

# Acknowledgements

- Eastern Illinois University graduate students and staff
- Illinois Department of Natural Resources
- United States Geological Survey
- Illinois Environmental Protection Agency
- Coles family and other landowners



# Midwestern Streams

- Heavily impacted by anthropogenic activities
  - 85% of streams affected by agriculture and urbanization
- Habitat modification and pollution in lotic systems:
  - Lowers freshwater diversity
  - Alters structure and function of instream biotic communities



# Stream Restorations

- Implementation of instream restorations to:
  - Increase habitat quality
  - Increase biotic integrity
- Millions of dollars spent on stream restorations annually
  - Ecological benefits are not fully understood
  - 20% of restored streams have post-restoration monitoring



Pant 2014

# Why study fishes?

- Fishes are good stream health indicators
  - Intolerant and tolerant species
  - Feed at different trophic levels
  - Long-lived
  - Ecologically dominant
  - Easy to collect and identify
- Useful to show stream recovery



# Fish Kill in Coles County, Illinois

- Vesuvius factory chemical spill in 2001
- Furfural plume spread
- Reported that
  - Over 250,000 fishes killed
  - Countless macroinvertebrates and other aquatic fauna
- Settlement money was used to fund restoration of a designated reach in Kickapoo Creek



# Kickapoo Creek, Coles County, IL



- Originates in Mattoon, Illinois and flows into the Embarras river
- ~15 km long third order stream
- Heavily impacted by agricultural land
- Uniform in depth and substrate

# Kickapoo Creek Restoration



- Started in 2009 finished in 2010
- Restoration included:
  - 500 meters of bank stabilization
  - Two artificial boulder riffles
  - Pool scouring keys

# Previous Studies of Kickapoo Creek

- Restoration only had a minor impact on fish biomass and community metrics (Pant 2014)
- Fish communities in unrestored sites stayed relatively the same (Favata 2016)
- Fish communities in restored sites were significantly altered (Favata 2016)
- Large delay seen in changes of Index of Biotic Integrity (IBI) (Favata 2016)





# Previous Stream Restoration Study

- Eastern Illinois University
- Rohr et al (2018) looked at the effectiveness of a stream restoration of a central Illinois stream.
- Found:
  - Species diversity was slowly increasing
  - No large changes observed in Index of Biotic Integrity (IBI) or species richness
- Recommends at least three years of stream monitoring after restoration
- Recommends more stream monitoring to justify money spent on instream restorations



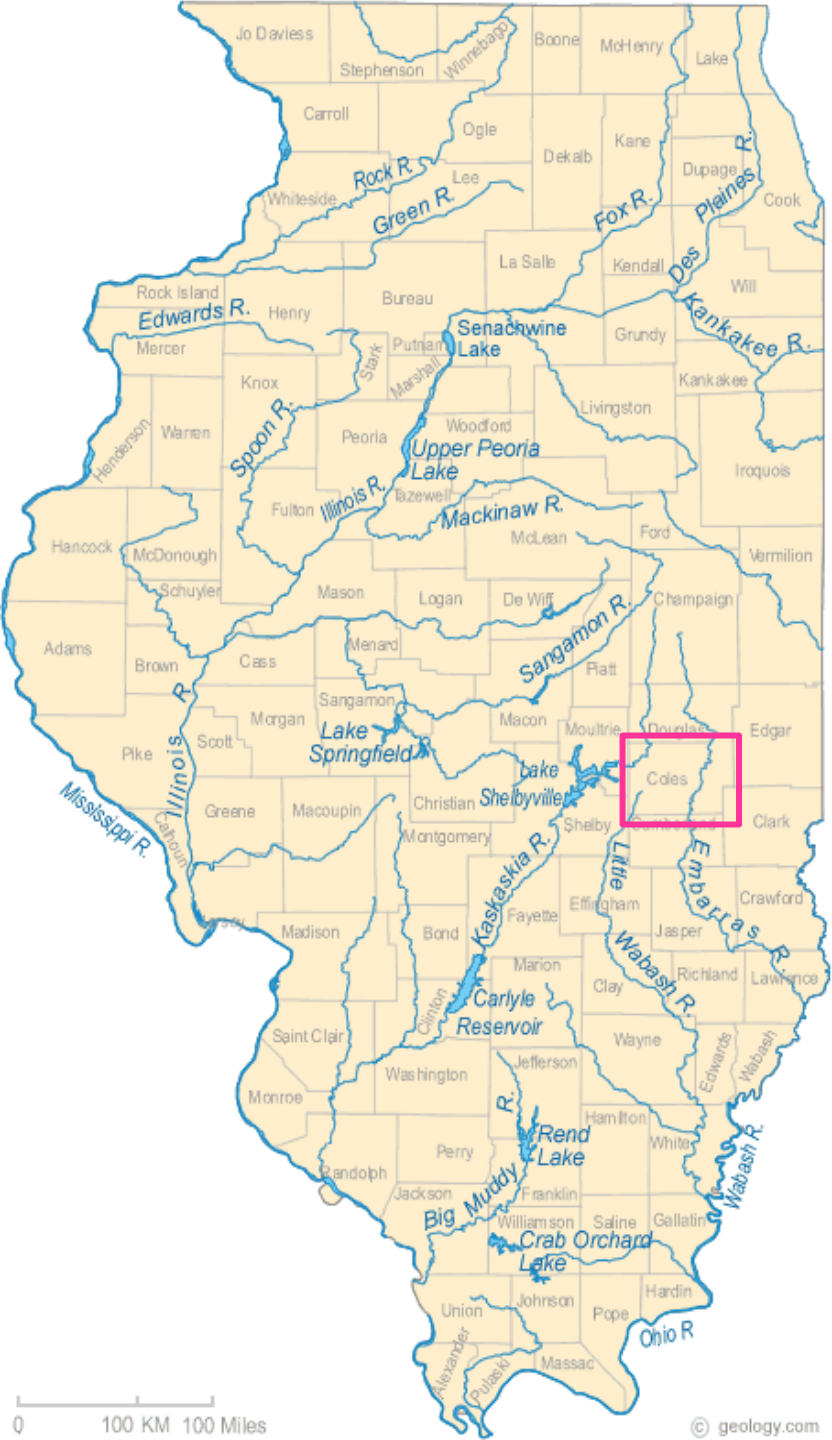
# Impacts of an Instream Restoration on Fish Communities and Abundance in a Midwestern Stream

ALEXIS L. VANDENBERG, DANIEL R. ROTH,  
EDEN EFFERT-FANTA, ROBERT E. COLOMBO

EASTERN ILLINOIS UNIVERSITY, CHARLESTON, IL

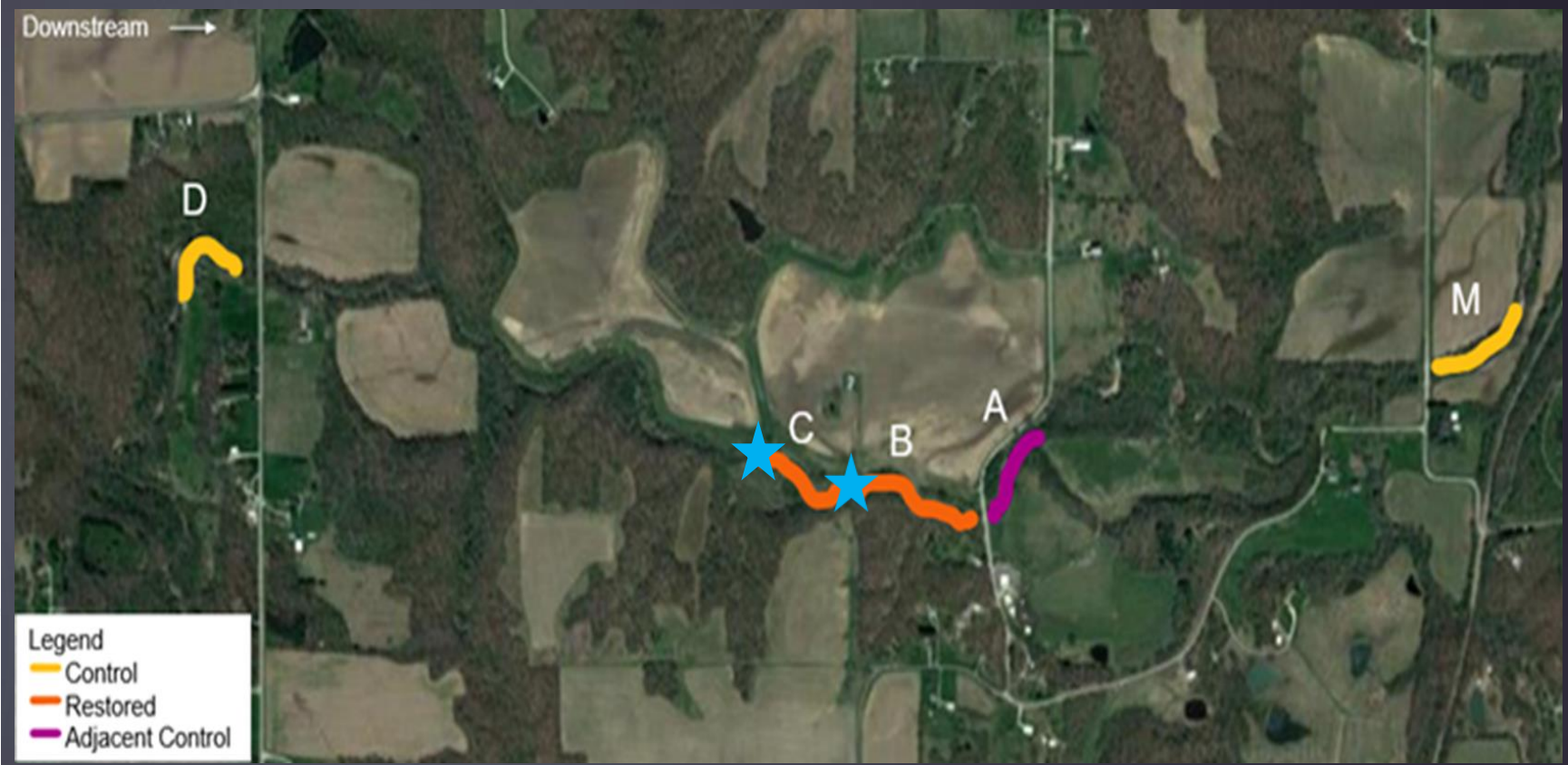
# Objectives

1. Observe change in species richness of each sampled year from pre-restoration in 2009 to post restoration 2021.
2. Observe the changes in habitat using scores from Qualitative Habitat Evaluation Index.
3. Compare community structure shifts between restored sites and unrestored sites over time.



