Center for Aquatic Chemistry and Environment
NSF Center of Research Excellence in Science and Technology

FIU's CREST Center for Aquatic Chemistry and Environment:

Untangling Sources, Transport and Ecosystem Responses to Contaminants, Pollutants And Other Stressors in South Florida Aquatic Ecosystems

Dr. Todd A. Crowl
Director, Institute of Water and Environment
Florida International University

Institute of Water and Environment

FLORIDA INTERNATIONAL UNIVERSITY

A platform for interdisciplinary collaboration across Florida International University's research and scholarship endeavors in wetland, coastal, aquatic, and climate change science

The Institute brings together existing centers, research programs and scientists and engineers from throughout FIU to address regional, national and global water and environmental issues.

Institute for Water and Environment (InWE)

Director: T. Crowl
Associate Directors: P. Gardinali, J. Fourqurean, T. Troxler (interim)
Program Manager: J. Guevara
Human Resources: R. Beades
Instructional Technology/Instrument Manager: M. Kershaw
Grant Administrator: C. Valois
Director of Communications: C. Allouch

MERI

Marine Education and Research Initiative

Director: J. Fourqurean
Asst. Dir., Education and Outreach: A. Soto
Asst. Dir., Marine Operations: T. Potts

Medina Aquarius

Lead: J. Fourqurean

NOAA – FKNMS (Florida Keys National Marine Sanctuary)

RB-NERR (Rookery Bay Estuarine Research Reserve)

SLSC

Sea Level Solutions Center

Interim Director: T. Troxler

SERC

Southeast Environmental Research Center

Co-Directors: T. Crowl, P. Gardinali

Facilities:
- Field Operations Center (FOC)
- Analytical Facilities

CREST-CAC$_h$E

Center for Aquatic Chemistry and Environment

Leads: Gardinali, Teutonico, Graham

Facility:
- CAChE Nutrient Analysis Lab

FCE Everglades Program

Lead: Gaiser

Office of Everglades Restoration Initiative (DOI)

Cross-Cutting Programs

SBEI (Sustainable Built Environment and Informatics) - *Vassigh*
SES (Socia-Ecological Systems) - *Mozumder*
IWG (International Water Programs) – *Boukerrou, Donoso*

Centers of Research Excellence in Science and Technology (CREST)

Goals:

- **Integrate education and research**
- **Promote development of new knowledge**
- **Enhances faculty research productivity**
- **Increases diversity in STEM disciplines**

Success:

- **Promote faculty engagement in research activities at the highest level**
- **Engage undergraduate and graduate students in the process of discovery and innovation**
- **Provide Students opportunities to become significant participants in the broader community of scholarship in their respective fields**

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CREST CAChE Research Mission

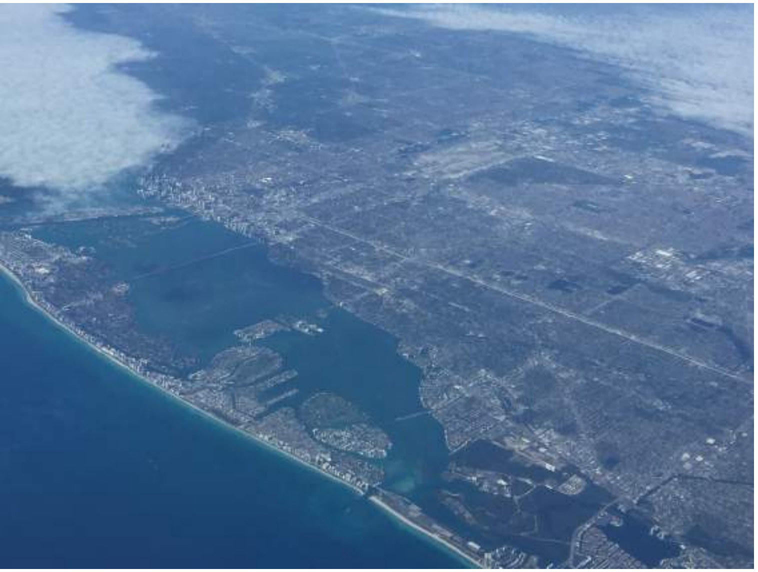
To detect the sources, transport, transformation and ecosystem responses to contaminants, pollutants and other natural stressors, under changing land-use and environmental conditions.

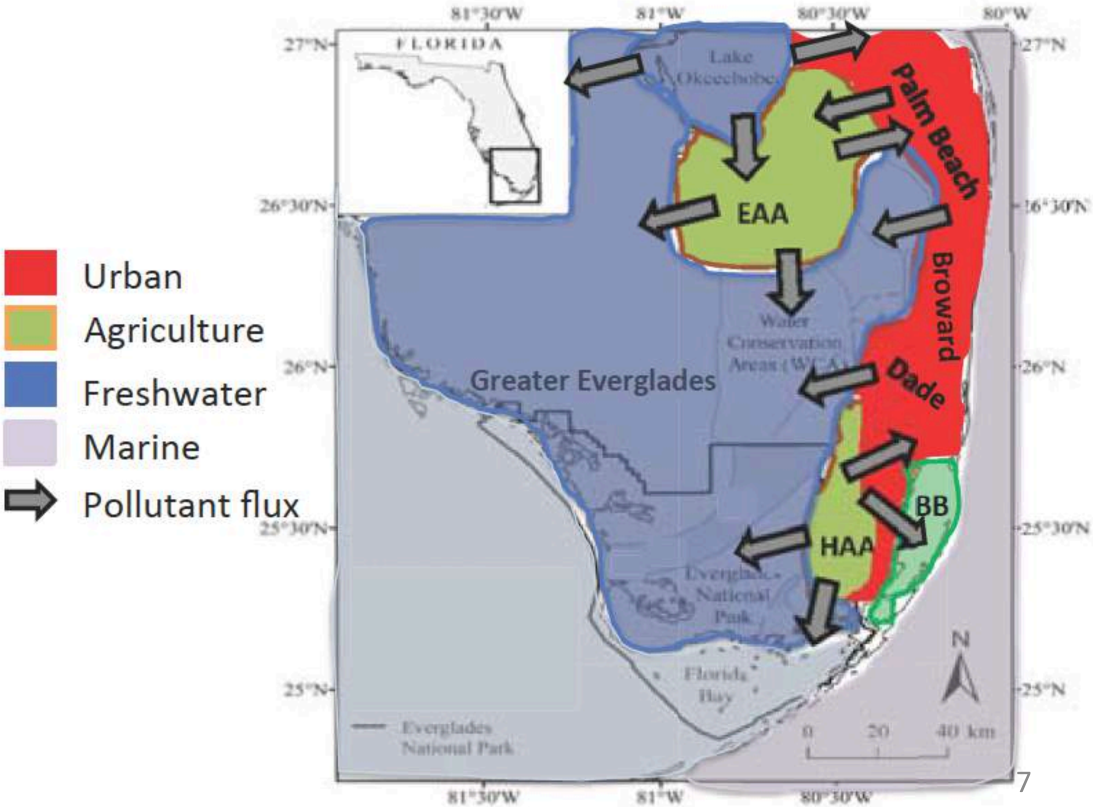
CREST CAChE

A campus-wide integration of students and faculty from 14 departments, 4 colleges, 2 Centers and the STEM Transformatoin Institute in fields from *environmental chemistry* to *computer intensive data analysis and visualization*…working together to tackle one of the region's most complex challenges: *environmental contamination*.

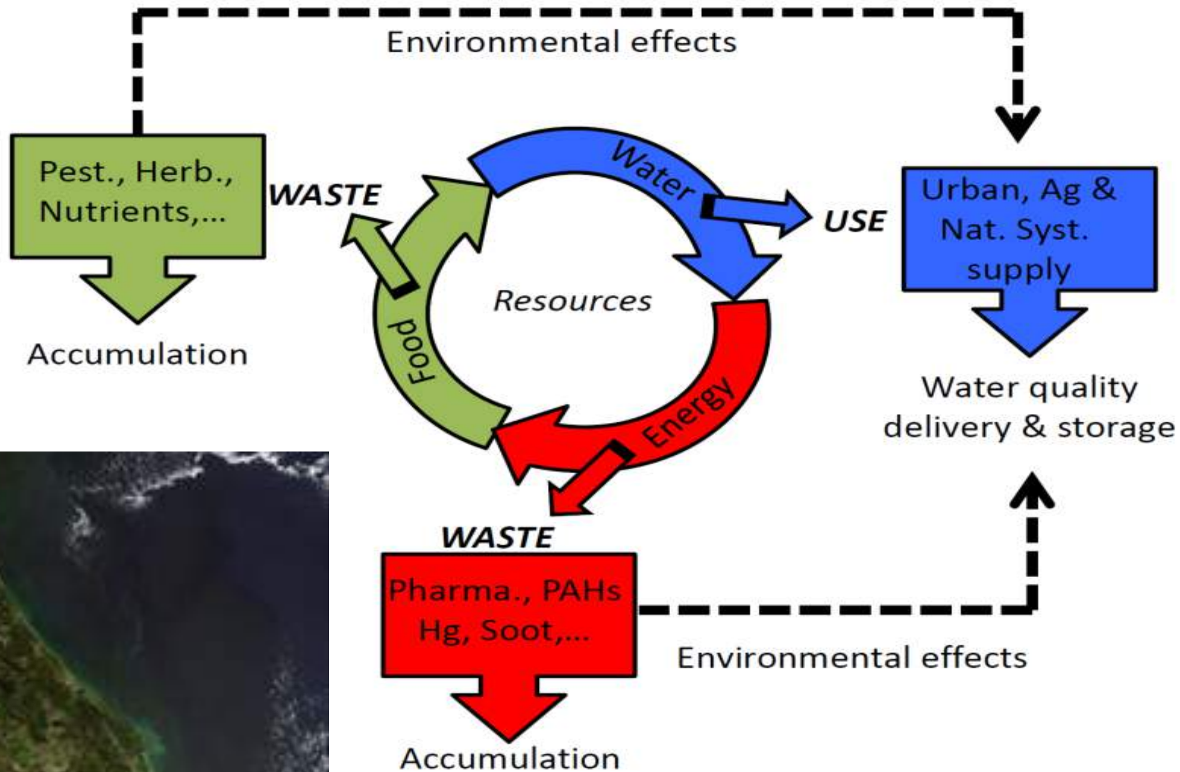
Context:

The hydrologic connectivity between the natural, agricultural, and urban landscapes results in a highly complex network of contaminant sources that are transported throughout the landscape





How it's all connected –Food-Water-Energy Nexus



The lives of the ~7 million inhabitants of South Florida are critically tied to the Greater Everglades, *the area's main source of freshwater*

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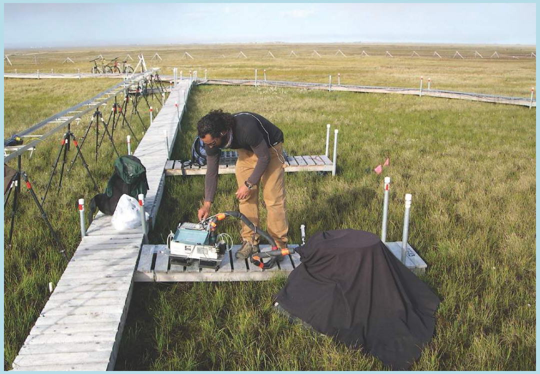
CREST CAChE Research Focus Areas

1. **Advanced sensing of environmental exposure to anthropogenic contaminants, pollutants and other natural stressors.**

2. **Quantifying the fate and transport of contaminants across landscape gradient transects in South Florida.**

3. **Assessing the effects on South Florida's aquatic ecosystems through data analytics, interpretation and visualization to convey environmental impacts to policy- and decision-makers.**



Research and Education Focus Areas

Detection and Identification | **Fate and Transport** | **Impacts and Visualization**

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Discovery-based Education

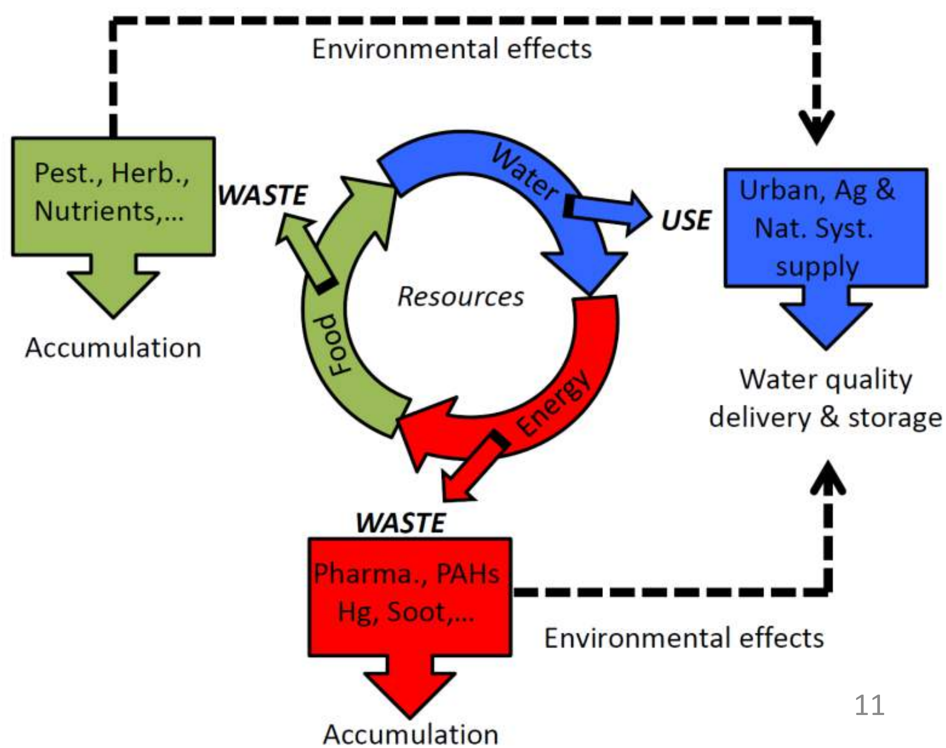
Research Focus Area 1

Detection and Identification

Measuring environmental exposure to *anthropogenic contaminants, pollutants and other natural stressors*. In the context of South Florida's closely-knit food-energy-water system, new methods of detection are required so that "exposure" can be characterized at very low concentrations for effective, early intervention.

