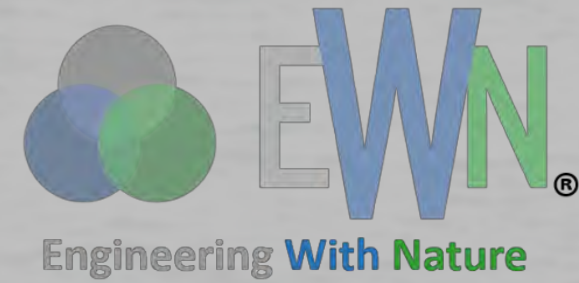


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Capitalizing on Positive Interactions to Enhance Coastal Dune Restoration Success

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Coastal Dune Restoration

Why is it needed?



Storm-induced dune erosion exceeding 5m per year

Coastal Dune Restoration

What is the typical approach?

Construction of dune toe via sand berm

+

Evenly-spaced transplants to stabilize material

Spacing reduces competition + maximizes revegetation



Plants Used in Dune Restoration: 'Foundation Species'



Sea oats
(*Uniola paniculata*)



Marram Grass
(*Amophila arenaria*)

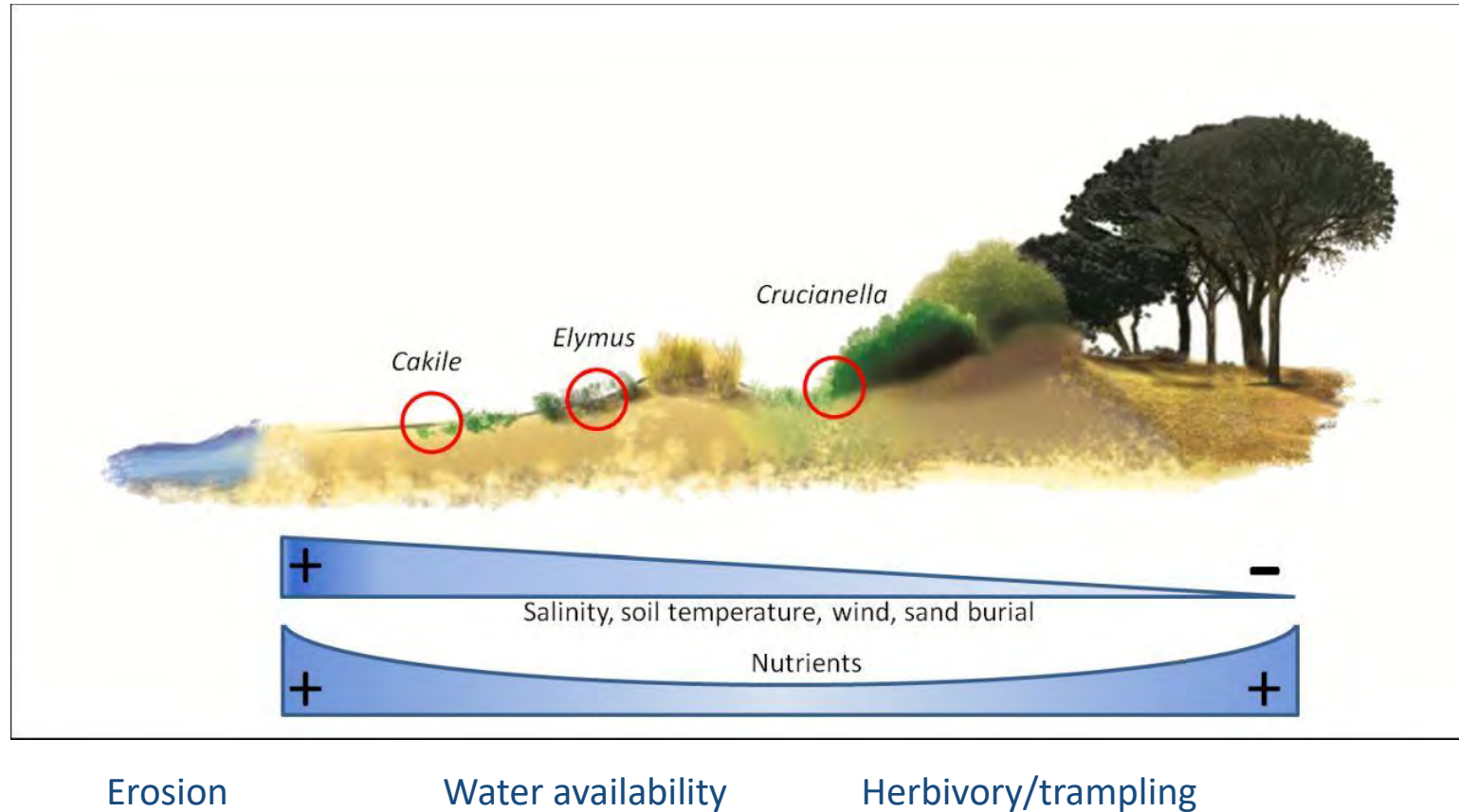


American Beach Grass
(*Calamagrostis breviligulata*)



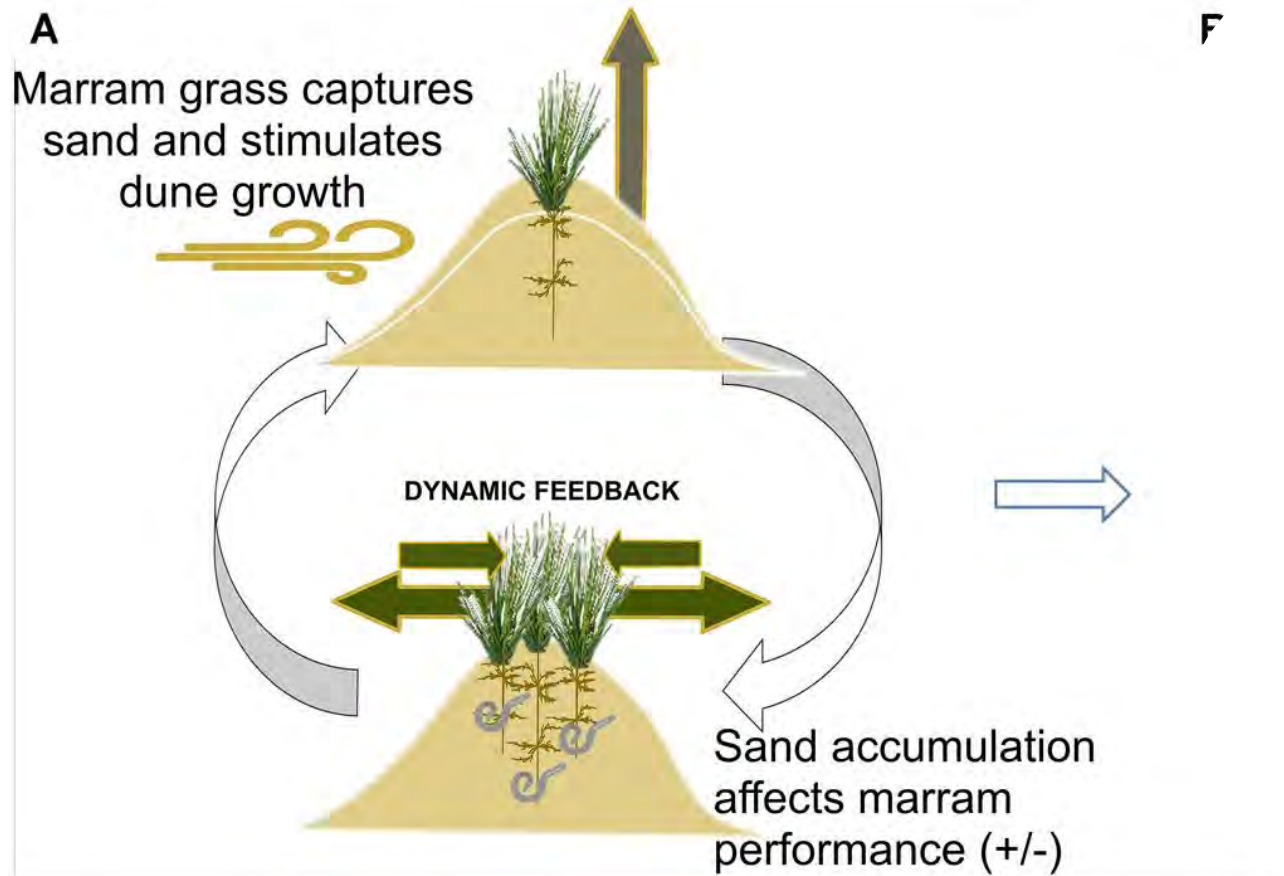
Often use the 'climax' species

What are the key stressors that control whether foundational grass transplants will survive or die?



Stressors vary spatially and over time

What are the key stressors that control whether foundational grass transplants will survive or die?



