How quickly can restored oyster reefs recover biogeochemical properties?

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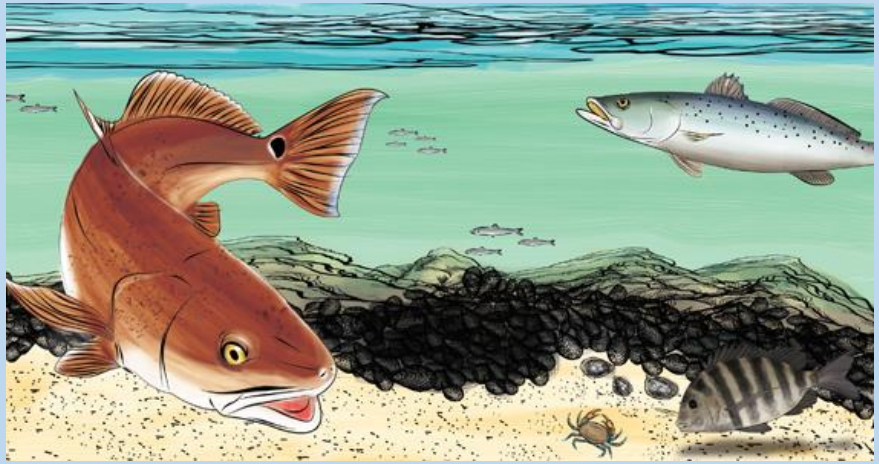
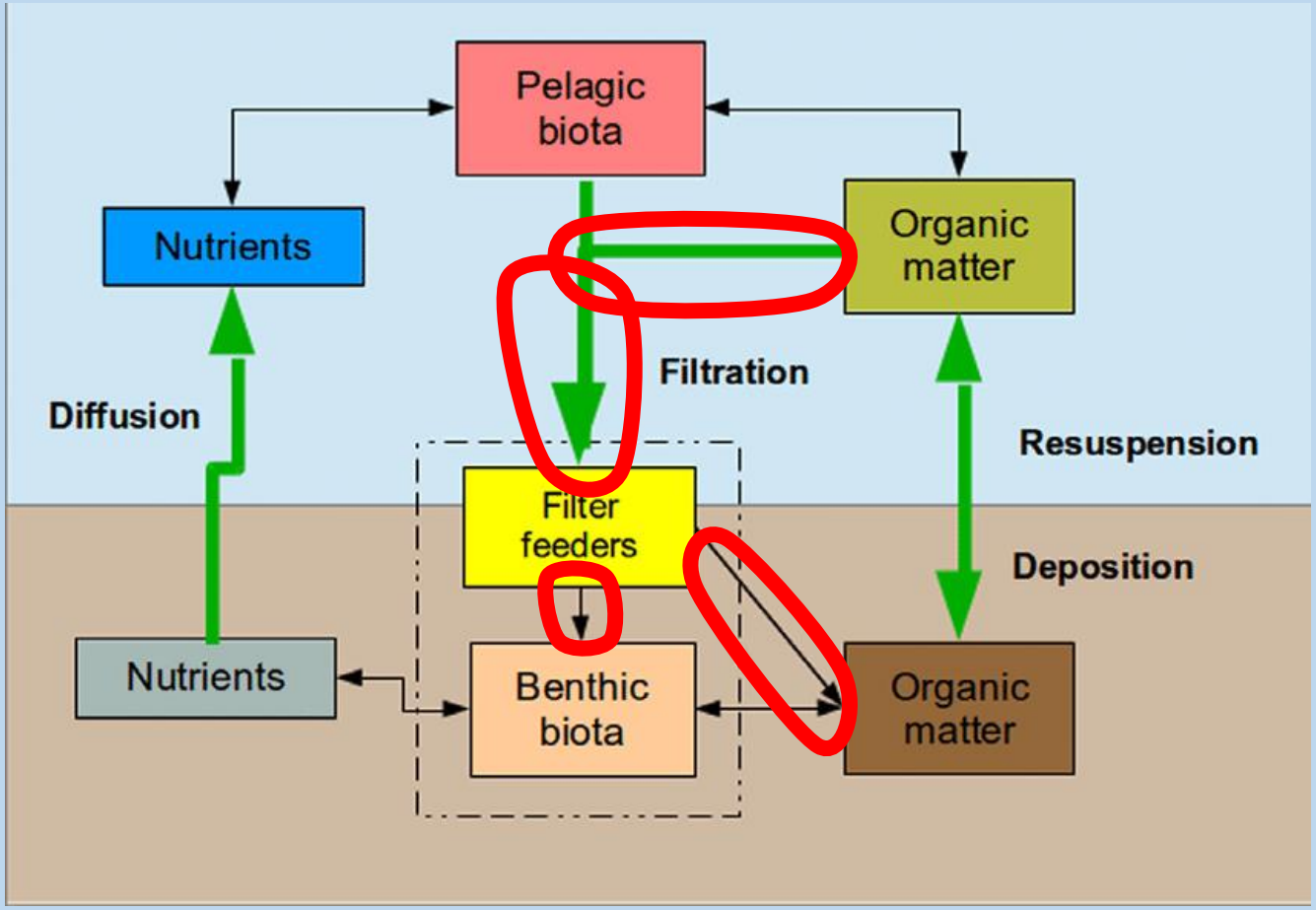
Measures of oyster reef recovery