How it's all connected

South Florida's Food-Water-Energy Nexus



Research Focus Area 1

Detection and Identification

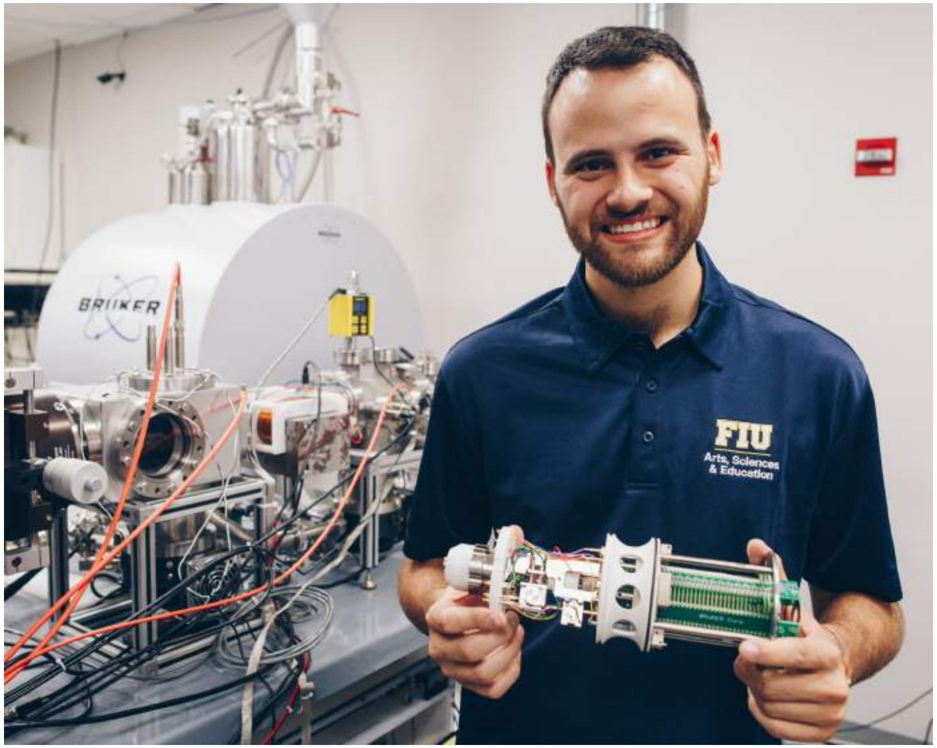
- Develop sensing technologies to determine known traditional or emergent pollutants at environmentally relevant concentrations (parts per billion to parts per-trillion) in multimedia samples (biotic and abiotic)

- Take advantage of recently developed cutting-edge analytical chemistry tools to assess changes of the overall molecular composition of target, suspect and unknown components present in environmental samples through a relevant ecosystem boundary

- Apply molecular biology know-how to simultaneously assess the genetic and functional responses of relevant organisms or receptors to identify the role of these pollutants or stressors in the creation of adverse outcome pathways that may influence ecosystem functioning.

Paolo Benigni, PhD (2017)

Advisor: Francisco Fernandez-Lima, Chemistry



Research Motivation

- Current techniques have a limited analytical range
  - Most of the traditional techniques are not capable of analyzing molecules that change in the environment.
  - Because of this, only a small fraction of environmental contaminants have been characterized

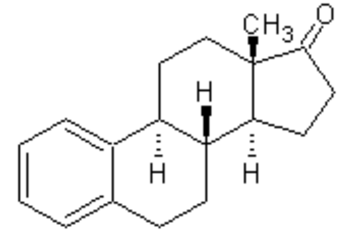
- This limits the scientific and chemical questions that can be asked!
  - How do chemical components change in the environment?
  - What are the health effects and environmental implications of these new molecules?

- **Goal: The development of advanced instrumentation for the discovery and analysis of environmental stressors**

Developing novel and advanced instrumentation

- Trapped Ion Mobility Spectrometry-Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (TIMS-FT-ICR MS)
  - Separation based on
    - Size (Collision Cross Section [CCS])
    - Mass (Chemical Formula)
- Increases our ability to **detect and identify molecules from complex mixtures**, such as crude oil during oil spills.
- Can assign chemical formulas and chemical structures to the measured components.

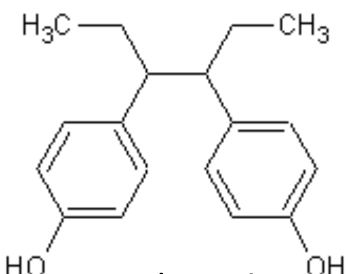
Estrone



$C_{18}H_{21}O_2^-$

CCS: 174 Å^2

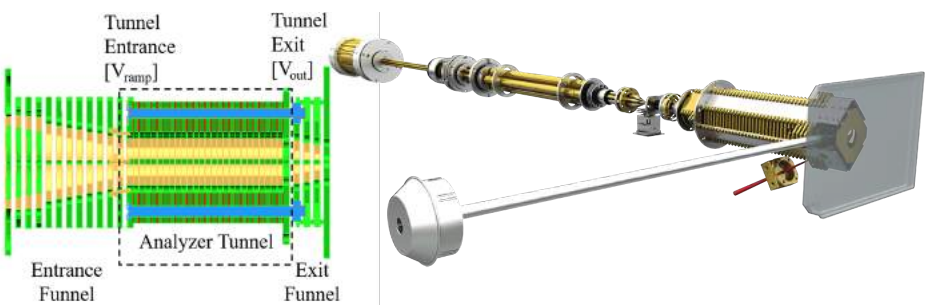
Hexestrol



$C_{18}H_{21}O_2^-$

CCS:177 Å^2

Isomeric (same mass) endocrine disruptors



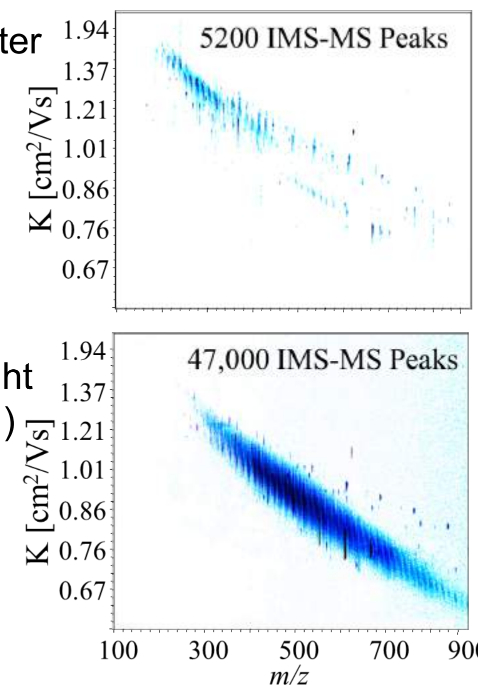
TIMS - FT-ICR MS

How light changes the chemical complexity of the water during oil spills

- The TIMS-FT-ICR MS platform can:
  - analyze very complex mixtures such as crude oil in water.
  - look at the fate of crude oil in seawater.
    - 5,200 molecules increasing to 47,000 molecules!
    - Find the chemical structure for unknown molecules.
  - **This is the only instrumentation in the world capable of providing this level of detail!**
    - The chemical complexity is so great that it requires ultra-high mass resolving power and high resolution ion mobility separation

Unexposed Water

115 hours of light (~30 day equiv.)



Kathleen Lugo, UG; Piero Gardinali, Adivsor
A citizen scientist project to check for bacterial contamination

Tidal floodwaters may be contaminated

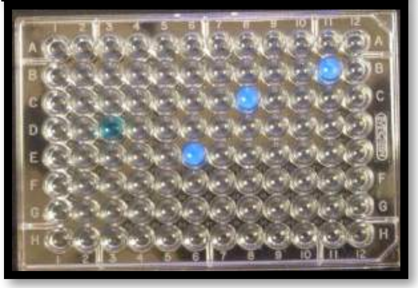
Miami Beach – King Tide event

Sample flood waters

Dip plate in the water, cover it

Incubate at home in a warm place

- Take first picture
- Illuminate with UV flashlight.
- Take second picture



Blue= presence, fluorescence = *E-Coli.*

- App will show result
- Data is uploaded to the FIU server

Kathleen Lugo
FIU Center for Aquatic Chemistry and Environment
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Afia Anjuman, PhD student
Advisor: Yong Cai, Chemistry

Problem:

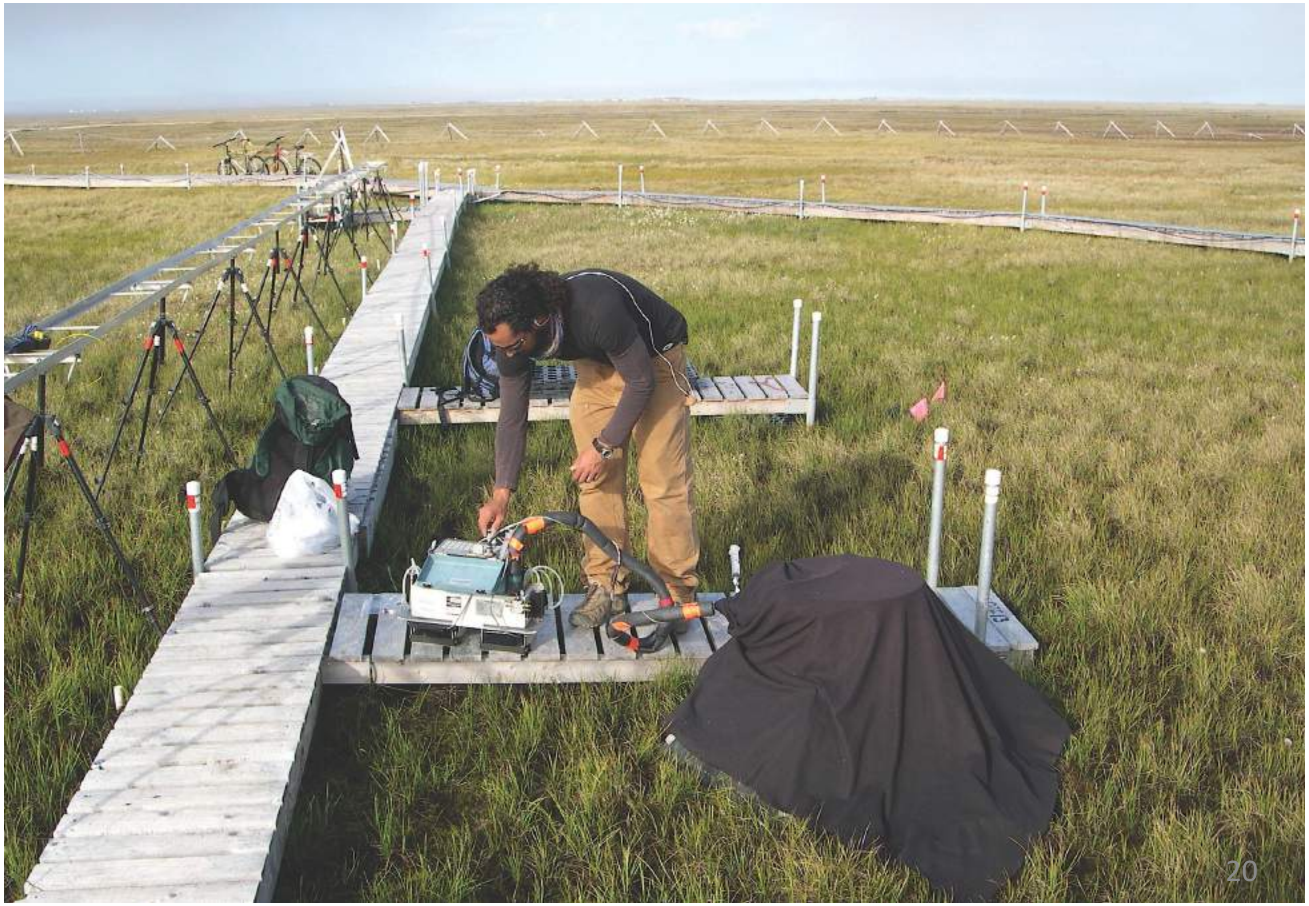
- Mercury (Hg): toxic element
- Methylmercury (MeHg): organic poisonous form of mercury
- Bioaccumulation through contaminated fish
- Environmental, biological, human health impact
- Periphyton: an organism of freshwater
- **Methylation of mercury has been observed in periphyton**

Questions/hypothesis

- The significance of periphyton in methylmercury production?
- In which aspects does increases in periphyton impact mercury methylation?
- A distinct algae/cyanobacteria that communicate with the periphyton environment is responsible for the enhancement of methylmercury production

Long term/overall purpose

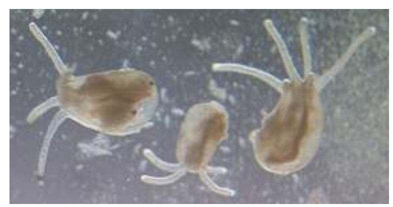
To understand the biogeochemical cycling, distribution, and bioaccumulation of Methylmercury.

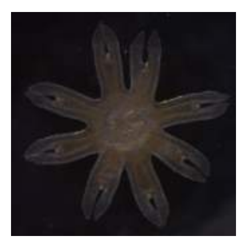


Abe Smith, PhD student
Advisor: Mike Heithaus, Biology

Question: How to use nonstandard organisms in aquatic toxicology to **detect effects of chemical or non-chemical stressors**?

- Demonstrate the use of **non-**standard indigenous organisms in **classical ecotoxicological testing**
- Apply endpoint data to relate toxicity to a **real-world scenario** including risk assessment
- Use a **new model organism in ecotoxicology** (starlet anemone, *Nematostella vectensis*)
- Try new endpoints to detect **impacts of chemical exposures** at sublethal exposure levels.

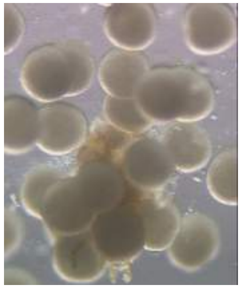


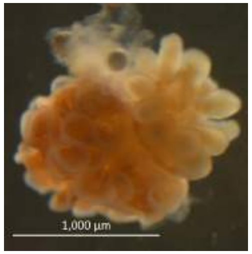


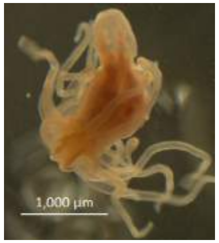
asmit065@fiu.edu

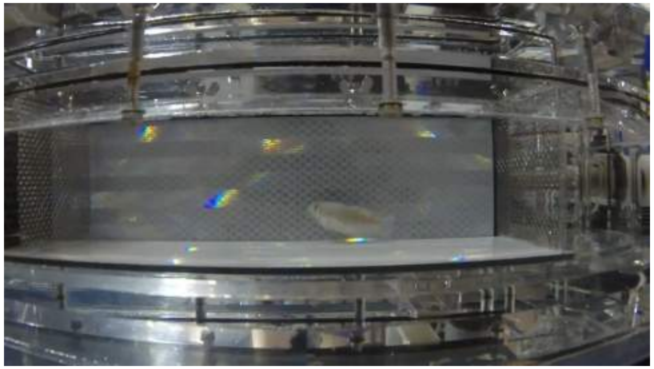
Methods

- Apply classical ecotoxicological techniques to new species relevant to an **environmental disaster assessment (NRDA**)
- Probabilistic risk assessment to determine risk from classical ecotoxicological endpoints using real-world chemical data
- **Acute toxicity trials with metals** on the estuarine starlet anemone; stress matrix development along with recovery to determine true death; early life stage embryological development trials
- **Swimming performance trials with sheepshead minnow and Florida pompano** using crude, weathered, and dispersed oil mixtures









asmit065@fiu.edu

Results

- **Generated toxicity data** (LC50s, EC10s, NOECs) for toxicants & petroleum mixes in terms of TPAH…applied through risk assessment using field collected chemistry data
- **Species Sensitivity Distributions** for cadmium and copper toxicity including new data from *N. vectensis*
- **Stress/Response matrix for anemone** juvenile & embryological development and new recommended methods (Based on current international toxicity testing standards)
- **Swim performance as a sublethal endpoint** shows promise but complete swimming profiles needed and more detail on fish fitness condition may help standardize data

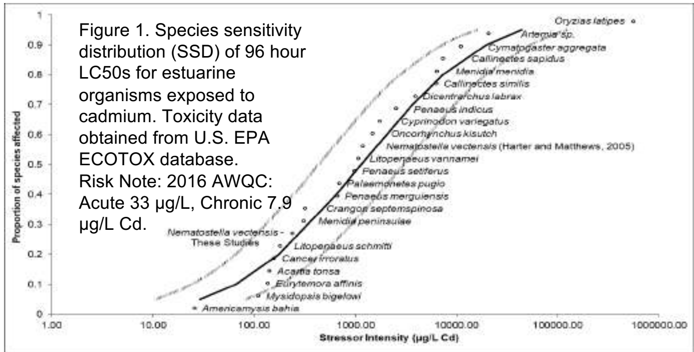


Figure 1. Species sensitivity distribution (SSD) of 96 hour LC50s for estuarine organisms exposed to cadmium. Toxicity data obtained from U.S. EPA ECOTOX database.
Risk Note: 2016 AWQC: Acute 33 µg/L, Chronic 7.9 µg/L Cd.