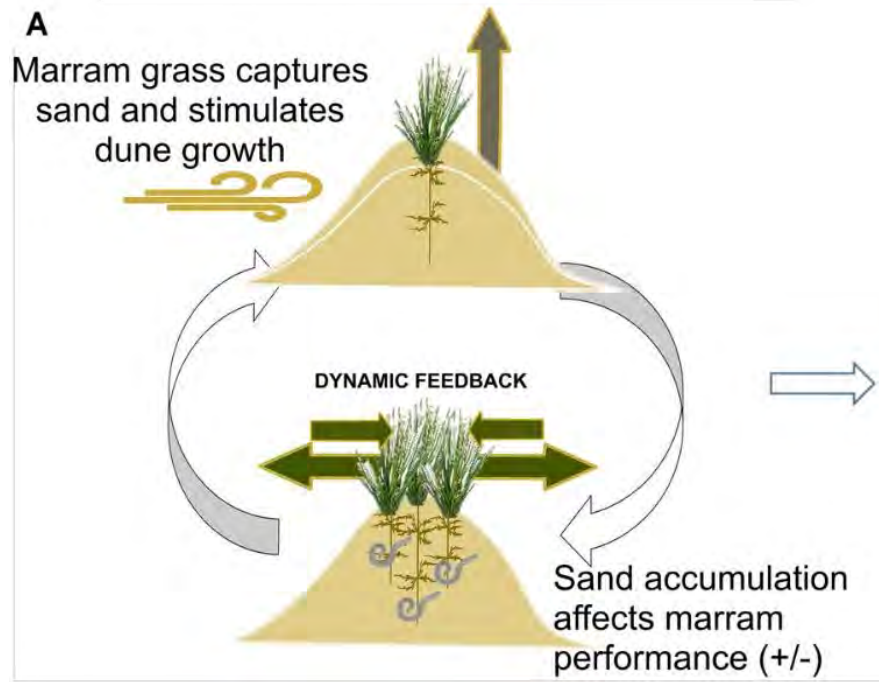
Bronte et al. 2021, *Frontiers in Ecology & Evolution*

Stressors vary over time due to weather and dune evolution

What types of species interactions may alleviate these stressors?

Intraspecific Interactions

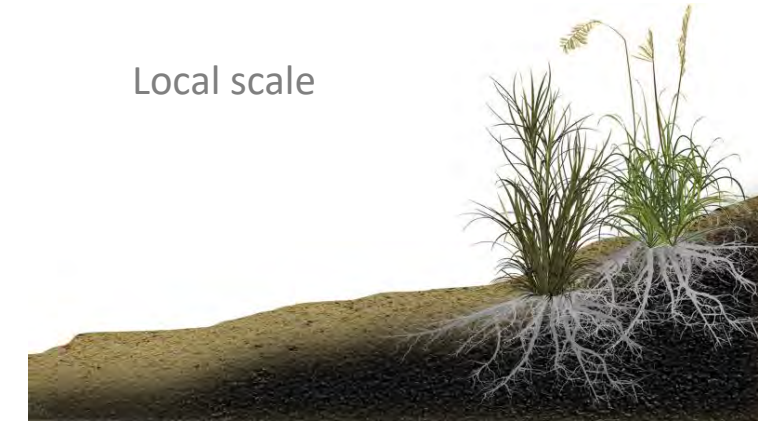
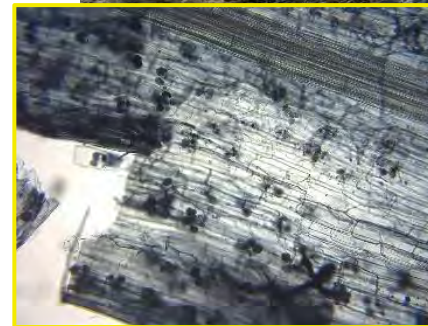
“Self-facilitation” via neighborhood benefits



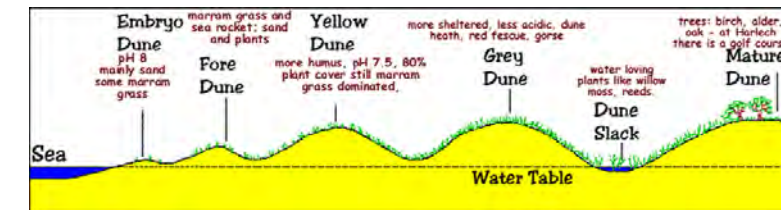
Inter-specific Interactions

Mutualisms

Facilitation



Local scale



Living and dead community members can engage in these interactions

Integrating Positive Interactions into Coastal Dune Restoration: How?



UF Center for Coastal Solutions' Research on Coastal Dune Restoration

Part 1: Wrack Influence



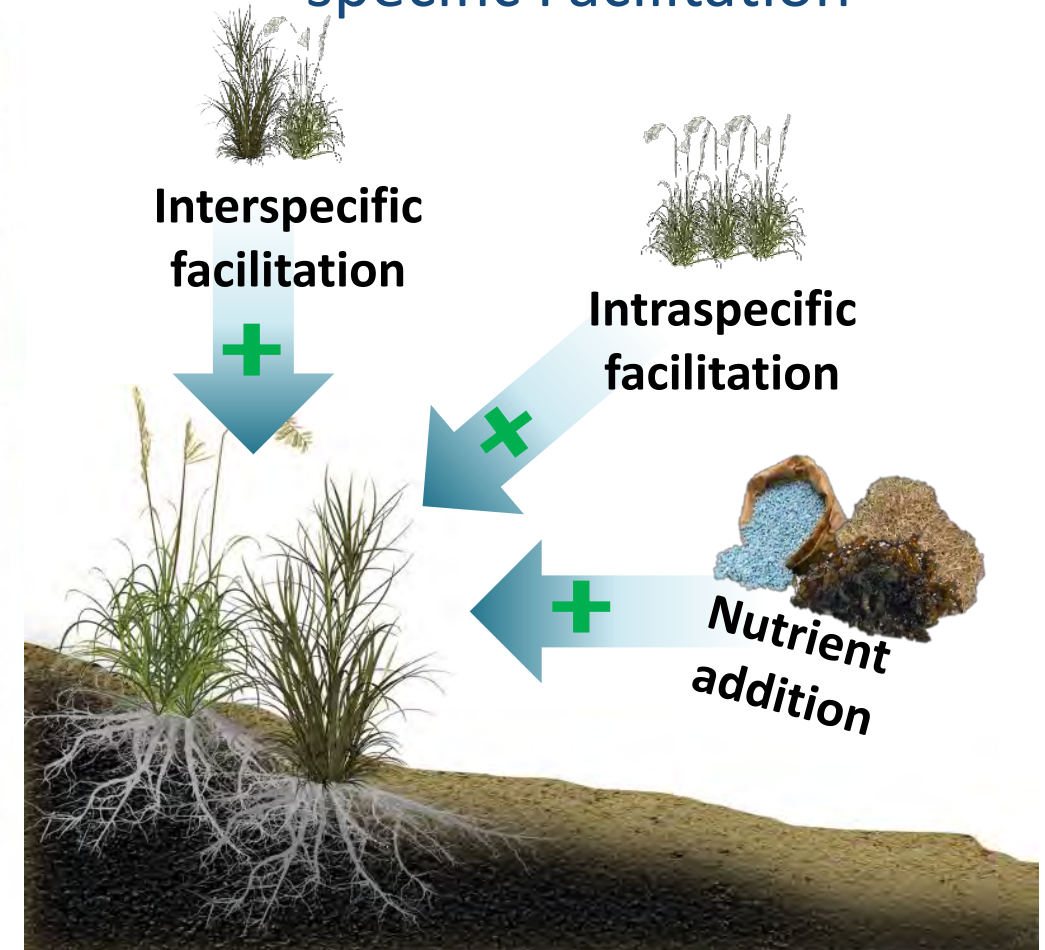
Part 2: Self-Facilitation

The Netherlands



Silliman et al. 2015 PNAS

Part 3: Self-Facilitation vs Interspecific Facilitation



Part 1: What is wrack's role in mediating plant succession and dune formation?

