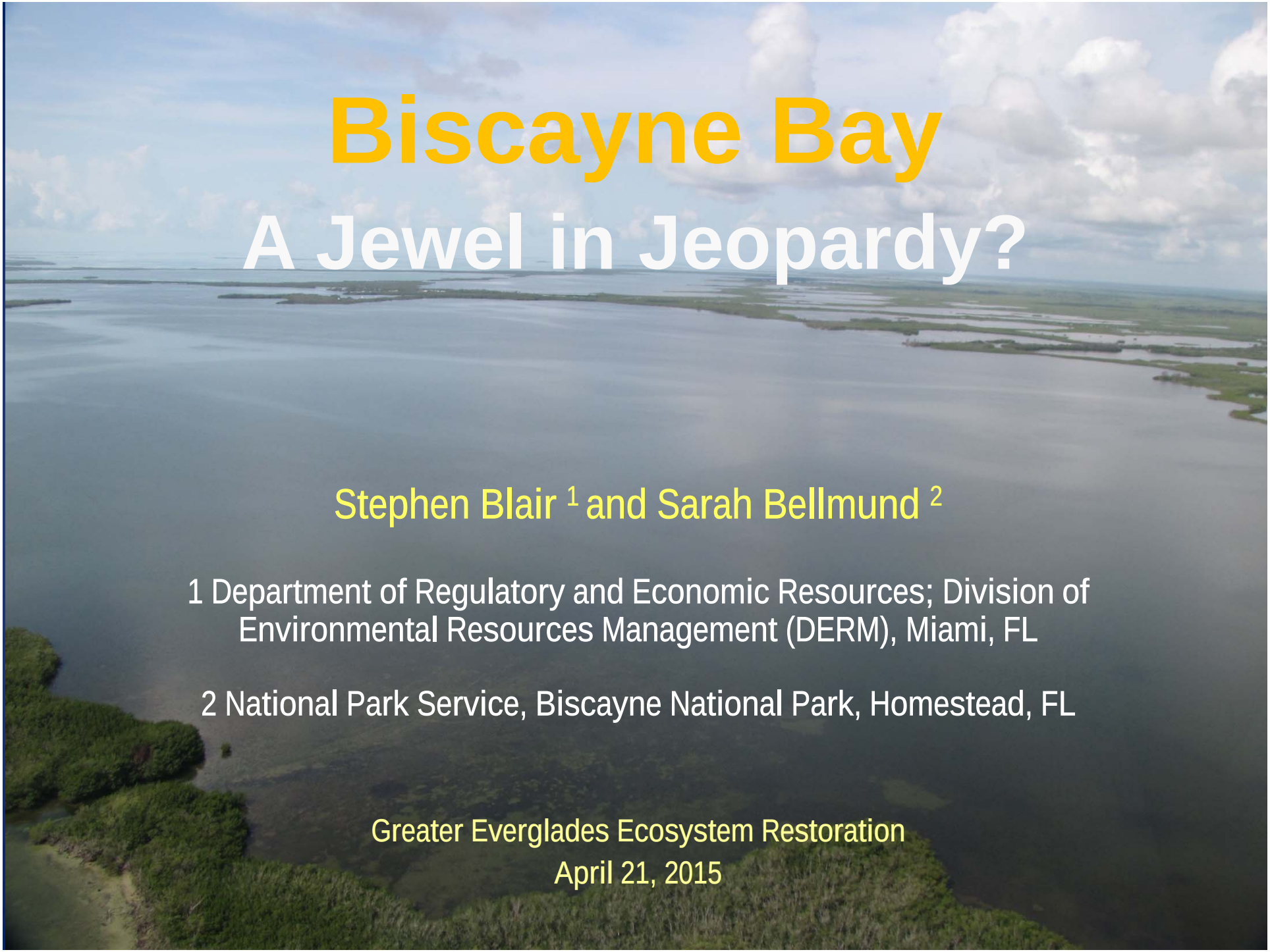

Biscayne Bay
A Jewel in Jeopardy?

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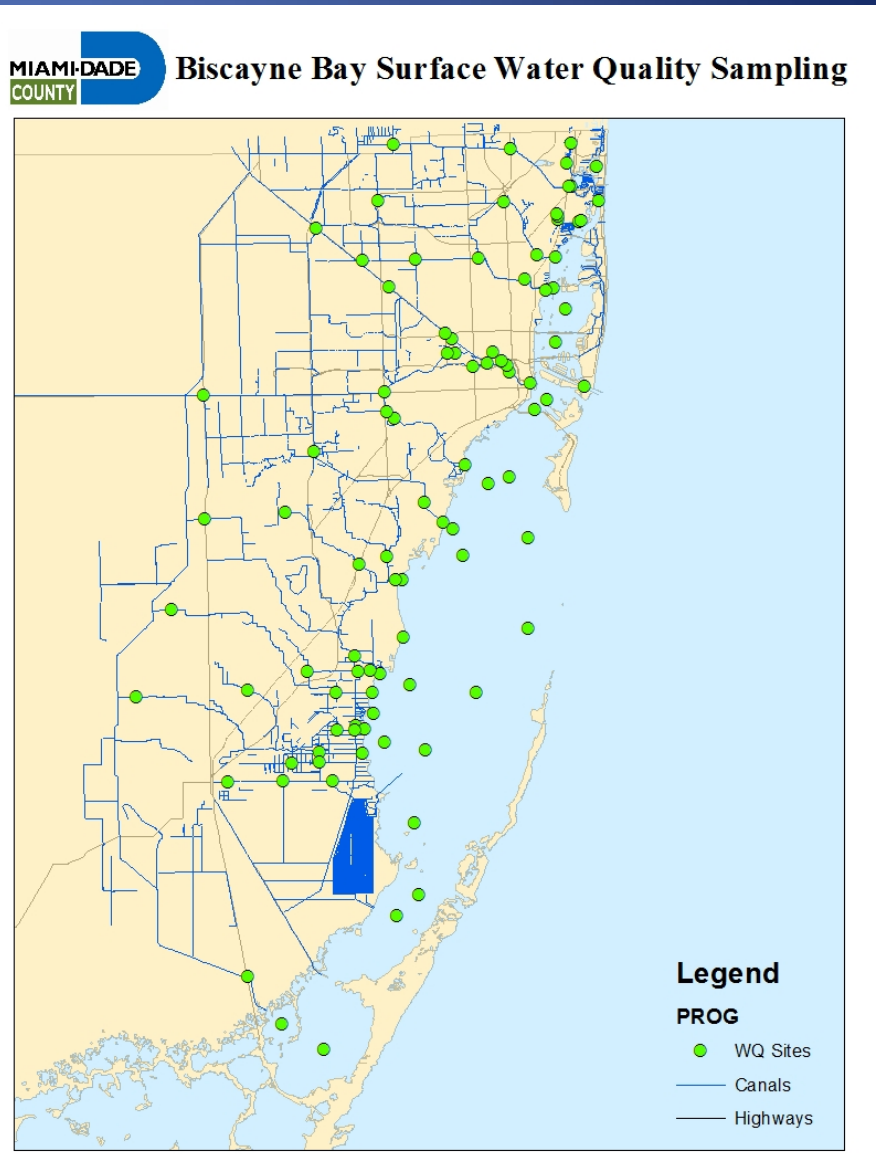
2 National Park Service, Biscayne National Park, Homestead, FL