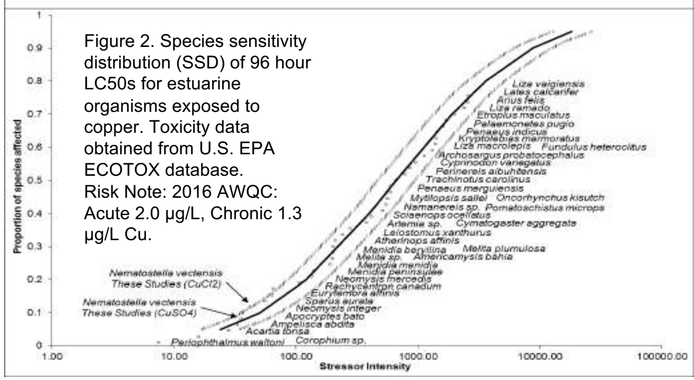
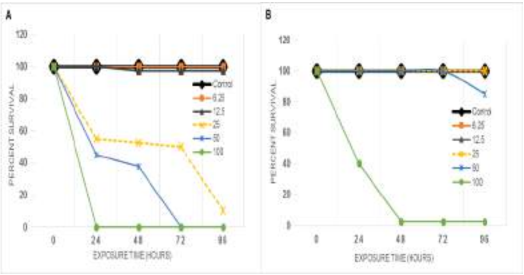


Figure 2. Species sensitivity distribution (SSD) of 96 hour LC50s for estuarine organisms exposed to copper. Toxicity data obtained from U.S. EPA ECOTOX database.
Risk Note: 2016 AWQC: Acute 2.0 µg/L, Chronic 1.3 µg/L Cu.



Figures A&B taken from Echols et al., (2016) *Chemosphere*.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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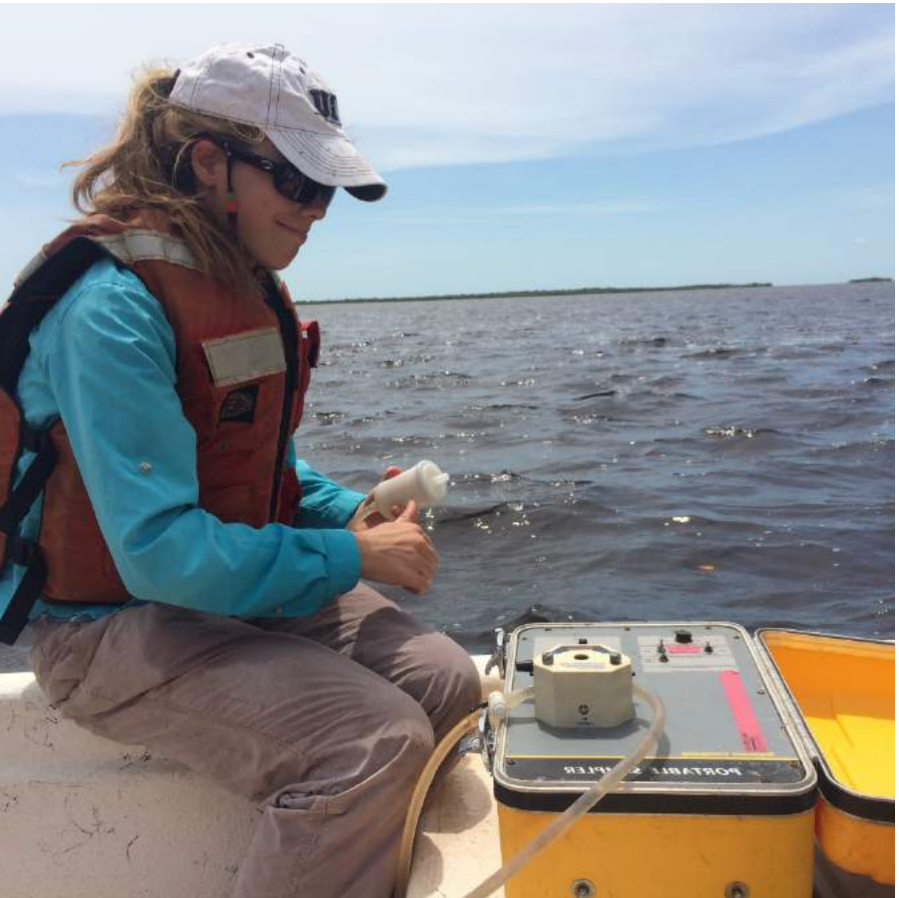
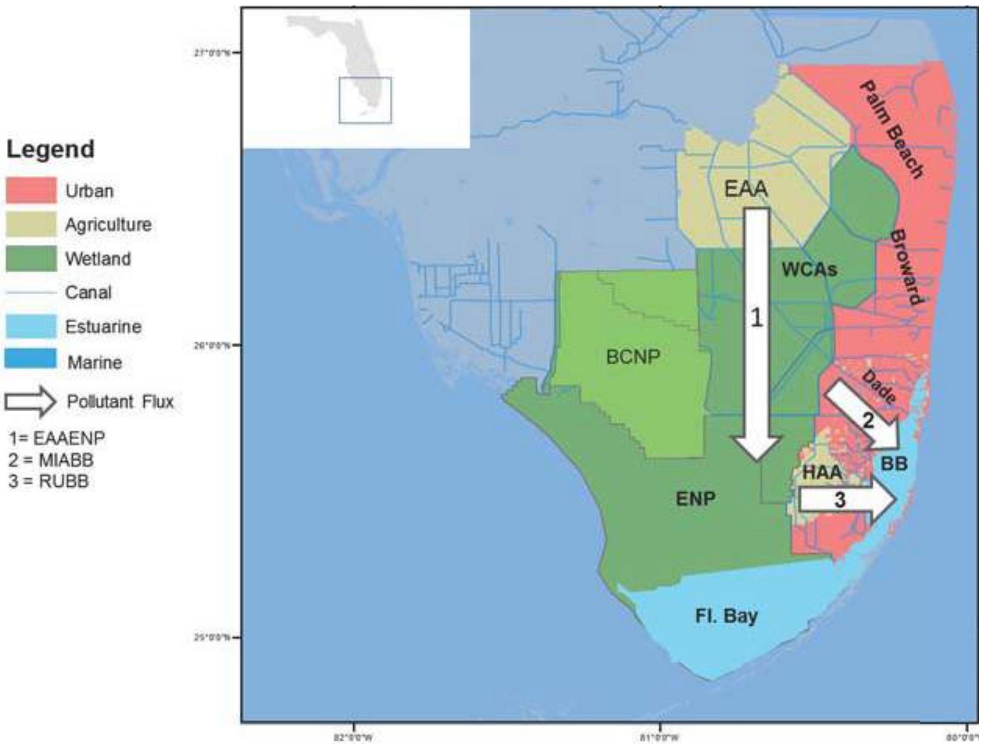
Research Focus Area 2
Fate and Transport

Using advanced sensing techniques to determine biogeochemical cycles and environmental impacts, by studying contaminant *sources, storage, transport and transformations* across South Florida's natural, agricultural, and urban landscapes





Research Focus Area 2

Fate and Transport

- Quantify the flux of water, nutrients, carbon, and pollutants/contaminants along transects that cross major land-use boundaries (agriculture, urban and natural).

- Hydro-dynamically model the flux of water and the transport of pollutants/contaminants and their associated biogeochemical processes along land-use boundary transects.

- Predict the potential transport of pollutants/contaminants and any adverse biological outcomes with changing land use or natural forcings

Himadri Biswas, PhD Student
Advisor: Mike Ross, Earth & Environment

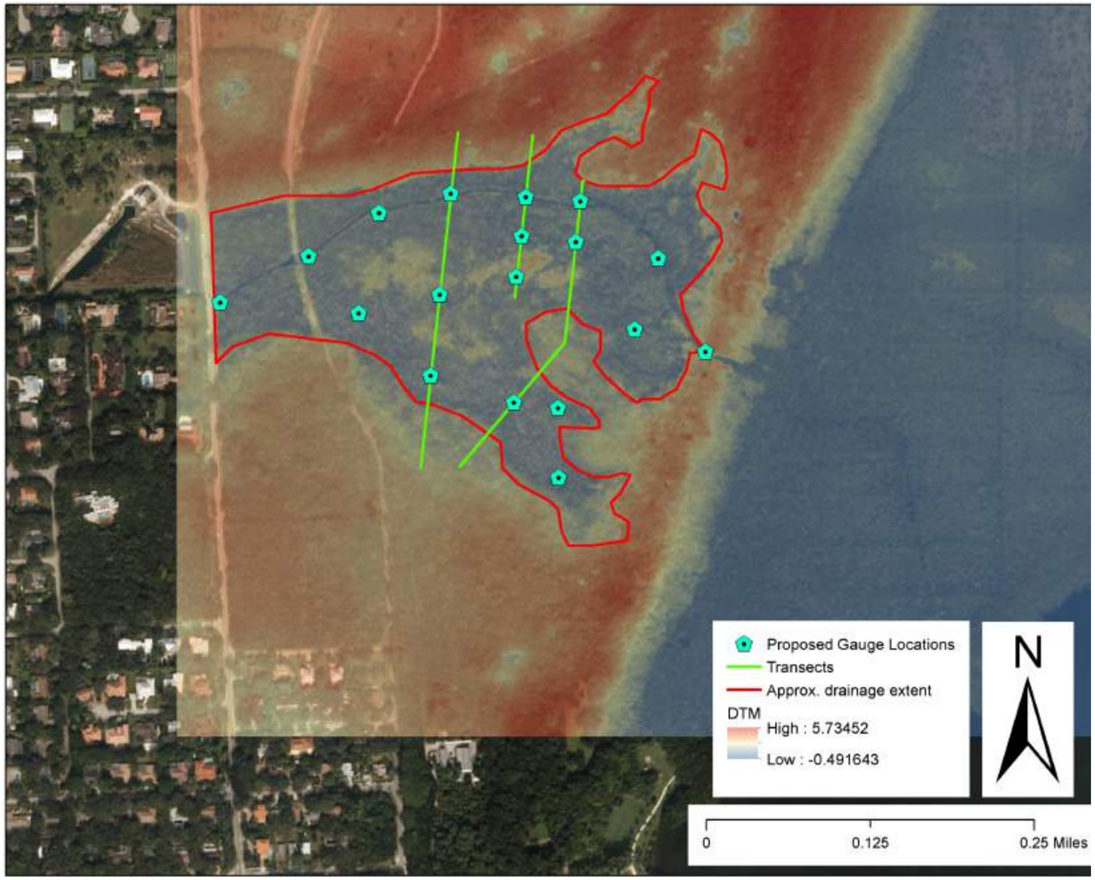
Effects of new water delivery pattern from extended C100 spur canal on hammock vegetation in the Deering Estate

Research questions:

1. What are the effects of water delivery on surface water level?
2. What are the effects of new surface water delivery pattern on hammock vegetation in the Deering Estate?

Methods

- Record surface water level using Hobo data loggers manufactured by Onset Computers
- Long-term monitoring (3-5 years)
- Periodically monitor and record observations on vegetation (such as tree mortality, affected species, etc.)



Expected results…

- Comparison of surface water level: before and after new water delivery pattern. Surface water level is expected to be higher.
- Tree mortality and vegetation stress is expected in areas with higher surface water level.

Angelica Moncada, PhD Student
Advisor: Assefa Melesse, Earth & Environment

Research focus: phosphorus loading in the Everglades Agricultural Area

- How can Best Management Practices' effectiveness be improved regarding phosphorus outflow?
- Geospatial analysis and modeling of particulate phosphorus source, transport, and fate
- General area: EAA
- Methods: GIS applications, current nutrient data analysis, possible field samples

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Earth and Environment

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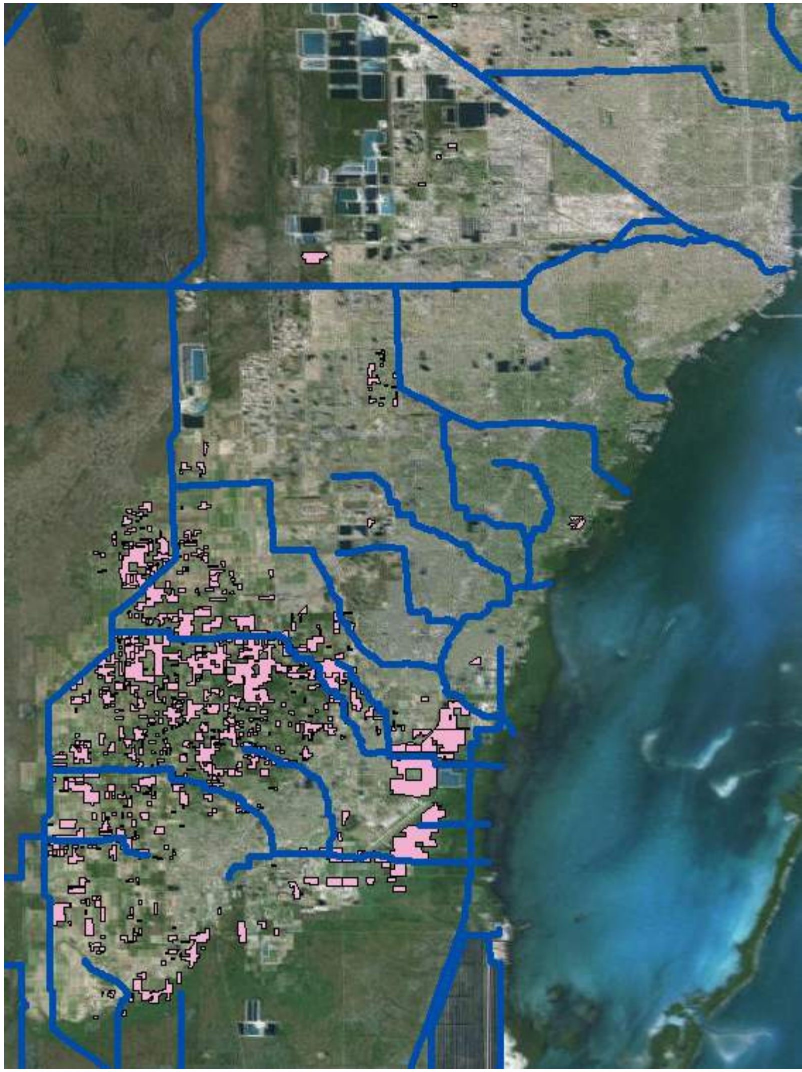
Samuel Kent, PhD Student

