Evaluating the co-occurrence of marine toxins and anthropogenic contaminants in marine sediment in the Florida Keys Marine Sanctuary.

Katherine Yang[1], Sarah Dietrick[1,2], Alison Robertson[1,2]

[1]Dauphin Island Sea Lab, Dauphin Island, Alabama

[2]Stokes School of Marine & Environmental Sciences, University of South Alabama, Mobile, Alabama

NSF Research and Mentoring Program for Postbaccalaureates (RaMP): Biological Opportunities and Training in Science (BOATS)

Background

Ciguatera poisoning is a severe form of seafood poisoning caused by ciguatoxins (CTXs), neurotoxins produced by benthic dinoflagellates like *Gambierdiscus*. Other natural toxins (i.e., maitotoxins, gambierones, and okadaic acid), produced by *Gambierdiscus* and other microalgae, that co-occur with CTXs may cause human illness (*1, 2*).

The impacts of anthropogenic contaminants on algal toxin production and organismal response are not well understood, even though they co-exist with phycotoxins and can have similar biochemical mechanisms. In order to deconvolute the complex interactions that might be happening between toxins and contaminants, we first need to determine the diversity and ecologically relevant concentrations in the environment.

Sediment is a useful matrix to help inform on the environment in shallow coastal systems and surrounding microalgae because it acts as a sink for various anthropogenic and natural toxins.

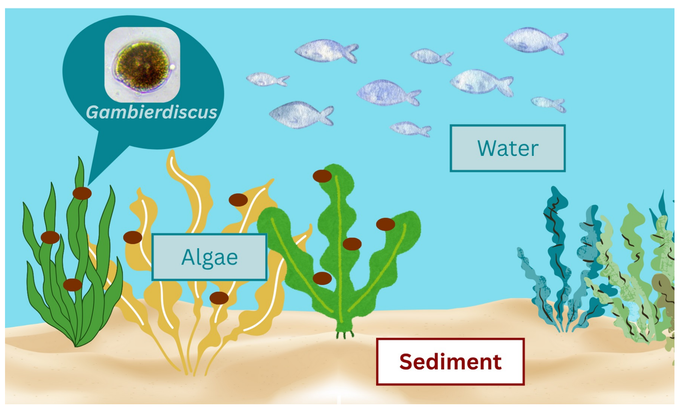


Fig. 1: Diagram of *Gambierdiscus* in its environment.

Research Objective

To determine the **ecologically relevant concentrations** of **trace metals**, **organic contaminants**, and **natural toxins** in Florida Keys sediment to support future analyses of their **combined effects** on marine ecosystems.

Sampling

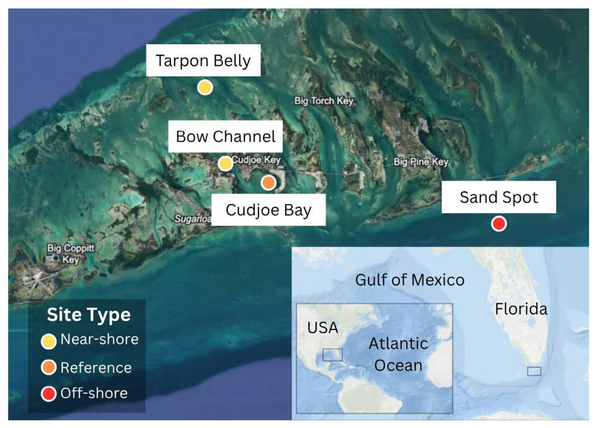


Fig. 2: Map of sampling sites in the Florida Keys Marine Sanctuary. Sites were selected because ciguatoxins and a variety of anthropogenic contaminants co-occur.

