: social acceptance, anti-pyric fuelbeds


Questions?