Advisor: Assefa Melesse, Earth & Environment

Research Focus: Fate & Transport/Impacts & Visualization

Research Topic:

- Nutrient transport modeling from agricultural nurseries through canals that lead to Florida Bay
  - Major focus on Homestead, houses the majority of nurseries in Miami-Dade



Nurseries and Vineyards (pink) Canals (blue)

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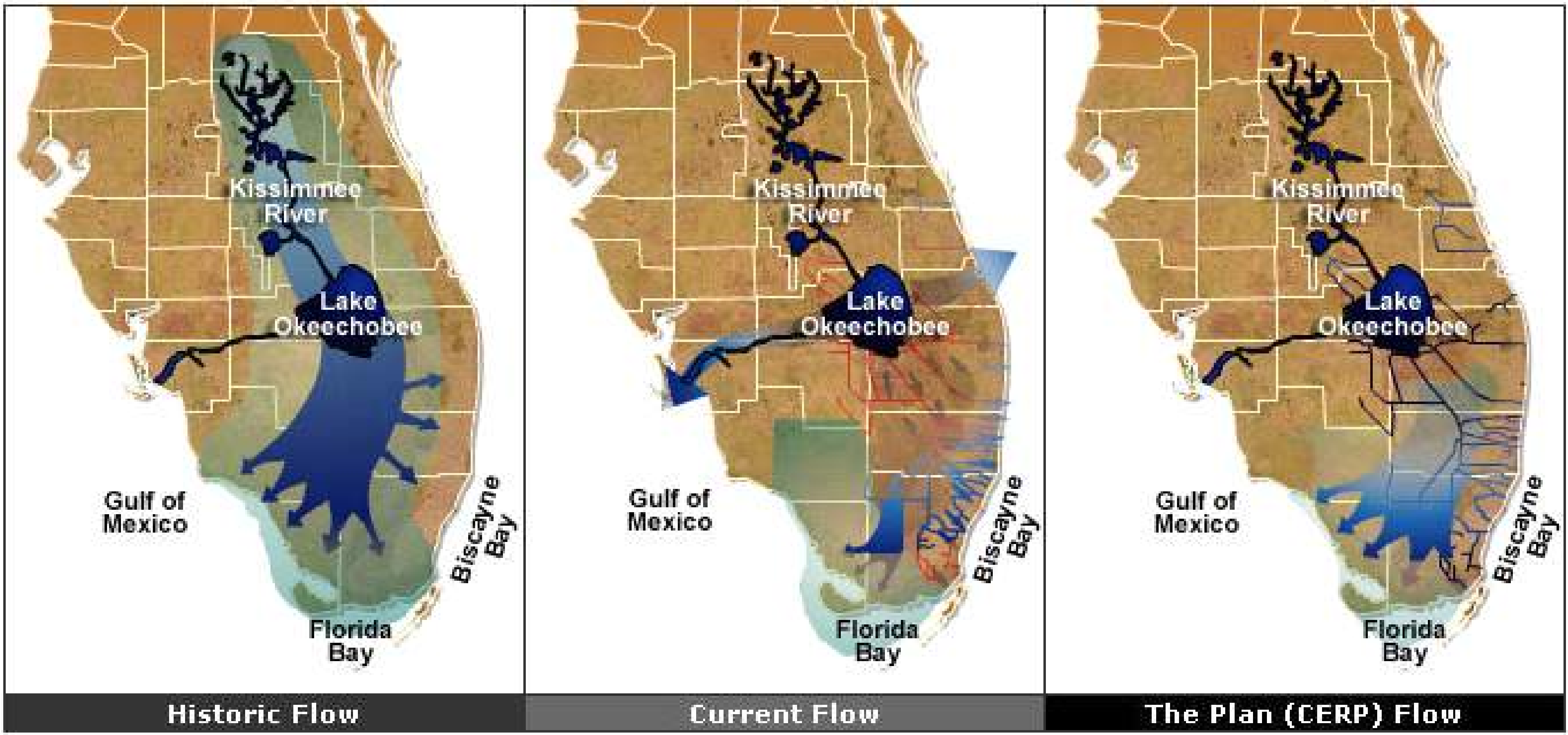
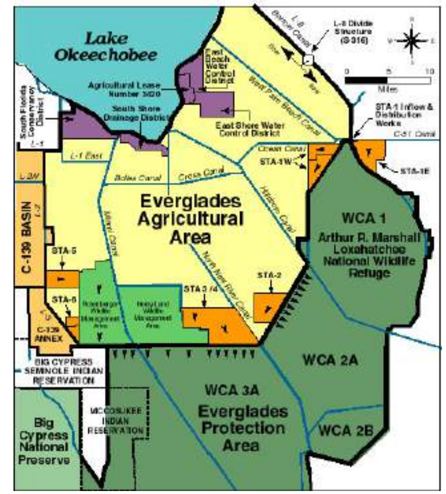
Restoring CLEAN freshwater flow

2000 – Central Everglades Restoration Plan



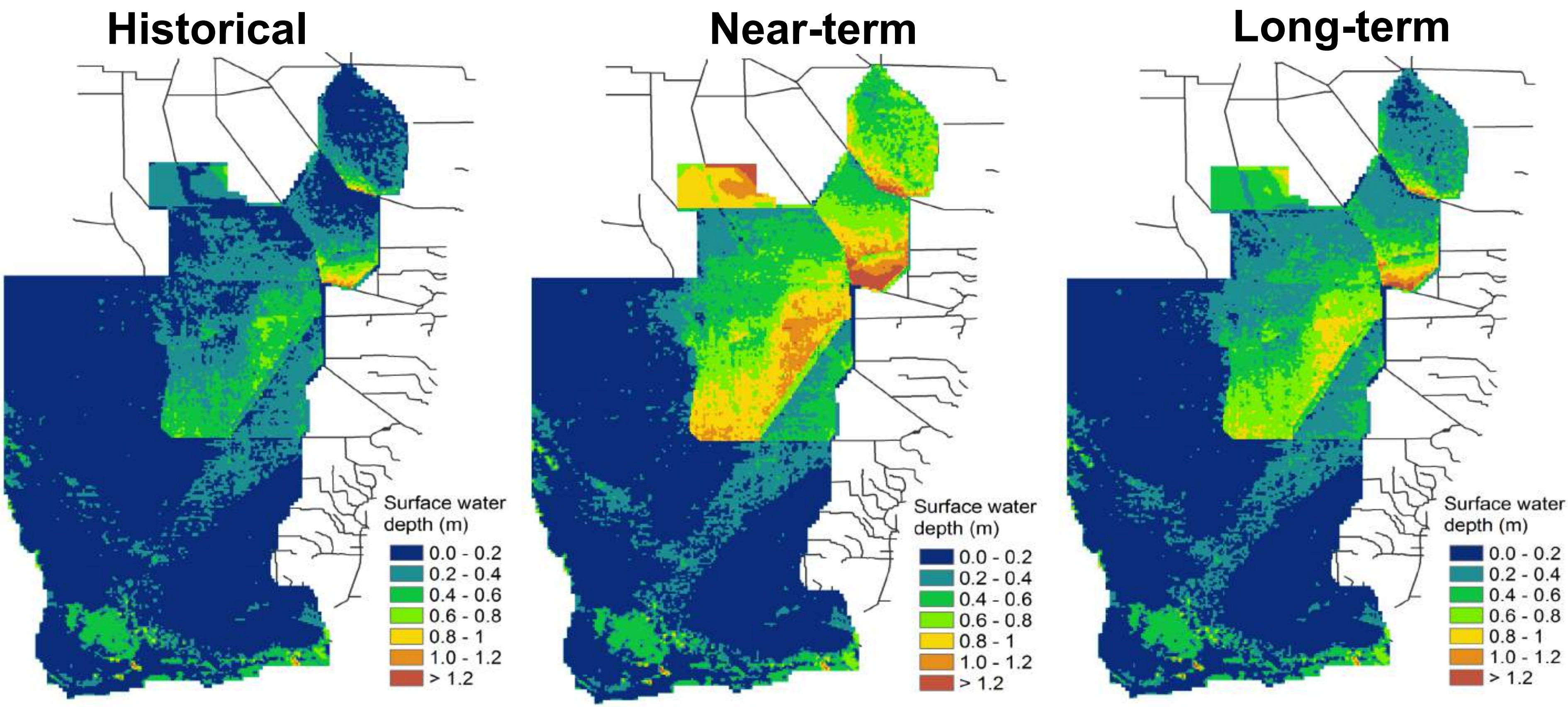
SOURCE: WWW.EVERGLADESPLAN.ORG


ATLANTIC OCEAN
N
Gulf of Mexico
Lake Okeechobee
Kissimmee R.
St. Lucie Canal
Caloosahatchee R.
LEGEND
Project planning under way
Project construction not yet begun
Project construction ongoing
Project construction complete
Pilot project construction ongoing
Pilot project construction complete
1. Hillsboro ASR Pilot
2. Kissimmee ASR Pilot
3. LPA Seepage Management Pilot
4. Decomp Physical Model
5. Picayune Strand Restoration
6. Site 1 Impoundment
7. IRL-S C-44 Reservoir/STA
8. Melaleuca Eradication and Other Exotic Plants
9. C-111 Spreader Canal
10. Biscayne Bay Coastal Wetlands
11. C-43 Basin Storage Reservoir
12. Broward County Water Preserve Areas
13,14. Central Everglades Planning Project
15. Loxahatchee River Watershed
16. Lake Okeechobee Watershed
17. Western Everglades
0 30 mi
0 30 km


Lake Okeechobee
Everglades Agricultural Area
C-139 BASIN
WCA 1
Arthur R. Marshall Loxahatchee National Wildlife Refuge
WCA 2A
WCA 2B
WCA 3A
Everglades Protection Area
Big Cypress National Preserve
BIG CYPRESS SEMINOLE INDIAN RESERVATION
MICCOSUKEE INDIAN RESERVATION
STA-5
STA-6
STA-2
STA 3/4
STA-1W
STA-1E
C-139 ANNEX
East Shore Water Control District
South Shore Drainage District

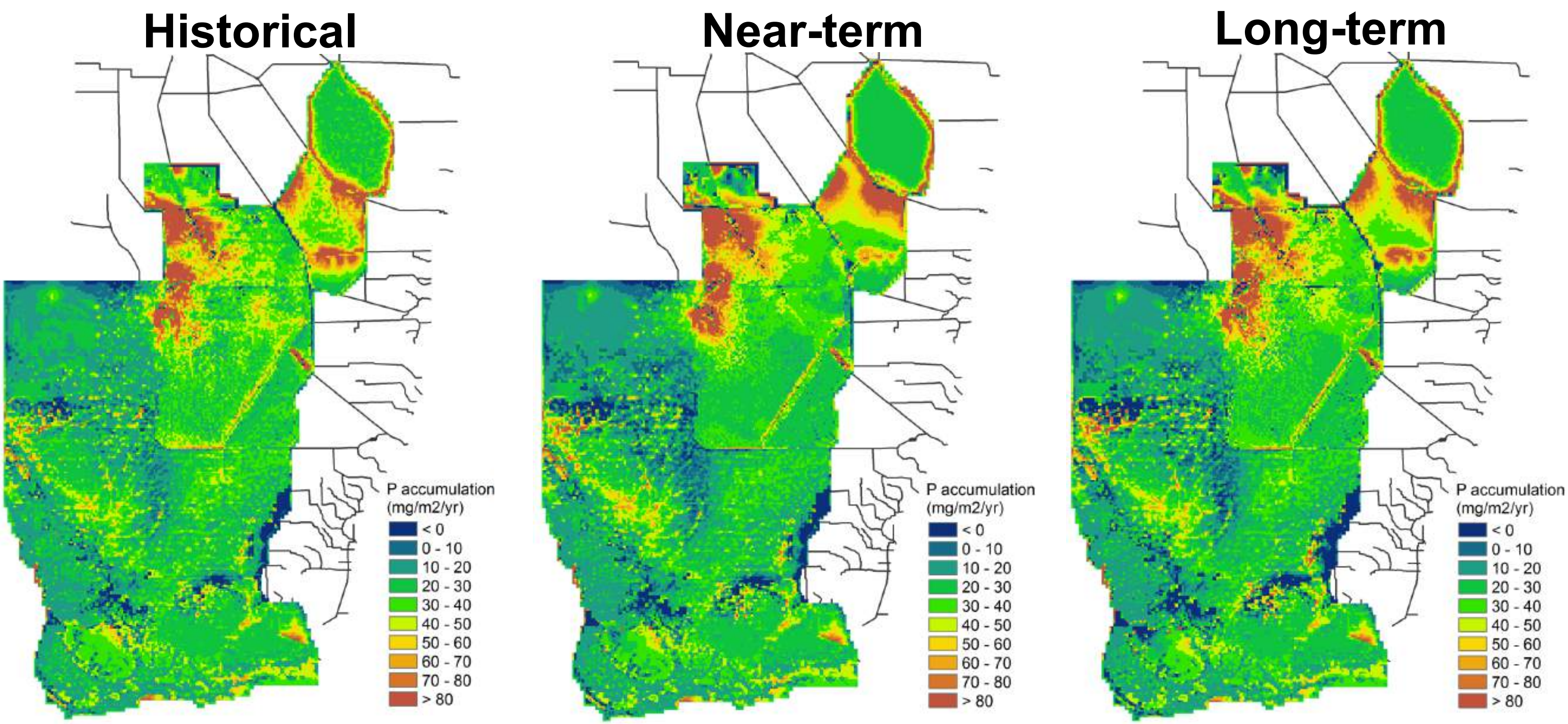

April 2001

Hydrologic response: historical, near-term, long-term



Average surface water depths for the period of simulation.

Phosphorus accumulation response: historical, near-term, long-term



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Research Focus Area 3

Impacts and Visualization

Data Synthesis and Risk Assessment

Using data analytics, interpretation and visualization to assess the effects on South Florida's aquatic ecosystems, and to convey environmental impacts to policy- and decision-makers.

The third Research Focus Area connects computer scientists with environmental experts throughout each of the Research Focus Areas, to develop data analytic methods that enable synthesis across large, complex datasets…so that we can conduct holistic effects-assessments for understanding South Florida's fragile aquatic ecosystems.

