Restoration as a Strategy for Increasing Ecological Resilience and Adaptation for Future Climate Change Regimes

John Shuey
Indiana Office of
The Nature Conservancy

The Nature Conservancy
Protecting nature. Preserving life.™

a.k.a., **Restoration is a strategy to reduce ecological stressors,** *not some gardener's fantasy about re-creating ecosystems*

… or meeting some regulatory requirement for mitigation

<u>Our mission is fairly unique:</u>

TNC conserves diversity for the sake of diversity

Our strategies are flexible and typically limited only by resource availability

Over the last 15 years, we have incorporated climate change adaptation strategies into everything we can

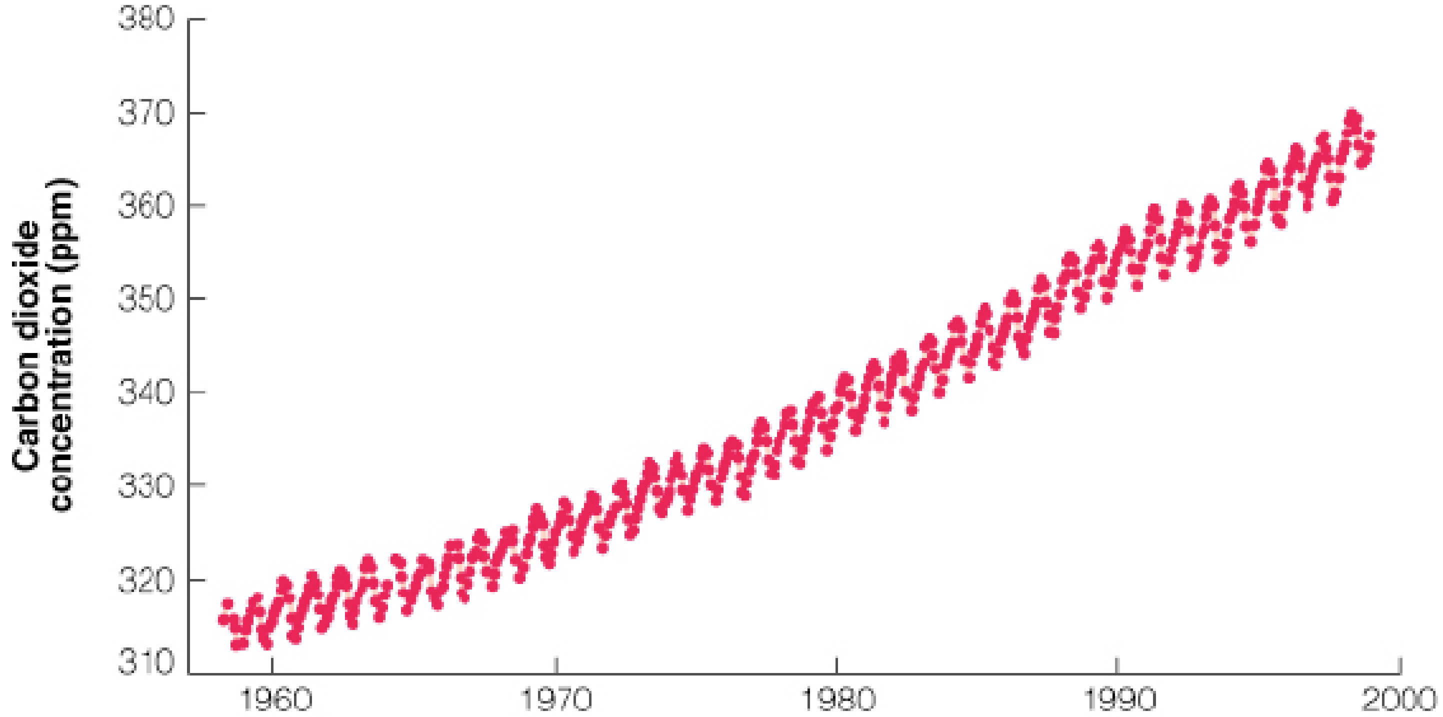
There are four basic approaches to managing ecosystems for future predicted climates

- Increase resistance to change – the attempt to defy predictable impacts from future climatic regimes
- **Promote resilience to change** – increase resiliency by managing ecosystem attributes that help cope with disturbance.
- **Enable ecosystems to respond to change** – Intentionally accommodate change, rather than resist it, to enable today's ecosystems to respond adaptively as environmental changes accumulate.
- **Realign management and restoration approaches to reflect future conditions** – look to future predicted climatic regimes, especially the predicted climatic surprises and threshold effects that can have extraordinary impact on community structure, and implements management strategies that ecologically pre-position communities for the future.

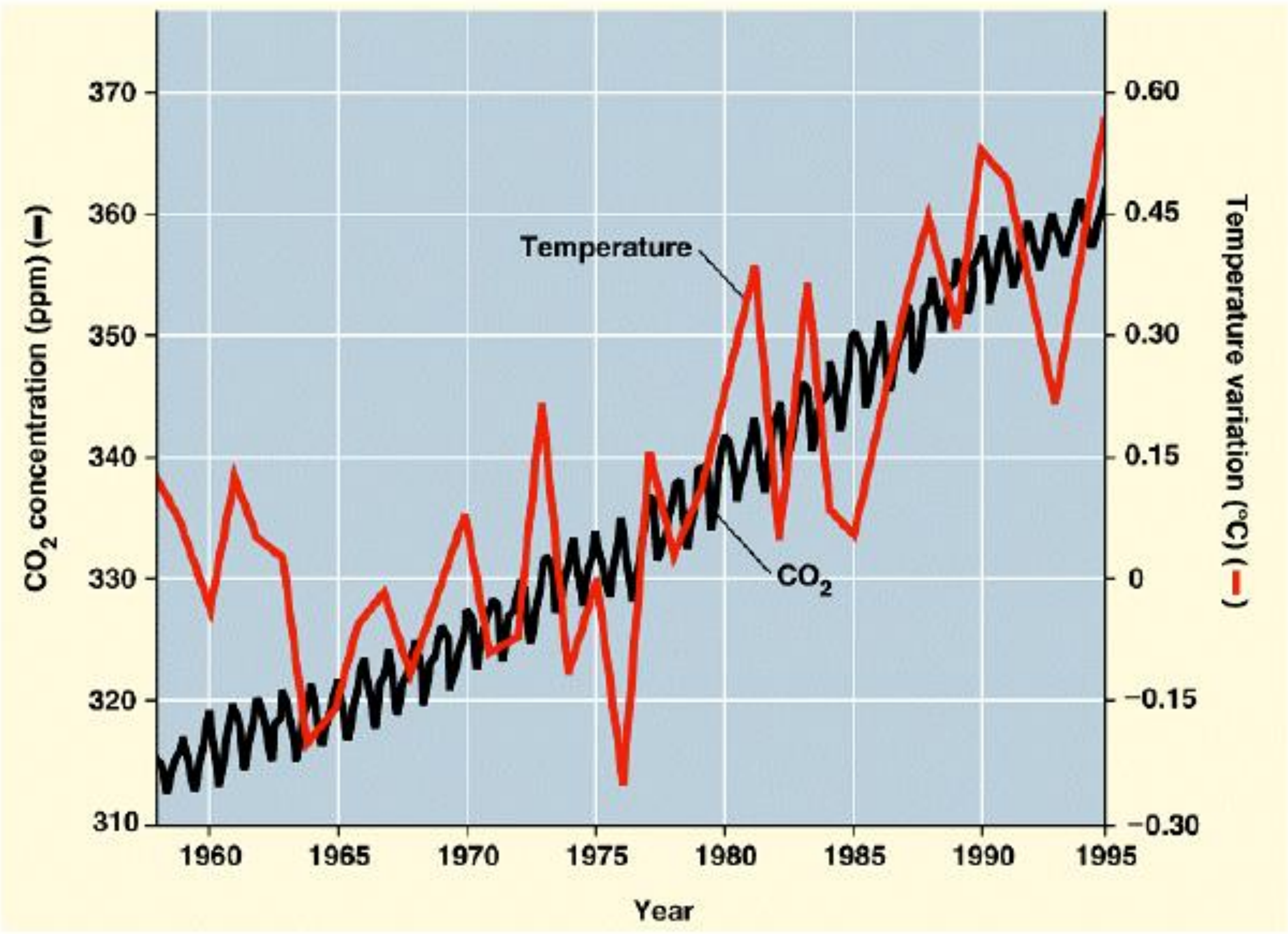
Climate Change:

- You’ve probably heard about it by now ?
- You probably understand the basics of predictions for your region ?
- You hopefully are designing restorations to accommodate those predictions ?

