

Florida's Coral Reef Water Quality Data Compilation, Analysis, and Decision Support



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Project Team and Funding

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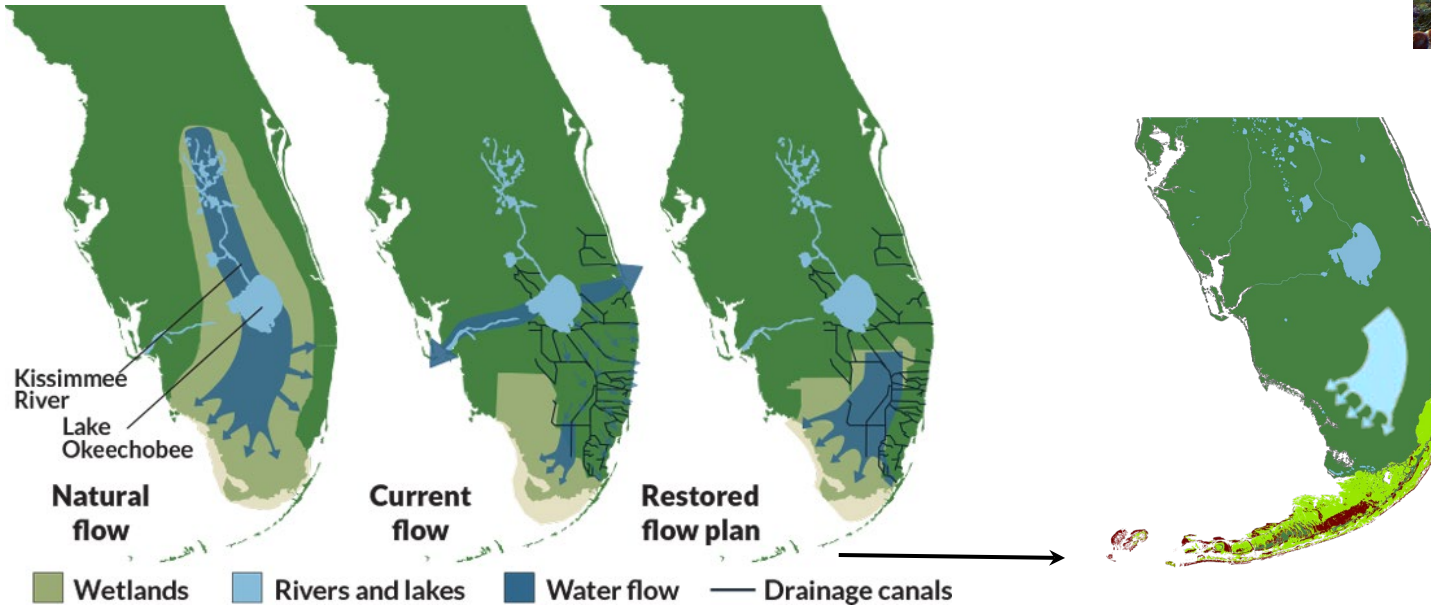
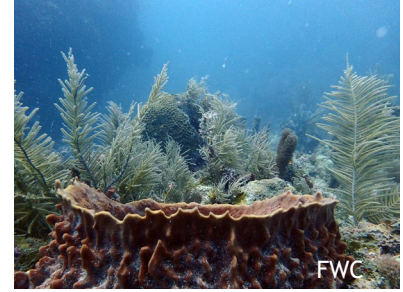


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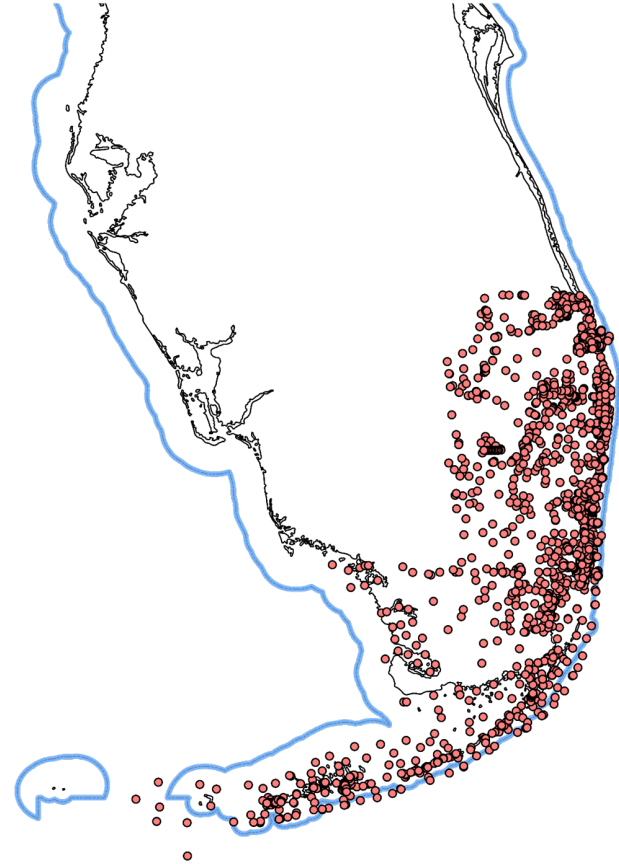
Introduction

- Changes in water quality impact benthic ecosystems:
 - Excess sedimentation and nutrient enrichment pose significant threats
 - Restoration efforts in the Everglades (CERP) ~\$23.2 billion



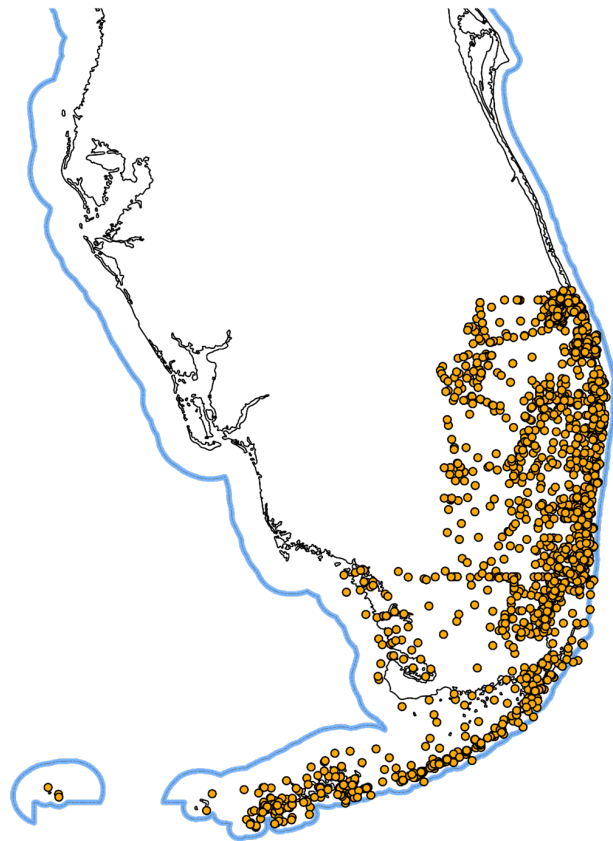
Introduction

- **Extensive Water Quality Data Collected Across Florida**
 - Water-Cat: **33388** active stations for Florida
 - **2000** from Martin County to Monroe (**26** different organizations)