- Common metrics
  - Reef height
  - Reef area
  - Number of oysters
  - Shell lengths
- Metrics of functioning
  - Fish abundance and diversity
  - Water filtration ability



How do reefs function as biogeochemical hotspots?

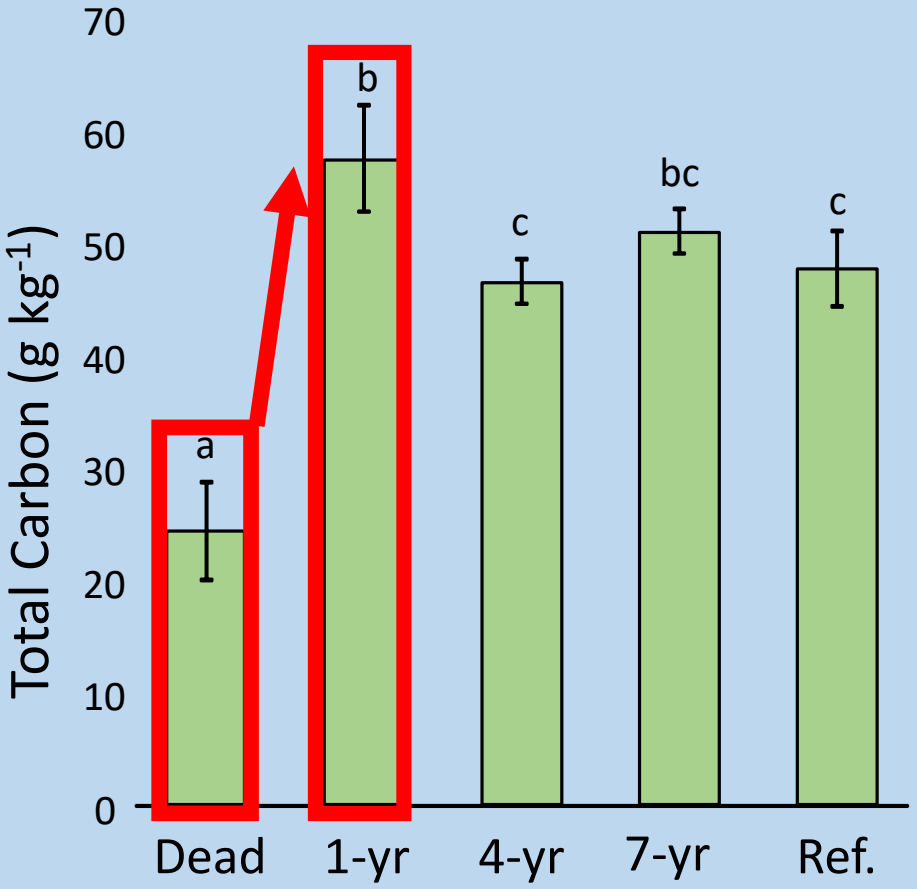
- Biotic factors (biodeposits and microbial sequestration)
- Abiotic factors (hydrodynamics and deposition)