0 100 KM 100 Miles

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**Legend**  
 — Control  
 — Restored  
 — Adjacent Control

# Fish Collection



- 2009-2013 AC electric seine
- 2021 DC barge electrofishing
- Power goal calculated with water temperature and ambient conductivity
- Fishes identified, measured, and weighed

# Qualitative Habitat Evaluation Index (QHEI)



- Developed by Ohio EPA (Rankin 2006)
  - Followed by Illinois EPA
- Six metrics: Substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality, and map gradient
  - Max score 100
- Used to collect macroinvertebrates
  - 20 jab method
  - D-frame nets

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Table 2. General narrative ranges assigned to QHEI scores. Ranges vary slightly in headwater ( $\leq 20$  sq mi) vs. larger waters.

Narrative Rating	QHEI Range	
	Headwaters	Larger Streams
Excellent	$\geq 70$	$\geq 75$
Good	55- to 69	60 to 74
Fair	43 to 54	45 to 59
Poor	30 to 42	30 to 44
Very Poor	$< 30$	$< 30$

# Data Analysis

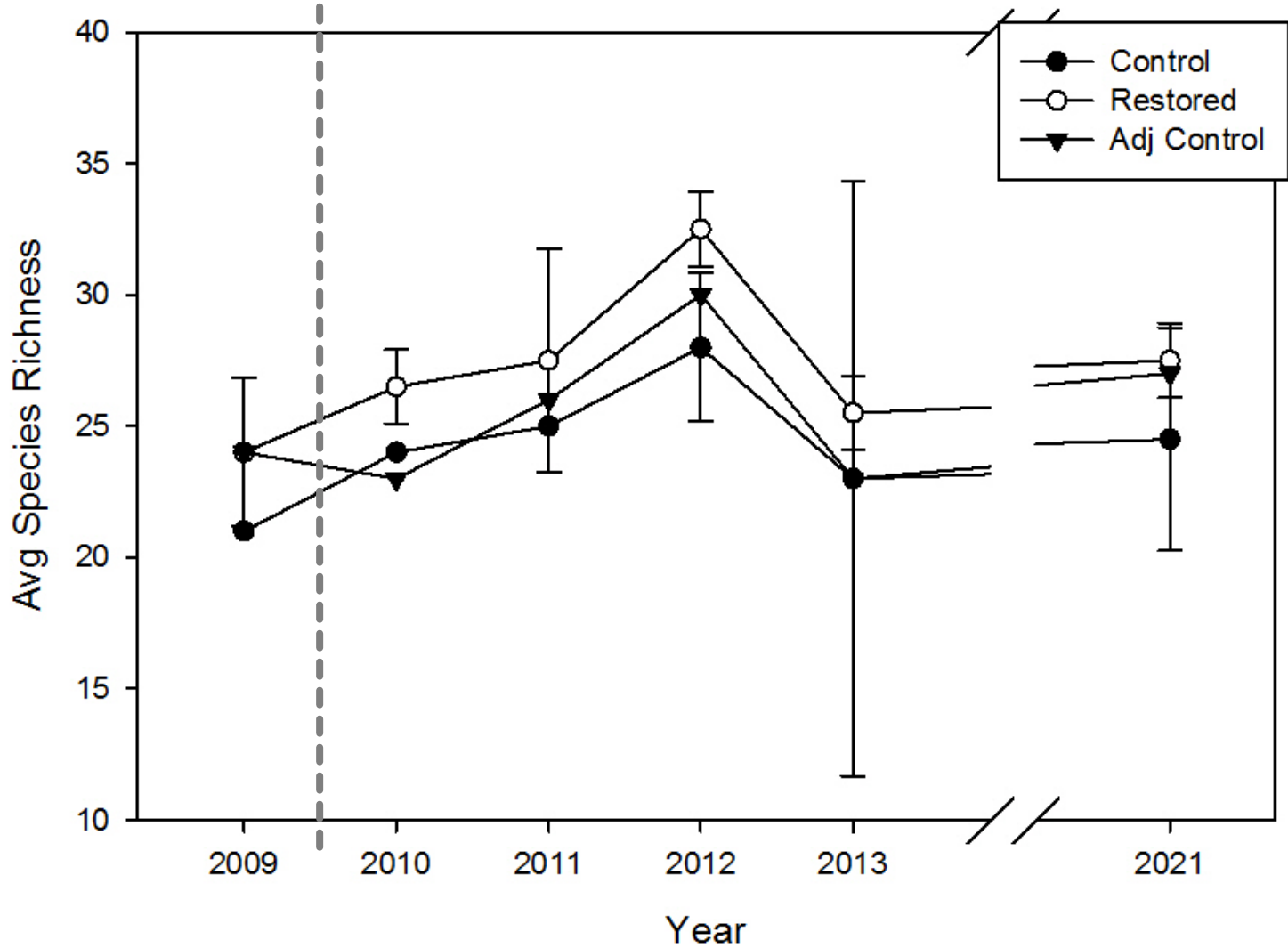
- Species Richness
  - Total number of species per year per site
  - Fall sampling events only
- Habitat scoring
  - Score out of 100 possible points using QHEI metrics per site per year
- Nonmetric Multidimensions Scaling (NMDS)
  - Excluded rare species: less than 0.01% of total individuals
  - Proportional fish community data was arc-sin square root transformed
  - Bray-Curtis dissimilarity
  - Created in R using package vegan
- Catch per unit effort
  - Average catch per 100 meters



# Objectives

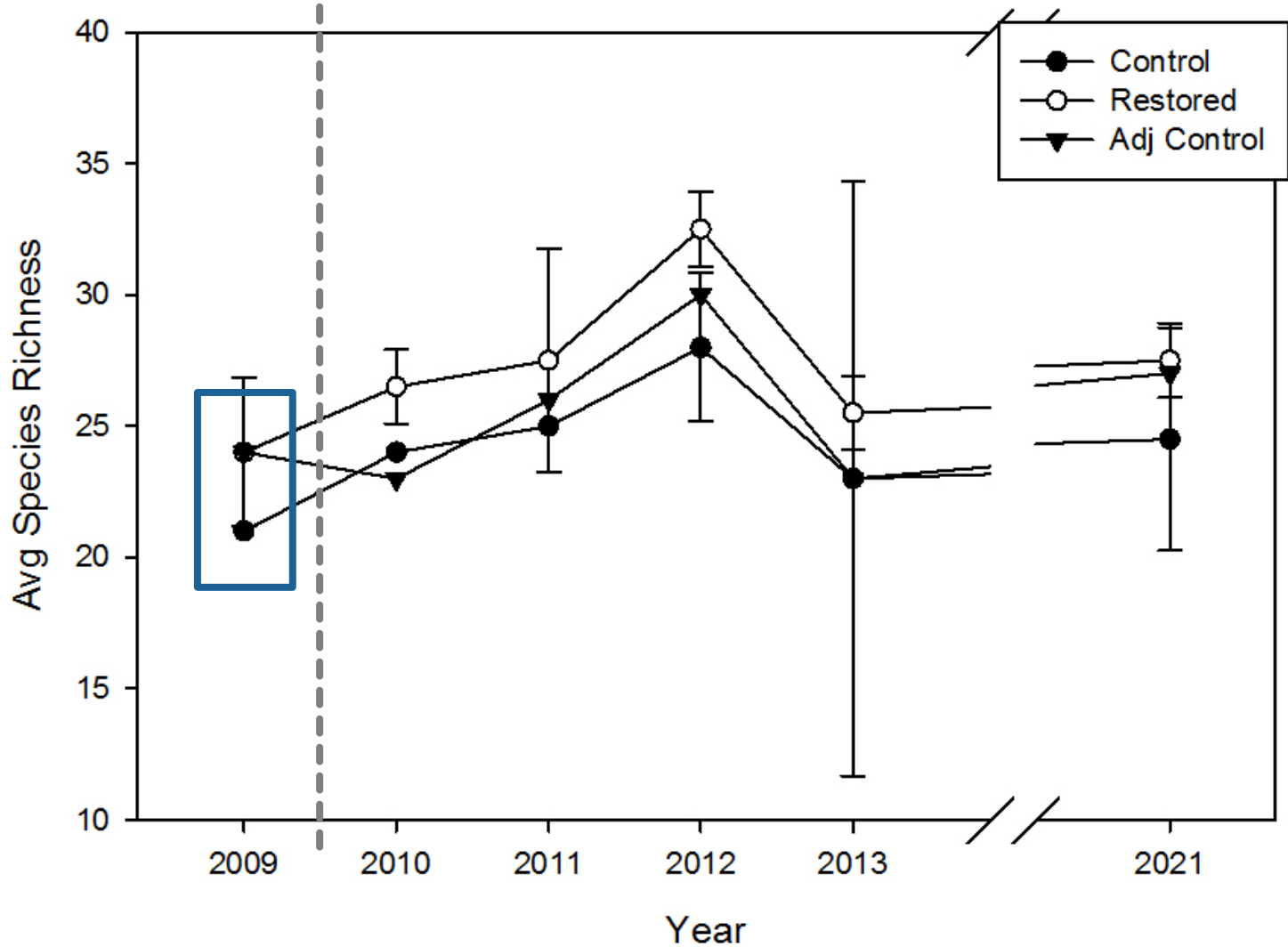
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# Average Species Richness