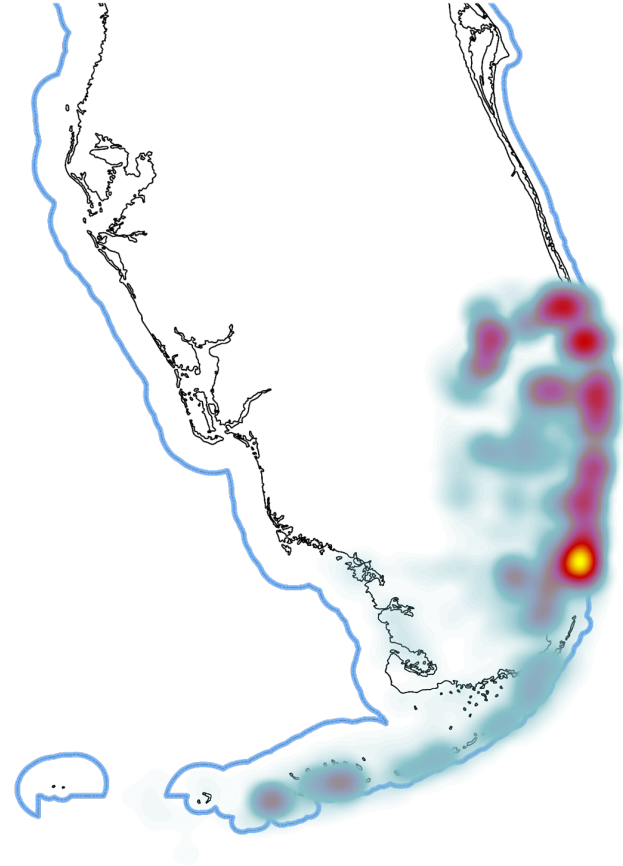
Introduction

- **Extensive Water Quality Data Collected Across Florida**
 - Water-Cat: **33388** active stations for Florida
 - **2000** from Martin County to Monroe (**26** different organizations)
 - WIN: **34309** stations for all Florida
 - **2839** from Martin County to Monroe (**20** different organizations)
 - SEACAR: over **90** programs sample for water quality
- **At first glance, it might seem like a lot, but...**



Introduction

- Not all areas have equal coverage
- Not all programs monitor for the same parameters
- Not all parameters are collected the same, e.g.
 - “Continuous” filter on WaterCat:
 - **33388 > 2588**
 - Uncorrected vs corrected chlorophyll
 - Different standards: NELAC

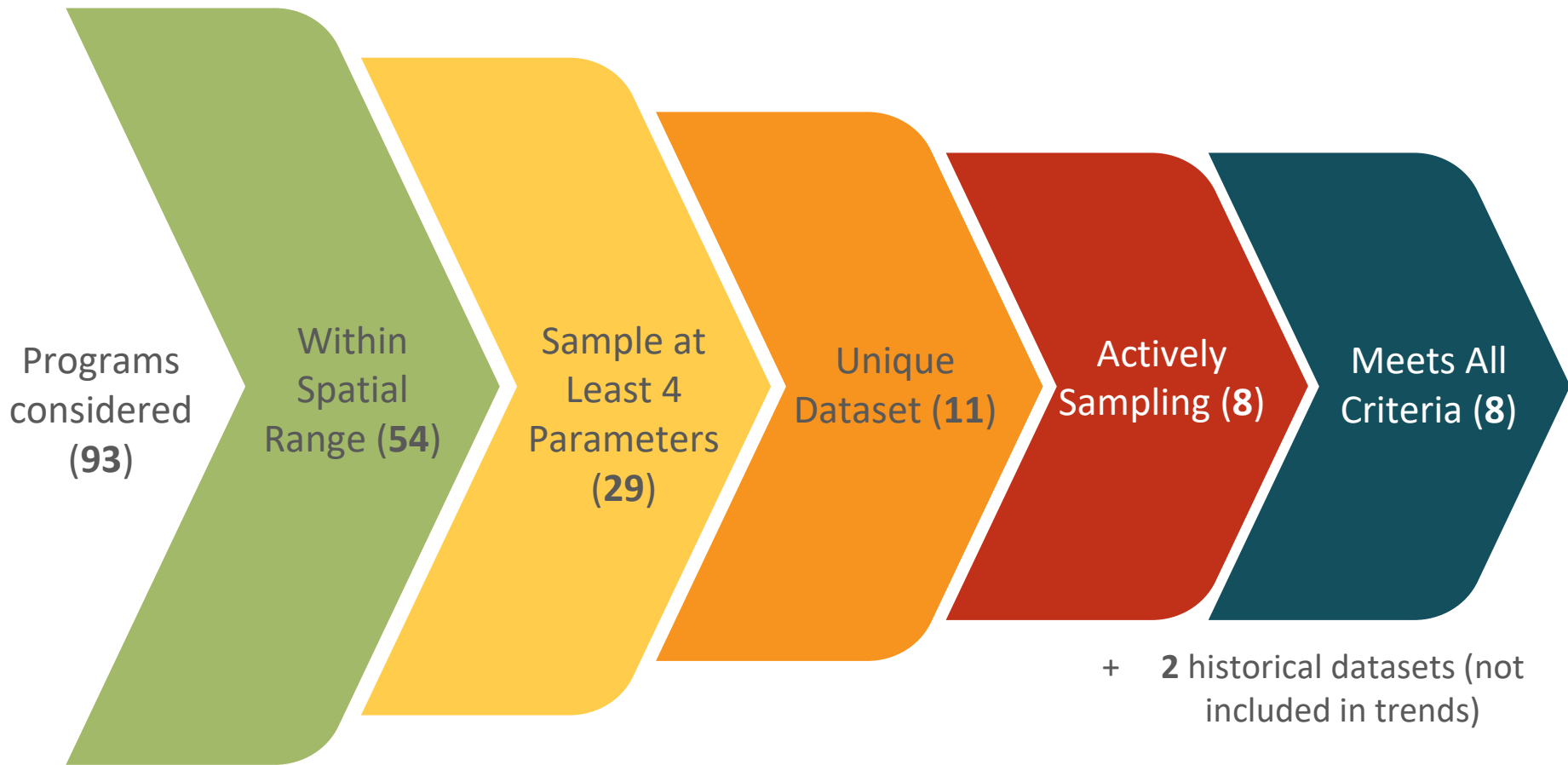


Goals & Objectives: Years 1 - 4

- Create a unified water quality monitoring dataset across Florida's Coral Reef
- Identify long-term trends and monitoring gaps
 - Focus on nutrients and water clarity



Methods - Overview



Methods - Parameters

Nitrogen

- Total Nitrogen
- Nitrite (NO₂)
- Nitrate (NO₃)
- Ammonium
- TKN

Phosphorus

- Total Phosphorus
- Orthophosphates (PO₄)

