THE UTILITY OF INDICES OF BIOLOGICAL INTEGRITY FOR DEPRESSIONAL WETLANDS IN CENTRAL OKLAHOMA

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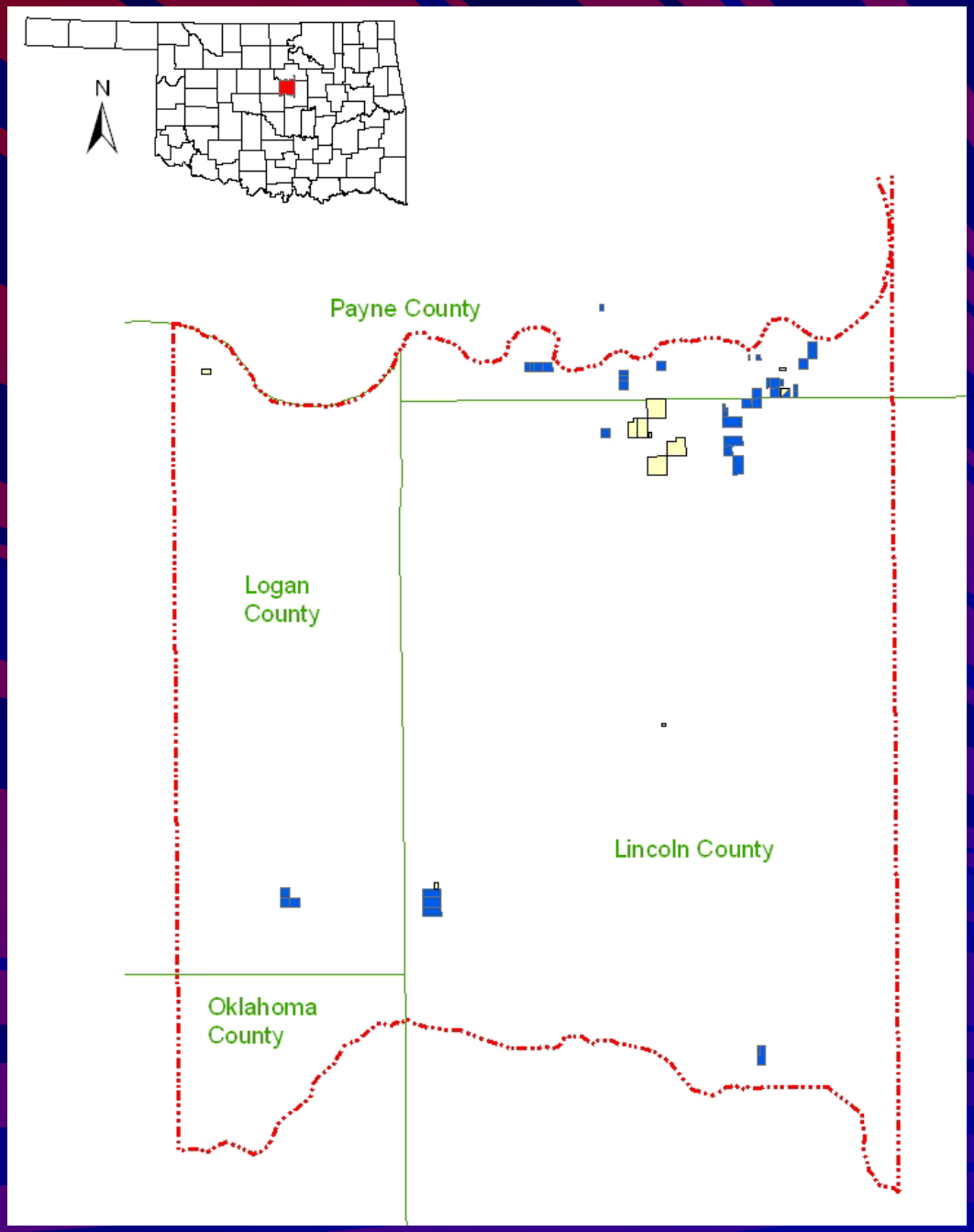
N
Payne County
Logan
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Lincoln County
Oklahoma
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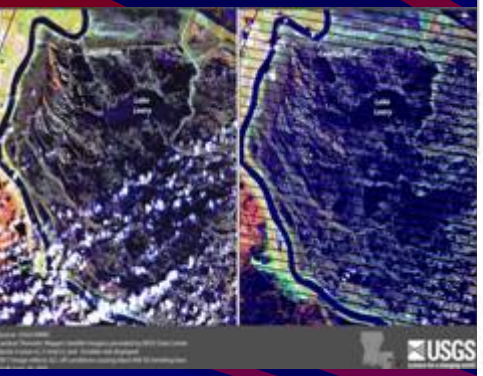
Iowa Tribe of Oklahoma
Office of Environmental Services