Research Focus Area 3

Impacts and Visualization

Data Synthesis and Risk Assessment

- Provide detailed characterization and measurement of the environmental pollutants
- Improve predictive abilities on effects of pollutants and address future water quality issues
- Explore, manipulate and visualize data; thus collaborate more effectively for risk assessment
- Conduct literature mining on the nature of contaminants and access relevant environmental information rapidly
- Communicate more effectively with decision makers and other stakeholders

Joshua Daniel Eisenberg, PhD Student
Advisor: Mark Finlayson, Computer Sciences

Towards Semantic Search for the Biogeochemical Literature

COGNITION NARRATIVE & CULTURE LABORATORY

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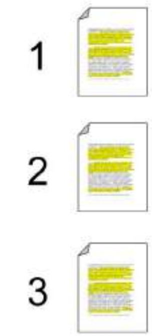
Vision

Center for
Aquatic Chemistry
and Environment
NSF Center of Research Excellence
in Science and Technology

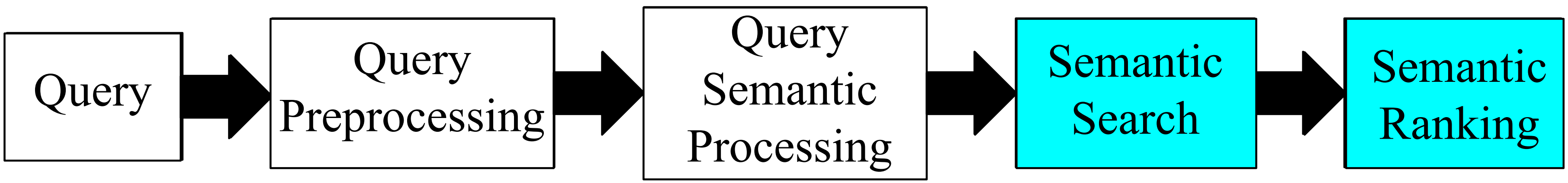
- Improve semantic search for biogeochemistry

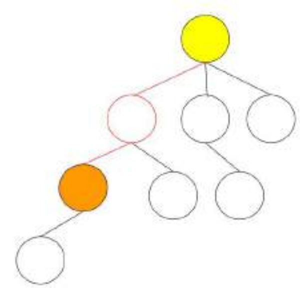
- Can we reuse ontological knowledge in ENVO for semantic search?

System Design



Contaminants in
everglades sediments





Contributions

- Running gold-standard annotation study
- Showed viability of using ENVO for semantic search
- Hand annotated 5 papers for ENVO concepts
- Designed and implemented graph search ranking algorithm

COGNITION NARRATIVE & CULTURE LABORATORY

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Tiffany Yanez, MS Student
Advisor: Todd Crowl, Biology

EFFECTS OF COPPER IN SAILFIN MOLLIES ACROSS DIFFERENT SALINITY RANGES

HYPOTHESES:

For Sailfin mollies I expect:

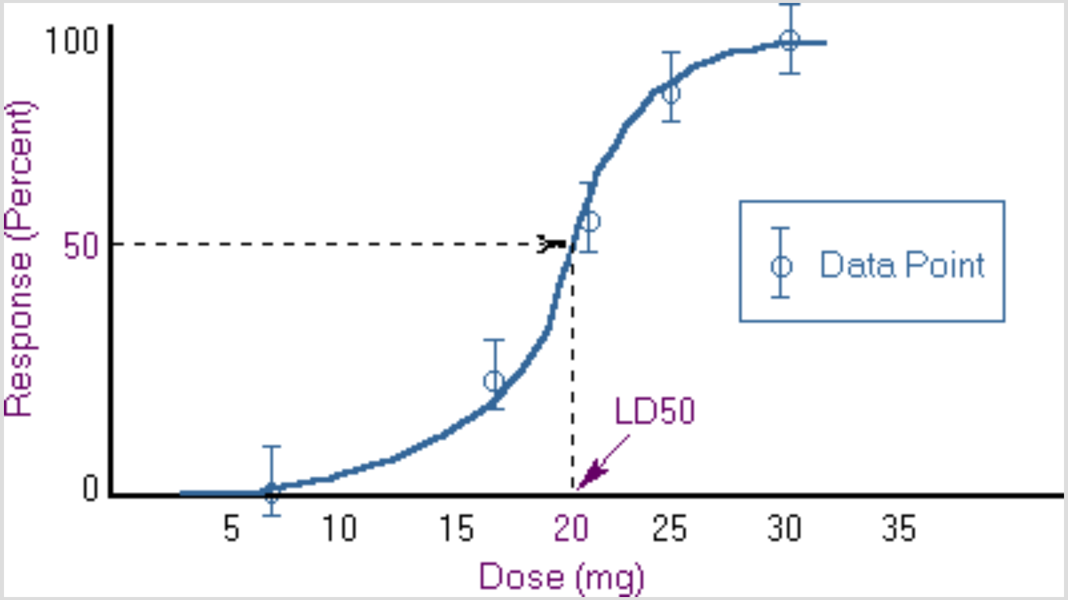
1) **Copper acute toxicity will decrease as salinity increases**
2) **An impairment in swimming performance ability will be apparent at 10% of their acute toxicity value**

To test these hypotheses:

1) Acute toxicity experiments
2) Swim performance experiments

ACUTE TOXICITY EXPERIMENTS

- Reference toxicant treatment as a positive control
- 4 different salinities (0, 8, 15 & 30 ppt)
- 5 different Cu concentrations (dilution of 50%) – **$CuSO_4 * 5H_2O$**
- 4 replicates with 10 individuals/container
- Total, dissolved and internal fish Cu concentration
- LC50: Lethal concentration that killed 50% of the individuals
- LD50: The lethal dose (inside the fish) that killed 50% of the individuals



SWIM PERFORMANCE EXPERIMENTS

- Critical swimming speed (U_{crit})

$$U_{crit} = U_f + U_s \times (T_f/T_s)$$

where:

U_f = the water velocity of the last completed step
U_s = velocity increments at each step
T_f = length of time the fish swam in the final step before fatigue
T_s = duration of a whole complete step

- Expose 15 fish/salinity at 10% of their acute lethality value for 1 week
- Acclimation of 30 minutes with no water flow
- 10 minutes at 10cm/s
- 13 steps: Every 5 min, speed will increase by increments of 3 cm/s. At step 7, steps will be prolonged to 15 minutes.
- Fish will be given 45 minutes to rest and then repetitive U_{crit} will be recorded
- Endpoint: Critical` swimming speed (U_{crit}); Repetitive U_{crit} ; ratio between repetitive U_{crit} and 1st U_{crit}, and oxygen consumption

MAIN EXPECTATIONS

- Copper toxicity will decrease as salinity increases
- An impairment in swimming performance ability will be apparent at 10% of their acute toxicity value
- Expect differences in the mortality and swim performance response of Sailfin mollies at different salinities based on potential variation in the mode of action on fish physiology.

Research and Education Focus Areas

Detection and Identification

Fate and Transport

Impacts and Visualization

Everglades

Critical Ecosystems

Research and Education Focus Areas

Detection and Identification | **Fate and Transport** | **Impacts and Visualization**




Everglades

Mangroves

Critical Ecosystems

Center for Aquatic Chemistry and Environment
NSF Center of Research Excellence in Science and Technology

Research Supplement
Mangrove Ecology

The Mangrove Research Supplement expands the expertise of our research team by adding an exploration of mangrove ecosystems, which serve as the *filter and connection* between the freshwater and marine ecosystems

How does carbon sequestration vary across mangroves in various physiographic settings?

What is the capability of mangroves to store contaminants and nutrients?

FIU Center for Aquatic Chemistry and Environment
NSF Center of Research Excellence in Science and Technology

Establishes FIU-UPR-USF collaborative project

Soil Coring

Age, Accumulation and Accretion

Accumulation = $\frac{\text{mass}}{\text{time}}$

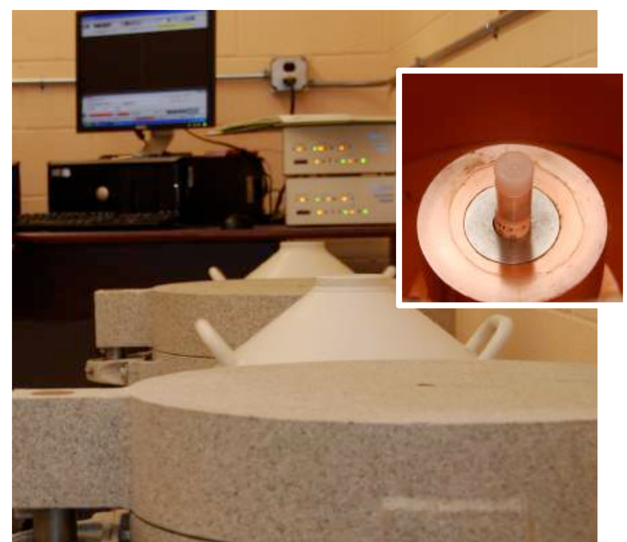
Organic Matter
Inorganic Matter
Organic Carbon
Carbonate etc.

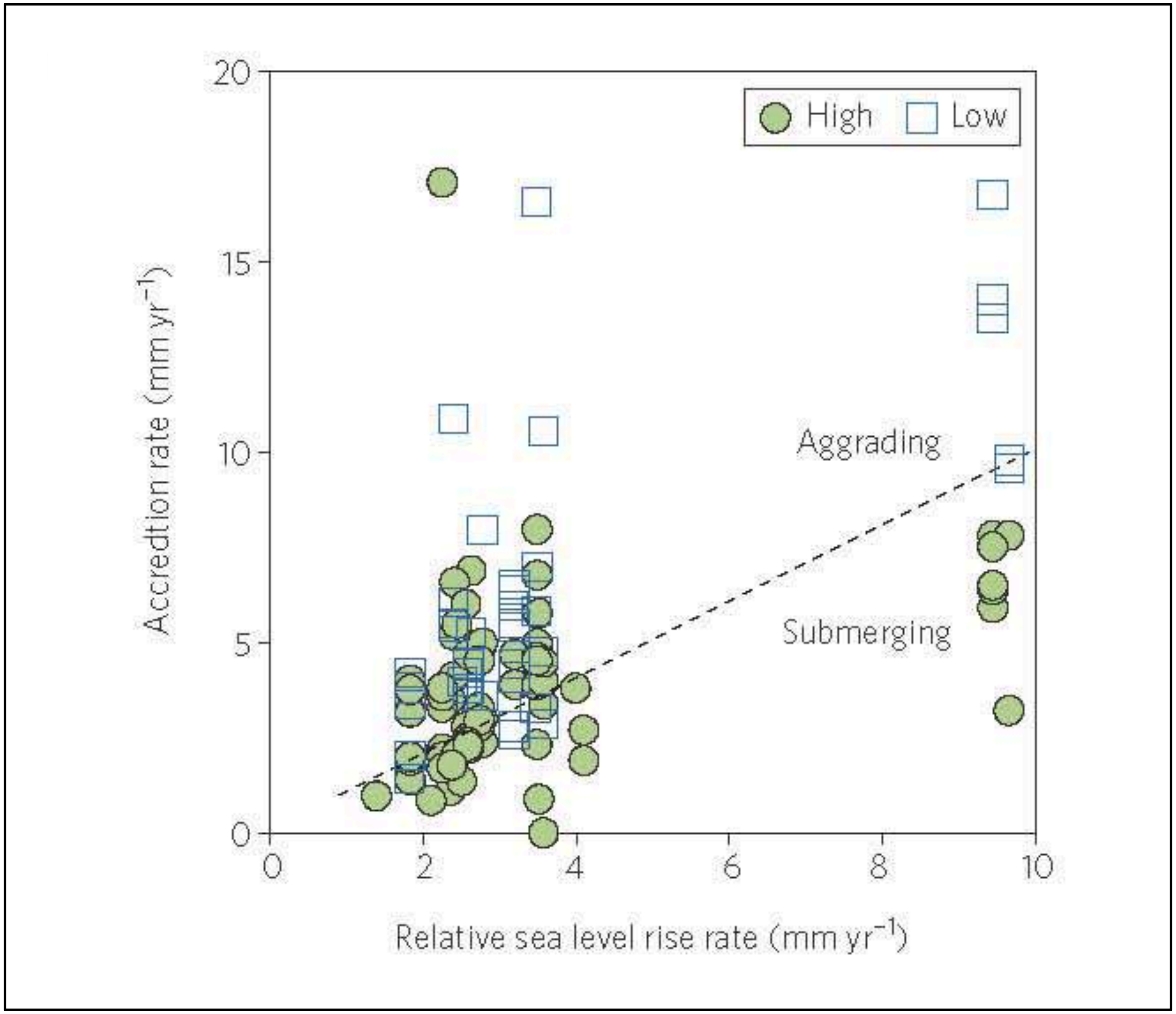
~50 yrs old

Accretion = $\frac{\text{depth}}{\text{time}}$

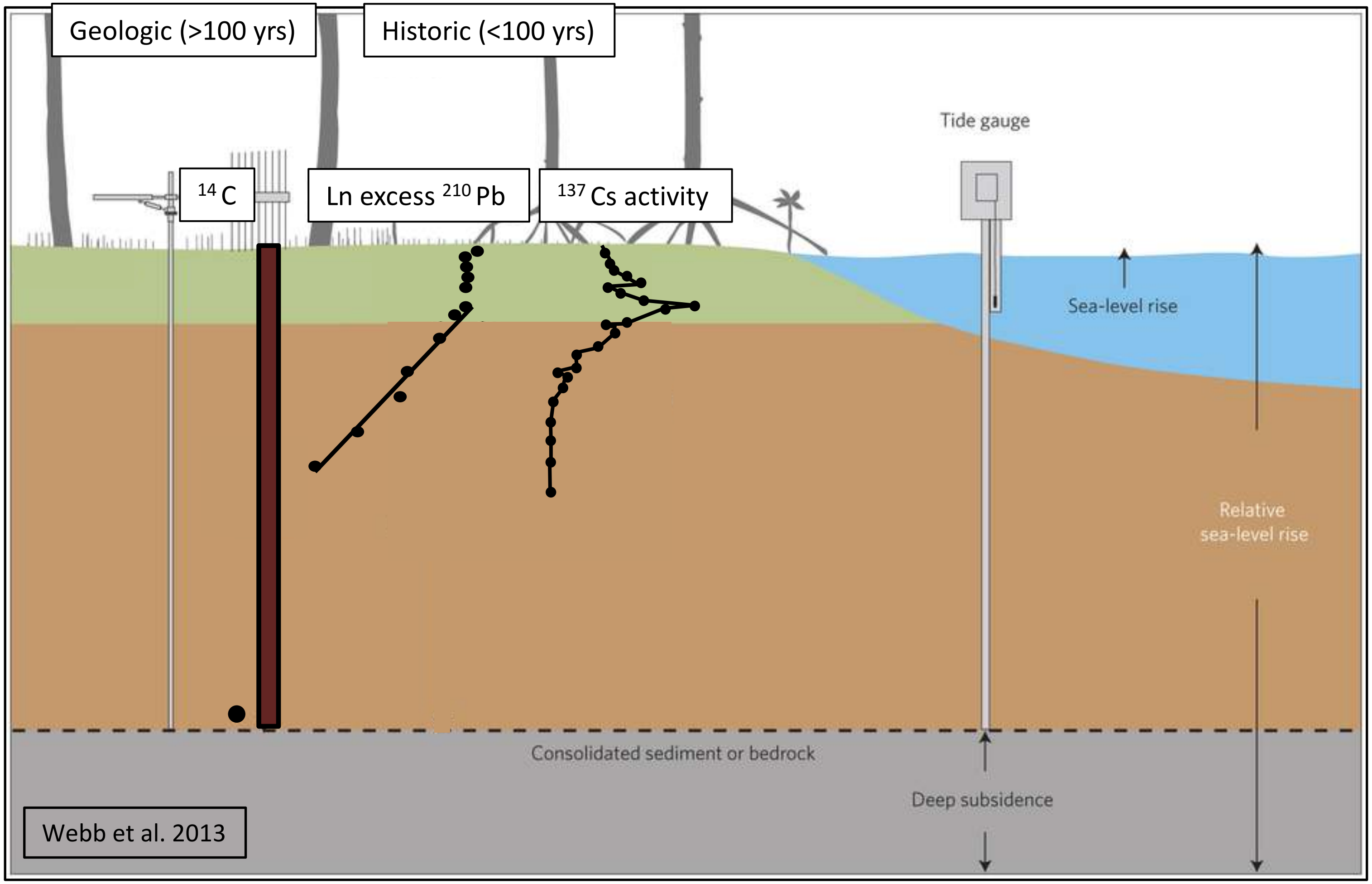
~100 yrs old

^{210}Pb Dating Method





Comparison between local relative sea level rise and accretion rates for low- and high-elevation marshes along Atlantic and Gulf Coast of North America and Europe. Dashed line is 1:1. From Kirwan et al. 2016.