Mauna Loa Observatory in Hawaii



CO_2 concentrations predicted to be 700 ppm in 2100

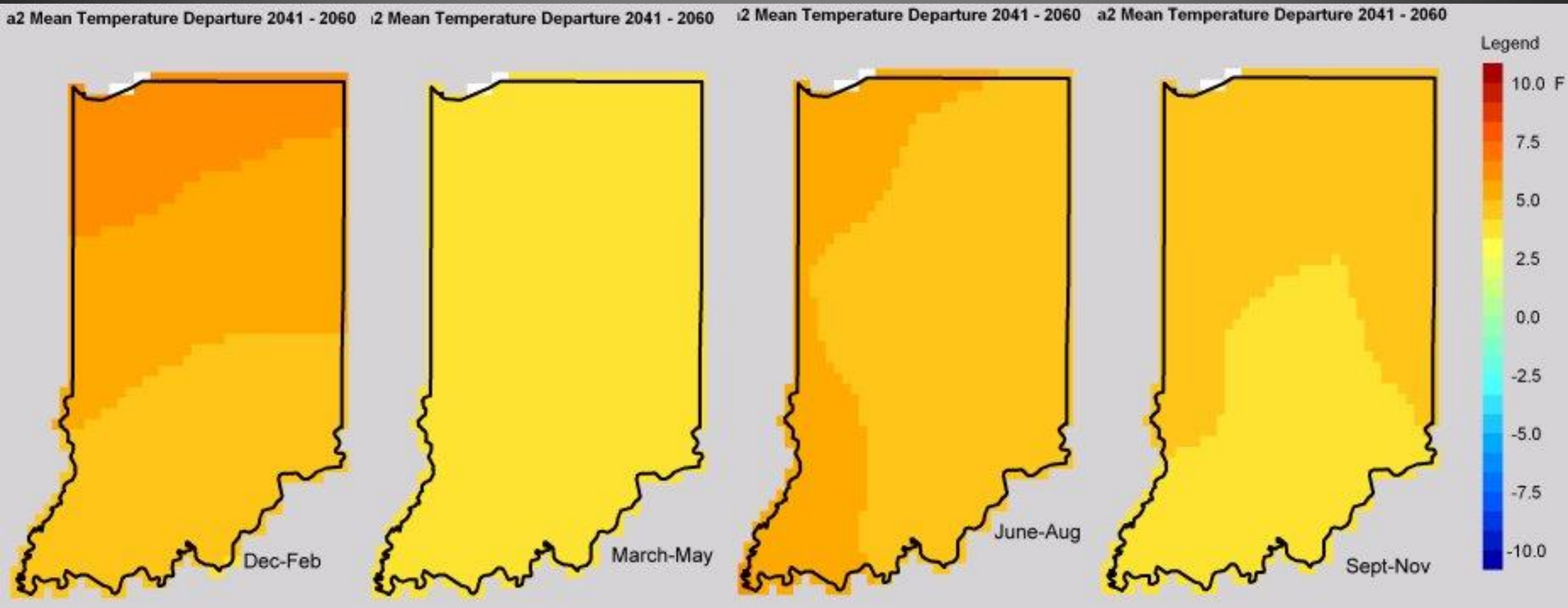


CO2 concentration (ppm) (—)
370
360
350
340
330
320
310
Temperature
CO2
1960
1965
1970
1975
1980
1985
1990
1995
Year
0.60
0.45
0.30
0.15
0
−0.15
−0.30
Temperature variation (°C) (—)

Change in Seasonal Temperature

Relative to today

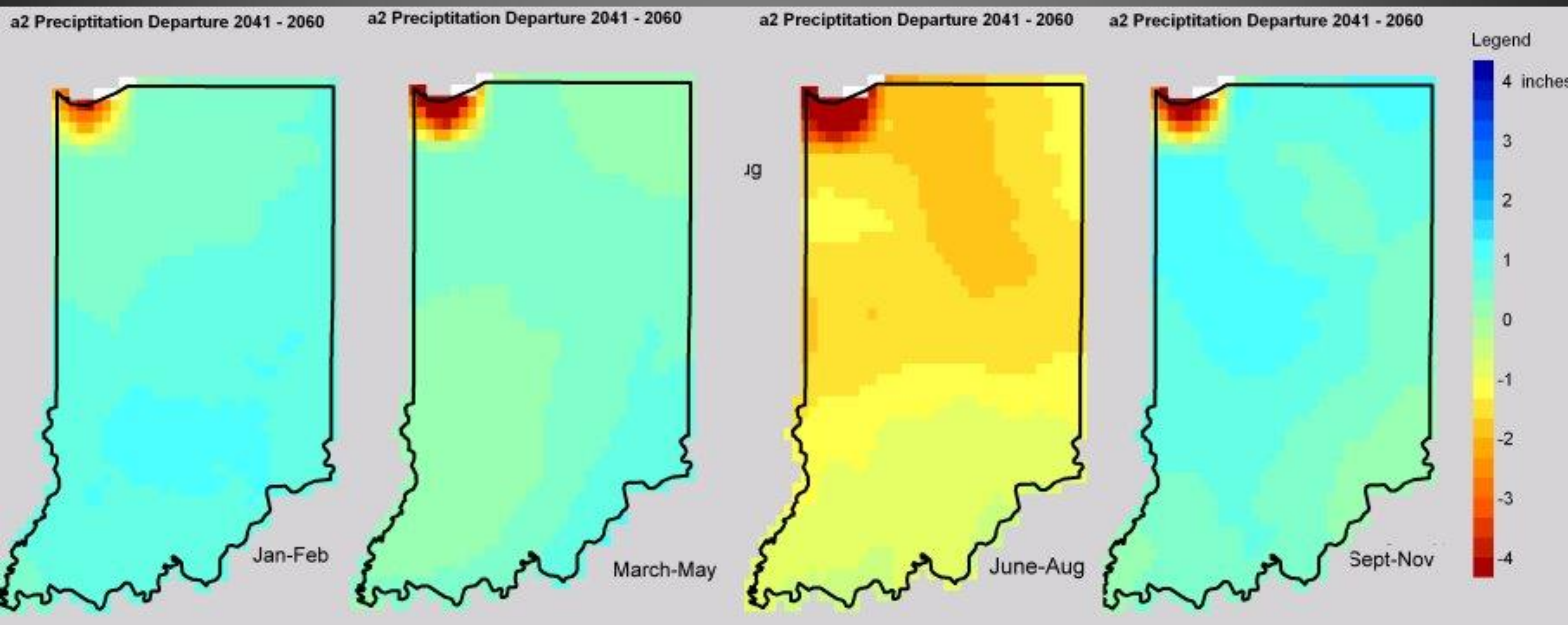
… it will be warmer



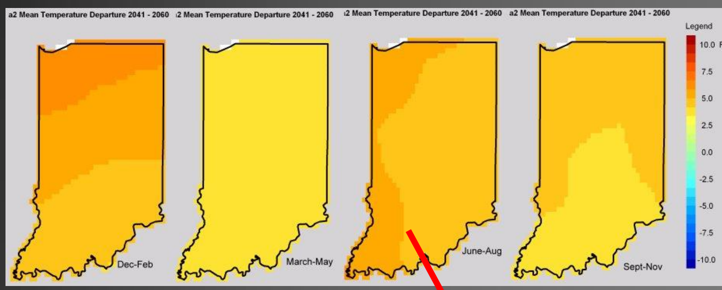
Change in Seasonal Precipitation

Relative to today – slightly increase cool season precipitation, decreased in the summer

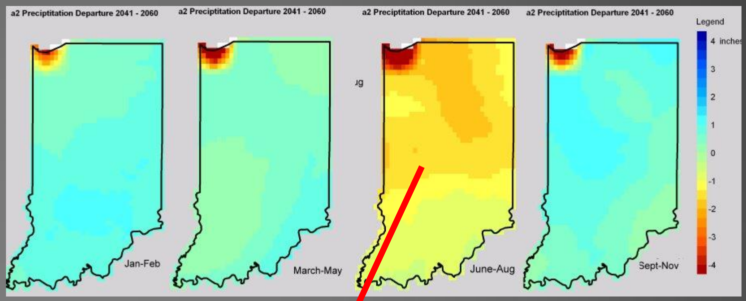
Probably an increase in “big” rainfall events



Solve the Equation



+



=

DROUGHT STRESS

Change in Future Climatic Moisture Deficit - 2081 to 2100

Model: CGCM3.1 (T47), SRES emission scenario: High (A2)

Projected end-of-century increase in drought stress for the project area. This will result in an increase from one month of consistent annual drought stress under current conditions to three to four months of annual drought stress at the turn of the century.

We can design restorations for that!

- Strategies that address the problem directly:
  - Create restorations that fight against the future
    - Usually by increasing moisture gradients via hydrologic restoration

- Strategies that pick the “future climate winners”
  - Restore drought adapted ecological communities
    - Select against drought intolerant species
    - Increase ecological resilience

The alternative seems unacceptable

- Create restorations that have a high-likelihood of failure in the foreseeable future

  - Create wetland restorations will be dry under future climate predictions?

  - Manage for drought susceptible communities likely to collapse under future climate predictions?

Goals for today

Discuss in detail two seemingly very different ecological systems

southern Indiana oak forests and northern Indiana oak savannas

Booth require restoration to drought-resistant ecological conditions

Booth are on ecological trajectories that could lead to ecological collapse under predicted future climate regimes.