Water Clarity

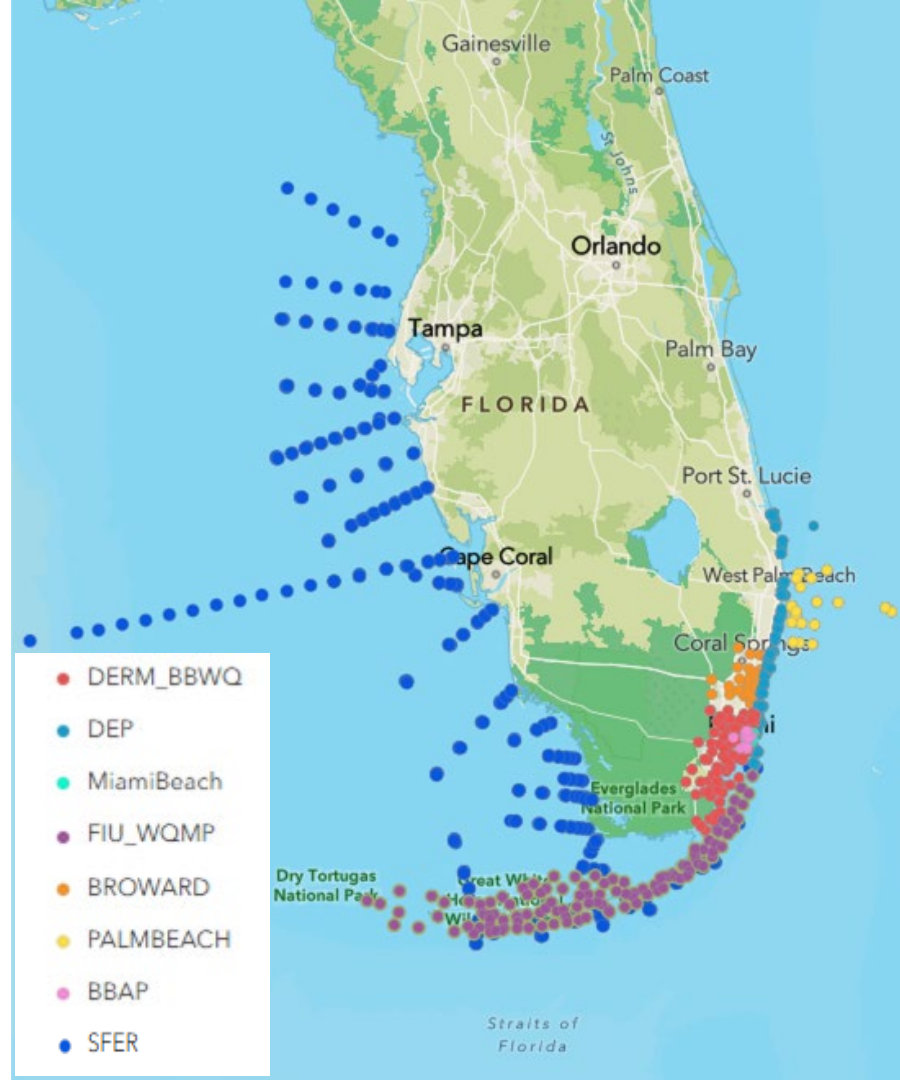
- Chlorophyll-a
- Turbidity
- Silicates



Sample at
Least 4
Parameters
(29)

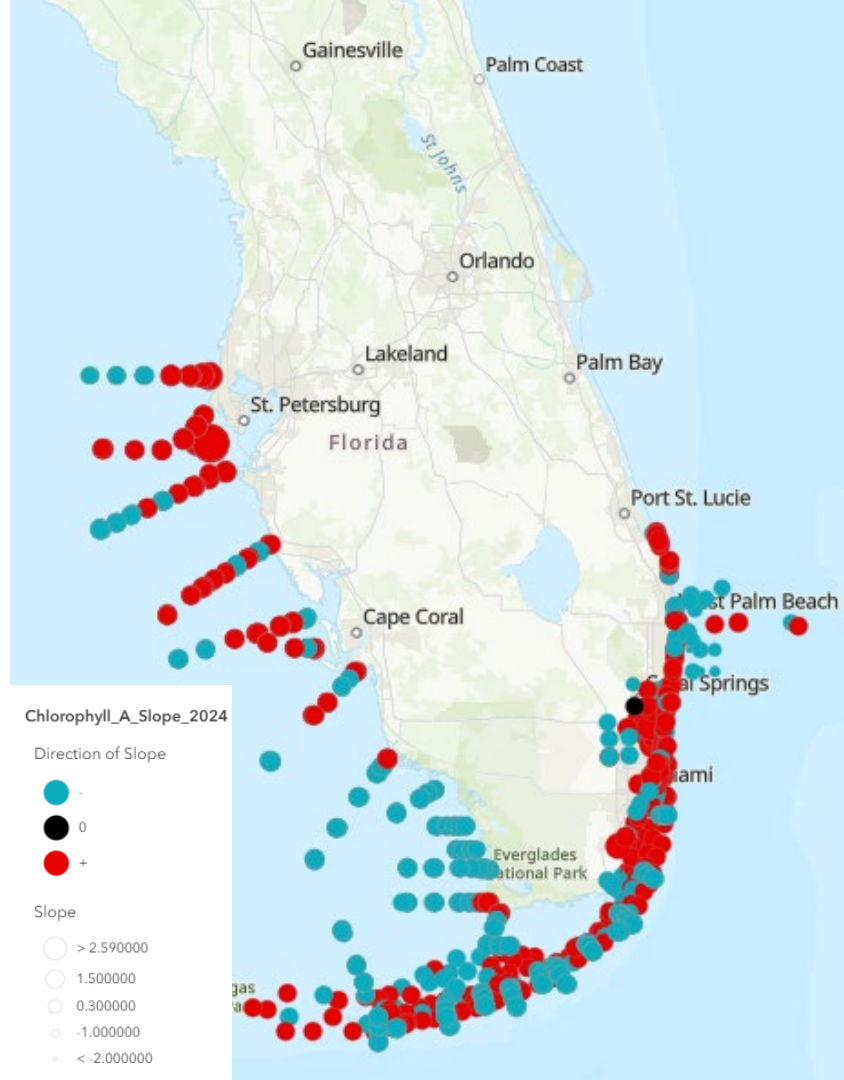
Results - Nutrient Monitoring Data Aggregation

- Sampling **Nitrogen, Phosphorus, Chlorophyll, or Water Clarity**
- **Over 5 years** of consistent data collection
- At least **annual samples** frequency
- **Eight** programs:
 - AOML
 - Biscayne Bay Aquatic Preserve/Water Watch
 - Broward County
 - DEP ECA
 - Miami DERM
 - FIU/SERC
 - City of Miami Beach
 - Palm Beach County



Results - Nutrient Monitoring Data Aggregation

- Are the programs **interoperable**?
- **Trend analysis** can help us compare overall similarity even if programs sample at different times
- **Identify hotspots**
- Ex: Chlorophyll-a **variable** but generally getting **worse** in SE FL



Results - Data Visualization Tool



Sampling program (icon color)

Switch between water clarity/Nitrogen/Phosphorous

Number of observations (icon size)

Filters:

- Actively sampling
- Time period
- Program
- Number of obs.



