Environmental Variance and Dispersal Explain Benthic Diatom Spatial and Temporal Beta Diversity in the Florida Everglades

Nick O. Schulte and Evelyn E. Gaiser

Department of Biology, Florida International University

Florida Coastal Everglades LTER

Acknowledgements

- Evelyn Gaiser
- John Kominoski
- Sylvia Lee
- Eric Sokol
- Joel Trexler

FIU
FLORIDA INTERNATIONAL UNIVERSITY

FCE LTER

U.S. Army Corps of Engineers®

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
PROTECTION OF THE EVERGLADES SINCE 1949

NATIONAL PARK SERVICE

Phycological Society of America

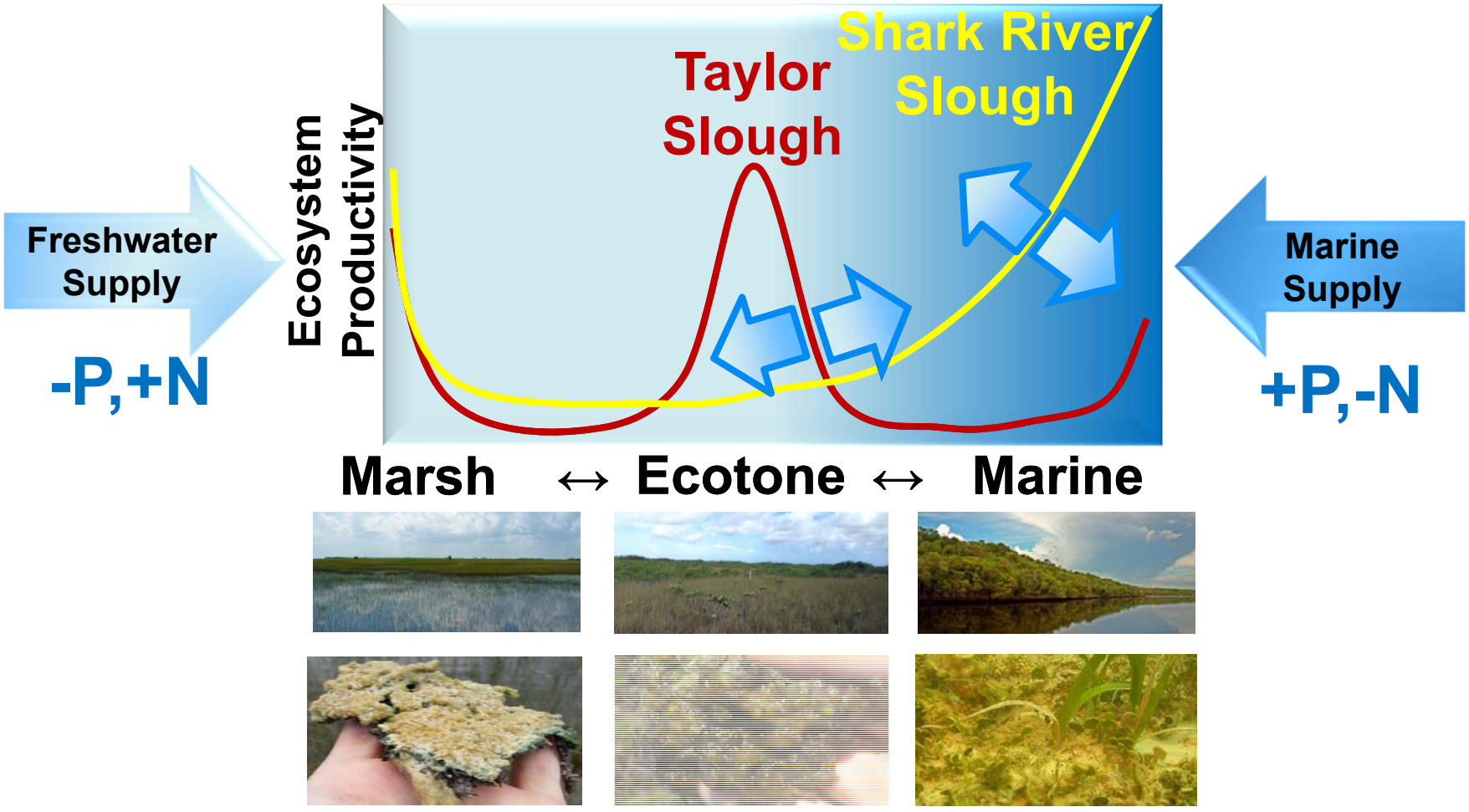
Introduction

Introduction: Everglades restoration

- Restore oligotrophic freshwater flow
- Mitigate effects of saltwater intrusion
- Oligohaline ecotone environmental & species diversity