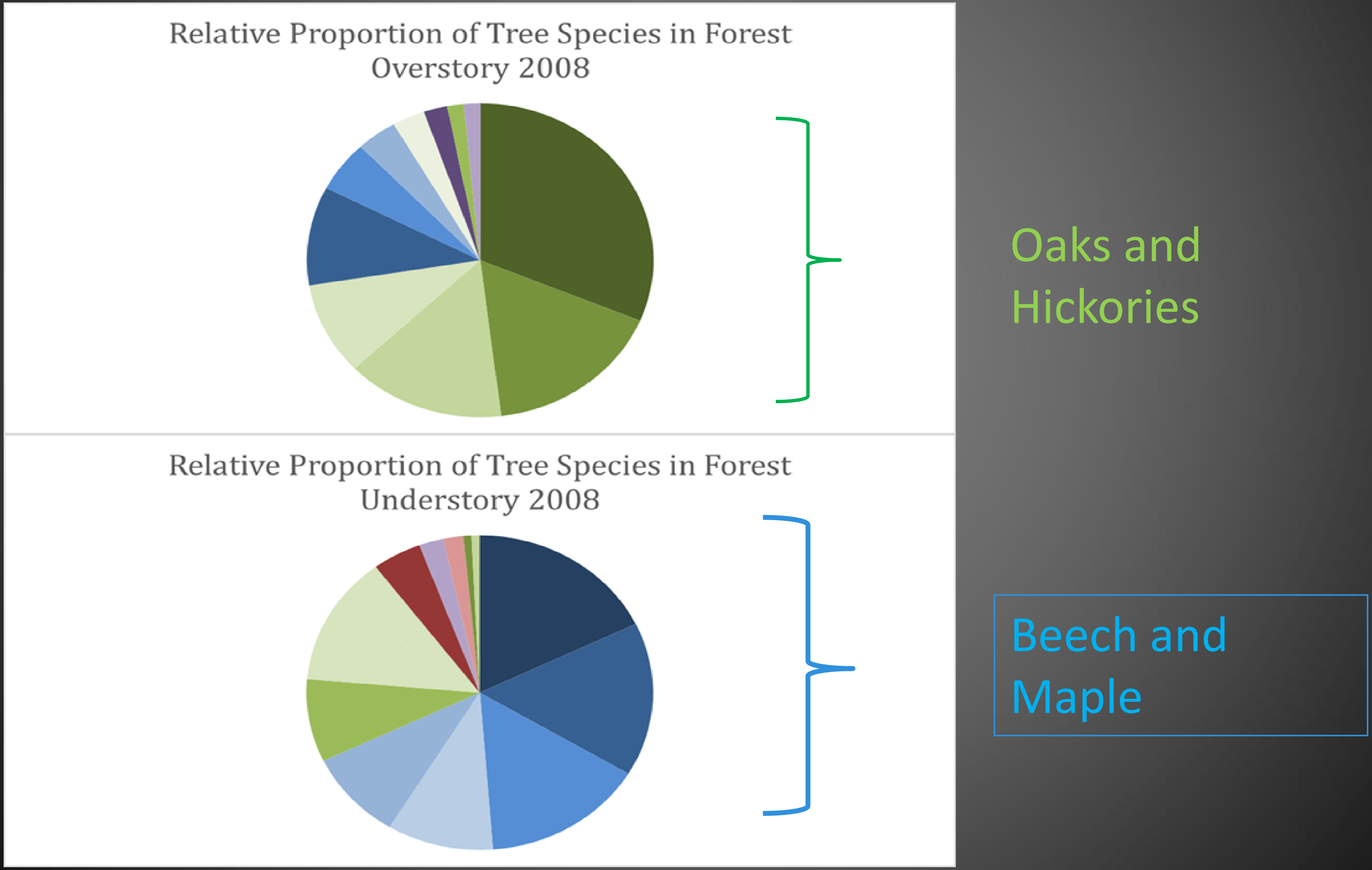
Goals for today

Show you snippets of other sites and climate change restoration strategies that we've folded in to "day-to-day" conservation


Mesophication
Southern Indiana Oak Woodlands

Mesophication : fire-maintained open lands converted to closed-canopy forests via fire suppression. As a result of increased shading, fire-sensitive plants began to replace heliophytic, fire-tolerant plants. Many fire sensitive species are highly susceptible to drought

Our fear is that we are allowing entire ecosystems to drift towards states that can literally collapse under future predicted climate regimes.



Unfortunately, fire alone can not restore structure to sites that have been fire suppressed for decades

Aggressive structural restoration

- Girdled maples, beech and poplar on ridge tops and south facing slopes
- Brush cut and stump-treated saplings of fire intolerant species across ridges

Followed with intensive fire treatments to further reduce competition from fire intolerant saplings

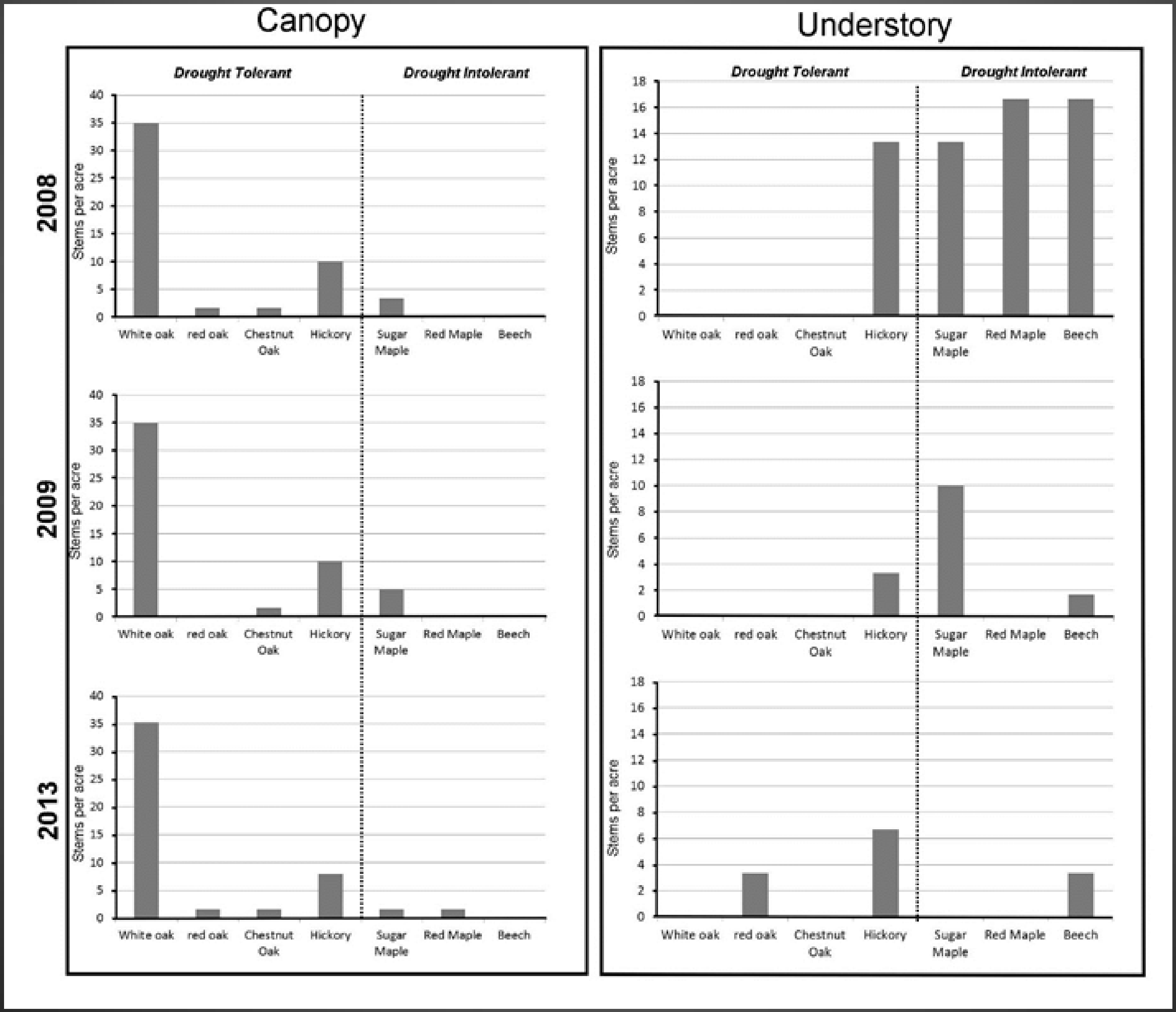
Forest stand with no treatments 6/15/2009