Time Series of WQ Parameters

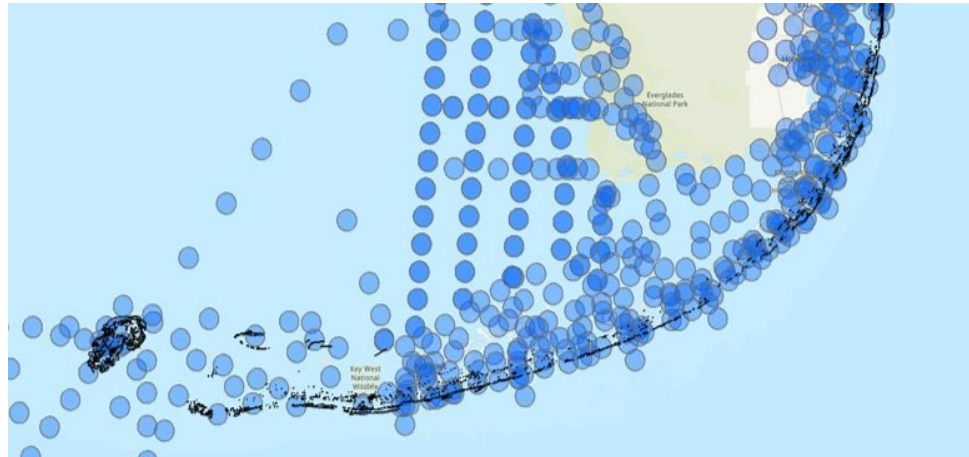
Results - Gap Analysis

- Spatial correlation (semivariograms)
 - Shows how far apart samples still reflect similar trends
 - Buffer distances vary by analyte: **1.7–7+ km**
 - No buffer for nitrogen due to strong inshore-offshore gradients

Total Phosphorus - 1.7 km buffer

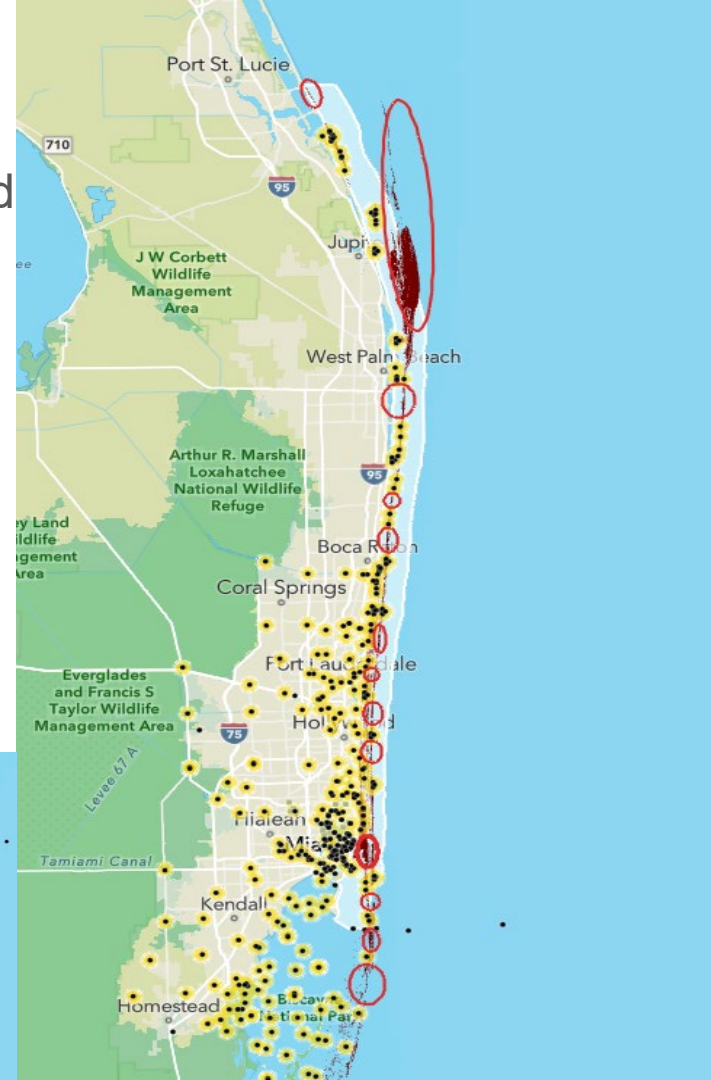
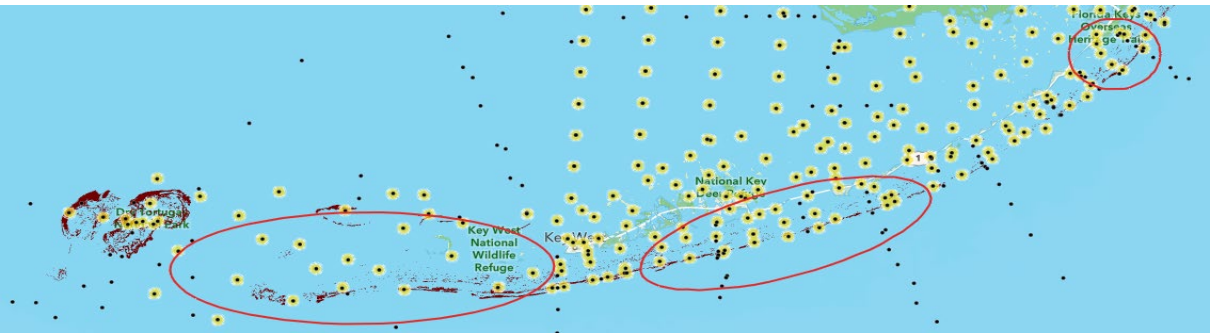


Orthophosphates - 3.5 km buffer



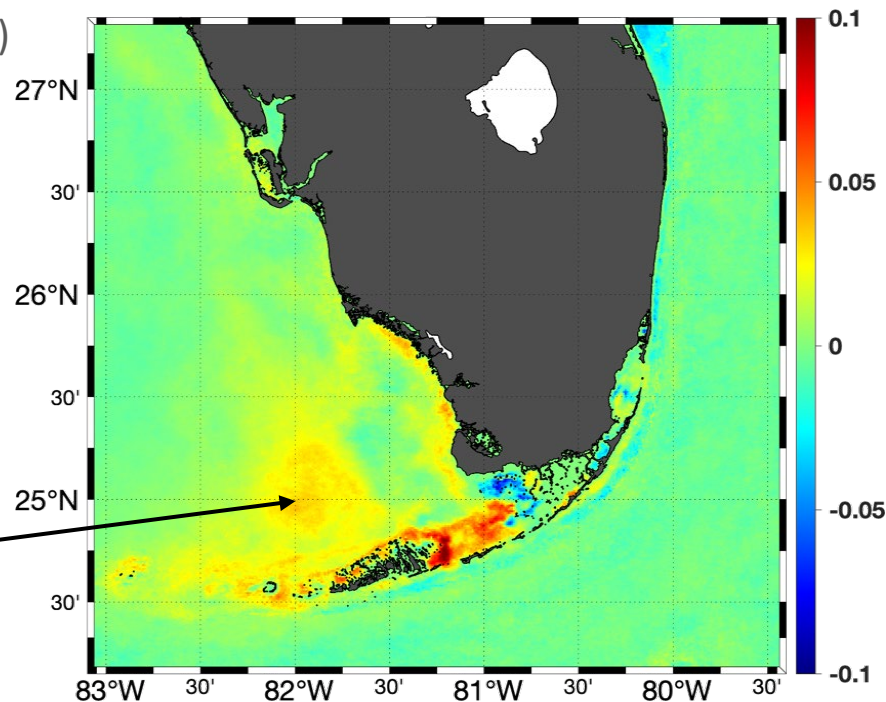
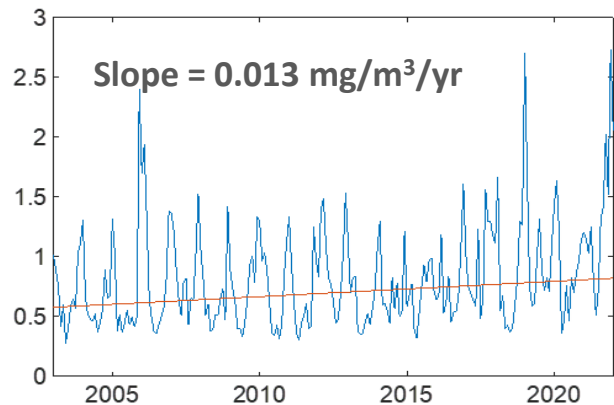
Results - Gap Analysis