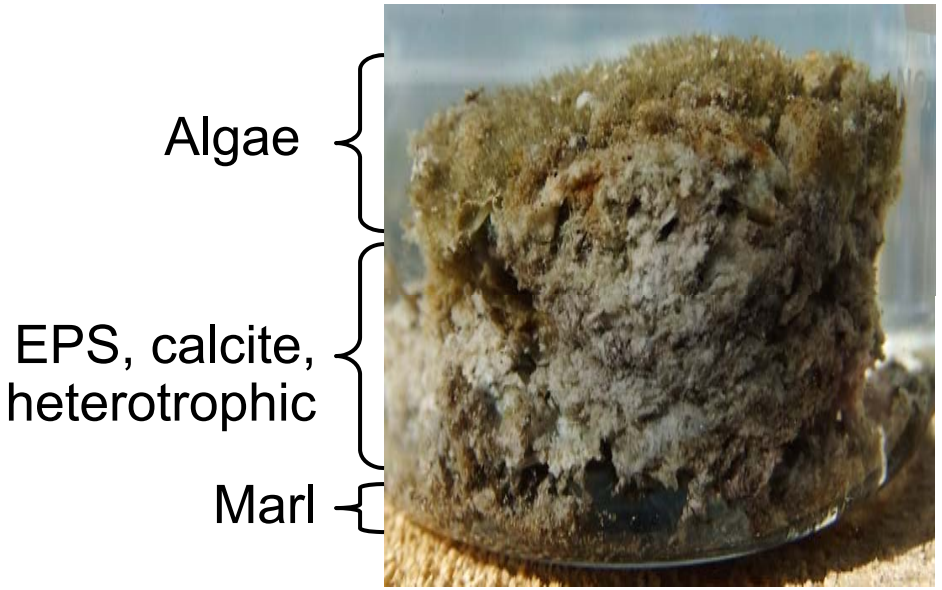
Introduction: FCE LTER

- Ecotone primary producer composition regulated by phosphorus, salinity, hydrology



Introduction: Periphyton

- Periphyton roles
- Composition

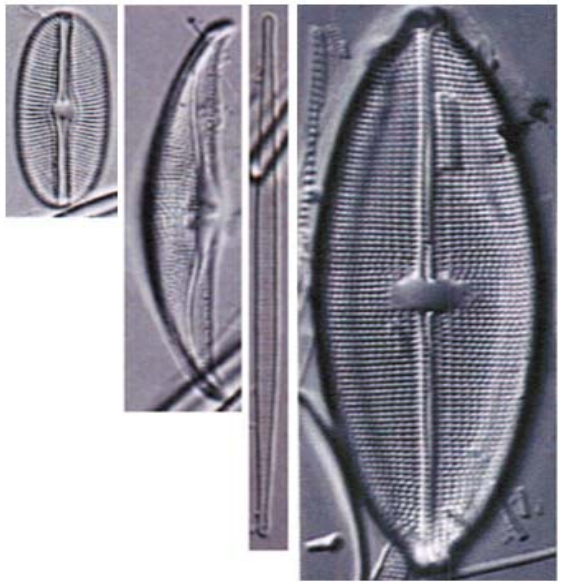


Introduction: Diatoms

- Unicellular, siliceous microalgae
- Sensitive to environmental & spatial heterogeneity