Forest stand post thinning, 6/17/2008

First growing season post spring fire, 6/15/2009

Forest stand post thinning and burning, 7/5/2013

Canopy is unchanged – but understory is moving towards drought tolerant species



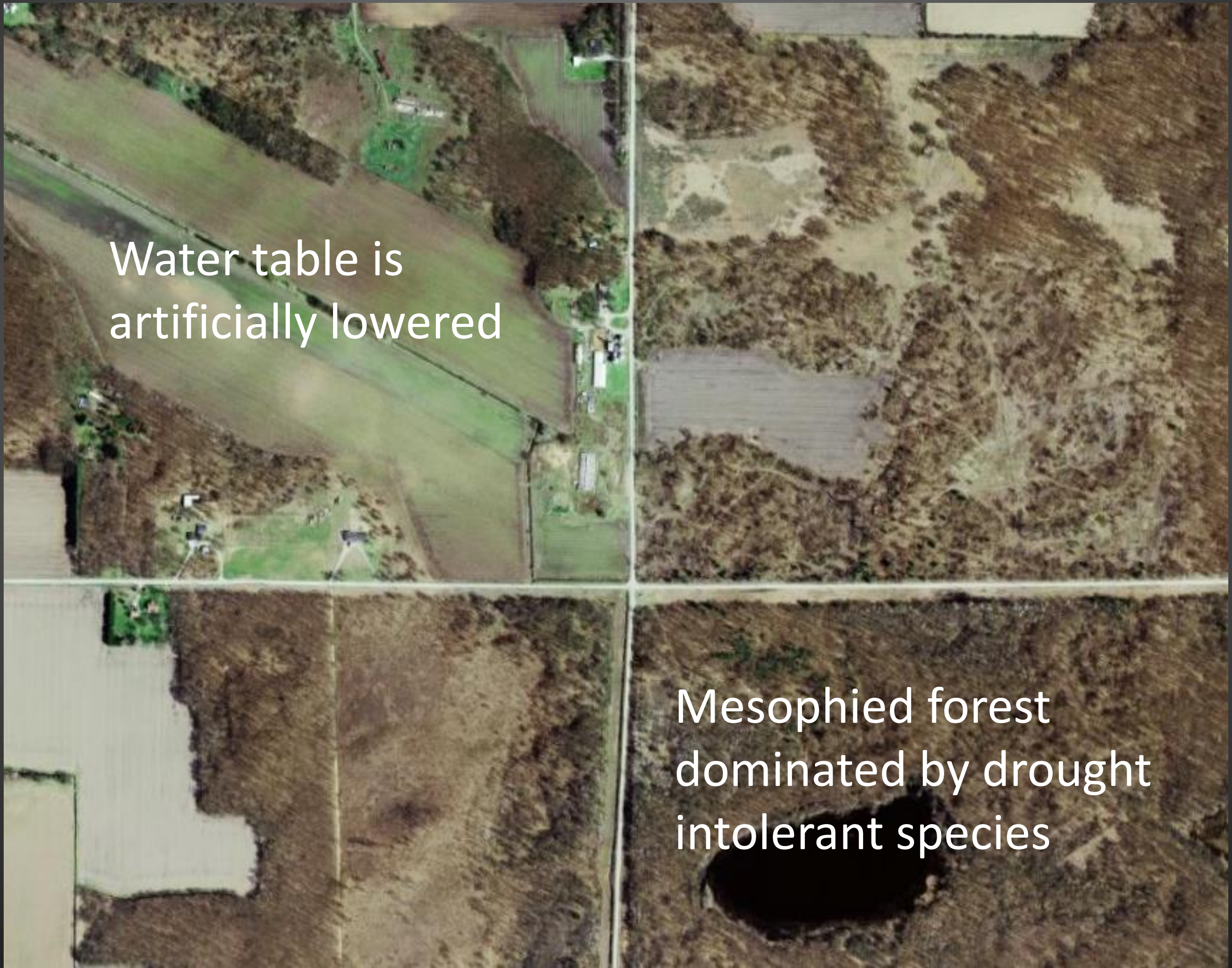
Our hope is that we can start regenerating oak & hickory saplings

…, and that we can start regenerating drought tolerant forests for the future on the Midwest

Oak Barrens occur naturally as complex mosaics of wetlands, sand prairies and xeric barrens

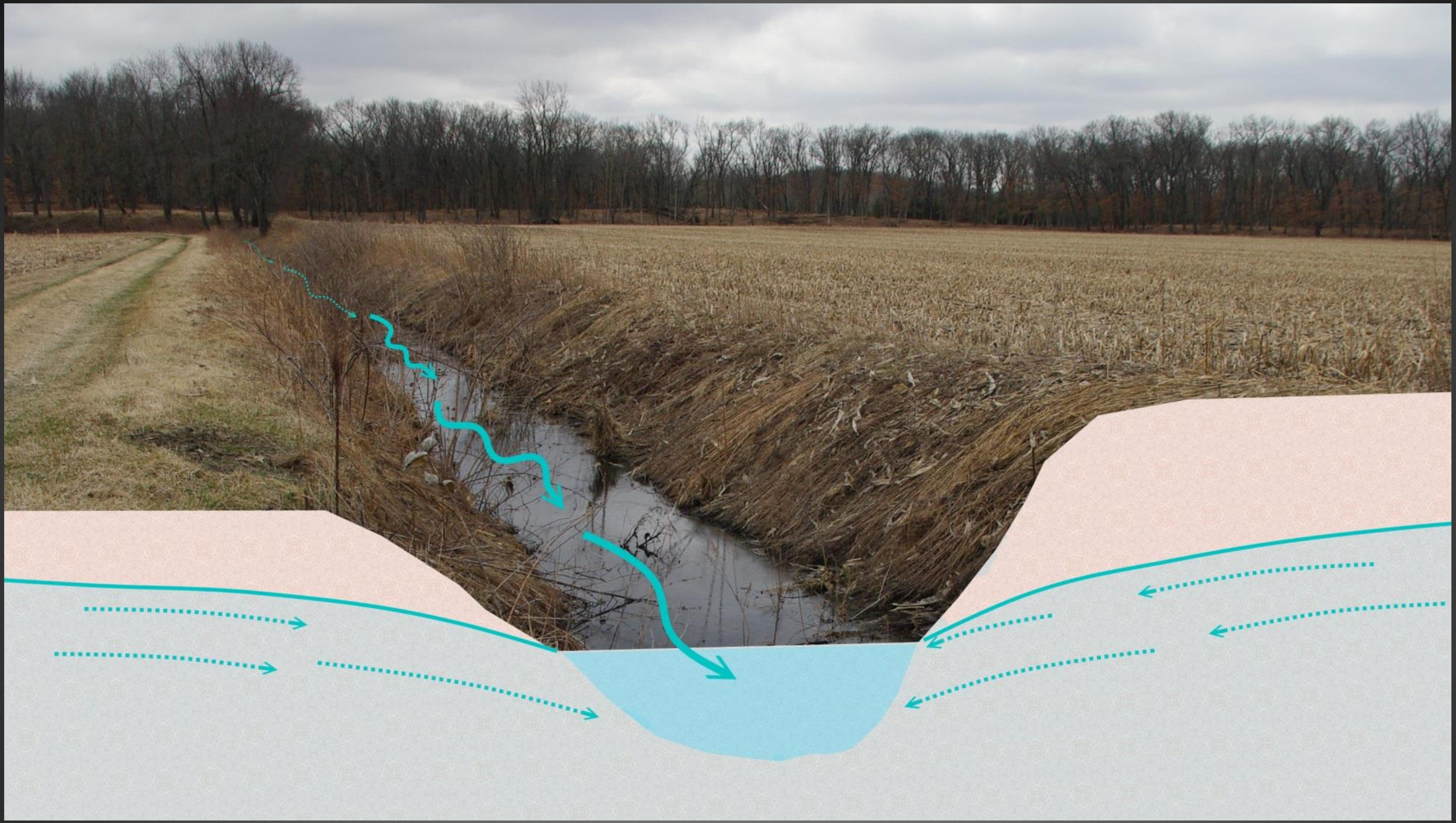
Unfortunately, wetlands have been drained, and uplands are fire suppressed and becoming “mesophied”

This creates two types of drought streesors.



Let’s talk about hydrology first…

In sand – these ditches pull down the near surface water table 24 hours a day, 365 days a year….



365 days per year, 24 hours per day,
these sand drains lower the water table from adjacent lands

Restoring the near-surface water table is reasonably straight foreword

Once surface drains are removed – the near surface water table simply emerges above ground level.

… the next day

We targeted agricultural tracts adjacent to conservation lands for acquisition and restoration.

