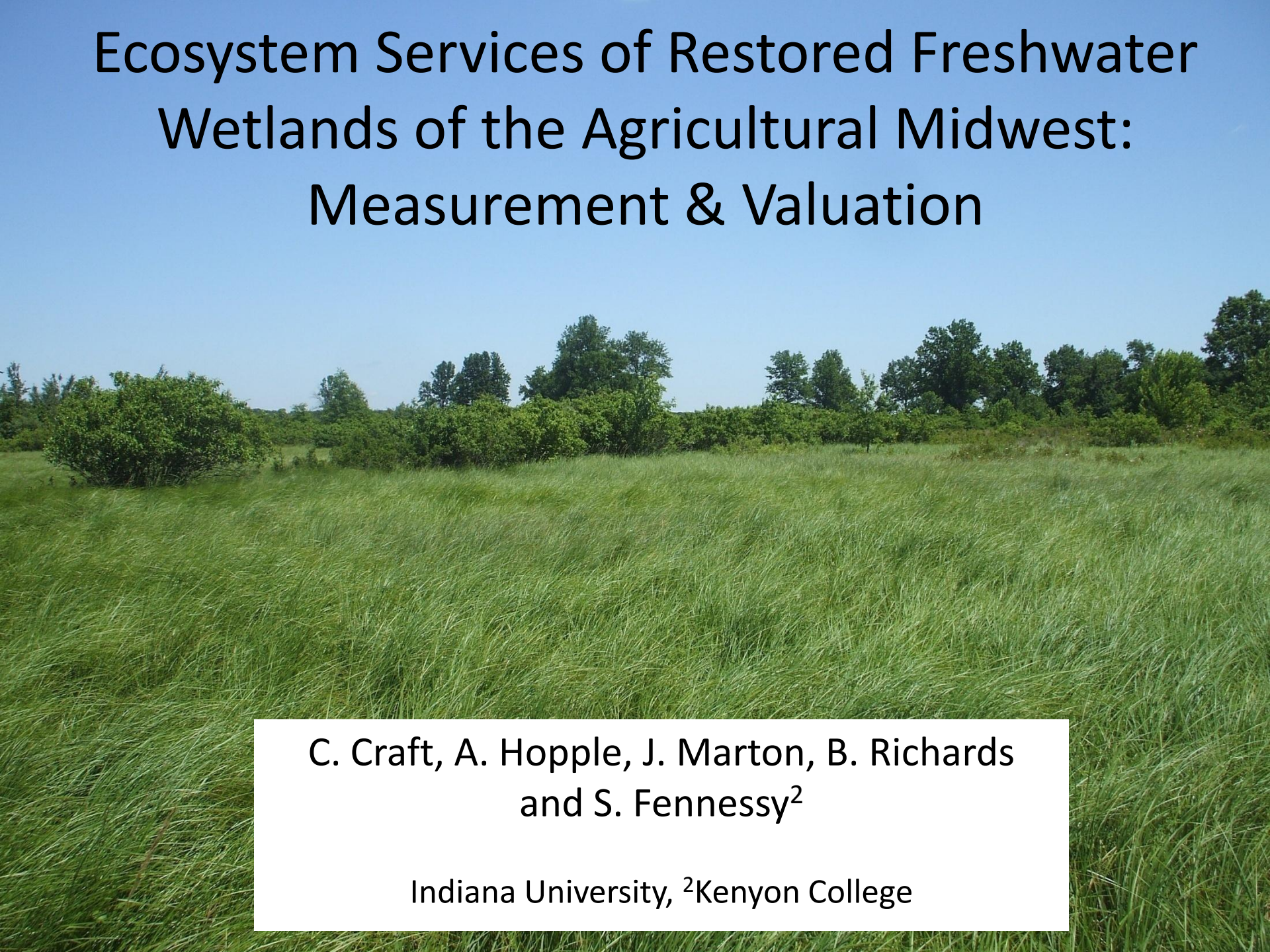
Ecosystem Services of Restored Freshwater Wetlands of the Agricultural Midwest: Measurement & Valuation