Greater Everglades Ecosystem Restoration
April 21, 2015

Miami-Dade County
Surface Water Quality Program

- **1979 – Initiated sampling (19 Bay Stations)**
- **Presently 95 stations** (47 'Bay'; 48 canal and tributaries)
- **47 Parameters assessed to annually (parameter depend.)**
  - Parameters including: PAR (Bay only),Temp, pH, DO, Salinity, TSS, BOD, Chl-a , Fecal Coliform Ammonia, NOx, TP, OPO4, TKN
- **Database of >3 million WQ records**
- **Only continuing Bay-wide ambient monitoring program**
- **21 (~30%) of 'Bay' monitoring stations discontinued in Oct. 2014 due to funding decrease**

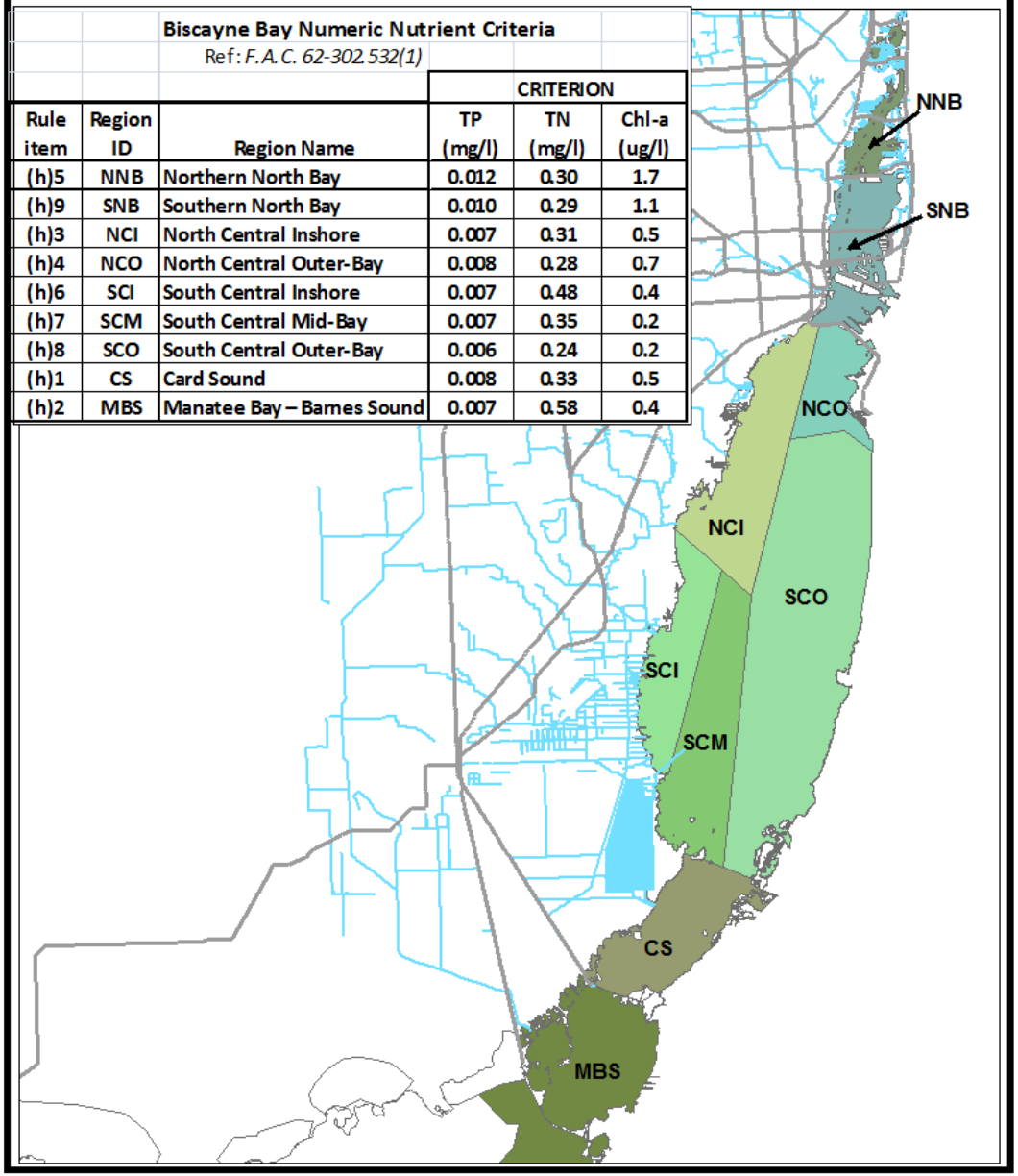


Numeric Nutrient Criterion Regions For Biscayne Bay (Dec., 2012)