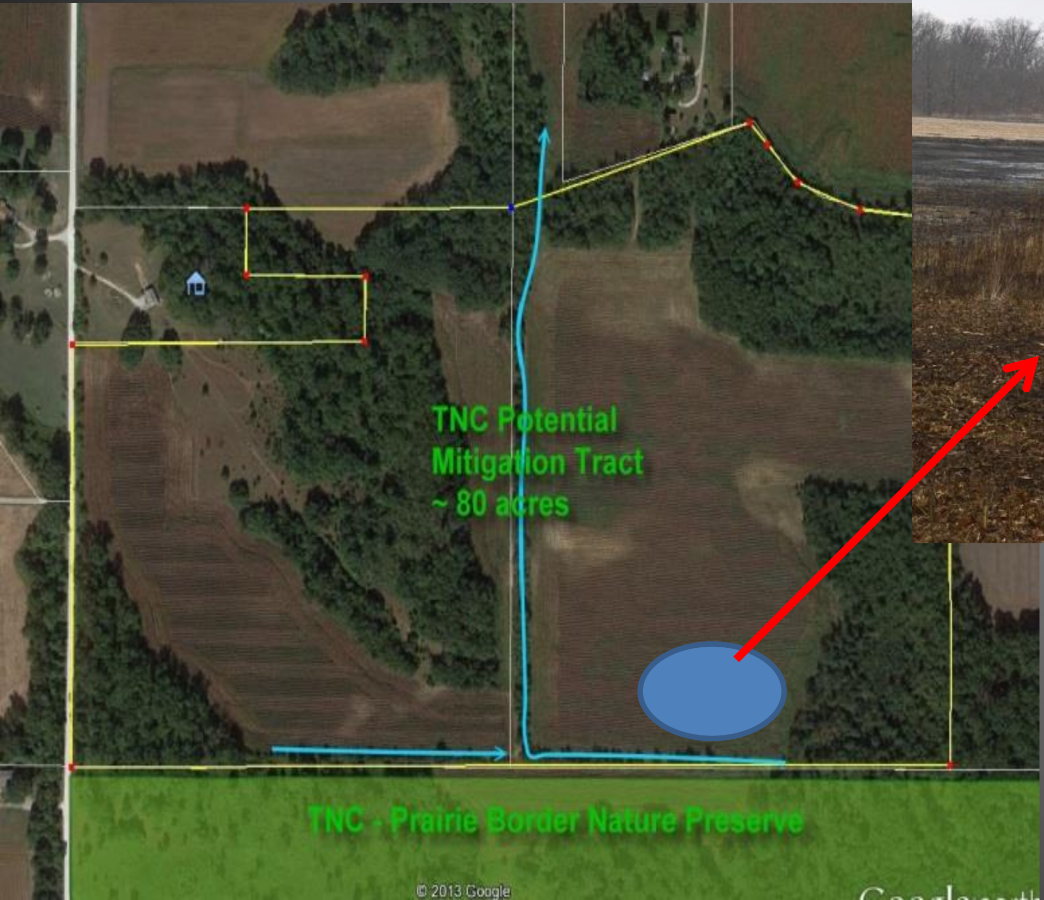
- 12 years later
- After 5 acquisitions

this work is nearing completion

It is possible to completely eliminate first order ditches

Ditch system eliminated last autumn – Already we see the response on our adjacent holdings.

Instant hydrologic gratification..

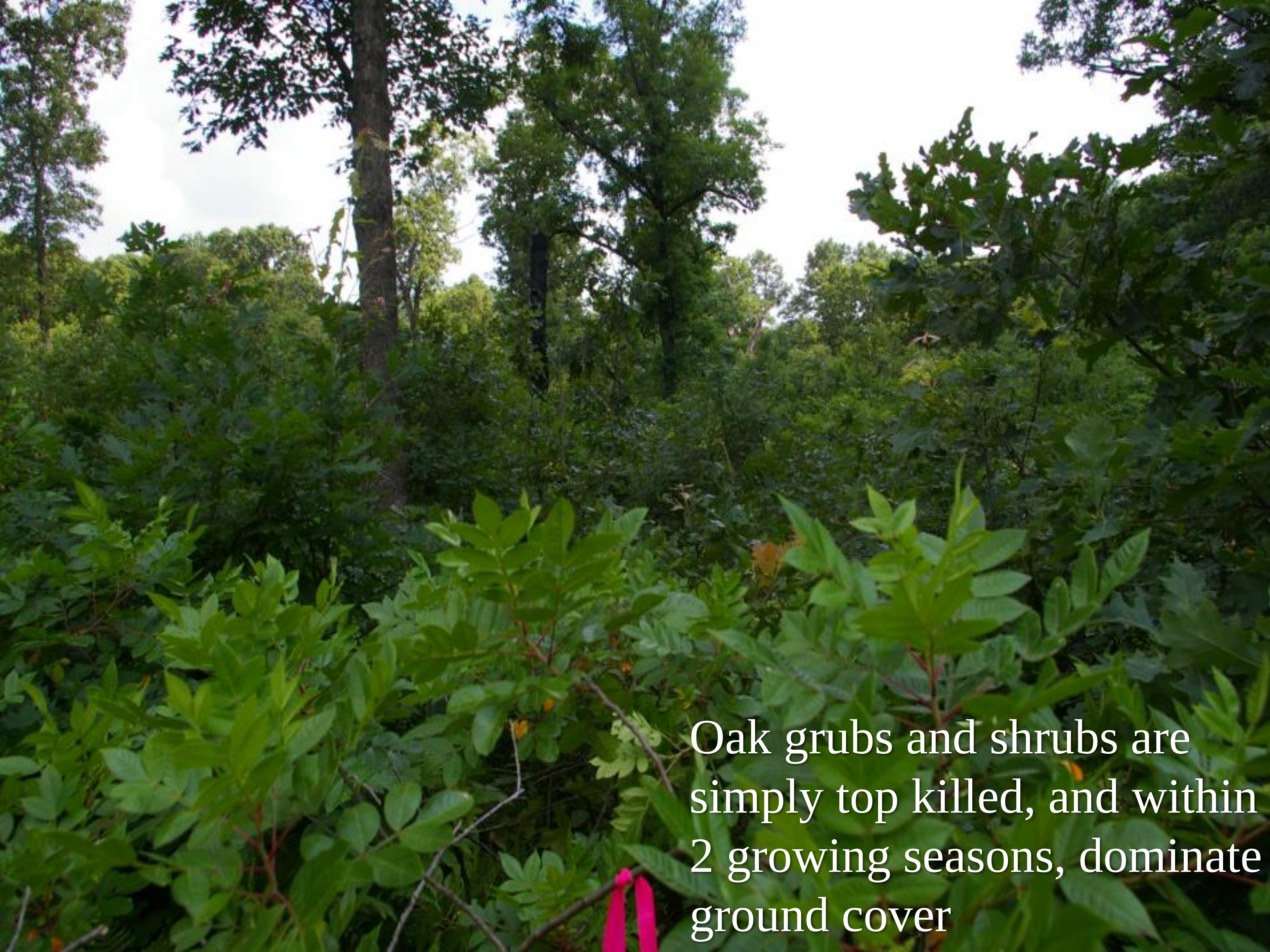


And of course- we re-establish appropriate local genotype plant communities

The barrens themselves are also susceptible to drought stress

Fire suppresion has created mesophied ~~forests~~


Unfortunately, fire alone won’t restore structure to fire suppressed barrens


Oak grubs and shrubs are
simply top killed, and within
2 growing seasons, dominate
ground cover

