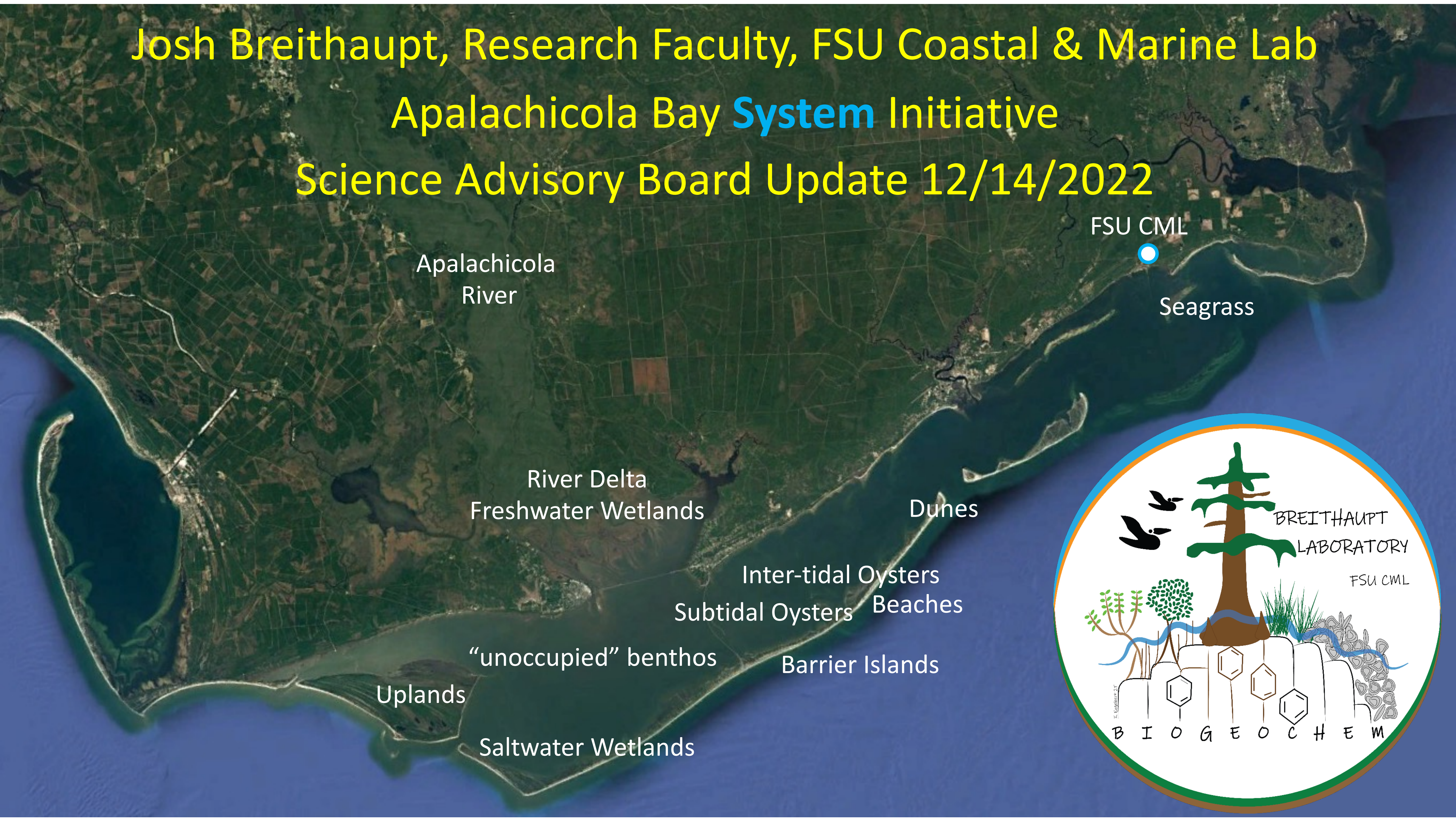
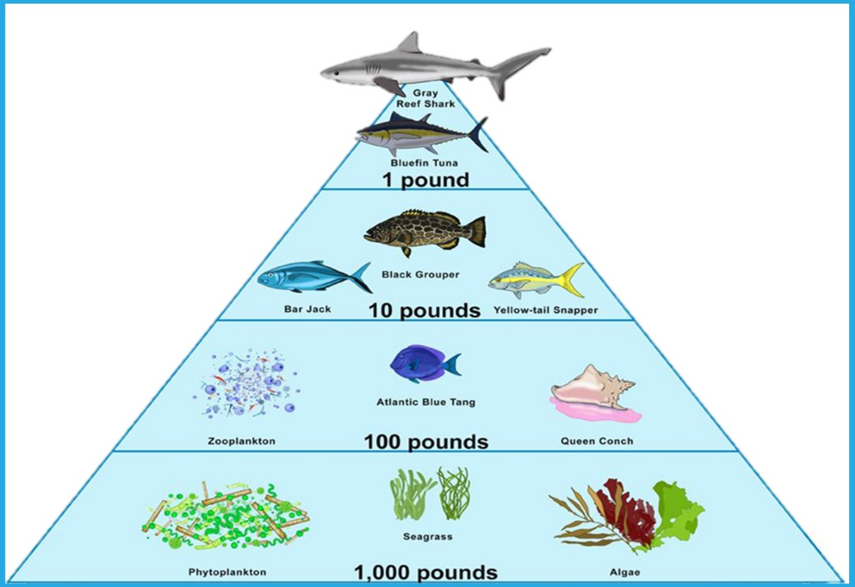
Josh Breithaupt, Research Faculty, FSU Coastal & Marine Lab

