An Assessment of Mitigation Wetland Performance

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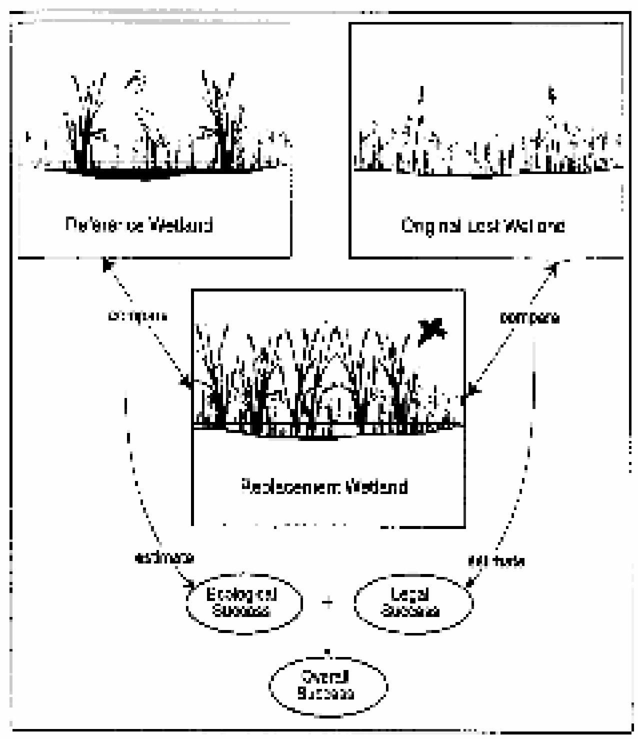
Wetland Mitigation



Mitsch and Gosselink, 2000

Key Conclusion of Report by the National Research Council (2001)

- The goal of no net loss of wetlands is not being met for wetland functions by the mitigation program, despite progress in the last 20 years

- This conclusion confirmed by more recent studies of mitigation wetlands and banks
    - In response to studies from 1995 to 2004 in Ohio, ecologically based assessments and performance criteria developed

Ecological Assessment Study Design:

- 10 natural and 10 restored (mitigation) wetlands
- biological assessments made based on vegetation, amphibian and macroinvertebrate community composition
- Ground water and surface water levels monitored
- ecosystem processes measured including biomass production, decomposition rates, and nutrient cycling rates.

Created wetland during drydown

Natural wetland during drydown

Fennessy et al. 2004

Natural

Mitigation - *restoration*

Mitigation - *creation*

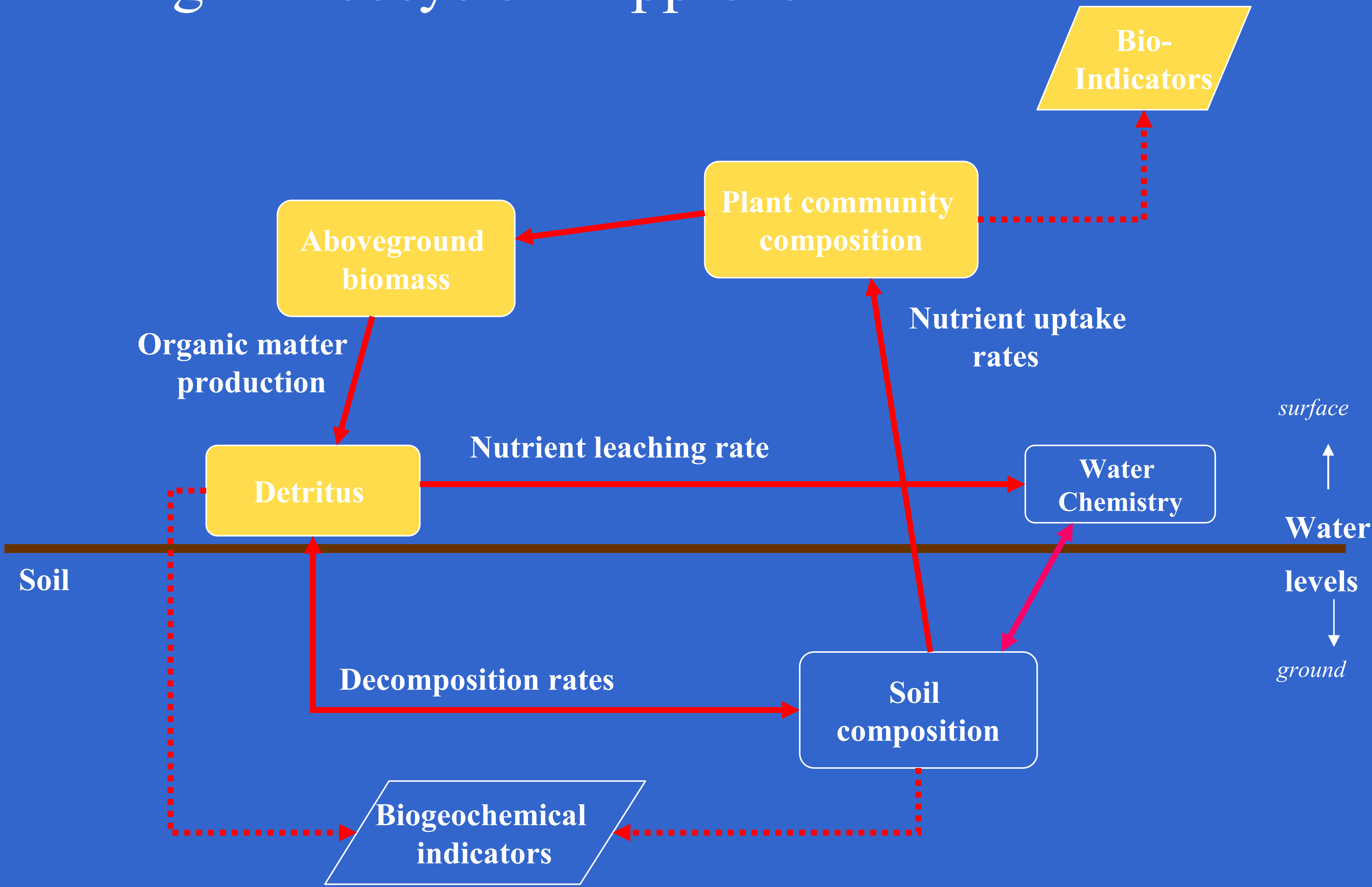
Site Selection

•Natural wetlands chosen over full gradient of ecological condition

•Mitigation wetlands chosen over a range of ages (0-10 years)