Biscayne Bay Numeric Nutrient Criteria

Ref: *F.A.C. 62-302.532(1)*

Rule item	Region ID	Region Name	CRITERION TP (mg/l)	TN (mg/l)	Chl-a (ug/l)
(h)5	NNB	Northern North Bay	0.012	0.30	1.7
(h)9	SNB	Southern North Bay	0.010	0.29	1.1
(h)3	NCI	North Central Inshore	0.007	0.31	0.5
(h)4	NCO	North Central Outer-Bay	0.008	0.28	0.7
(h)6	SCI	South Central Inshore	0.007	0.48	0.4
(h)7	SCM	South Central Mid-Bay	0.007	0.35	0.2
(h)8	SCO	South Central Outer-Bay	0.006	0.24	0.2
(h)1	CS	Card Sound	0.008	0.33	0.5
(h)2	MBS	Manatee Bay – Barnes Sound	0.007	0.58	0.4



Numeric Nutrient Criteria (NNC) for Coastal Waters

- State established NNC for
  - Total Nitrogen (TN)
  - Total Phosphorus (TP),
  - Chlorophyll-a (Chl-a)
- Nine compliance regions within Biscayne Bay and adjacent waters, each with defined criteria
  - Regions defined by Briceno et al. (2010)
  - Various state and local agencies, universities, pub/priv. participants.
- Biscayne Bay has one of the lowest collective criteria of any estuary in the state (TN, TP, Chl-a)

Nutrient Concentrations in Biscayne Bay

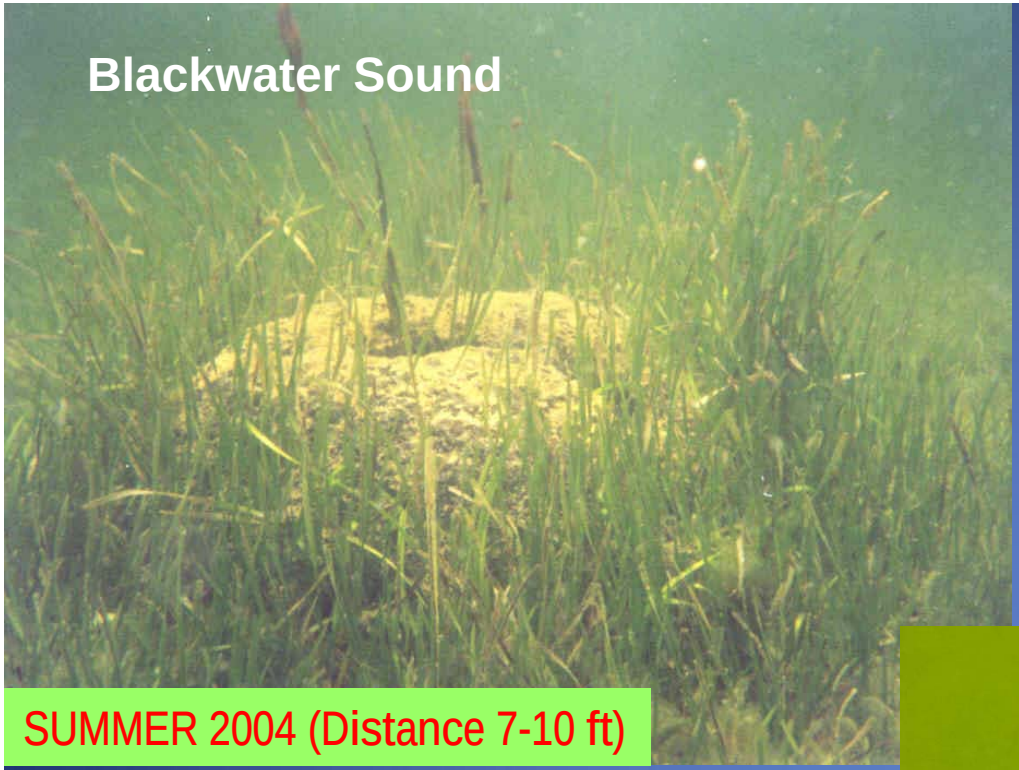
- TN and TP conditions relatively consistent over time (2009-2014) and space (nutrient regions)
- Bay System has consistent and overall low nutrient concentrations.
  - TP AGMs* = 0.002 – 0.006 mg/l across nutrient regions
  - TN AGMs* = 0.05 -0.33 mg/l across nutrient regions.
  - TP AGMs compliant with criteria across all Bay regions; normally <50% of criterion
  - TN AGMs compliant with criteria across all Bay regions; normally <50% of criteria.

All Is Not Be Well in Paradise!

Three Unprecedented events have occurred over the past 8 years that indicate Bay system's fragile balance may be compromised

These events call to question the stability of the Bay system into the future.

Two of the 3 events have caused significant ecological impacts, and are expected to take decades to recover.