- Semivariogram analysis of Total Phosphorus overlaid with the URM reveals several gaps
 - Largest gap in the Kristin Jacobs Coral Ecosystem Conservation Area + small gaps throughout Miami-Dade and Broward counties (*some filled with newer programs*)
 - Sampling gaps in the Florida Keys, Marquesas and Dry Tortugas



Results - Remote Sensing Data

- Satellite imagery to fill in sampling gaps
 - MODIS satellite (1-km pixel, 2003-present)
 - Chlorophyll-a, SST and reflectance (turbidity)
 - Thiel-Sen slope used to compare with in-situ data



Goals & Objectives: Years 4 - 6

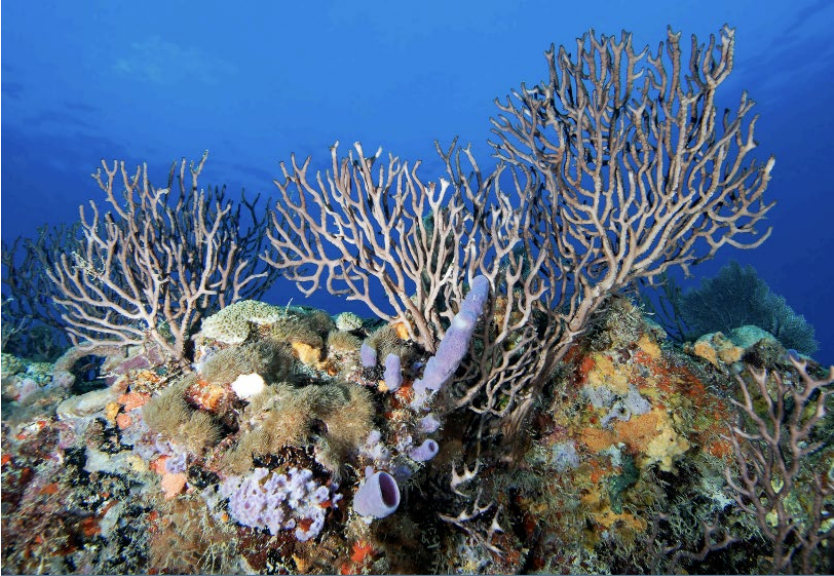
- Contribute to FCRCT integrated framework to answer question: can we detect change from management and restoration efforts?
- Inventory of abiotic water quality and biological and ecological monitoring programs



Unified Monitoring Framework for Florida's Coral Reef

PRIORITY FOCUS: INVENTORY EXISTING MONITORING PROGRAMS

- **ACTION 1:** Inventory existing **water quality** monitoring programs along FCR and nearshore coastal waters of South Florida.