Fennessy et al. 2004

Taking an Ecosystem Approach



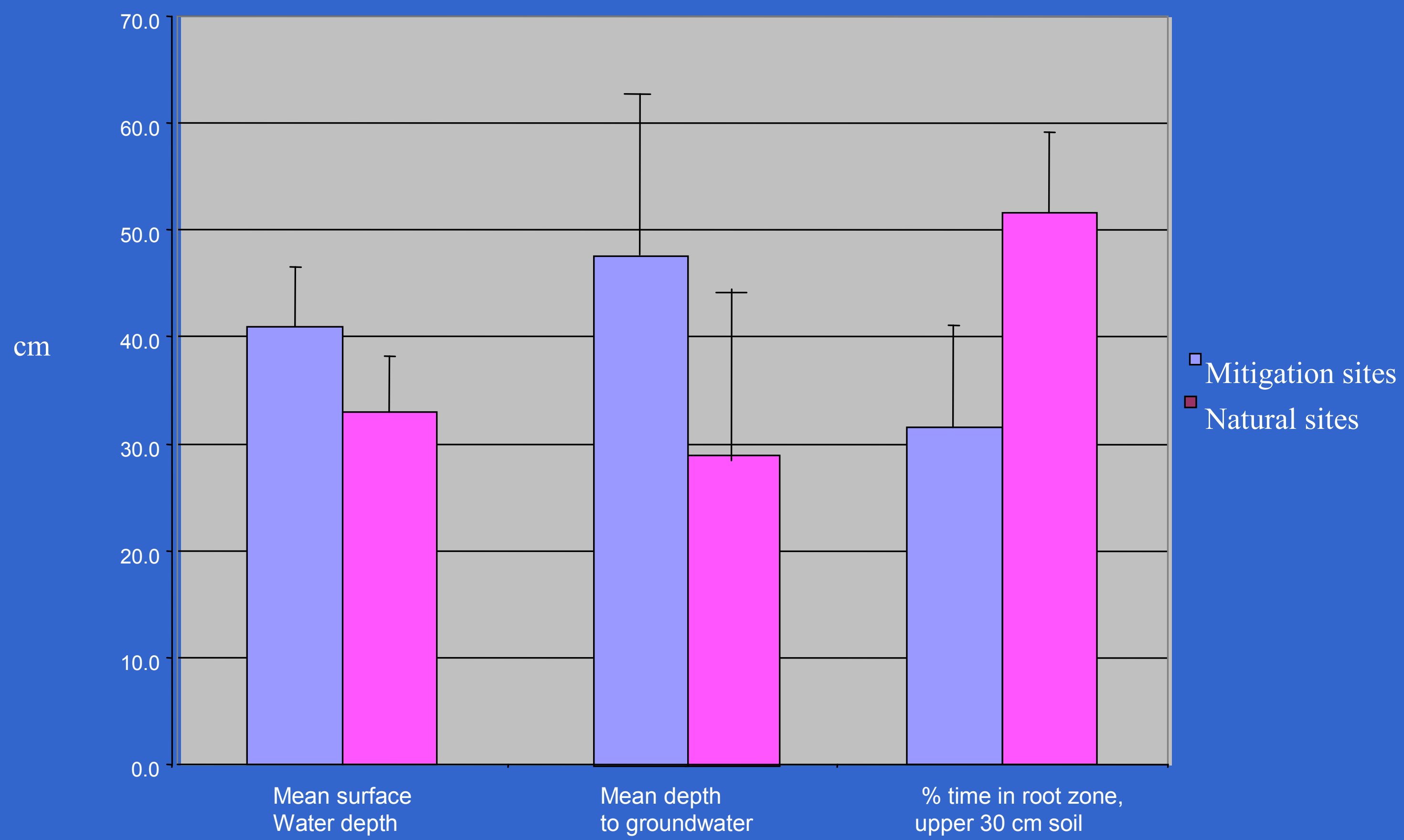
Fennessy et al. 2004

Hydrology: trends in mitigation wetlands

- Created wetlands tend to be deeper with longer hydroperiod (e.g., Magee et al. 1999, Cole and Brooks 2000)

- Hydrological failures lead to mitigation project failure (e.g., Erwin 1991, Galatowitch and van der Valk 1996)

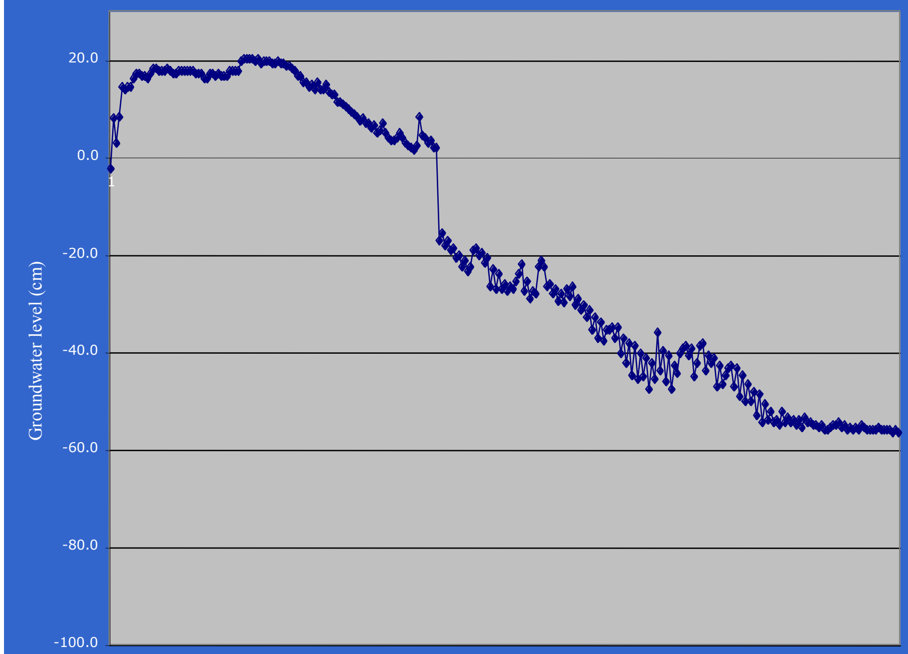
Hydrological characteristics of natural and mitigation wetlands



Fennessy et al. 2004

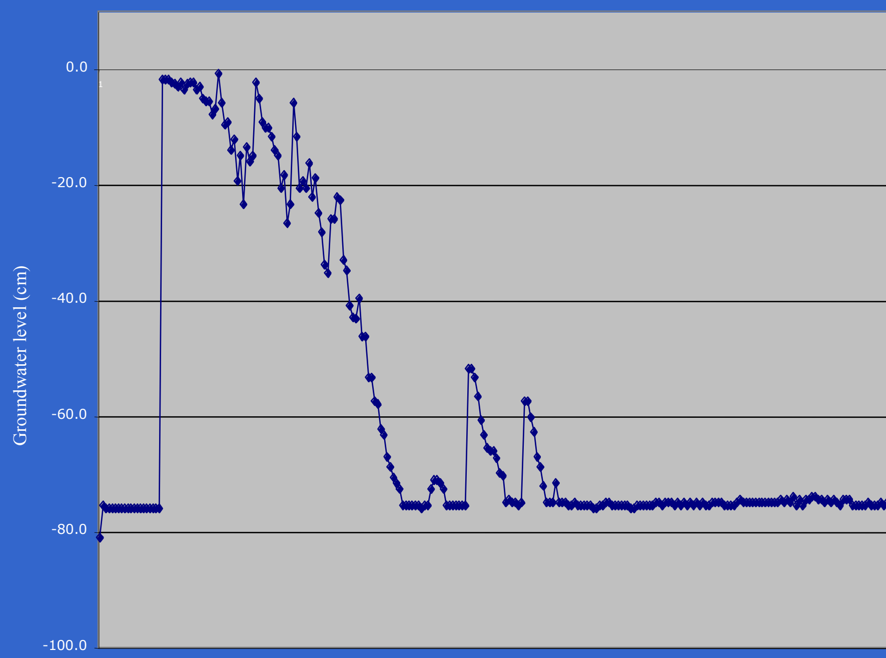
Hydrological characteristics of natural and created wetlands