H: Wrack stimulates post-hurricane plant recolonization and dune formation



Davide De Battisti



John Griffin



Hallie Fischman



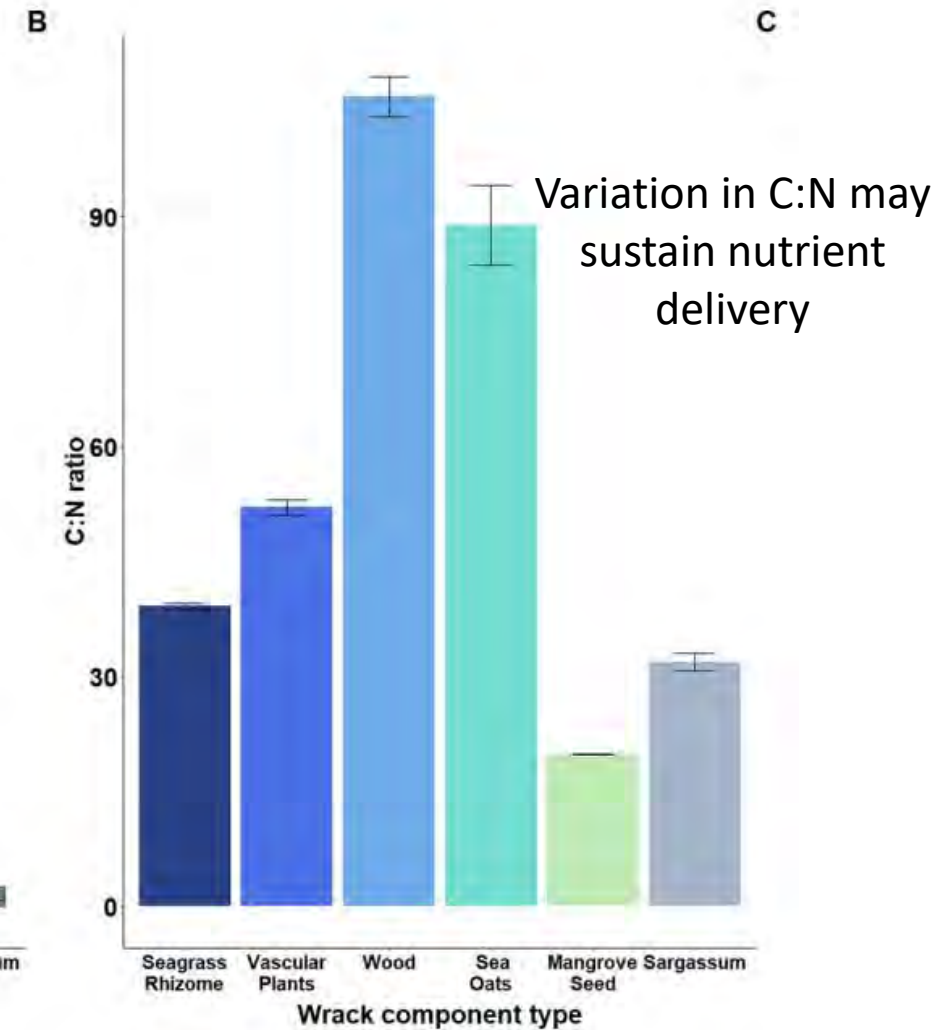
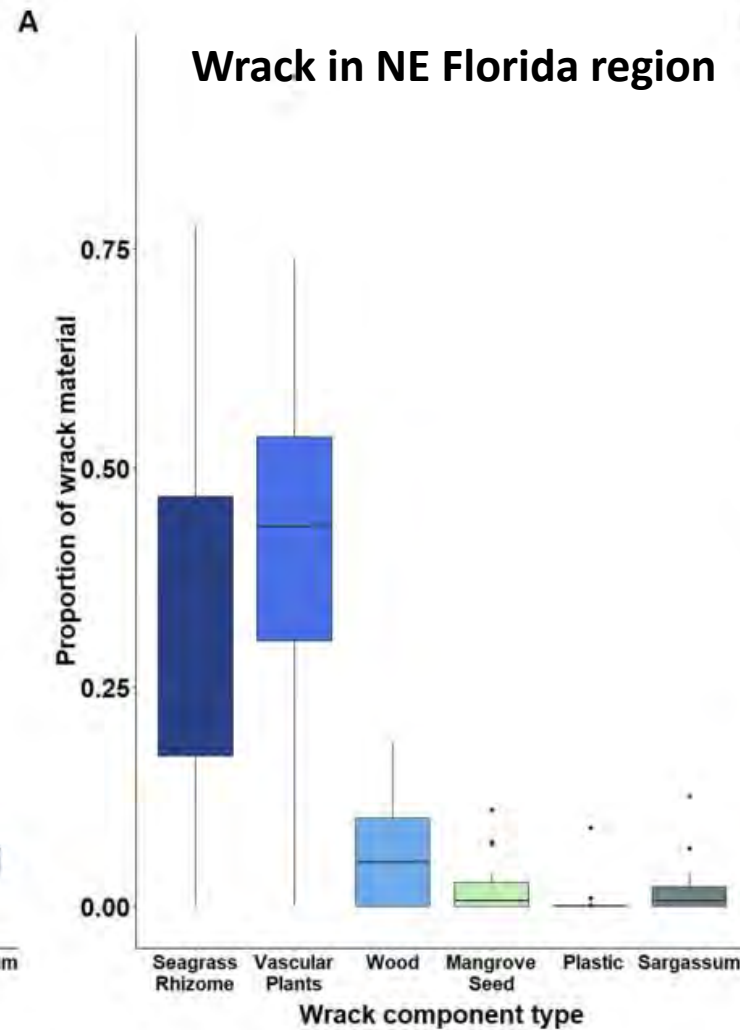
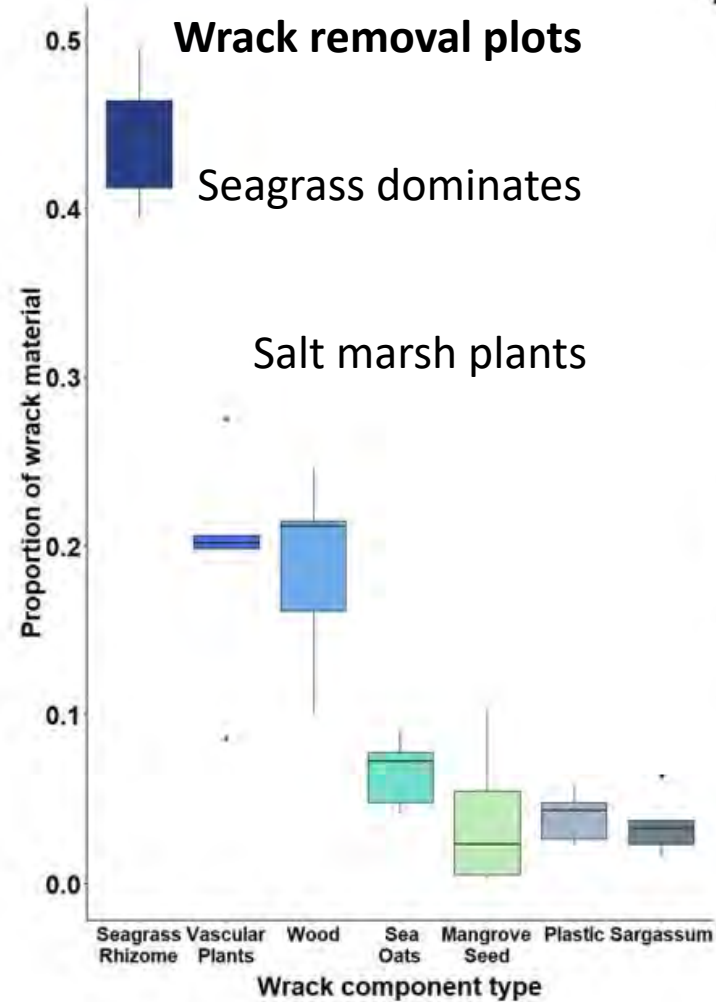
Sinead Crotty