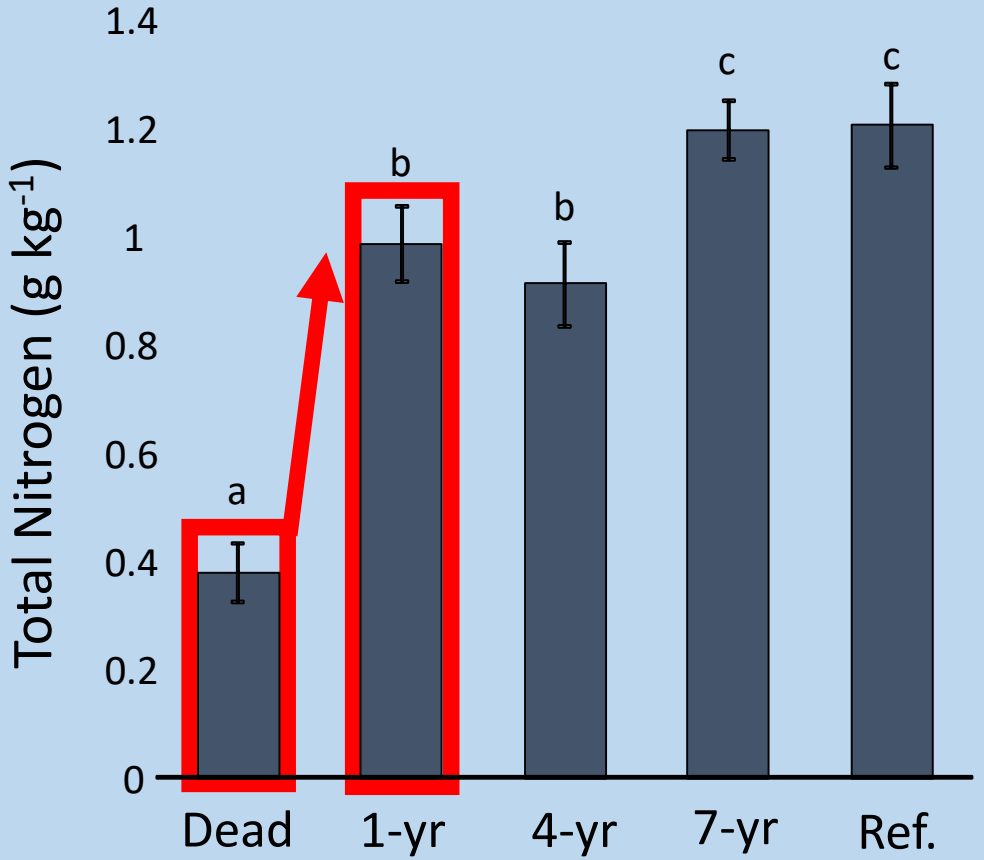


Newell et al. 2005

Sediment nutrient storage as reefs age

- In one year, organic matter content increased by 164%, Total C by 236%, Total N by 260%