Apalachicola Bay **System** Initiative

Science Advisory Board Update 12/14/2022

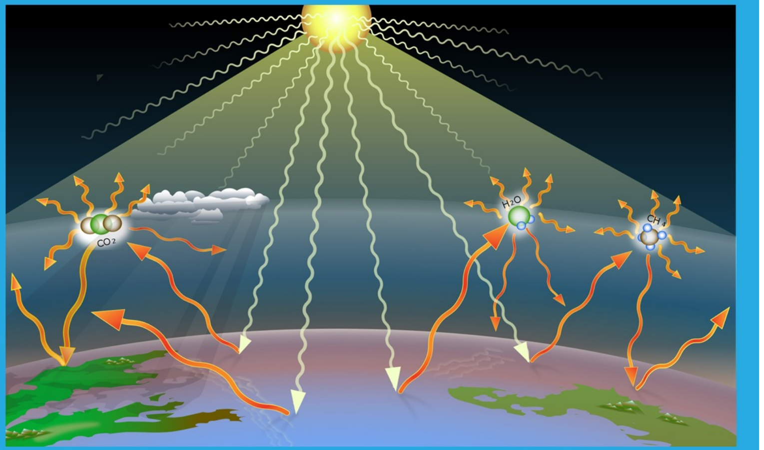


The Importance of Carbon



https://www.nationalgeographic.org/photo/marine-food-pyramid-1/

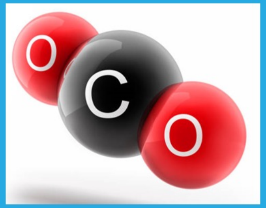
Food/ energy



https://en.wikipedia.org/wiki/Greenhouse_gas#/media/File:Greenhouse-effect-t2.svg

Greenhouse Gases

Physical Structure



+

= carbonic acid

Ocean Acidification

frontiers | Frontiers in Forests and Global Change
ORIGINAL RESEARCH
published: 01 July 2022
doi: 10.3389/ffgc.2022.852910

Check for updates

Coastal Wetland Soil Carbon Storage at Mangrove Range Limits in Apalachicola Bay, FL: Observations and Expectations

Havalend E. Steinmuller[1], Joshua L. Breithaupt[1], Kevin M. Engelbert[1], Prakhin Assavapanuvat[2] and Thomas S. Bianchi[2]*

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AGU ADVANCING EARTH AND SPACE SCIENCE

Geophysical Research Letters

RESEARCH LETTER
10.1029/2022GL100177

Refining the Global Estimate of Mangrove Carbon Burial Rates Using Sedimentary and Geomorphic Settings

Joshua L. Breithaupt[1] and Havalend E. Steinmuller[1]

[1]Coastal & Marine Laboratory, Florida State University, St. Teresa, FL, USA

Key Points:

- The global data set of mangrove organic carbon (OC) burial rates is highly skewed; the average of the transformed data is 138.6 g m^{-2} yr^{-1}
- Use of a global, spatially explicit mangrove typology indicates terrigenous settings have higher OC burial rates than carbonate settings
- More OC burial rate observations are needed for data-deficient regions, including deltas and the African continent

Supporting Information:

Supporting Information may be found in the online version of this article.