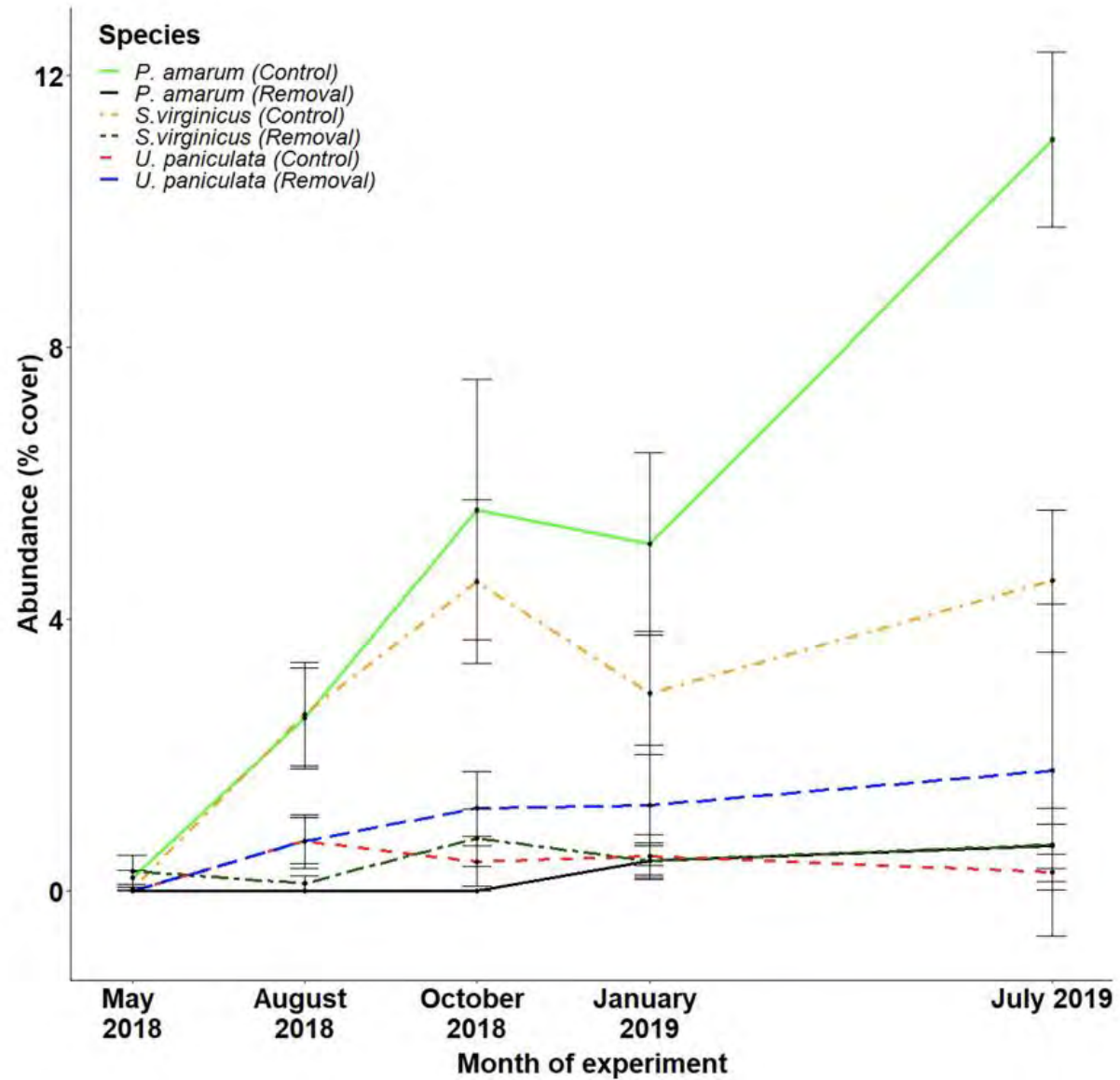


Matt Joyce

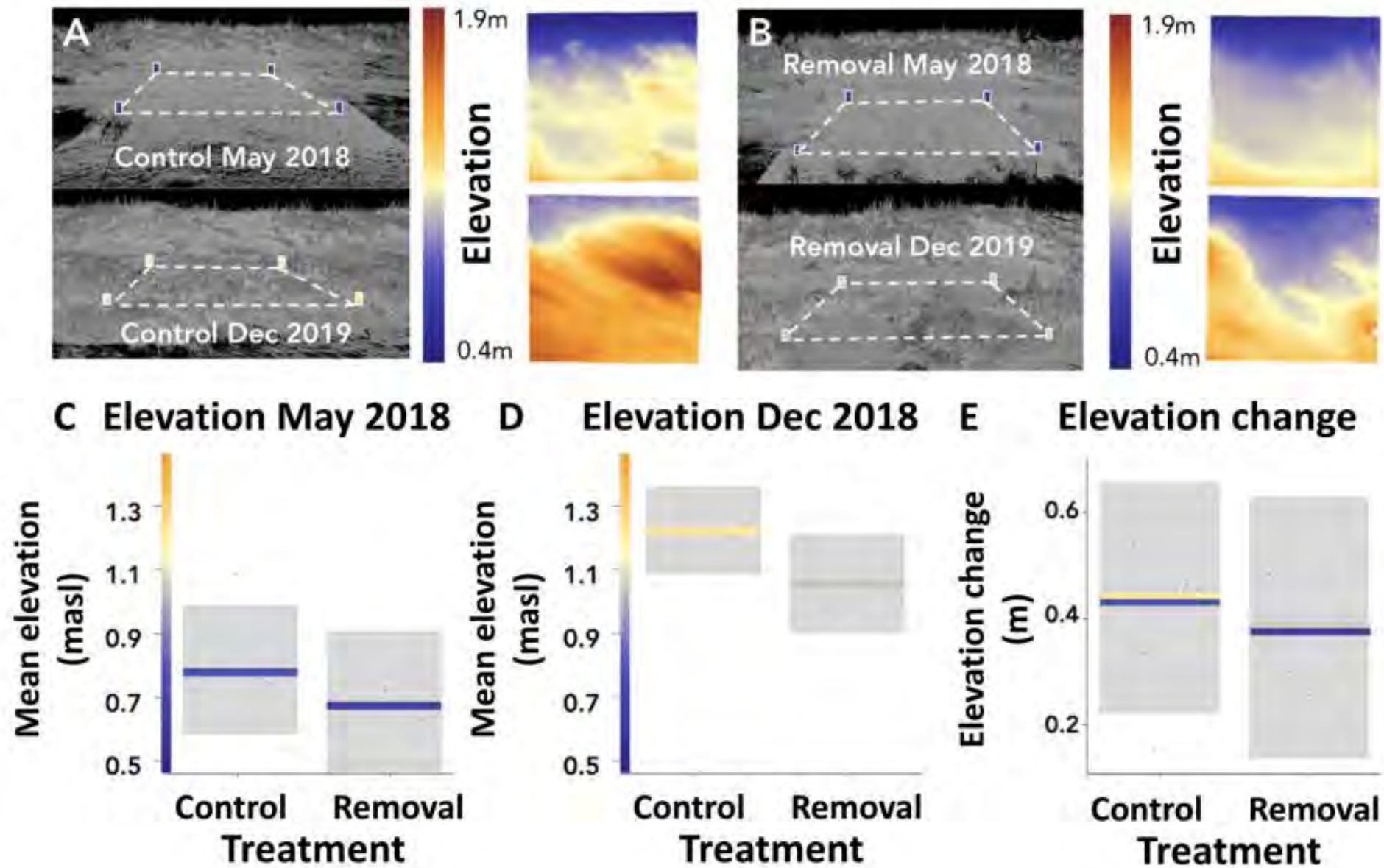


Multiple Coastal Systems Supply Wrack to Dunes





Findings suggest that *Panicum* is the more prolific early succession species, primarily where it is facilitated by wrack



Wrack + enhanced plant growth facilitate embryo dune formation

Study Take-Home

Wrack (detritus from other coastal systems) facilitates dune recovery.

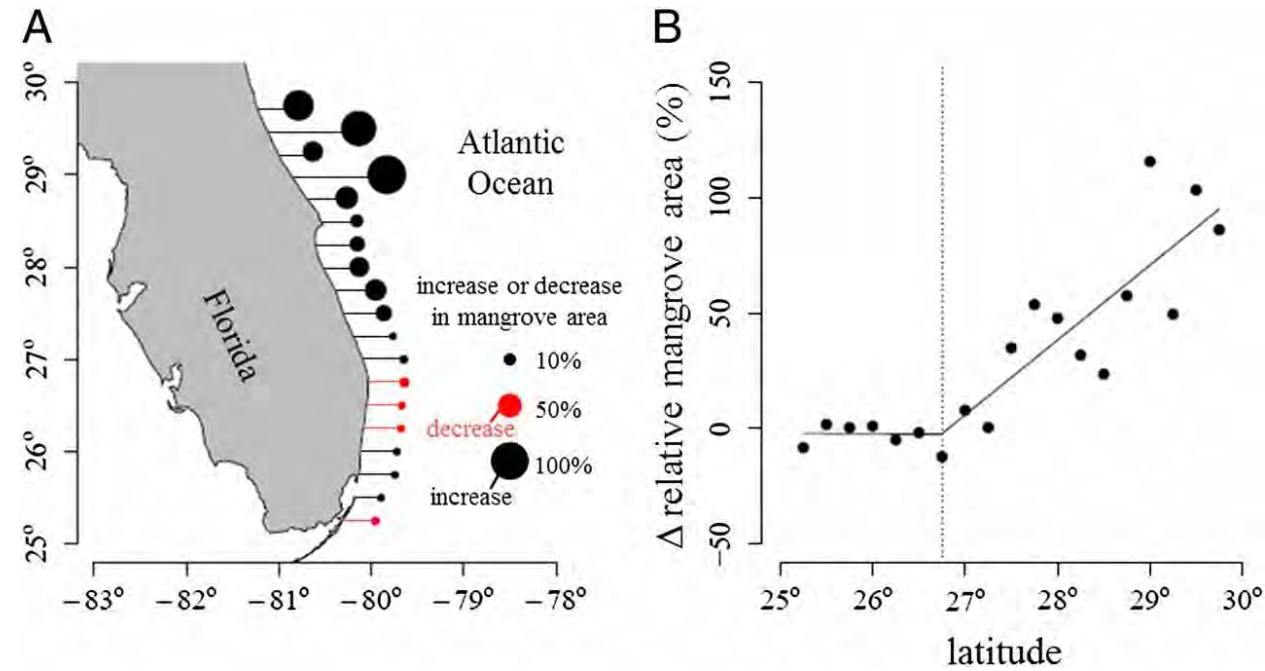
Beach grooming is likely adverse to dune recovery and stability.



Future Directions

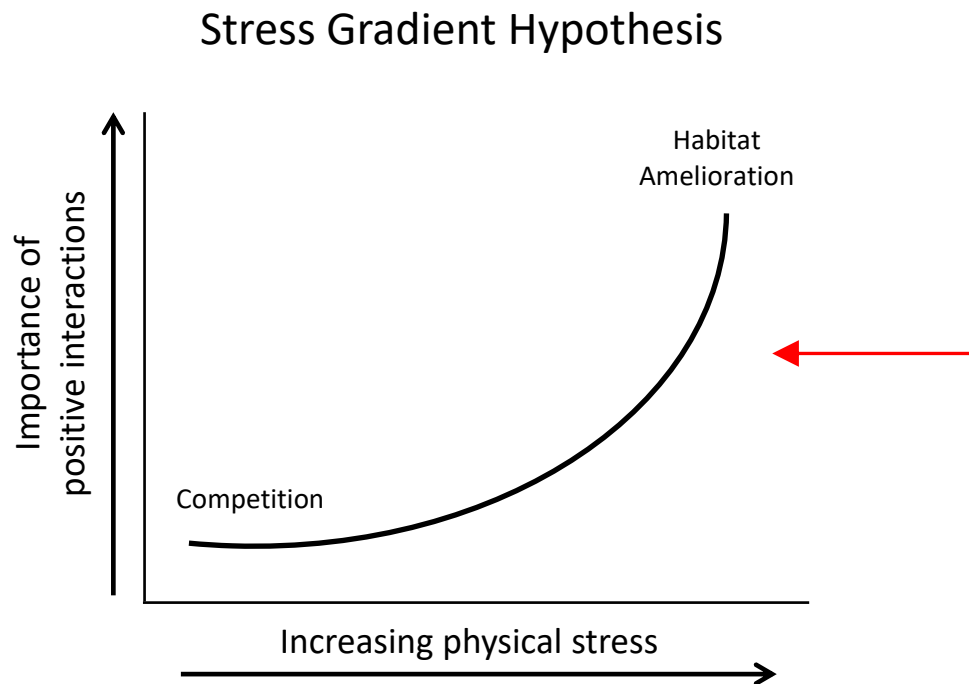
Wrack composition is likely shifting with climate change and human impacts.