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Wetland Services

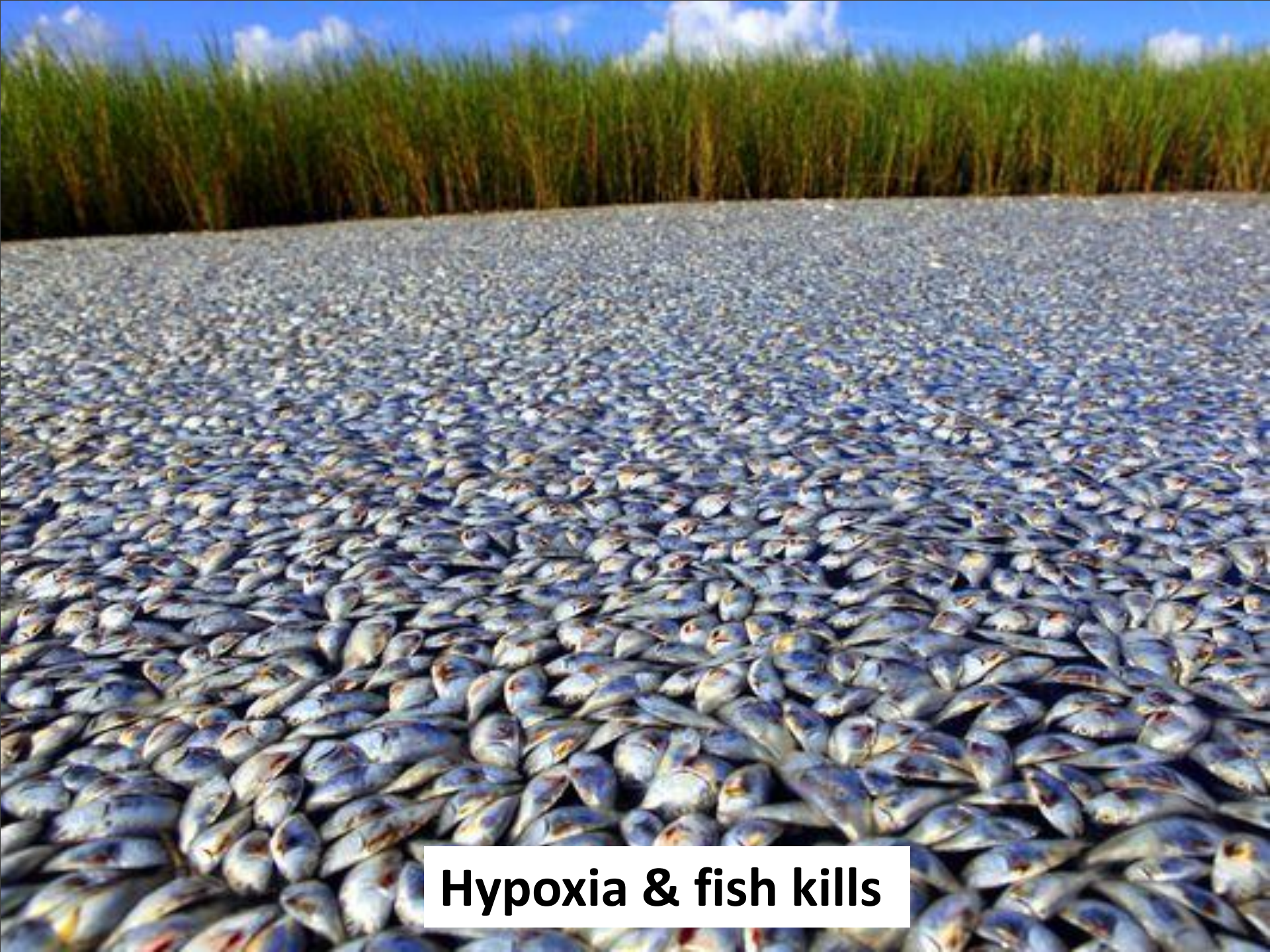
- Nutrient (N,P) sinks and transformers
- Carbon sequestration
- Biodiversity & habitat
- Flood abatement

Wetland Loss

- More than 90% of depressional, floodplain and riparian wetlands.