Abstract This study provides updated analysis of multi-decadal mangrove organic carbon (OC) burial rates. The available data indicate mangroves bury 138.6 (120.3–158.8, 95% C.I.) g OC m^{-2} yr^{-1} locally, or 20.18 (17.52–23.12) Tg yr^{-1} globally. We contend that this common approach of upscaling from a single local-scale rate obscures critical environmental differences in burial rates. By implementing a recently formalized, spatially explicit global mangrove typology, we find carbonate setting mangroves have lower burial rates than terrigenous settings, and that upscaling based on representative rates for sedimentary setting alone or a combination of sedimentary and geomorphic settings, increased the global scale annual burial to 22.10 (18.26–26.05) and 24.17 (19.77–25.50) Tg yr^{-1}, respectively. We propose that future work should focus less on consolidating a single confidence interval for mangrove OC burial rates, and should instead explore drivers of spatial variability based on sedimentary and geomorphic settings.

Estuaries and Coasts
https://doi.org/10.1007/s12237-022-01131-4

SPECIAL ISSUE: WETLAND ELEVATION DYNAMICS

Check for updates

Comparing Vertical Change in Riverine, Bayside, and Barrier Island Wetland Soils in Response to Acute and Chronic Disturbance in Apalachicola Bay, FL

Havalend E. Steinmuller[1,3,4] · Ethan Bourque[2] · Samantha B. Lucas[2] · Kevin M. Engelbert[1] · Jason Garwood[2] · Joshua L. Breithaupt[1]

Received: 26 May 2022 / Revised: 31 August 2022 / Accepted: 28 September 2022

AGU ADVANCING EARTH AND SPACE SCIENCE

Geophysical Research Letters

COMMENTARY
10.1029/2022GL101979

Going Local: How Coastal Environmental Settings Can Help Improve Global Mangrove Carbon Storage and Flux Estimates

Pierre Taillardat[1]

[1]NUS Environmental Research Institute, National University of Singapore, Singapore, Singapore

Key Points:

- Carbon burial rates between mangrove sedimentary and geomorphic types were analyzed in Breithaupt and Steinmuller (2022, https://doi.org/10.1029/2022GL100177)
- Greater carbon burial rates were reported in terrigenous deltas and estuaries rather than in lagoons and carbonate settings
- Comparing carbon burial rates with other stocks and fluxes between mangrove types can help refine the global mangrove carbon budget

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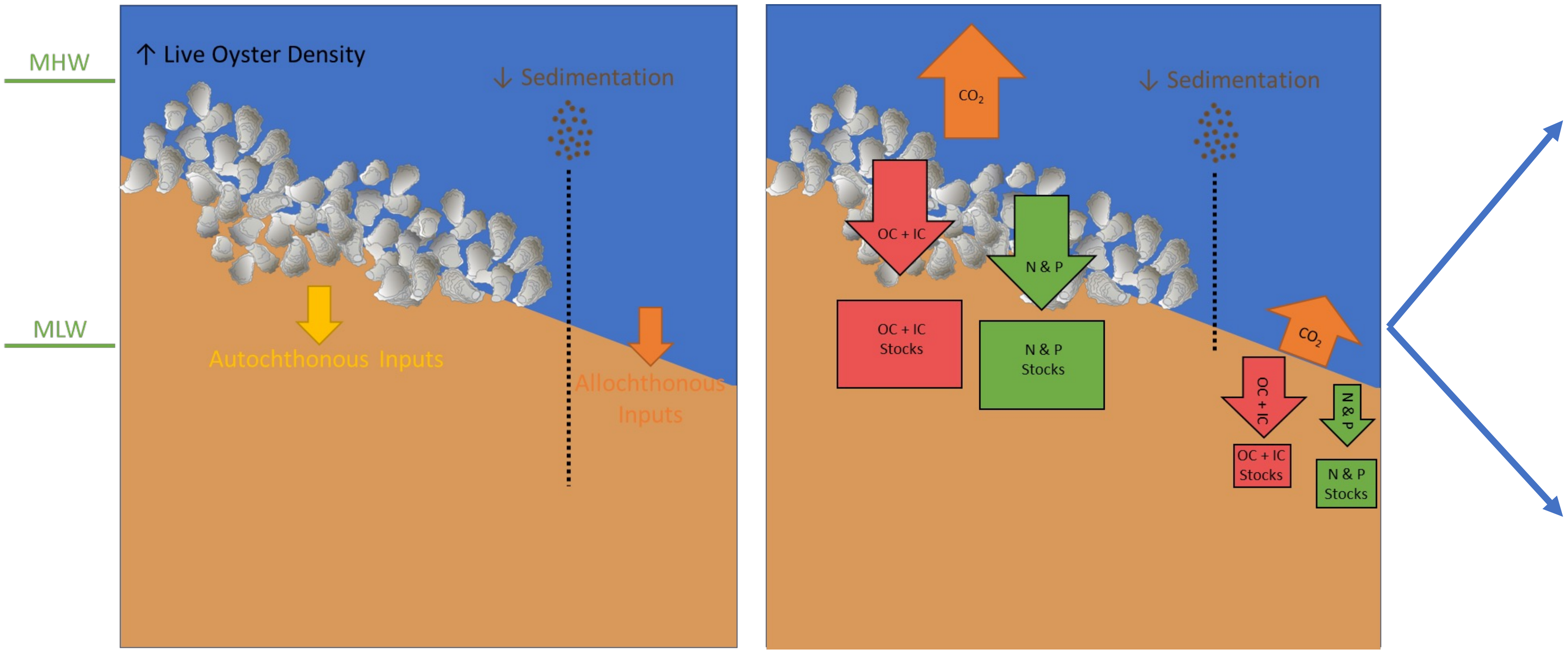
Abstract The magnitude and variability of mangrove carbon storage are uncertain and still being discussed. In a recent article, Breithaupt and Steinmuller (2022, https://doi.org/10.1029/2022GL100177) completed a literature review and compared mangrove organic carbon burial rates between different coastal environmental settings (CES) that integrate sedimentary supply (terrigenous vs. carbonate) and hydrogeomorphic settings (delta, estuary, lagoon, open coast). They found greater burial rates in terrigenous delta and estuaries while lower rates were reported in lagoons and carbonate settings. Surprisingly, these CES relationships do not strictly match previous mangrove soil carbon stock estimates but were consistent with biomass stocks. The CES approach used by Breithaupt and Steinmuller should be used for other mangrove carbon stocks and fluxes estimates to refine our understanding of mangrove carbon cycling and storage.