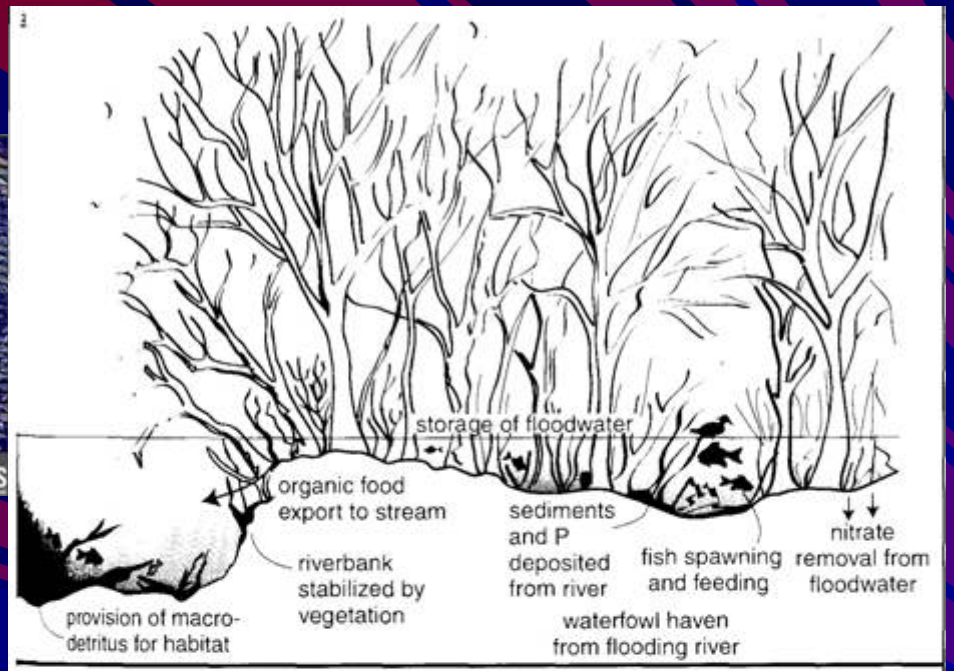
Water Monitoring Program

Funding

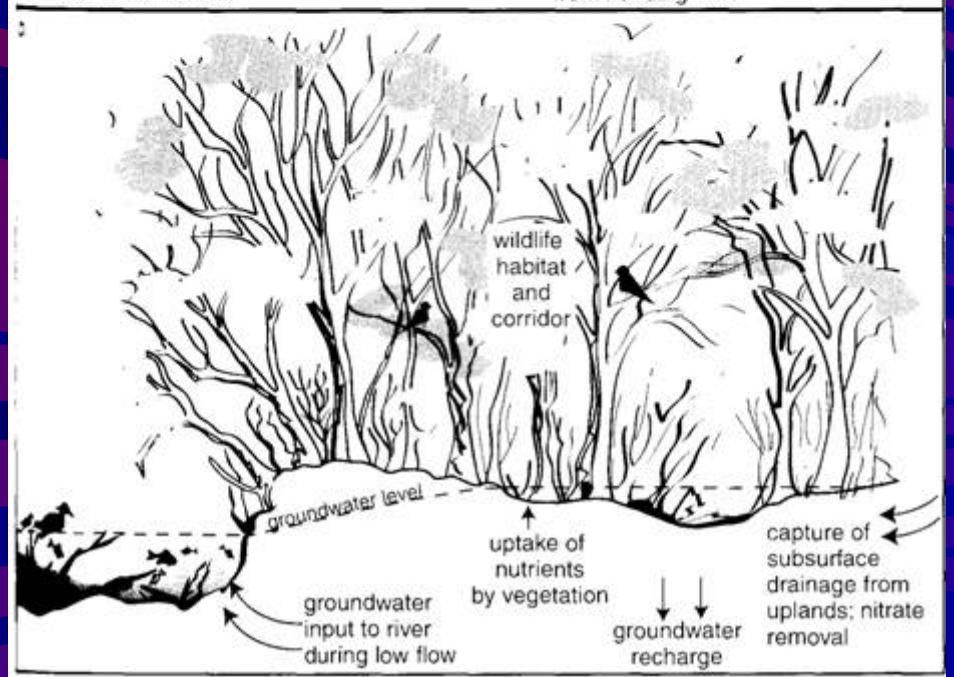
US. Environmental Protection Agency

Oklahoma Office of the Secretary of the Environment



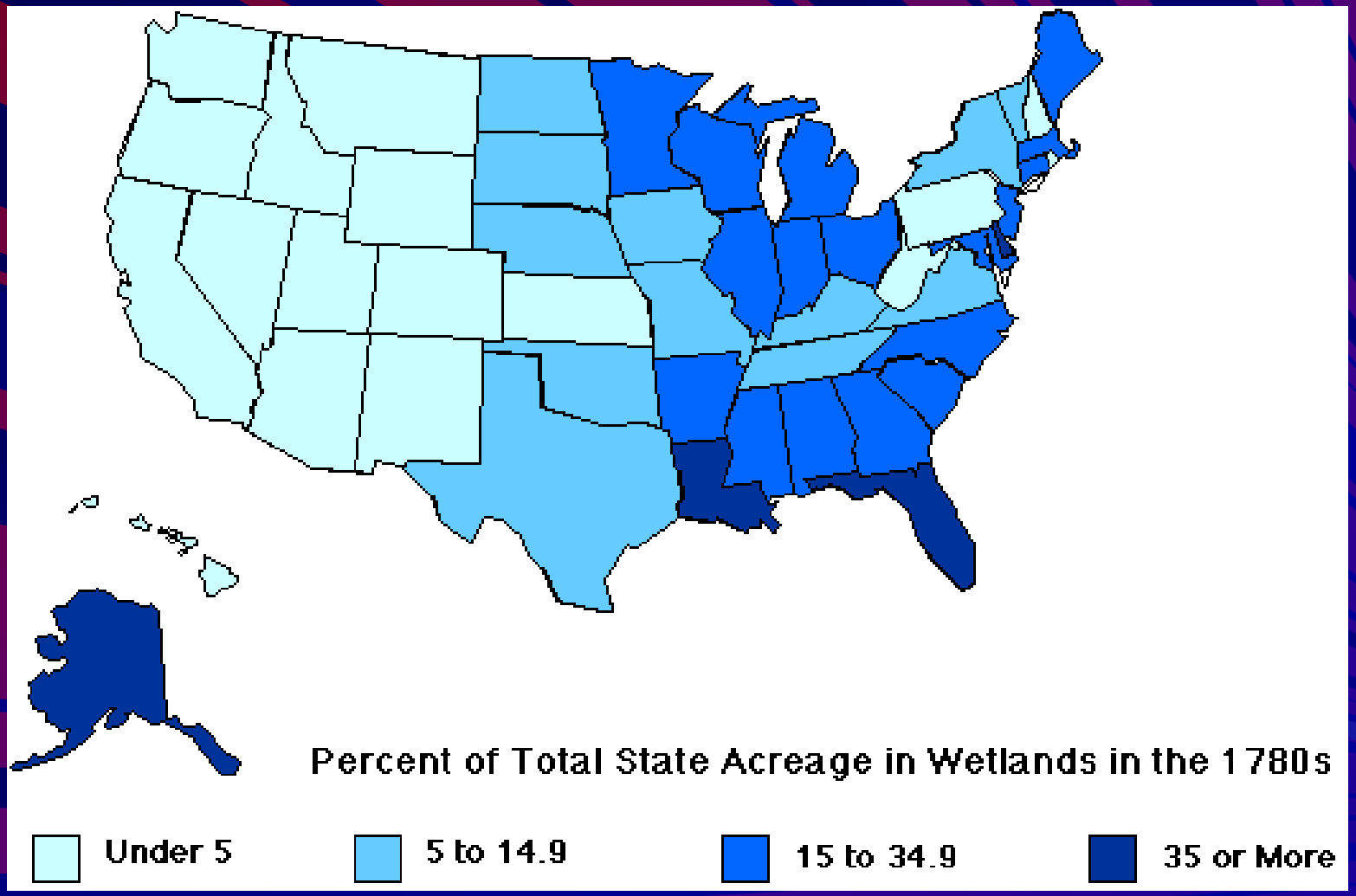


Mid-America Hunting Association



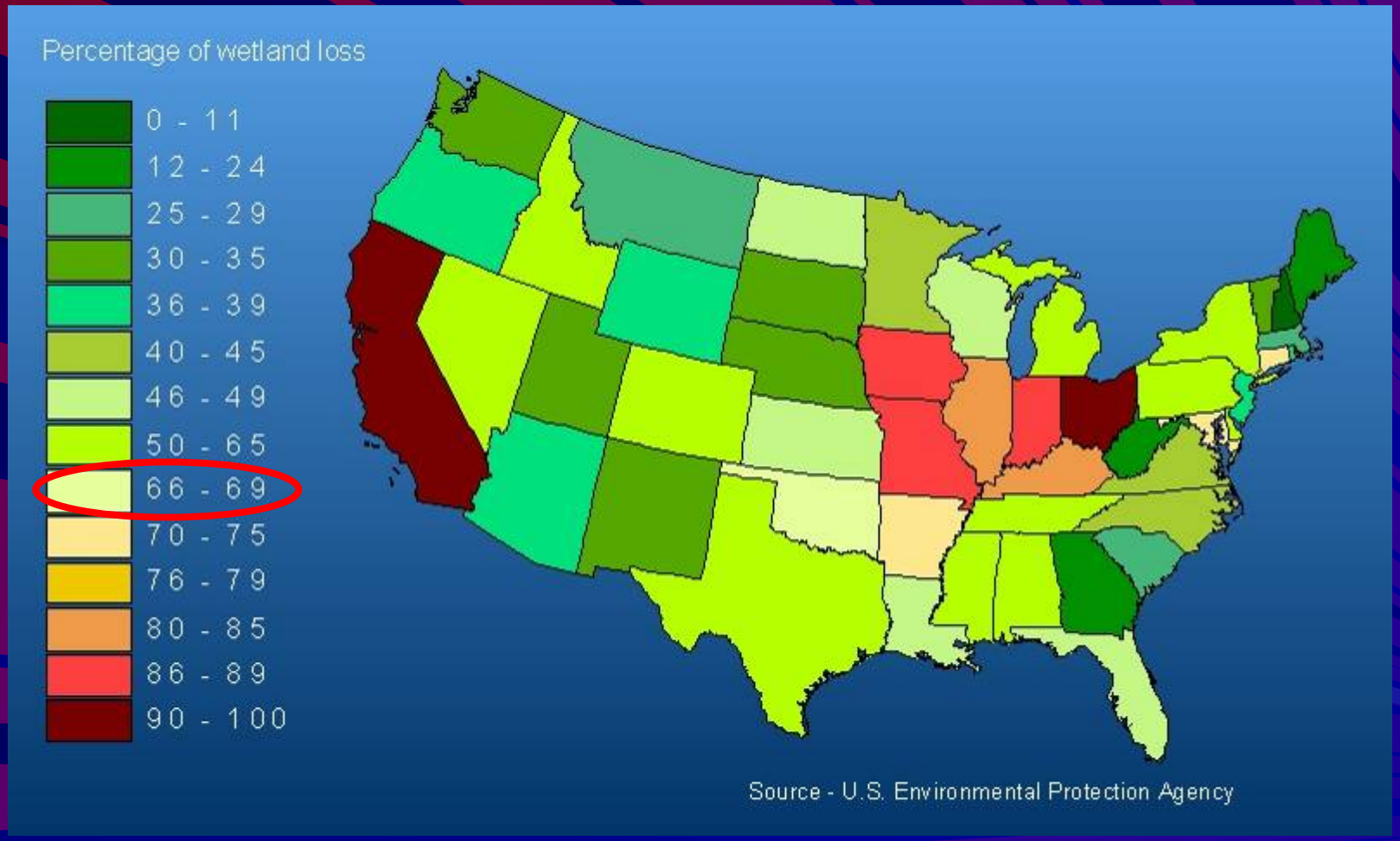
Stephen Koury

Where were wetlands?



http://www.twingroves.district96.k12.il.us/Wetlands/General/VanishingWetlands.html

Wetland Loss



Wetland Monitoring

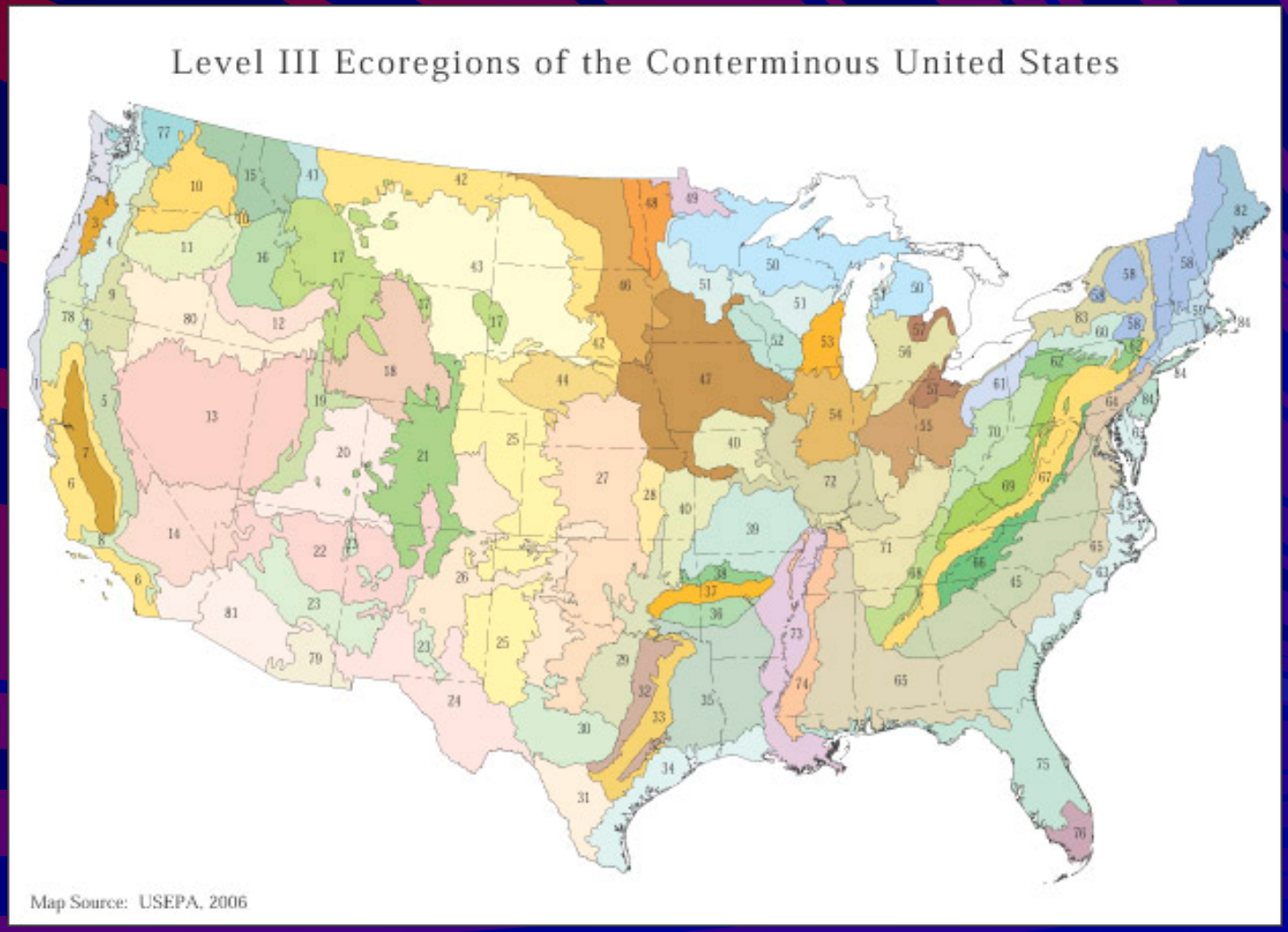
- Level 1
  - Broad and landscaped based
  - Completed in the office
- Level 2
  - Rapid field assessment (< 1/2 day)
- Level 3
  - Intensive and biological
  - One day in the field and lab time