Calamus (natural wetland)



Days (May 14 to September 30, 2001)

Big Island (mitigation wetland)



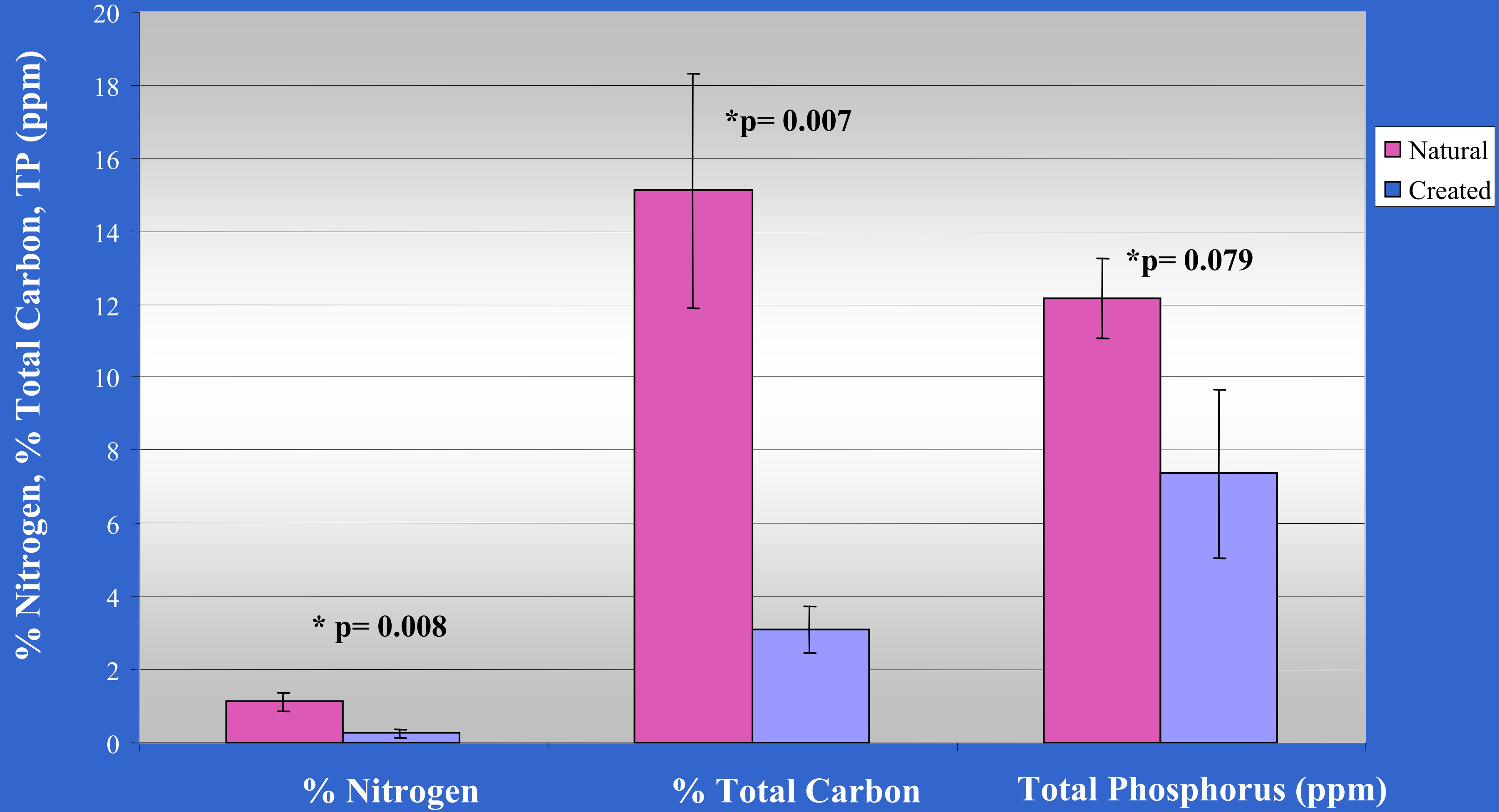
Days (May 27 to September 30, 2001)

Fennessy et al. 2004

Soils: trends in mitigation wetlands

- Soil organic matter (SOM) and nitrogen higher in natural wetlands (Bishel-Machung et al. 1996, Craft 2000)
- Accumulation in SOM and N over time varies:
  1) No significant change (Bishel-Machung et al. 1996, Shaffer and Ernst 1999, Cole et al. 2001, Fennessy et al. 2004)
  2) Detectable increases over time (Craft et al. 1999)
- Bulk density higher in mitigation wetlands (Fennessy et al. 2004)
- Microbial activity lower in created wetlands (Hossler and Bouchard 2006)

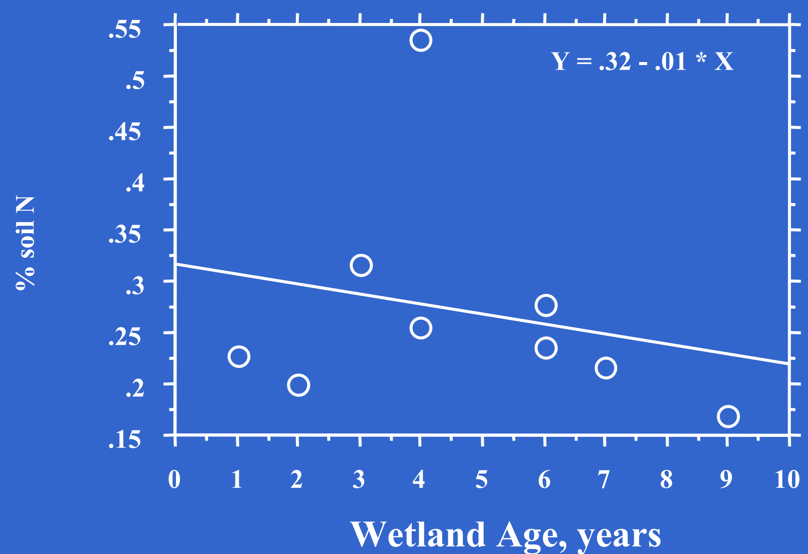
Soil nutrient levels in natural and created wetlands