Plain Language Summary Mangrove forests are intertidal ecosystems efficient at trapping carbon

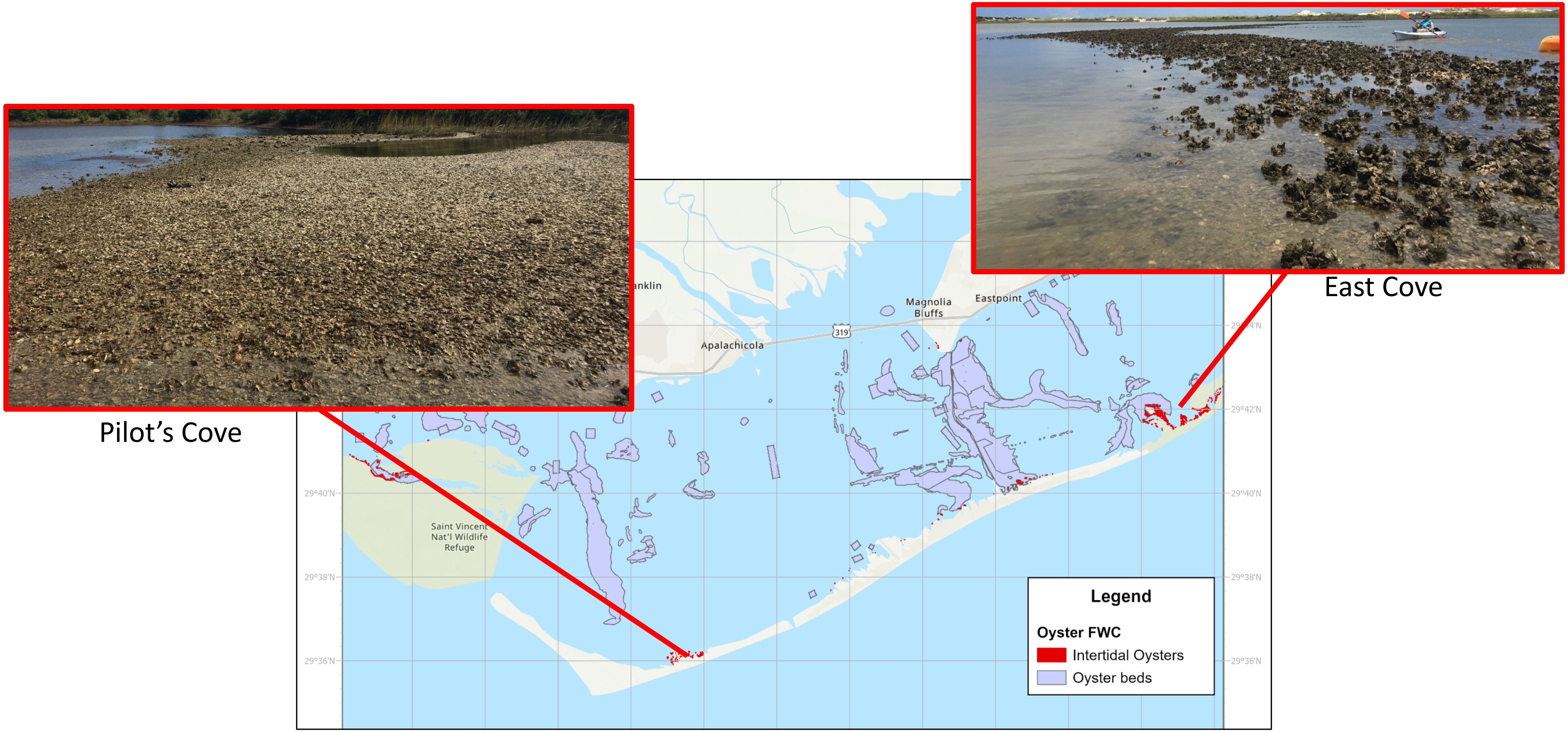
Oysters filter organic matter from the water and concentrate it in sediments (SOM).