from Fennessey et al. (2004)

Index of Biological Integrity (IBI)

- First developed for fish in streams
  - Karr, 1981
- Past 20 years, developed for wetlands
  - Ohio
  - Minnesota
- Most use macroinvertebrate and plant assemblages (Adamus, 1996)

Steps in Developing an IBI

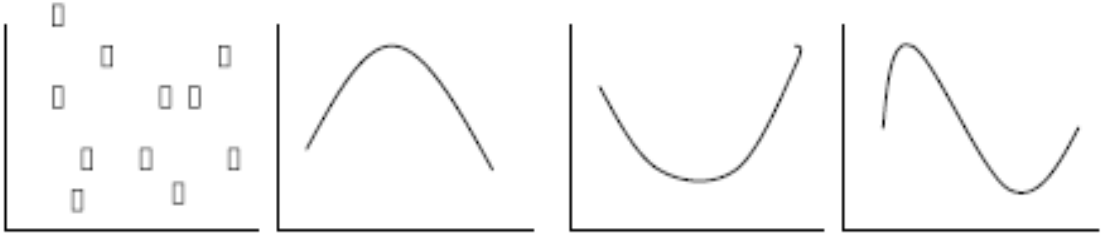


Steps in Developing an IBI

Metric/Disturbance Relationship

The simplified graphs below show relationships that have limited acceptability. Exceptions are noted with the two middle two panels, which indicate peak attribute responses with intermediate levels of disturbance. Attributes with such responses may make appropriate metrics with proper adjustments in metric scoring.

X-Axis = Increasing Human Disturbance
Y-Axis = Attribute Value



X-Axis = Increasing Human Disturbance
Y-Axis = Attribute Value

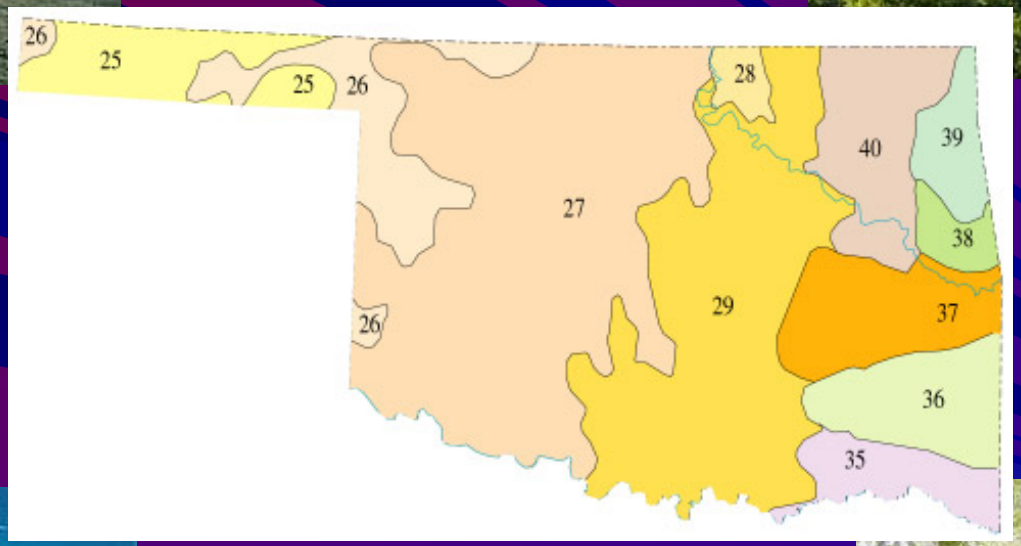
Source: Developing Metrics and Indexes of Biological Integrity

Steps in Developing an IBI

Metric Description	Range	Score
Number of intolerant taxa: Leucorrhinia, Libellula, Tanytarsus, Procladius, Triaenodes, Oecetis	5-7	5
	3-4	3
	0-2	1
ETSD metric: # genera mayflies, caddisflies; presence of fingernail clams (Sphaeriidae) and dragonfly larvae	7-10	5
	4-6	3
	0-3	1
Tolerant taxa proportion of count of individuals to total sample count: Trichochorixa, Enallagma, Erpobdella, Physa, Cricotopus, Dicrotendipes, Endochironomus, Glypotendipes, and Paratanytarsus	<42%	5
	>42-69%	3
	>69%	1
Dominant three taxa: proportion of count of individuals in the dominant three taxa to the total sample count	<54%	5
	>54-74%	3
	>74 %	1
Corixidae proportion of beetles and bugs in activity trap samples: count of individual Corixidae to total beetle and bug count	<33%	5
	33-67%	3
	>67%	1
Chironomid genera	14 ->21	5
	7-13	3
	0-6	1
Total number of dragonfly and damselfly genera (Odonata metric)	6-10	5
	4-5	3
	0-3	1
Leech taxa	5-9	5
	3-4	3
	0-2	1
Snail taxa	7-9	5
	4-6	3
	0-3	1
Total number of invertebrate taxa: larval chironomids, caddisflies, mayflies, dragonflies, damselflies, beetles, bugs, leeches, snails, macrocrustaceans, diptera and fingernail clams	>52-77	5
	37-52	3
	<21-36	1
Total possible scoring range for invertebrate IBI		10-50
Range for excellent condition		35-50
Range for moderate condition		23-34
Range for poor condition		10-22

Source: Wetland Biological Assessment Case Studies

Will IBI's Work in Oklahoma?



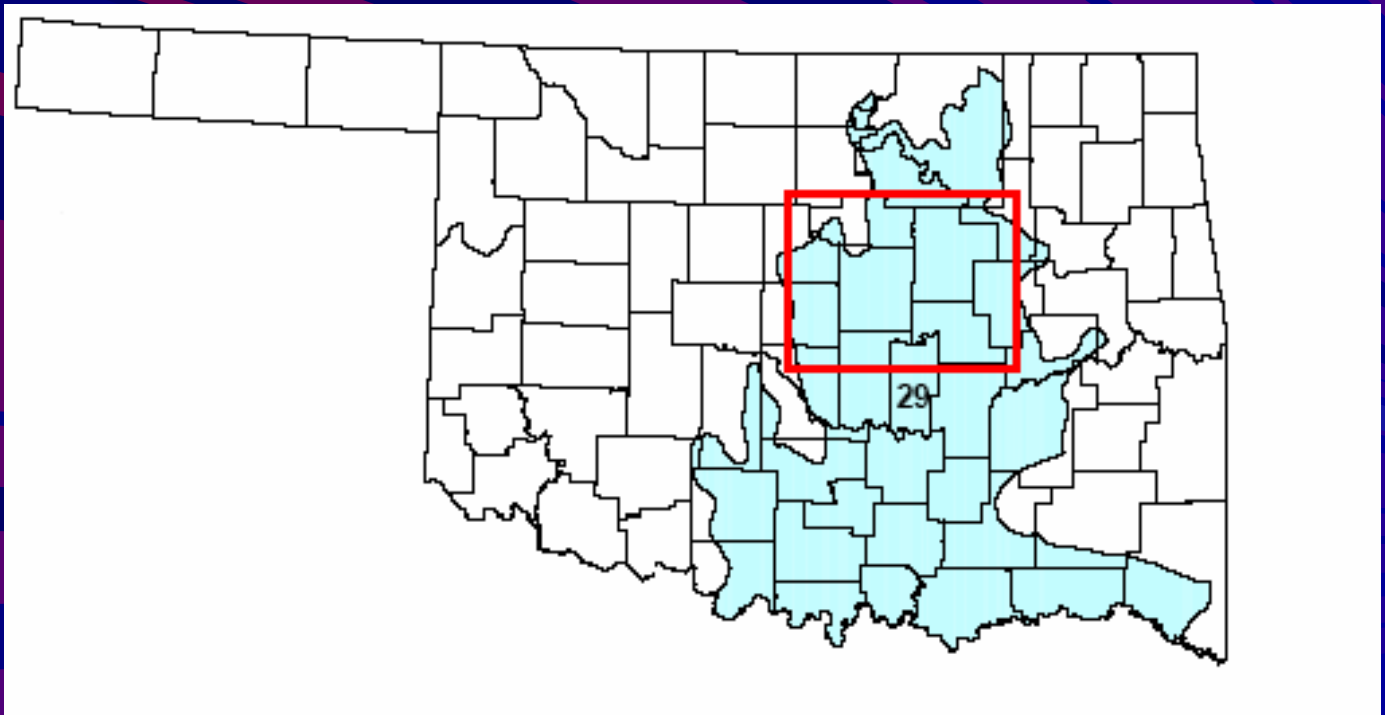
Objectives

- Determine similarity between created wetlands and natural wetlands.