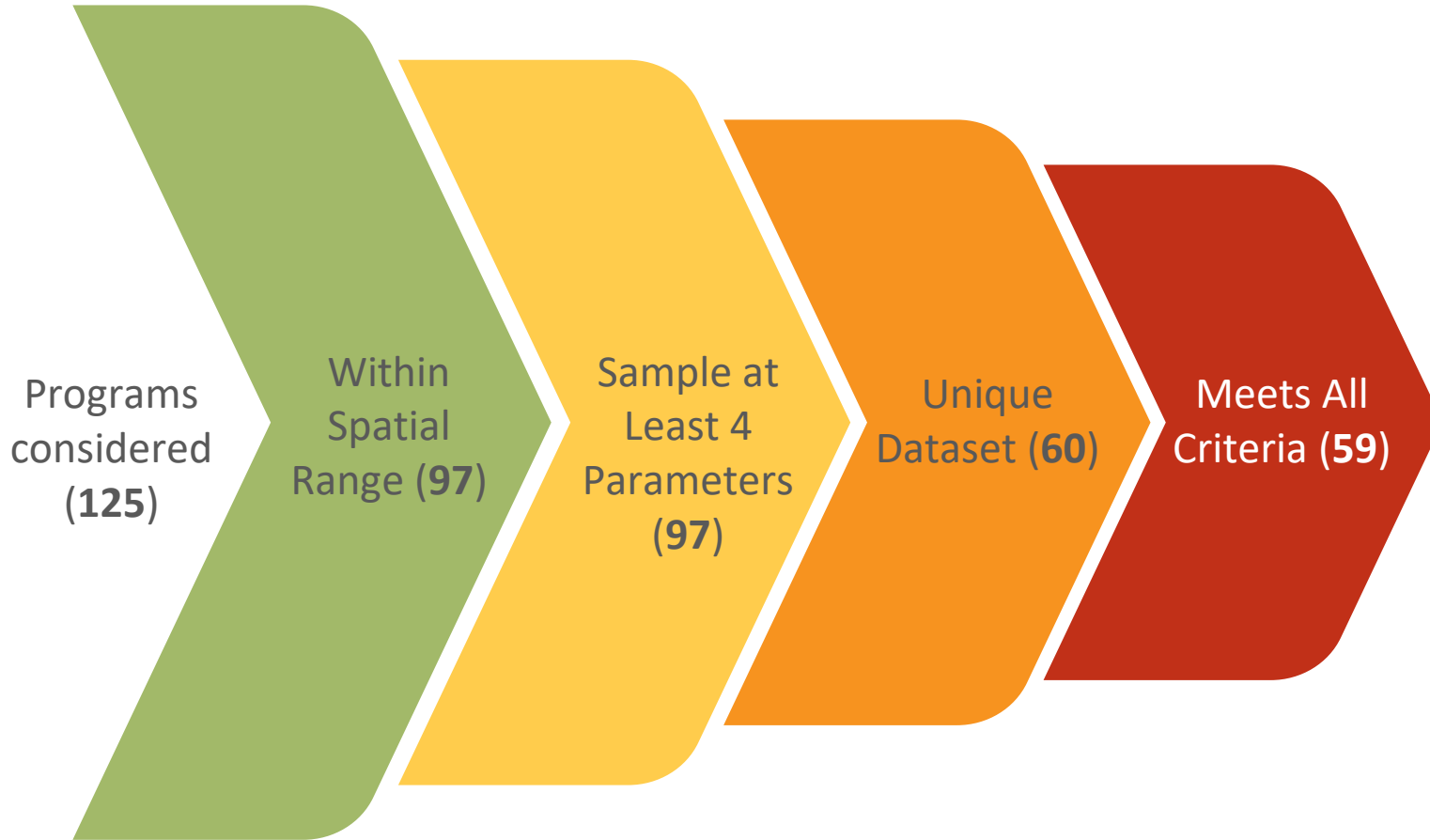


UNIFIED MONITORING FRAMEWORK FOR FLORIDA'S CORAL REEF

ADOPTED: November 9, 2023

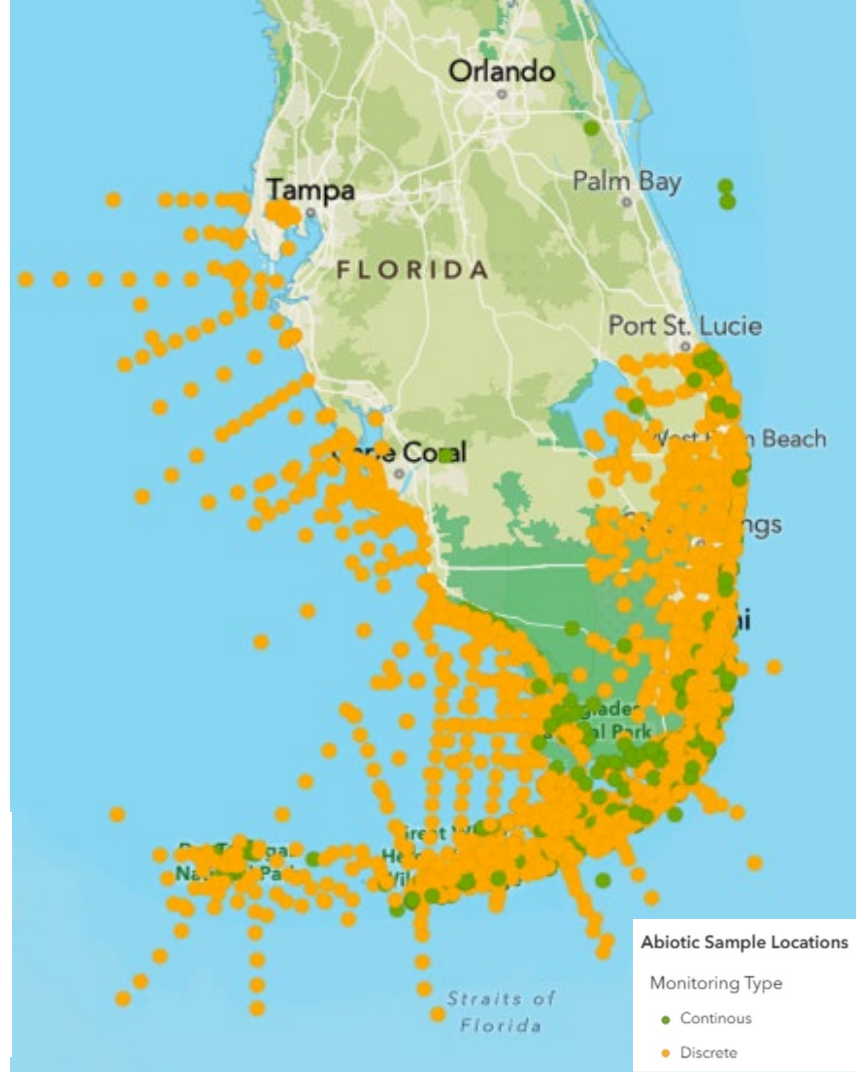


Methods - Overview



Action 1 - *Abiotic* Sampling Program Inventory

- pH, DO, salinity or temperature
- 59 programs
- Where are abiotic factors being sampled and how?
 - Parameters
 - Frequency (continuous/discrete)
 - Depth
 - Sampling program
- Cheaper/faster to sample
 - Fill gaps and track water mover



Unified Monitoring Framework for Florida's Coral Reef

PRIORITY FOCUS: INVENTORY EXISTING MONITORING PROGRAMS

- **ACTION 2:** Inventory existing **biological or ecological** monitoring programs related to FCR and associated within the South Florida ecosystem.



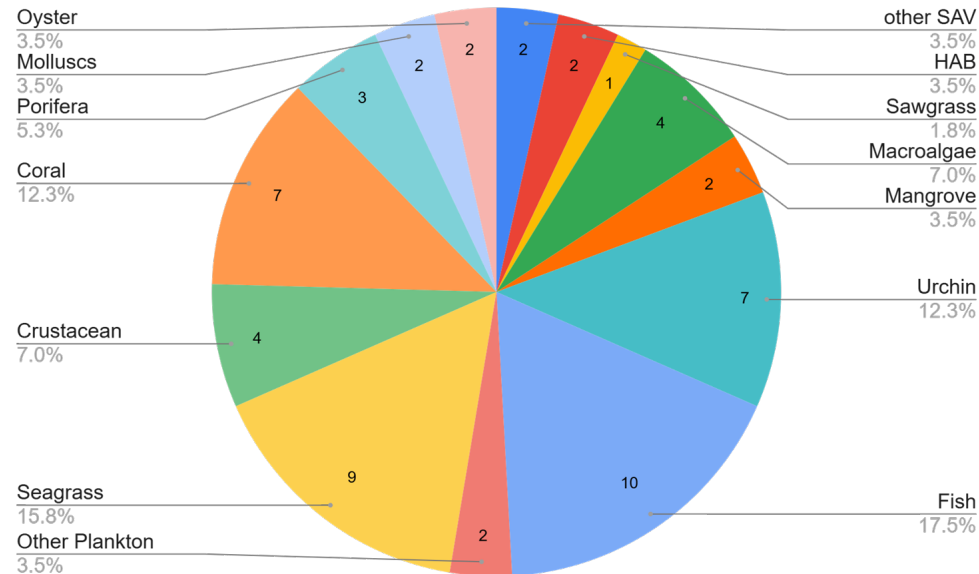
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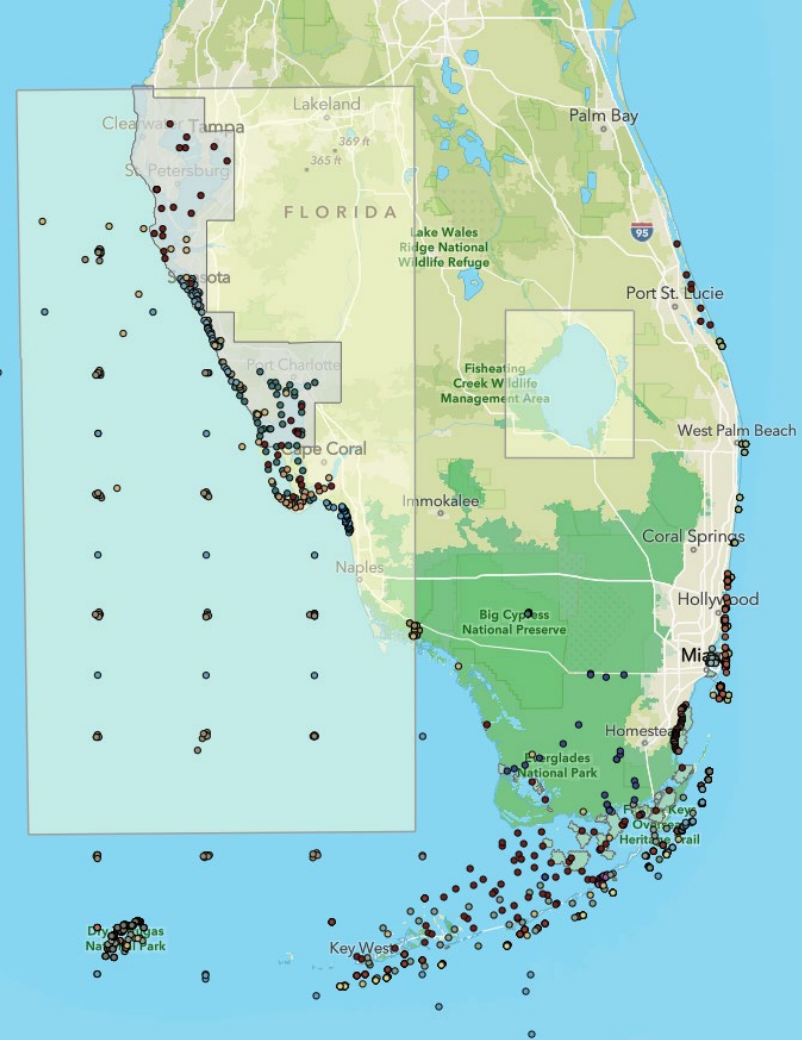
Action 2 - Biological and Ecological Monitoring Program Inventory