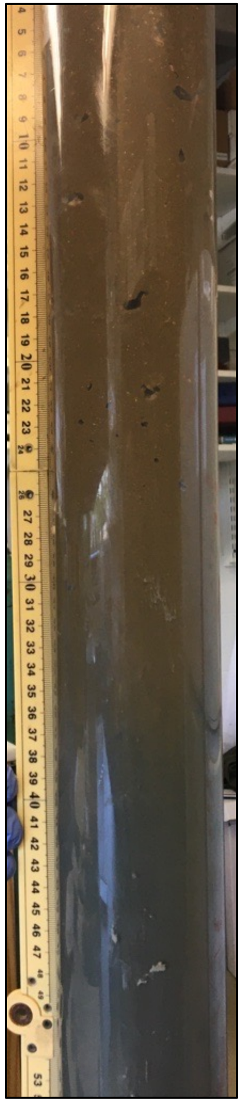
Q1: What is the history of SOM sequestration on reefs?

Q2: What happens to the health of the Bay when oysters are gone?

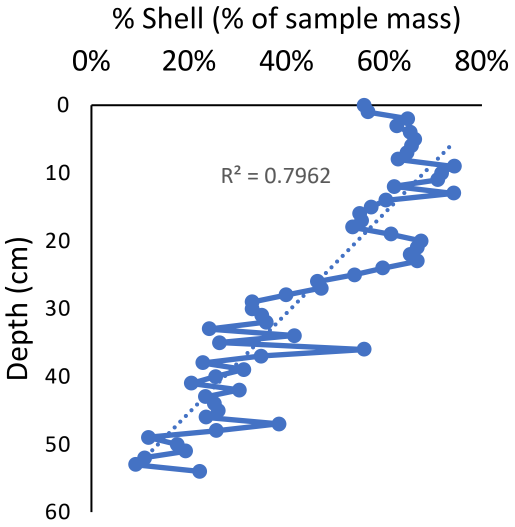
Intertidal reef condition varies substantially within the region.

