Primary productivity of *Spartina alterniflora* following freeze-induced mangrove loss in south Texas

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Introduction

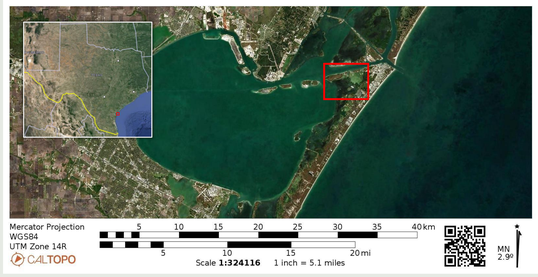

Fig 1. Red polygon indicates south Texas study site.

- **Winter Storm Uri** (Feb 2021) caused **99% mortality** in a black mangrove-dominated marsh community in south Texas (Figs. 1 & 2).
- Smooth cordgrass (*Spartina alterniflora*) has since rapidly recolonized large areas of dead mangroves, despite low redox potentials in the soils.
- Shifting dominant vegetation types will impact carbon sequestration and coastal protection capabilities
- **How does freeze-induced mangrove loss impact the primary productivity of recolonizing *Spartina*?**

Fig 2. Dead mangroves in south Texas following Winter Storm Uri.

Research Hypotheses

1. Post-freeze soil conditions are characterized by **high soil organic matter** and **low redox potentials.**
2. Patches of recolonizing *Spartina* can withstand soils with low redox potentials; however, **net photosynthetic rate is low**.

Methods

- Collected 4, **10-cm sediment cores** at each patch to measure soil **organic matter**, sediment **ammonium**, and sediment **carbon-to-nitrogen (C:N) ratios**
- Made **in-situ redox potential** measurements on 1-2, **30-cm sediment cores** at various **depths** in each patch
- Made **in-situ** measurements of **photosynthetic rate** at all **vegetated patches**

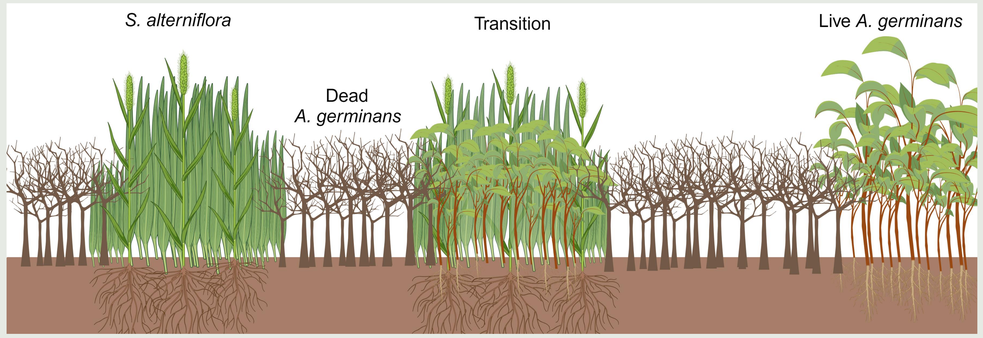

Fig 3. Conceptual diagram of patches in the landscape mosaic. At each patch, redox potential was measured with a redox microelectrode (Unisense), and at vegetated patches, an infrared gas analyzer (LI-6400; LI-COR Biosciences, Inc.) was used to measure photosynthetic rate (credit: biorender.com).

Wetland Soil Conditions

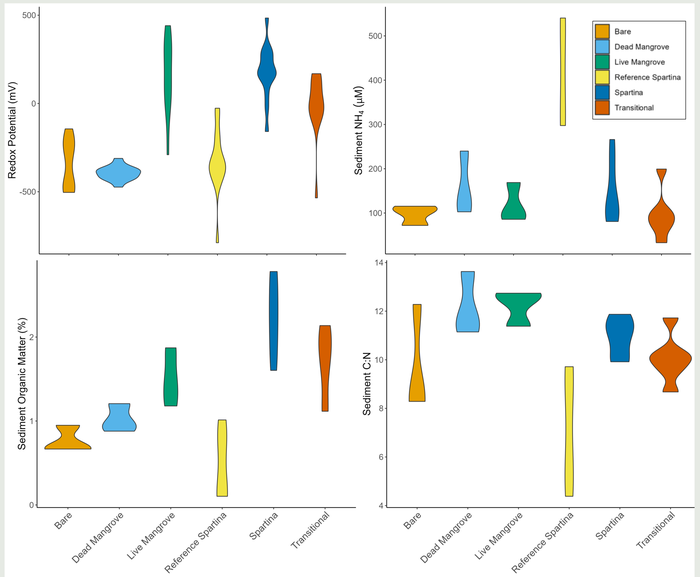

Fig 4. Wetland soil conditions (organic matter, redox potential, ammonium, and C:N) in various patch types.

Dead mangrove soils
low redox potentials & high C:N

- Anoxic conditions and degraded organic matter sediments

Recolonizing *Spartina* soils
high redox potentials, sediment organic matter, and C:N

- Oxic and organic-rich sediments

Spartina Photosynthetic Rate

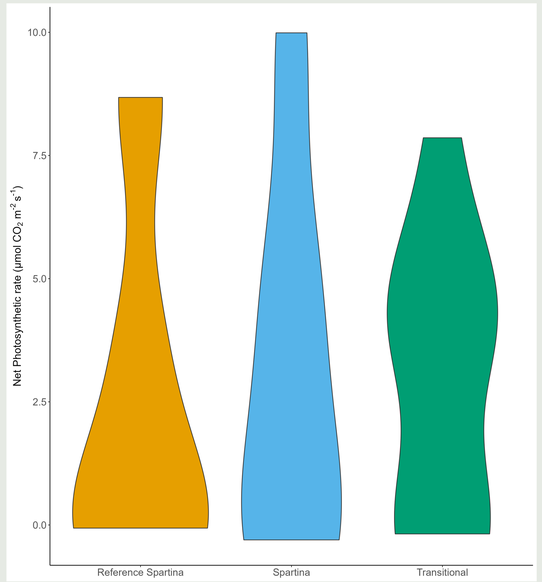

Fig 5. Net photosynthetic rate of *Spartina* in various patch types.

Net photosynthetic rates in *Spartina* were **not significantly different across patch types**, despite high soil variability.

Conclusion

- *Spartina* maintains a consistent rate of net photosynthesis, indicating resilience to changing abiotic conditions.
- *Spartina* patches have oxic and organic-rich sediment
- *Spartina* has the ability to rapidly recolonize a wetland habitat following the release of the competitively dominant black mangrove[2].

Fig 6. Recolonizing *Spartina* 2 years after Winter Storm Uri (Port Aransas, TX).

Acknowledgments

This project was supported by the Paul Gucwa Memorial Fund, a Jackson School fund dedicated to the direct benefit of undergraduate students. I would like to thank Lisa Young and Malvika Patil for their help and support.

References

[1]Martinez, M. *et al.* Integrating Remote Sensing with Ground-based Observations to Quantify the Effects of an Extreme Freeze Event on Black Mangroves (Avicennia germinans) at the Landscape Scale. *Ecosystems* (2023) doi:10.1007/s10021-023-00871-z.

[2]Tyler, A. C. & Zieman, J. C. Patterns of development in the creekbank region of a barrier island Spartina alterniflora marsh. *Marine Ecology Progress Series* **180**, 161–177 (1999).