- Increased nutrient loading, freshwater and coastal eutrophication and hypoxia.


Nutrient enriched stream


Coastal eutrophication


Hypoxia & fish kills

USDA Farm Bill
Wetland and Riparian Restoration

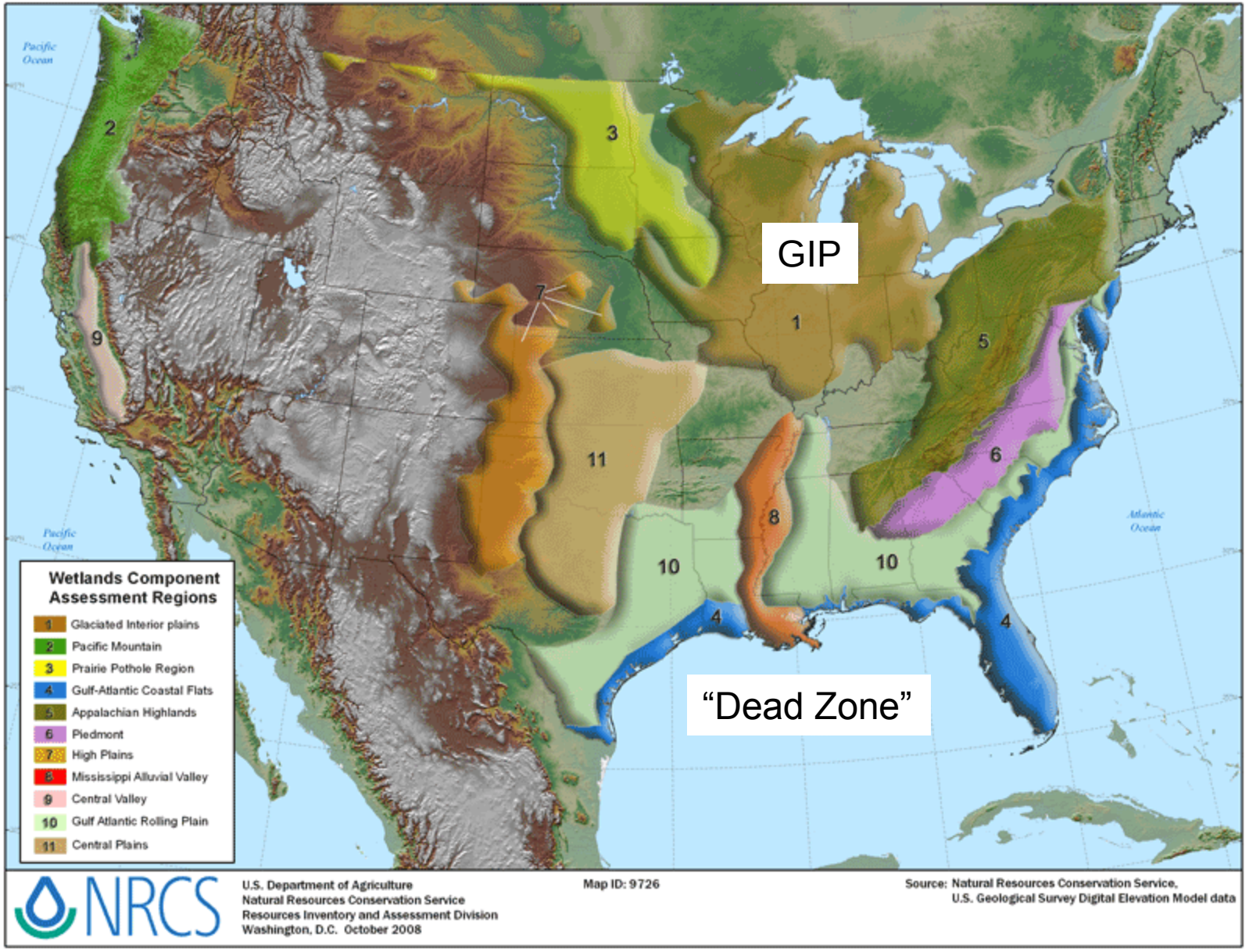
- USDA Farm Bill- Wetland Reserve Program (WRP – water quality & habitat) and Conservation Reserve Program (CRP – erosion control).