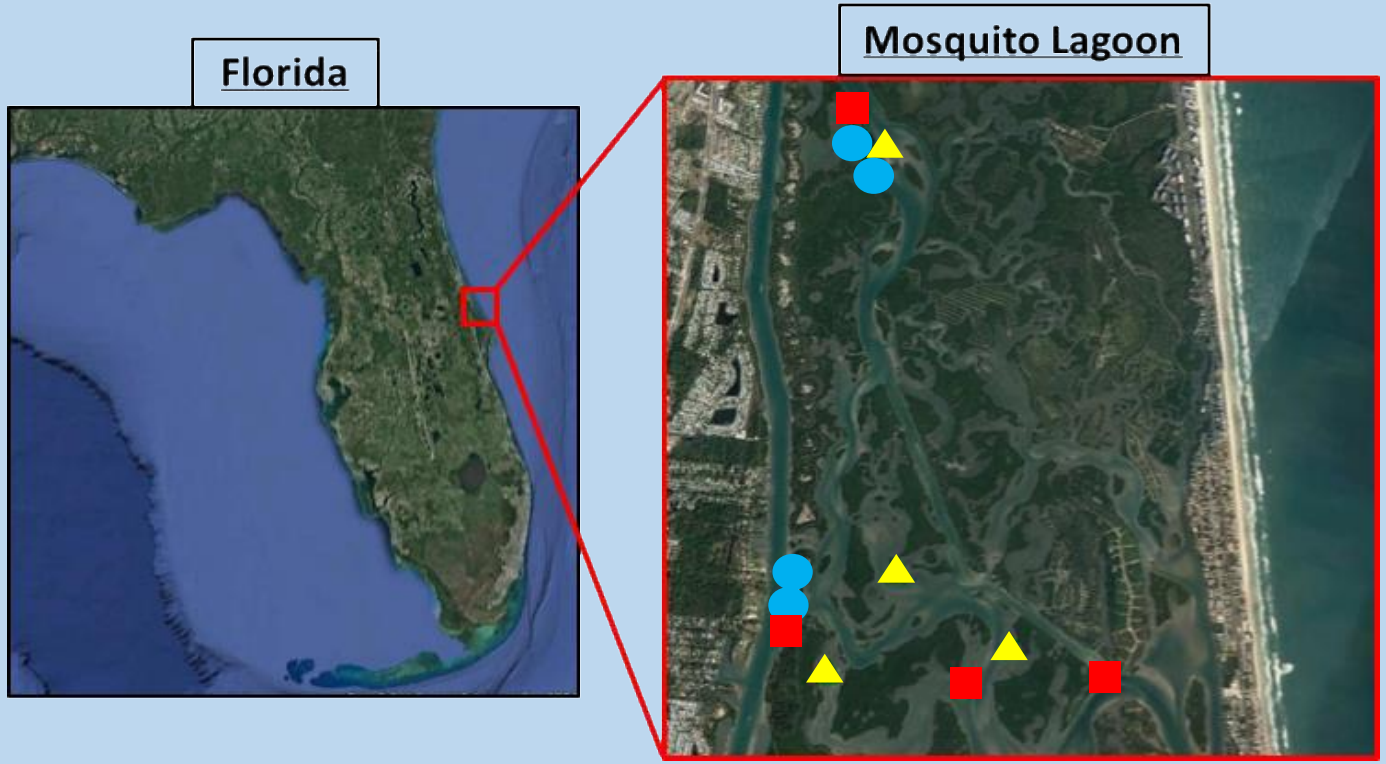
Chambers et al., 2018

Research Question

- Within the first year of restoration, when do restored reefs in Mosquito Lagoon achieve natural reef biogeochemical functioning?

- Higher resolution measurements of changes in sediment biogeochemical properties over the first year

Study Site



Legend

- 4 Dead reefs
- 4 Natural reefs
- 4 Restored reefs

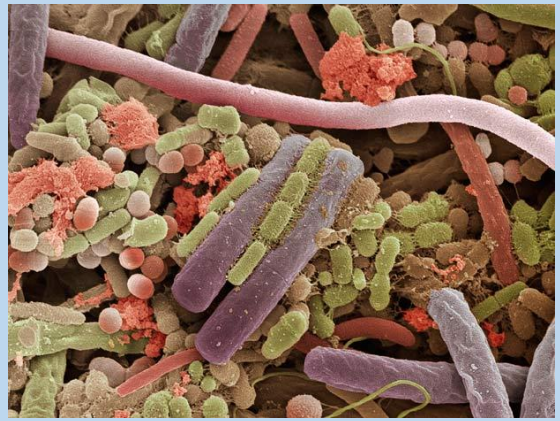
- Boat wakes cause dead margins
- 40% loss of oyster reef coverage within Canaveral National Seashore since 1943 (Garvis et al. 2015)

Methods

- Before-after-control-impact study design
- Time points: before restoration, 1 week, 1 month, 6 months, 9 months, and 12 months
- Only one before measurement

Methods

- “Short-term” bioavailable nutrients
  - Carbon – DOC
  - Nitrogen – ammonium (NH_4^+) and nitrate (NO_3^-)
  - Phosphorous - PO_4^{3-}

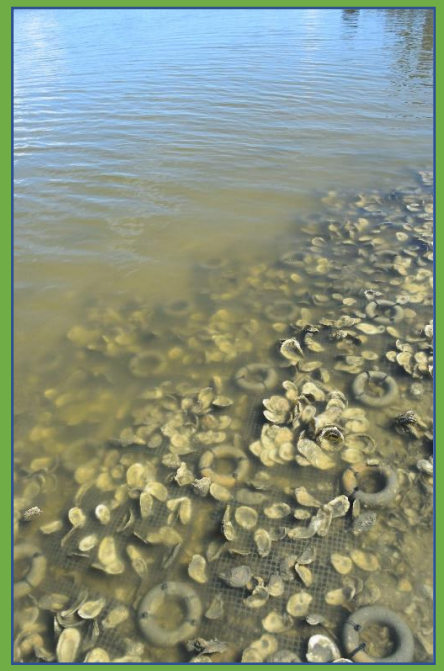


- “Long-term” stored nutrients
  - Total nitrogen
  - Total carbon, phosphorous, and organic matter content in progress