Using mechanical treatments to thing understory


Very aggressive herbicide follow-up is required


2009

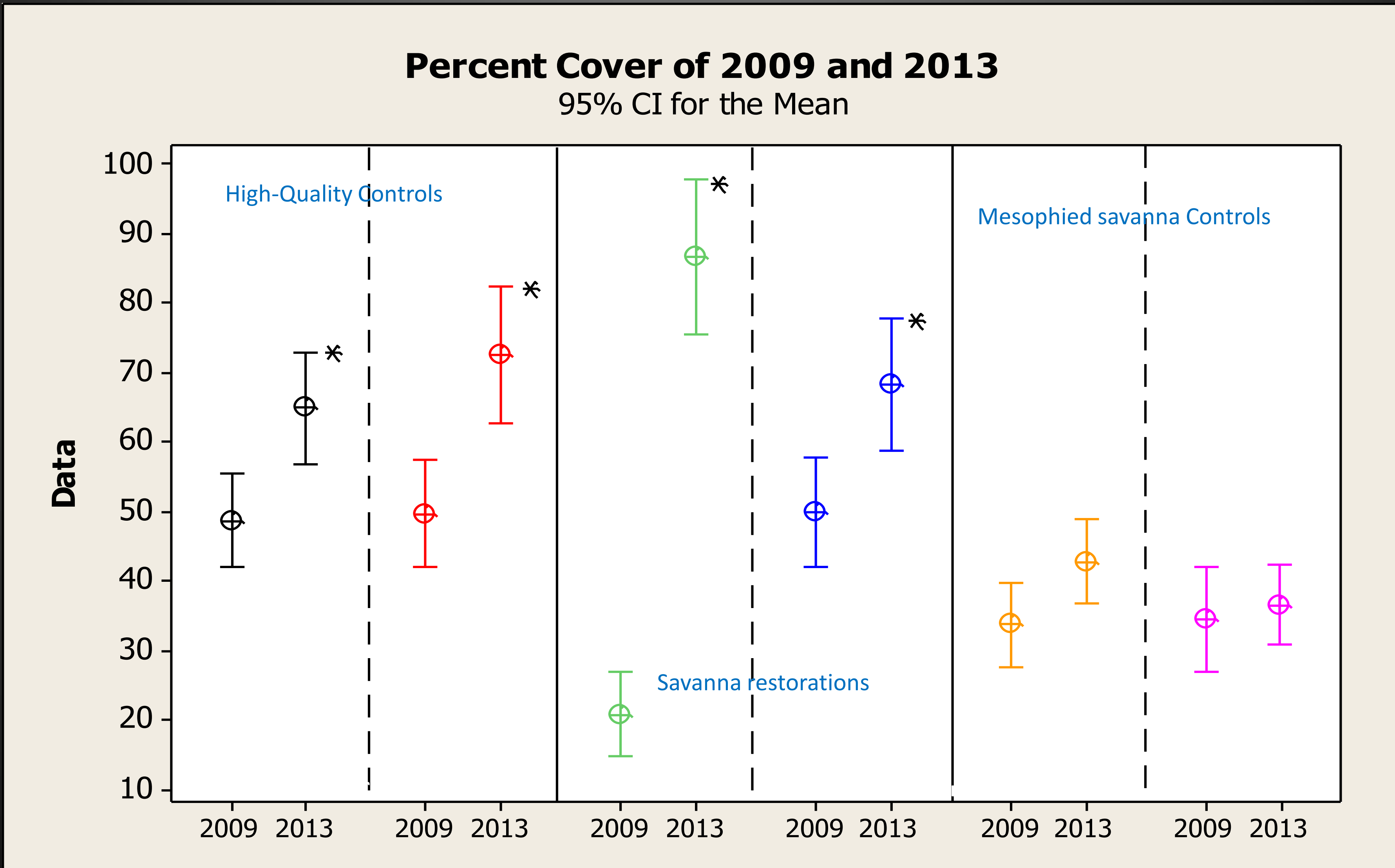
2011

2013

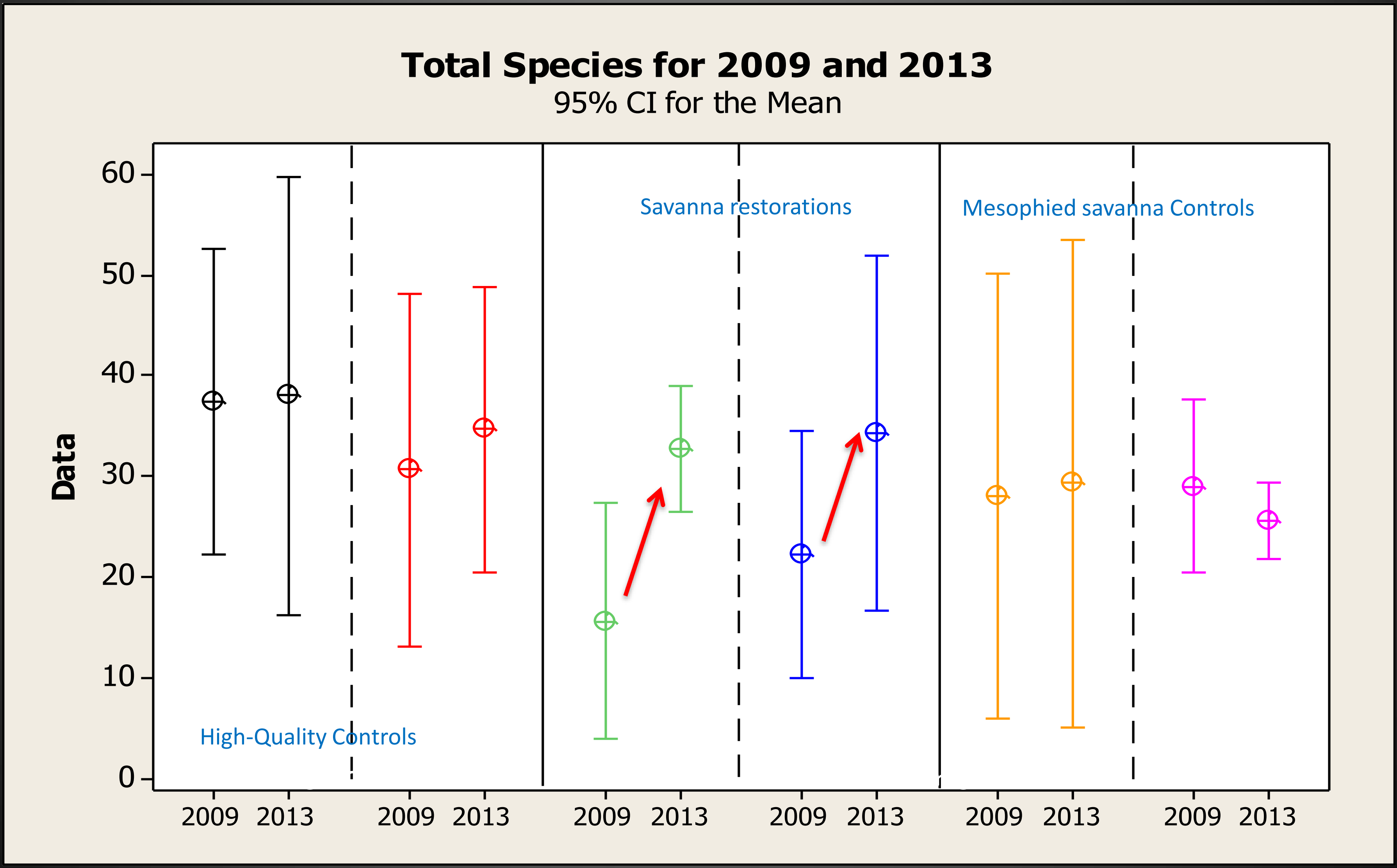
Herbaceous cover responded to the increase in light


And you can have "savanna in a can"
within a couple of years…

Statistically, we saw dramatic increase in % cover of herbaceous species



Number of species increased in our treatments as well – and we will further explore this relationship.



Our hope is that through short-term intensive intervention, we can create systems that can be maintained with minimal interventions

The idea being simple

Top to bottom, we have habitats that are adapted to future predicted climatic regimes

Three other quick and simple examples

Near surface fragipan creates “flatwoods hydrology”