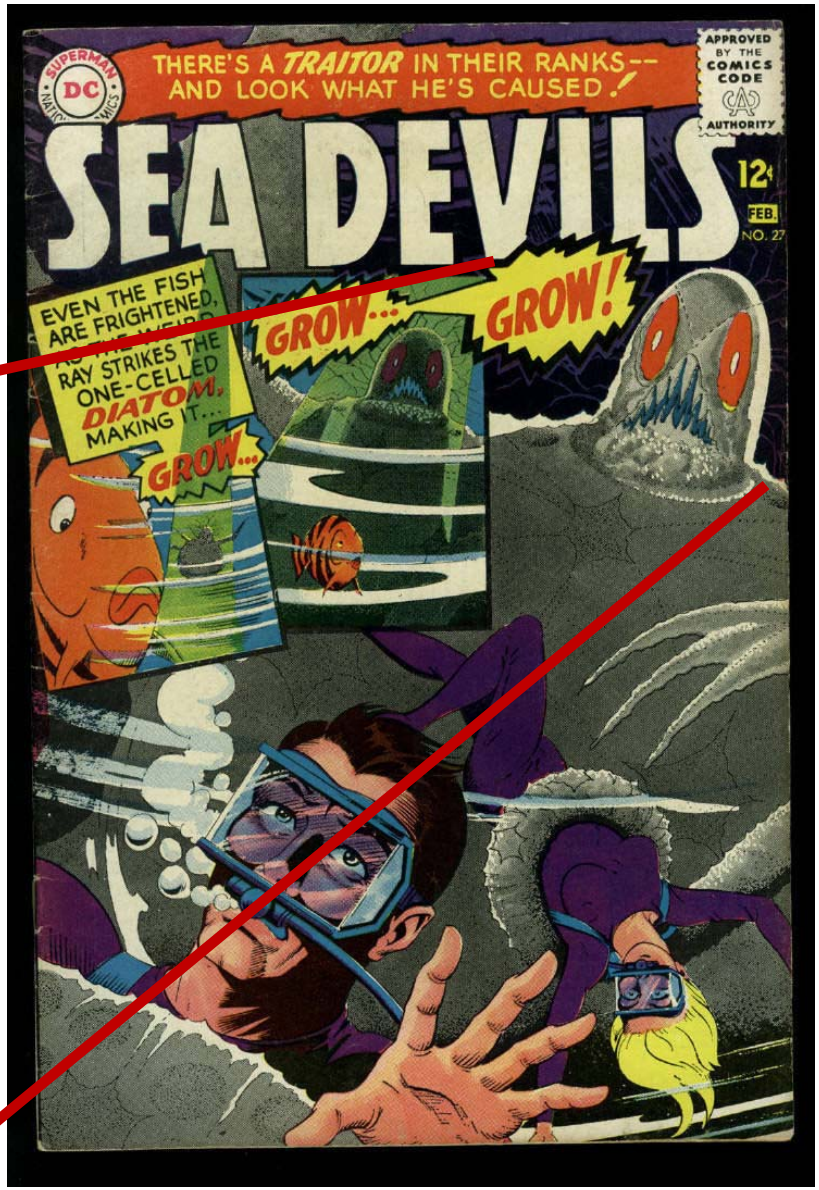
Freshwater

Oligohaline



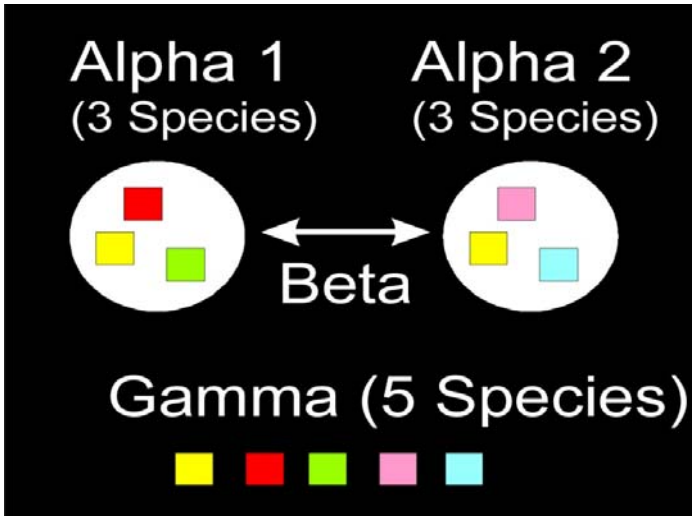
Introduction: Diatoms

- Indicators of water quality changes



Introduction: Beta diversity (β)

- Metacommunity framework
- Species turnover
  - Difference in species composition between:
    - 2+ local communities
    - Local and regional communities
- Spatial and temporal



Introduction: Microbial community structure

- Ecosystem structure & function
- Controls on microbial assembly unresolved
  - Particularly in Everglades ecotone
    - Sensitive to changes from SLR

Objectives

Objectives: Q_1 and H_1

- Q_1: How do spatial and temporal diatom β compare among freshwater and oligohaline?

- H_1: Oligohaline higher than freshwater

Objectives: Q_2 and H_2

- Q_2: What is natural environmental variance in freshwater and oligohaline?

- H_2: Oligohaline higher than freshwater

Objectives: Q_3 and H_3

- Q_3: What environmental variables explain freshwater and oligohaline β across sites and years?

