

Biology and Ecology of Invasive Eurasian Milfoil (*Myriophyllum spicatum*) in Mobile Bay, Alabama

Charles W. Martin¹ and John F. Valentine²

¹University of South Alabama &
Dauphin Island Sea Lab



Invasive Species

"We must make no mistake: we are seeing one of the great historical convulsions in the world's fauna and flora."

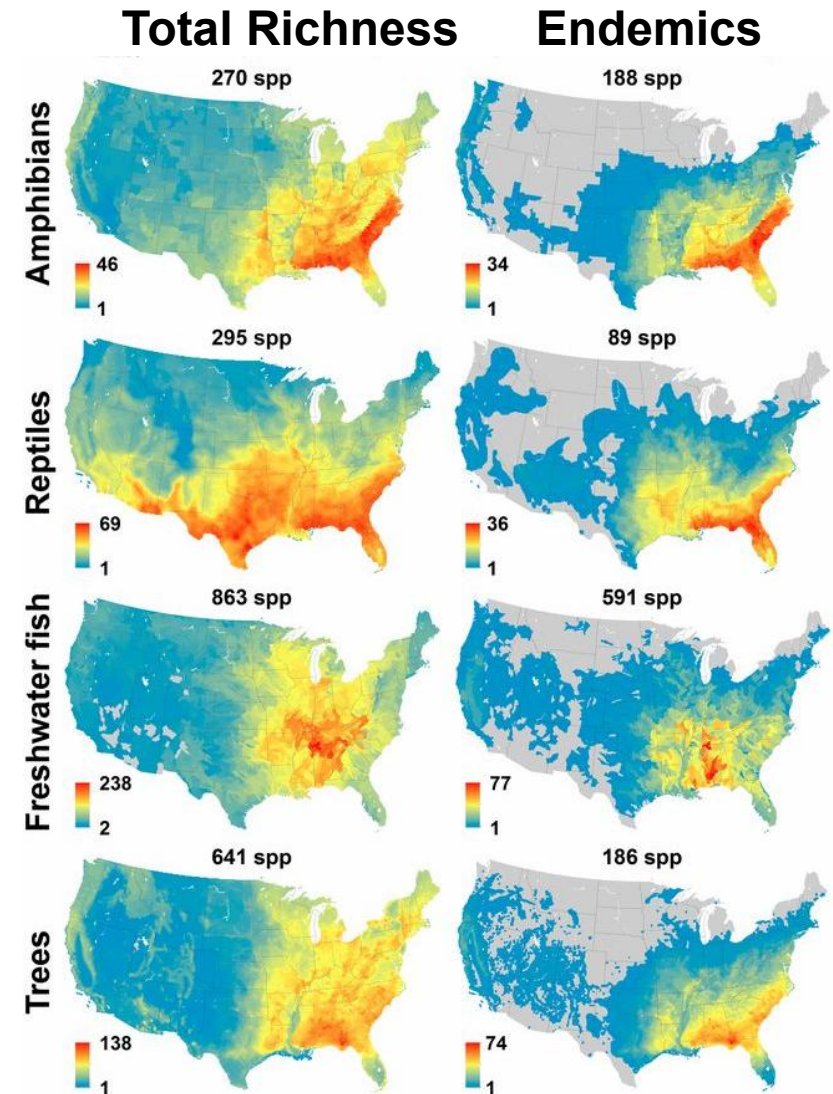
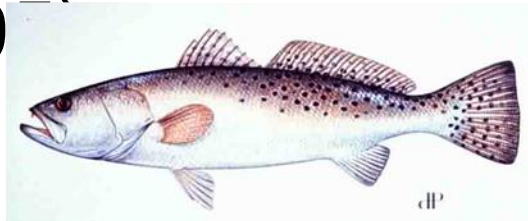
-Charles Elton (1958) in *The Ecology of Invasions by Plants and Animals*



Source: World Conservation Monitoring Centre, "Global Biodiversity" Chapman & Hall, London

The Mobile-Tensaw Delta: a biodiversity hotspot

- Mobile-Tensaw Delta is the only national wildlife refuge that supports more than 100 native taxa
- Established in 1991 as a "hotspot" for biodiversity



From: Jenkins et al. 2015

Eurasian Milfoil (*Myriophyllum spicatum*) in Mobile Bay, Alabama

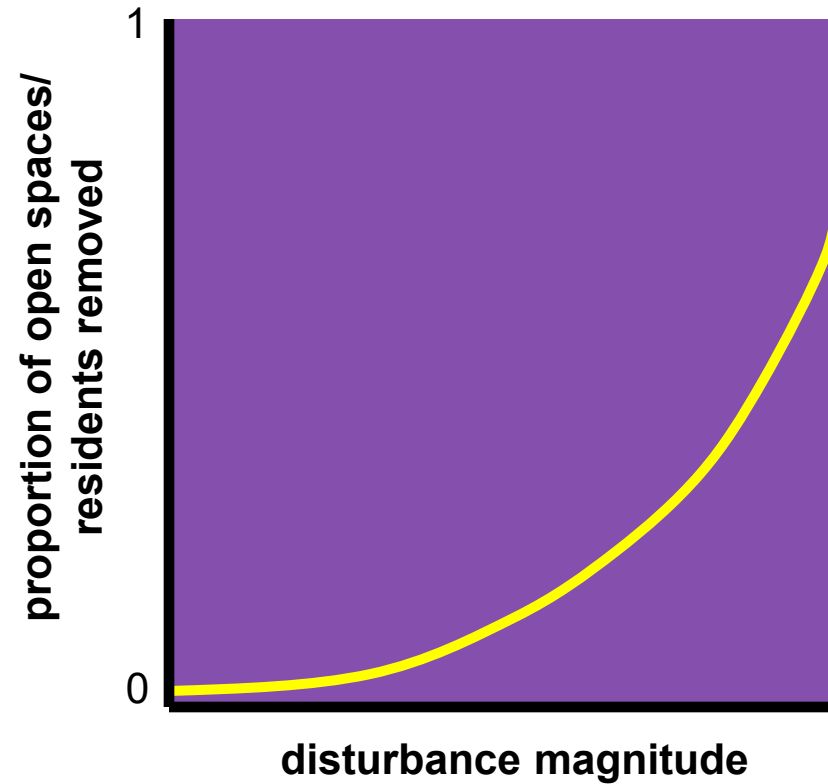


Talk Outline

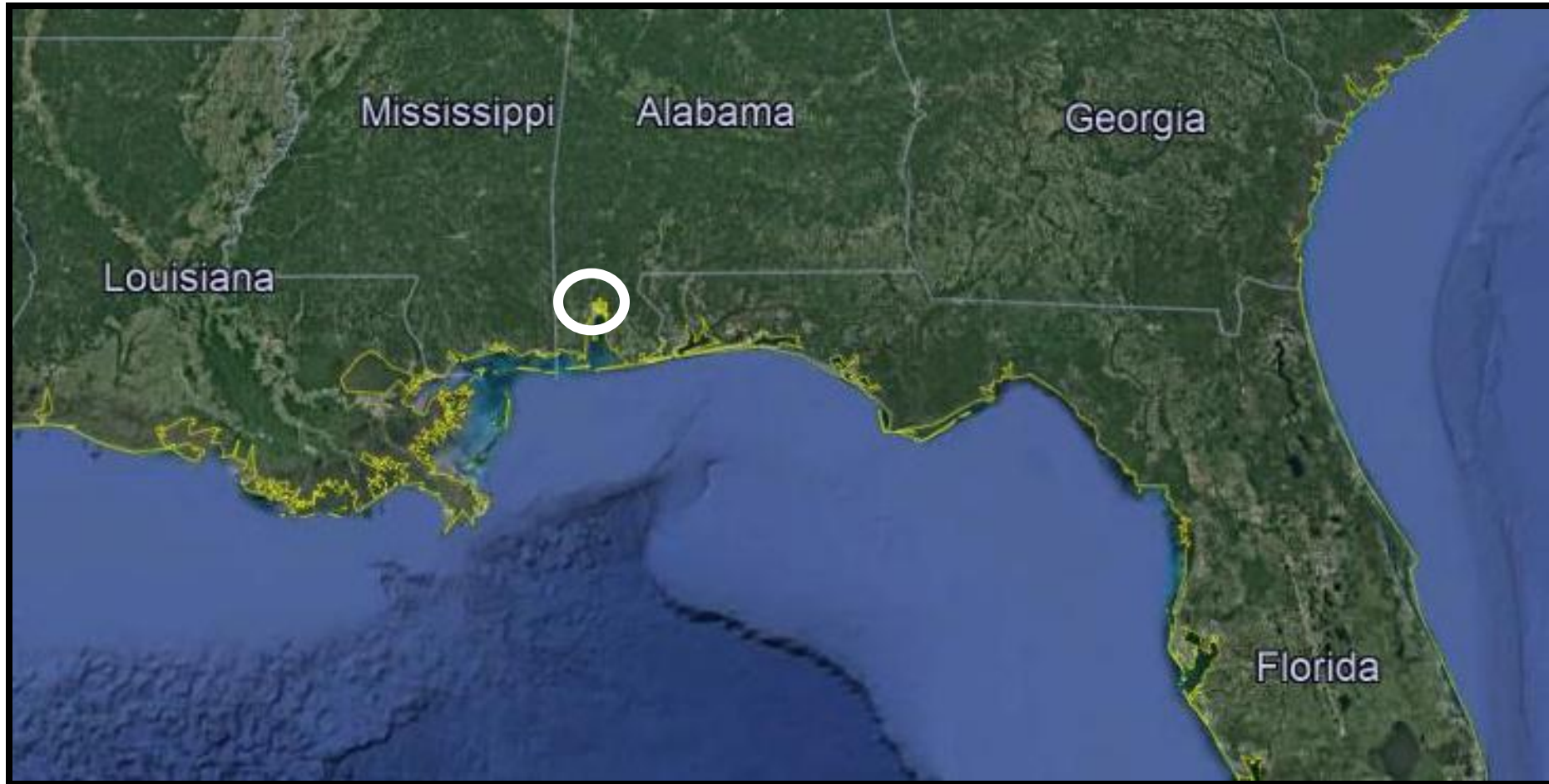
1. What factors influence the distribution of Eurasian milfoil?
2. How does milfoil influence nekton?
 - Are community composition patterns different than native SAV?
 - Is the invasion of this complex macrophyte a “trophic dead-end” for higher trophic levels?

Disturbance Theory: how do invasive species become established?

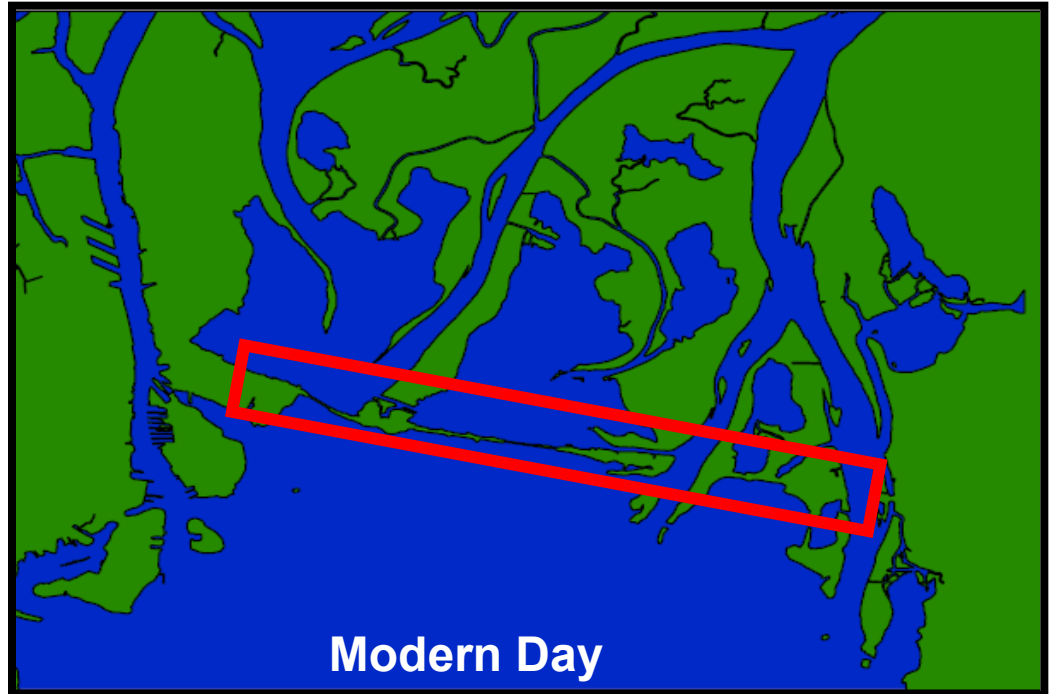
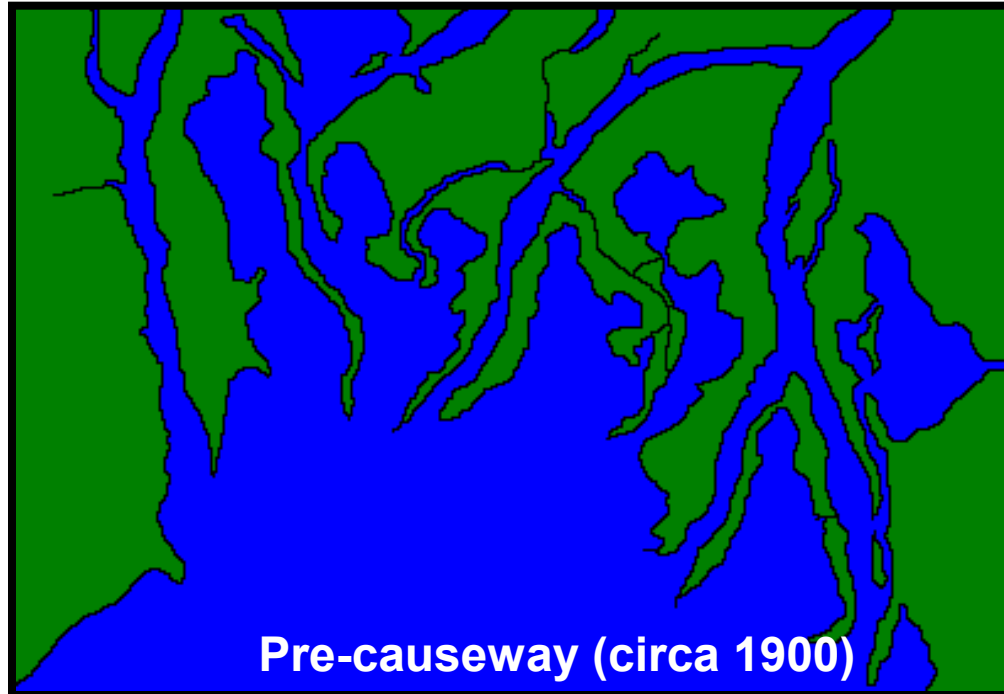
- The greater the disturbance, the more habitat becomes available!



The Highway 90 Causeway



The Highway 90 Causeway



In the 1920s an earthen causeway was constructed across Mobile Bay. This is potentially an ecosystem-wide disturbance.