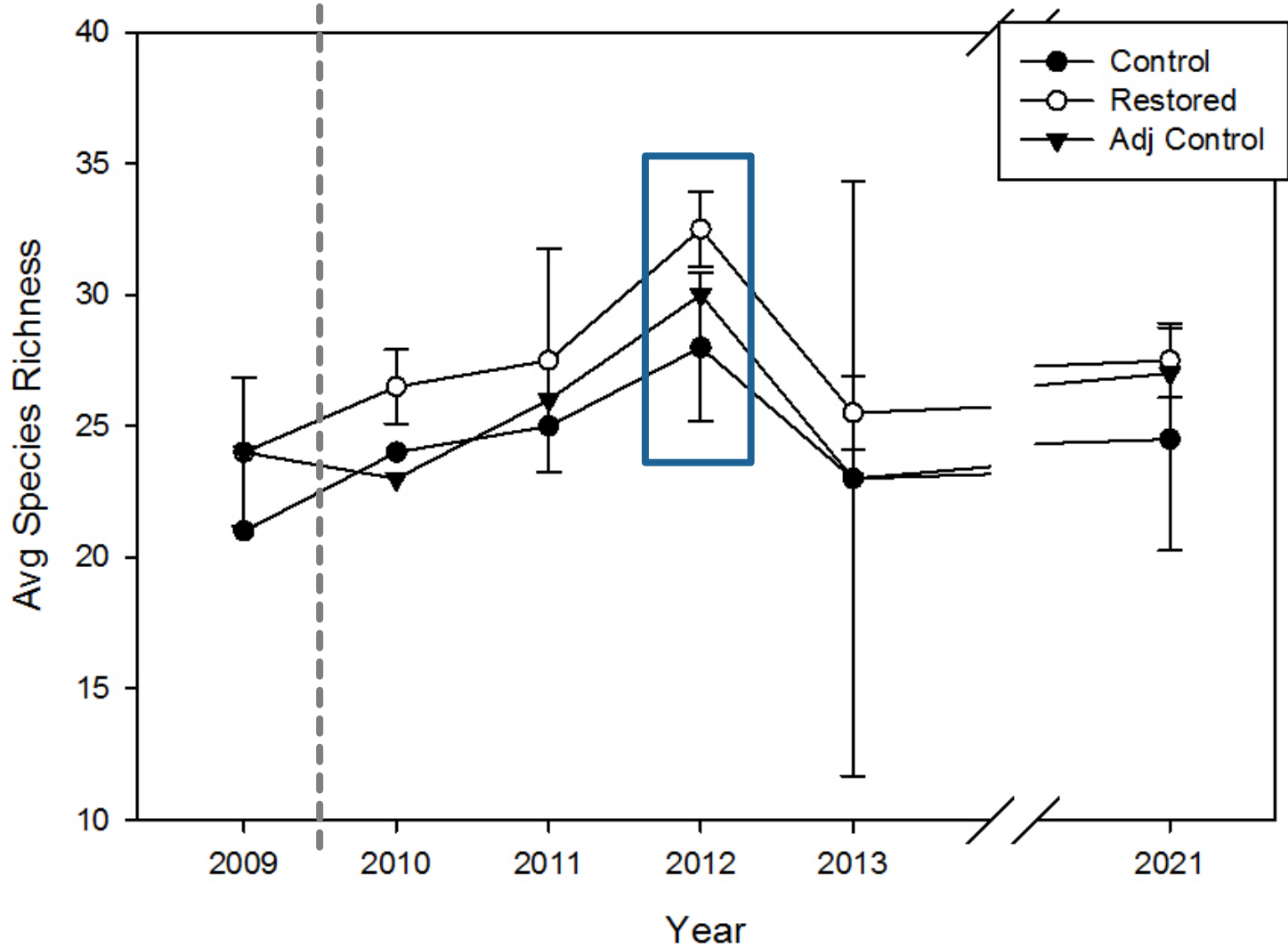
- Pre-restoration (2009) species richness is relatively low
- Peaks in 2012
- Throughout post-restoration, restored sites are highest in species richness
- In 2021 restored sites have the highest average species richness