SUMMER 2004 (Distance 7-10 ft)

- Natural and anthropogenic factors played into the initiation and its duration
  - Katrina-Rita-Wilma storms
  - US1 widening construction practices – mangrove grinding/mixing
- Recovery of benthic community impacts has been slow; seagrass populations remain well below pre-bloom conditions

1. Unprecedented Cyanobact. Bloom in the Southern BB System (2005-2008)

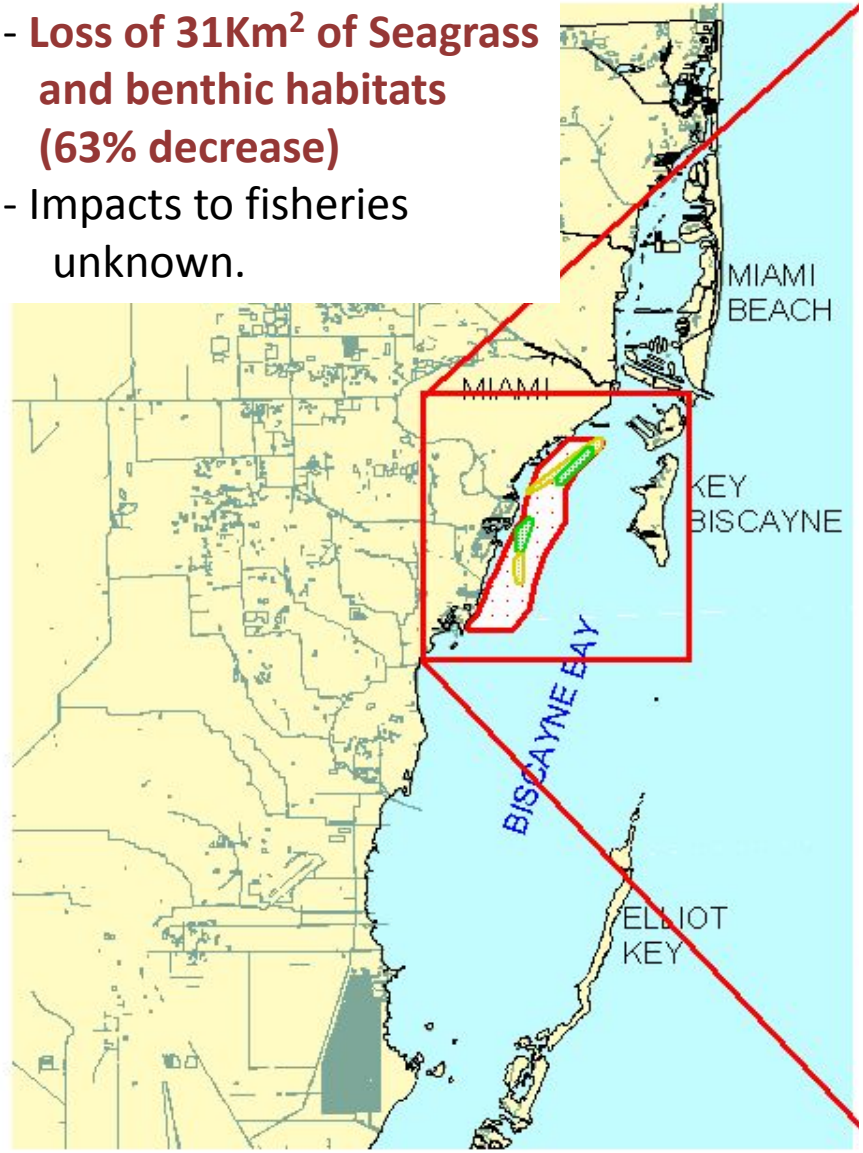
- Loss of corals, sponges & significant impact on seagrass
  - Up to 73% decrease in shoot densities in some basins.
- Impacts to loberster, finfish & shrimp fisheries

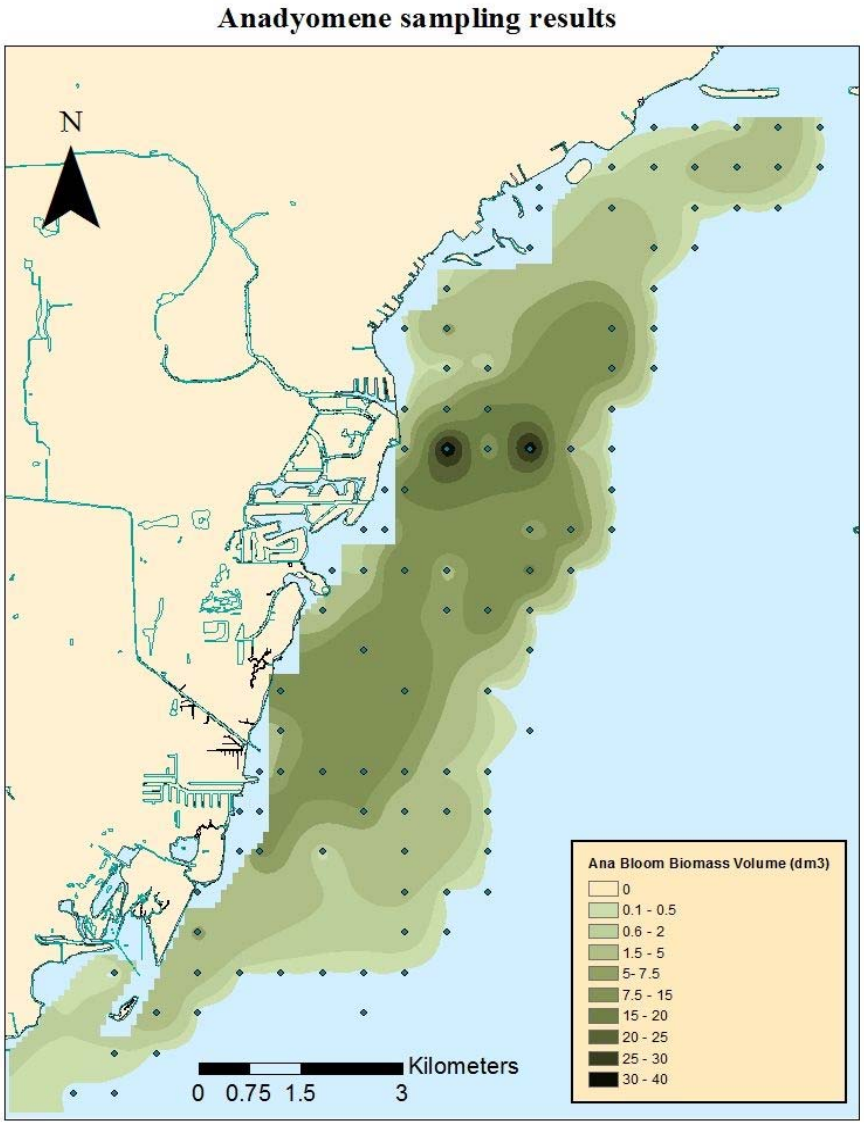
SUMMER 2006 (Distance ~ 1 ft)