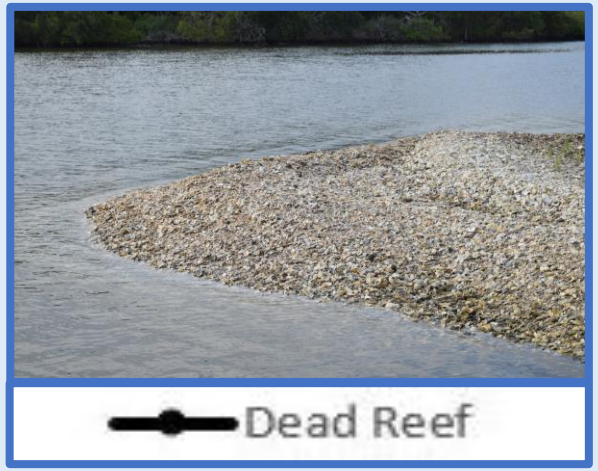
Total = Organic + Inorganic

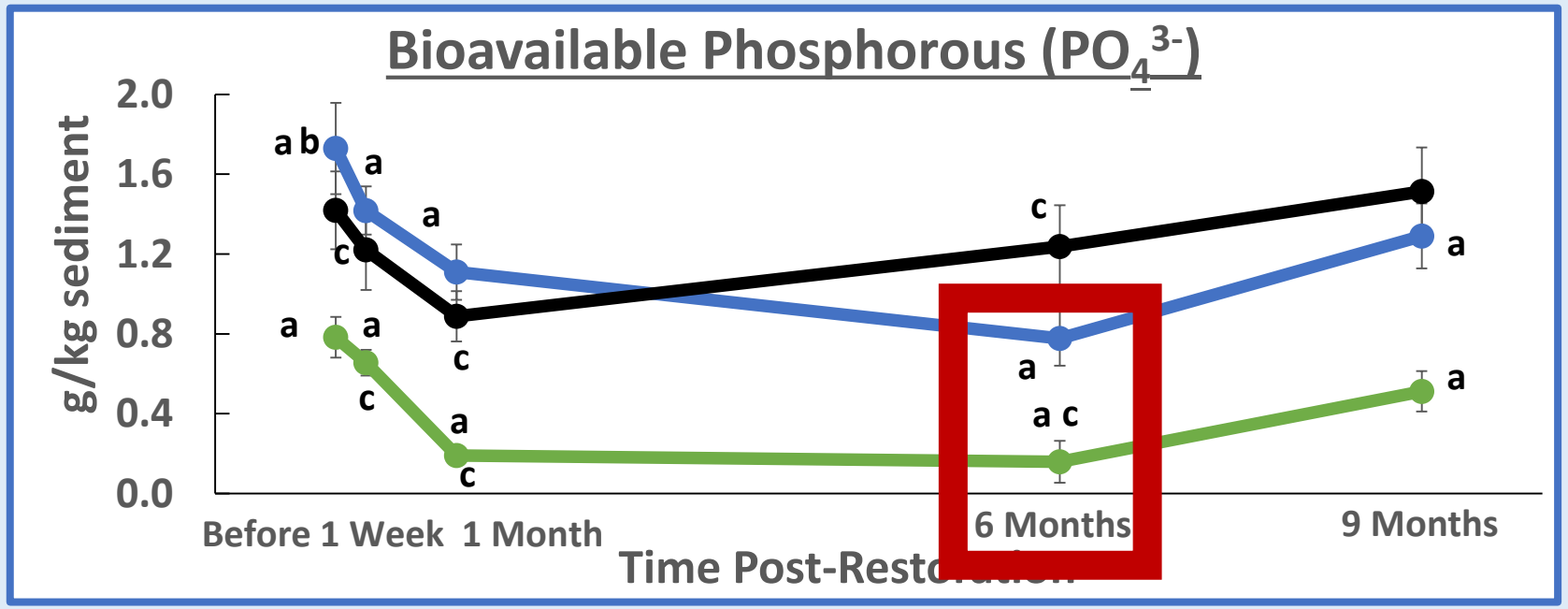
- Evaluate biogeochemical functioning by measuring nutrient burial