1927





**City of
Mobile**



The Causeway

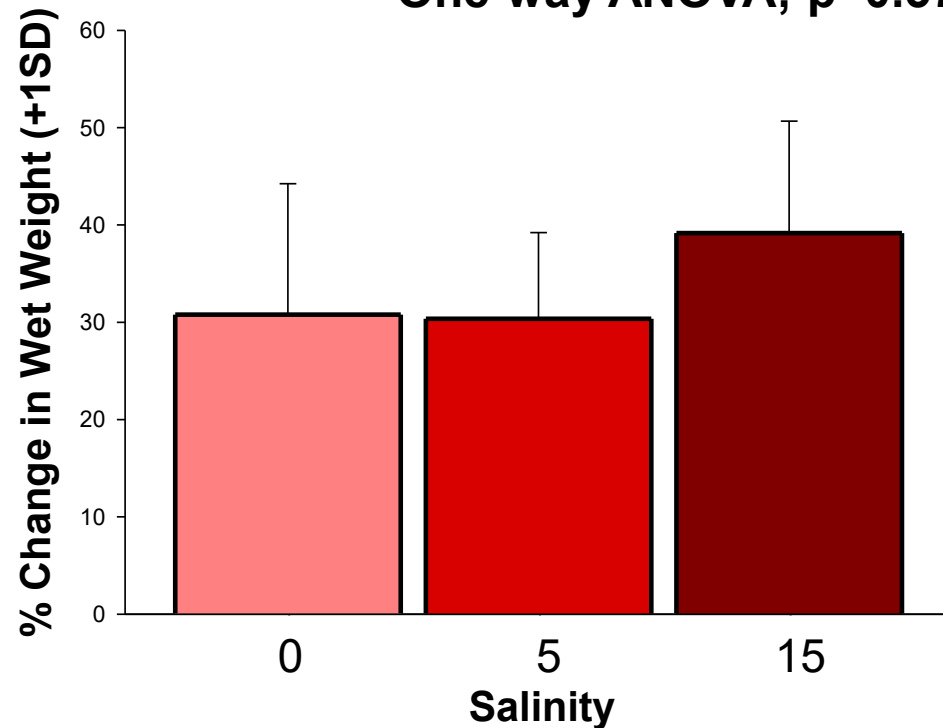


What controls milfoil distribution in Mobile Bay?

- Milfoil is most successful north of the causeway



One-way ANOVA; $p=0.57$

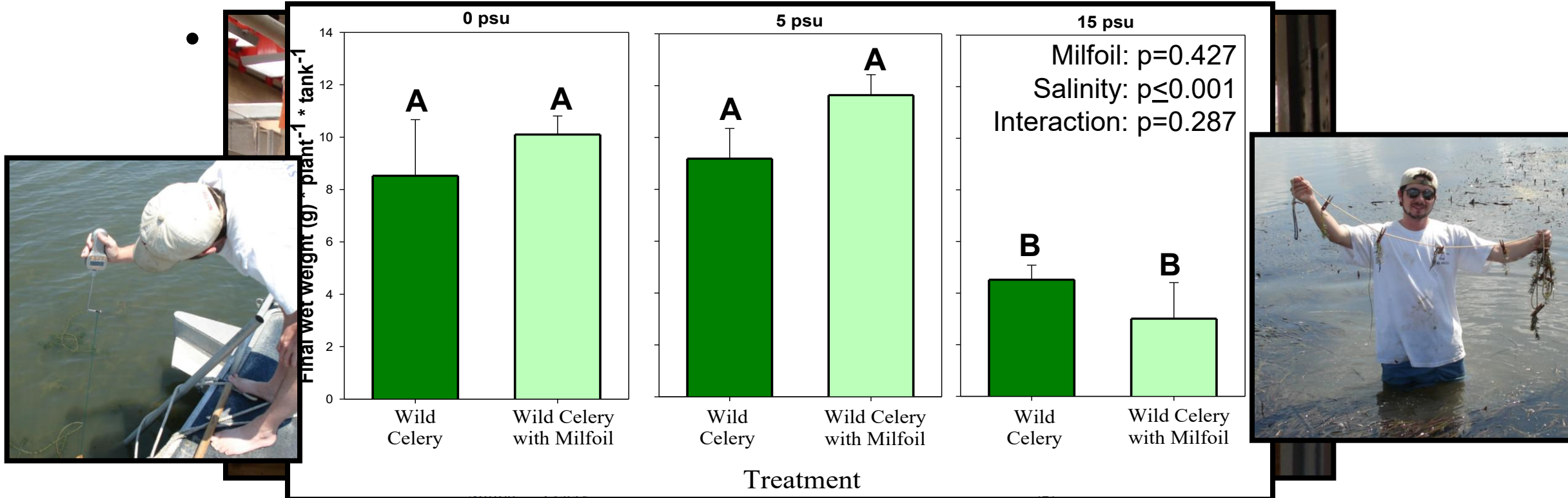


Martin, C.W. and J.F. Valentine. 2012. *Marine Ecology Progress Series* 449:109-119.

Martin, C.W. and J.F. Valentine. 2014. *Hydrobiologia* 727(1):177-184.

What controls milfoil distribution in Mobile Bay?

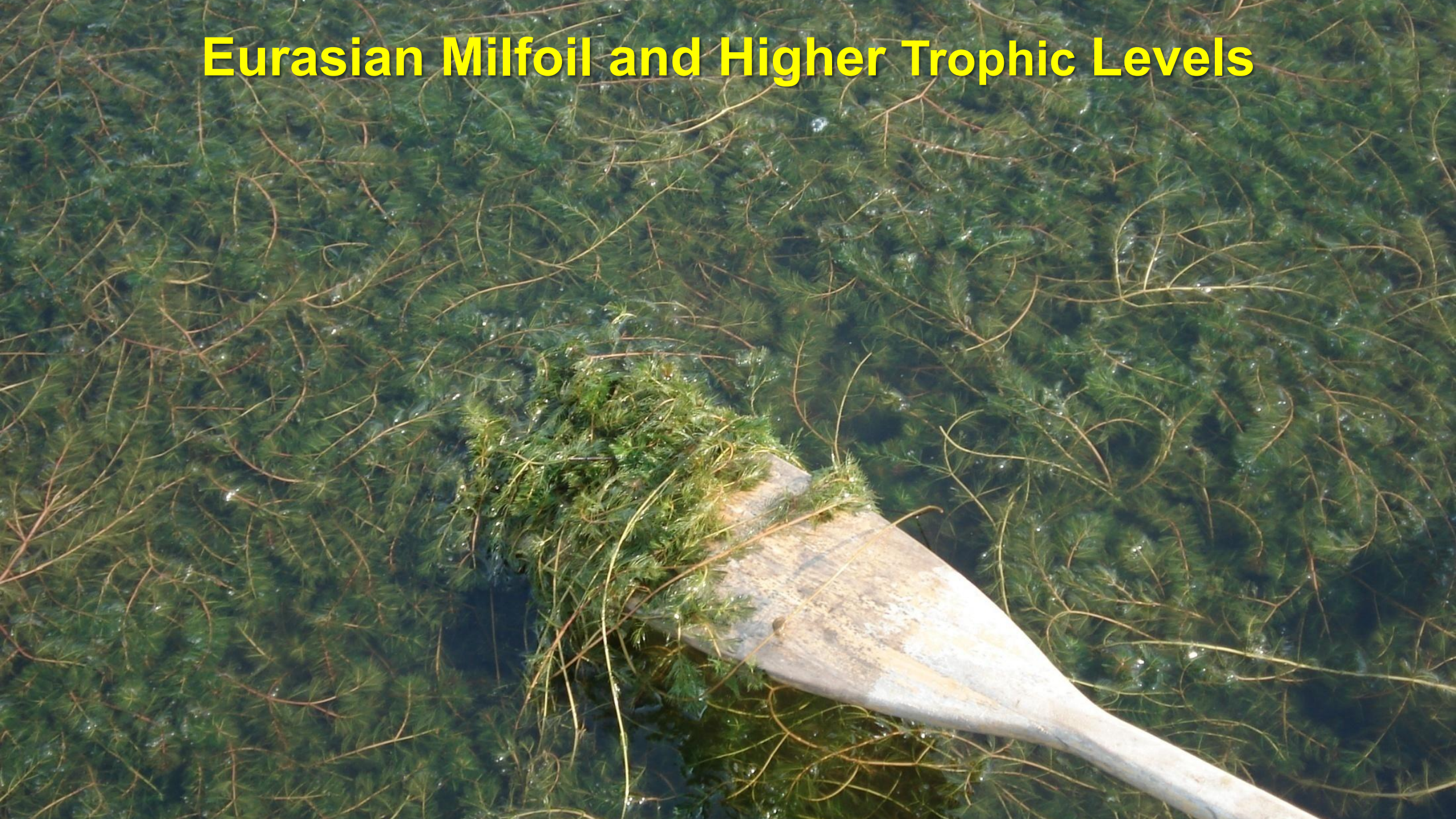
- Milfoil is most successful north of the causeway
- Salinity tolerance is high
- Milfoil does not competitively exclude native species



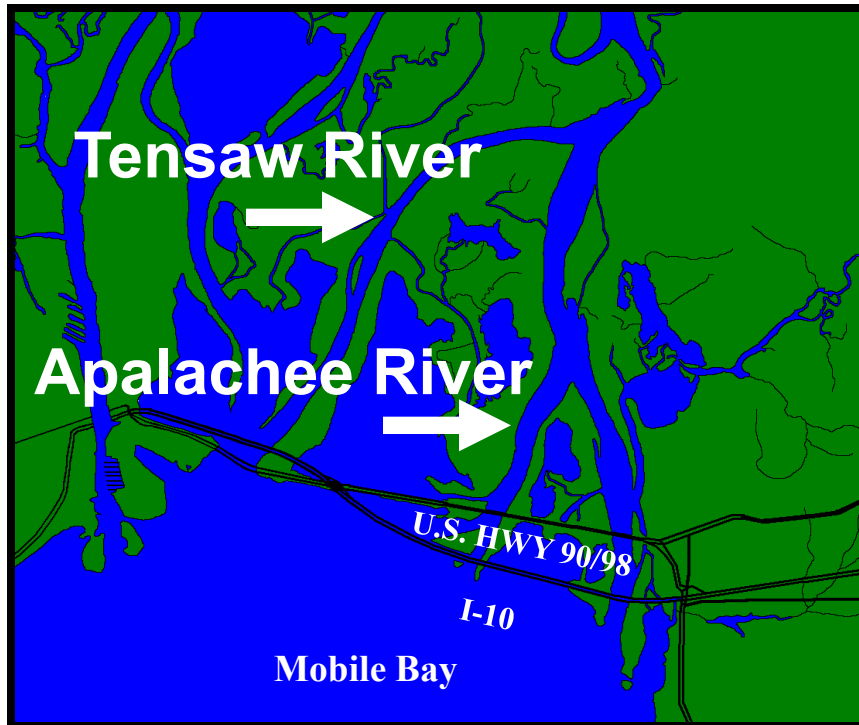
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Martin, C.W. and J.F. Valentine. 2014. *Hydrobiologia* 727(1):177-184.

Eurasian Milfoil and Higher Trophic Levels

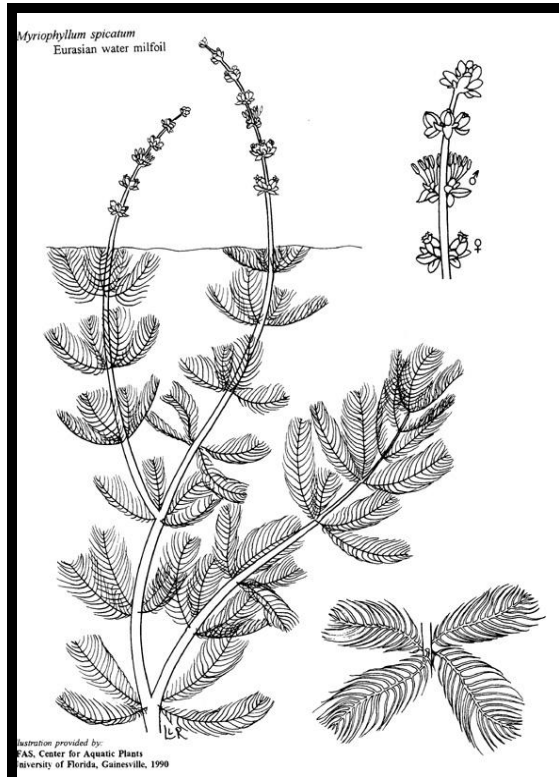


Nekton Collection in Milfoil



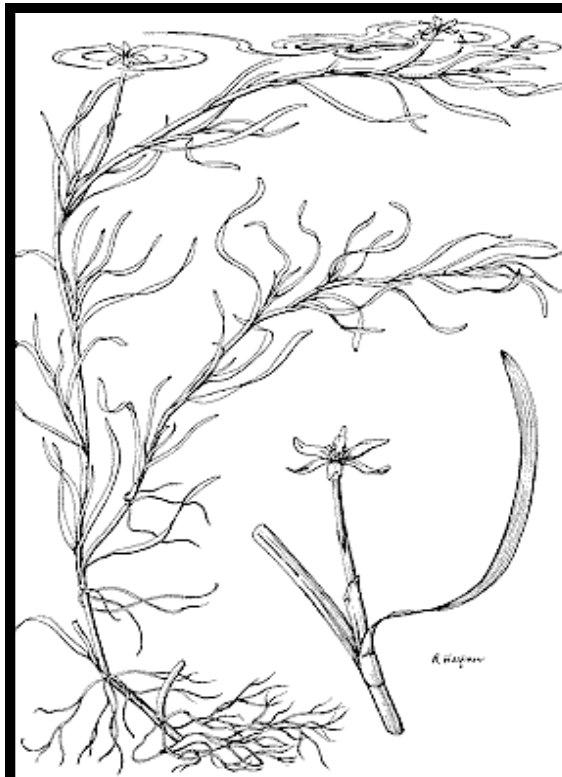
Bimonthly collections along each river
from June-October in 3 SAV species





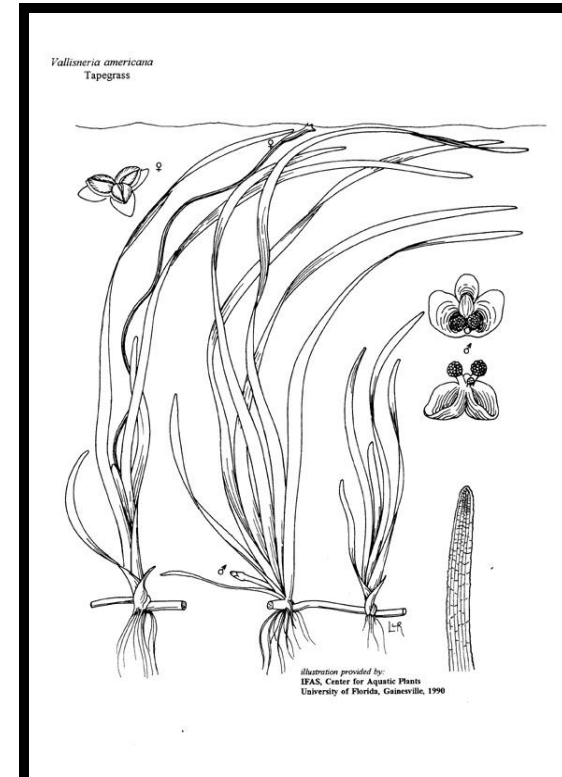
Eurasian Milfoil
(*Myriophyllum spicatum*)

D = 1.93



Stargrass
(*Heteranthera dubia*)