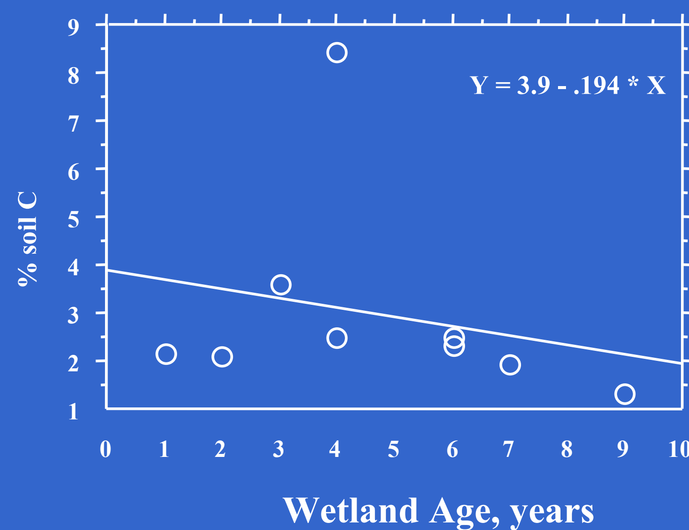
Fennessy et al. 2004

Recovery trajectories in soil composition in mitigation wetlands

% Soil Nitrogen



% Soil Carbon

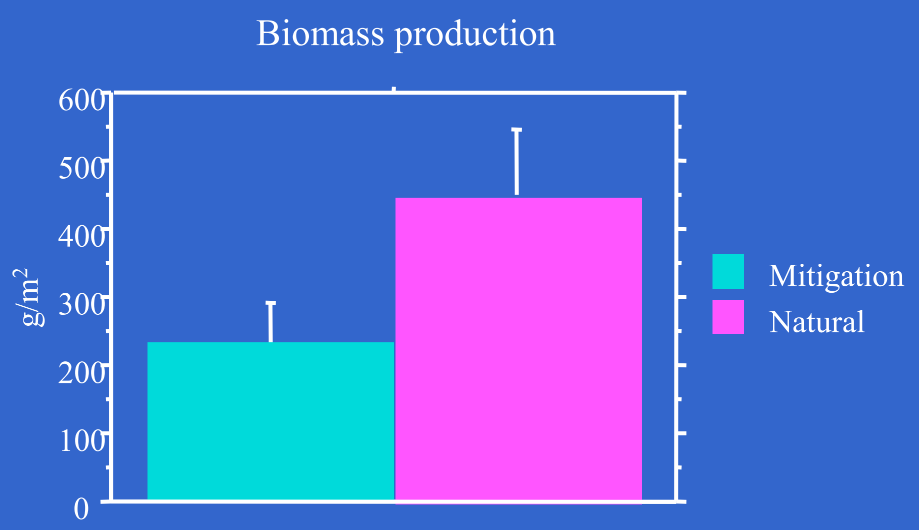


Fennessy et al. 2004

Vegetation: trends in mitigation wetlands

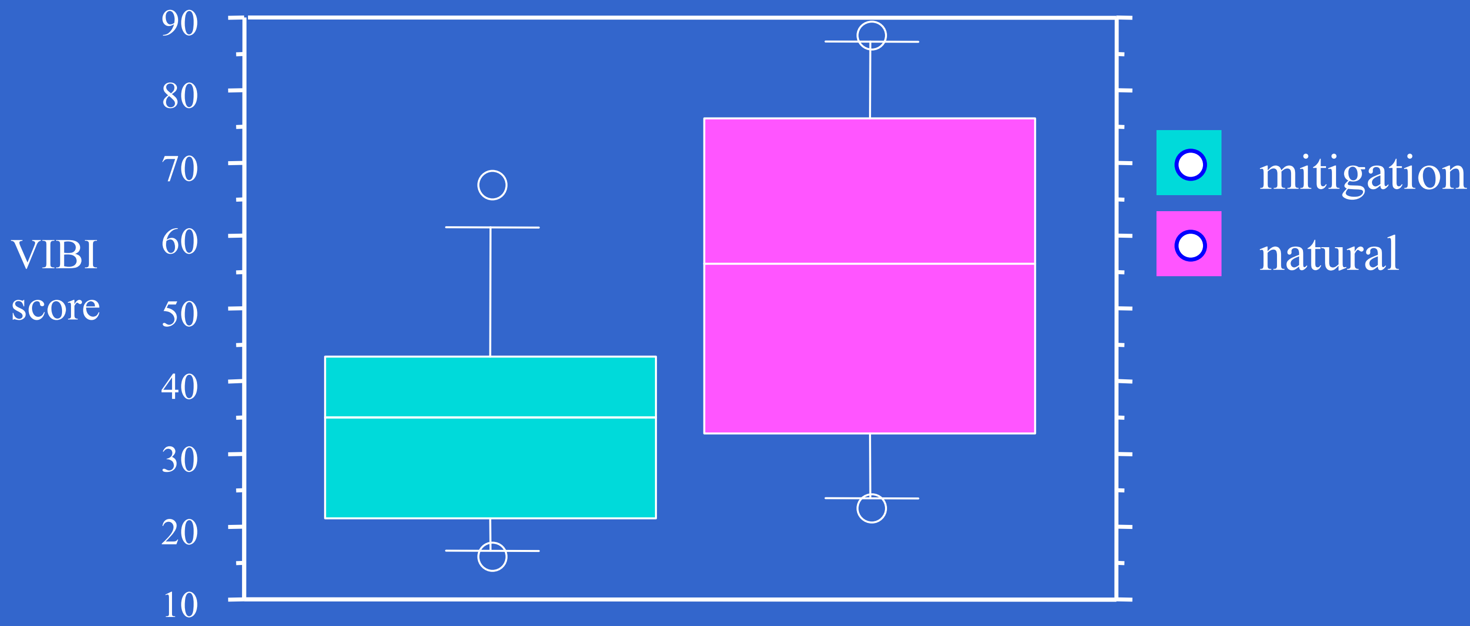
- Macrophyte communities can develop quickly
- Species richness typically lower in mitigation sites with more non-native species (Erwin 1991, Magee et al. 1999, Fennessy et al. 2004, Spiels 2005)
- Biomass production in mitigation sites varies relative to natural sites
  - Equivalence in some studies within 5 years (Craft et al. 1999)
  - Higher production in created wetlands (Cole 1992)
  - Lower production in created wetlands (Fennessy et al. 2004)