- Over 100,000 ha of WRP and CRP restoration in the Glaciated Interior Plain (GIP) since 2000.
  - Approximately 0.2% of estimated loss

Objectives

I. *Do restored wetlands (and riparian buffers) provide ecosystem services (water quality improvement , C sequestration, biodiversity, greenhouse gas emissions) comparable to natural counterparts?*

II. *What are the economic benefits ($$$) of restoring these services? (C sequestration, N, P accumulation)*


GIP
“Dead Zone”
Wetlands Component Assessment Regions
1 Glaciated Interior plains
2 Pacific Mountain
3 Prairie Pothole Region
4 Gulf-Atlantic Coastal Flats
5 Appalachian Highlands
6 Piedmont
7 High Plains
8 Mississippi Alluvial Valley
9 Central Valley
10 Gulf Atlantic Rolling Plain
11 Central Plains
NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resources Inventory and Assessment Division
Washington, D.C. October 2008
Map ID: 9726
Source: Natural Resources Conservation Service, U.S. Geological Survey Digital Elevation Model data

Wetland Restoration…


…means plugging ditches

10 year-old restored wetland

Riparian Restoration…

…means planting trees

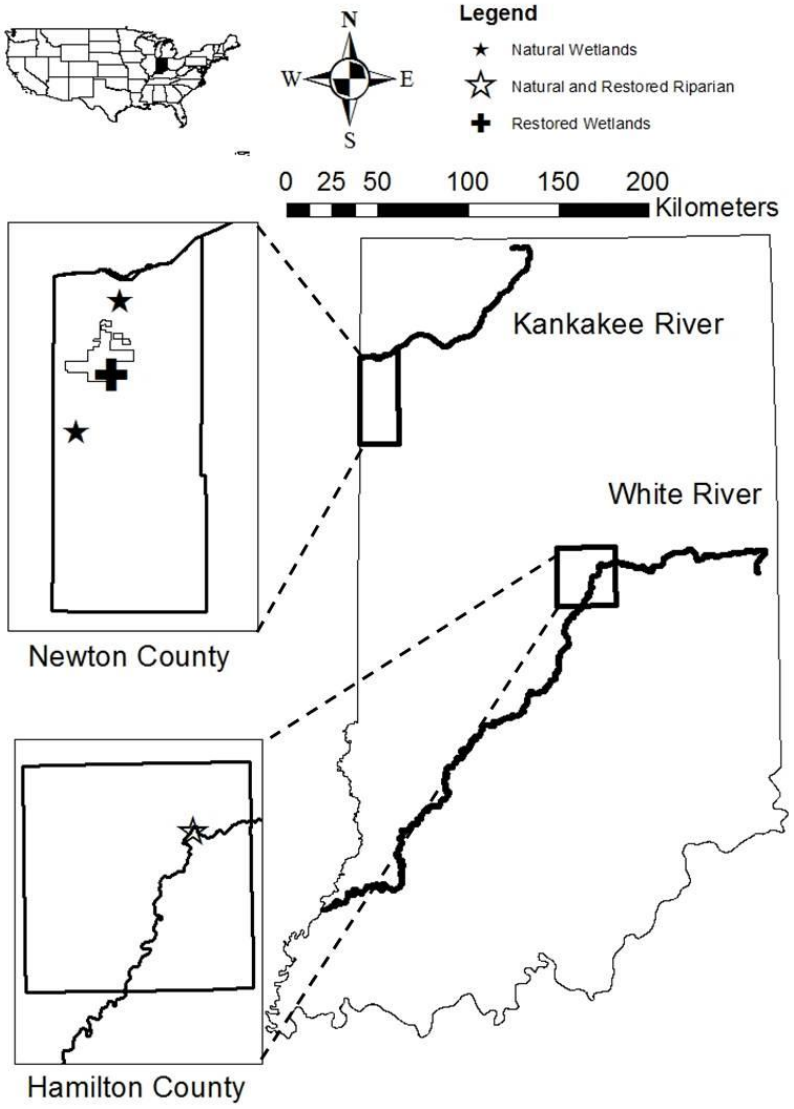
4 year-old restored riparian buffer


Forested Riparian Buffer

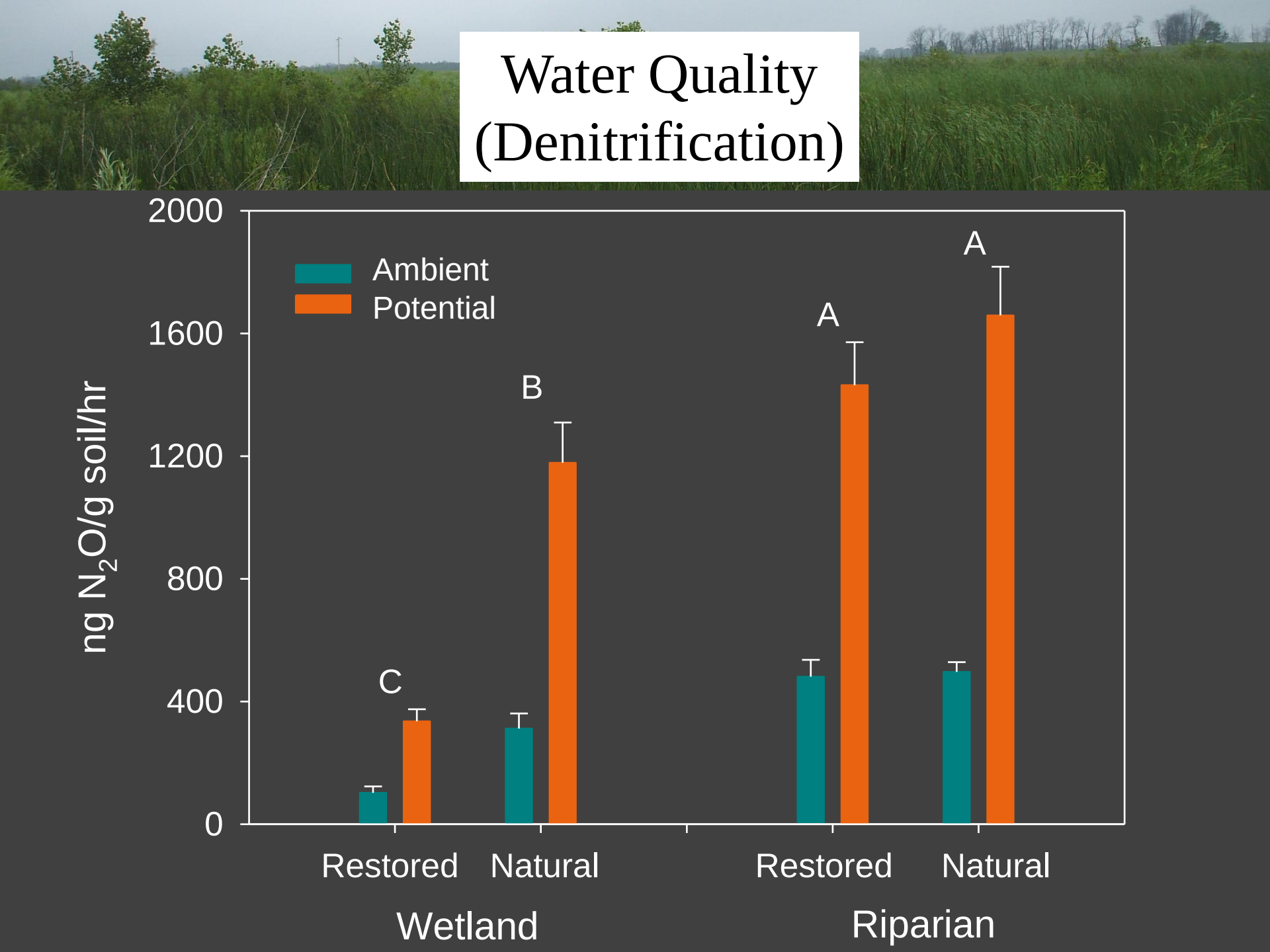
Study Sites

Wetlands

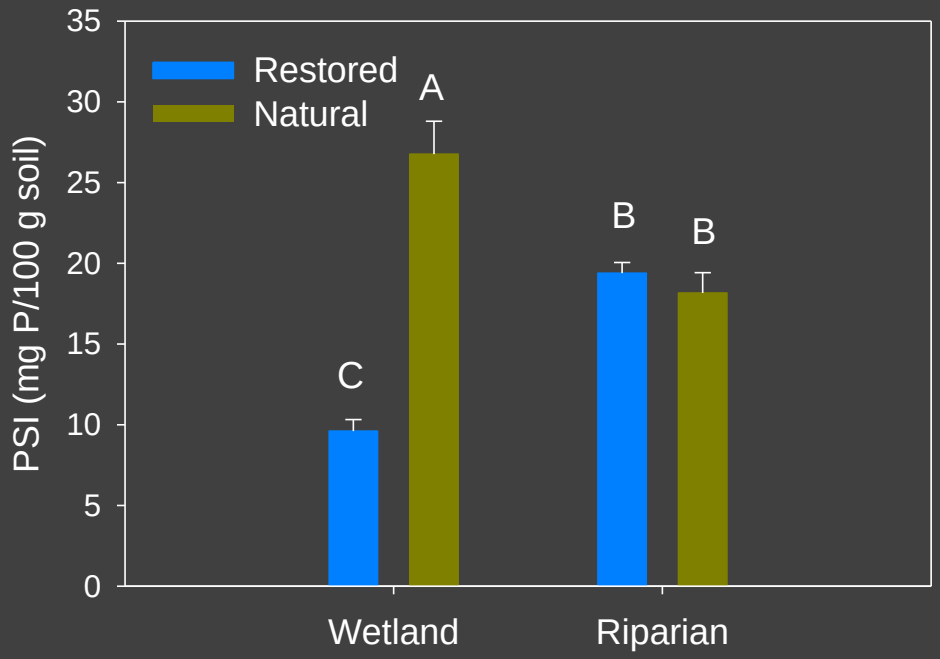
Riparian Buffers



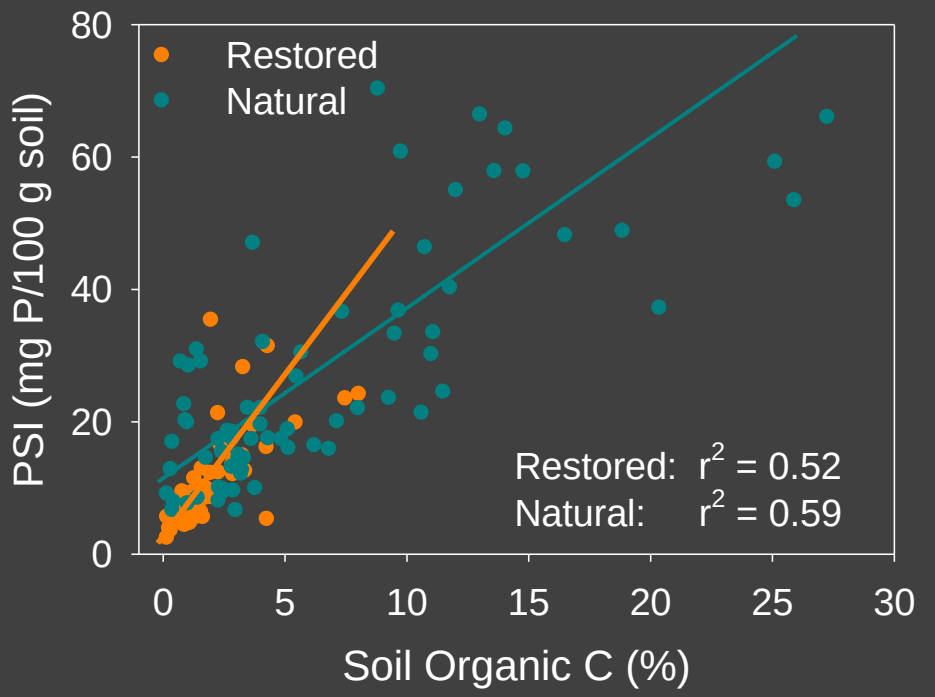
Water Quality (Denitrification)



Water Quality (P Sorption)