Radioisotope geochronology data used to quantify long-term (historic, geologic) sedimentation. Modified after Webb et al. 2013.

Does climate drive changes in nutrient concentrations of mangrove sediments?

A comparison between Basin and Fringe Forests in La Parguera, Puerto Rico

Tatiana Barreto Vélez | University of Puerto Rico | Mentor Danielle Ogurcak

Objectives

- Correlate changes in downcore sediment composition with precipitation and temperature records
-
- Study differences between fringe and basin forests in La Paguera

Basin vs Fringe

- Fringe forests
  - tidal flushing
  - higher percent phosphorus would be expected compared to basin
- Basin forests
  - develop at lower elevation behind the

Research Methodology

International Institute for Tropical Forestry

- Core processing for **Loss on Ignition (LOI)** and **Dry Bulk Density (DBD)**

Seagrass Ecosystems Research Lab

- Elemental Analysis for **Total Carbon** and **Nitrogen**
- **Total Phosphorus** Colorimetry

Joseph Smoak Lab

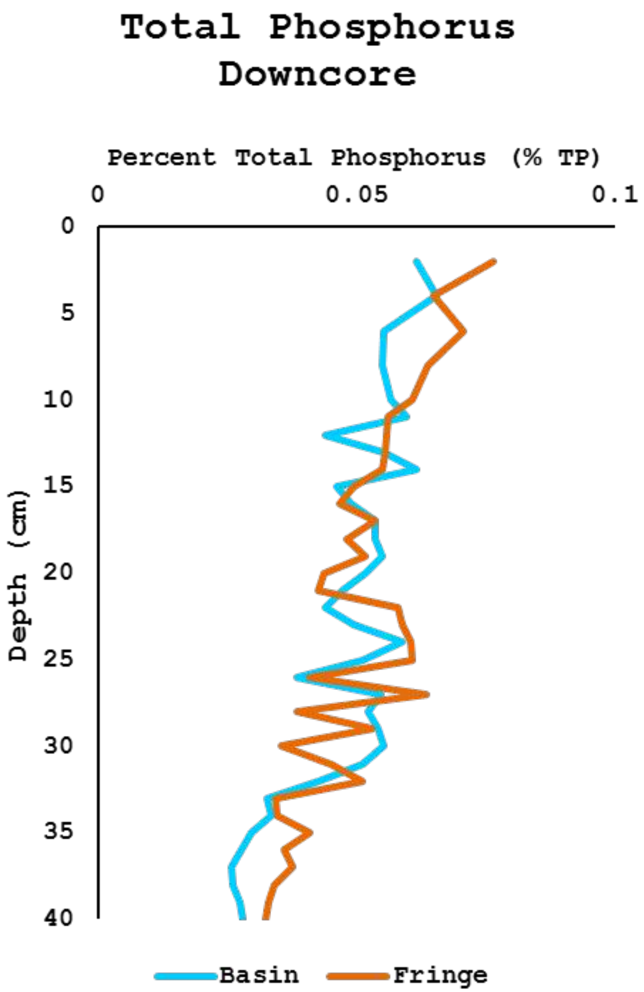
- **Lead-210**

Core sampling sites in La Parguera, Puerto Rico

Soil core collection
Picture by Danielle Ogurcak

Core sectioning
Picture by Amanda Chappel

Sample homogenization
Picture by Maria Pulido



- TP values are similar to pristine setting values of 0.04 +/-0.01 (Sanders et al., 2014)
- Global increase in nutrient transport to oceans in the 20th century (Beusen et al., 2016)

Preliminary conclusion

High nutrient availability could cause mortality of mangroves during drought. Intensified by low precipitation, sea level rise, and hurricanes.

Next Steps

- Correlate Lead-210 dating accumulation rates with climate change data
- Predict how mangrove sustainability might be affected by predicted climate change

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Research and Education Focus Areas

Detection and Identification | **Fate and Transport** | **Impacts and Visualization**

Everglades

Mangroves

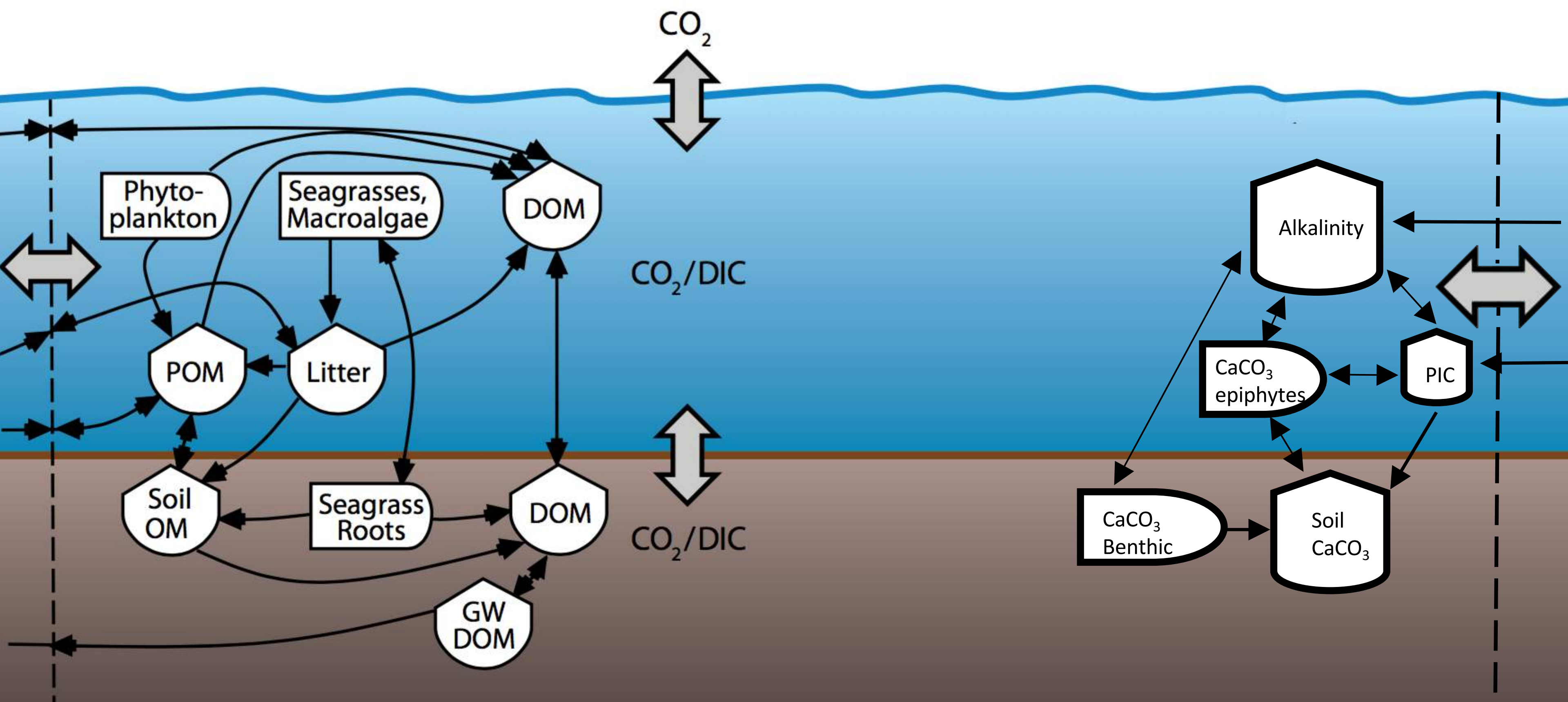
Shallow Marine Habitats

Critical Ecosystems

Jason Howard, PhD Candidate
Advisor: James Fourqurean, Biology

How do ecological and environmental factors control CO_2 production in seagrass meadows

Factors that control organic carbon storage and metabolism
Factors that control calcification and carbonate dissolution
Their net effect on CO2 and it’s likelihood to exchange with the atmosphere



Sediment characteristics are measured across natural and artificial gradients of environmental conditions using chemical analyses

The related changes in the water column are measured using deployed instruments across the marine end of the Everglades

Seagrasses in South Florida are typically autotrophic ecosystems with organic carbon storage and breakdown controlled by sediment type and seagrass canopy characteristics

In warm, productive Florida Bay, **CO_2 consumption by seagrasses is negated by high net calcification** and its associated CO_2 production

The ratio of these antagonistic processes determines the net CO_2 source/sink characteristics of the ecosystem. This ratio is controlled by local ecology and environmental conditions

Claudia Carrión Banuchi, Undergraduate student
Jason Howard, Christian Lopes, PhD Students
Advisor: James Fourqurean, Biology

Measuring decomposition rates of cellulose in soils beneath seagrass beds using artist canvas

Goals

1) Develop a standardized method to measure decomposition rates of organic matter in seagrass soils.

2) Calibrate method to relate measured units (tensile strength loss of standardized material) to ecologically important units (weight loss) of organic matter.

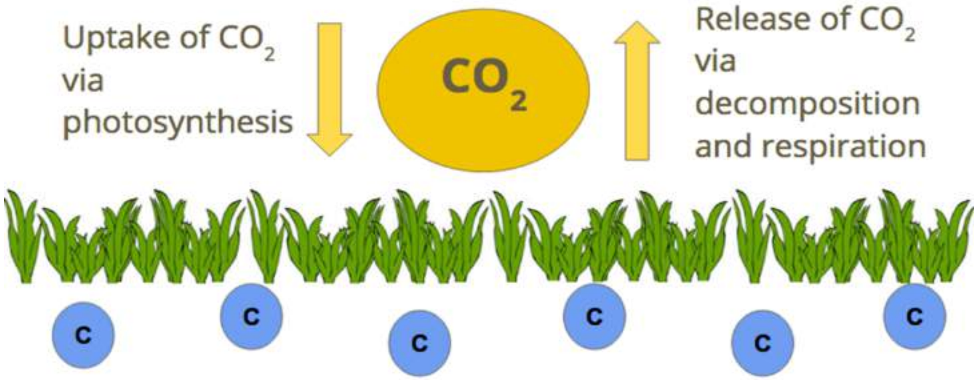
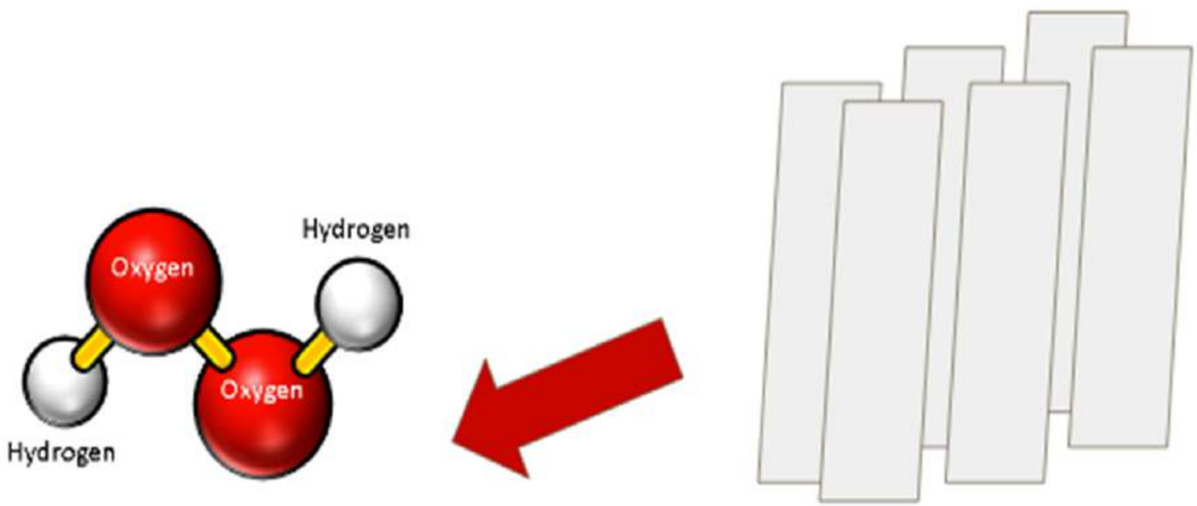


Figure 1. Flux and storage of carbon in seagrass sediment.

Research Methodology

1) Preweighed canvas strips were placed in hydrogen peroxide for controlled oxidation to mimic decomposition.

2) Strips were removed daily, dried, post-weighed, and torn with a tensometer to measure maximum tensile strengths, the force necessary to tear the fabric.



Results

A prominent correlation between weight loss from decomposition and tensile strength was identified in the artist canvas.

This finding was promising enough to continue on with a field test of the method

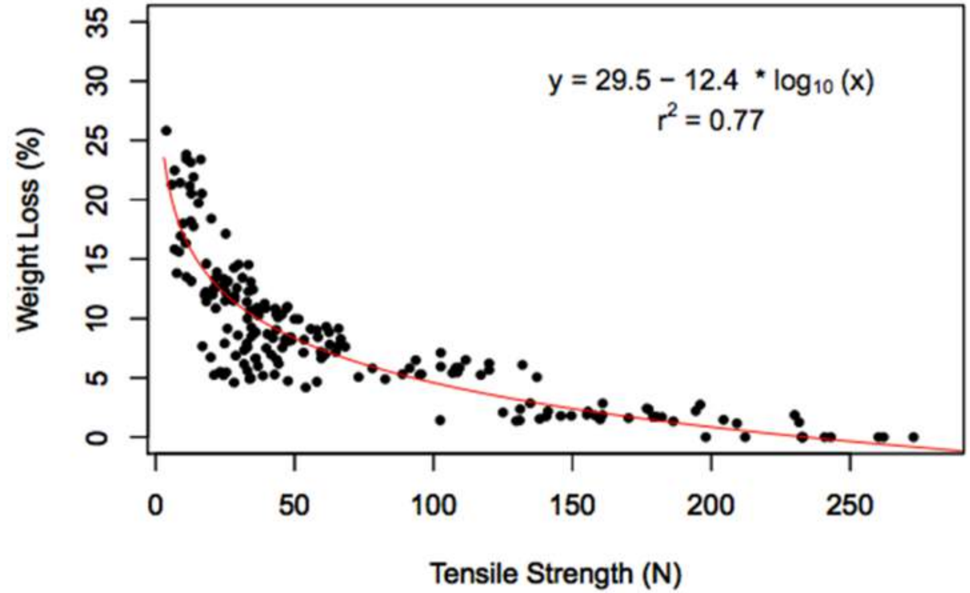


Figure 1. Linear model relating % weight loss vs tensile strength of decomposing strips of artist canvas

Future Work

Cellulose strips deployed in various coastal environments of the Florida Keys will be analyzed to understand factors influencing soil decomposition.