D = 1.23



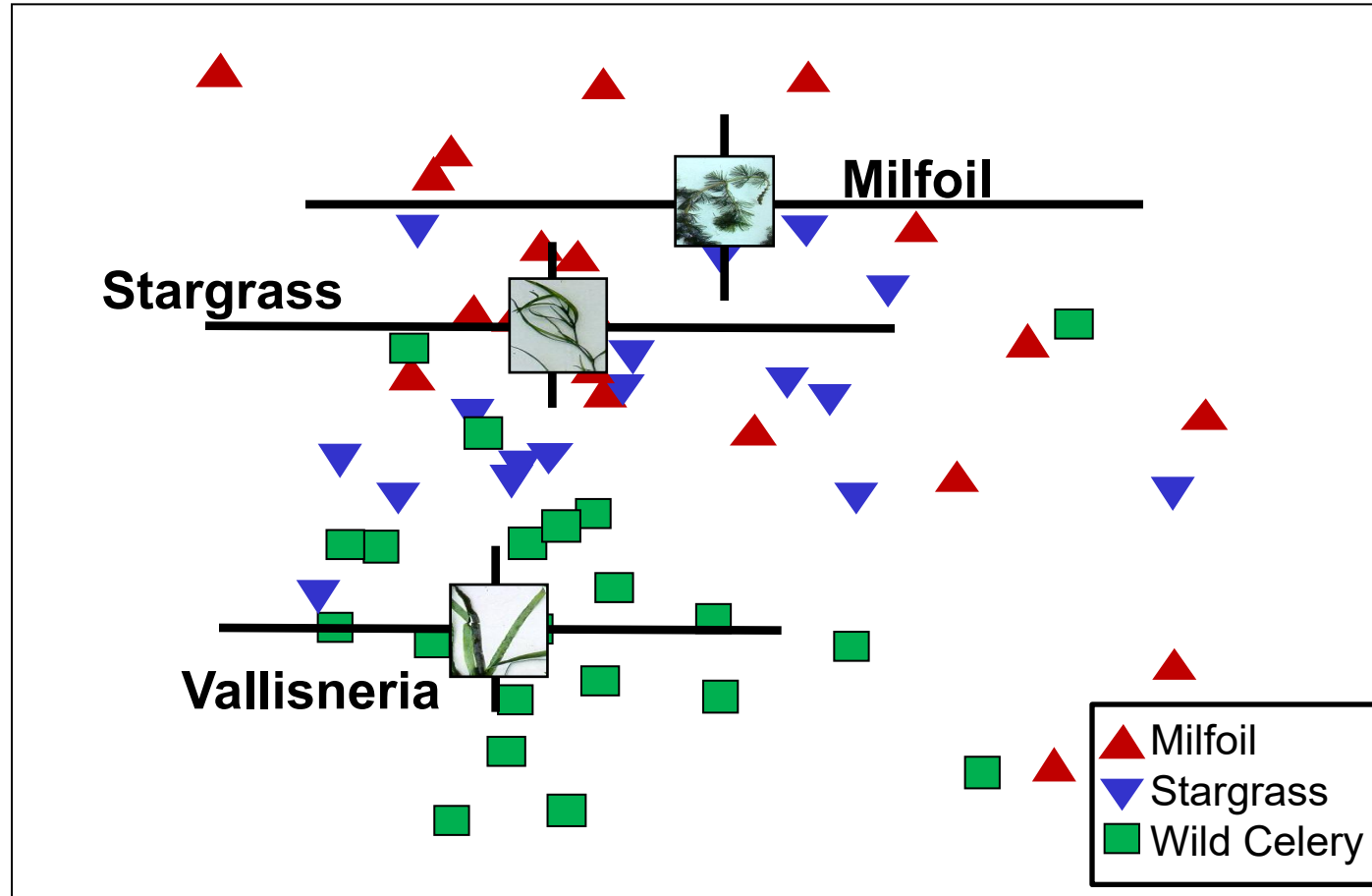
Wild Celery
(*Vallisneria americana*)

D = 1.06

*Line drawings by University of Florida/IFAS Center for Aquatic and Invasive Plants. Used with permission.

Martin, C.W. and J.F. Valentine. 2011. *Estuaries and Coasts* 34(2):364-372.

Community Structure of Milfoil and Native SAV



Faunal communities differ between milfoil and wild celery ($p=0.01$), but not between milfoil and stargrass ($p=0.15$)

Eurasian Milfoil

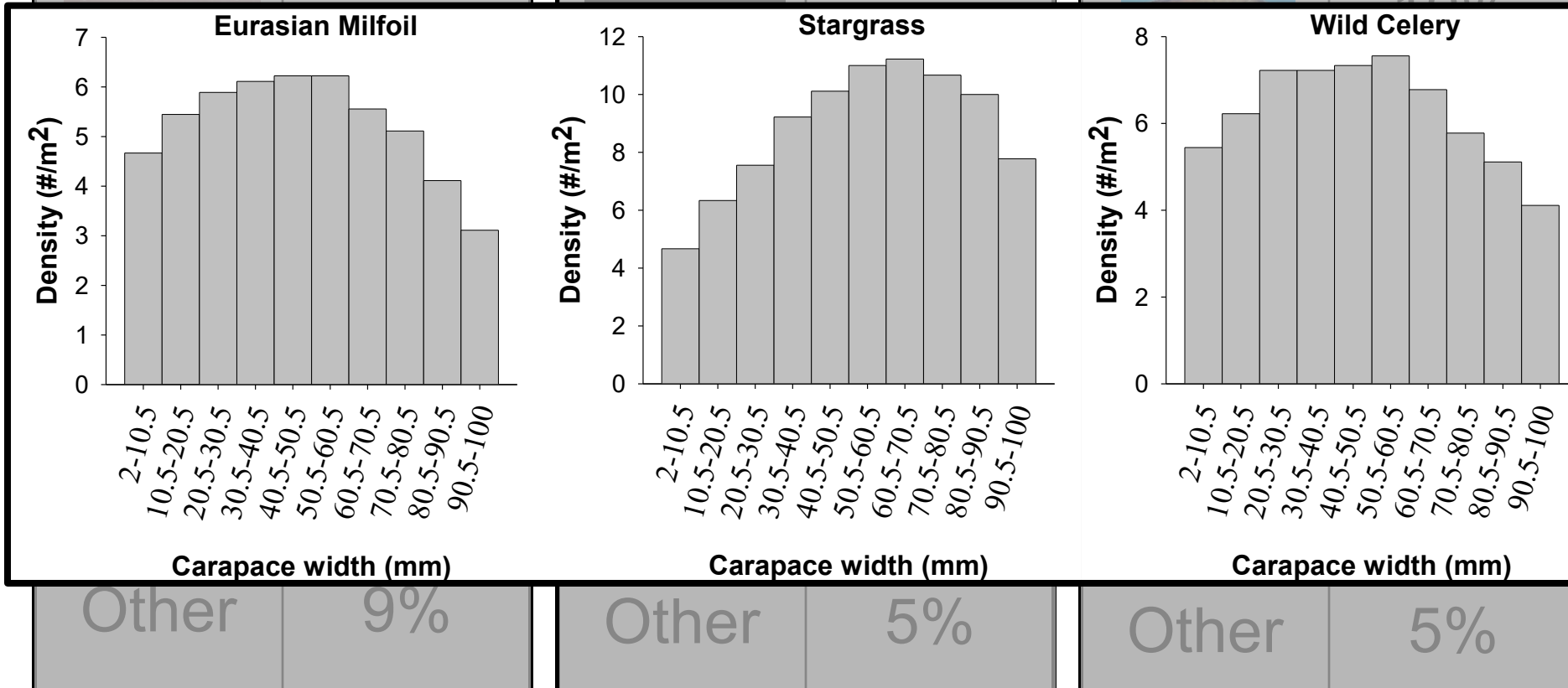
	30%
	29%

Stargrass

	30%
	27%

Vallisneria

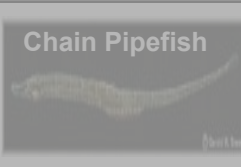
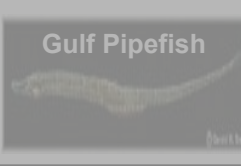
	33%
	24%
	43%



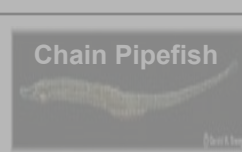
Eurasian Milfoil

 Blue crab	30%
 Rainwater Killifish	29%
 Grass Shrimp	18%
 Redspotted Sunfish	11%
 Brown Shrimp	6%
Other	9%

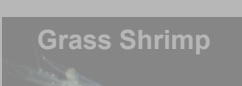
Stargrass

 Rainwater Killifish	30%
 Blue crab	27%
 Grass Shrimp	17%
 Redspotted Sunfish	8%
 Chain Pipefish	7%
 Gulf Pipefish	7%
Other	5%

Vallisneria

 Blue crab	33%
 Grass Shrimp	24%
 Brown Shrimp	10%
 Redspotted Sunfish	10%
 Goby	7%
 Chain Pipefish	6%
 Gulf Pipefish	5%
Other	5%

Eurasian Milfoil

	30%
	29%
	18%

Stargrass

	30%
	27%
	17%

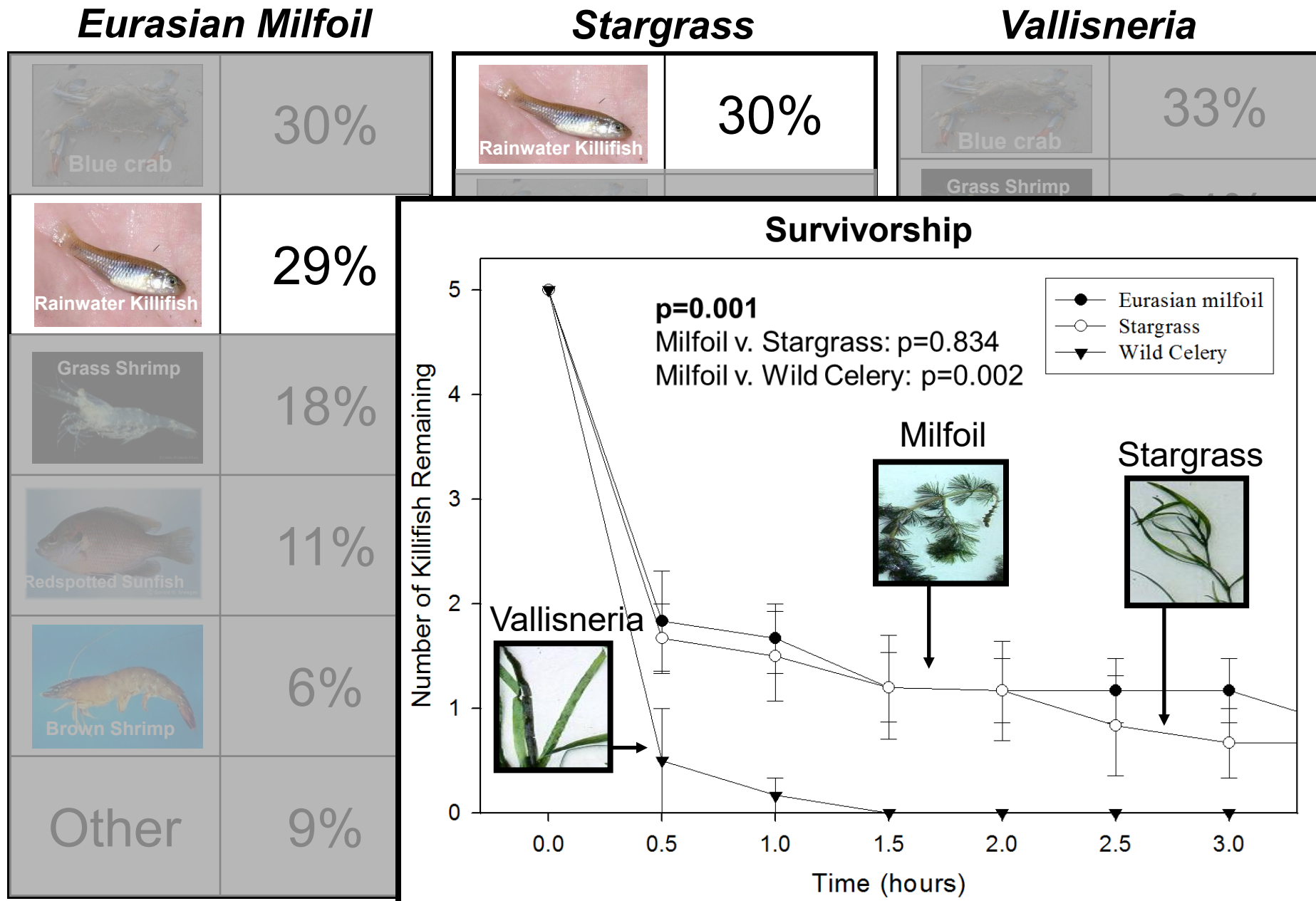
Vallisneria

	33%
	24%
	10%
	10%



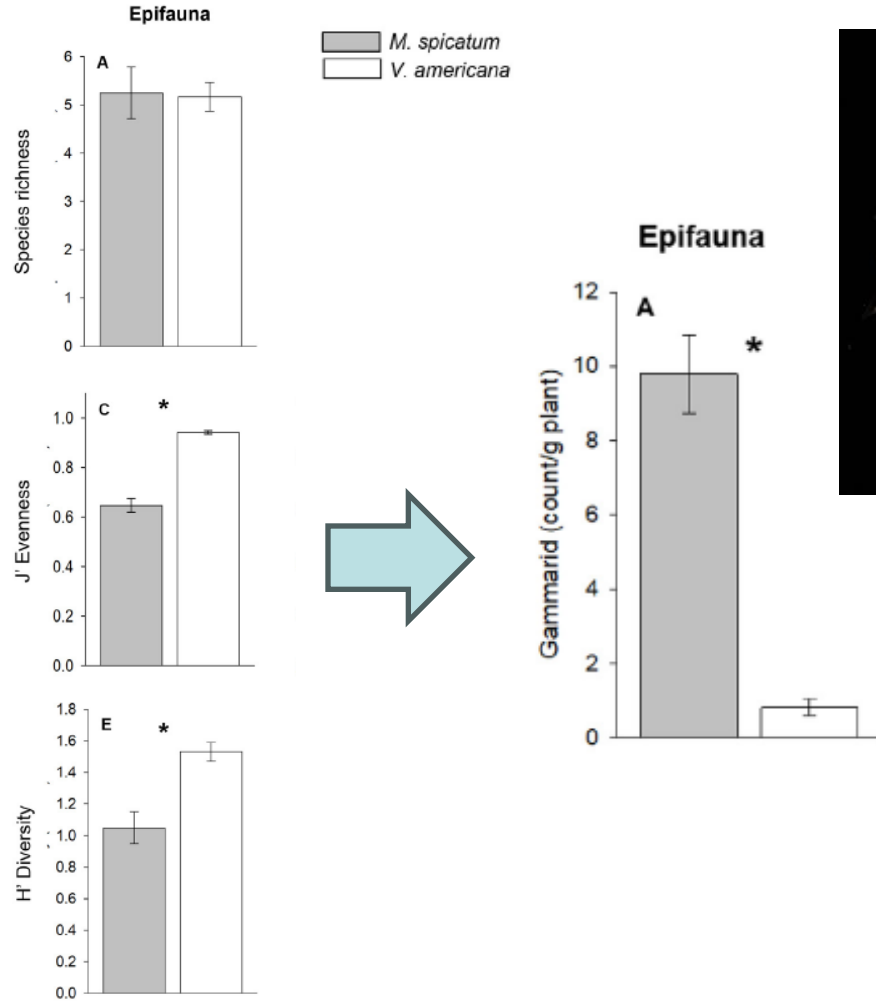
Taylor Kauffman,
DISL intern

Other	5%
Other	5%
Other	5%



Martin, C.W. and J.F. Valentine. 2011. *Estuaries and Coasts* 34(2):364-372.