- Evaluate the response of metrics from previously developed IBIs to disturbance in Oklahoma wetlands.

Wetland Selection

- 18 palustrine, emergent wetlands
  - 12 natural wetlands
  - 6 created wetlands



Wetland Disturbance Score

- Rating from 0 to 30
- Buffer zone
  - Width (>50m, <10m)
  - Surrounding land use
- Vegetation within wetland
  - Mowed
  - Livestock activity
- Hydrology
  - Levee/dams
  - Installed outlet/drainage structure

Disturbance Score = 0

Disturbance Score = 20

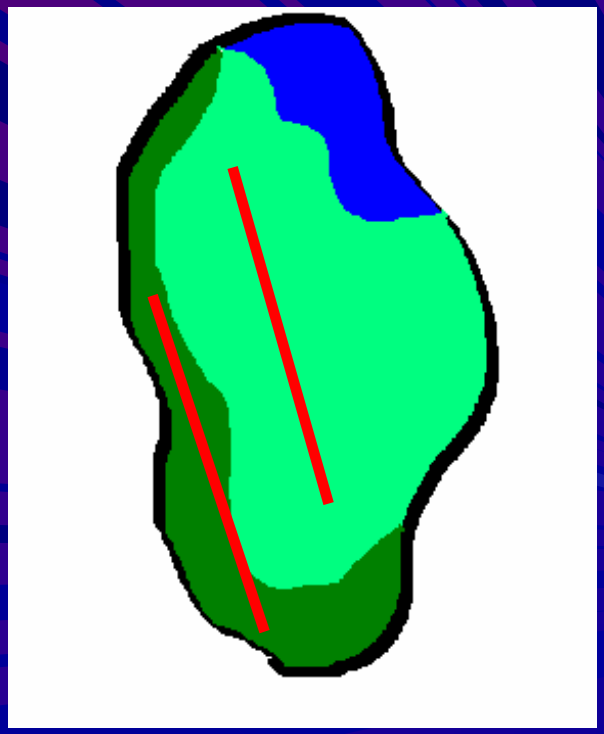
Abiotic Factors

- Water Depth
- Quanta Hydrolab
  - Temperature
  - pH
  - Dissolved Oxygen
  - Salinity
  - Turbidity
  - Specific Conductivity

- Hach Test Kit
  - Total phosphate
  - Nitrate
- Standard Methods
  - Alkalinity
  - Hardness

Vegetation Assemblage

- Fall 2003, Summer 2004, Summer 2005
- Cover Map
- 1 transect with at least 4 quadrants in each habitat type
  - Percent coverage
  - Identified to lowest taxon



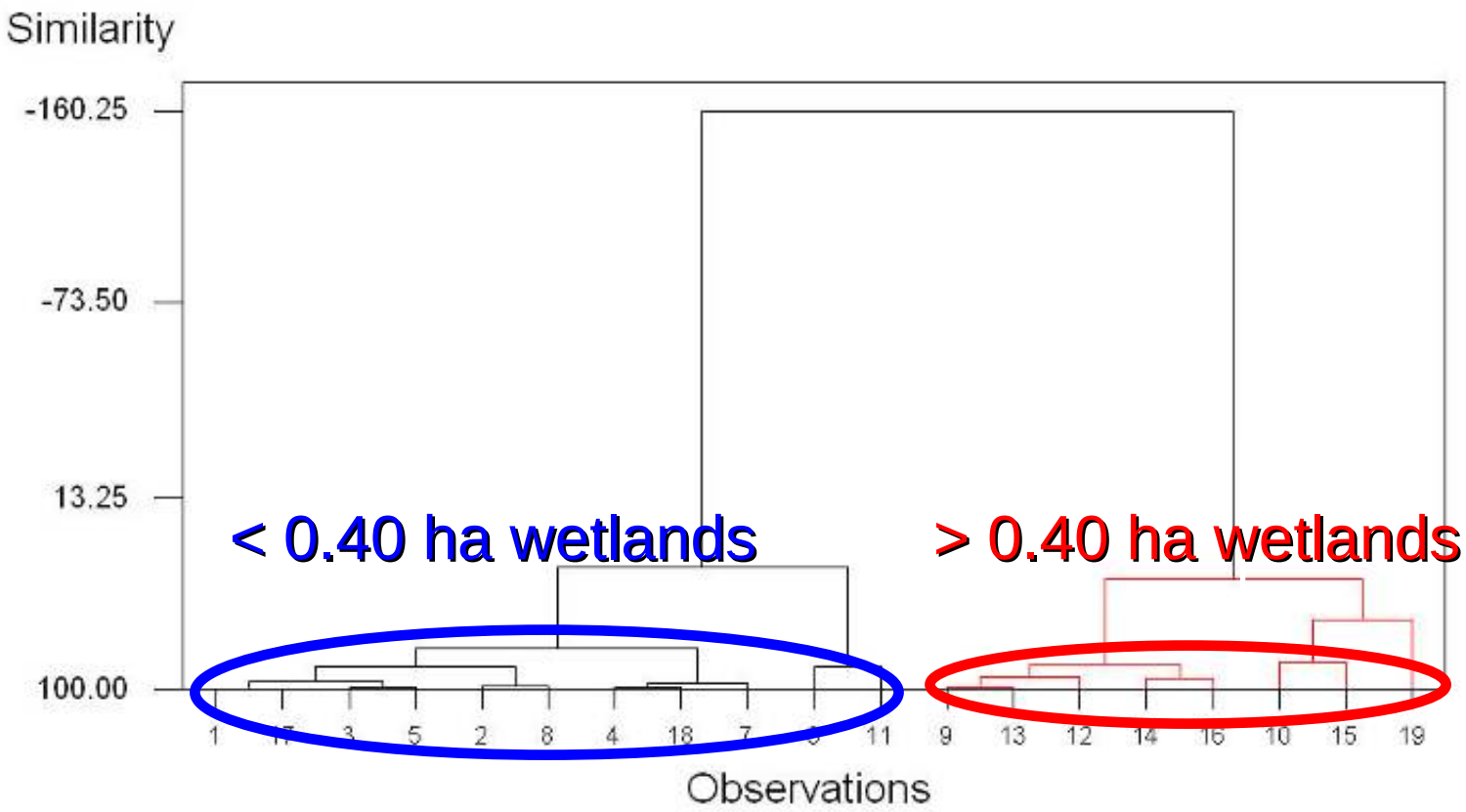
Macroinvertebrate Assemblage

- Seasonal sampling between October 2003 and July 2005
- 2 samples from each habitat type
  - At least 4 samples per wetland
- D-frame dipnet
- Identified to lowest taxon

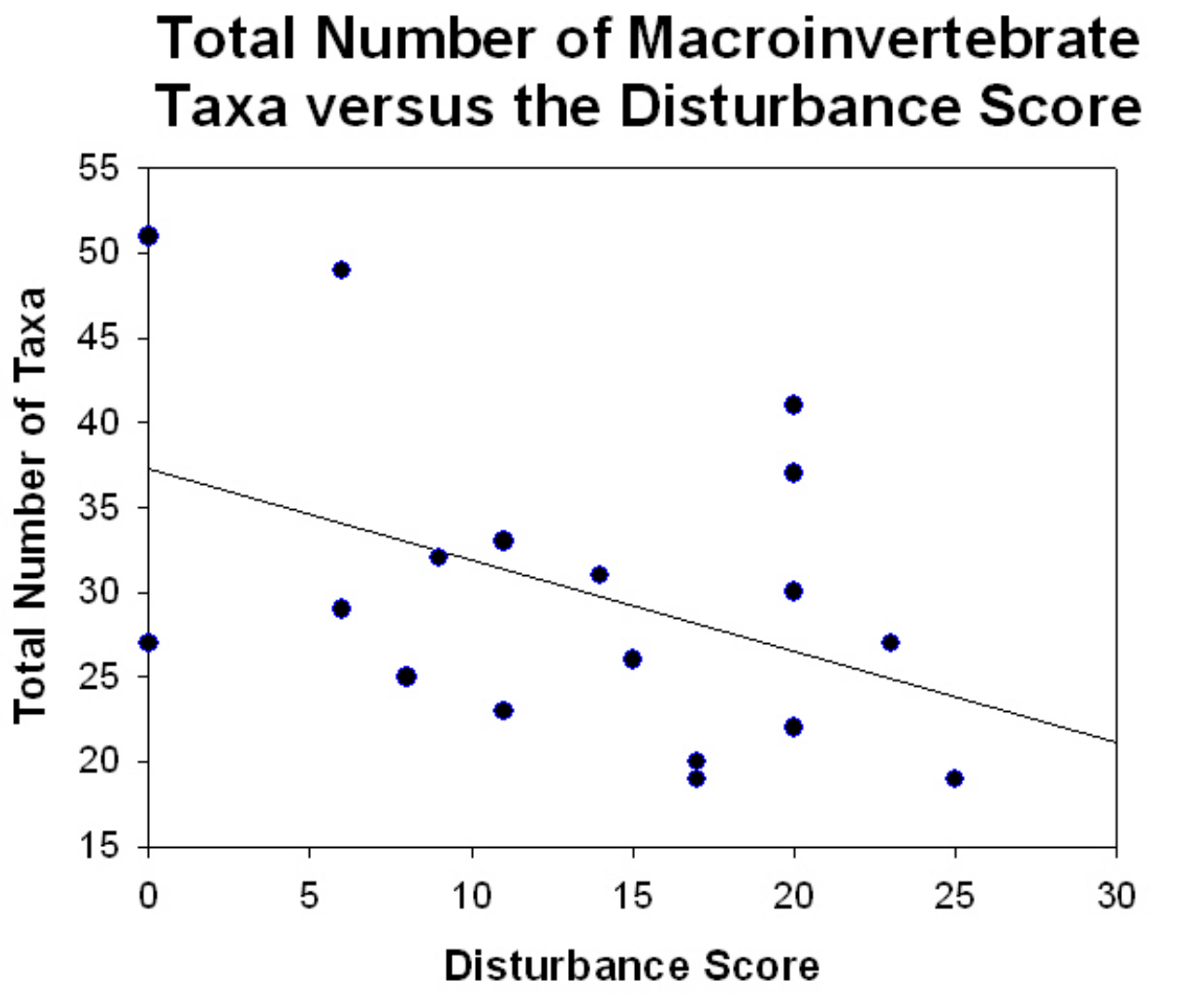
Avian Assemblage

- Seasonal sampling between October 2003 and July 2005
- 10 min. point count and playback tape
  - No precipitation and <25km/hr wind
- 3 times per season with 2 week interval