- H_3: Both → Phosphorus & conductivity

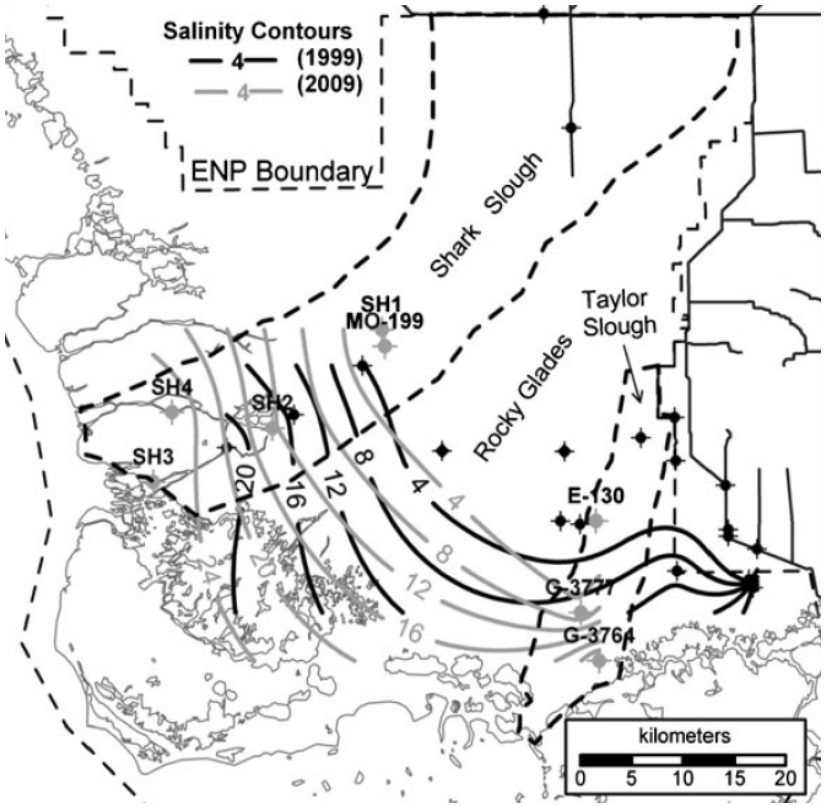
  Freshwater → Hydroperiod & periphyton quantity

  Oligohaline → Periphyton quality

Methods

Methods: Site selection

- CERP MAP sites
  - 2006 – 2013
  - 8 freshwater
  - 8 oligohaline



Saha *et al.* 2011

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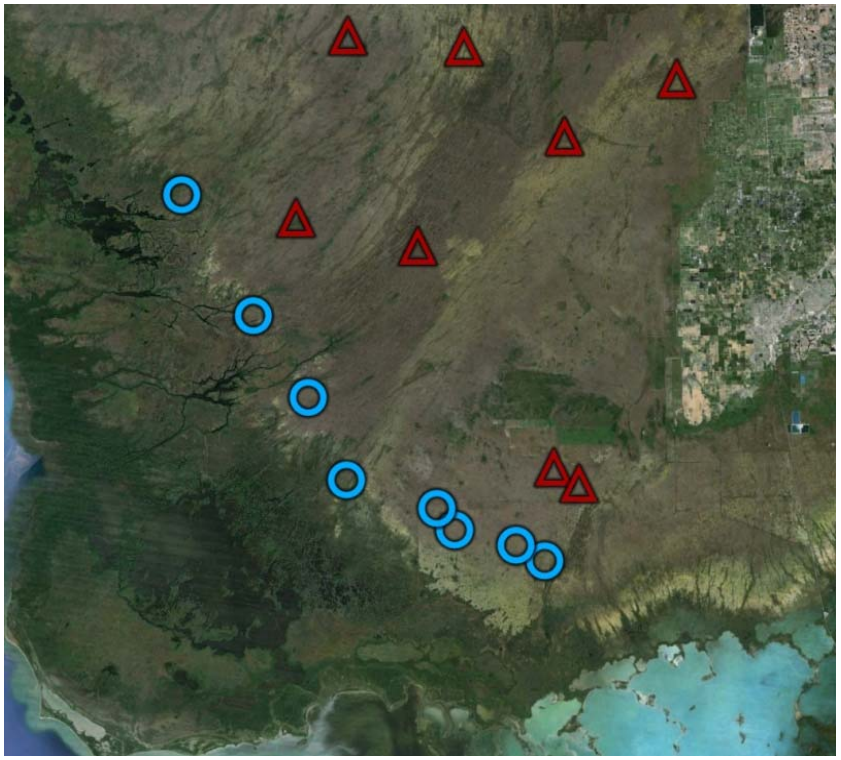