Sopping wet in the winter

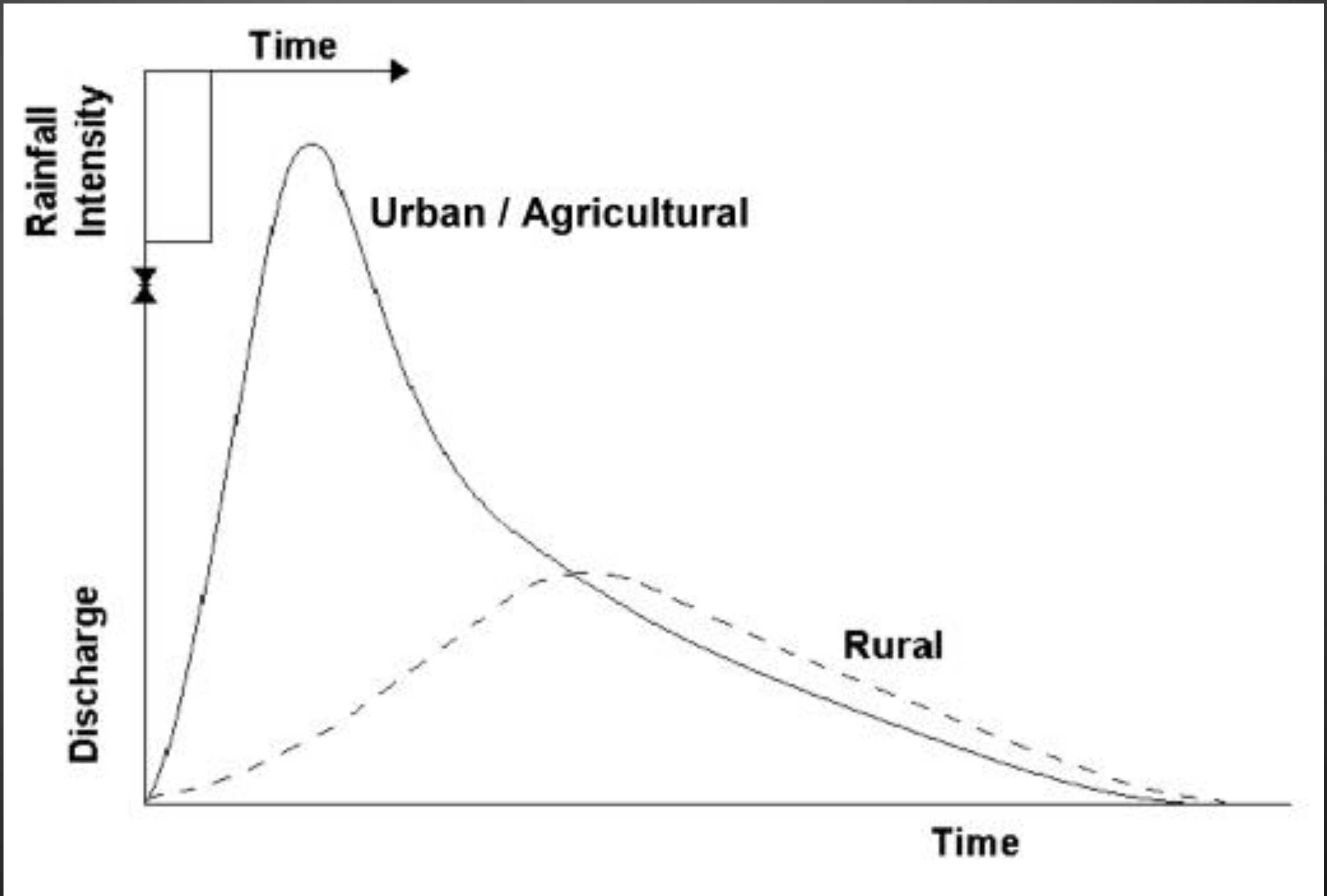
Bone dry in the summer

Access mitigation funding to block "100-year old" perimeter ditches

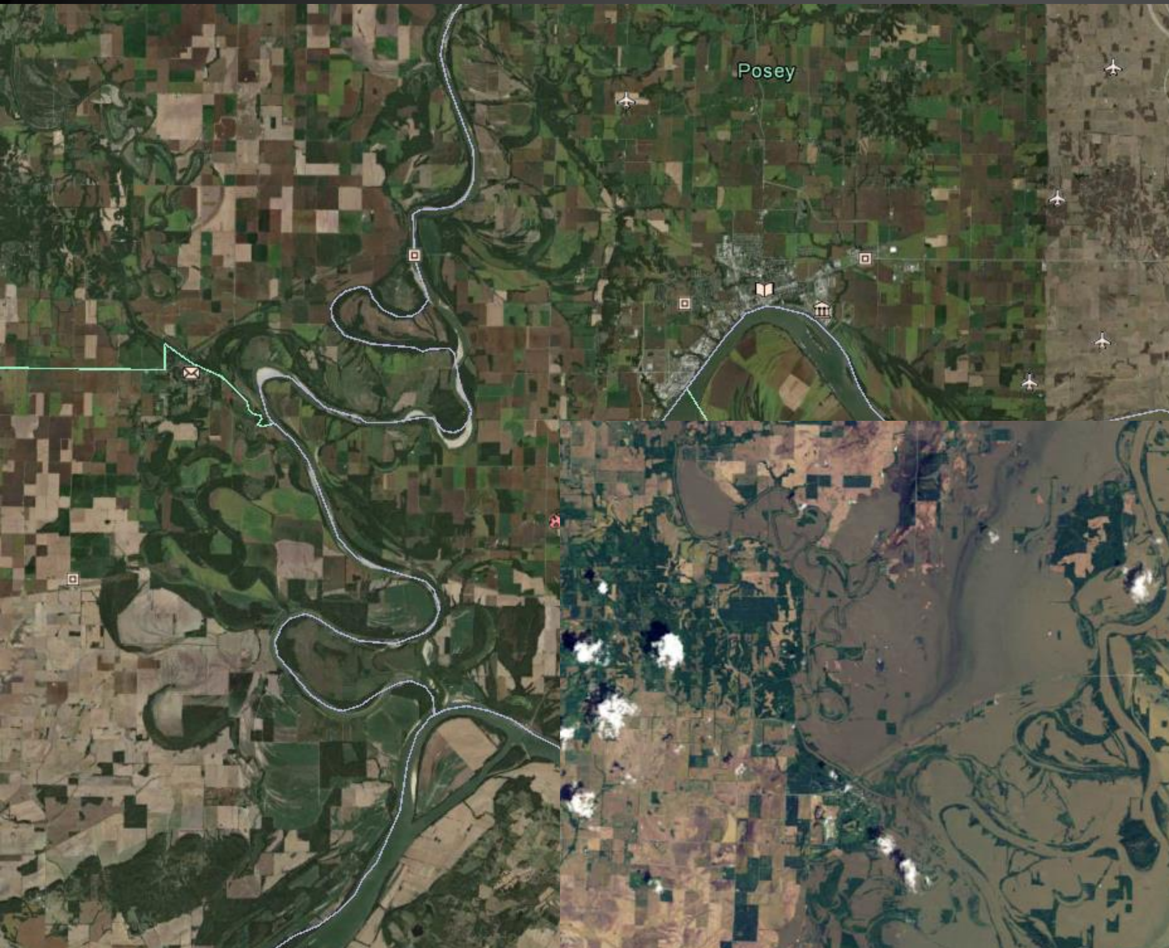
Adaptation to future ecosystem processes / disturbances

Agricultural ditches combined with increased storm intensity will disrupt downstream hydrology and increase flooding.

Increased storm intensities impact ag-stream communities in so many ways…

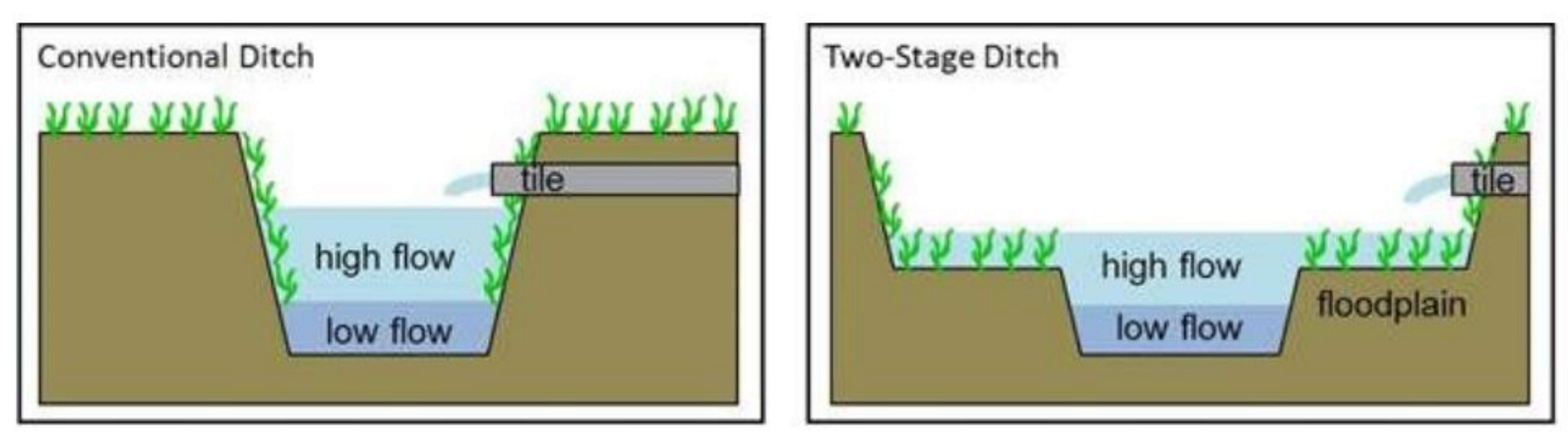


100 year floods are seemingly becoming "annual events"



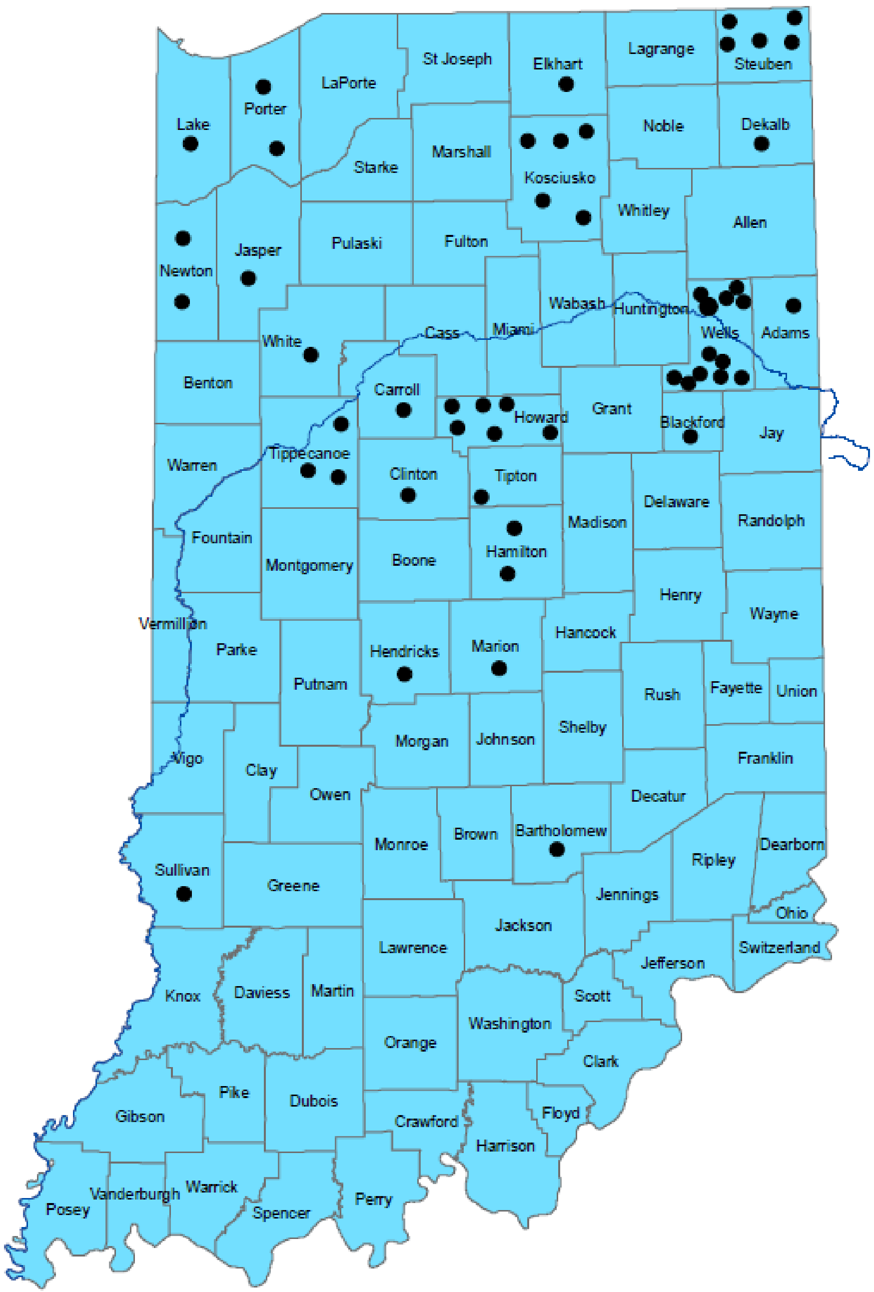
Adaptation to future ecosystem processes / disturbances

- Strategy – Design and implement agricultural drainage system that slows release of run off



Create drainage system that is compatible with agriculture and decreases non-point source loadings as well as decreased peak flows during extreme events

January 2014 Two-Stage Ditches
51 projects/ 21 counties/ 22 miles of ditch



Our restoration strategy has been to enhance enabling conditions such that others implement the practice.