Evaluating these cross-system subsidies and their influence on restoration is an exciting frontier



Part 2: Can we improve dune restoration outcomes by applying the principles of the Stress Gradient Hypothesis?

Hypothesis: Intra-specific Facilitation (i.e. clustering transplants and increasing planting density) Achieves Greater Benefits when Stress is High



Clustering transplants –
or increasing density –
to achieve habitat
amelioration benefits is
key in high stress
environments



Hallie Fischman

Bertness & Callaway 1994

Methods: Intraspecific Restoration Experiment

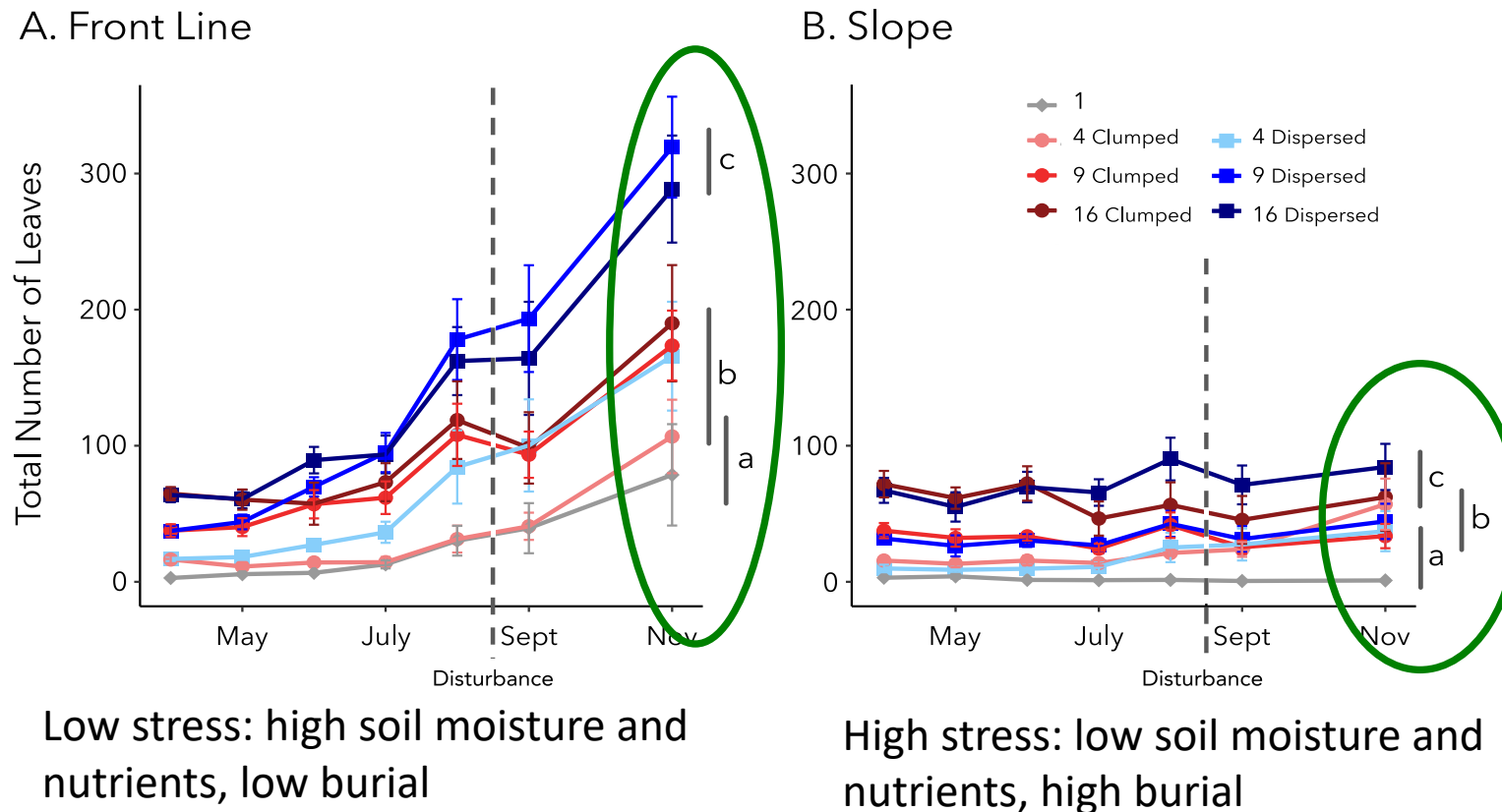
Two zones: high stress (slope) and low stress (front line)