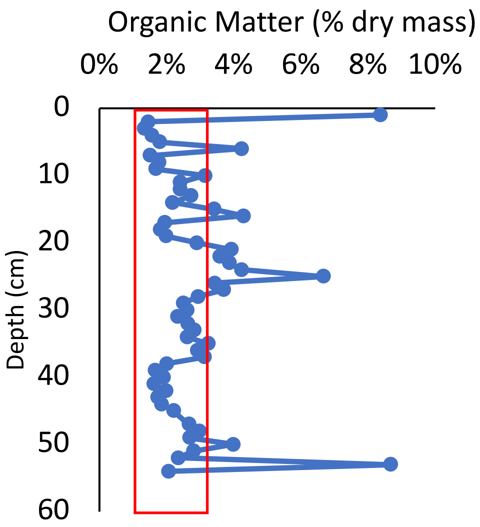


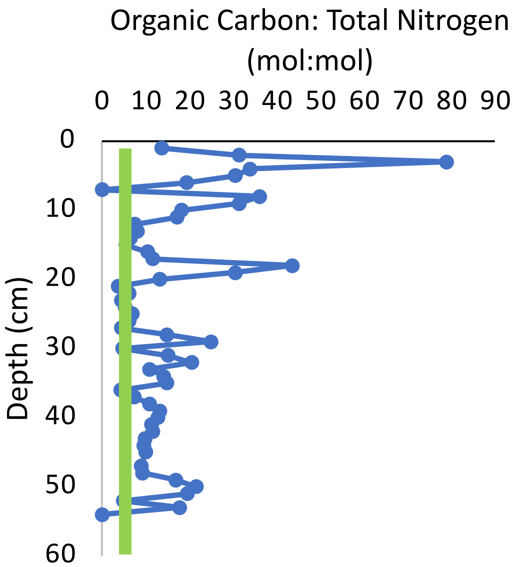
Q1: how does oyster abundance affect reef sediment organic matter characteristics?



- Potential proxy of oyster abundance
- Historical reconstructions
  - Pb-210 dating
  - Organic matter source and degradation state







What can “unoccupied” benthic environments tell us about the health of Apalachicola Bay?

Organic carbon content of sediments as an indicator of stress in the marine benthos

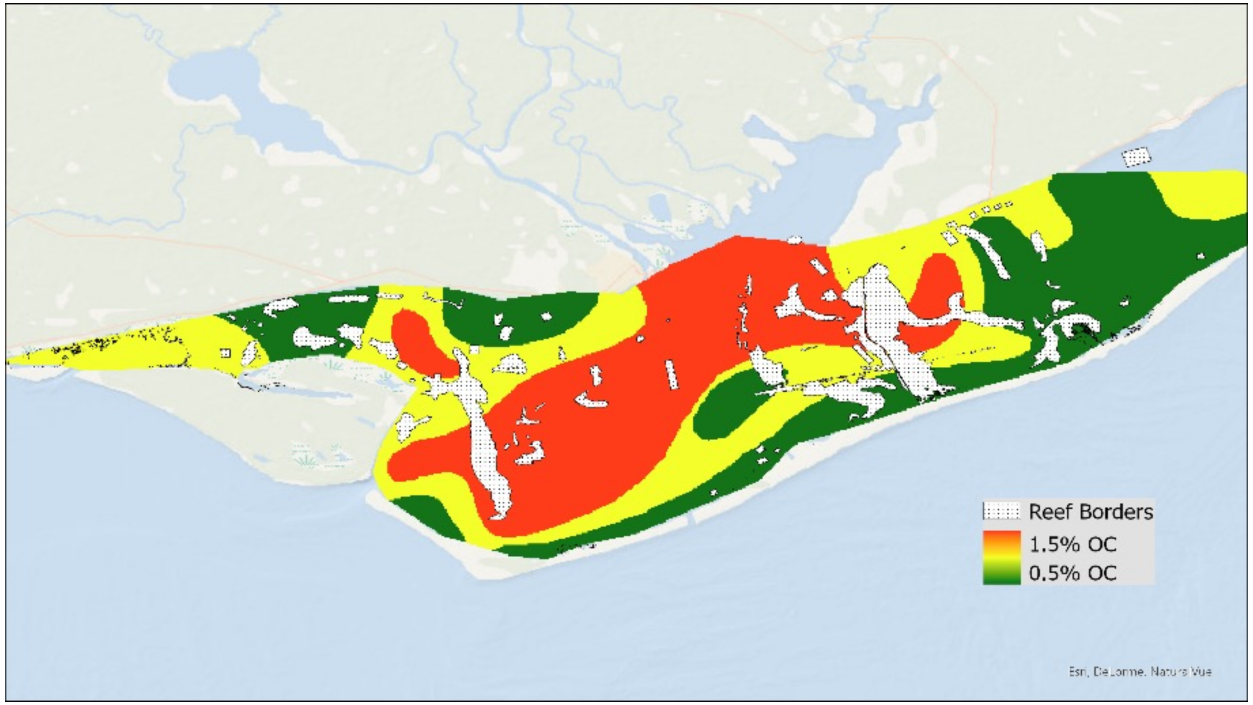
J. Hyland[1,*], L. Balthis[1], I. Karakassis[2], P. Magni[3], A. Petrov[4], J. Shine[5], O. Vestergaard[6], R. Warwick[7]