# Average Species Richness



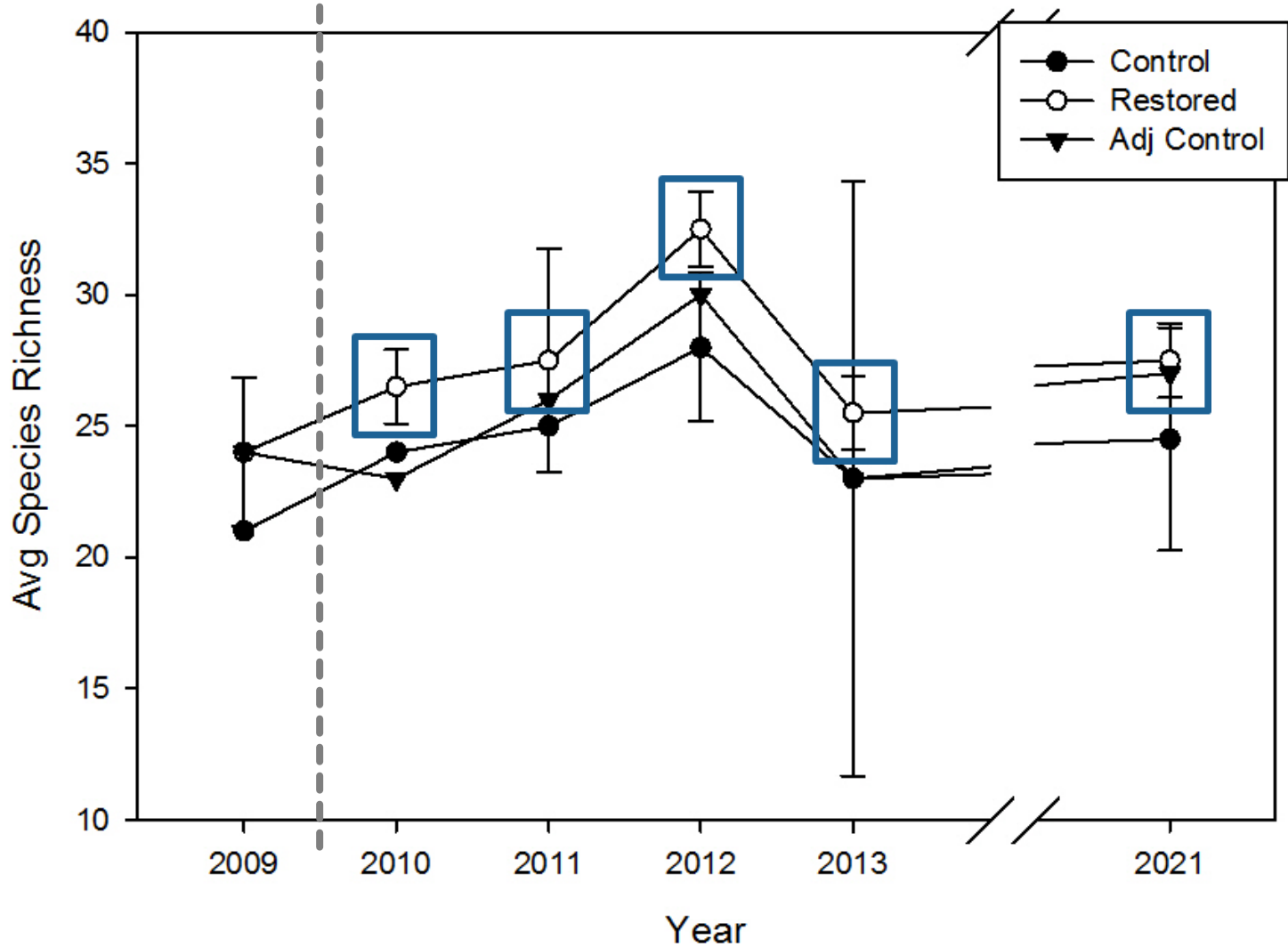
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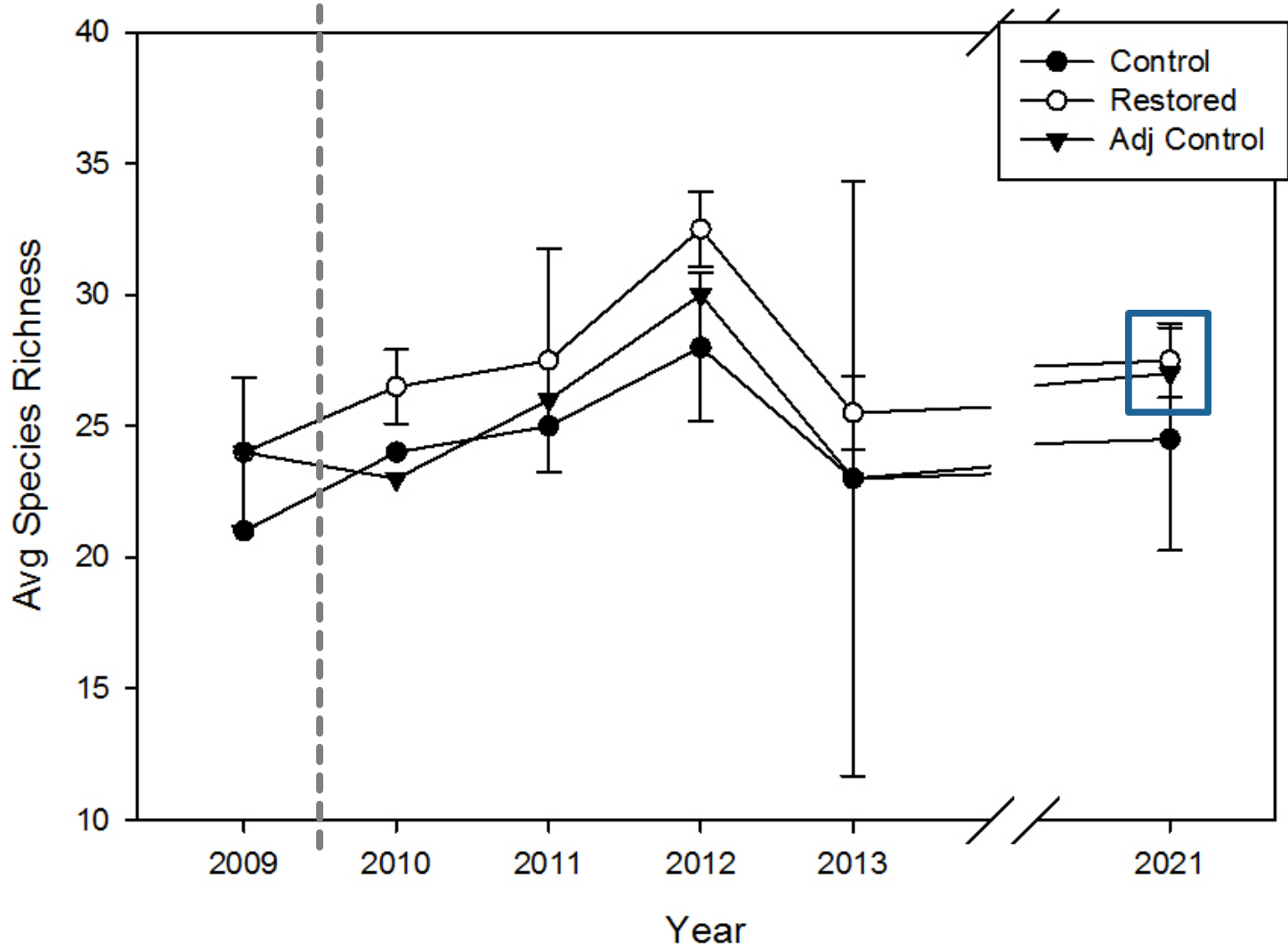
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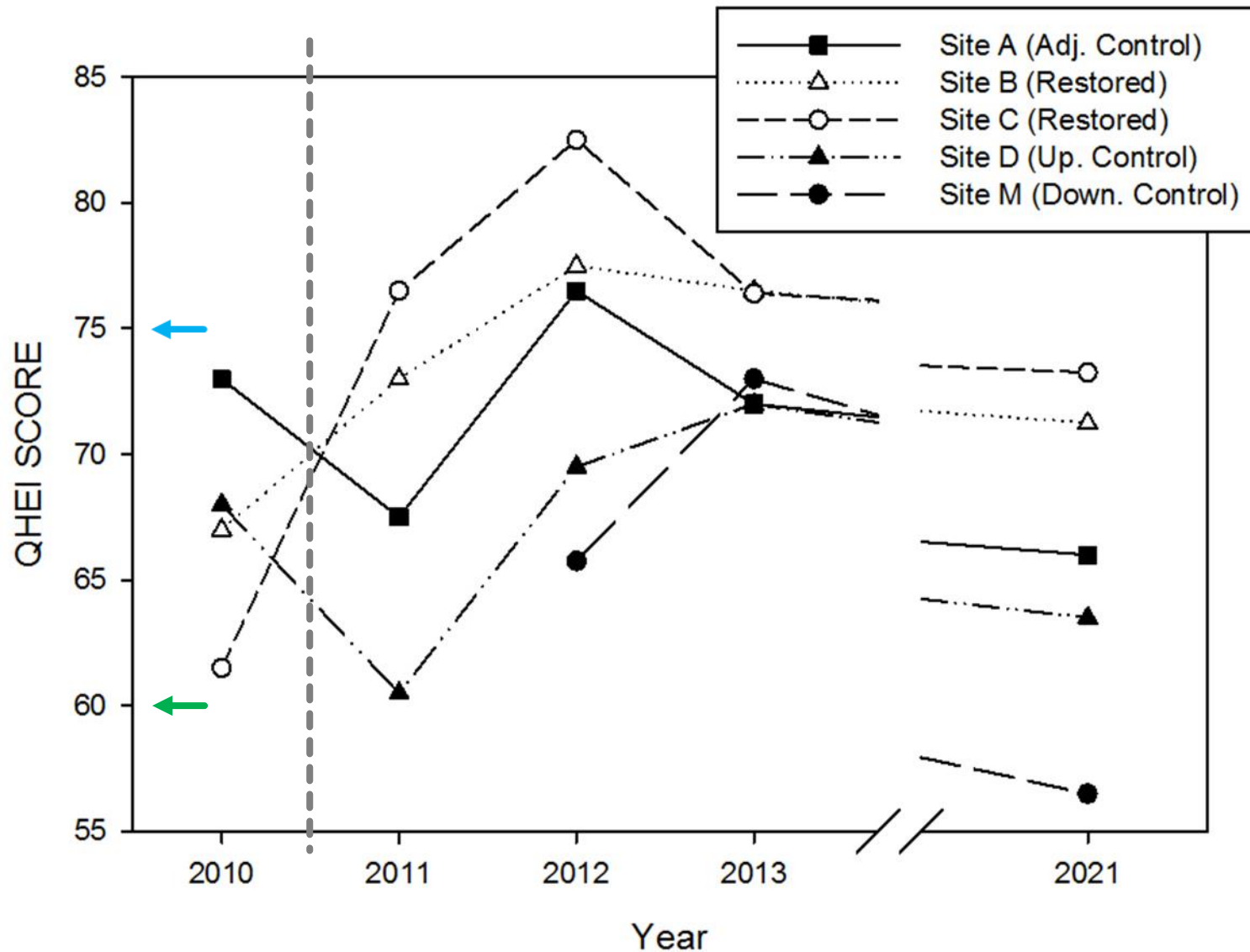


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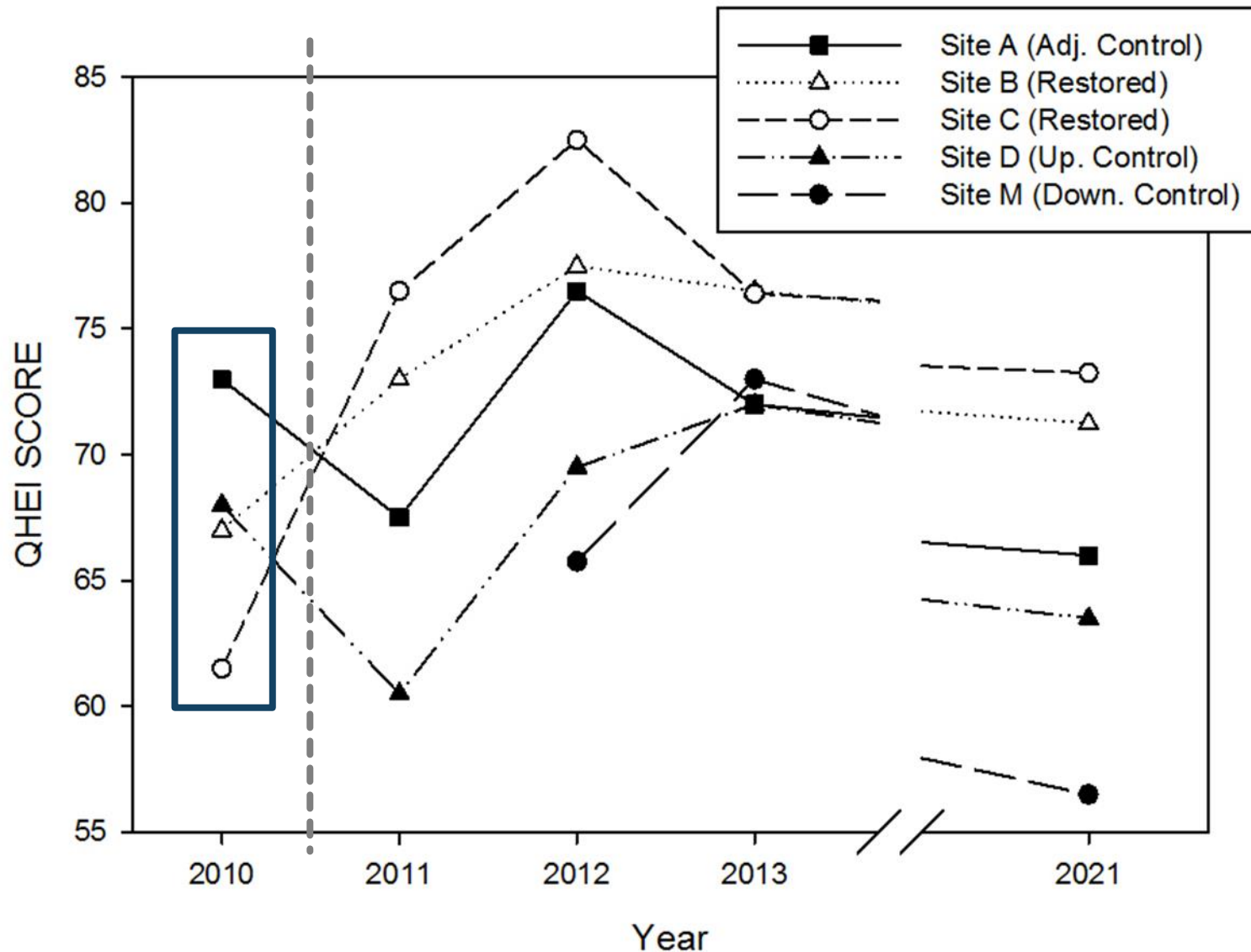
# Qualitative Habitat Evaluation Index scores