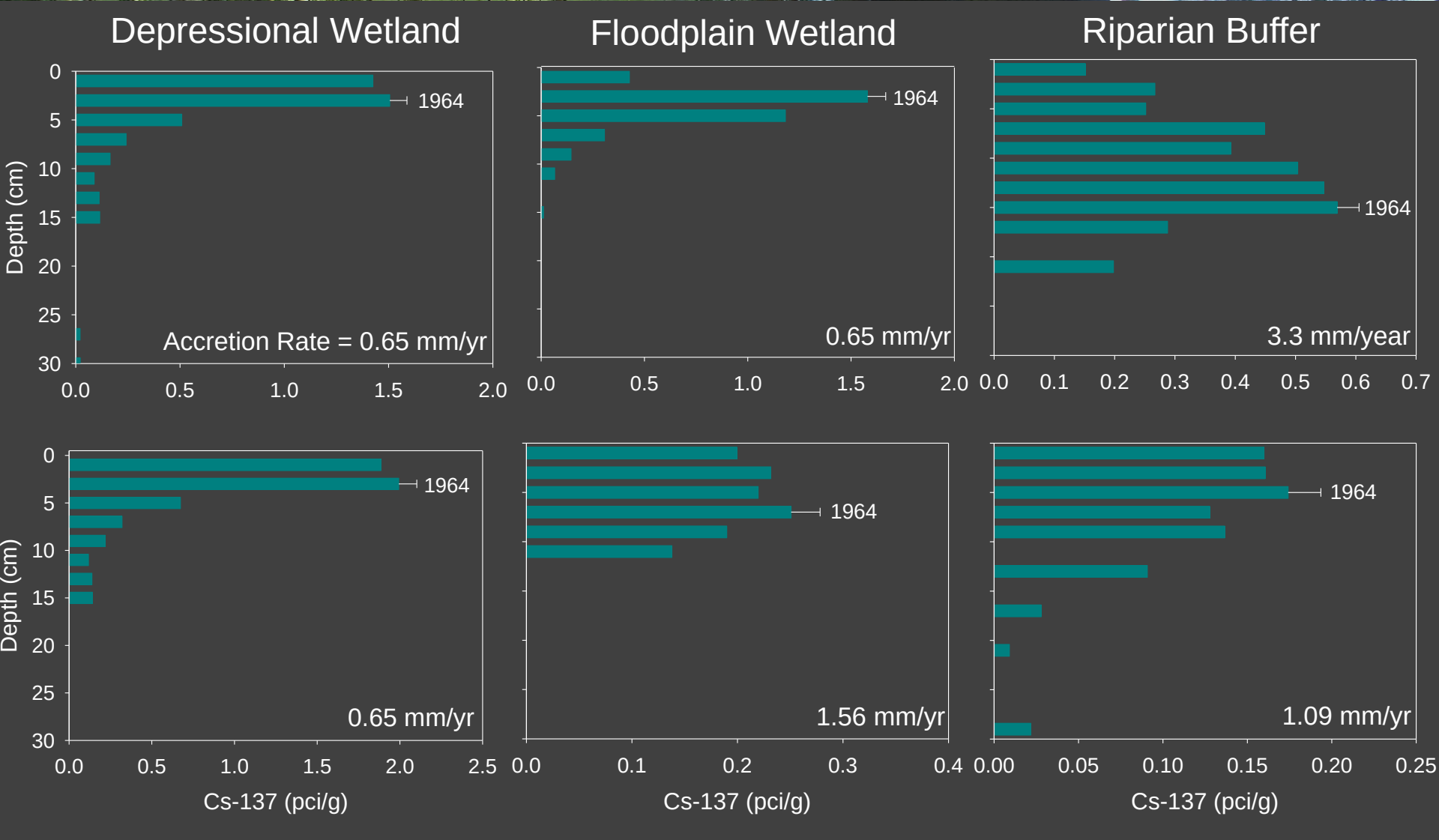
Wetlands



Measurement of Carbon Sequestration

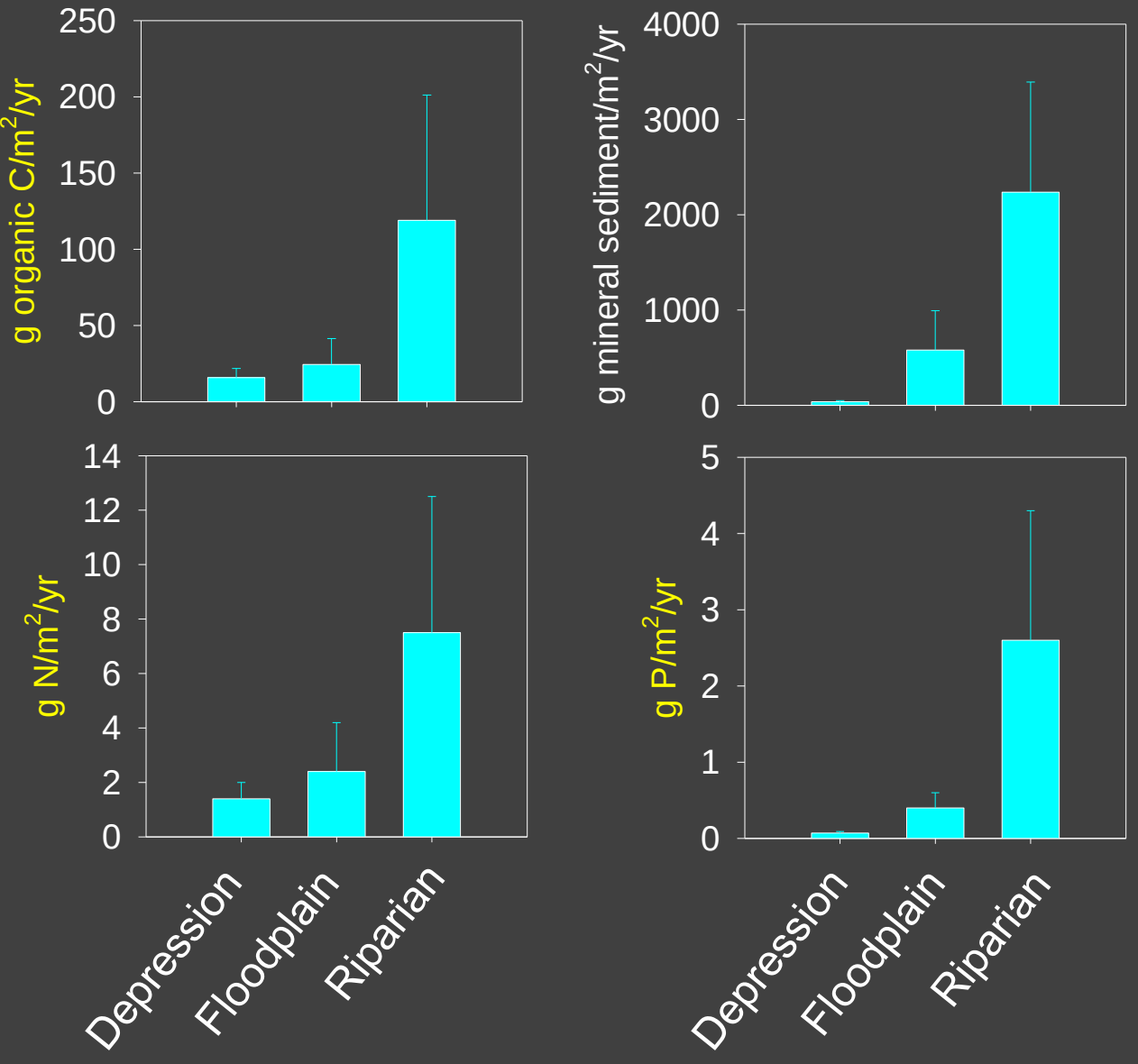
- Fallout from nuclear weapons testing
- ^{137}Cs marker layer
- Provides soil accretion rate, C sequestration, N,P accumulation