	Sed. Org. Carbon (%)		
	<1%	1-3.5%	>3.5
1) Mean $E(S_{10})$ Declining benthic species richness	5.3 (171)	4.2 (68)	2.4 (50)
2) Percent samples with degraded benthos (B-IBI score 3; sensu Van Dolah et al. 1999)	7.6% (170)	54% (67)	78% (50)
3) Percent samples with high chemical contamination of sediments (mean ERM quotient > 0.058, sensu Hyland et al. 1999)	3.5% (171)	31% (68)	90% (50)
4) Percent samples with low DO in near-bottom water (DO < 2 mg l^{-1}, sensu Diaz & Rosenberg 1995)	0.6% (170)	4.5% (67)	24% (50)

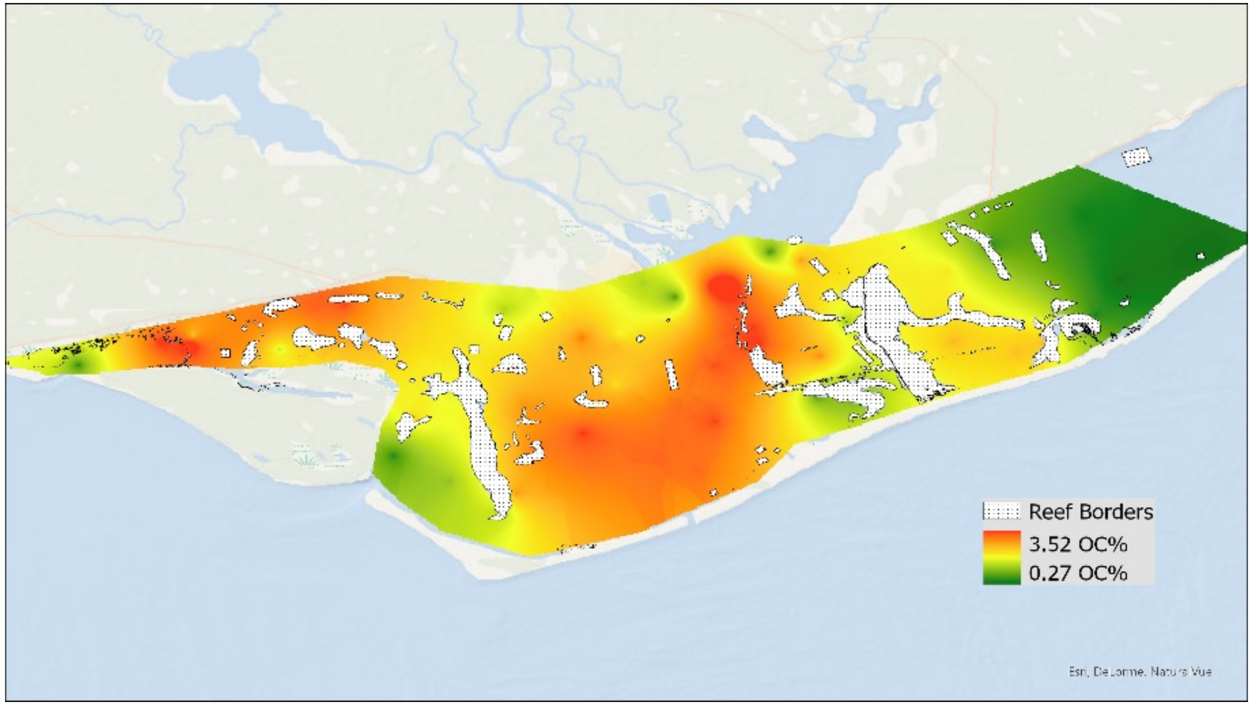
Hyland et al. 2005

Q2.1: has collapse of the oyster population affected the health of the Bay?