CERP MAP oligohaline (O) and freshwater (Δ) sites

Methods: Data collection

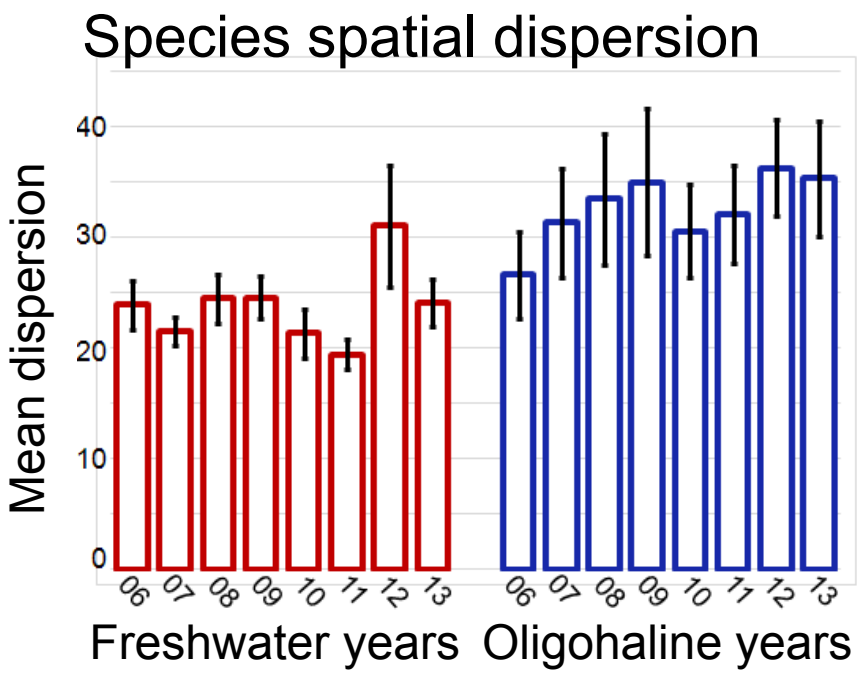
- Hydrology
  - Hydroperiod
  - Conductivity
- Periphyton quantity
  - Biovolume
  - Ash-free dry mass
- Periphyton quality
  - % Phosphorus
  - % Organic content
- Diatom composition

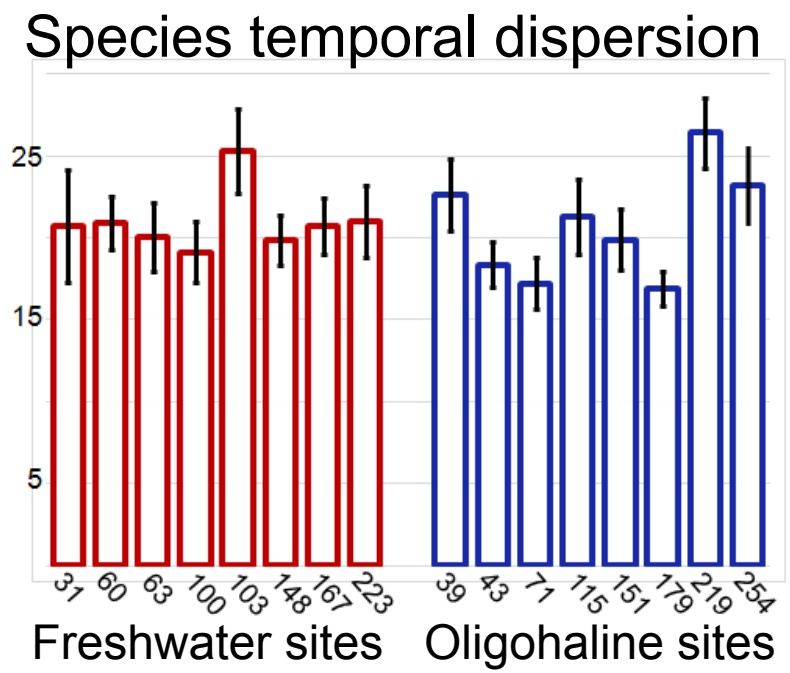
Methods: Data analysis

- Tests of homogeneity of dispersion
  - Variability of β
- "BEST" analyses
  - Variables explaining β
- Variation partitioning
  - Categorize explanatory factors of β