Aboveground biomass and nutrient accumulation differs by wetland type



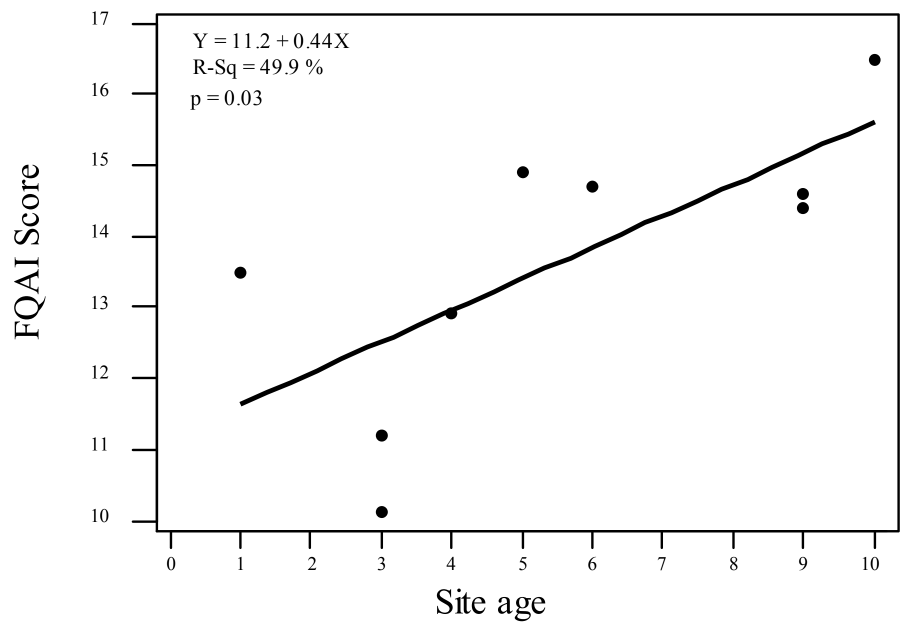
Fennessy et al. 2004

Using biological indicators to assess mitigation success: the Vegetation IBI

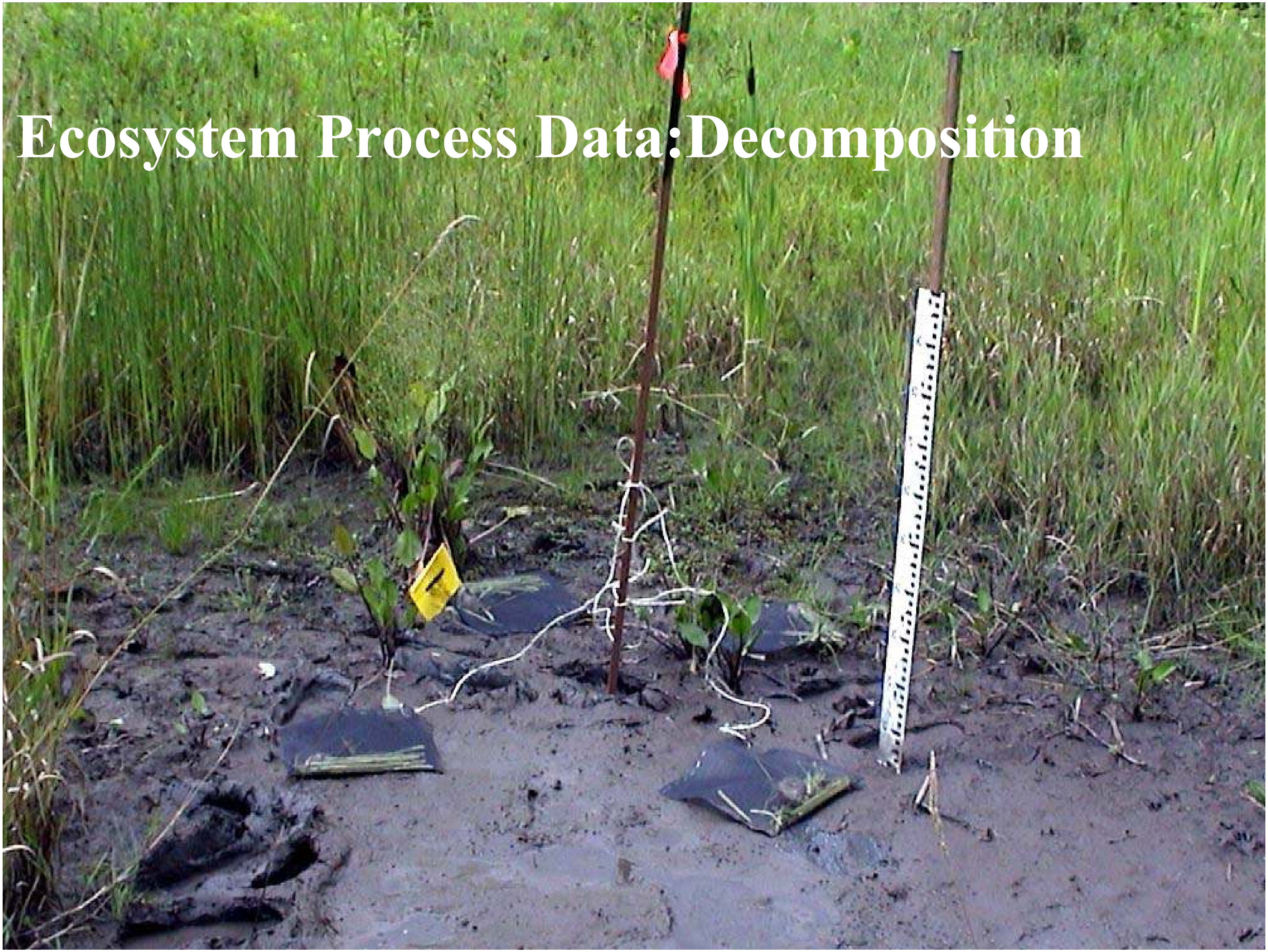


Fennessy et al. 2004