- Pre-restoration (spring 2010) scores were all under 75
  - Restored sites lowest
- Restored sites' scores increased after completion of restoration (2011)
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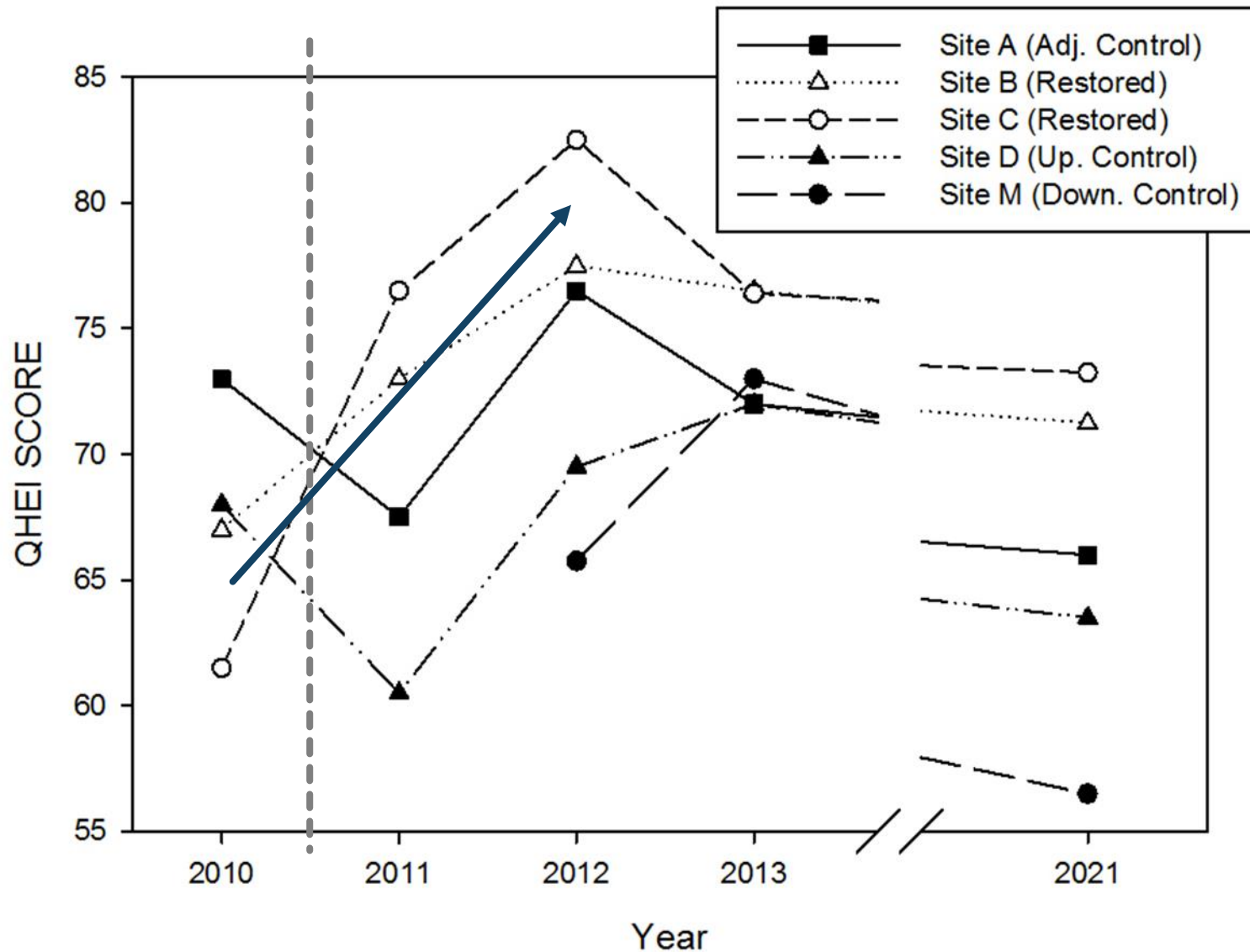


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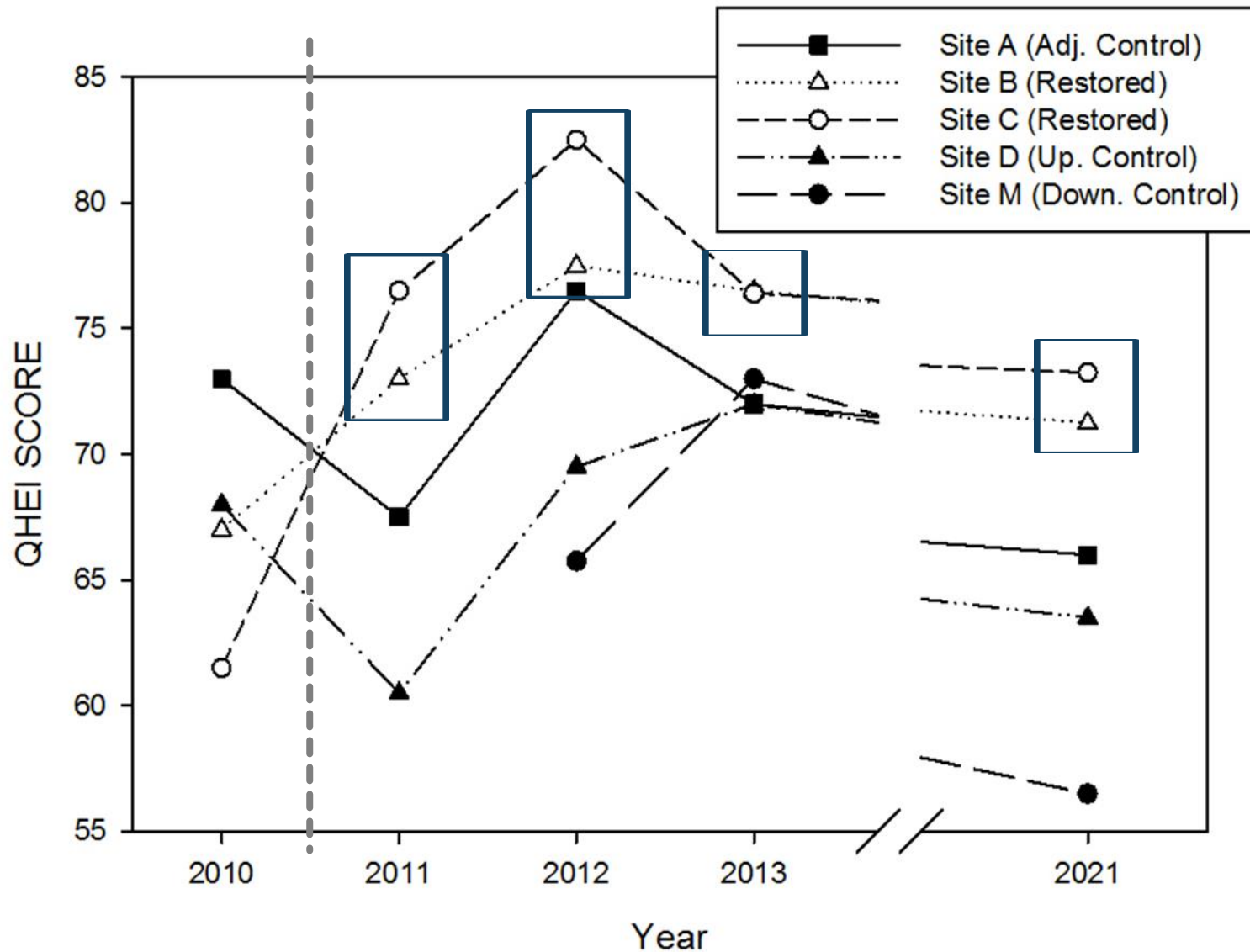
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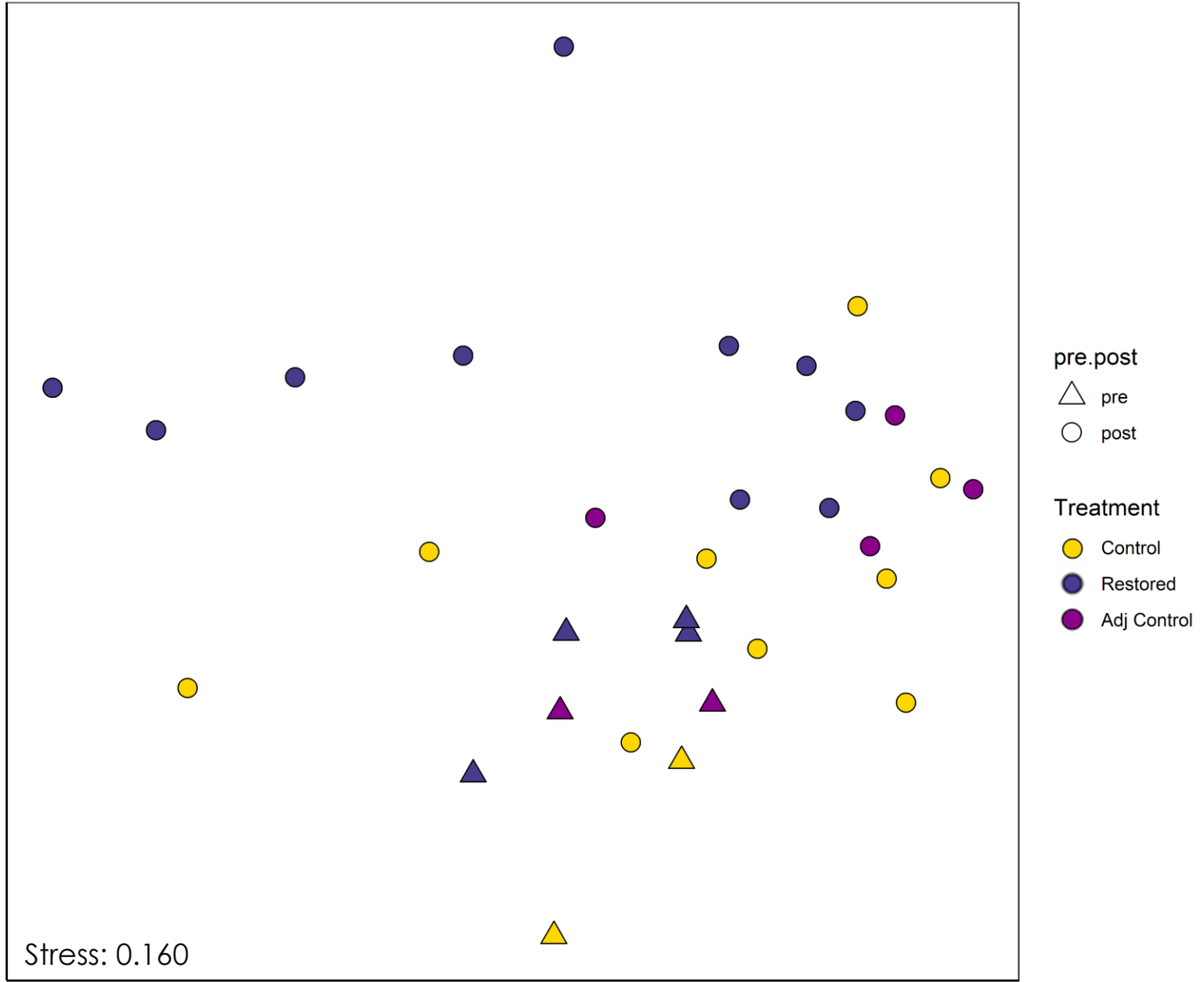