Two treatments: clumped and dispersed *Uniola*

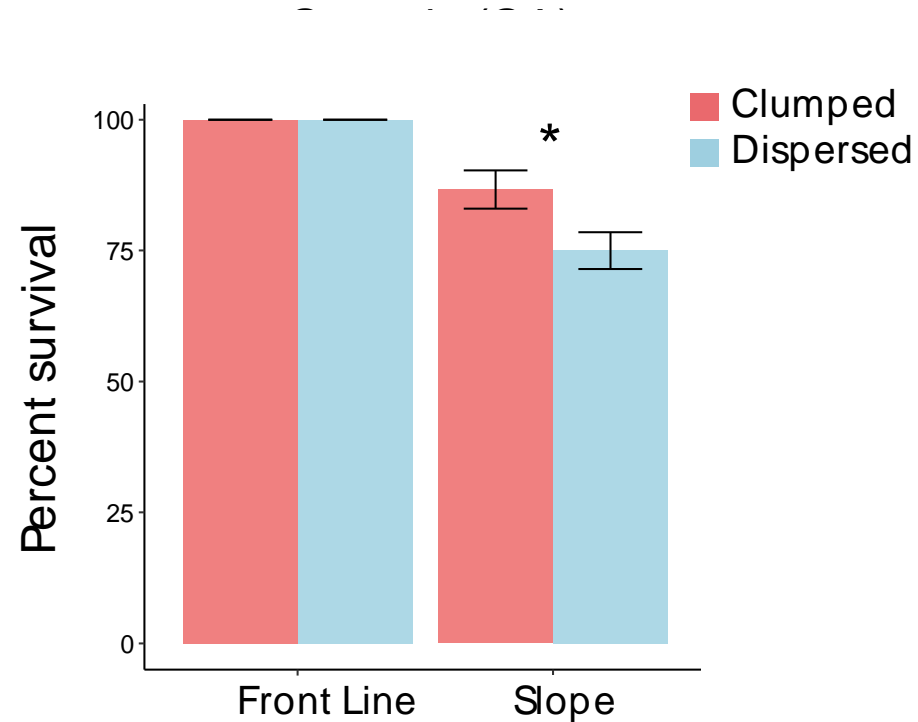
Three densities: 4, 9, and 16 plants



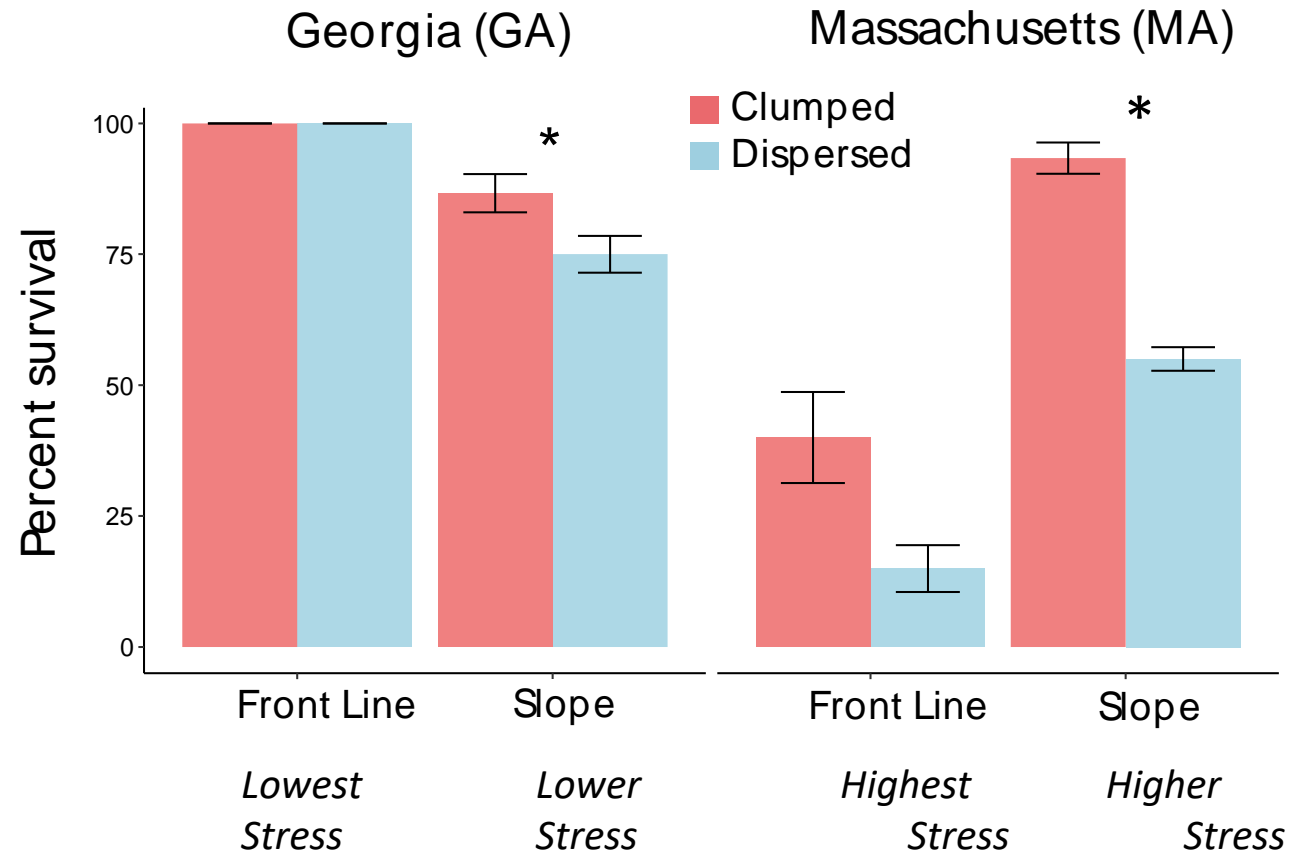
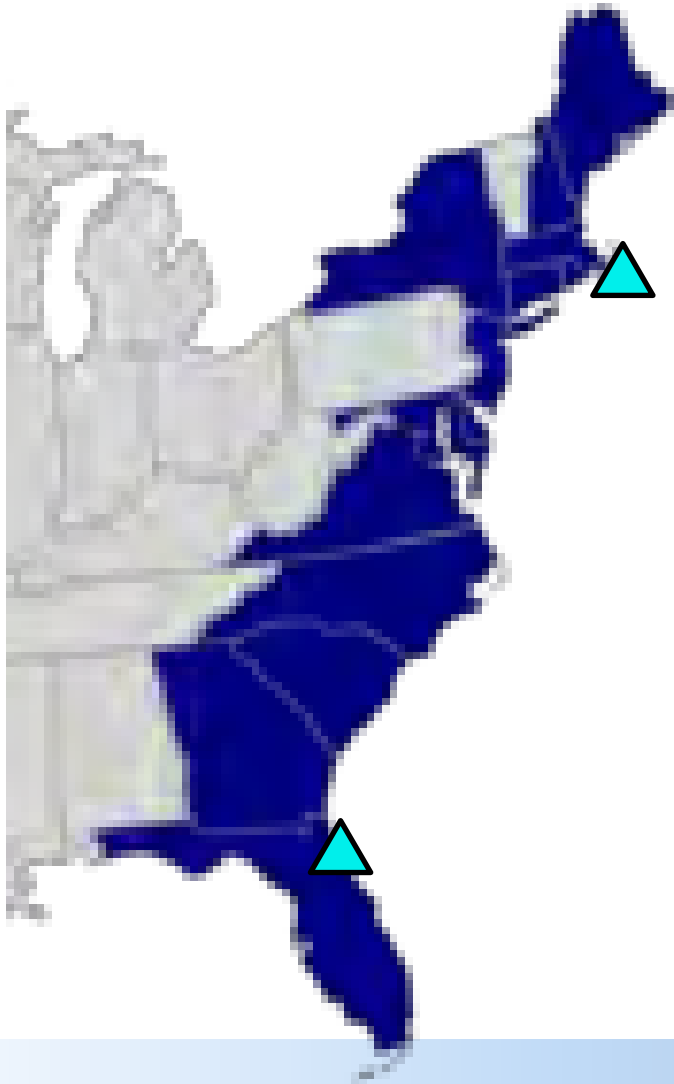
Leaf Counts: Plants Perform Far Better in Lower Stress Front Line & Barely Grow in High-Stress Slope



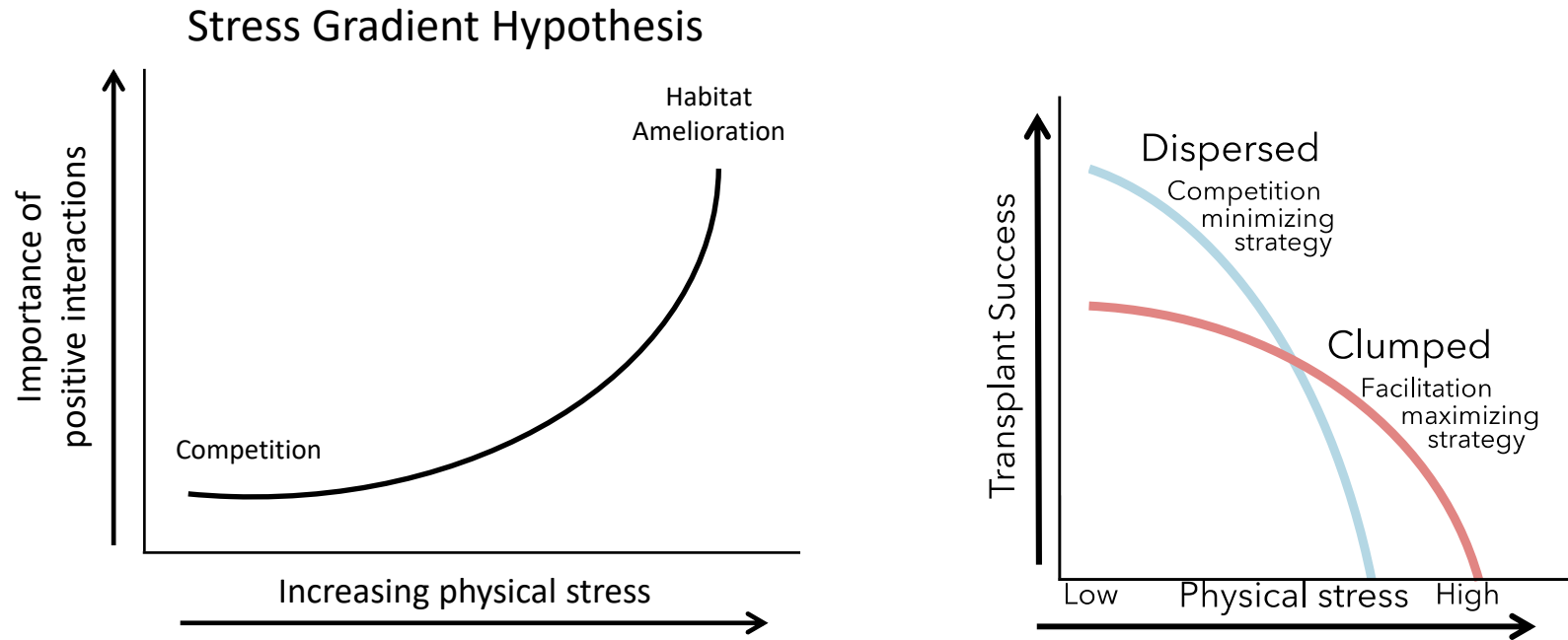
Survival – Clumping improves transplant survivorship on the higher stress slope, but provides no benefit along lower stress Front Line



In all locations with elevated stress, clustering improves survival



Take Away: Cluster when stress is high!