More animals doesn't necessarily mean more biodiversity



~11x more
amphipods in
milfoil!



Marissa Hall, NSF REU student

Hall, M., K. O'Shaughnessy, B. Kiley, A. McDonald, T. Faurie, Z. Hendrickson, A. Reimer, S. Smith, **C.W. Martin**. 2024. *Gulf and Caribbean Research* 35(1):SC25-SC30.

A grassbed is not a uniform habitat



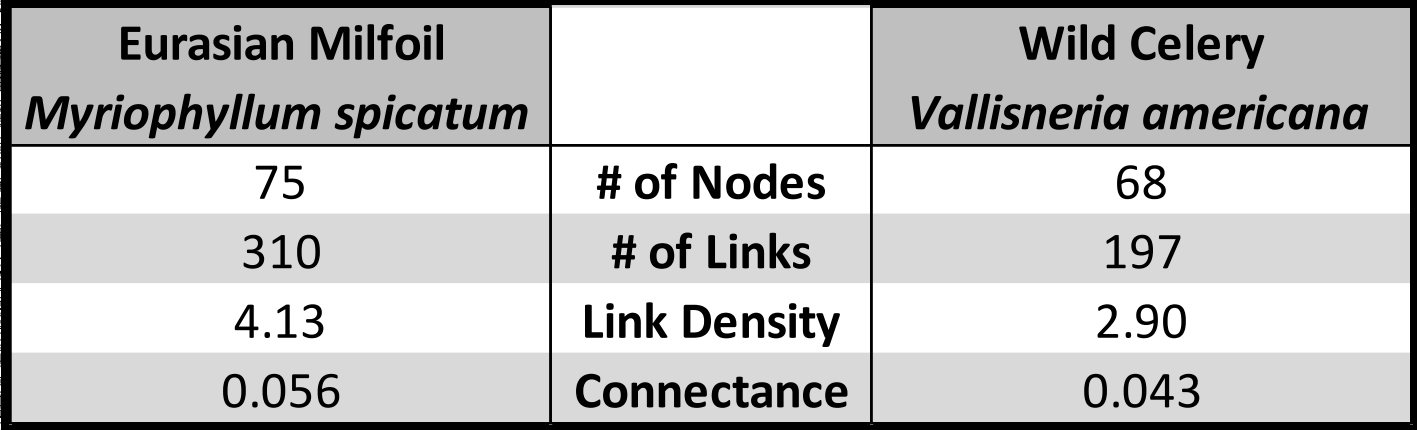
Epifaunal species can vary between edge and interior, but mobile fishes may not.



Steven Vrolijk, NSF REU student

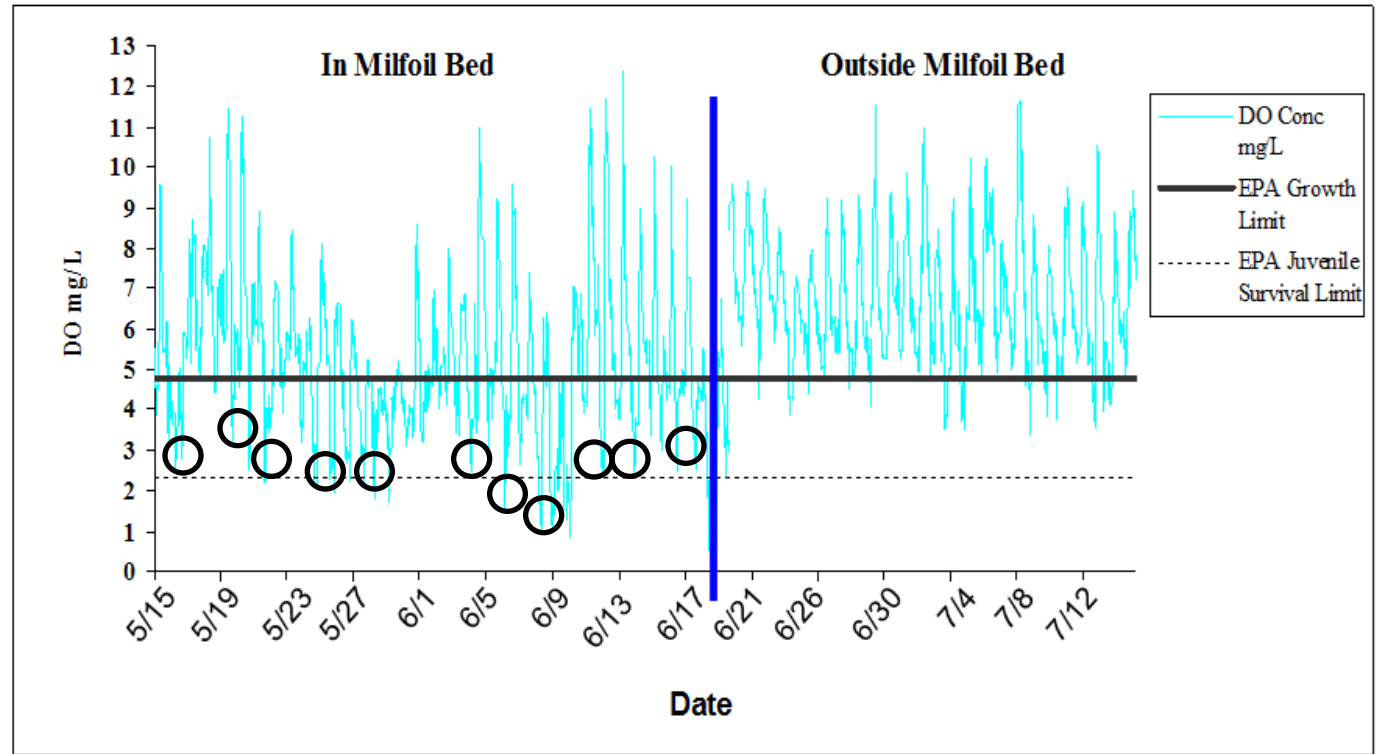
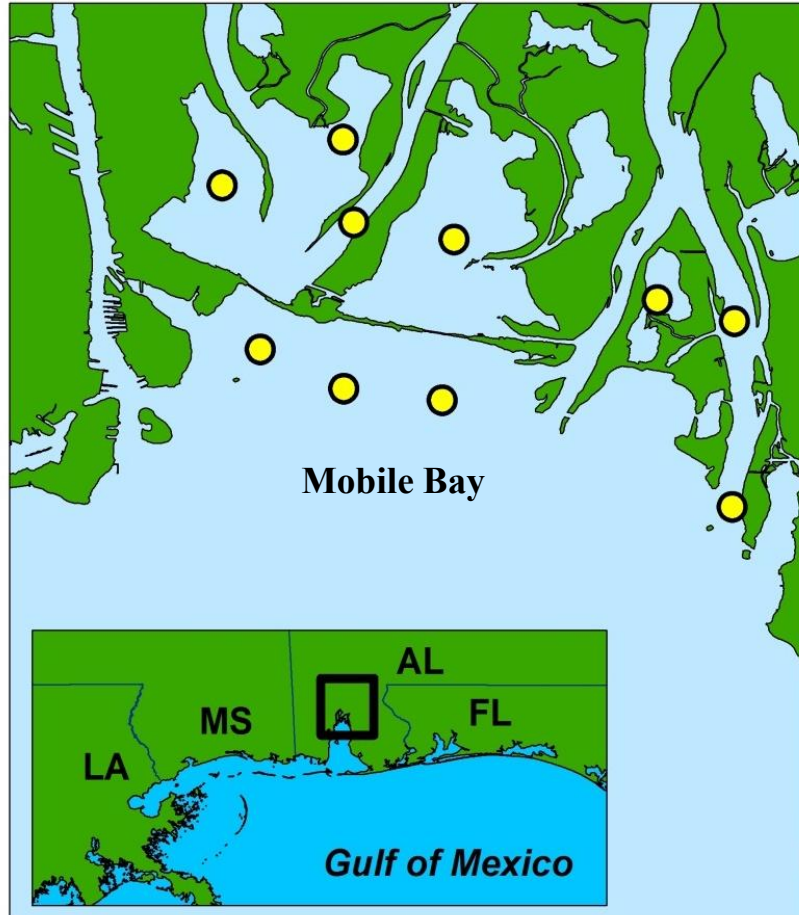
Vrolijk, S., K. O'Shaughnessy, A. McDonald, Z. Hendrickson, B. Kiley, A. Reimer, S. Robertson, S. Smith, E. Sullivan, **C.W. Martin**. 2024. *Gulf and Caribbean Research* 35(1):SC25-SC30.

Wild Celery
Vallisneria americana



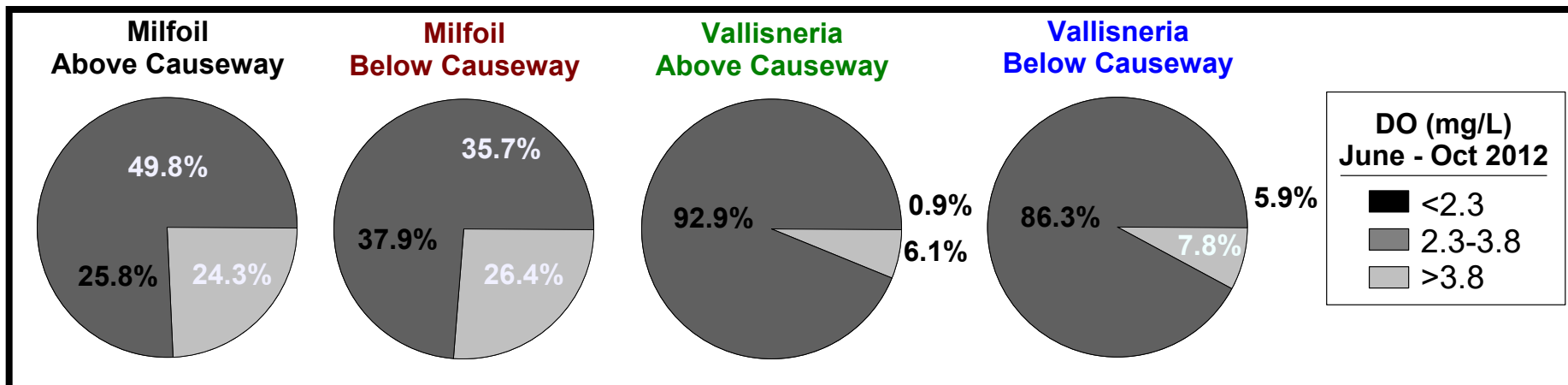
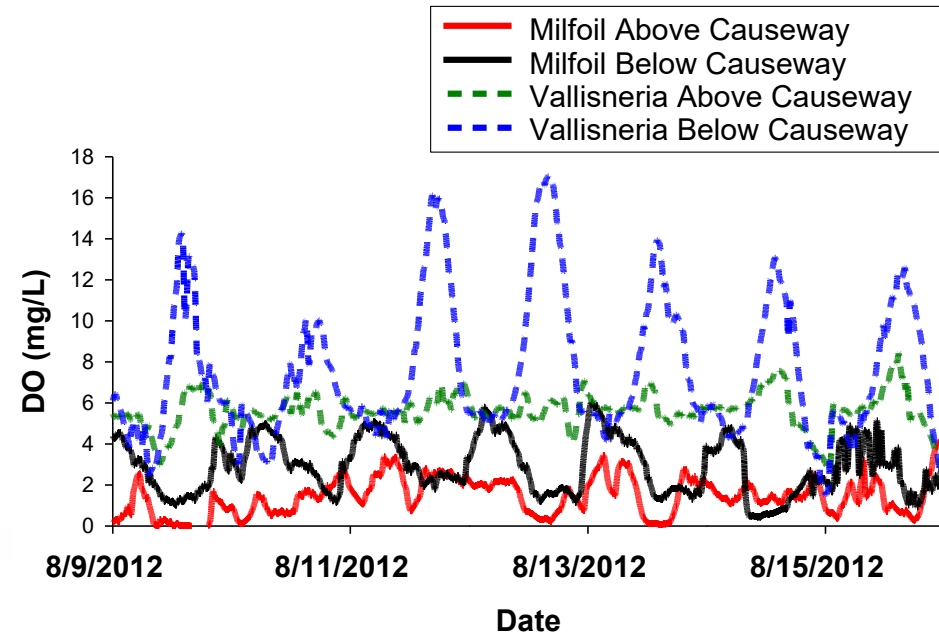
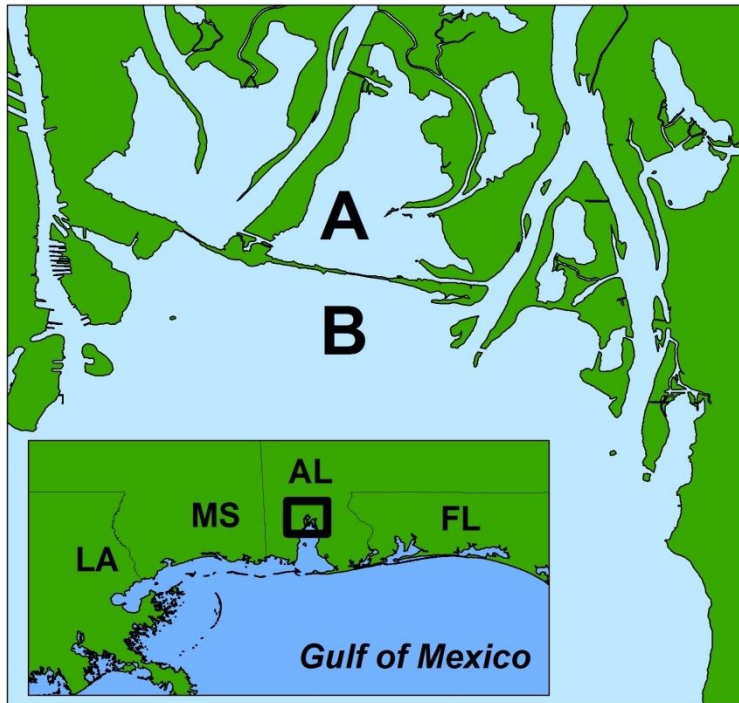
Martin, C.W. and J.F. Valentine. 2017. *Frontiers in Environmental Science* 7:166.

But wait... what about night time?