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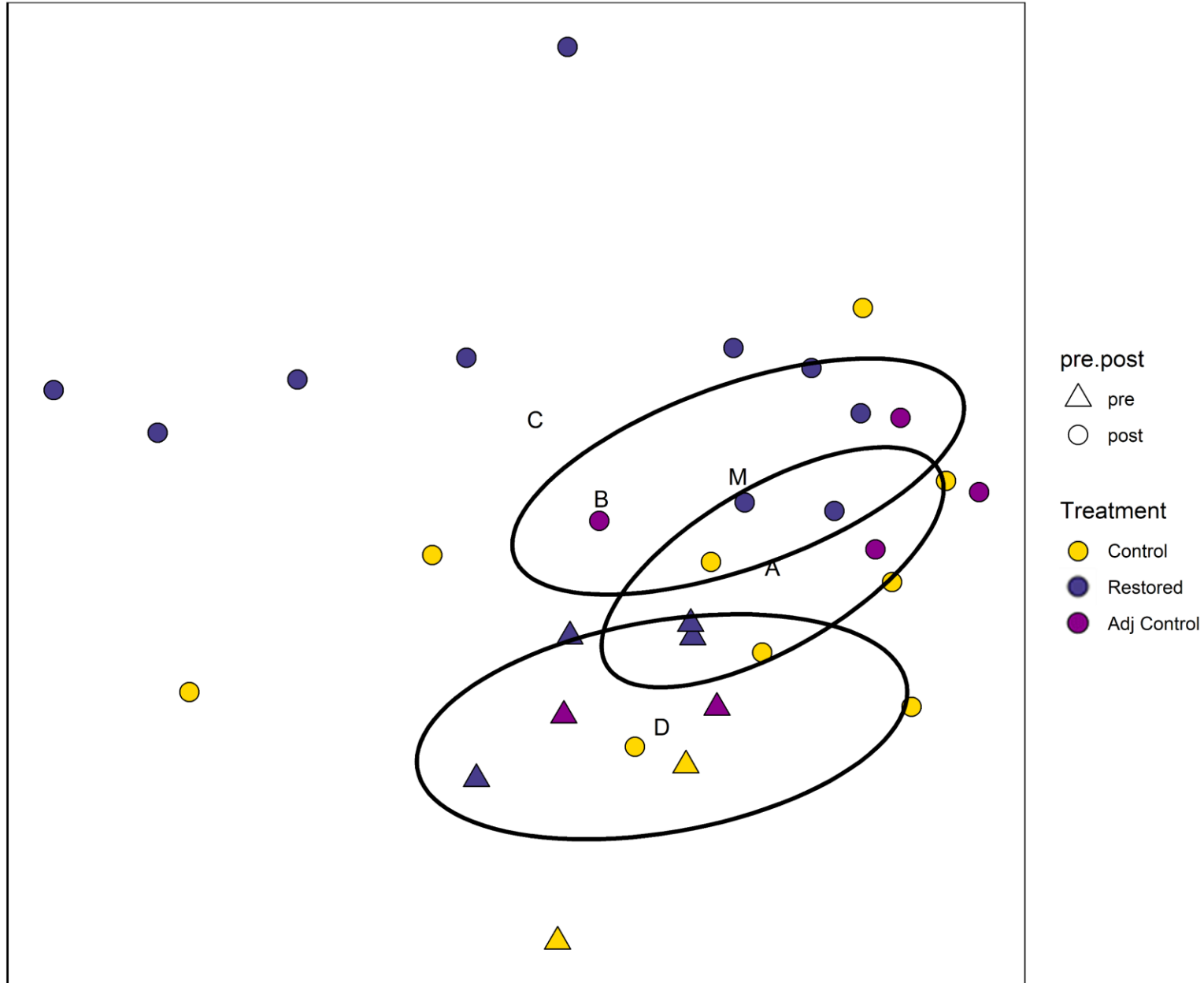
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### Kickapoo Creek NMDS



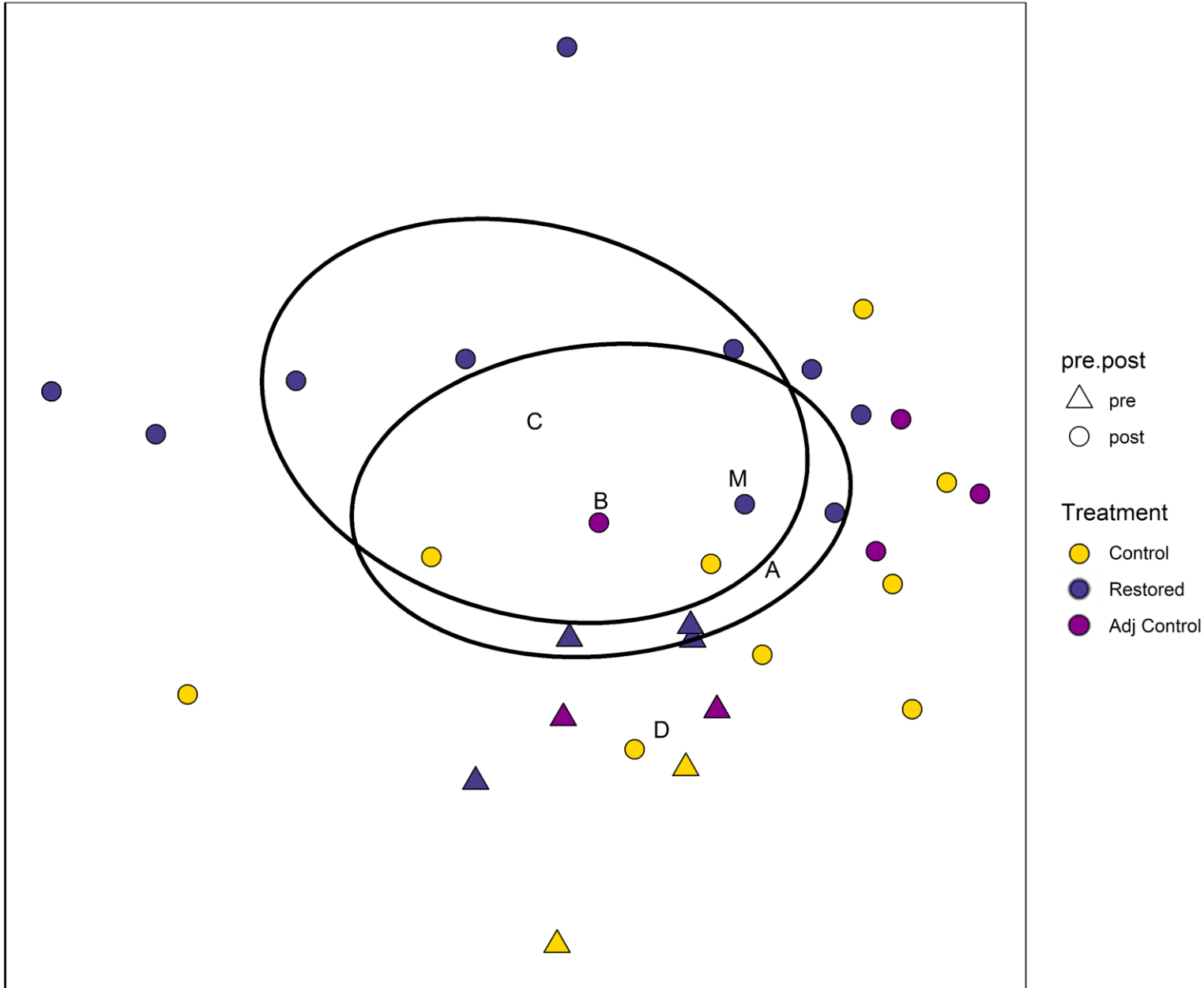
- Restored and control sites did not differ pre-restoration ( $F_{1,3}=1.23, P=0.67$ )
- Restored and control sites did differ post-restoration ( $F_{1,25}=2.50, P=0.03$ )