Metric Data Analysis



Metric Data Analysis



Metric Results

Abiotic Factor	Small wetlands		Large Wetlands	
Depth			-	Sp04
Temperature	+	Fa04	+	Su04
Dissolved Oxygen	+	Fa04	+	Su04
Specific Conductivity	-	Fa03	- -	Sp04 Fa04
Salinity	-	Fa03		
Alkalinity	- -	Fa03 Fa04	-	Su05
Hardness	- -	Fa03 Fa04	- -	Fa04 Su05
Total Phosphorus	- +	Fa03 Su04	+ +	Su04 Su05
Total Nitrogen	+	Fa04	+	Su05
pH			+ -	Fa03 Fa04

Metric Results

Vegetation Metric	Small wetlands		Large Wetlands	
Prop. Carex spp.			-	Su04
Prop. tolerant spp.	+	Fa03		
Prop. OBL spp.	-	Su04	- -	Su04 Su05
Prop. FACW spp.	+	Su05		
Prop. perennial spp.			-	Su05
Prop. aquatic quild spp.	-	Fa03		
Floristic Quality Assessment Index	-	Su05	-	Su04

Metric Results

Macroinvertebrate Metric	Small wetlands		Large wetlands	
Taxa richness	- -	Sp 04 Su 04		
# Chironomid taxa	-	Su 04		
# Leech genera			-	Su 05
# Gastropod genera	- -	Sp 04 F 04		
# Intolerant taxa	-	Su 04		
Ephem./Trich./Sphaerid/Diptera (ETSD)	-	Sp 04		
Prop. Corixidae	-	Su 04		

Metric Results

Macroinvertebrate Metric	Small wetlands		Large wetlands	
Prop. Diptera			-	Su 05
Prop. in dom. taxa	+	F 03	-	Su 05
Prop. gatherers			- -	F 03 F 04
Prop. shredders	-	F 03	+	Su 04
Prop. predators			+	F 04
Shannon-Weiner Diversity	-	F 03		

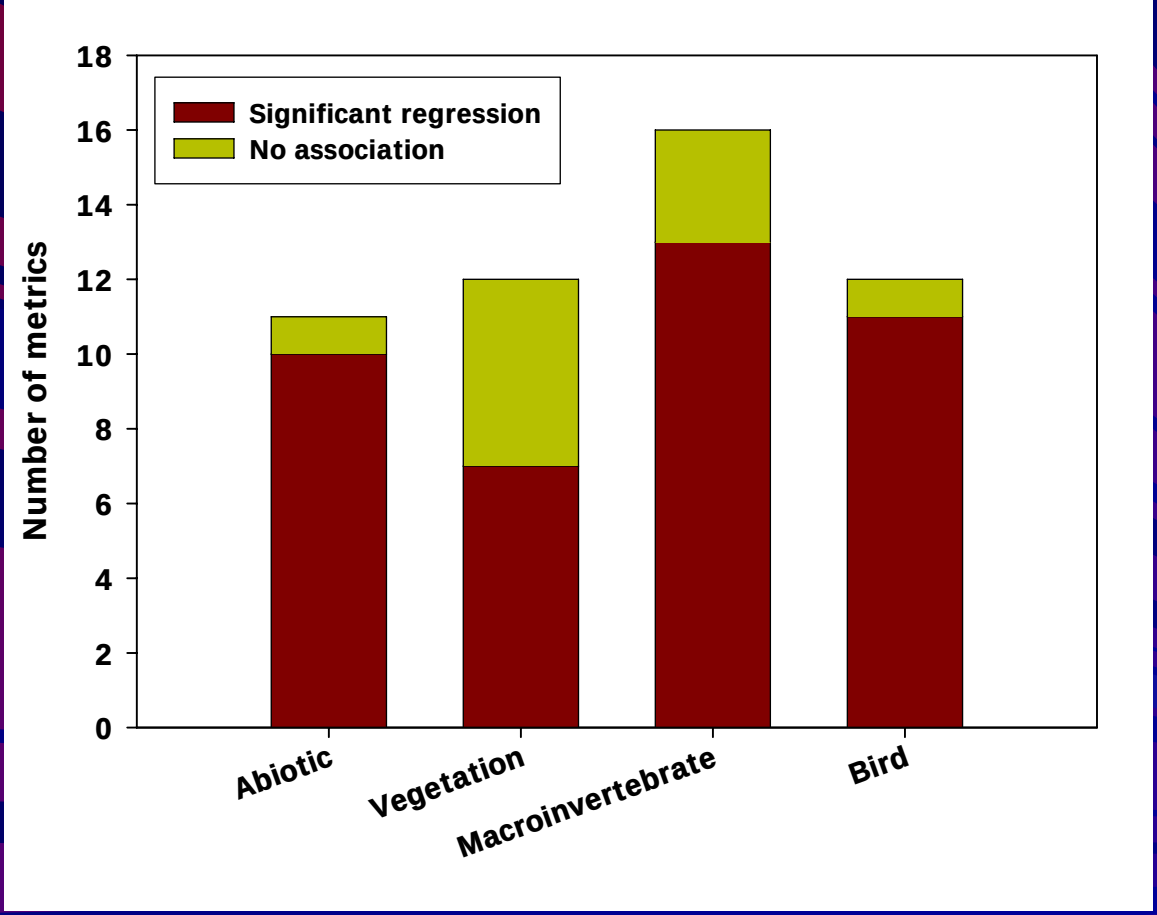
Metric Results

Avian Metric	Small wetlands		Large wetlands	
Species richness			- - - - -	F 03 Sp 04 Su 04 F 05 Su 05
Prop. Insectivore sp.			-	F 04
Prop. Omnivore sp.	+ +	Su 04 Su 05		
Prop. Edge sp.	+	Su 05	-	Sp 04
Prop. Resident sp.			-	F 04
Prop. Migratory sp.	- -	Sp 04 Su 04		
Prop. Single brood sp.			-	Su 04
Prop. Waterfowl sp.			-	F 03

Metric Results

Avian Metric	Small wetlands		Large wetlands	
Prop. Shorebird spp.			+	Sp 04
Prop. in dom. taxa	-	Su 05	+ -	Sp 04 F 04
# Obligate Wetland spp.			- -	Su 04 Su 05
Shannon-Weiner Diversity	-	Su 05	- - -	F 03 Sp 04 F 04

Metric Results



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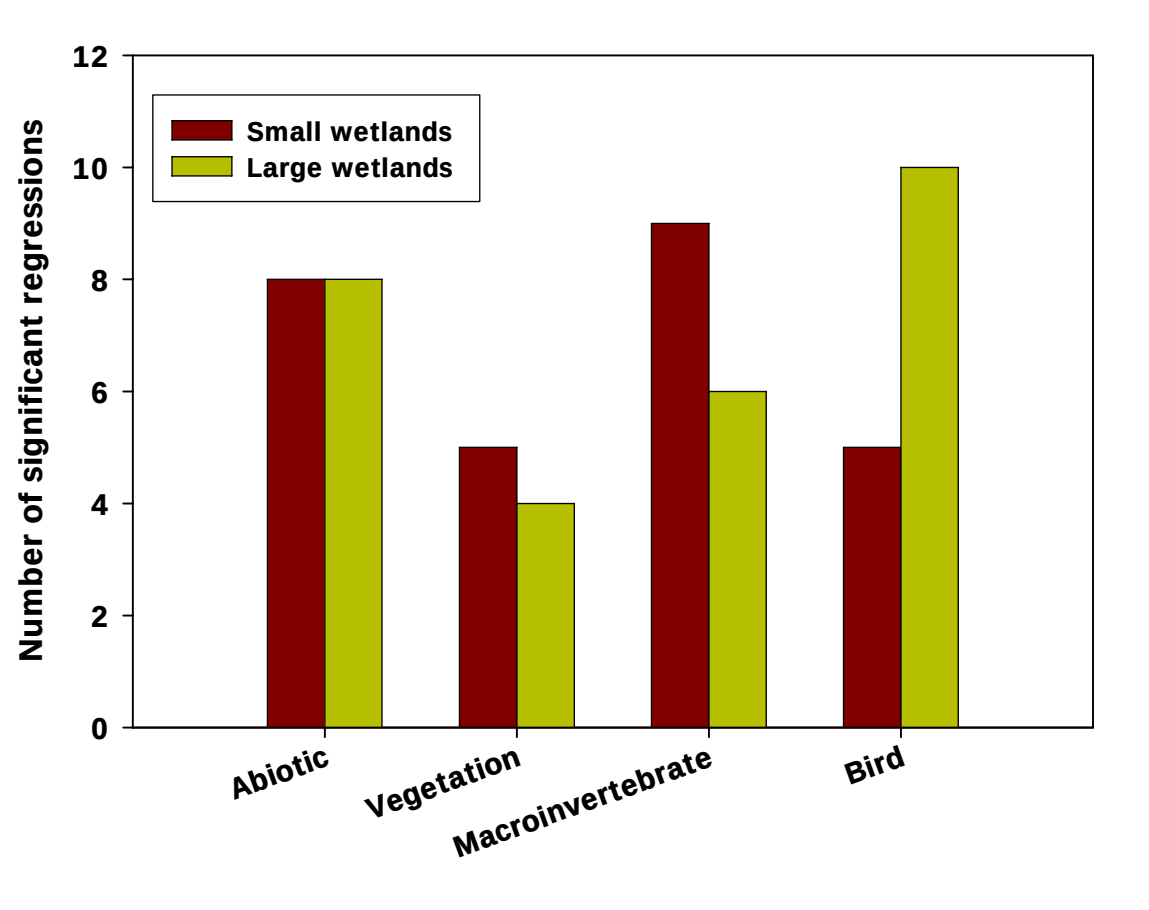