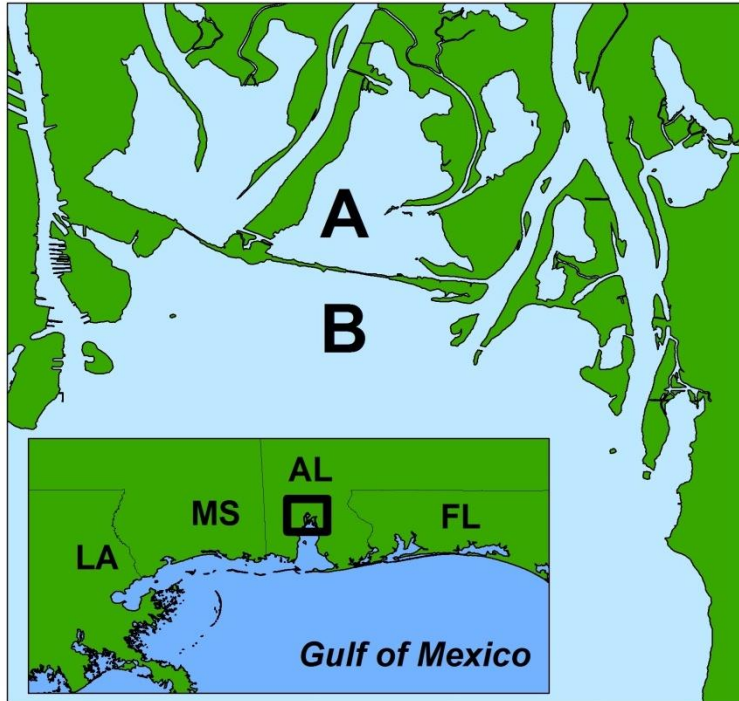


Increased incidences of nightly hypoxia in milfoil

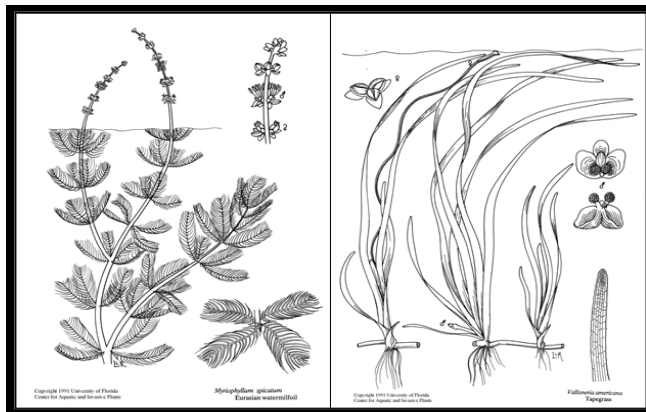
Hypoxia occurs nightly in milfoil north of the causeway



Influence of Hypoxic Events on Assemblages



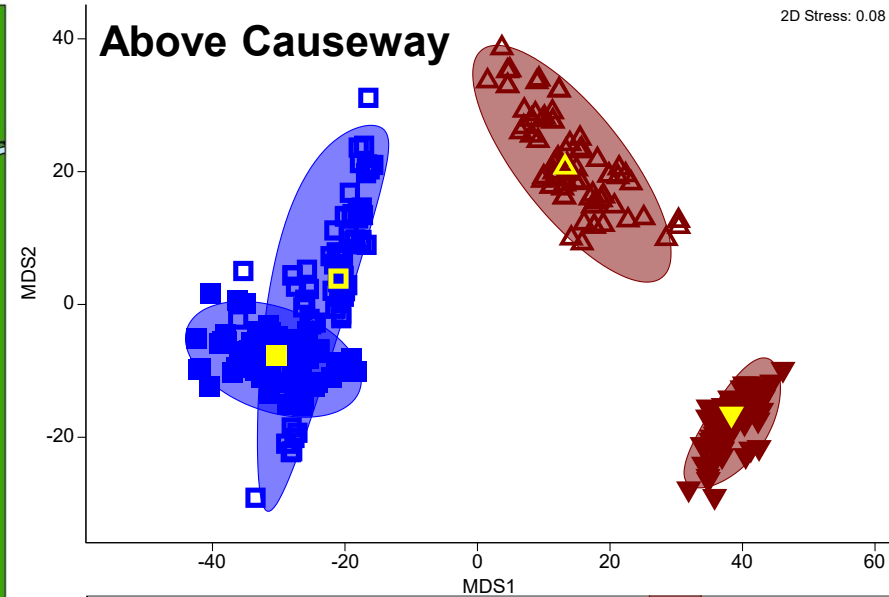
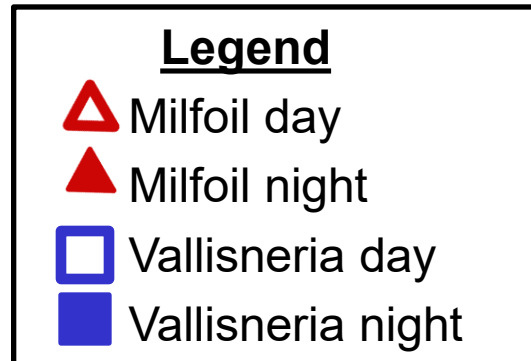
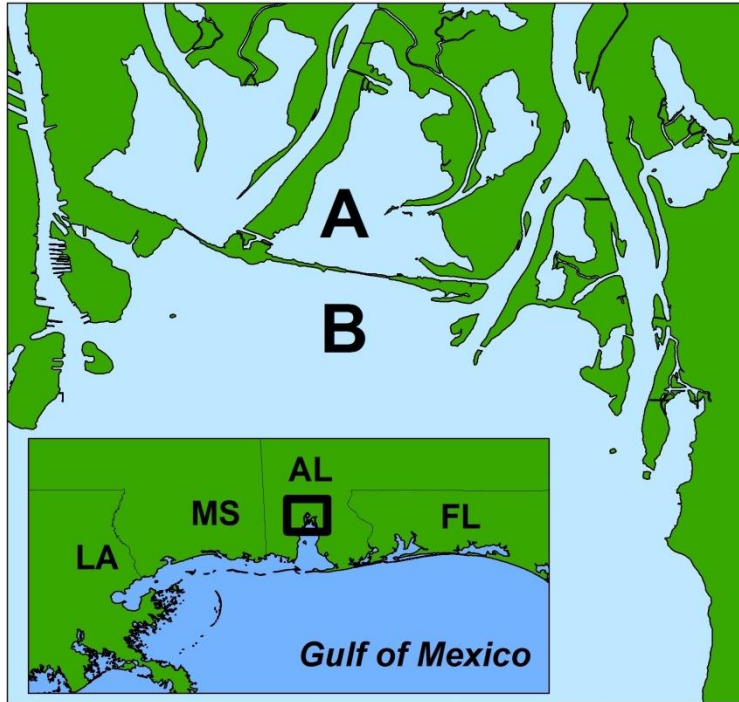
Suction



Sampling occurred at:

- 2 areas: Above and Below the Causeway
- 2 habitats: Eurasian milfoil and Vallisneria
- 2 times: day and night

Influence of Hypoxic Events on Assemblages



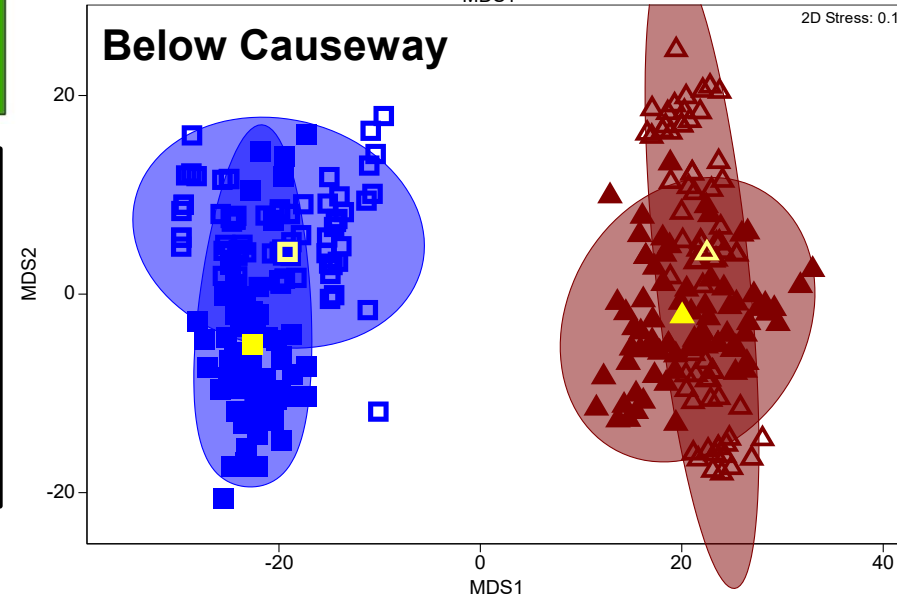
ANOSIM

SAV

$p=0.001$

Day/Night

$p=0.002$



ANOSIM

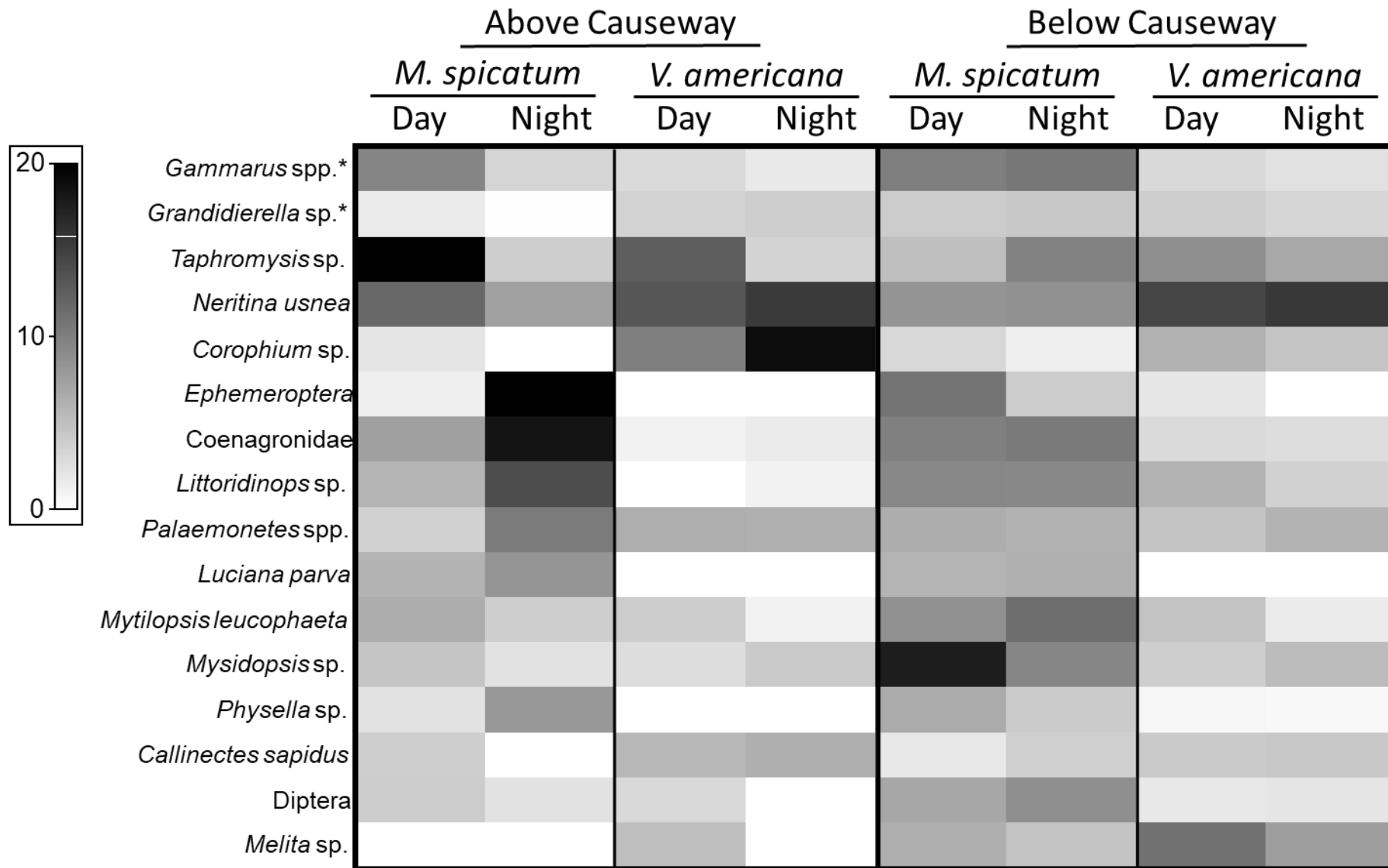
SAV

$p=0.001$

Day/Night

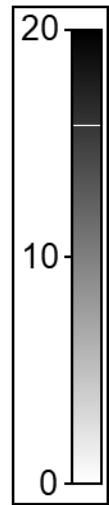
$p=0.438$

Influence of Hypoxic Events on Assemblages



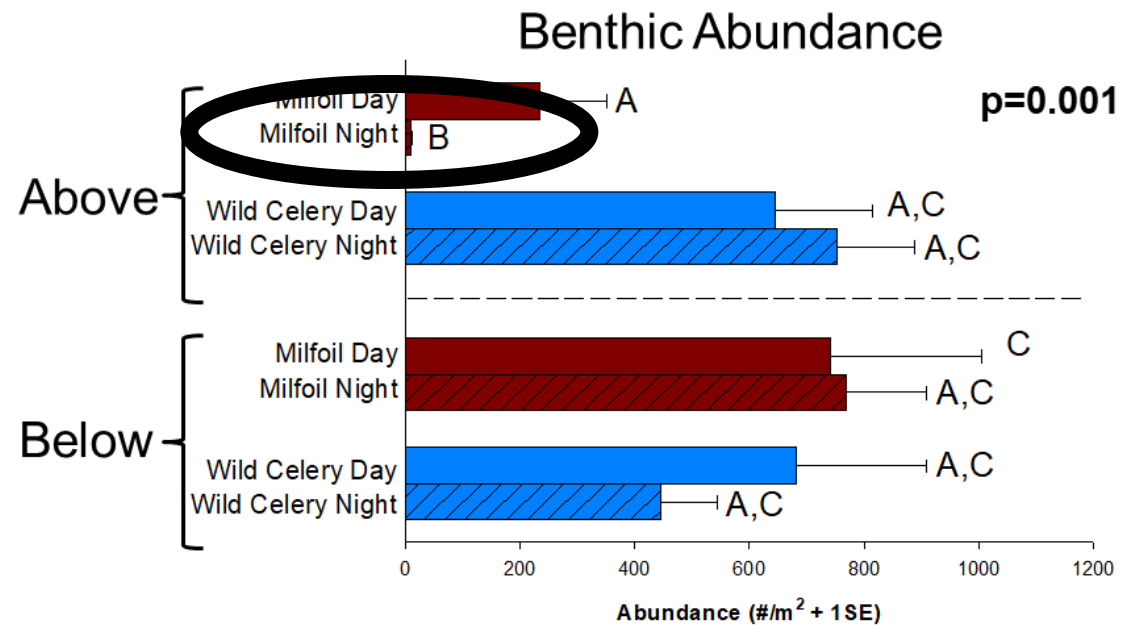
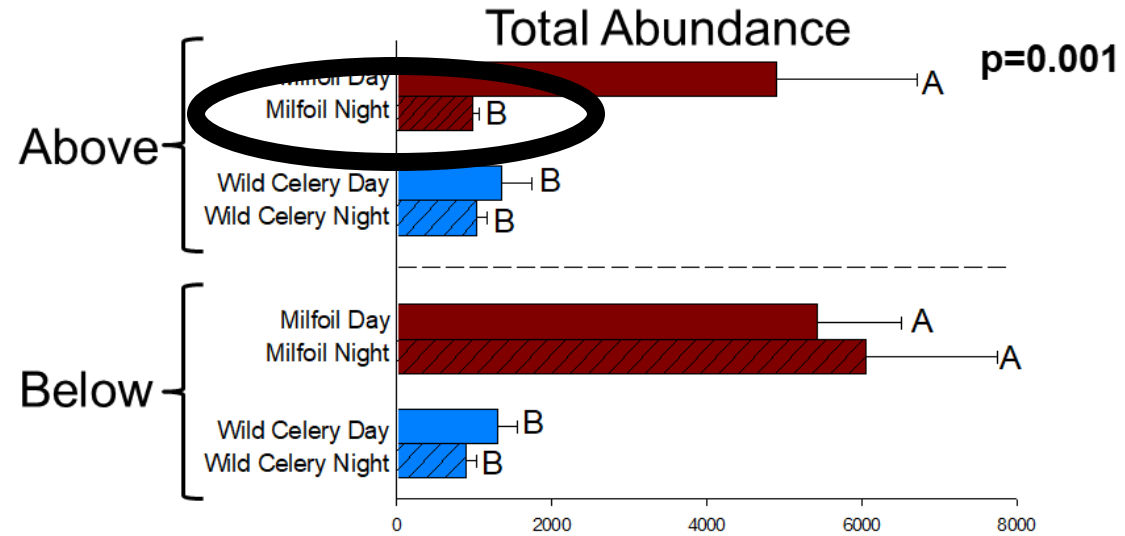
*Denotes 5% of actual values