Results

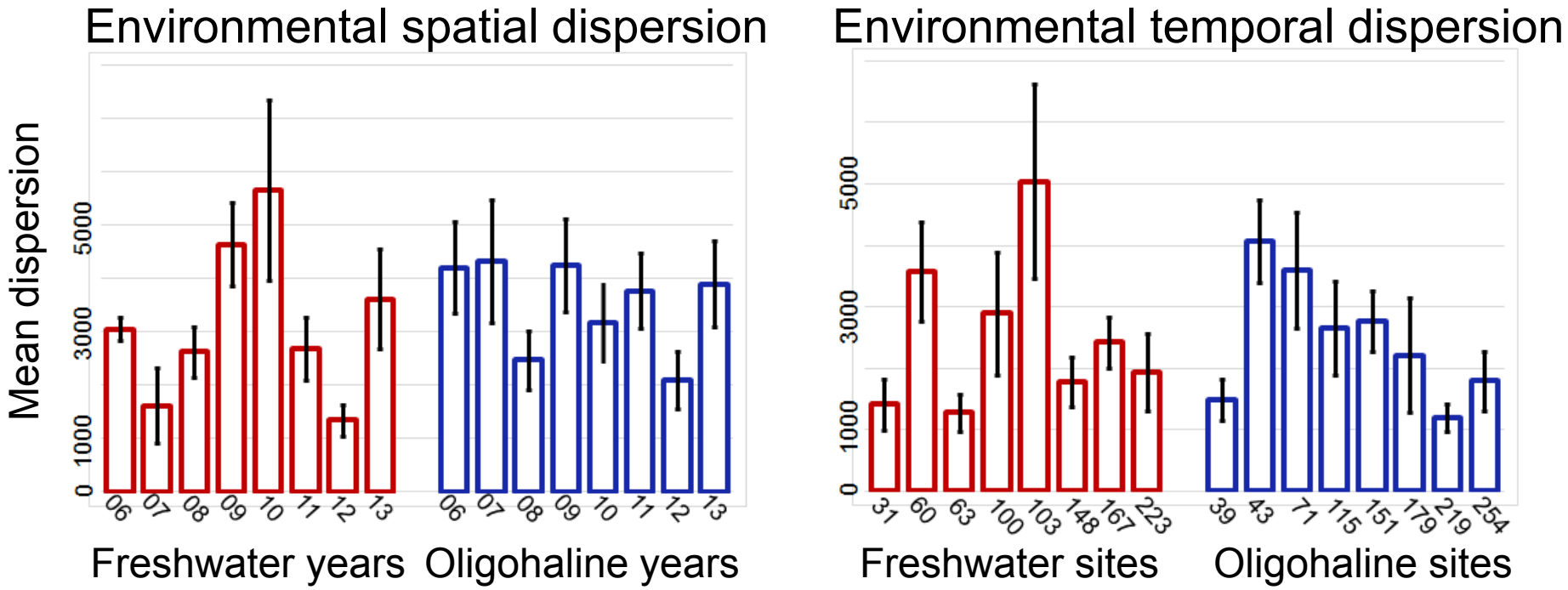
H_1 Results: Species dispersion





- Higher spatial β in oligohaline
- Low temporal β difference between regions

H_2 Results: Environmental dispersion



- Higher spatiotemporal variability in freshwater

H_3 Results: Explanations of β

Region	ρ	Explanatory Variables (no order)				
All	0.599	COND	BIOV	TP	OC	WD
Freshwater	0.373	BIOV	COV	AFDM	WD	HYDRO
Oligohaline	0.379	OC	DM	WD	HYDRO	

- Both → Conductivity & phosphorus
- Freshwater → Hydroperiod & periphyton abundance
- Oligohaline → Periphyton quality & hydroperiod

Discussion

- Both regions → environmental controls?
  - Low dispersal between regions?
- Freshwater β → dispersal limitation?
  - Low environmental correlation despite high variability
- Oligohaline β → species interactions?
  - Low environmental correlation and variability

Ongoing and future work

Discussion: Ongoing and future work

- Contributions of dispersal-based factors
- Species interactions
- Diatom & periphyton community structure change
- Using diatoms to monitor ecotone change

Conclusions

Conclusions

- More species turnover across oligohaline region
- Low temporal change within sites in both regions
- More environmental variance in freshwater
- Regional β explained by environmental differences
- Local β likely influenced by dispersal & species interactions

Questions?

Stephanocyclus meneghiniana??