Recovery trajectories for FQAI score



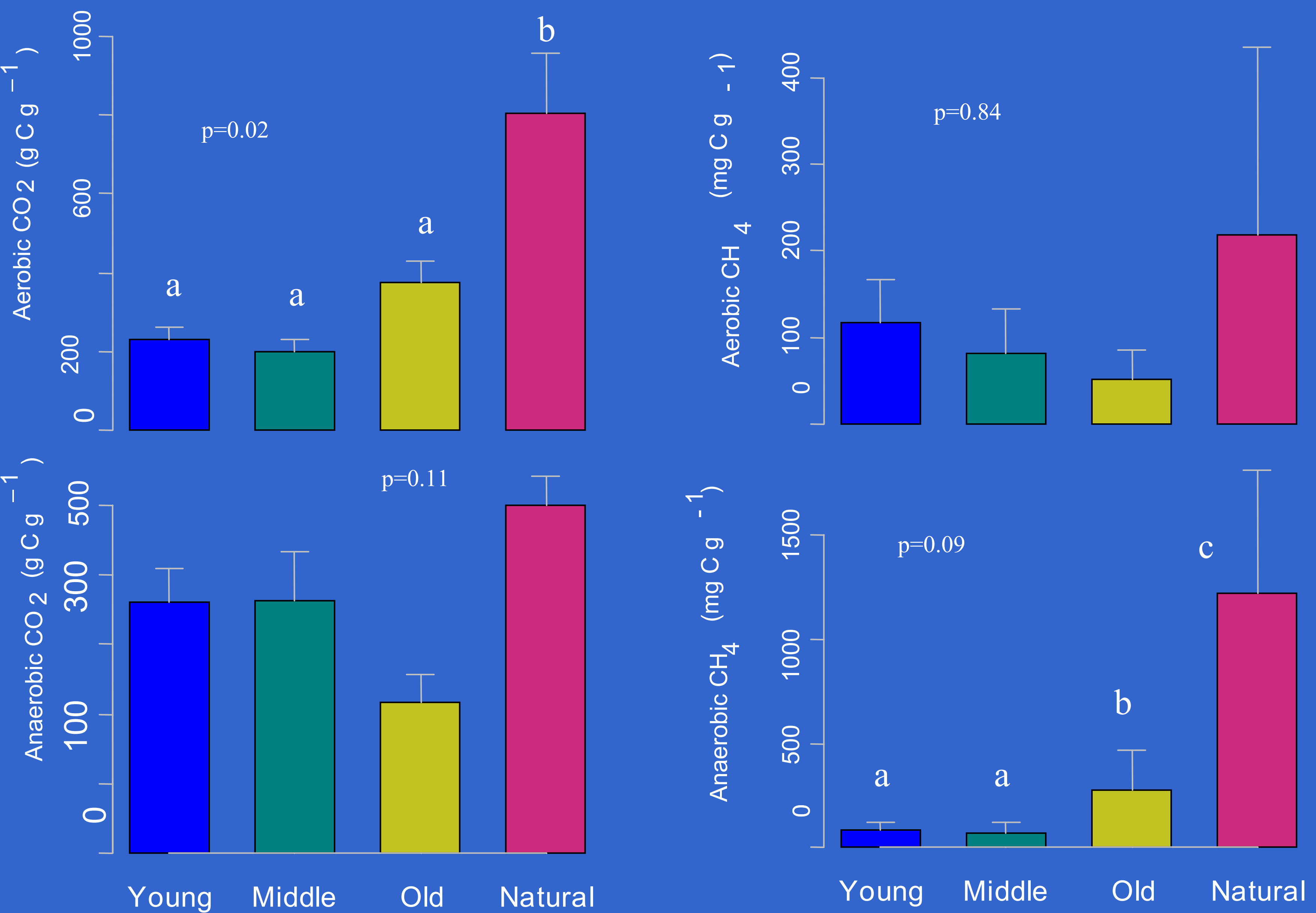
Fennessy et al. 2004


Ecosystem Process Data:Decomposition

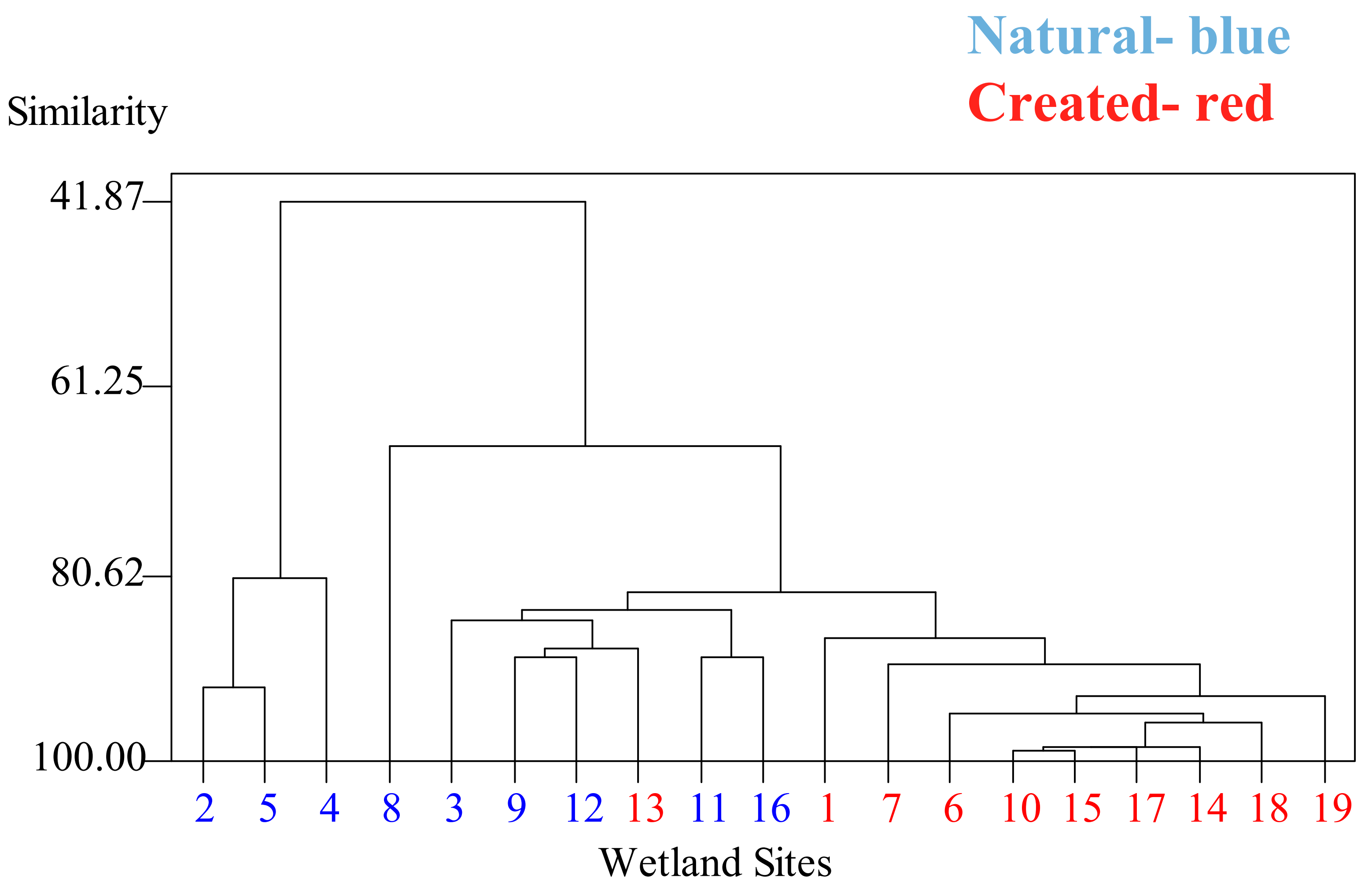
Patterns of Ecosystem development

Microbial activity (labile carbon)

(Data from Hossler and Bouchard 2006)