Metric Conclusion

- Avian and macroinvertebrates had the most significant metrics
- Season and size influence metric/disturbance relationship
- More variation in metric/disturbance relationship explained in larger wetlands

Considerations in Developing IBI in Oklahoma

- Hydroperiod and season
- Disturbance gradient
- More metrics specific to Oklahoma fauna

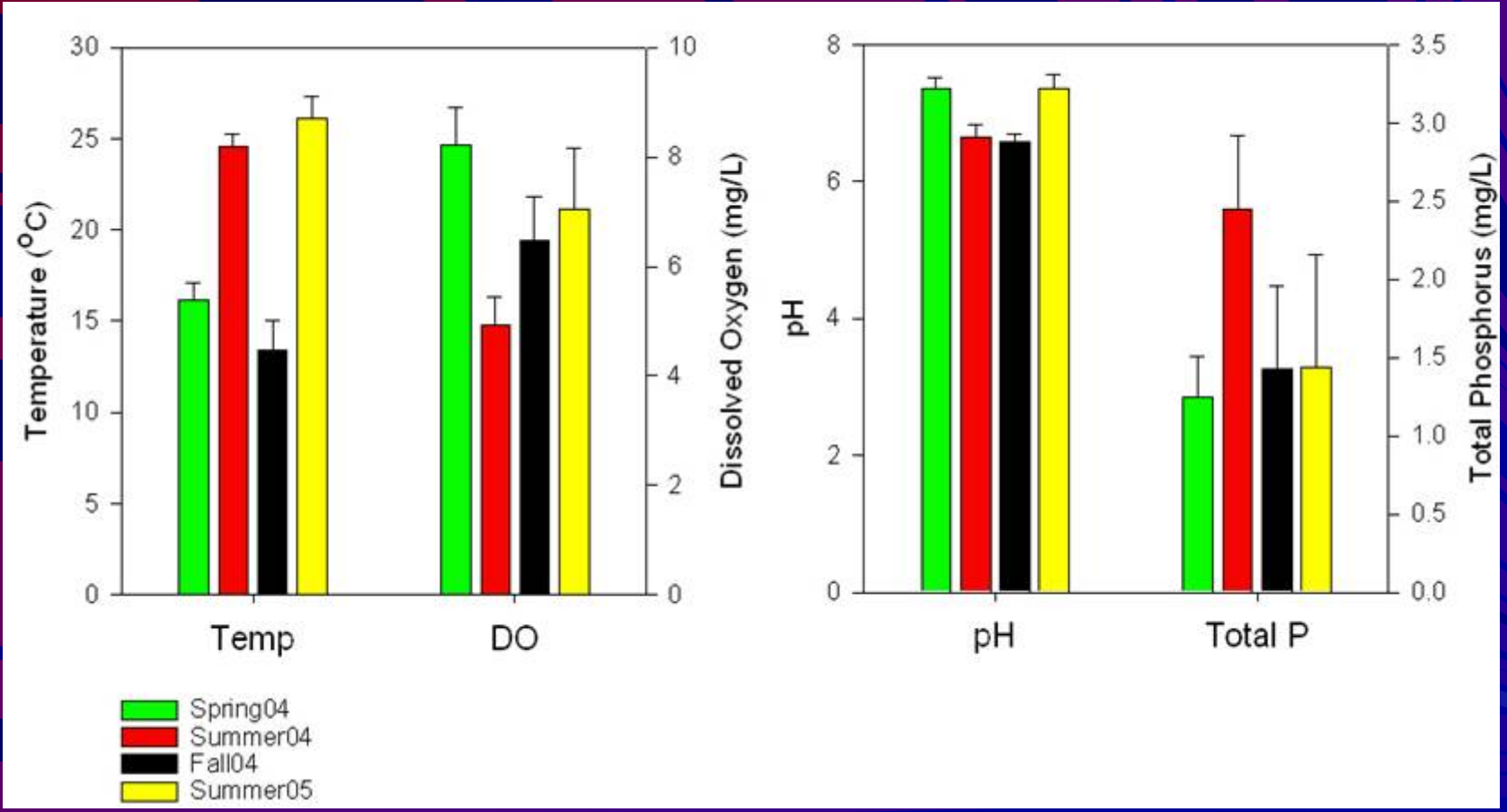
Natural vs. Created

- Natural Wetlands
  - Hydric Soil
  - Generally no dams
- Created Wetlands
  - Non-hydric soils
  - Associated with dams

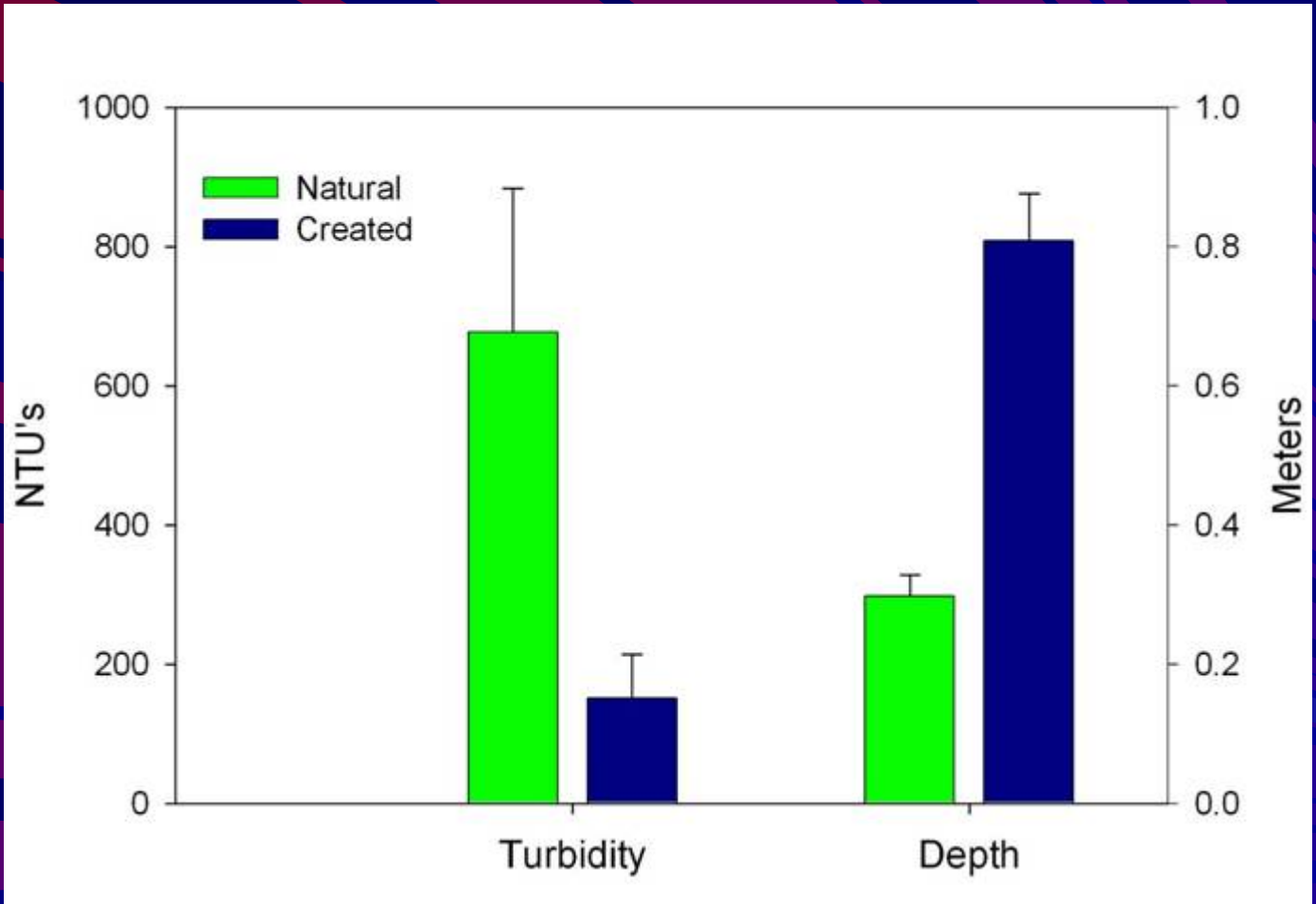
Natural vs. Created Data Analysis

- Two-way Analysis of Variance
  - Wetland type and season
- Jaccard's similarity index