We expect greater decomposition rates fo strips incubating in sandy patches without seagrass, where there are erosional, oxic sediments.

Our model allows decomposition rates to be calculated and compared between environments.

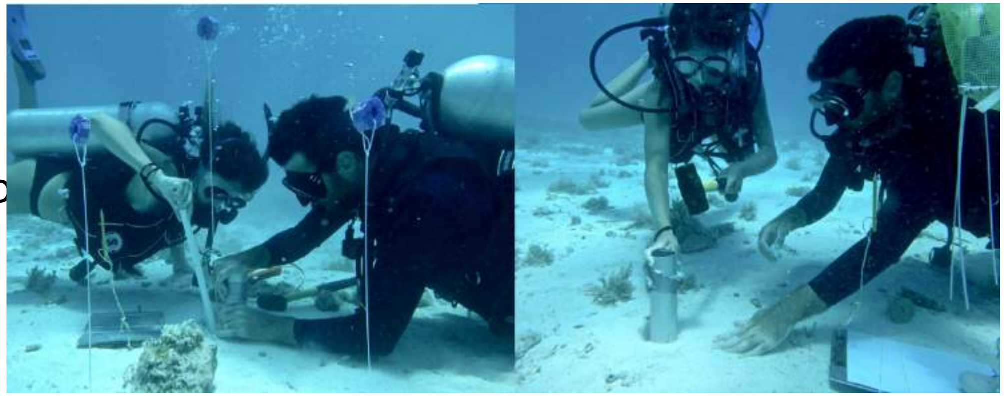


Figure 2: Canvas strips were deployed in the Florida Keys and will remain incubating for a duration of 3 months.

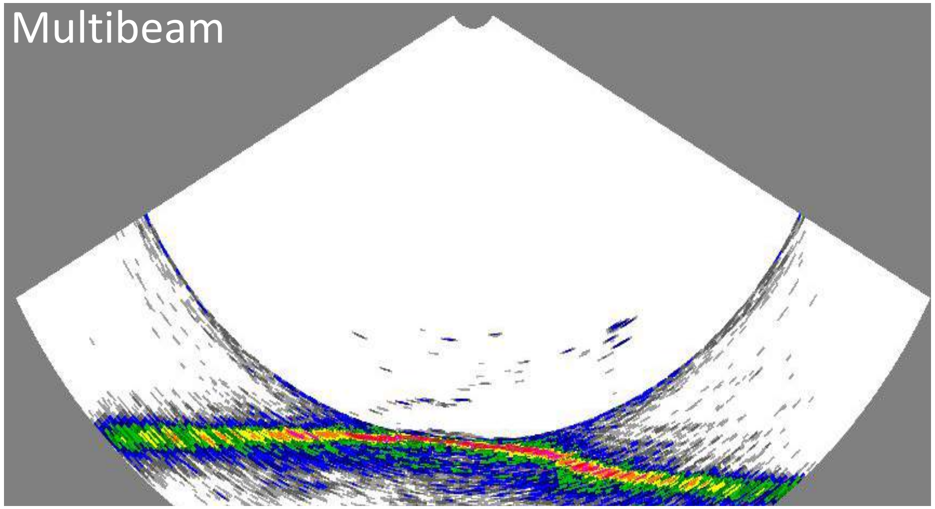
Autonomous Surface Vessel
Kevin Boswell; Kevin.boswell@fiu.edu

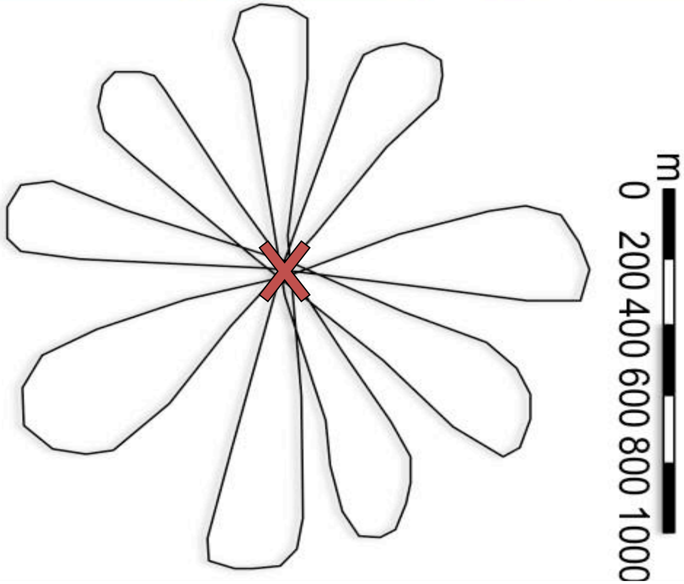
Supports:

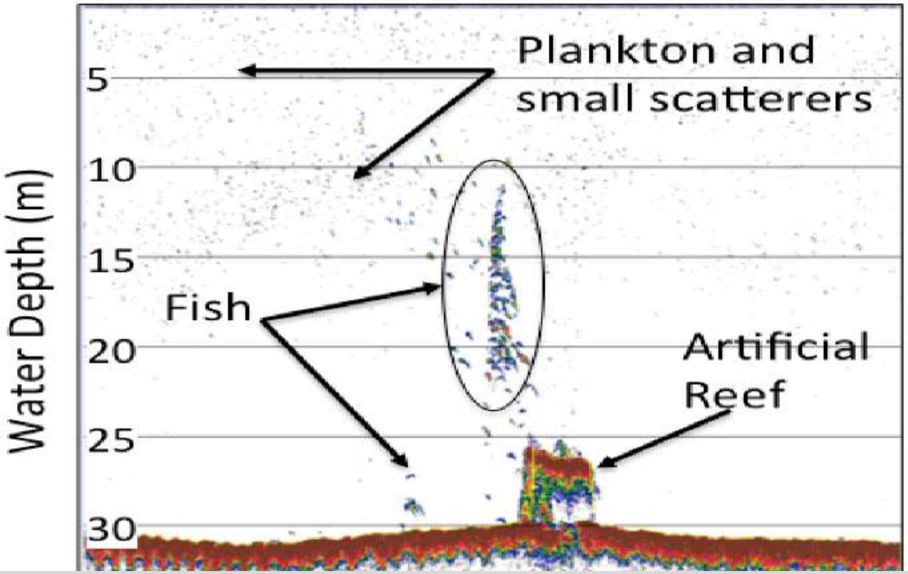
- Fisheries Ecology
- Behavioral Studies
- Habitat Classification
- Bathymetric profiles

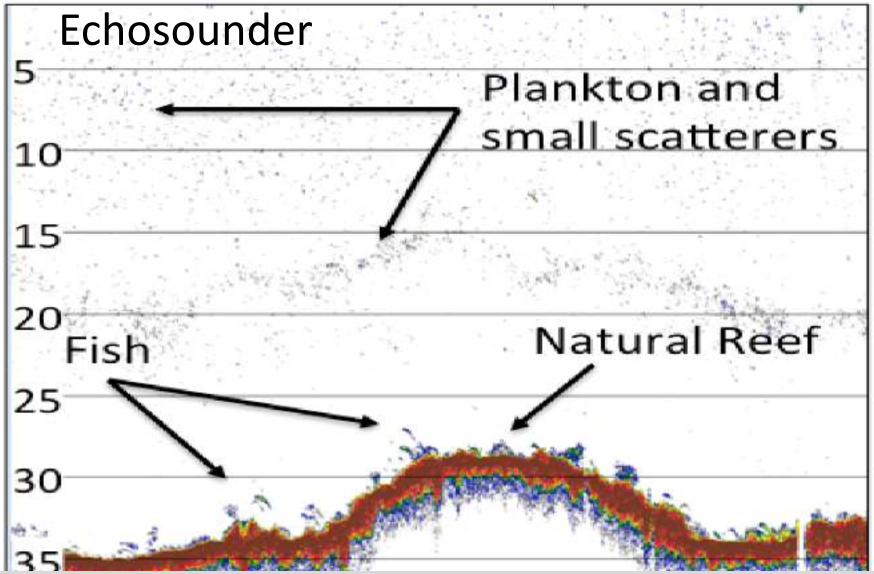
FIU Institute of Water and Environment

Multifrequency/Wideband Acoustics



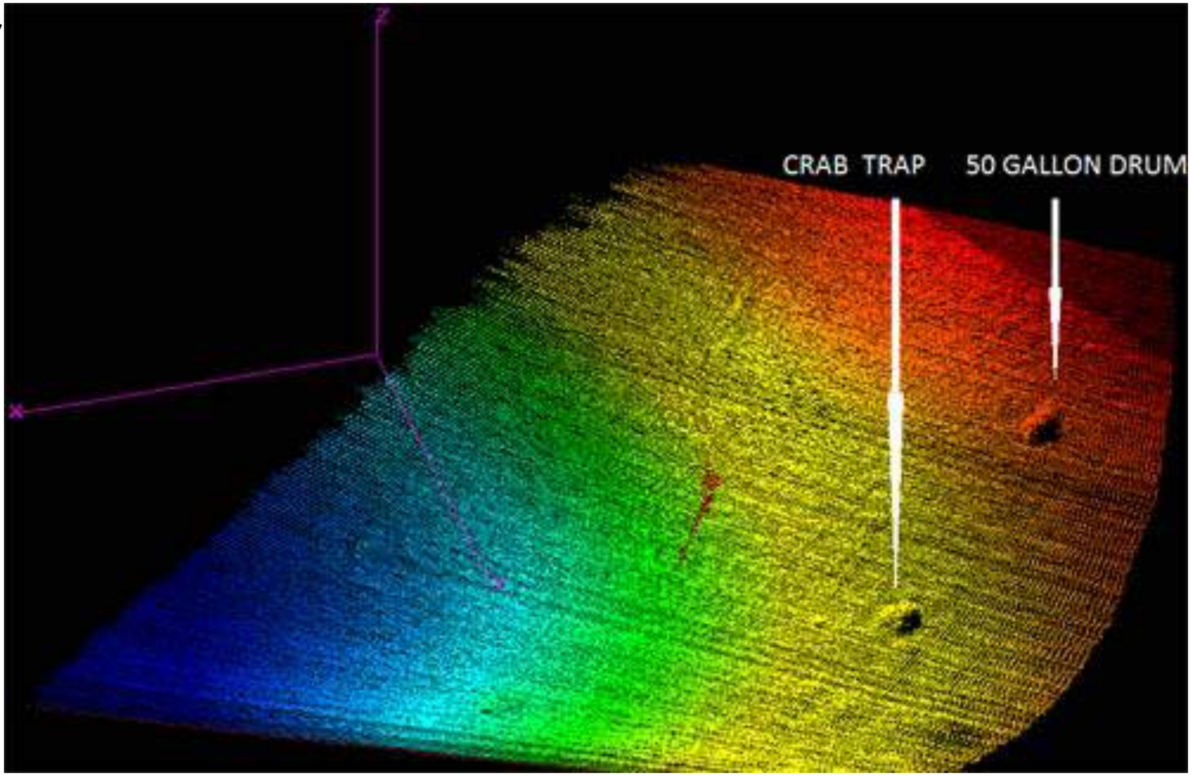


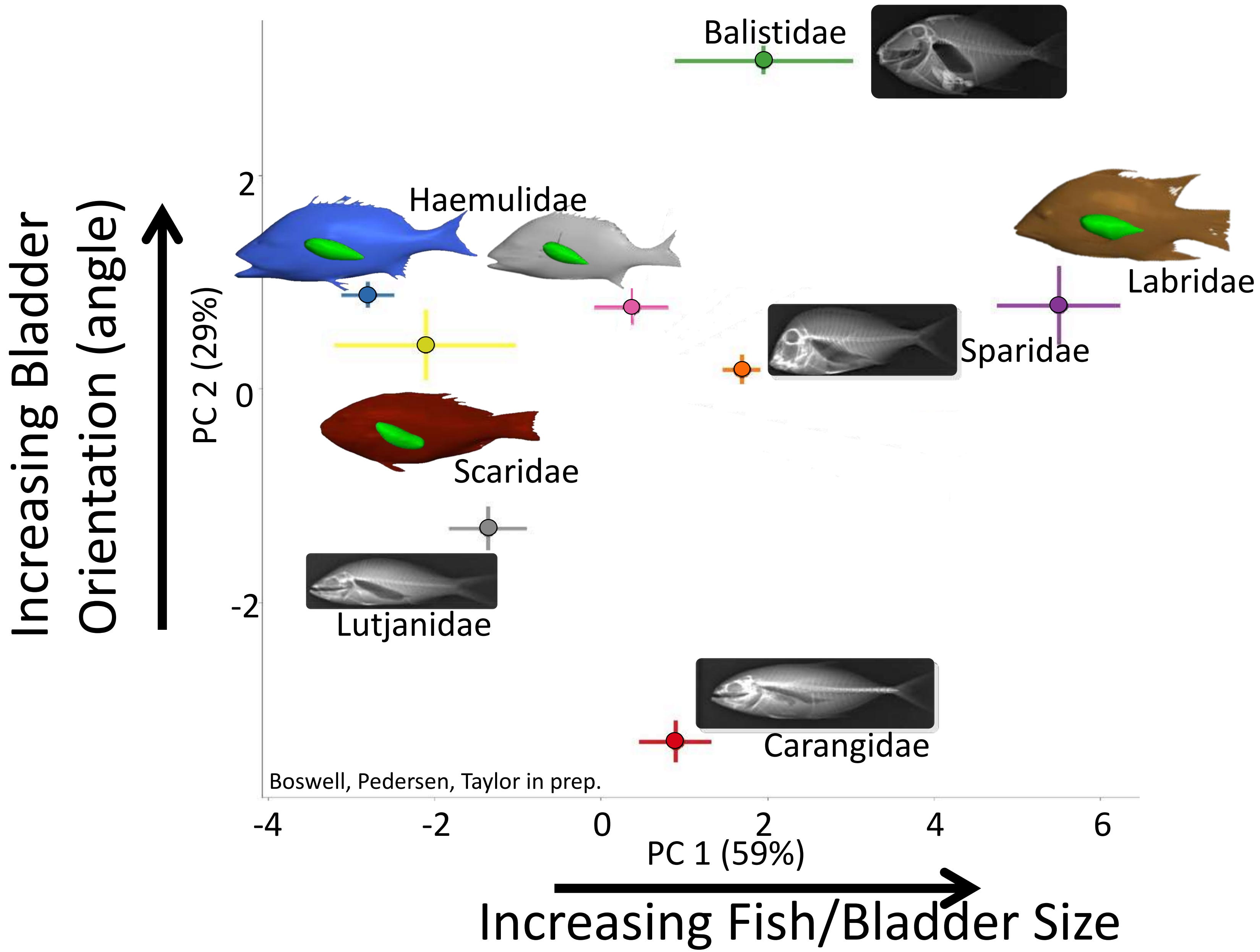




Fine-scale bathymetry in shallow coastal waters

Kongsberg M3 Multibeam sonar




Balistidae
Haemulidae
Labridae
Sparidae
Scaridae
Lutjanidae
Carangidae
Increasing Bladder Orientation (angle)
PC 2 (29%)
2
0
-2
-4
-2
0
2
4
6
PC 1 (59%)
Increasing Fish/Bladder Size
Boswell, Pedersen, Taylor in prep.