2. Coverage of Macro-algal Bloom in West-Central Biscayne Bay

Pre-1999 0 Acres; 1999-2003 - 725 acre; 2003-2008 - 1,025 acres; 2009-2010 - 7, 750 acres

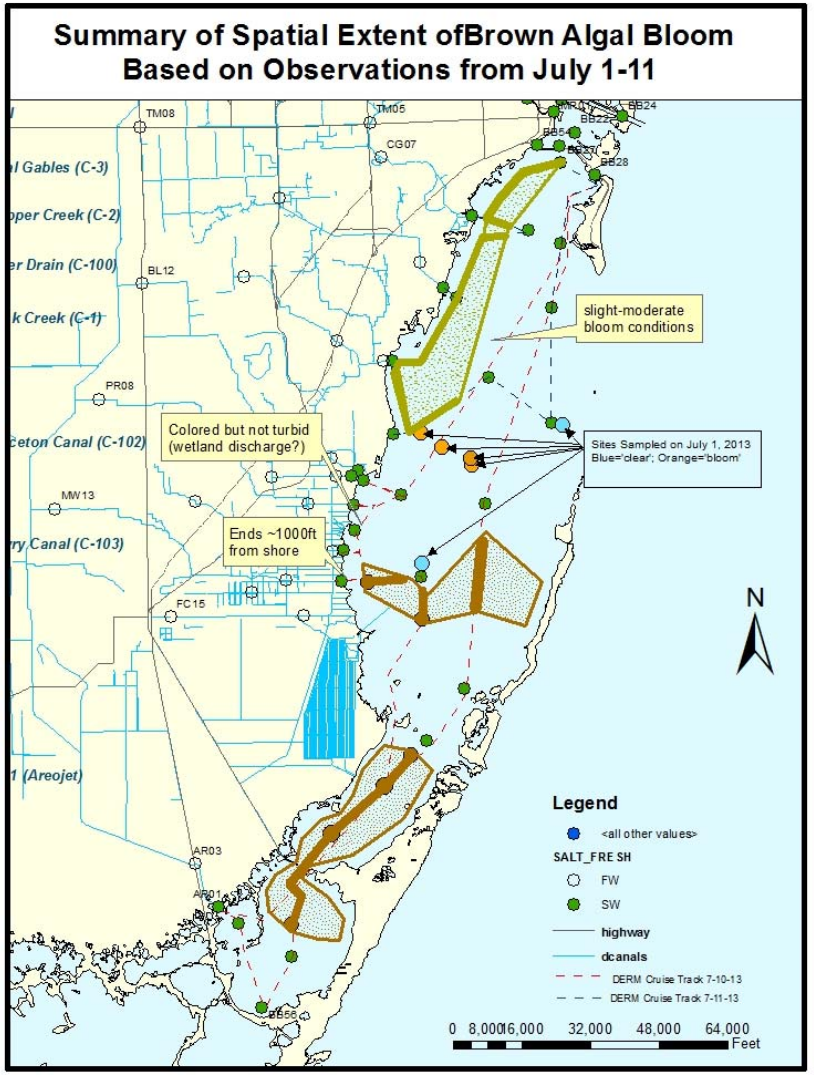
- **Loss of 31Km^2 of Seagrass and benthic habitats (63% decrease)**
- Impacts to fisheries unknown.