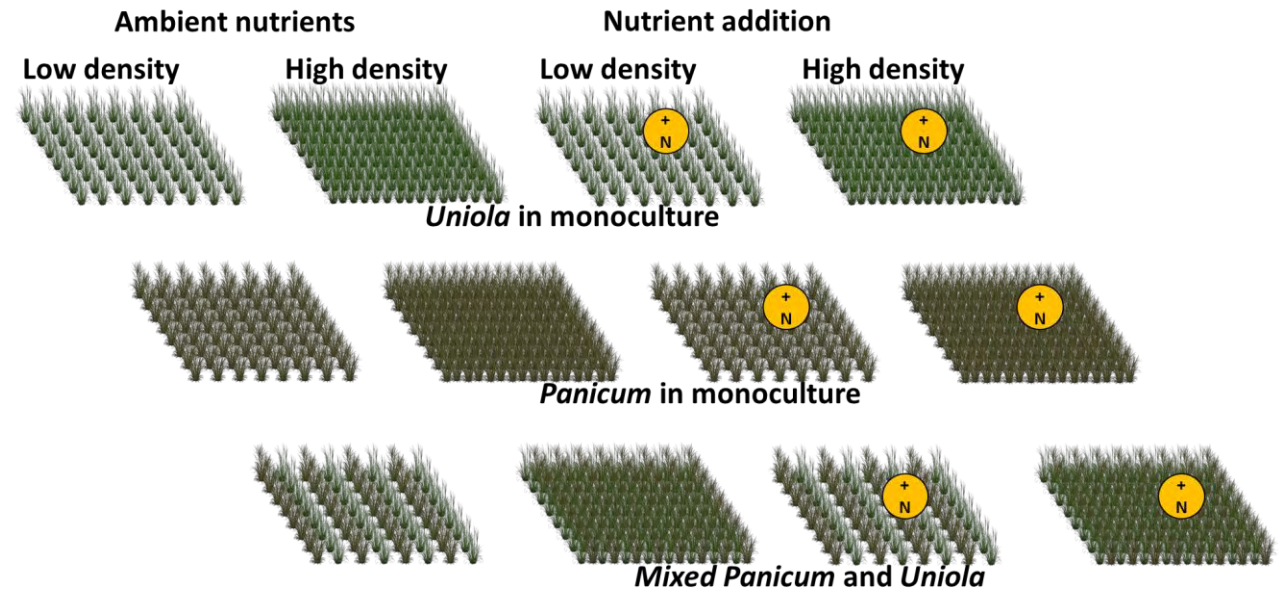
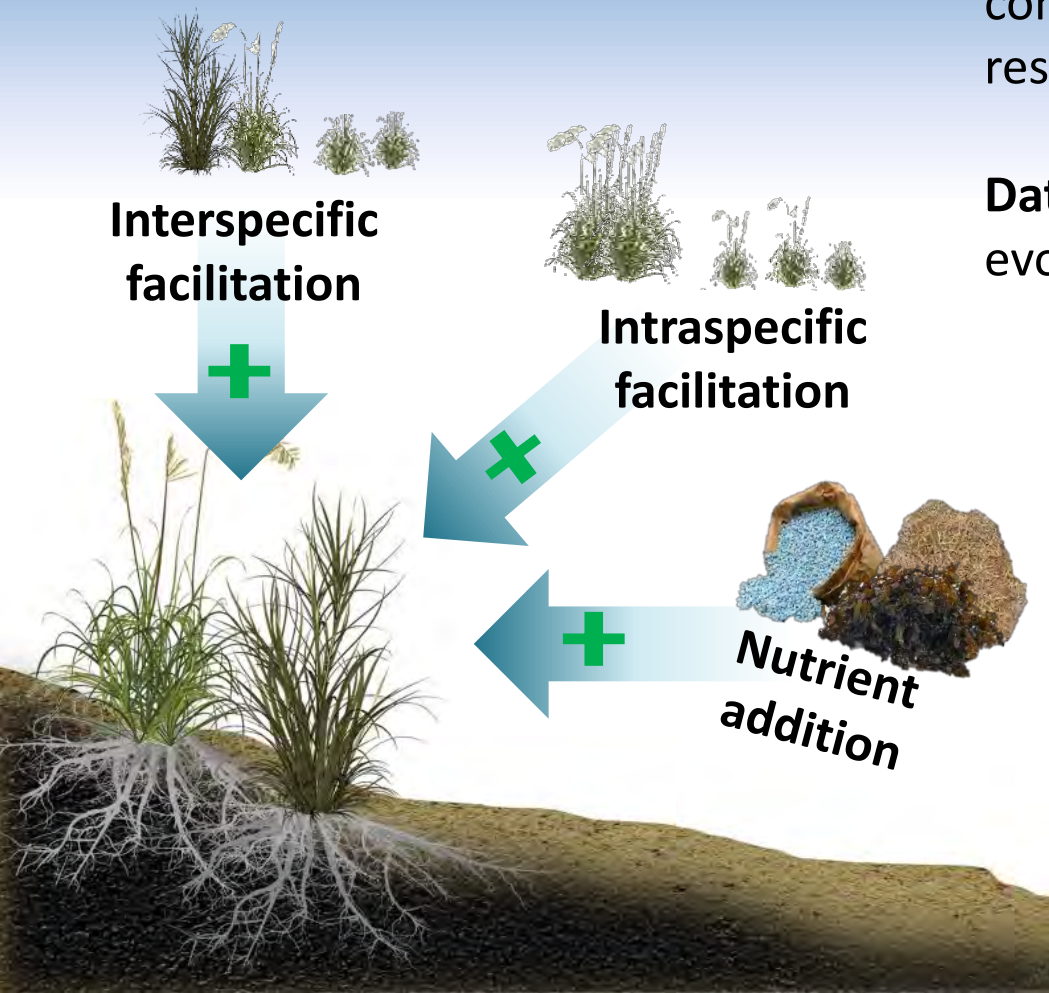


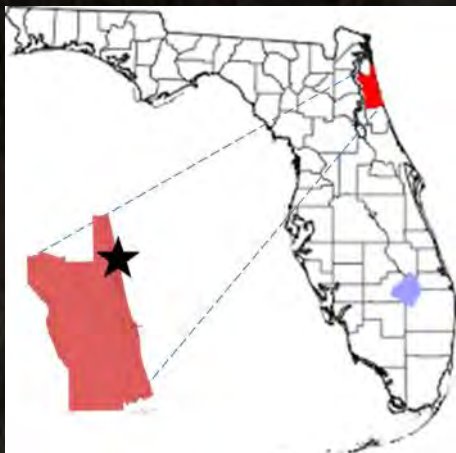
Understanding the physical stress levels of each restoration site and where those levels fall on the stress gradient is crucial to optimizing successful restorations

Study 5: Should we harness positive inter- or intraspecific interactions to enhance plant growth following restoration?

Method: Manipulative field experiment to determine what combinations of planting density, outplant species composition, and nutrient addition maximize dune restoration success

Data gathered: above- and belowground growth, geomorphic evolution, sediment chemistry, biodiversity metrics



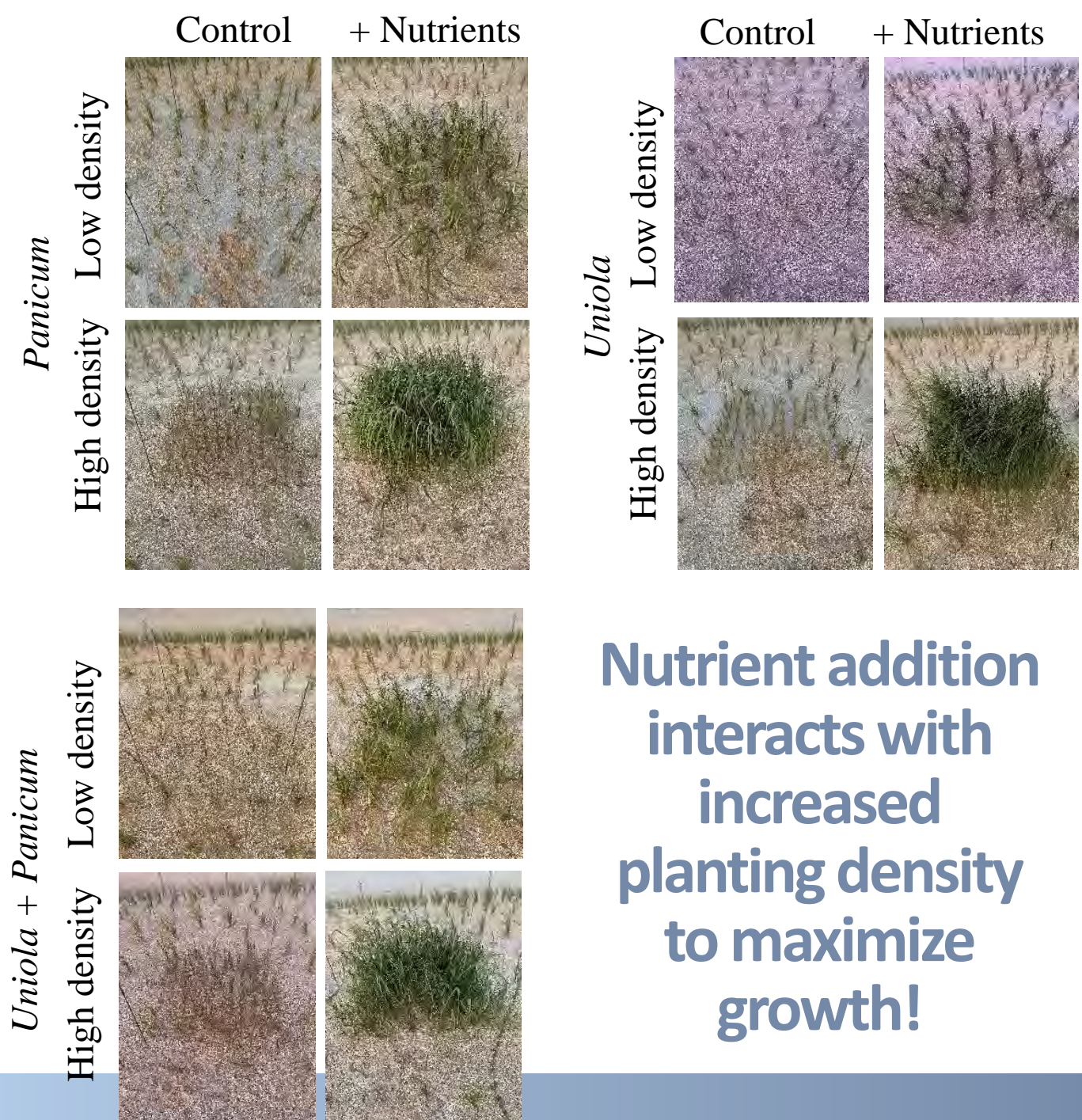
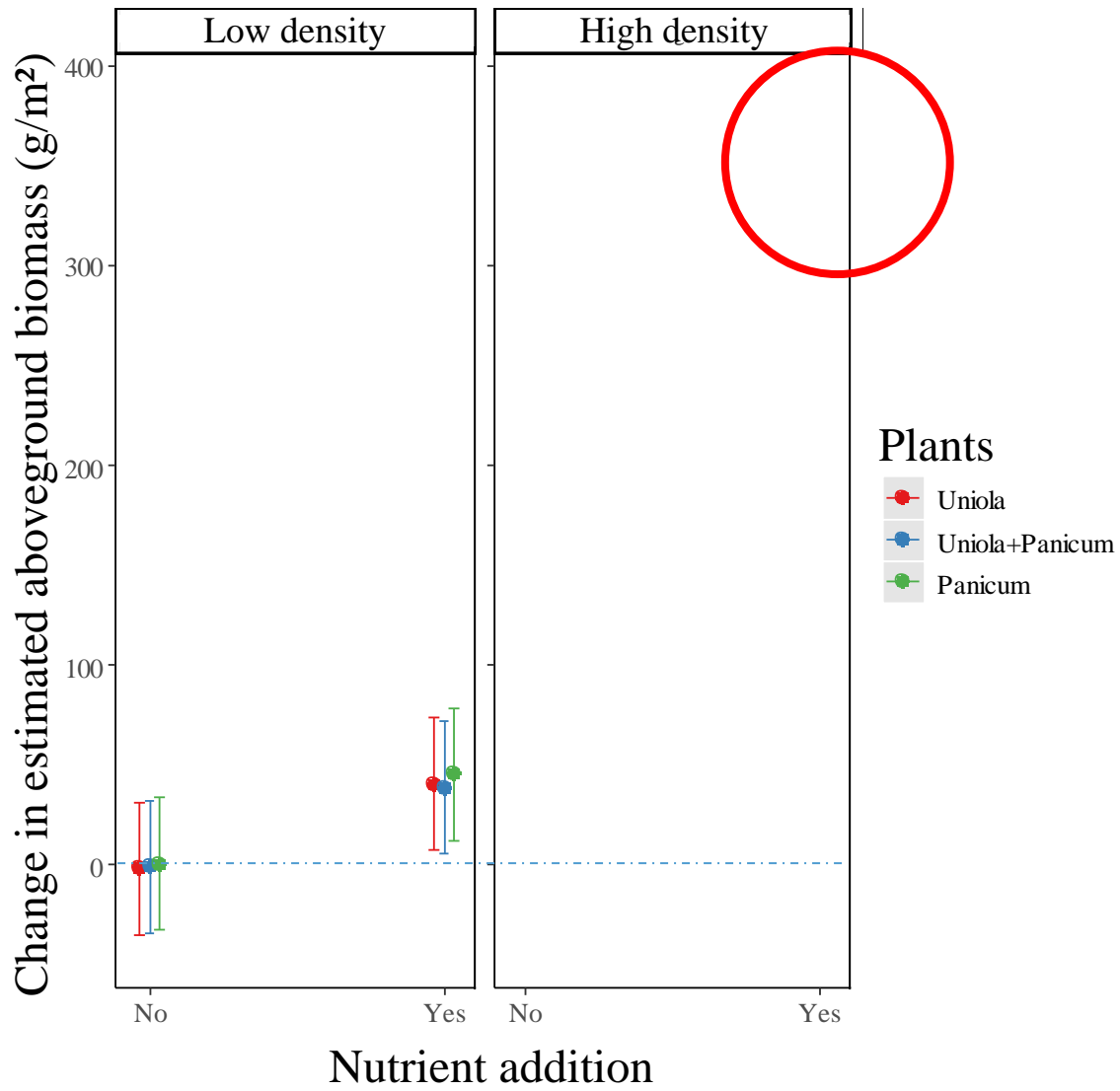