Influence of Hypoxic Events on Assemblages



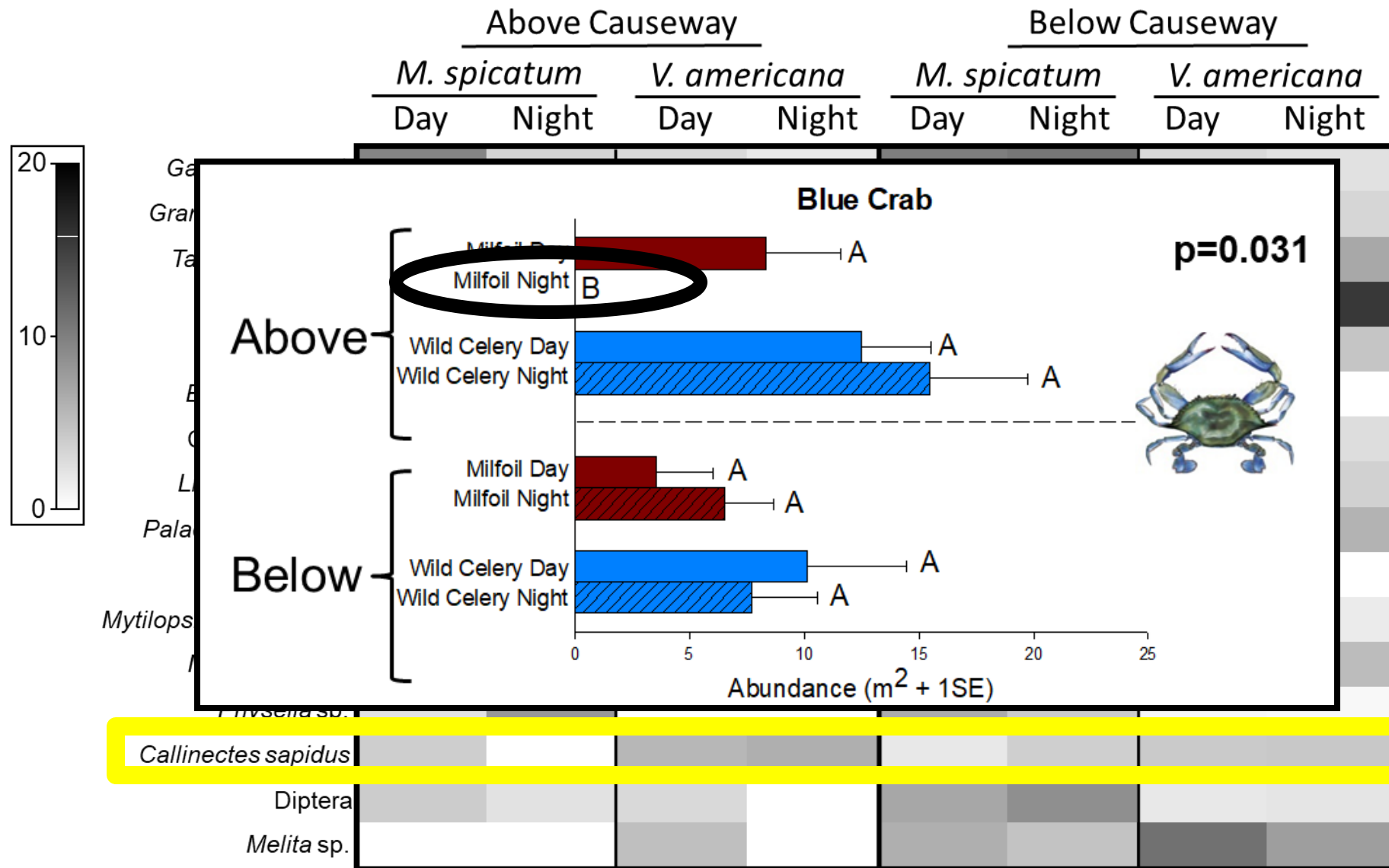
Gammarus spp.*
Grandidierella sp.*
Taphromysis sp.
Neritina usnea
Corophium sp.
Ephemeroptera
Coenagrionidae
Littoridinops sp.
Palaemonetes spp.
Luciana parva
Mytilopsis leucophaeta
Mysidopsis sp.
Physella sp.
Callinectes sapidus
Diptera
Melita sp.

*De



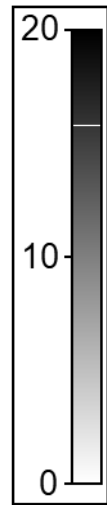


Influence of Hypoxic Events on Assemblages

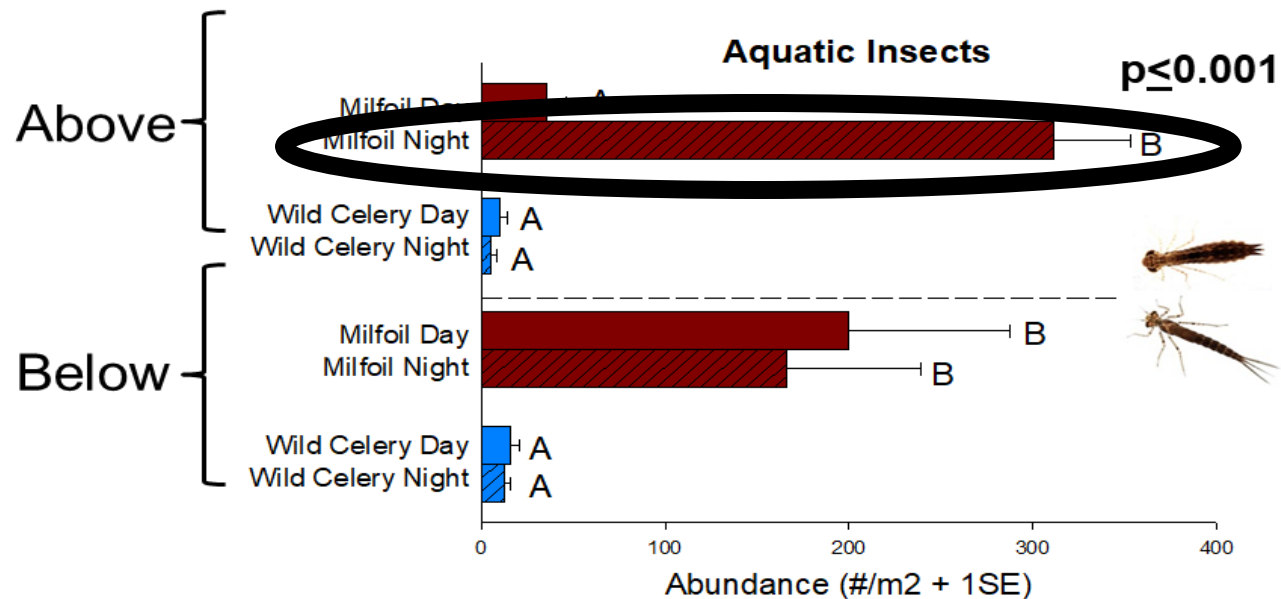
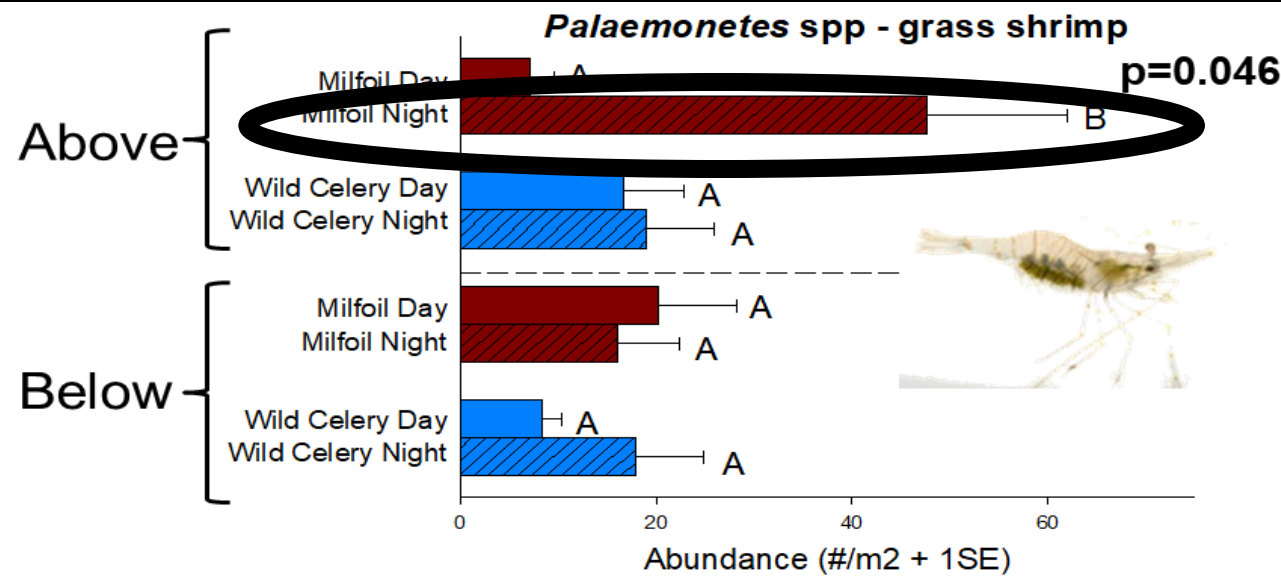


*Denotes 5% of actual values

Influence of Hypoxic Events on Assemblages



Gammarus
 Grandidierella
 Taphromys
 Neritina u
 Corophiu
 Ephemero
 Coenagro
 Littoridinop
 Palaemonetes
 Luciana
 Mytilopsis leucop
 Mysidops
 Physel
 Callinectes sa
 D
 Meli



Bar chart shows 5% of actual values

Summary: Milfoil in the Mobile-Tensaw Delta

- Hydrology plays a strong role in invasive milfoil establishment and impacts
- Milfoil provides habitat for many species of nekton
 - High abundance of commercially important species such as blue crabs
 - Higher survival for rainwater killifish in structurally-complex grasses such as milfoil
- However, nightly incidences of hypoxia in milfoil north of the causeway reduced occupancy patterns for many species



Acknowledgements

- **Funding:** Gulf of Mexico Research Initiative, Northern Gulf Institute, Mobile Bay National Estuary Program, Alabama Center for Estuarine Studies, USA, DISL
- *The funders had no role in the design, execution, or analyses of this project.*
- **Alabama:** J. Valentine, K. Heck, S. Powers, K. Blankenhorn, T. Kauffman, L. Steele, R. Puntila, S. Sklenar, S. Madsen, M. Dueker, L. Lee

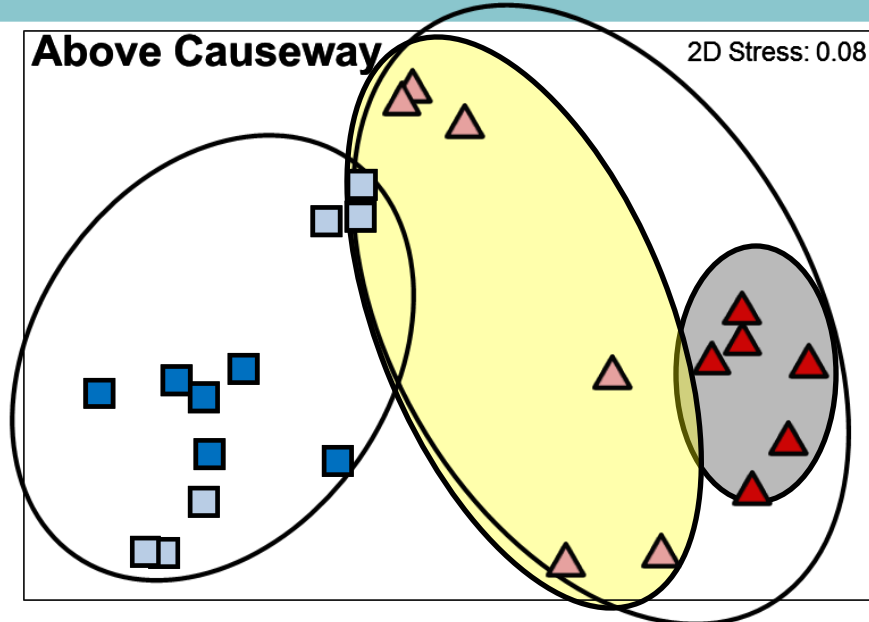
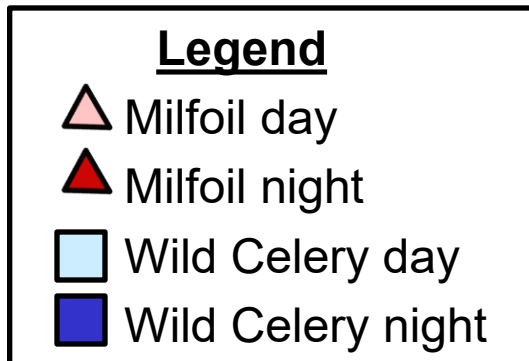
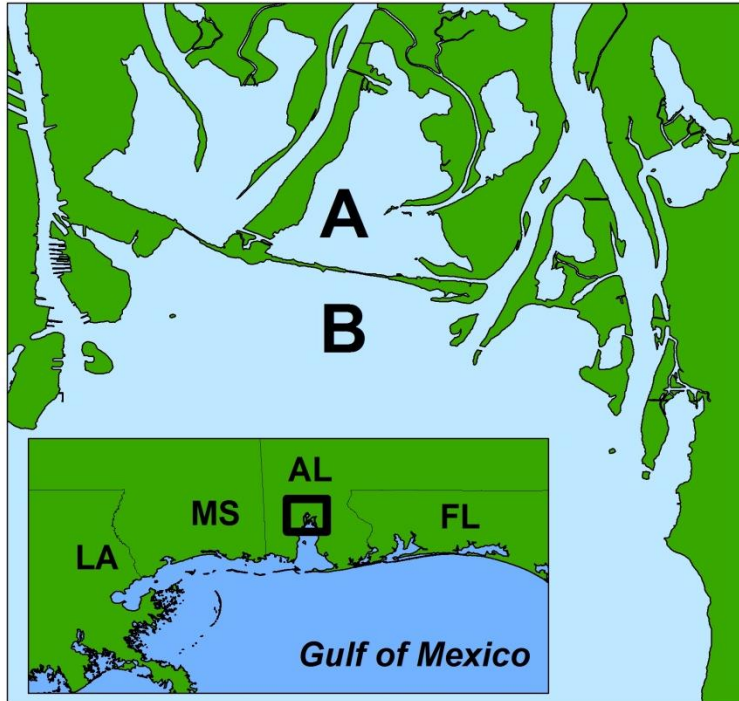
Charlie Martin, cmartin@disl.edu

John Valentine, jvalentine@disl.org

References

- Hall, M., K. O'Shaughnessy, B. Kiley, A. McDonald, T. Faurie, Z. Hendrickson, A. Reimer, S. Smith, and C.W. Martin. 2024. *Gulf and Caribbean Research* 35:SC25–SC30.
- Kauffman, T.C., C.W. Martin, and J.F. Valentine. 2018. *Marine Ecology Progress Series* 592:97–108.
- Martin, C.W. 2011. *Journal of Ecosystem & Ecography* 1:e101.
- Martin, C.W. 2017. *Aquatic Ecology* 51:159–165.
- Martin, C.W. and J.F. Valentine. 2011. *Estuaries and Coasts* 34:364–372.
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- Rozas, L.P., C.W. Martin, and J.F. Valentine. 2013. *Marine Ecology Progress Series* 492:9–20.
- Vrolijk, S., K. O'Shaughnessy, Z. Hendrickson, B. Kiley, A. McDonald, A. Reimer, S. Robertson, S. Smith, E. Sullivan, and C.W. Martin. 2026. *Gulf and Caribbean Research* 37:SC16–SC22.