## Kickapoo Creek NMDS



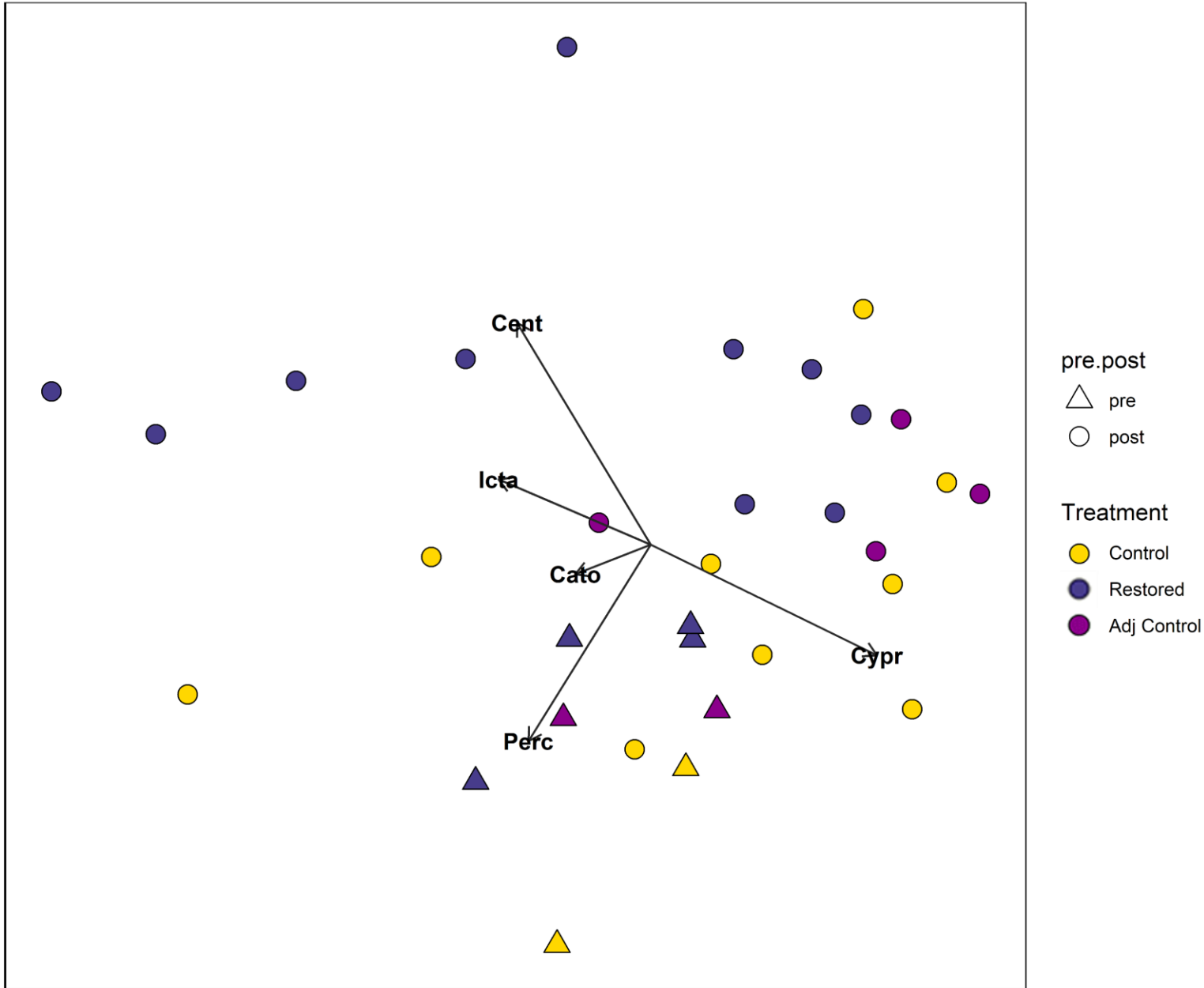
- Ellipses represent one SD based on site centroid in control sites
- Not much change seen in community structure