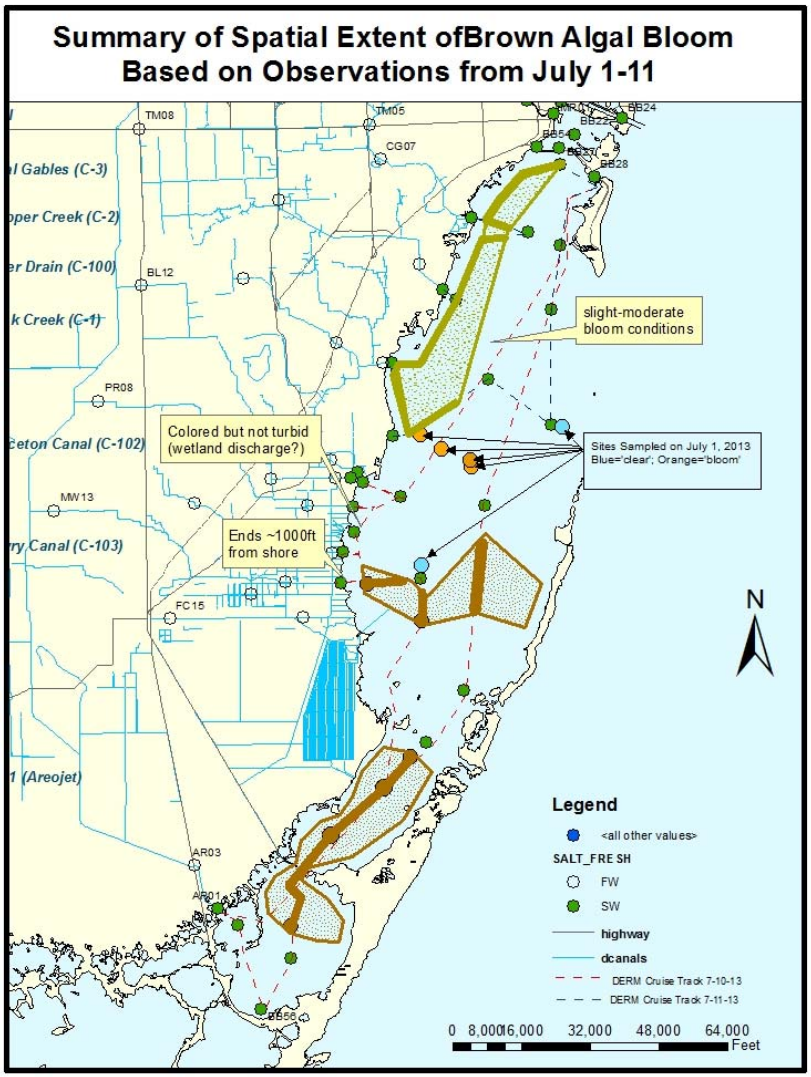


3. Diatom Bloom in Central Biscayne Bay 2013

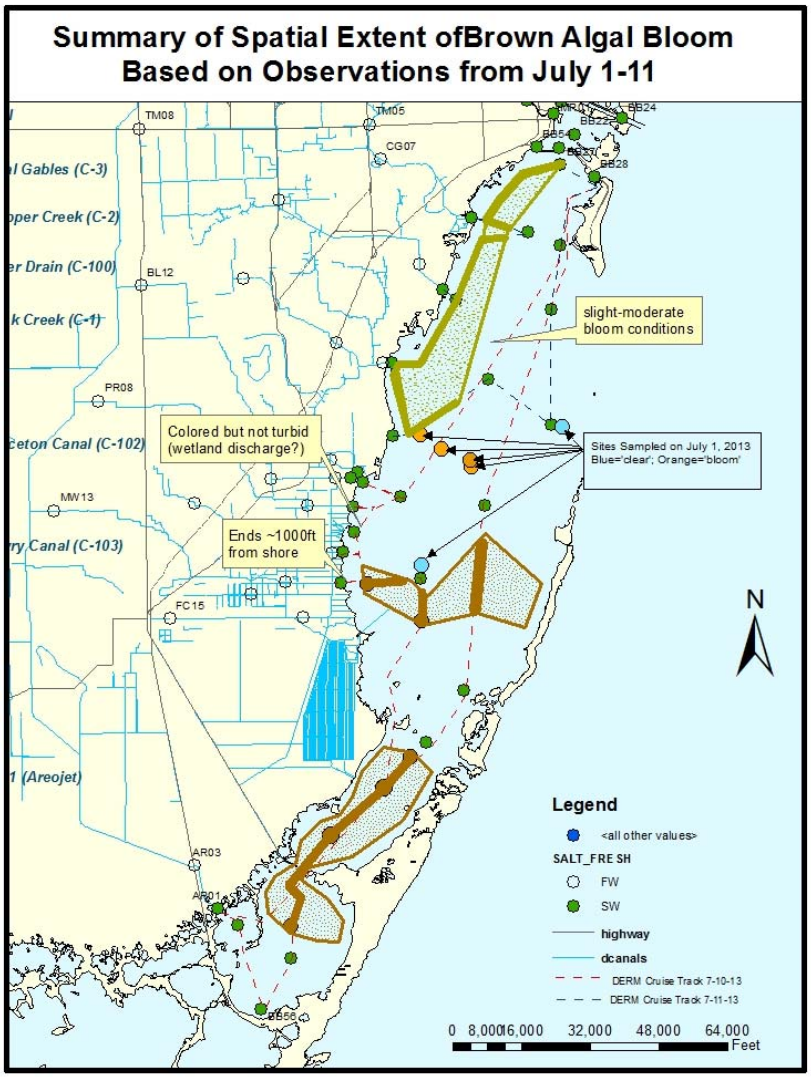
- Bloom in 'open water' regions of the Bay .
- Heavy regional rainfall during the month preceding the bloom
  - 3rd largest cumulative discharge on record for Miami-Dade coastal structures.
  - Nutrient conc. in canals were normal, but volume released resulted in very heavy 'load'
- Bloom duration: 2-3 months
- First occurrence of bloom in 'open waters' of the Bay since monitoring began
- No significant ecological impacts