- 116 programs > 33 final programs
- Included coral/benthic inverts, fish, red tide, seagrass, mangroves, pelagic plankton



Action 2 - Biological and Ecological Monitoring Program Inventory

- Survey locations could be fixed or random
 - Monitoring locations were either polygons or points



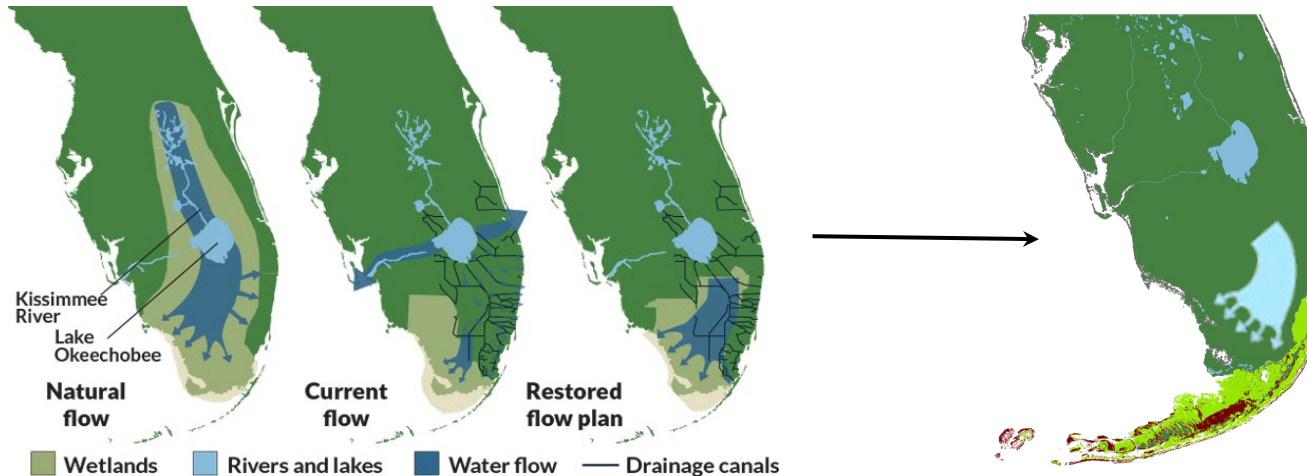
Improving our inventories

- Survey was sent out to relevant partners to gather feedback on our abiotic and biological/ecological inventories
 - To capture information on programs/sampling locations we might've missed
 - To gather feedback on the data discovery products
 - Survey is still open:



Conclusion & Future Steps

- Collecting water quality data is important, but significant effort is required to make it compatible and useful
 - Essential to assess impacts of major restoration projects and better inform management efforts
- Ensuring public accessibility is an additional challenge
 - Integration with SEACAR – automatic quarterly updates and easy access
 - All web maps have been added to ArcGIS HUB:



Integration with SEACAR

https://data.florida-seacar.org/programs/details/10006



Program Info

* Website	https://myfwc.maps.arcgis.com/apps/mapviewer/index.html?webmap=fc1ae00969284d2da070150decf5ec7d
* Region(s)	SE
* Summary	For the past four years, research scientists from the Florida Fish and Wildlife Conservation Commission, the University of South Florida, the Florida Keys National Marine Sanctuary, the NOAA Atlantic Oceanographic and Meteorological Laboratory, and the University of Miami have comprehensively reviewed the wide array of water quality data collected in southern Florida, compiled comparable datasets, visualized trends in water quality data, and constructed a set of criteria for standards between monitoring programs that would allow for increased interoperability. Through year 4, the team has identified 8 programs that meet the criteria for inclusion in the database across the FCR. These eight programs include: NOAA AOML (Atlantic Oceanographic and Meteorological Laboratory) South Florida Ecosystem Restoration Cruise, the Florida International University South Florida Estuaries Water Quality Program, the DERM Water Quality Monitoring Program, the Broward County Water Quality Monitoring Program, the DEP-ECA Coral Ecosystem Conservation Area Water Quality Assessment Program, the City of Miami Beach Water Monitoring, the North Biscayne Bay Seagrass Loss Water Quality Monitoring Program and Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring, and the Palm Beach County Ambient Water Quality Monitoring Program. Additionally, the research team has developed and released to the public many products including trend and gap analyses, maps, and other data visualizations.
* Parameters	Aggregated parameters include TN, Nitrite, Nitrate, Ammonium, TKN; TP, Orthophosphate; Silicates, Turbidity. Not all parameters are available all locations, as some programs do not collect all parameters.

Notes	Year 1 StoryMap: https://storymaps.arcgis.com/stories/52a114b2d89d4e60ac3fd75d713d90f7 Year 2 StoryMap: https://storymaps.arcgis.com/stories/af888136b3264d15bad463be3d8a9b22 Year 4 Webmap: https://myfwc.maps.arcgis.com/apps/mapviewer/index.html?webmap=5db2476fb39e4b22939fa994b5fea2b3 Abiotic Inventory: https://myfwc.maps.arcgis.com/apps/mapviewer/index.html?webmap=484bf5d4c6445a4d904d0045e0843703 Biological and Ecological Monitoring
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Contacts

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Program Extent



Map of Sample Locations

Export Standardized Data

Habitat(s) : Indicator(s)	Last Updated	File Download
Water Column : Nutrients, Water Quality, Water Clarity	02/26/26 03:41 PM	(91.77 MB)
Geodatabase File	N/A	(51.52 KB)
DIP Document	N/A	(315.62 KB)

Water Quality ArcGIS Online Hub

<https://water-quality-myfwc.hub.arcgis.com/>



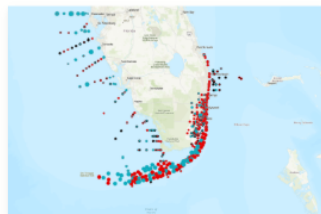
Florida's Coral Reef Unified Water Quality Monitoring Data Compilation



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Current Data

Water quality data was aggregated from 8 providers: NOAA Atlantic Oceanographic and Meteorological Laboratory, Florida International University Southeast Environmental Research Center, Miami-Dade County Department of Environmental Resource Management, Florida Department of Environmental Protection (DEP), Broward County, City of Miami Beach, DEP Biscayne Bay Aquatic Preserves, and Palm Beach County.



Slope Map Water Quality 2024

2024 data that summarizes the Theil-Sen slope (calculated as...