How do hypoxic events influence nekton?



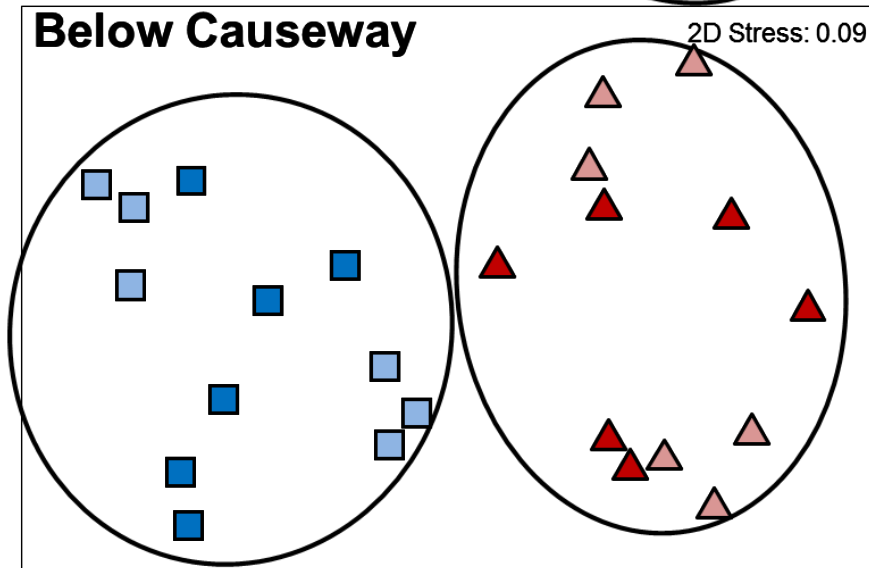
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SAV

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Day/Night

$p=0.002$



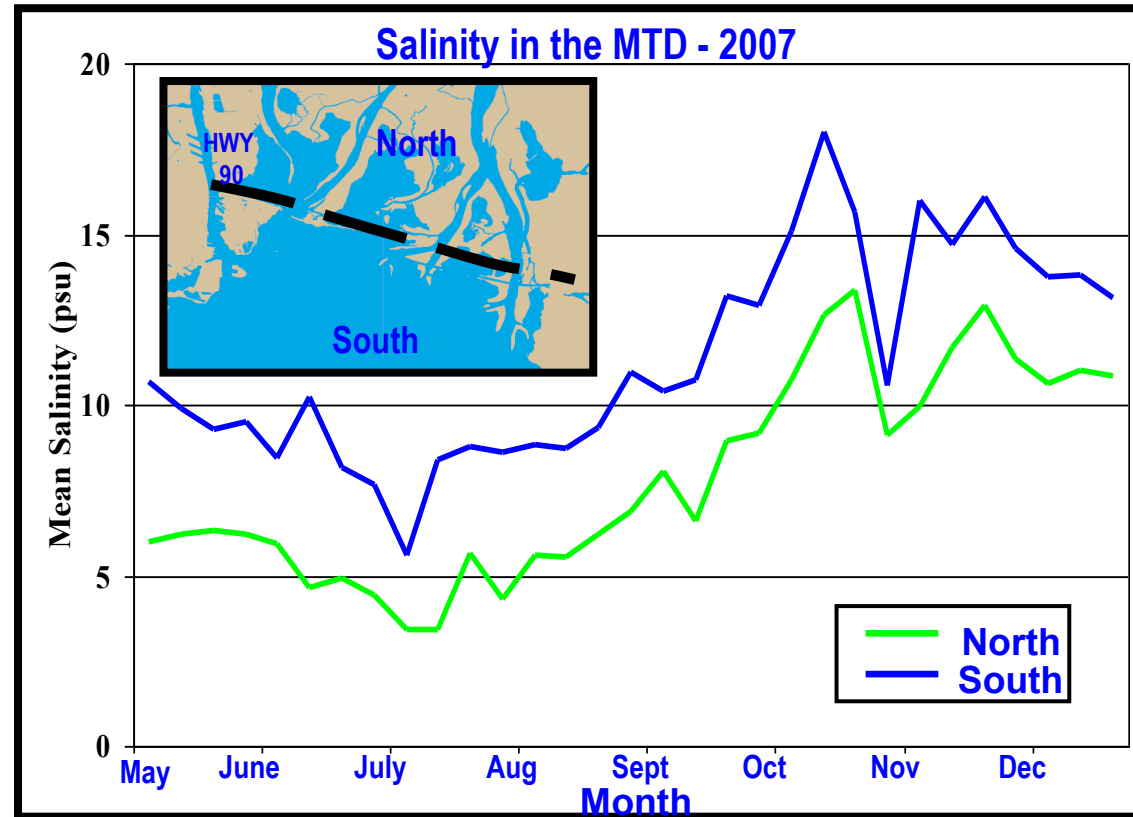
ANOSIM

SAV

$p=0.001$

Day/Night

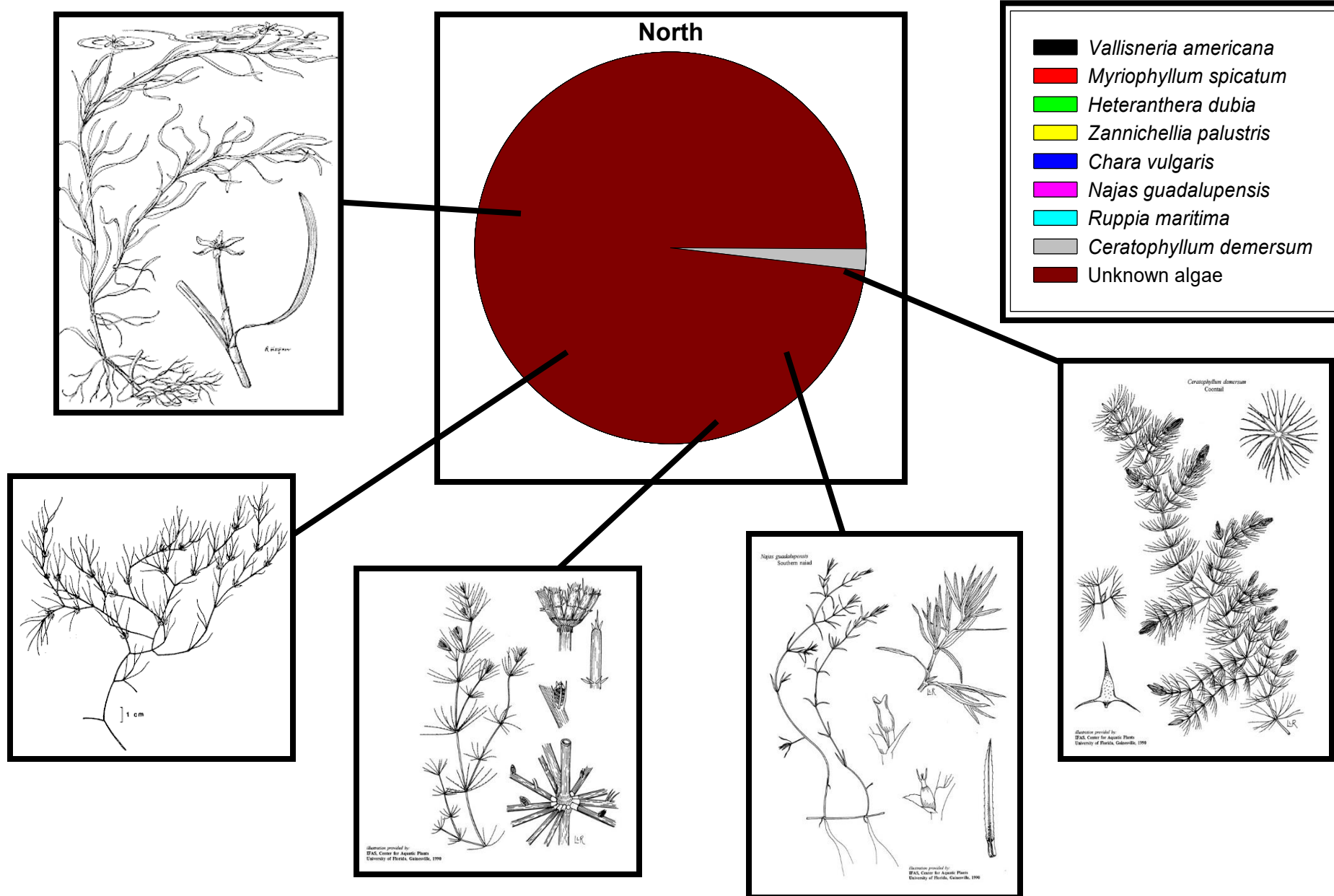
$p=0.438$



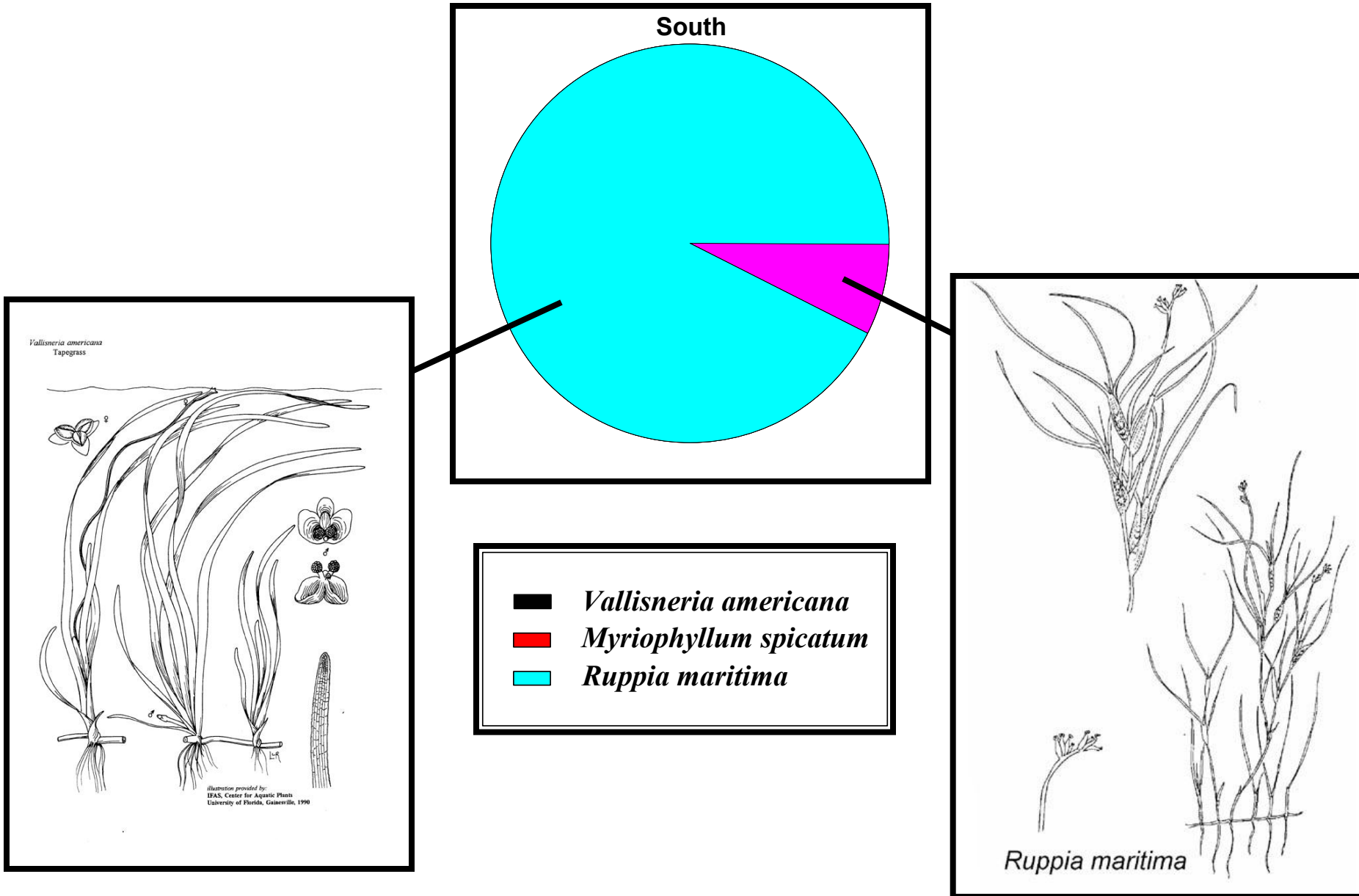
3. Do physical processes control the distribution of milfoil in Mobile Bay?



Field Survey Results



Field Survey Results



**Invasive Eurasian Milfoil (*Myriophyllum
spicatum*) in the Mobile-Tensaw,
Alabama**



Invasive Species

"We must make no mistake: we are seeing one of the great historical convulsions in the world's fauna and flora."