22 miles of 2-stage ditches off by two orders of magnitude!

Fish Creek mussel community –

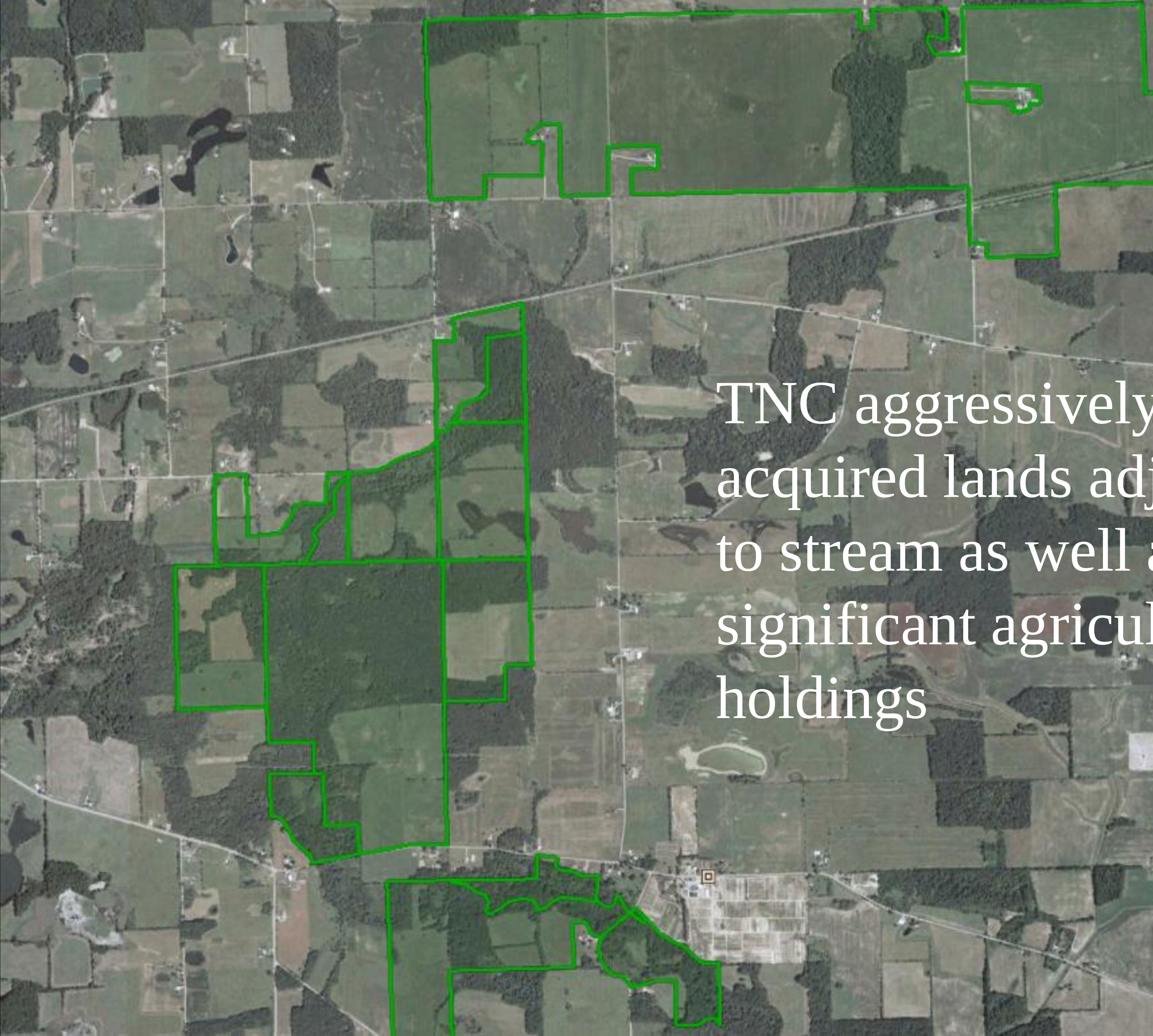
Additional hydrologic restoration strategies

Fish Creek landscape

Surface wetlands diverted into sub-surface drains

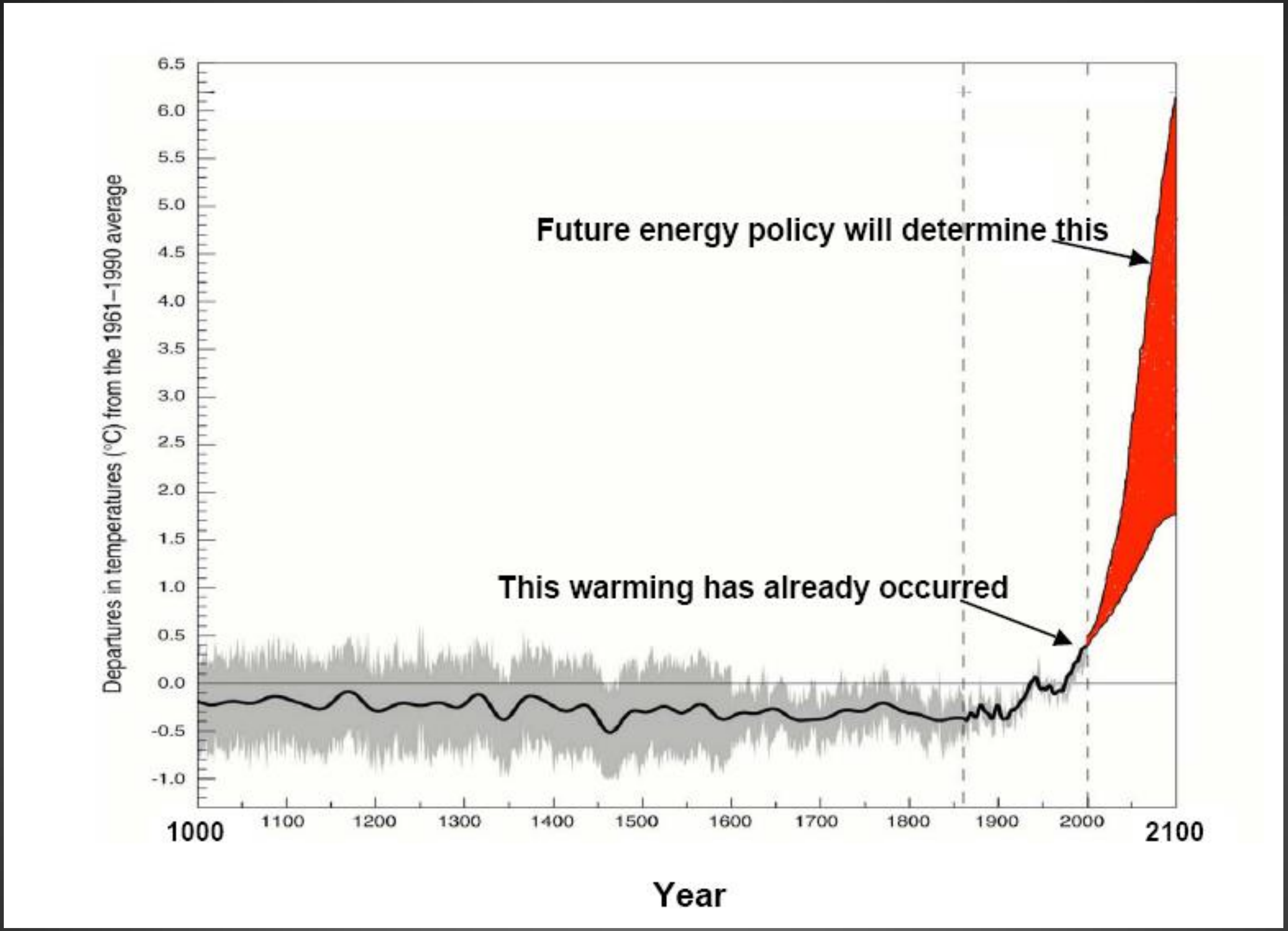
-Very flashy during storm events

-Decreased “low flows”



TNC aggressively acquired lands adjacent to stream as well as significant agricultural holdings

… in part to move surface water into near surface water table in order to improve hydrology



The ultimate impact of climate change is inherently unpredictable

Climate adaption strategies require long-term commitments

- Adaptive management and constant re-assessment of “future-predicted” conditions is critical
  - Agencies must recognize that “5-year and out” mitigations are sure-fire failures

<u>**There are no simple *silver bullet* climate adaption actions**</u>

- Strategies unfold over time and require programmatic coordination – these are not *simple restorations*
  - Often – it's about specific expanses of land that, once assembled, will potentially have the desired impact
  - and the cummulative impact of multiple restorations at the appropriate scale

Our collective working credo – is that:

It’s our obligation to move the bar forward, so that the next generation managers are better positioned for the future.

We do not claim to have all the answers and we are prepared to accept alternative strategies

Acknowledgements –Critical Funding Sources

WILDLIFE CONSERVATION SOCIETY

NIPSCO

NATIONAL FISH AND WILDLIFE FOUNDATION NFWF

and of course our members and traditional donors

Contact Information:

jshuey@tnc.org