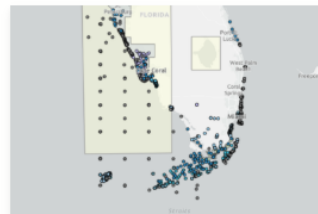
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2024 Unified Water Quality Monitoring Data

2024 and 2025 aggregated water quality data for water...

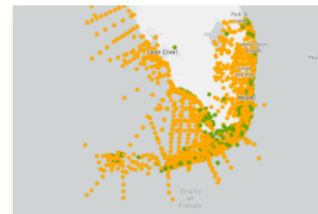
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Biological Ecological Monitoring Inventory

Inventory of biological and ecological coastal monitoring...

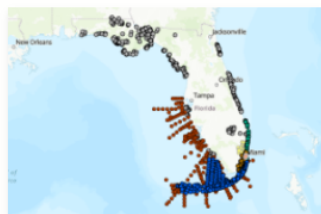
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Abiotic Inventory Web Map

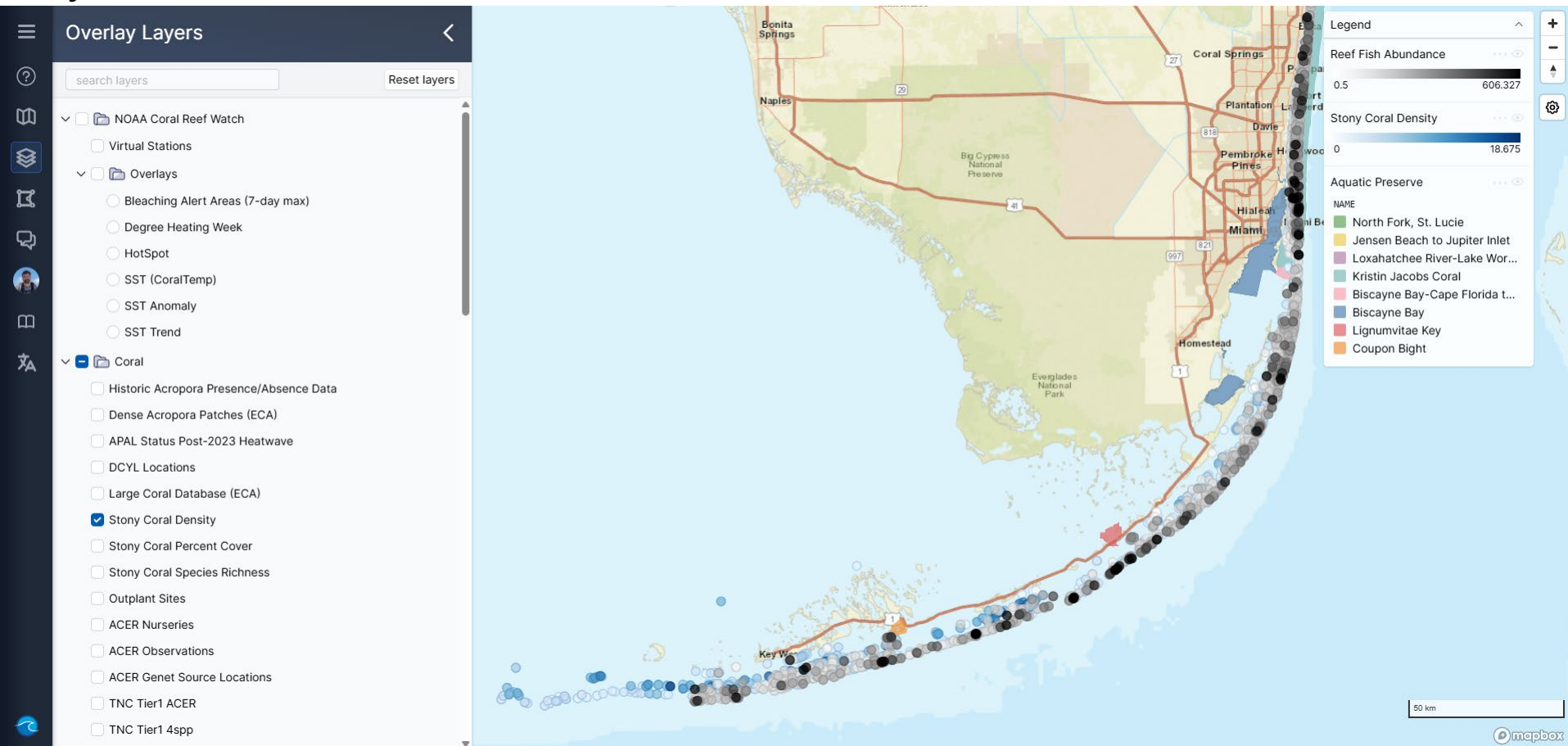
Abiotic inventory of water quality monitoring programs in SE...

[Explore](#)



Current Water Monitoring Stations

Future Goals: Integration of WQ Data into Coral Reef Decision Support System



Future Goals: CECs

● Contaminants of Emerging Concern (CECs) map

- Pharmaceuticals
- 'Forever' chemicals
- Personal care products
- Microplastics

● Update 2021 project

- FWRI inventory of 'Endocrine disrupting compounds'
- Projects up to 2017
- Results available via StoryMap:

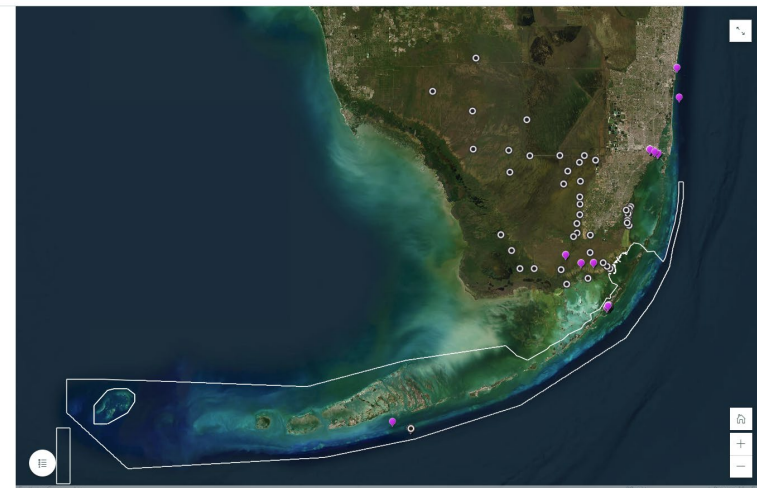


Distribution of Selected Chemicals

Hormones

- Progesterone
- Estrone
- Equilin
- Androsterone
- 17β-Estradiol

- Not-detected
- Detected



Filter Results by Data Provider

Select a category

- ☒ All Data Providers
- 2015 Florida Keys NMS
- Aqua Thesis (2005)
- Downs et al. (2006)
- Gardinali and Zhao (2002)
- Harman-Fetcho et al. (2005)
- Maxey Dissertation (2006)
- NCCOS NS&T: Benthic Surveillance
- NCCOS NS&T: Biscayne Bay
- NCCOS NS&T: Deepwater Horizon
- NCCOS NS&T: Mussel Watch

*Please allow a moment for map to filter.



of Sites Sampled
951

of Chemicals Sampled
621

1 of 20

Details

Data Source	All Data Providers
Project	
EDC Tested Y/N	Y
Chemicals Sampled	
Sample Type	
Project Citation	
Project POR	
Result Type	

Thank you! Questions?

Email: David.Kochan@MyFWC.com