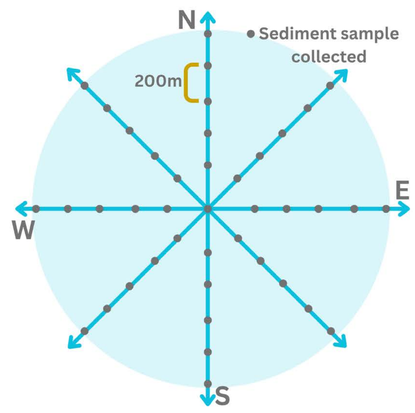


Fig. 3: Sampling schematic. High resolution sampling was performed at the Tarpon Belly and Bow Channel sites. Each site had 41 samples, and sampling was performed over two time periods (January and March, 2025).

Preliminary Results

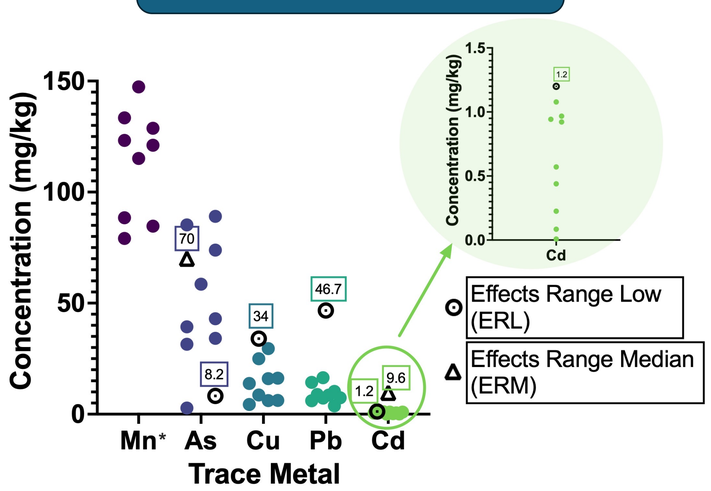


Fig. 4: Trace metal concentrations. The trace metals measured are on the x-axis and each point within a column represents the concentration measured from a single sample. The relevant Effects Range Low (ERL; open circle) and Effects Range Median (ERM; open triangle) values are indicated above each column where relevant. These sediment parameters measure toxicity to marine organisms (*3*).
*ERL and ERM values not known for Mn.