Methods



Results – Short-term nutrients





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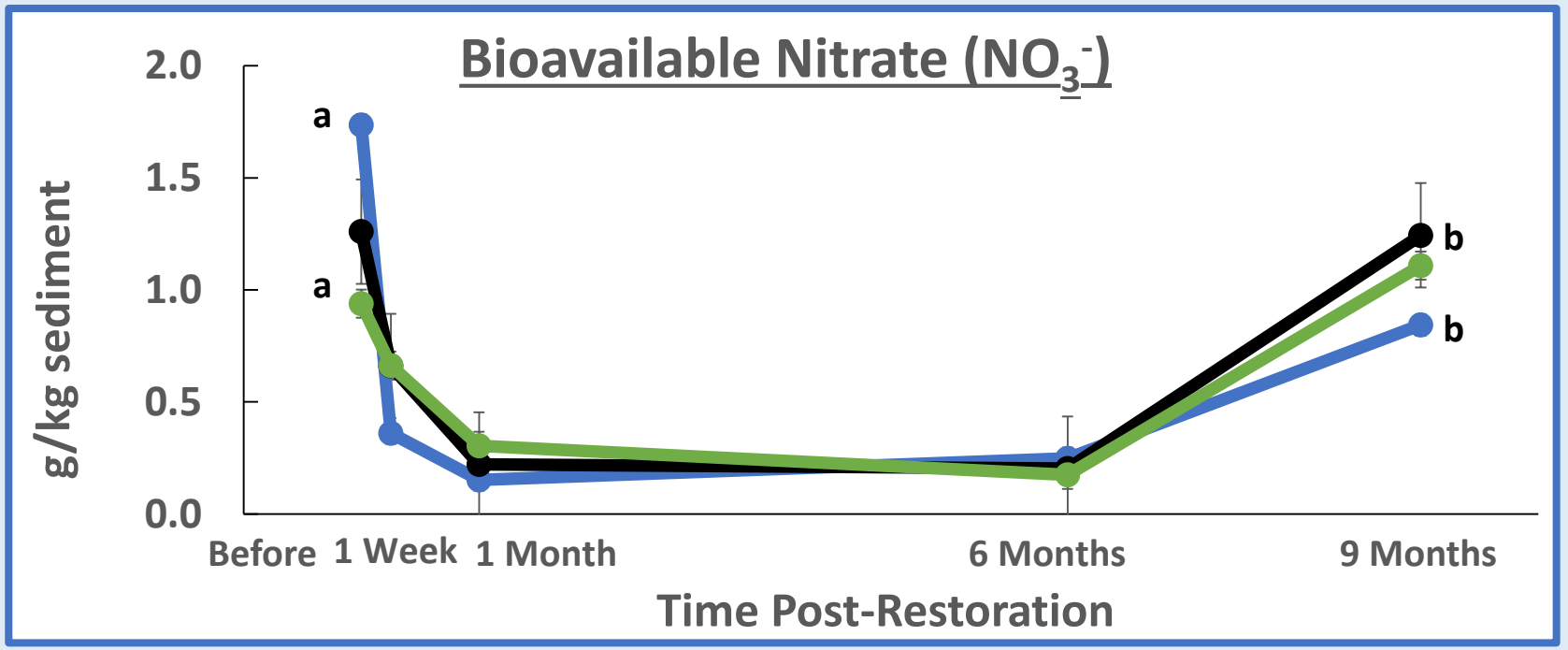
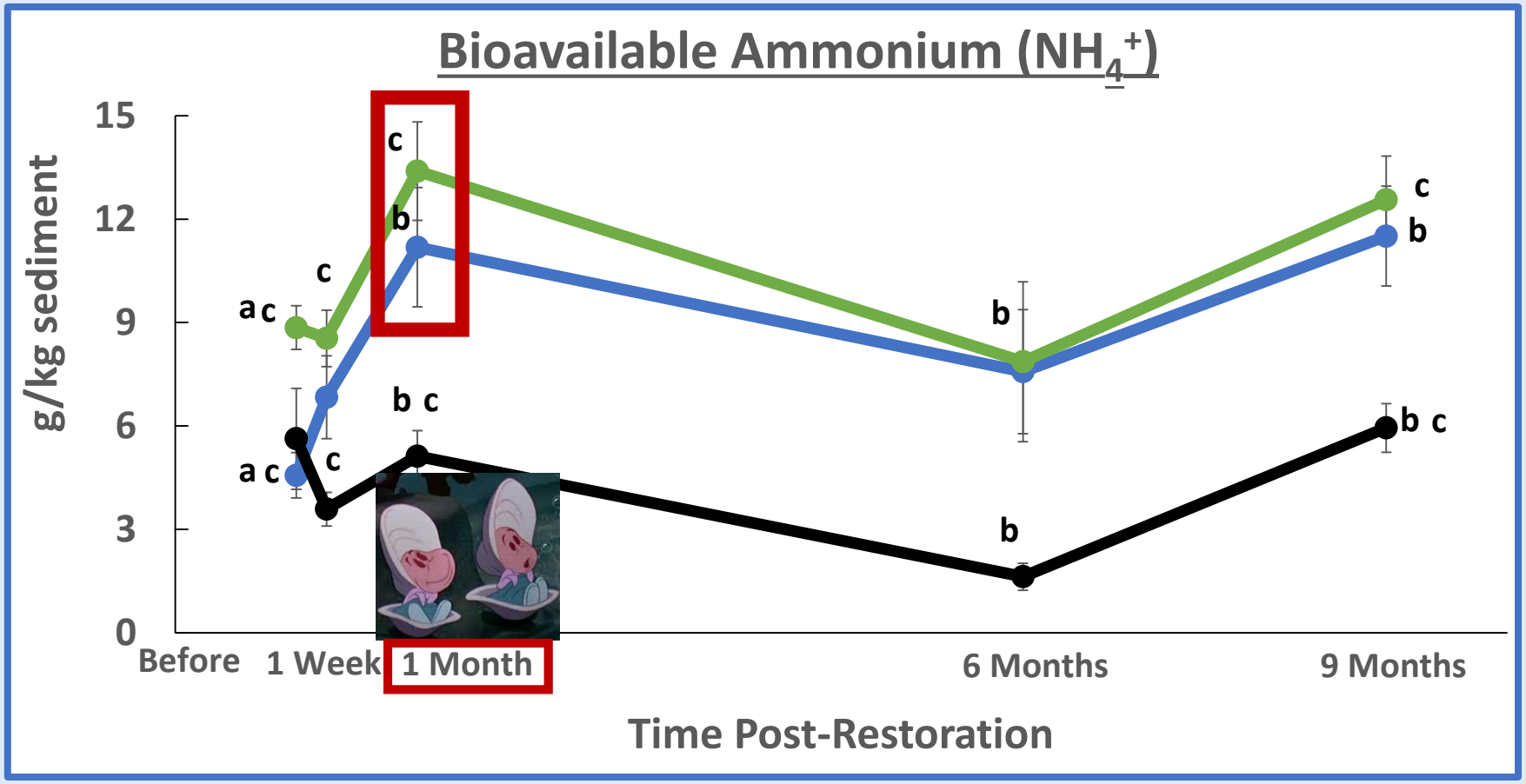