Natural vs. Created Results

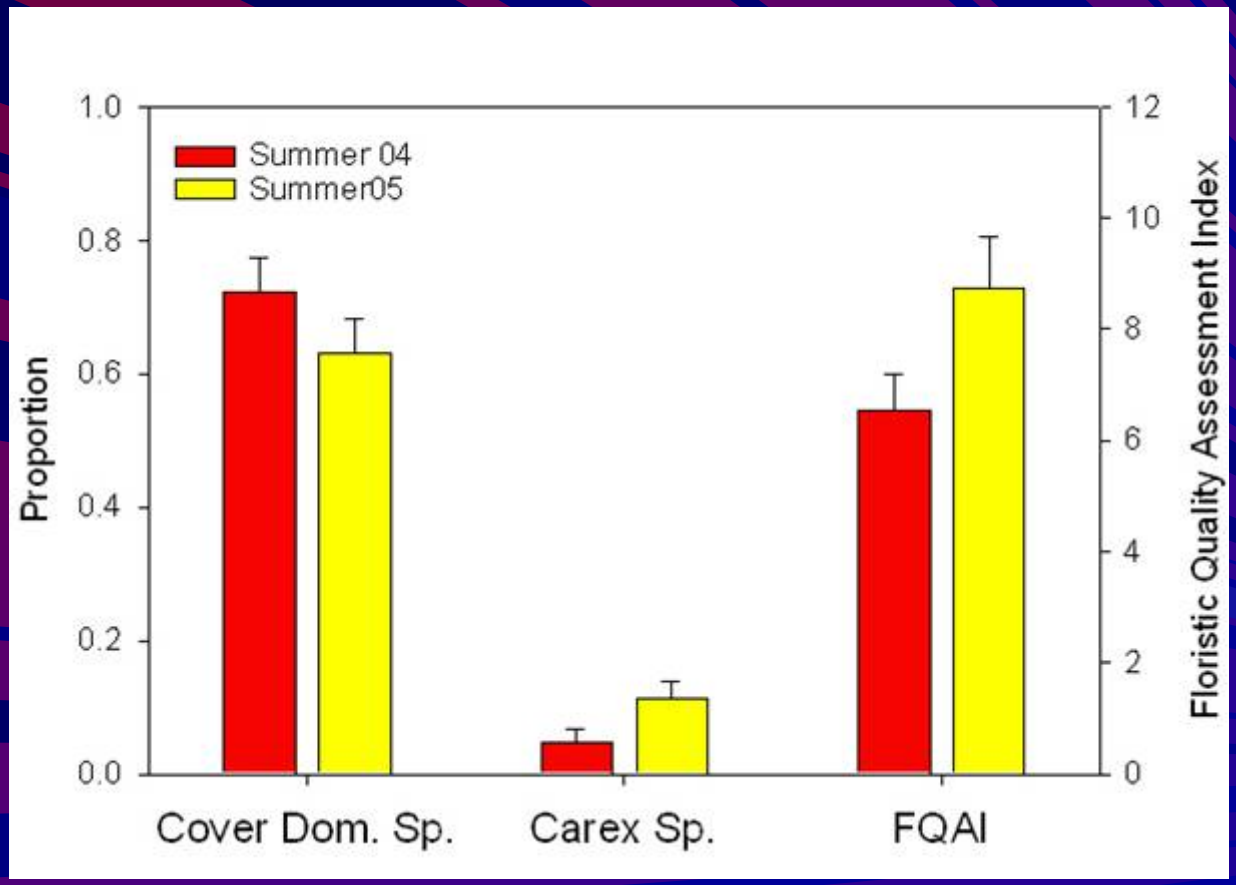


Natural vs. Created Results



Natural vs. Created Results

- Vegetation Assemblage

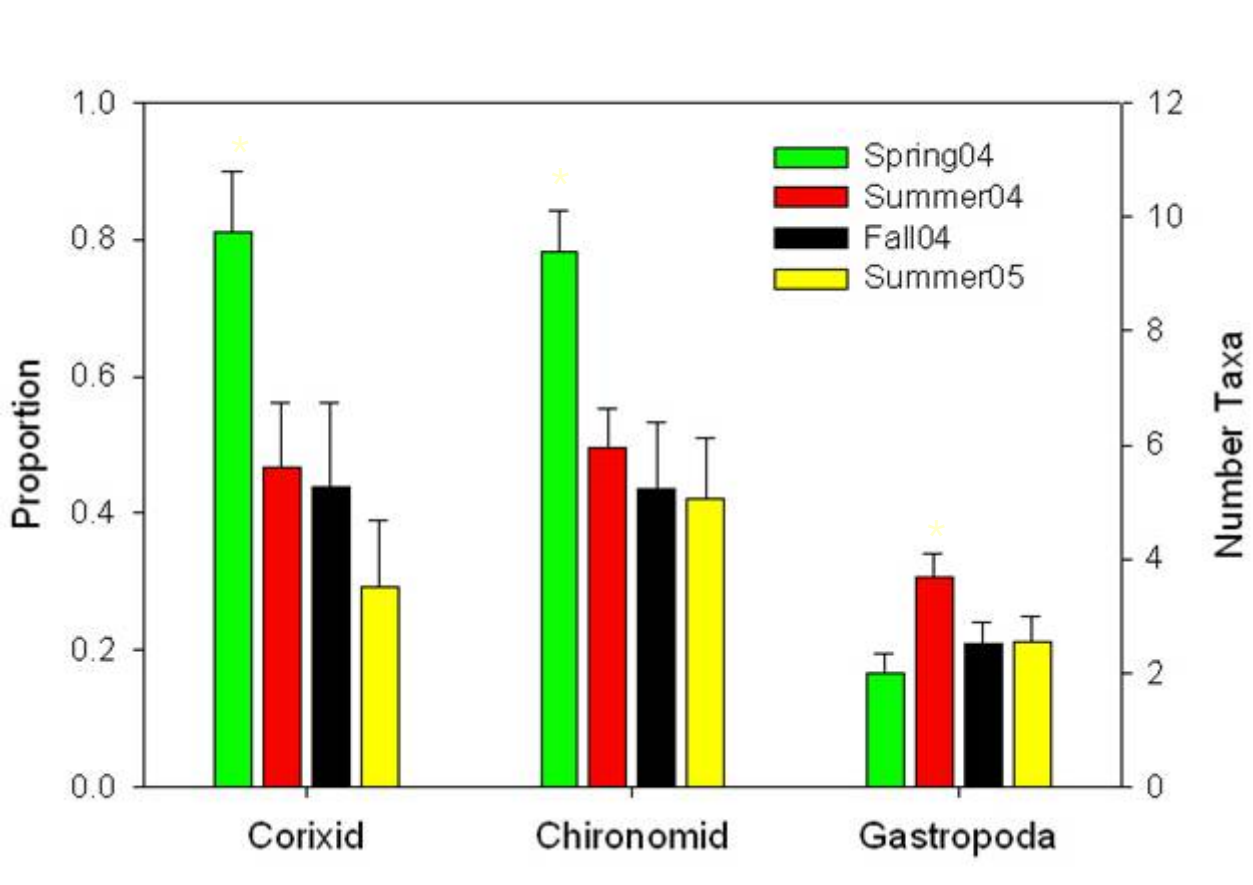


Natural vs. Created Results

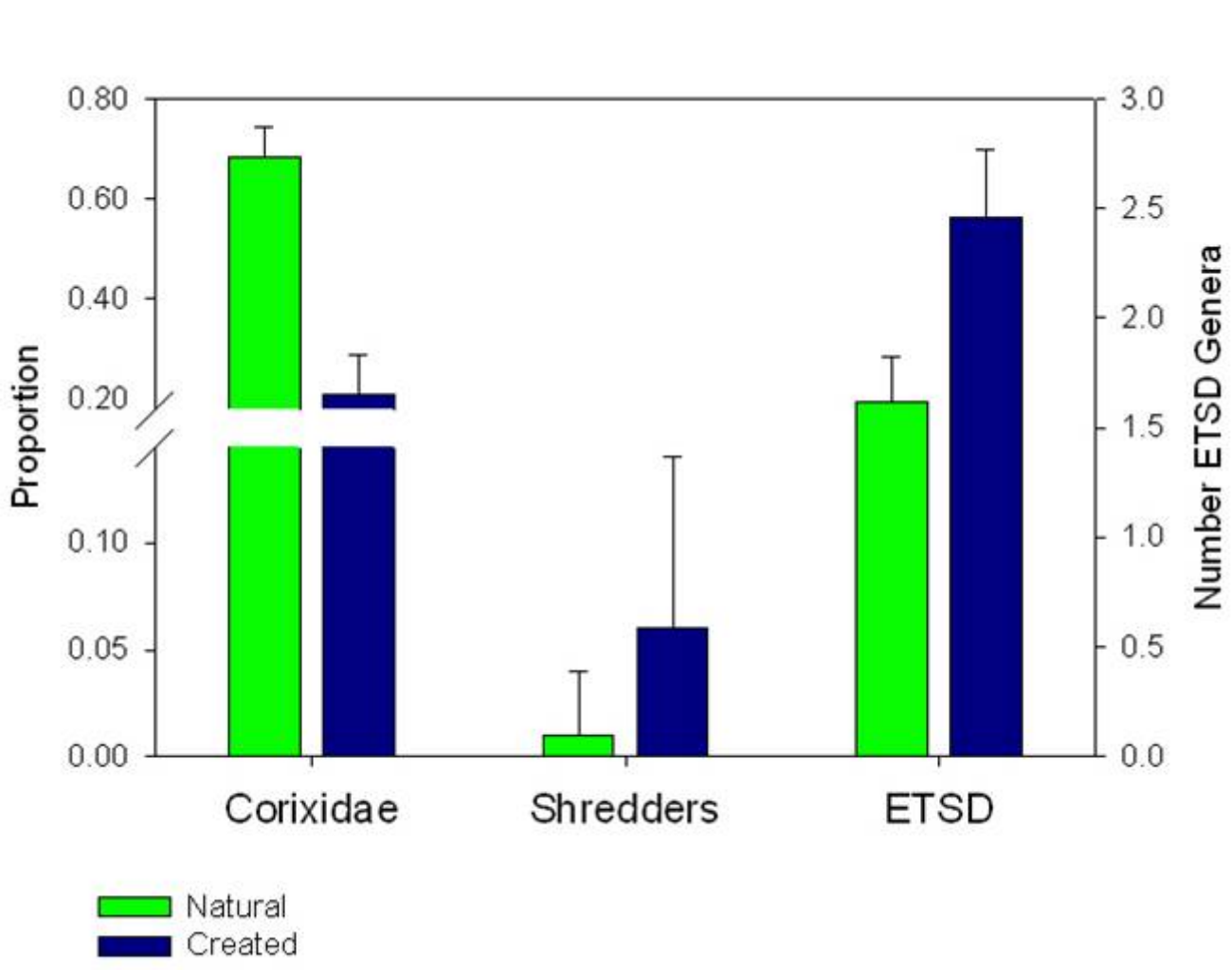
- Proportion of perennial spp.
- 38% similarity
  - More *Eleocharis* spp. and *Polygonum* spp. in natural wetlands
  - Floating primrose and longleaf pondweed in created wetlands