A cluster analysis of natural and created wetlands



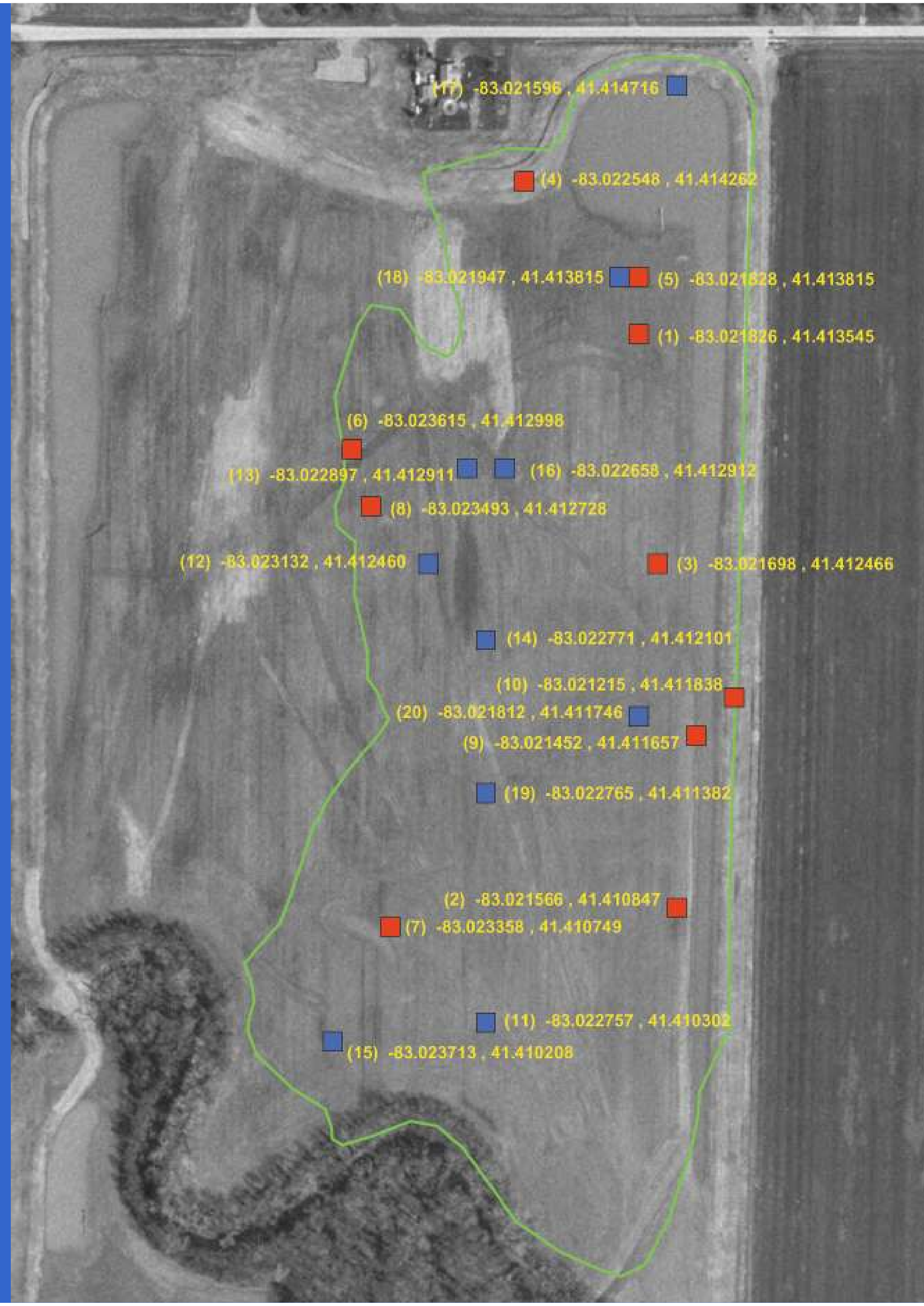
Fennessy et al. 2004

Ecological performance of mitigation banks

- No net loss not being met in many studies
  - Survey of 68 banks found that 26% did not meet acreage requirements resulting in loss of 8,400 ha nationally (Brown 1999)
  - Recent Ohio study found 24% (400 ha) did not meet jurisdictional requirements (Mack and Micacchion 2006)
  - Vegetation establishment judged successful in half of banks surveyed (Spiels 2005)
- Landscape effects
  - Loss of urban wetlands (Ruhl and Salzman 2006)

Ecological Assessment of Wetland Banks in Ohio: Random plot sampling

Ohio EPA, 2006

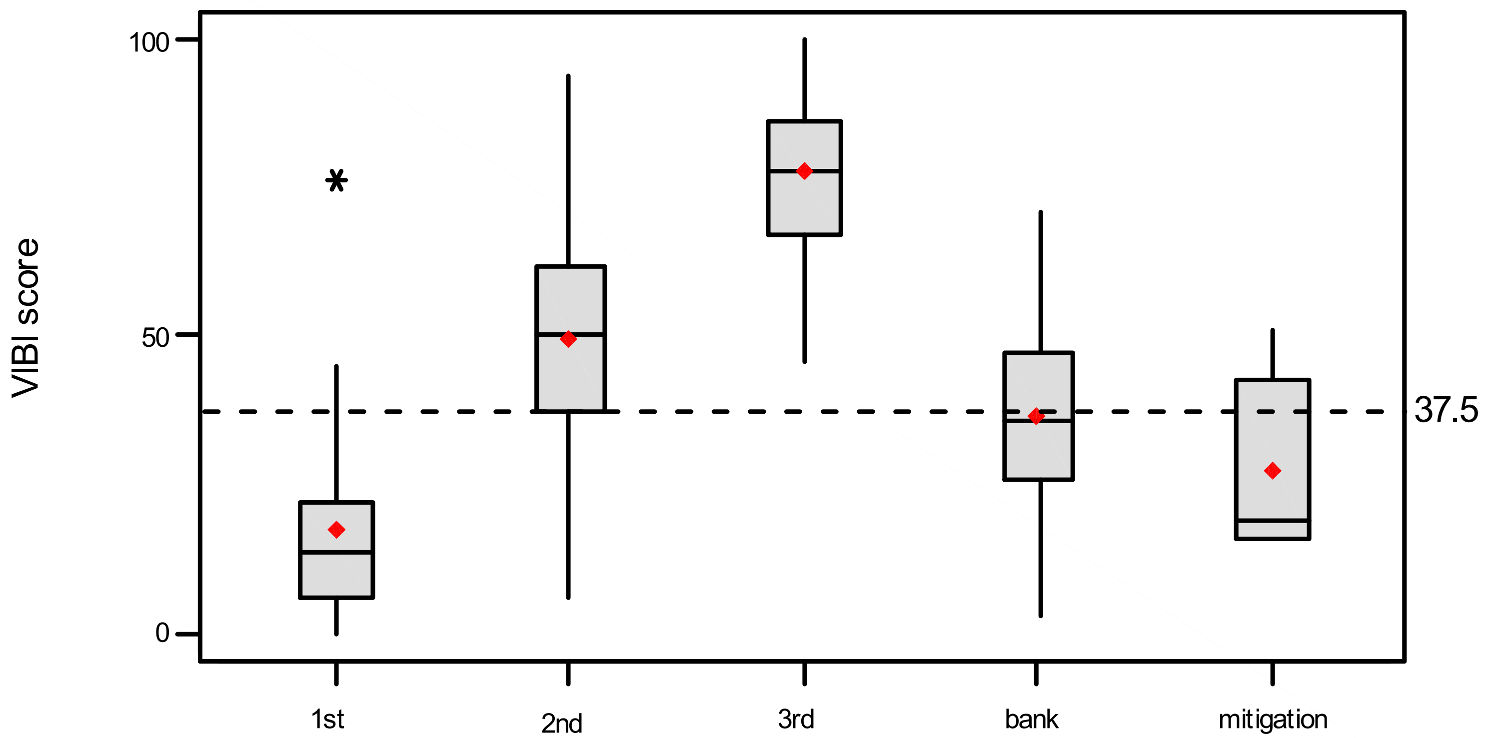


Area of open water at Ohio Banks

site	area(ha)	area(ac)	water (ha)	water (ac)	%total area
Big Island	76.3	188.4	24.4	60.3	32%
Cherry Valley	25.9	63.9	1.7	4.2	7%
Chippewa Centra	38.3	94.5	5.1	12.6	13%
Grand River	21.9	54.2	5.8	14.4	27%
Hebron	11.9	29.3	2.0	4.8	17%
Little Scioto	28.5	70.5	14.6	36.1	51%
Panzner	36.3	89.5	4.8	11.9	13%
Sandy Ridge	44.3	109.4	25.9	64.1	59%
Slate Run	14.9	36.7	5.3	13.1	36%
Three Eagles	26.8	66.1	4.0	9.9	15%
Trumbull Creek	29.2	72.1	18.0	44.4	62%
White Star	38.5	95.0	0.0	0.1	0%
		969.6	net loss (ac)	-275.9	
			percent bank acreage that is not "wetland"	28%	
			net loss from "sold out" banks (ac)	173.6	