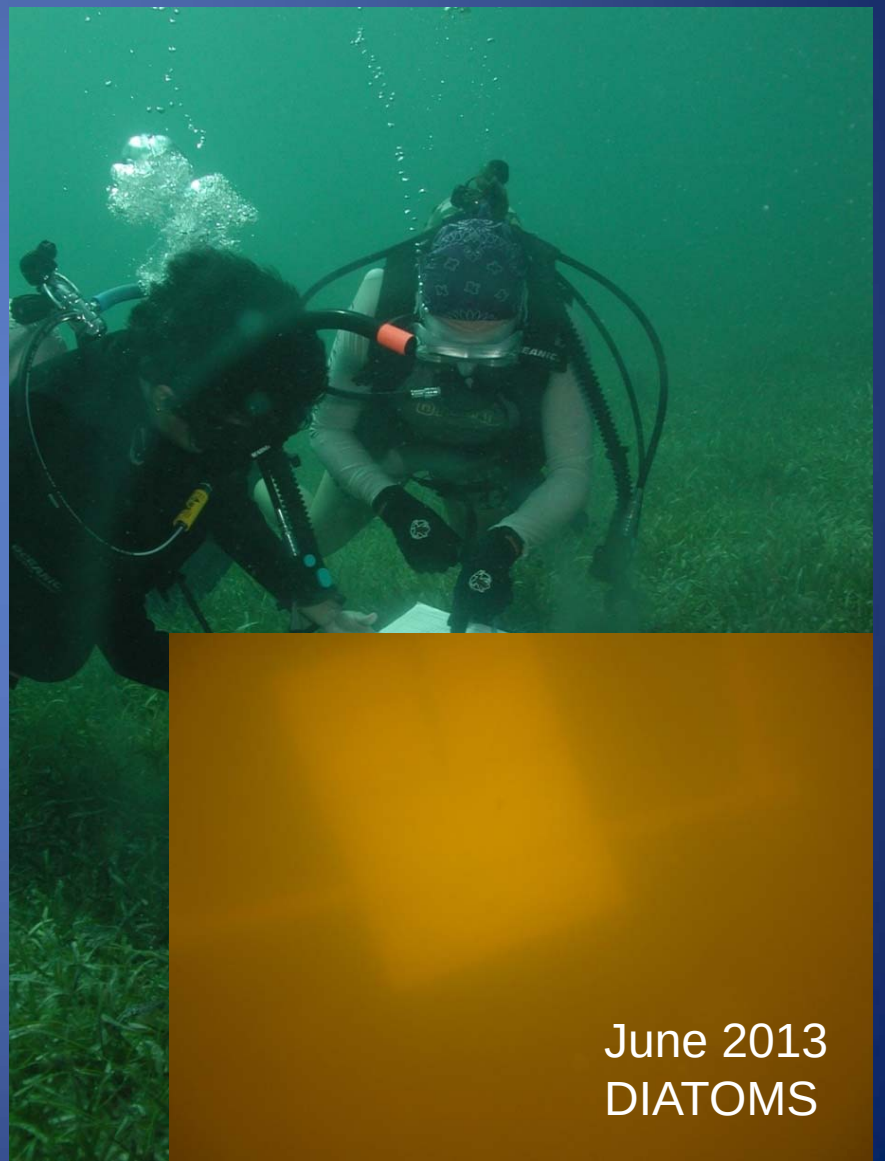


Diatom Bloom in Central Biscayne Bay 2013



Diatom Bloom in Central Biscayne Bay 2013





June 2013
DIATOMS

Diminishing Resilience?

- **Bay has history of prior ‘Phosphorus’ ‘spikes’ without persistent elevated Chl-a, until 2005**
- **The first macroalgal bloom documented in the bay persists for more than 5 years, and caused a 63% loss of seagrass within the affected area**
- **It appears that the system has not been able to handle recent nutrient loads without disruption of the stability of the system**
- **Changes occurring at very low levels of nutrient concentration (need more sensitive methods?)**
- **Long-term data set (monitoring) *is paramount* in discerning and understanding change**

WHAT'S AT STAKE?

BISCAYNE BAY

- Biscayne National Park
- FL Aquatic Preserves
- Outstanding Florida Waters
- National Marine Sanctuary

- Wildlife and listed species habitat
- Fisheries nursery; Fishing industry
- Exceptional recreational and economic resources

What's at Stake?

In 2004, Biscayne Bay related uses generated an estimated ***$6.3 billion*** in income within the County, and ***$627 million*** in tax revenues (SFWMD/Hazen Sawyer 2005).

The most significant 'Activities' were:

	Income	Tax Revenue	County Jobs
Recreation	$2,100 million	$257 million	57,100
POM shipping	$3,900 million	$331 million	74,000
Miami River ship	$ 339 million	$ 37 million	6,100
Commercial Fishing	$ 17 million	$ 2 million	470
TOTALS	**$6.325 Billion**	**$627 million**	**137,500**
(in 2015 dollars)	$8,037 Billion	$793 million	