- Sediment nitrate levels may be changing seasonally

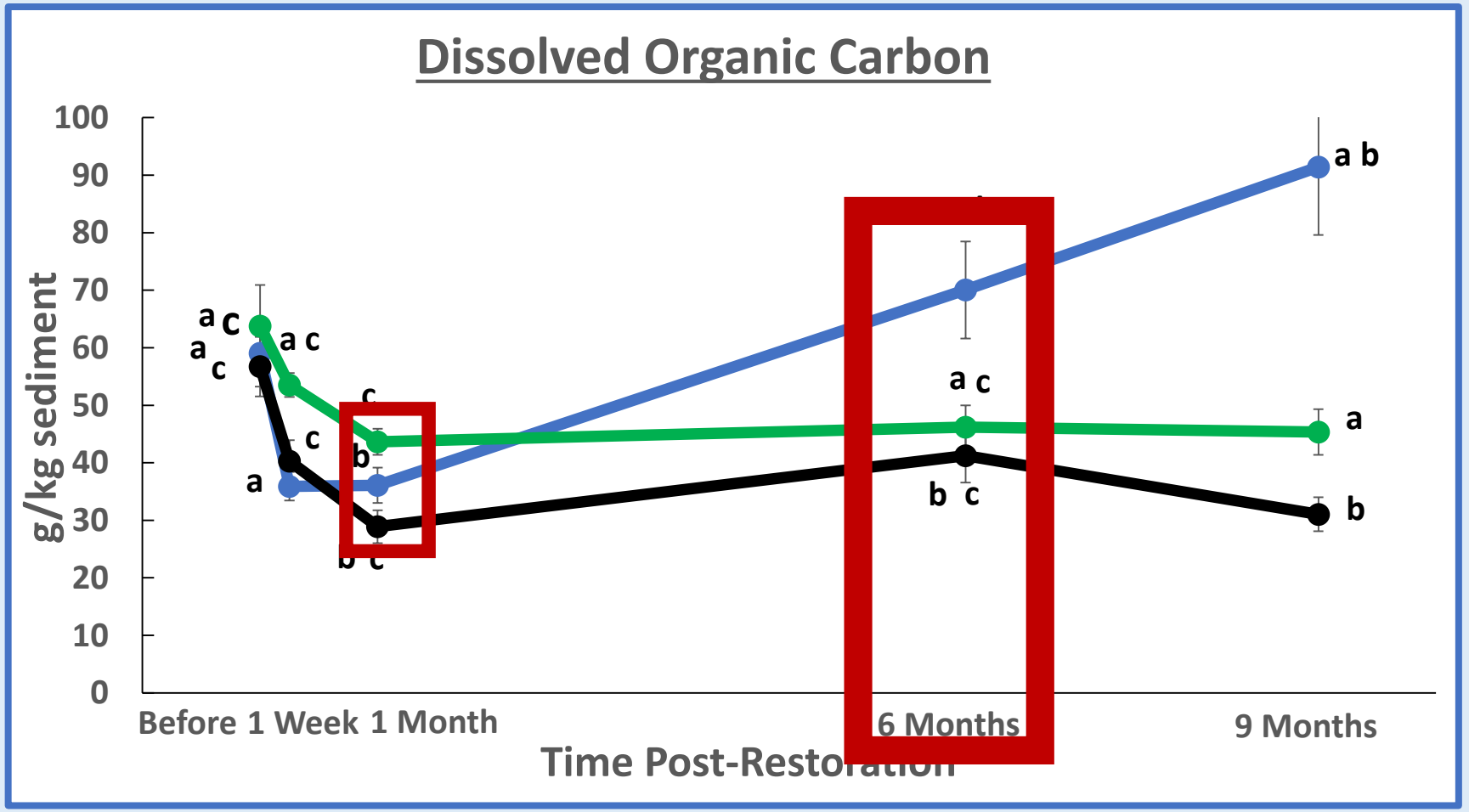
Results – Short-term nutrients



- Ammonium concentrations reach natural reef levels at 1 month post-restoration
- Related to number of oysters and reef thickness?