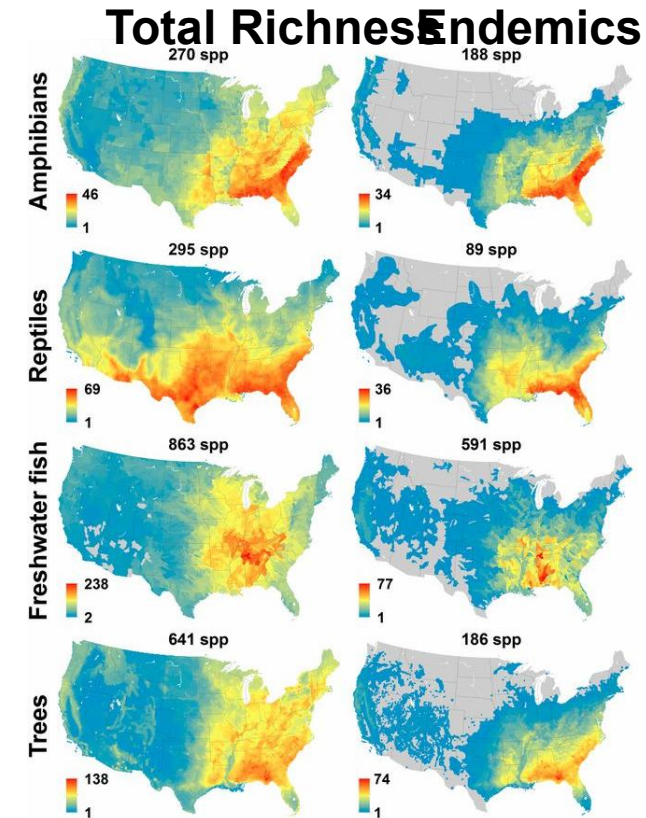
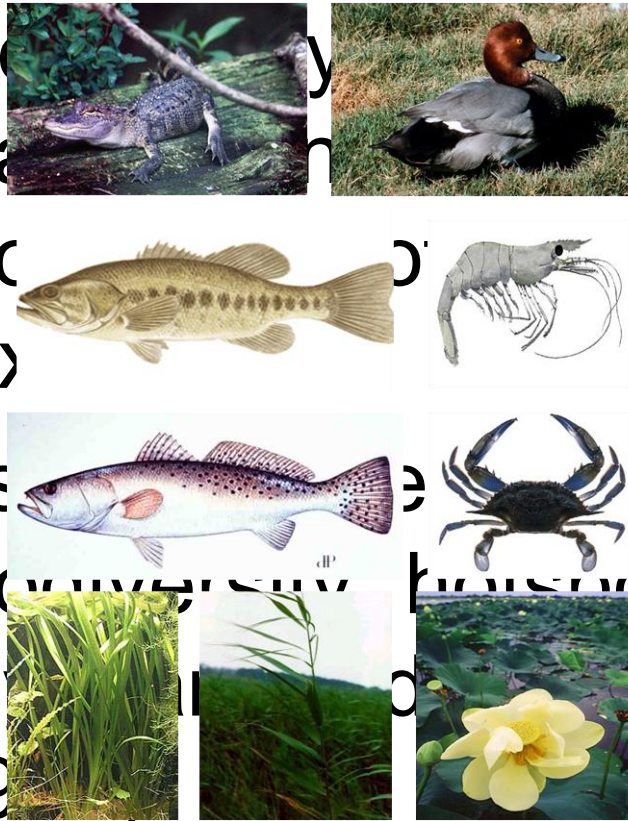
-Charles Elton (1958) in *The Ecology of Invasions by Plants and Animals*



Source: World Conservation Monitoring Centre, "Global Biodiversity" Chapman & Hall, London

The Mobile-Tensaw Delta: a biodiversity hotspot

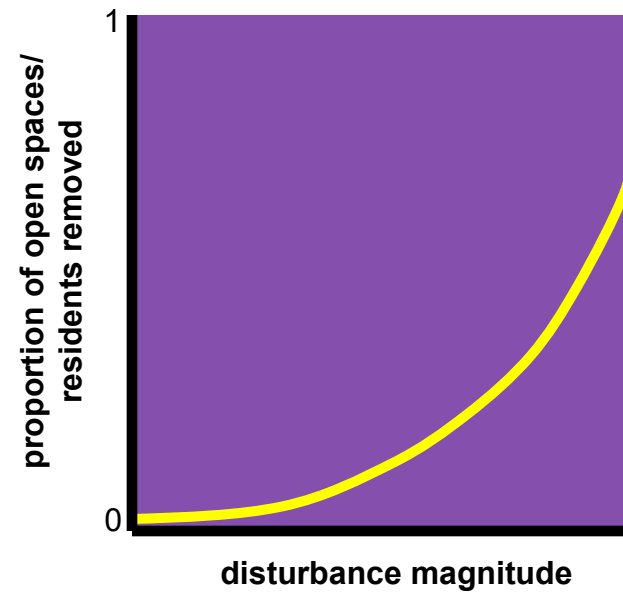
- Mobile-Tensaw Delta is a biodiversity hotspot
- It is a biodiversity hotspot because of its high species richness and endemism
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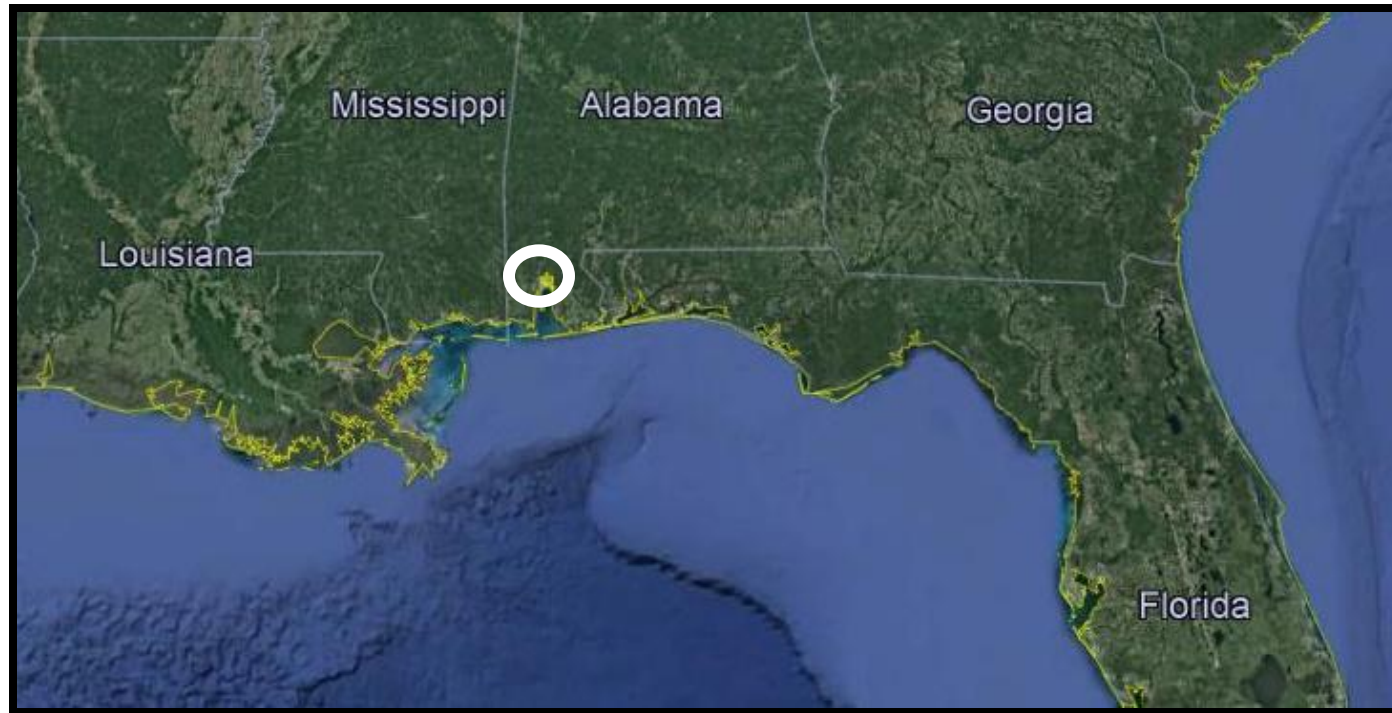
From: Jenkins et al. 2015

Disturbance Theory: how do invasive species become established?

- The greater the disturbance the more habitat that will opened!

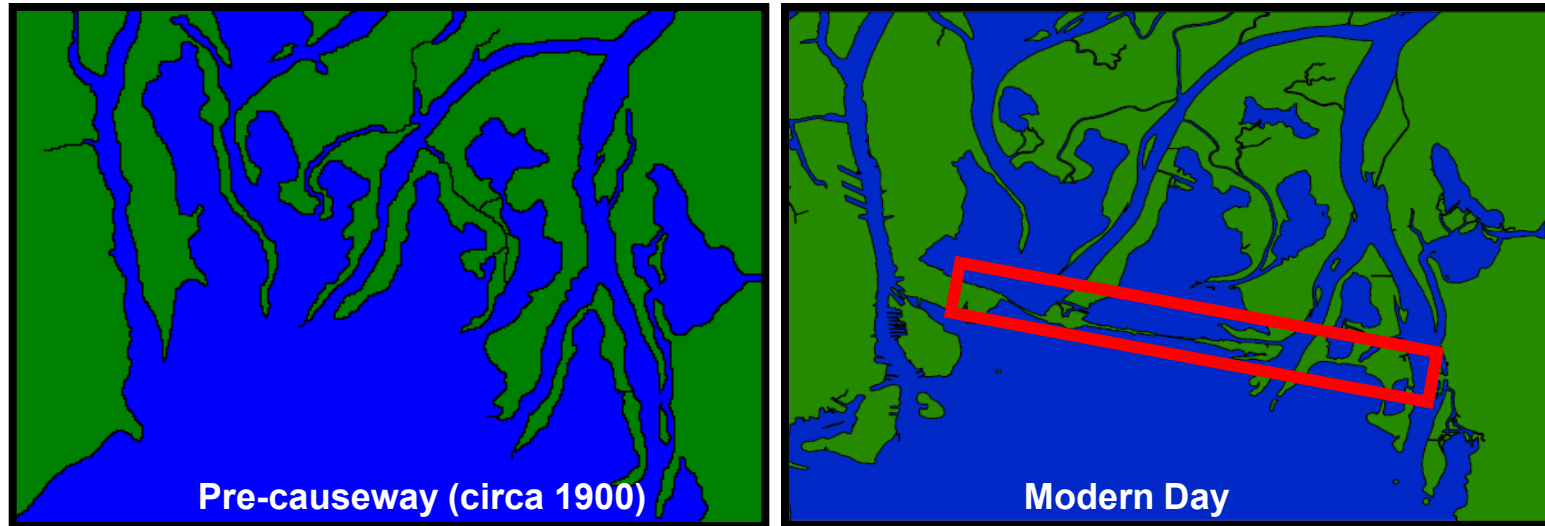


The Highway 90 Causeway



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In the 1920s an earthen causeway was constructed across Mobile Bay. This is potentially an ecosystem-wide disturbance.

1927



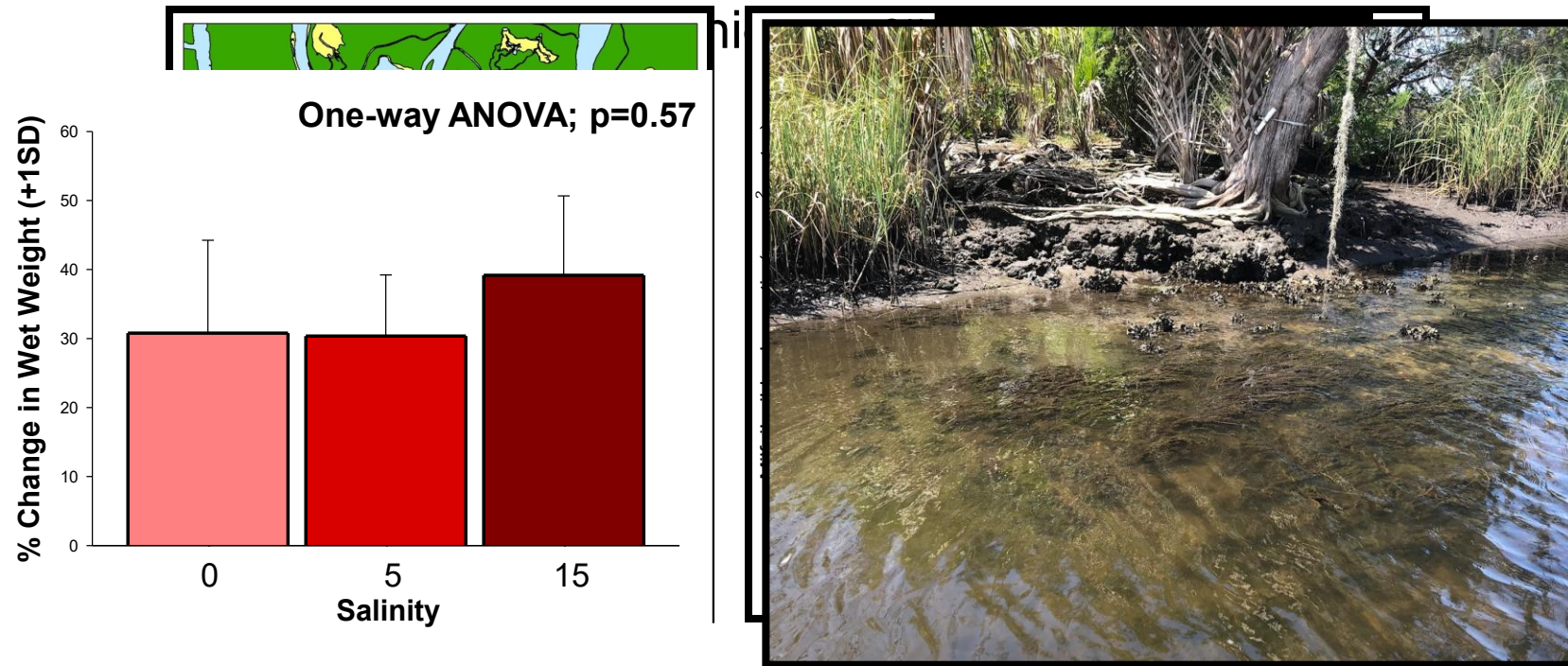


City of
Mobile

The Causeway

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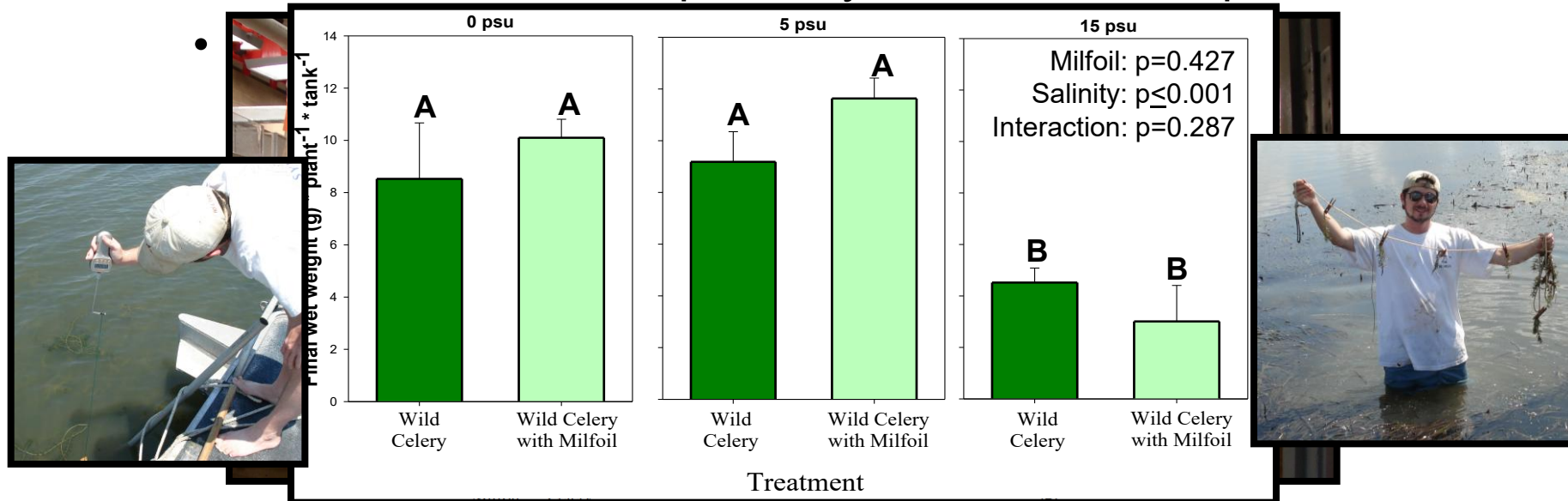


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Martin, C.W. and J.F. Valentine. 2014. *Hydrobiologia* 727(1):177-184.

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