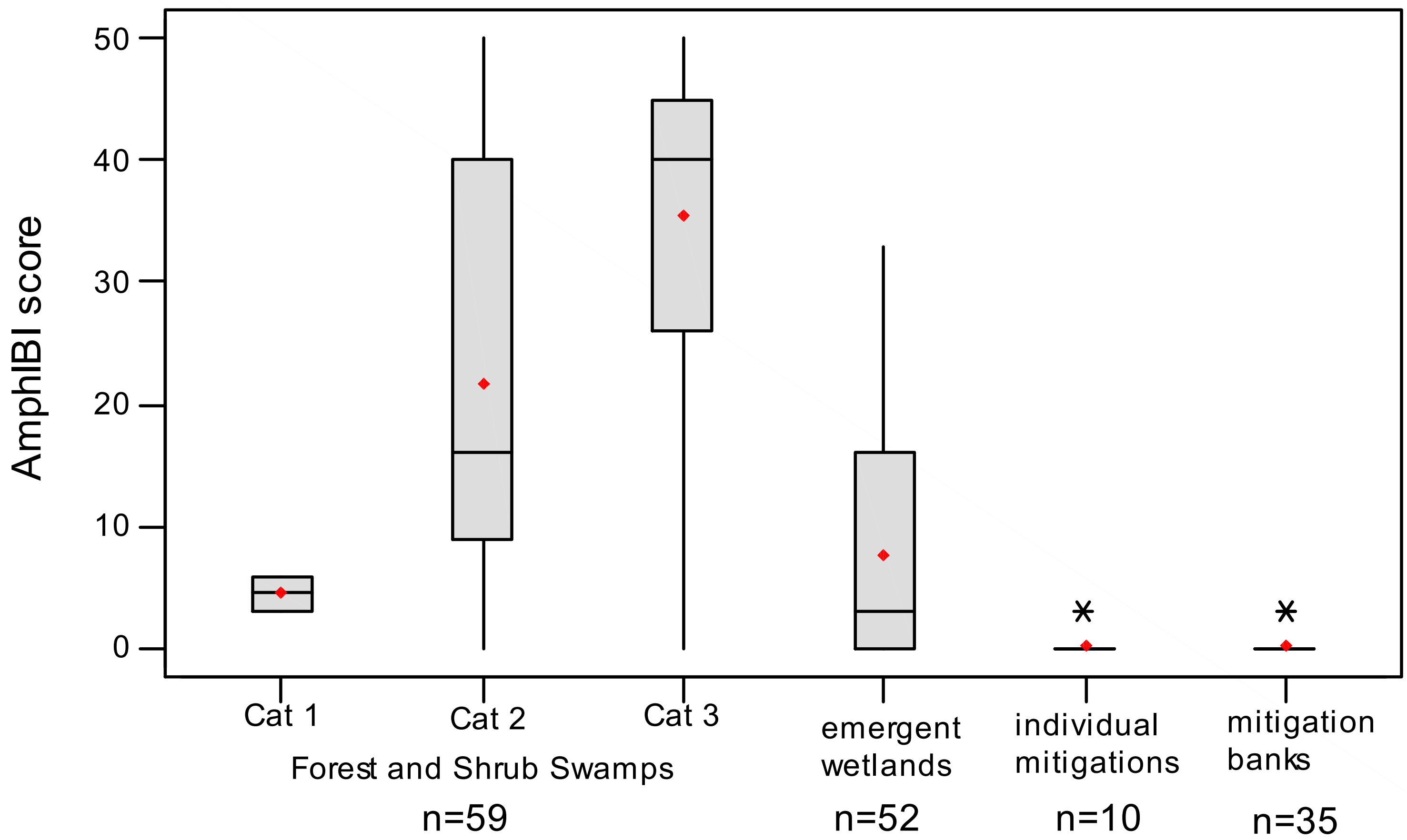
Ohio EPA, 2006

Ecological Quality of Ohio Banks



Ohio EPA, 2006

Ecological Quality of Ohio Banks



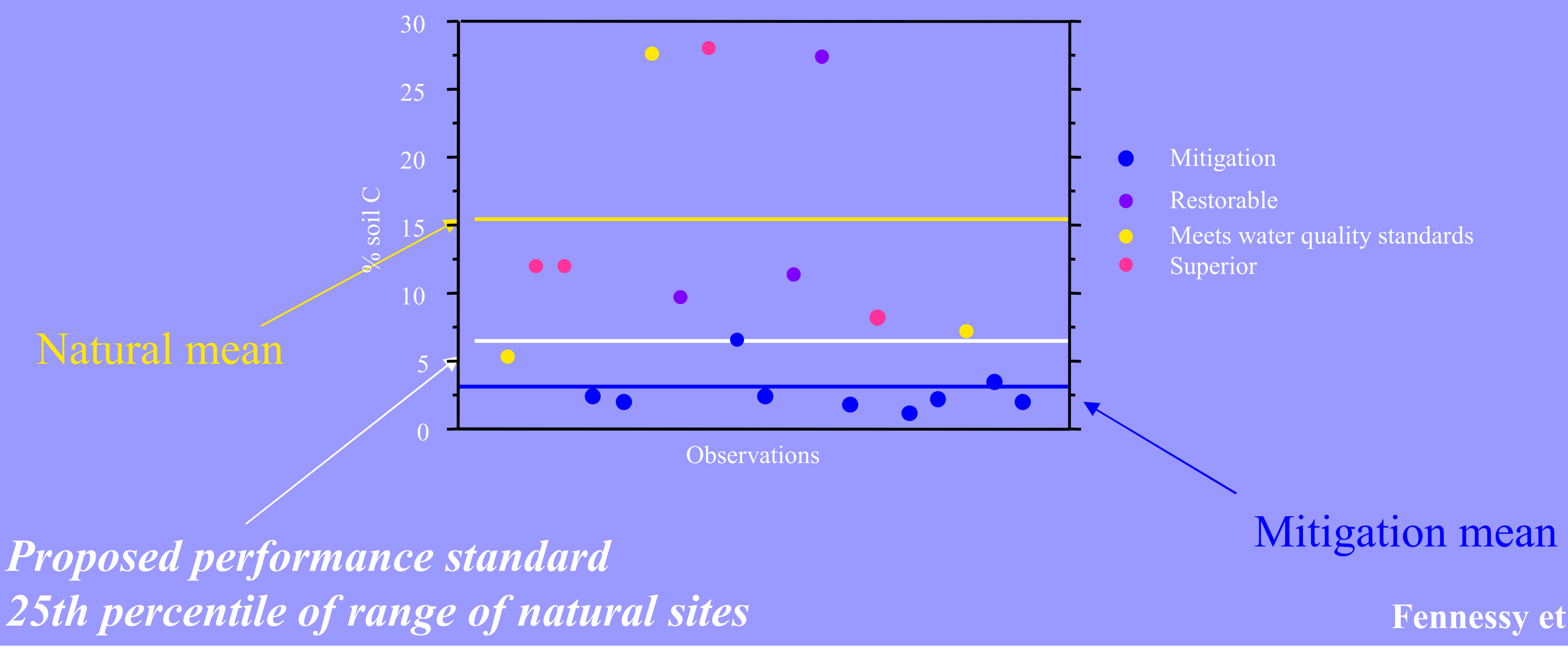
Ohio EPA, 2006

“The establishment of ecological success criteria is not only possible but essential to determine if the objectives of compensatory mitigation are being met”

GAO Report to Congress

Translating monitoring data to performance standards: soil carbon

Natural wetlands: 15.1 ± 9.7 %
Mitigation wetlands: 2.9 ± 2.1%



Fennessy et al. 2004

Limits to Success

- What we know about good project design and management has not translated well to work on the ground:
  - Soils
  - Landscape setting
  - Ecologically relevant performance standards

Ohio Wetland Program Publications:

http://www.epa.state.oh.us/dsw/wetlands/WetlandEcologySection_reports.html

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