Soil Accretion in Natural Systems



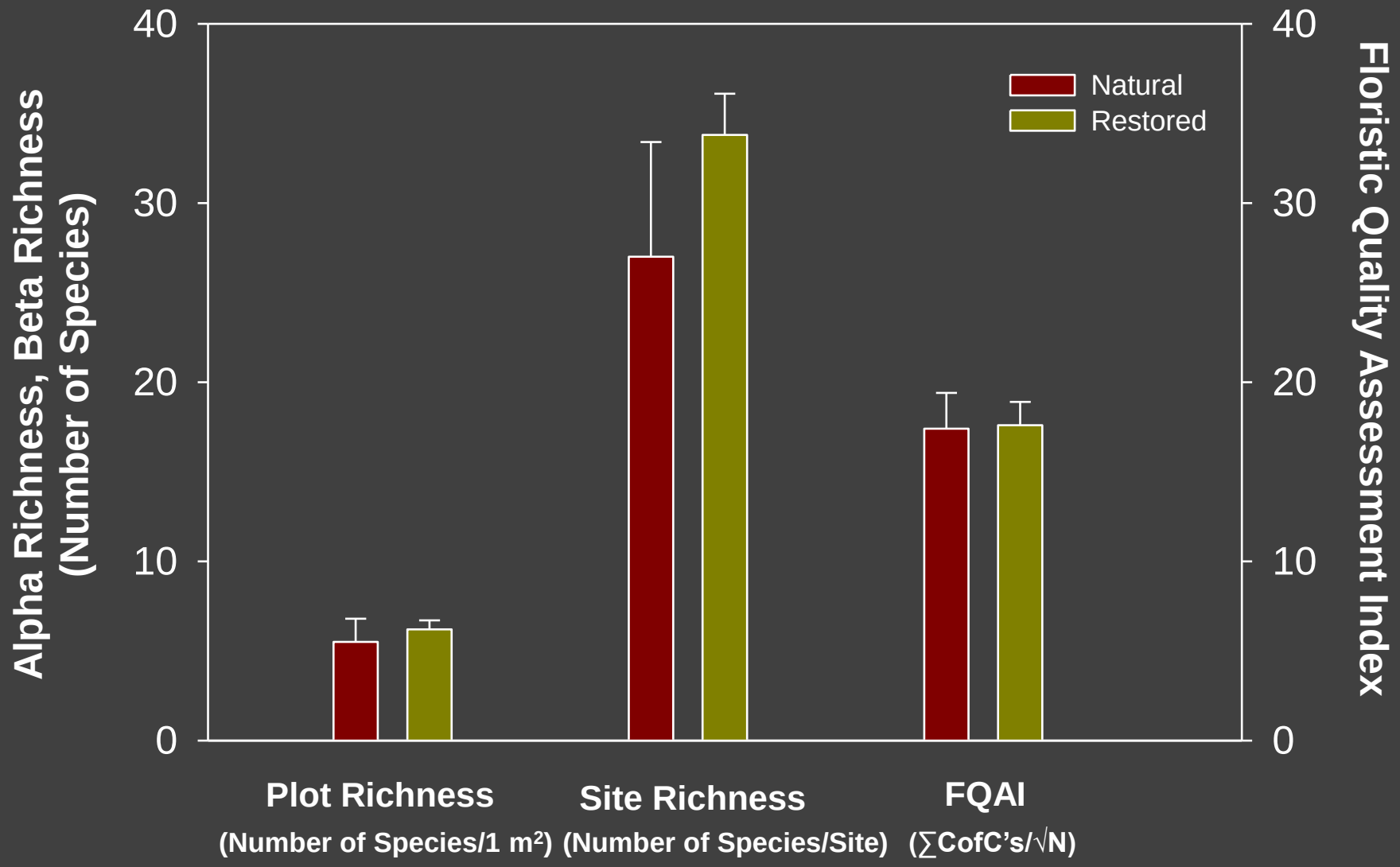
Carbon Sequestration and N, P Accumulation

(Natural Systems)



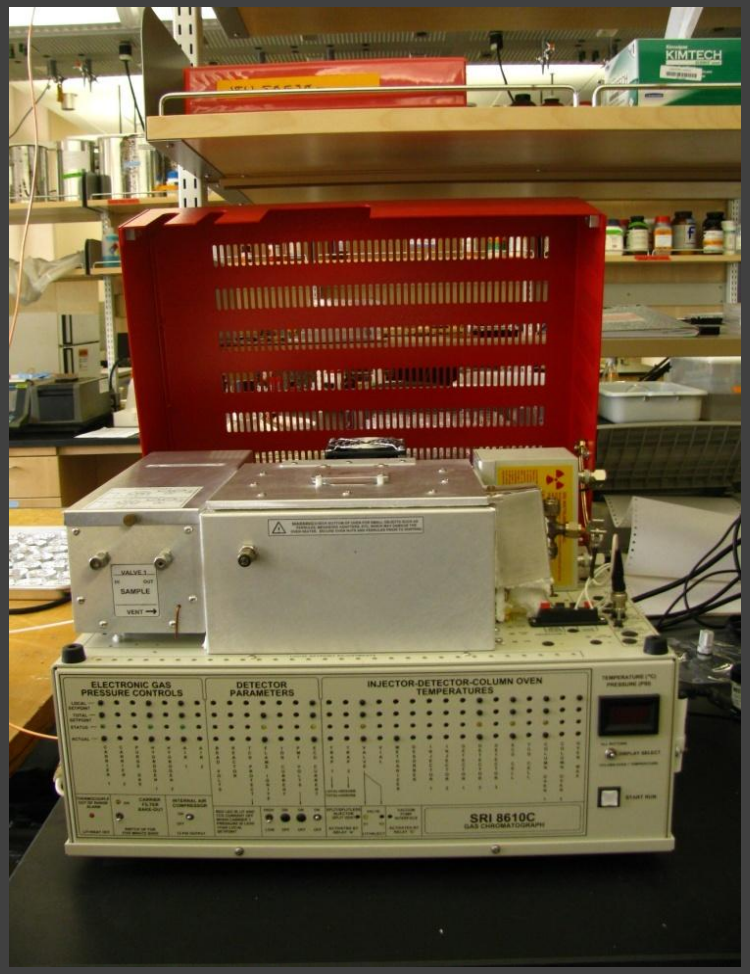
Plant Biodiversity
(Wetlands)