Javier A. Rodriguez-Casariego, PhD Student
Advisor: Jose Eirin-Lopez, Biology

Environmental epigenetics: Non-traditional molecular tools for effects assessment.

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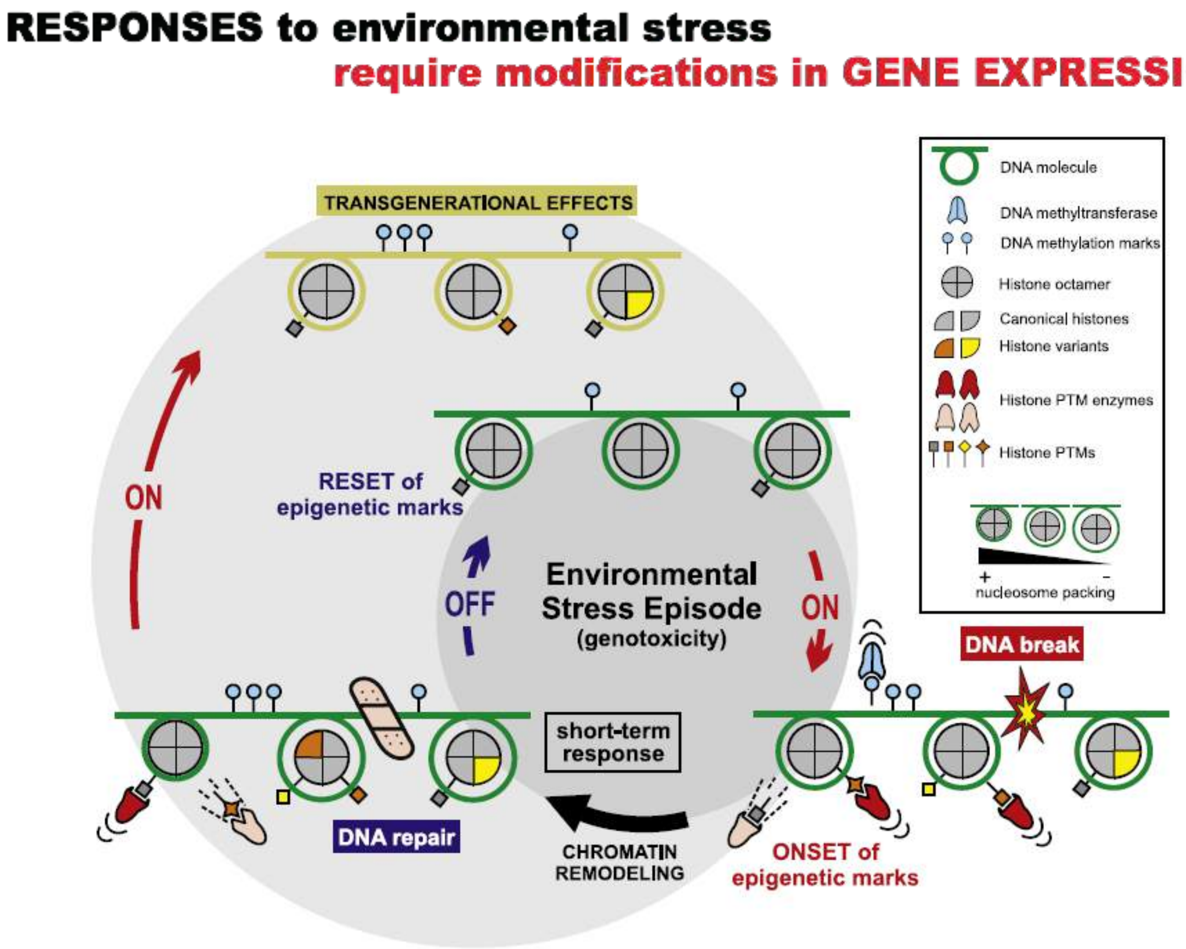
CHROMEVOL
chromevol.com

How are epigenetic mechanisms involved in organisms responses to environmental stress?



Epigenetic mechanisms

- Regulators of gene expression.
- Induced by environment
- Can be reset after stress reduces.
- Can be potentially inherited trans-generationally.

Are different stressors triggering specific epigenetic markers?

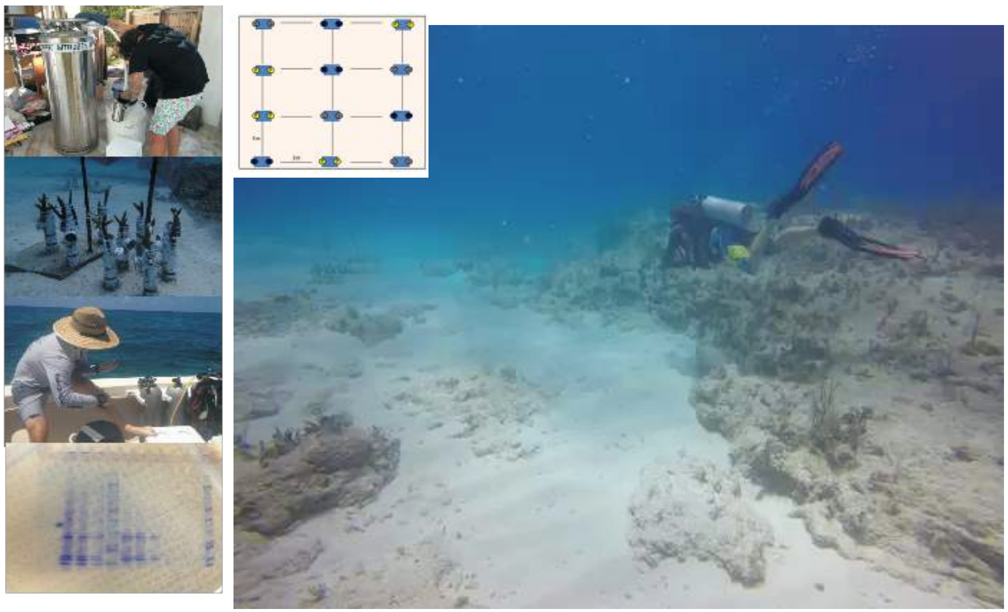
Great biomarker potential

METHODS

Analysis of epigenetic mechanism responding to pollutants and contaminants

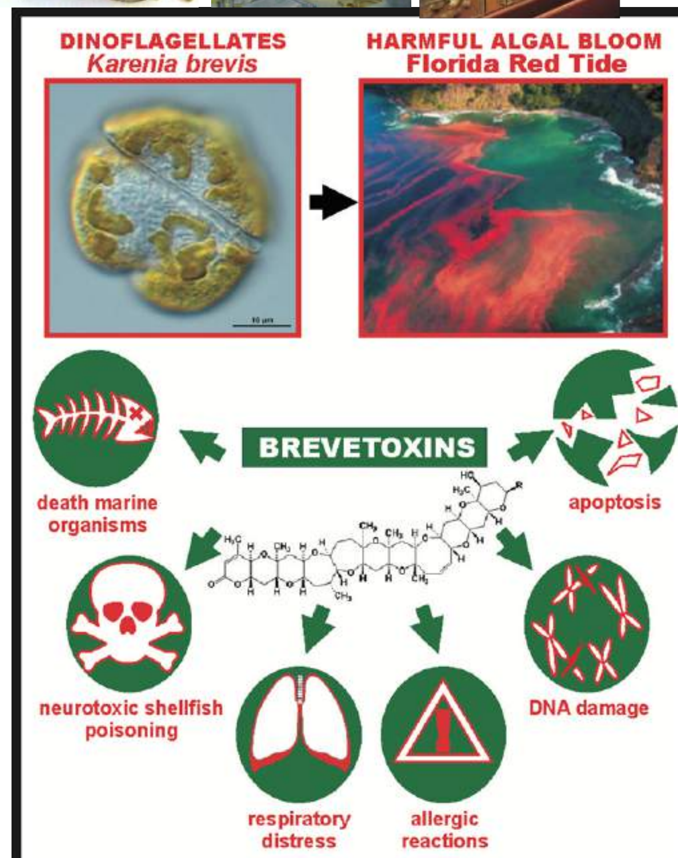
Epigenetic responses in corals

climate change (temperature changes)
pollution (nutrient loading)



Epigenetic responses in bivalve molluscs

biotoxin Brevetoxins

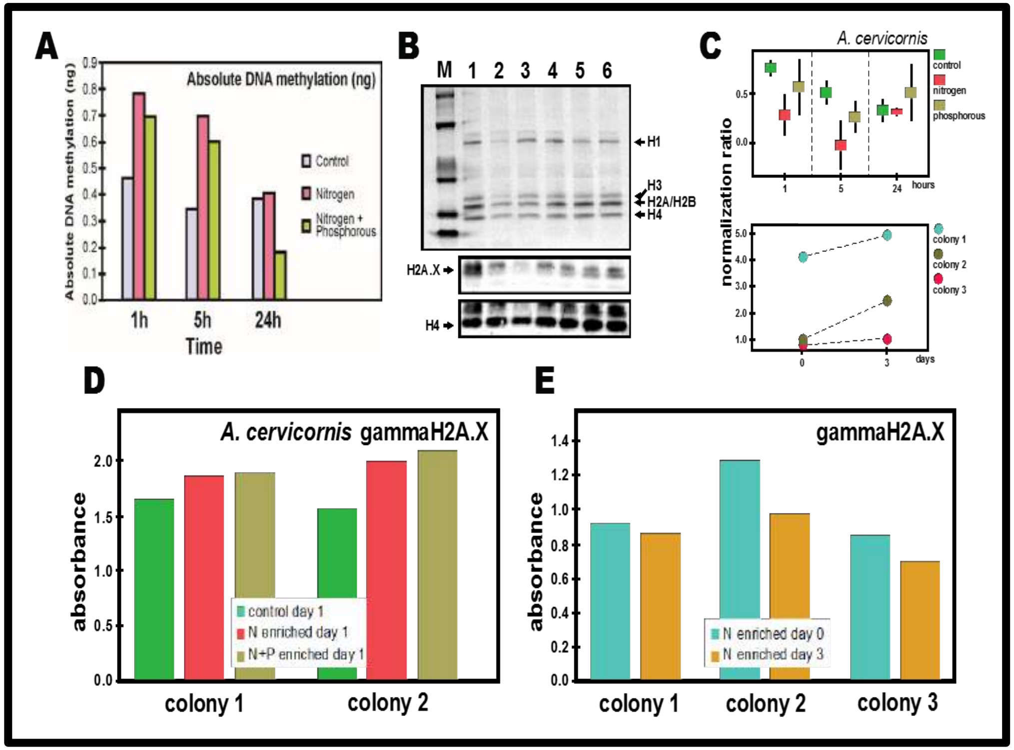


Assess the impact of pollution on the health of these population/ecosystems

Develop epigenetic biomarkers of stress (DNA methylation, histone variants and PTMs, and non-coding RNAs.

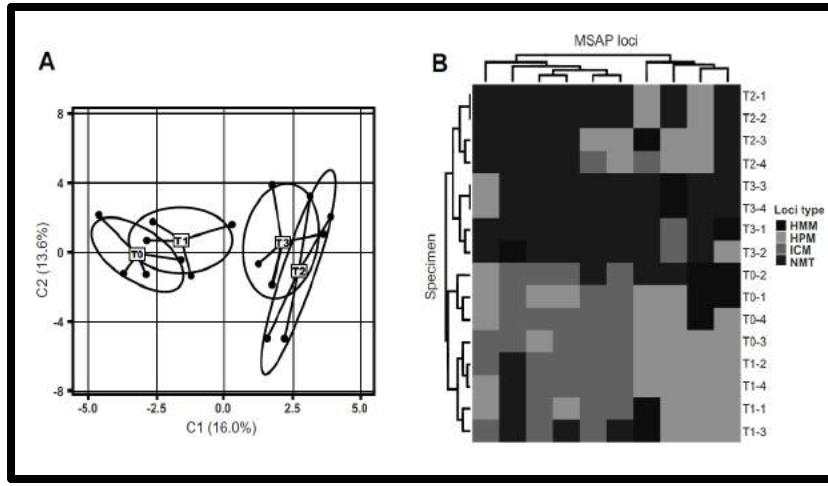
RESULTS SO FAR

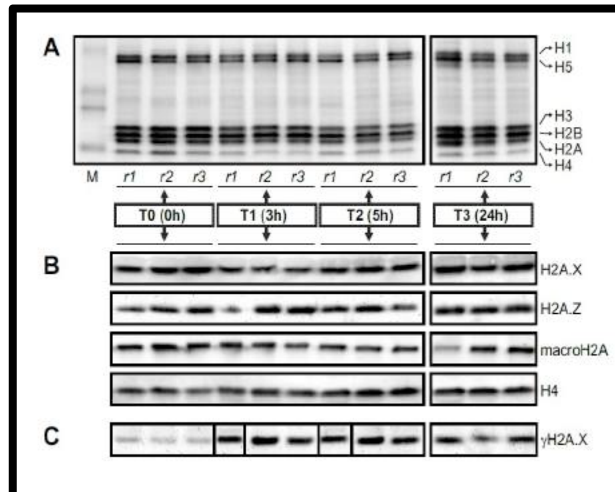
Staghorn coral exposed to nutrients



- **Rapid reduction in global DNA methylation upon exposure to nutrient stress.**
- H2A.X phosphorylation (γH2A.X) displays a dynamic response, increasing early in the exposure to all nutrients and being impaired in the nitrogen only treatment (phosphorus starvation syndrome)
- H2A.X gene expression is increased 3 days after nitrogen only exposure probably as a compensatory mechanism.

Eastern oysters exposed to red tide





- Changes in global DNA methylation with exposure.
- **H2A.X phosphorylation (γH2A.X) increases during exposure, related to DNA damage repair.**

Partnerships and Collaborations

- ***develop practical solutions to problems related to water quality in a natural-agricultural-urban setting, and to***

- ***create a modeling platform that will enable policy-makers and managers to make informed decisions***

This partnership includes:

- South Florida Water Management District
- Environmental Protection Agency
- National Park Service
- Everglades National Park
- U.S. Geologic Survey
- Miami Dade College
- Miccosukee Tribe of Indians
- Miami-Dade Schools
- Florida Keys Community College
- Department of Interior

Thank you!

tcrowl@fiu.edu