# Kickapoo Creek NMDS



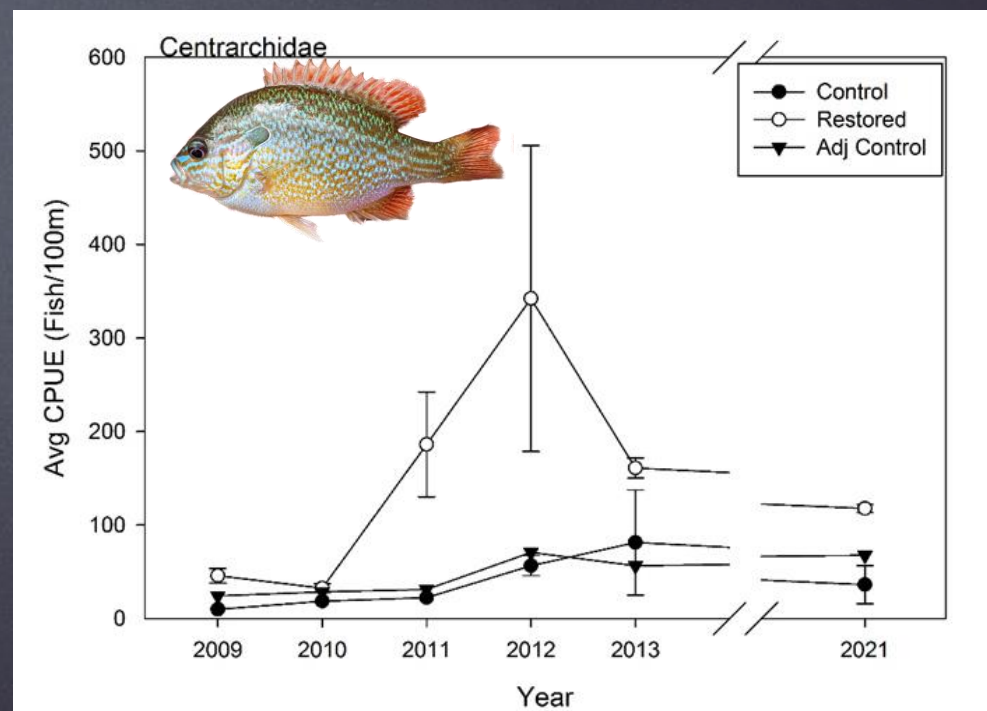
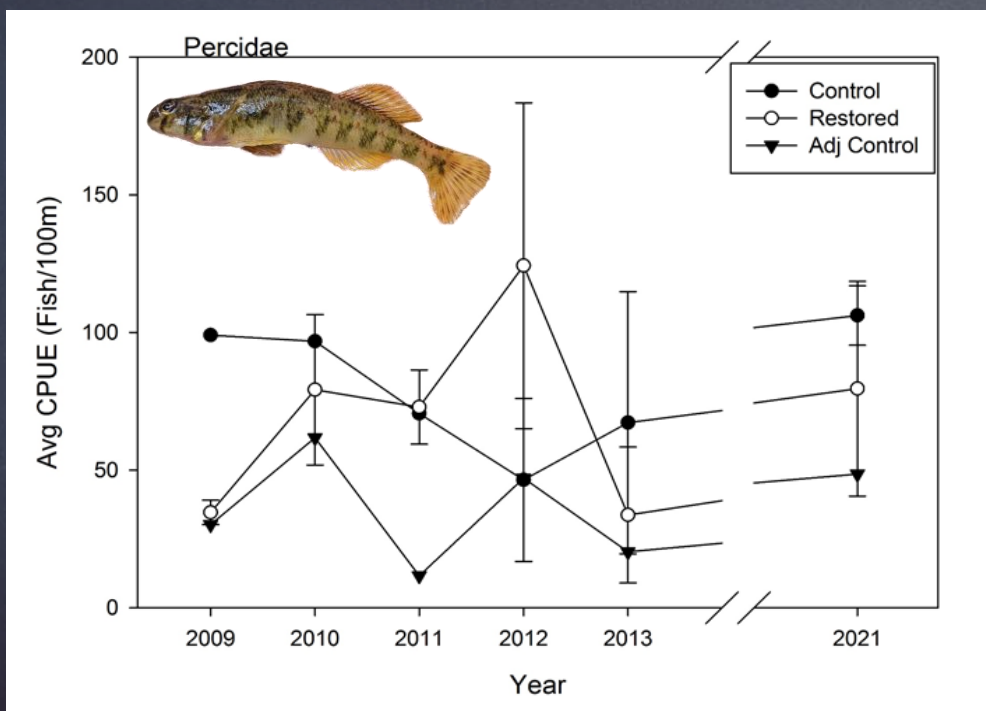
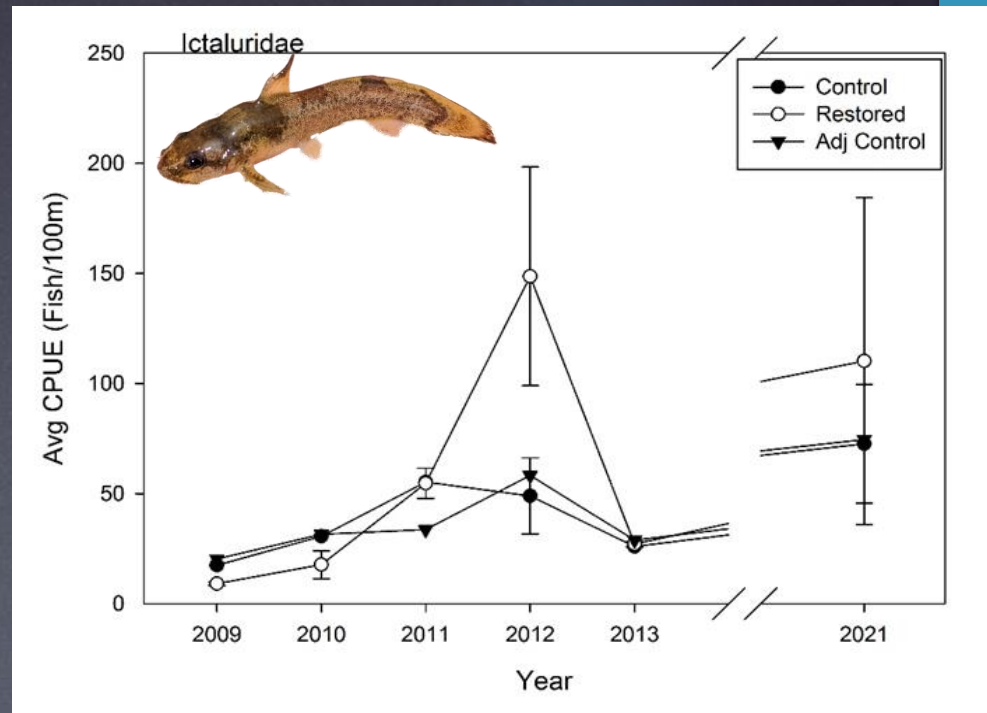
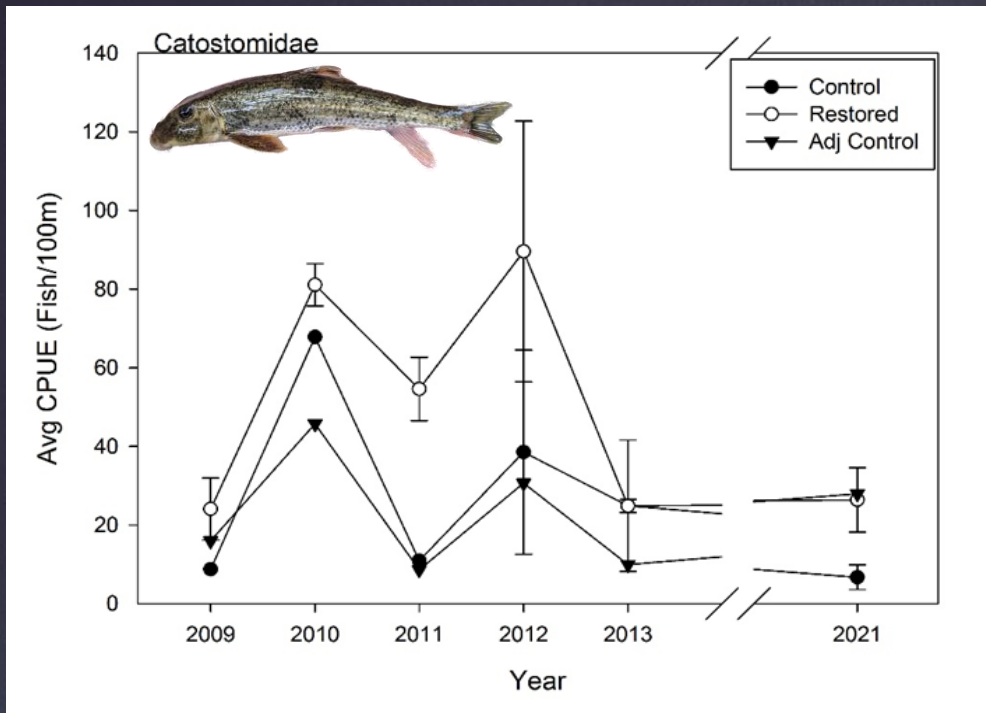
- Ellipses represent one SD based on site centroid in restored sites
- Large shift seen in community structure

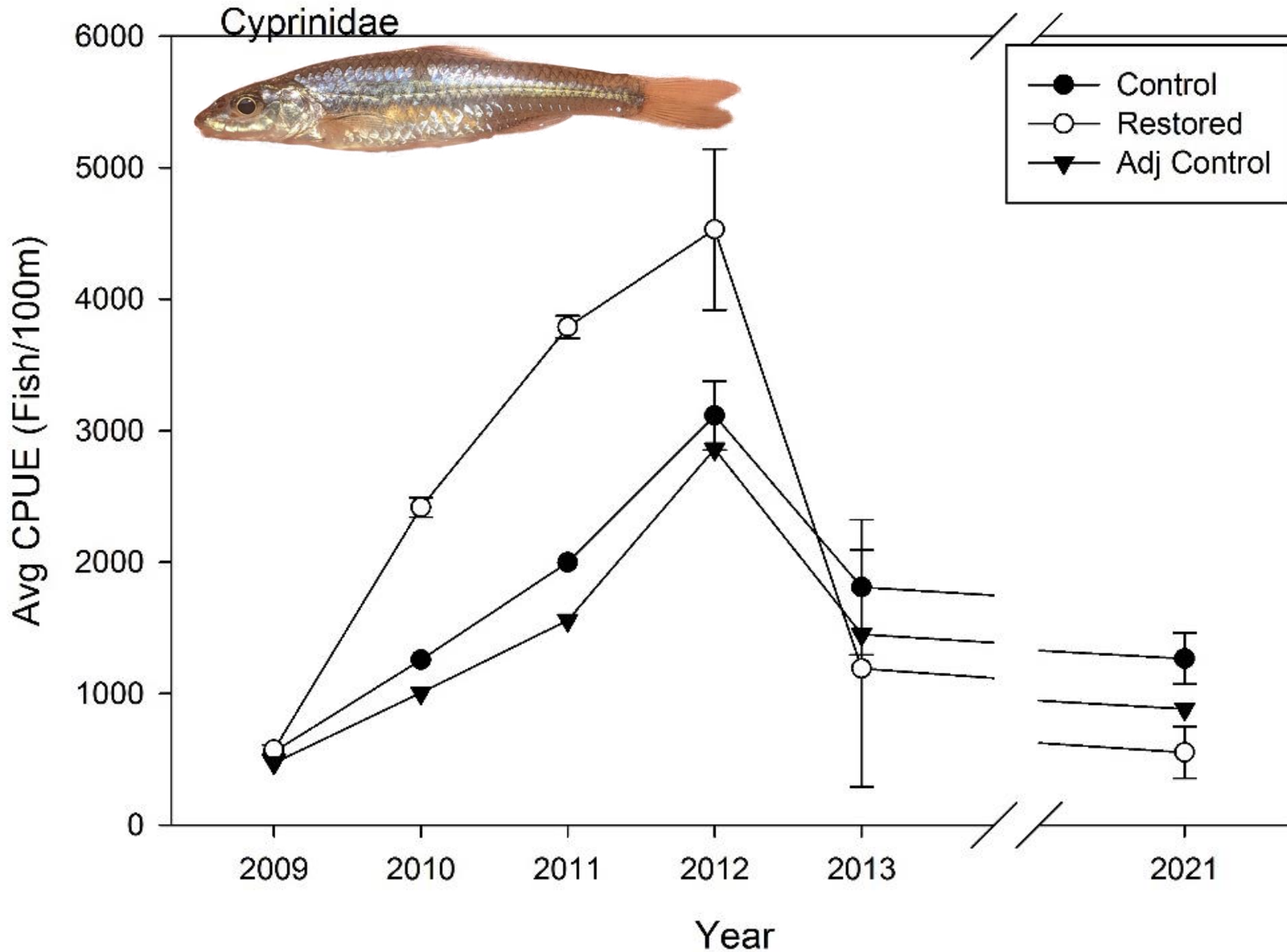
Kickapoo Creek NMDS



- Five fish families
  - Centrarchidae
  - Ictaluridae
  - Catostomidae
  - Percidae
  - Cyprinidae







- More recent years show higher cyprinids in control sites
- Driving force of control sites' community structure

# Conclusions

- Increase seen in species richness and QHEI scores of restored sites when compared to unrestored sites.
  - Improved habitat allows for increased diversity
- Large shift in community structure of restored sites
  - Unrestored site communities stayed relatively clustered
  - Unrestored sites mainly occupied by Cyprinidae



# Future Directions

- Long-term effects of restoration on fishes
  - Three more years of biannual sampling
  - Observe trends in fish community metrics and habitat
- Long-term effects of restoration on macroinvertebrates
  - Four years of biannual sampling



# Questions?

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