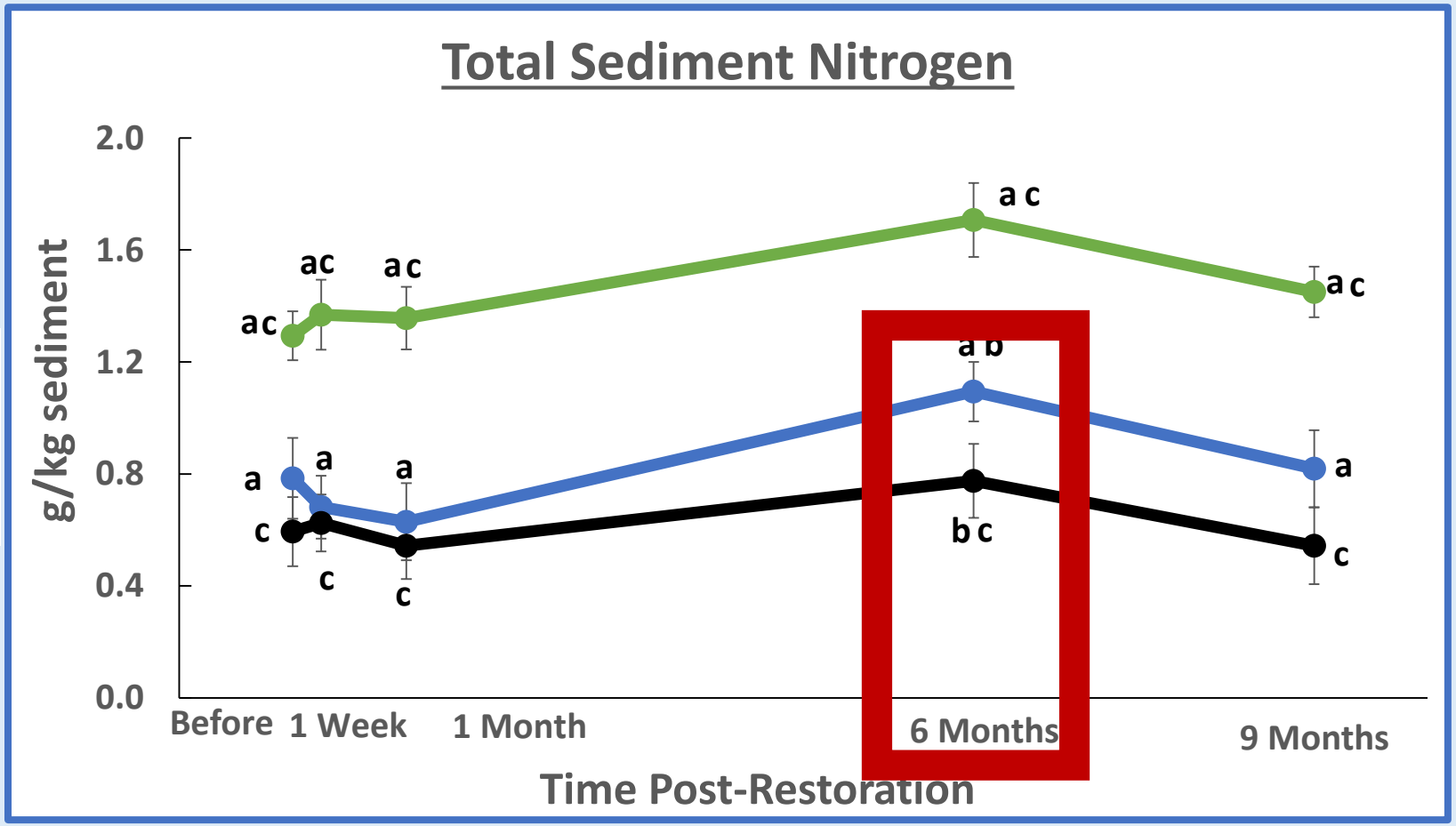
Results – Short-term nutrients

- **Restored reef sediments exceed natural reef levels by 6 months post-restoration**



Results – Long-term nutrients

- Total nitrogen higher than dead reefs after 6 months post-restoration



Conclusions

- Biogeochemical properties respond to restoration at different rates in Mosquito Lagoon
  - Phosphate and total nitrogen begin to differ from dead reefs at 6 months
  - Ammonium and dissolved organic carbon reach natural reef levels by 1 month

- Biogeochemical functioning on Mosquito Lagoon Reefs is restored by 6 months?
- Sediment nutrient levels can help monitor restoration success

Future directions

- **Relate sediment nutrient changes to number of oysters and reef thickness**
- **Percent organic matter as simpler method to monitor recovery of biogeochemical functioning**
- **Investigation of these sediment properties on oyster reefs in other areas**

Acknowledgements

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