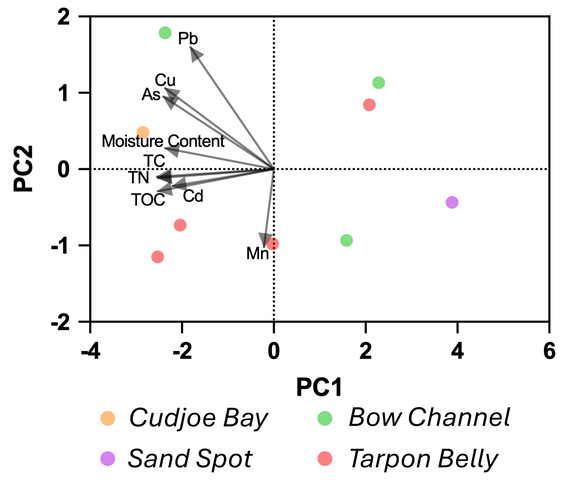
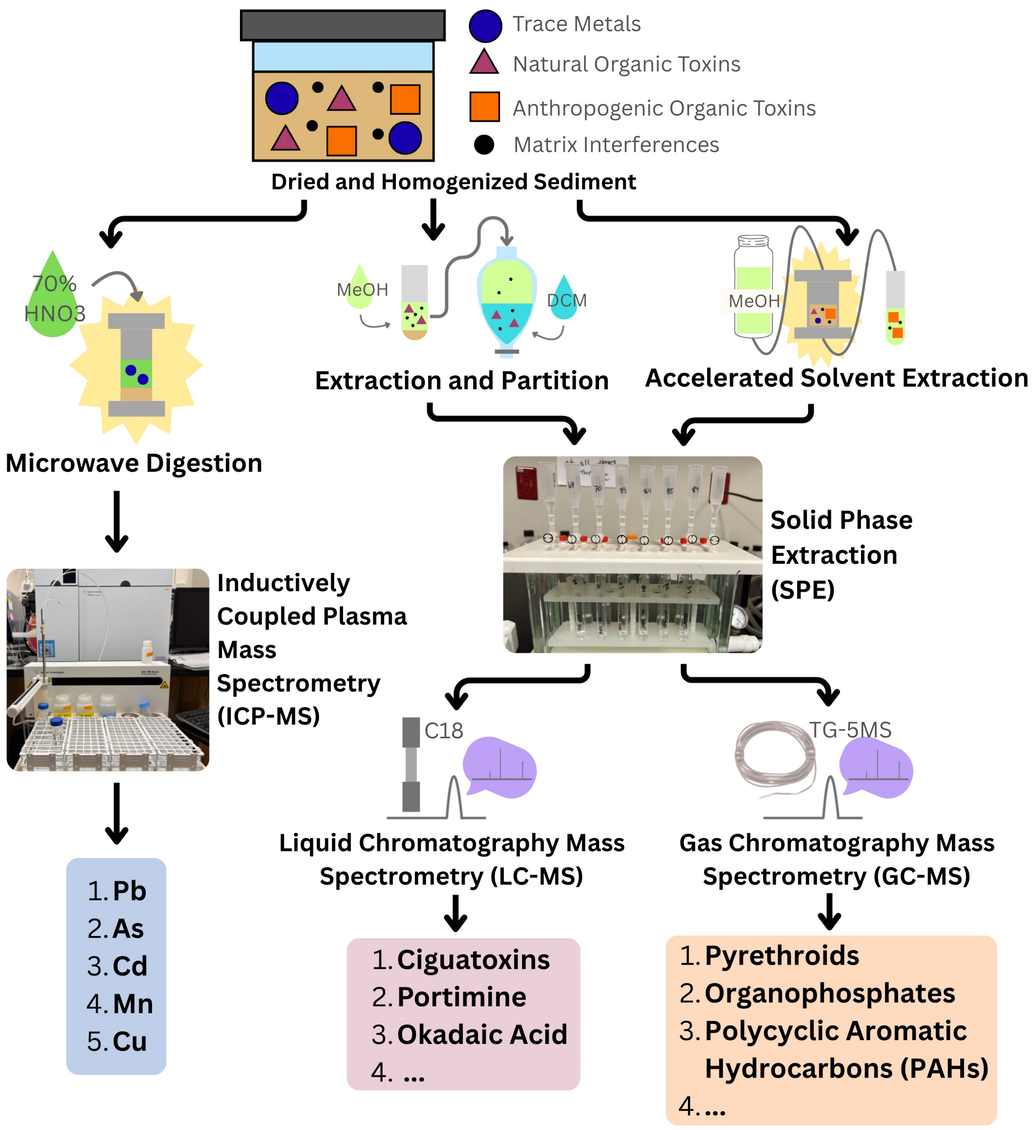


Fig. 5: Principal component analysis of moisture content, total organic carbon (TOC), total carbon (TC), total nitrogen (TN), and trace metals. Each sample is represented by one point and different sites are distinguished by color. Loadings, represented by the labeled arrows, demonstrate the relative importance of the original variables to the principal components.

Analysis Approach



Future Directions

Combine bioassays of environmental samples with non-targeted analysis to guide identification of unknown neurotoxic compounds.

Evaluate the effects of Florida Keys-relevant mixtures and concentrations on *Gambierdiscus* growth and toxin production.

Acknowledgements

This work was supported through the Bonefish Tarpon Trust and Florida Fish and Wildlife Commission, and National Science Foundation (NSF) Partnerships in International Research and Education Program (CiguaPIRE; 1743802). KY was supported by the NSF Research and Mentoring for Postbaccalaureates in Biological Sciences (RaMP) program "Biological Opportunities and Training in Science (BOATS; 2318922)" at the Dauphin Island Sea Lab (DISL). We appreciate the support from scientists and colleagues at the DISL and University of South Alabama for this work, especially Dr. Clay Bennett for assistance with statistical analysis.

Citations

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3. Long, E. R.; Macdonald, D. D.; Smith, S. L.; Calder, F. D. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management* 1995, 19 (1), 81–97.