Natural vs. Created Results

- Macroinvertebrate Assemblage



Natural vs. Created Results

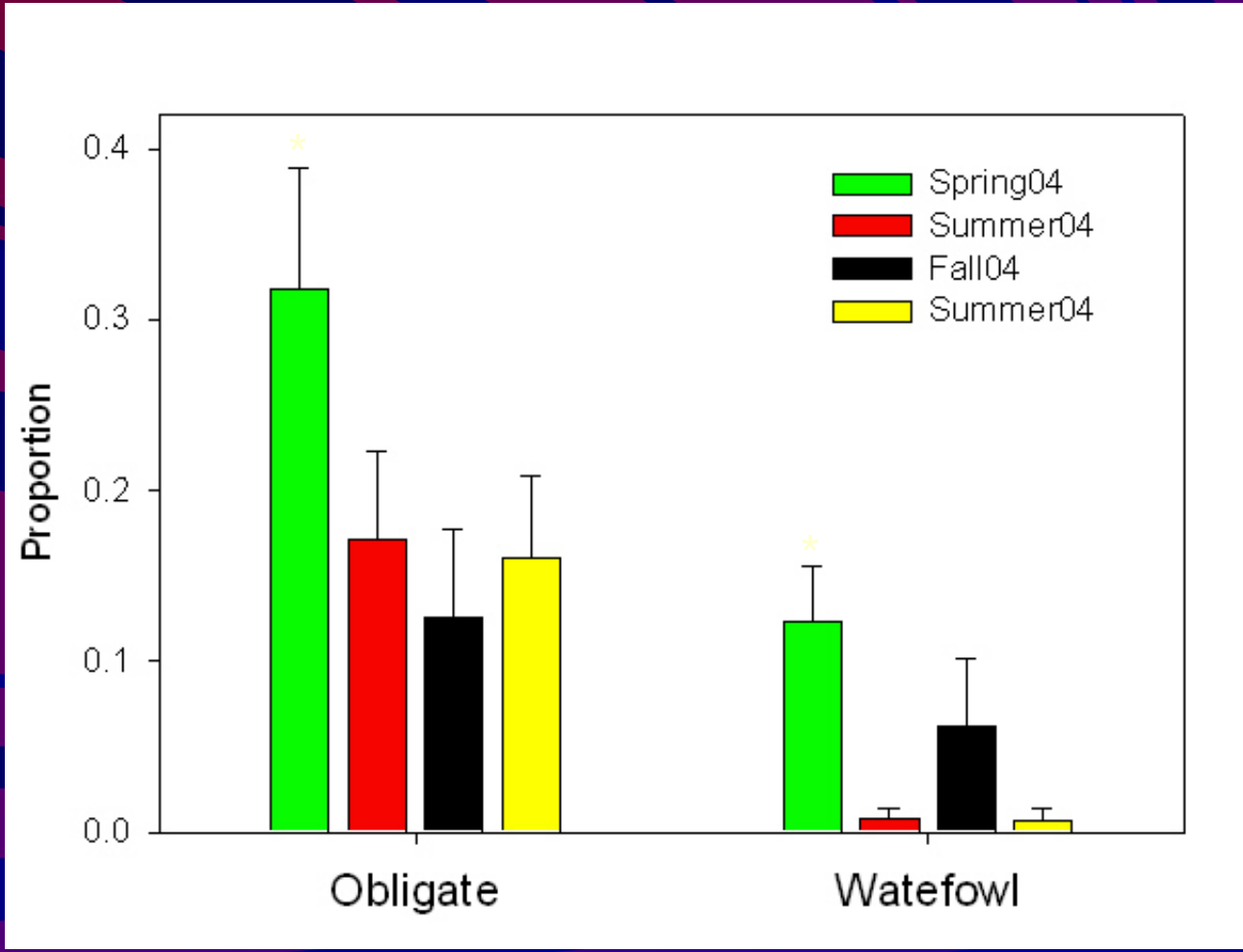


Natural vs. Created Results

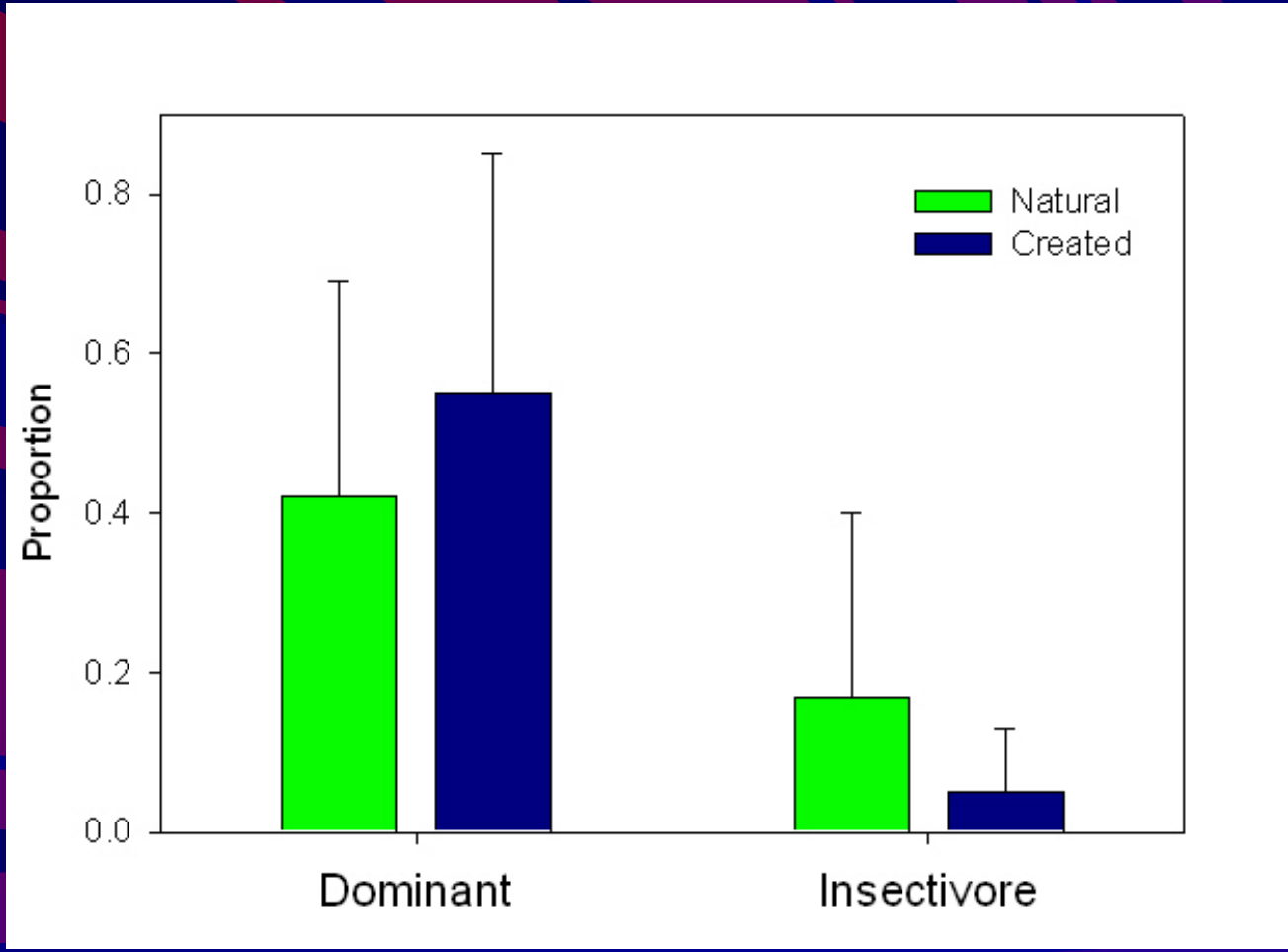
- 55.9% similarity
  - Notostraca and Hydrozoa found in natural wetlands.
  - More Ephemeroptera and Chironomidae genera in created wetlands.

Natural vs. Created Results

- Avian Assemblage



Natural vs. Created Results



Natural vs. Created Results

– 64.7% similarity
  - Great egrets and greater yellowlegs only in natural wetlands
  - American coots, great-tailed grackle, and northern bobwhites only in created wetlands.

Natural vs. Created Conclusions

- 2 abiotic variables and 6 metrics were different
- Caution should be used when using both natural and created systems in assessments.
- Caution should be used when determining which assessment method for determining created wetland health.

What it Means for Oklahoma

- IBI a promising level 3 assessment method for the state
- Birds and macroinvertebrates provided more information than plants
- Caution when using created wetlands in assessment methods

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