Engelbert, MS Thesis Chapter 1

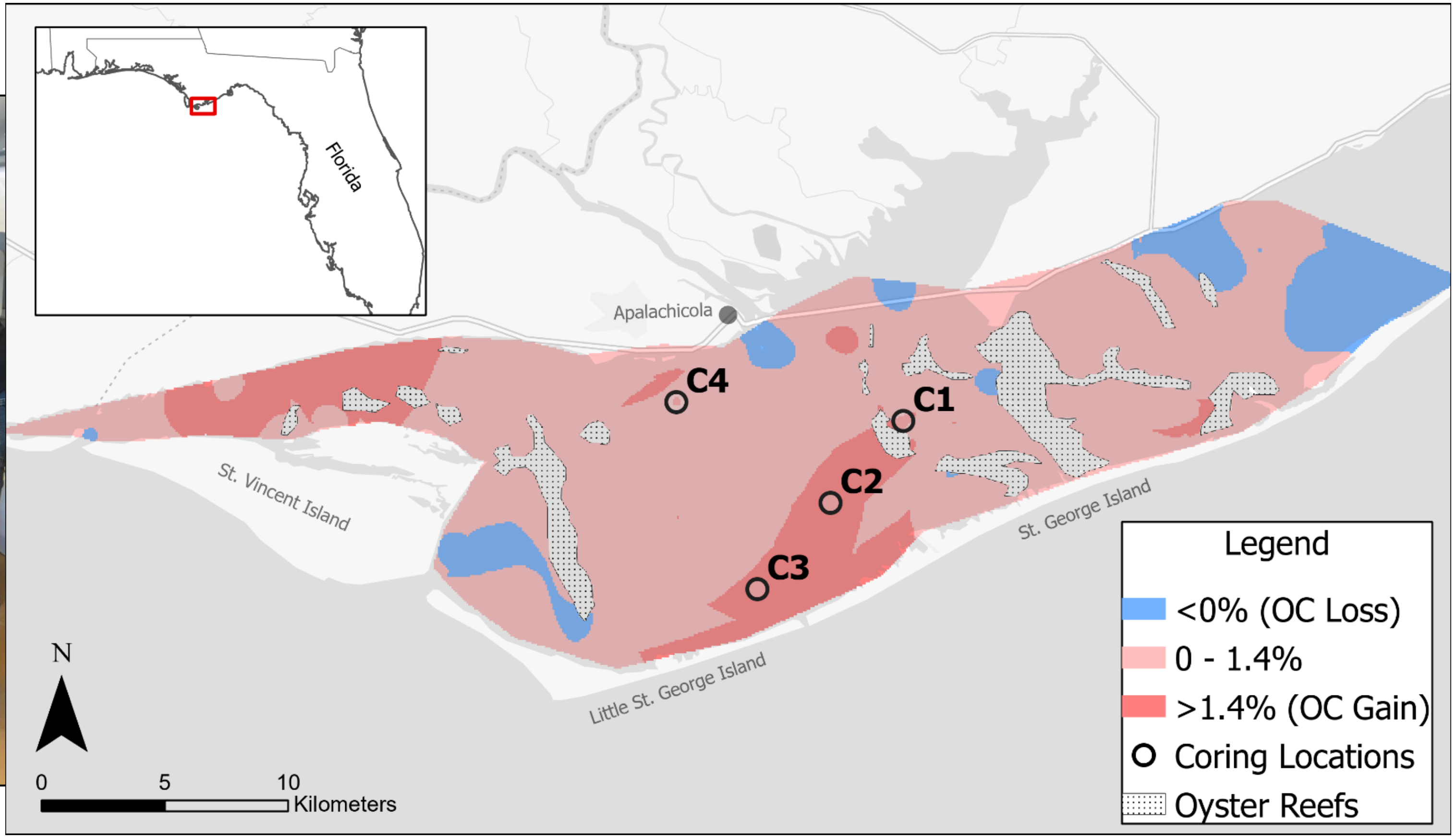


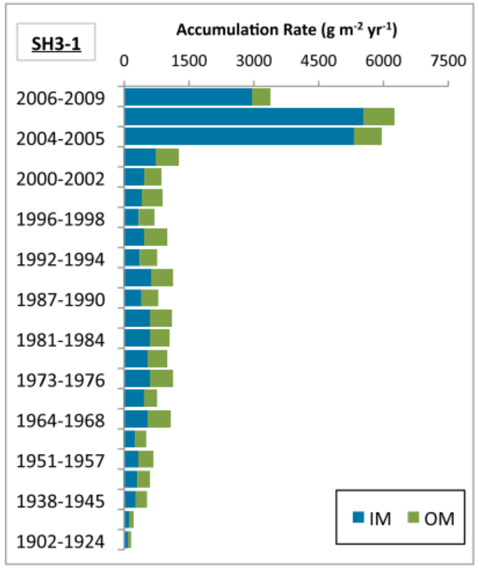
Kofoed & Gorsline 1963



2021 Data

Q2.2: what is the **timing**, **source**, & **state** of this organic enrichment of the Bay?





Breithaupt et al. 2014