Species Richness and Floristic Quality

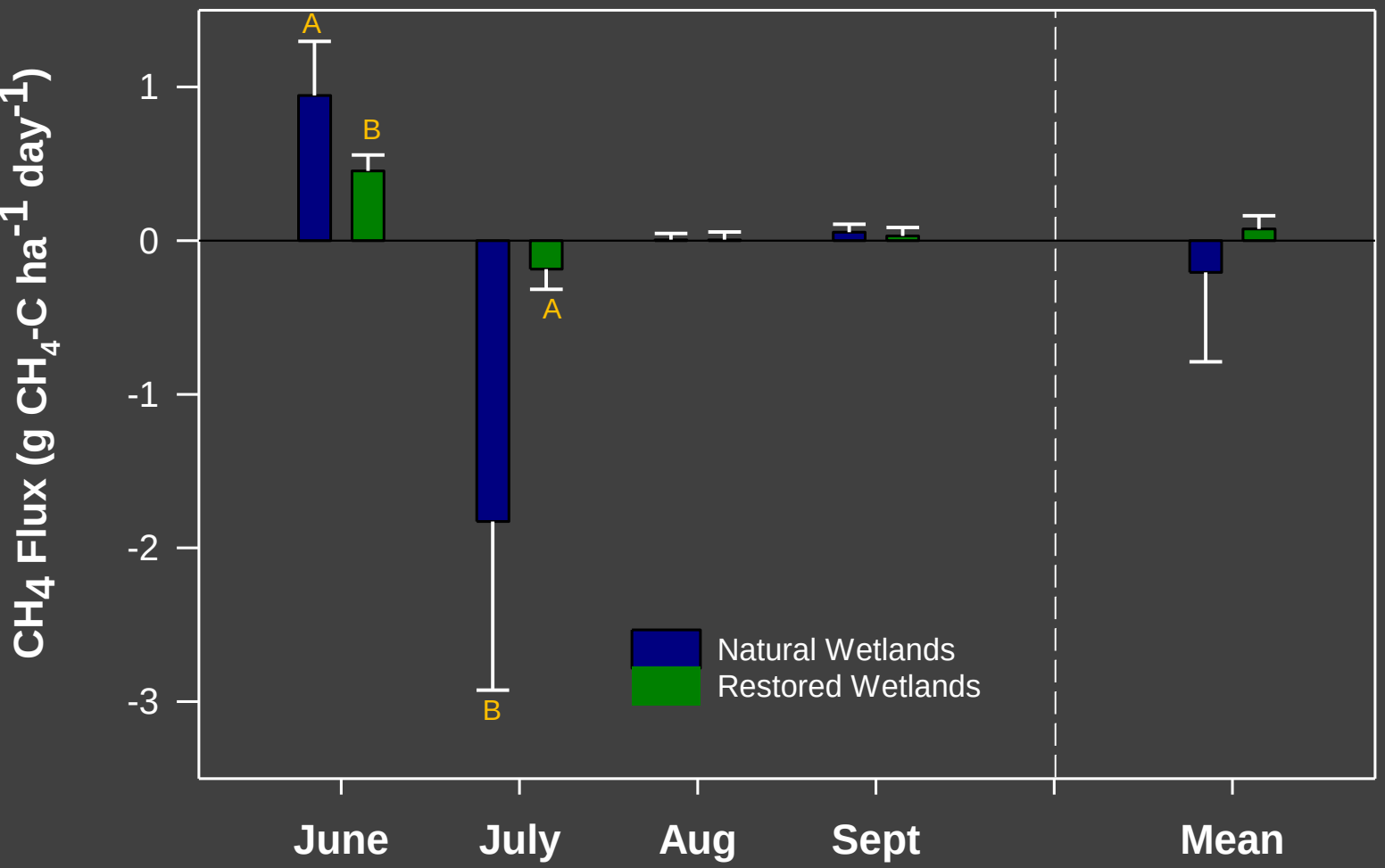


Greenhouse Gas Emissions (Wetlands)

Anaerobic Incubations & Static Flux Chamber Measurements



Chamber- CH_4


CH4 Flux (g CH4-C ha-1 day-1)
1
0
-1
-2
-3
A
B
A
B
Natural Wetlands
Restored Wetlands
June
July
Aug
Sept
Mean

Questions

I. *Do restored wetlands (and riparian buffers) provide ecosystem services (water quality improvement , C sequestration, biodiversity, greenhouse gas emissions) comparable to natural counterparts?*

II. *What are the economic benefits ($$$) of restoring these services? (C sequestration, N, P accumulation)*

Carbon and Nutrient (N, P) Trading Credits

	Carbon[1] ($ t C)	Nitrogen[2] ($ kg N)	Phosphorus[3] ($ kg P)
Credit	0.18 - 33	21 - 97	313

[1] Chicago Climate Exchange (CCX) - European Union (EU)

[2] Ribaudo et al. 2005

[3] NC Dept. of Environment and Natural Resources

$ Value of C Sequestration & N,P Accumulation

(GIP – Corn Belt)

Ha Restored [1]	100,000
Carbon ($/yr)	900 -163,000
Nitrogen ($/yr)	83 - 383 x 10^6
Phosphorus ($/yr)	444 x 10^6

[1] Since 2000.

Sequestration/accumulation calculated using the mean value of wetlands and riparian buffers.

Conclusions

- Restored wetlands contribute less to WQ improvement than natural wetlands. Restored riparian buffers are comparable to natural buffers.

- Plant biodiversity and greenhouse gas emissions are comparable in restored and natural wetlands. Emissions are low.

- Most economic valuation is linked to WQ improvement, not much to C sequestration.

USDA

DNR

The Nature Conservancy

Protecting nature. Preserving life.™

HAMILTON COUNTY PARKS & RECREATION DEPT.