Exxon
station

Experimental area





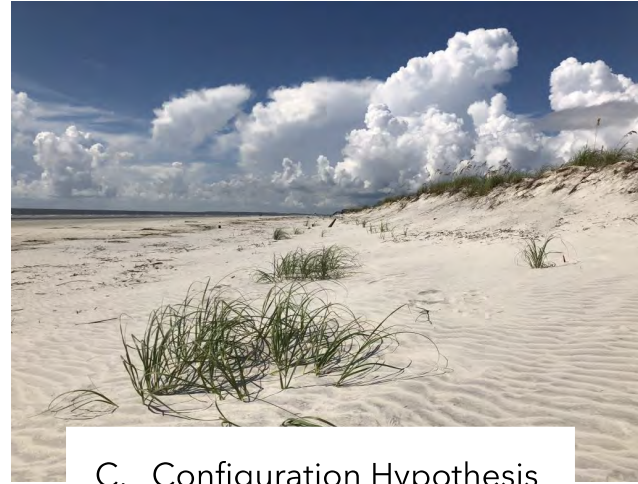


Final Guidance on Integrating Positive Interactions into Dune Restoration

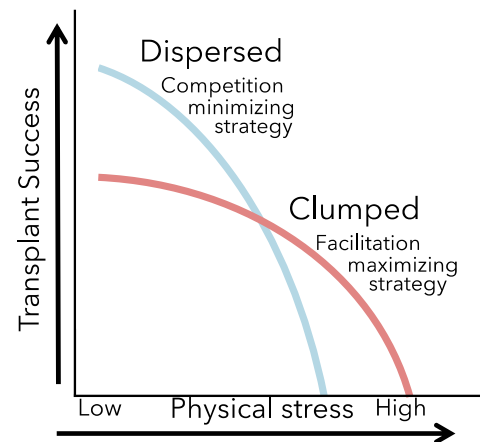
Part 1: Integrate Wrack



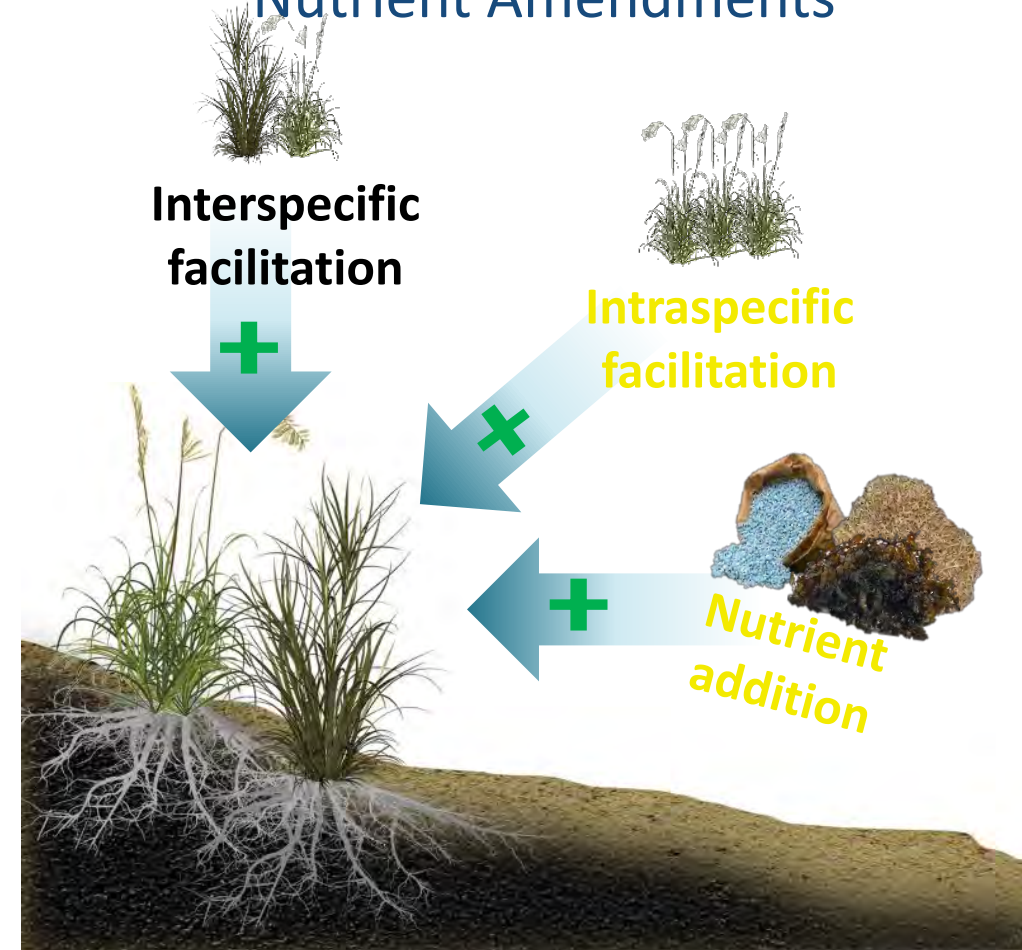
Part 2: Cluster when stressful



C. Configuration Hypothesis



Part 3: Integrate Self-Facilitation + Nutrient Amendments



More information:

Dr. Christine Angelini, Director (c.angelini@ufl.edu)

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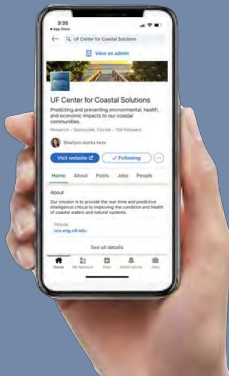
Instagram



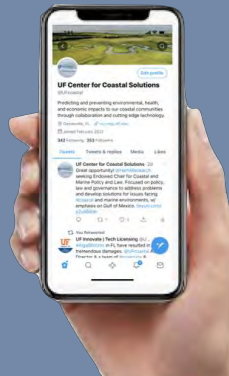
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