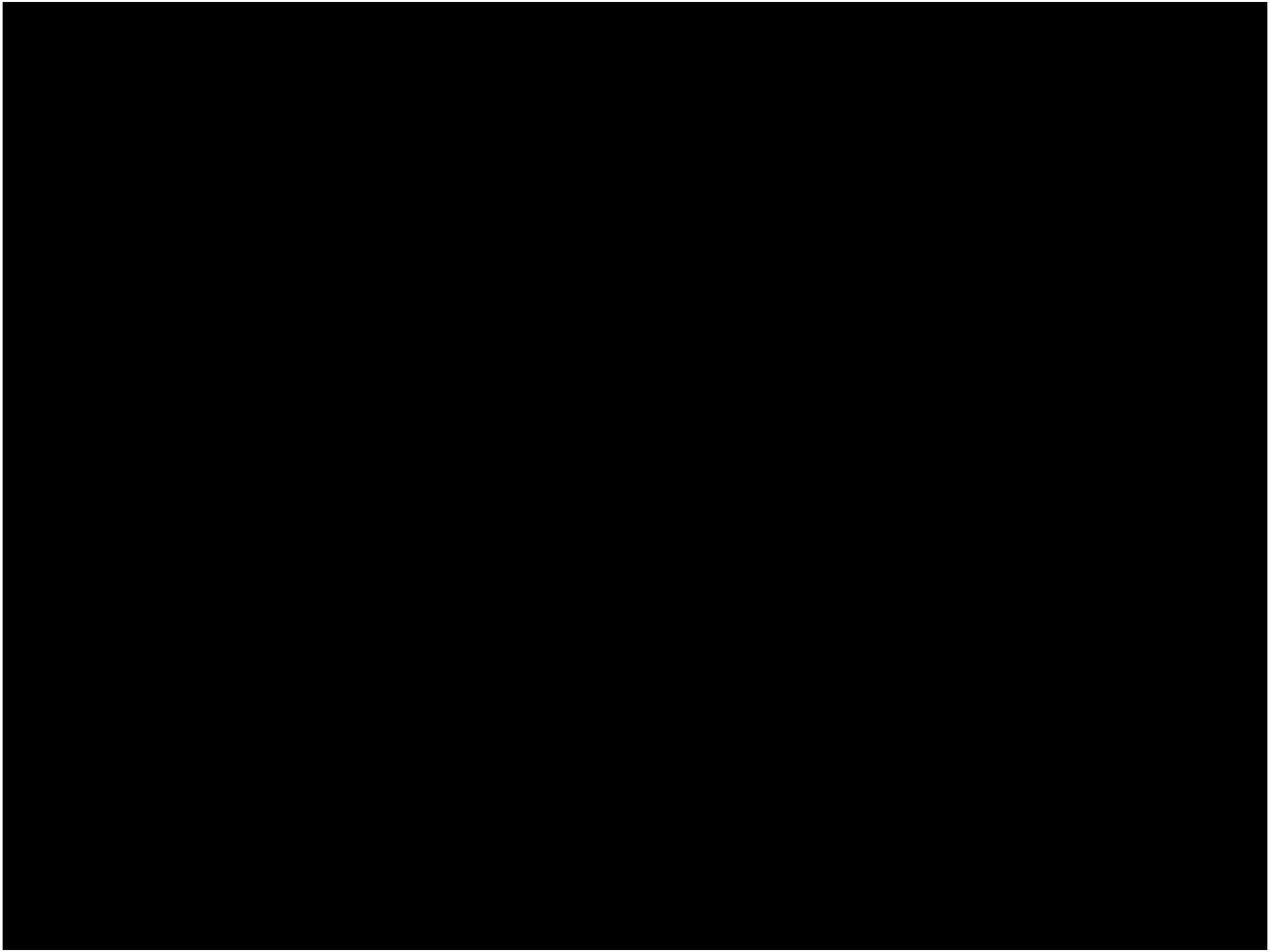
Summary

- **The recent unprecedented bloom events may indicate the Bay, or regions of the bay are reaching a 'tipping' or destabilizing point**
- **These imbalances have occurred despite the fact that nutrient conditions are well within established criteria**
- **Blooms and impacts occurred without demonstrative changes in water quality**
  - **Do we have the *criteria right*?**
  - **Do we have the *right criteria*?**

Summary (con't)

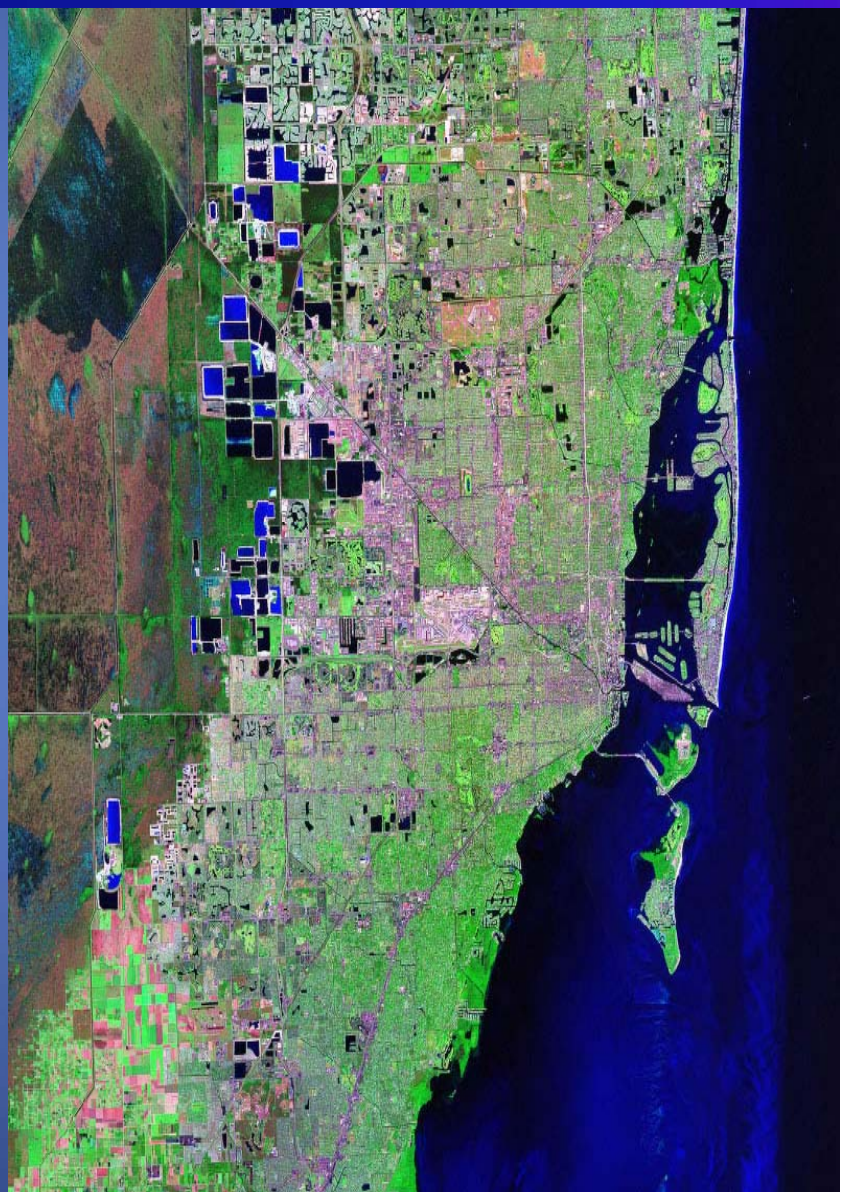
- **Need to continue:**
  - **Efforts to upgrade infrastructure and minimize urban run-off & land based sources of pollution**
  - **Habitat restoration activities, focusing on habitats that augment resilience of the system (seagrass , wetlands)**
- **The ecological stability, and sustainability, as well as economic values of the Bay are at risk.**
- **NOAA's Habitat Focus Area program providing renewed attention and supporting research understanding processes and developing tools to help us understand issues affecting Bay**


Thank you!
For More information:
Blairs@miamidade.gov
Miami-Dade Water Quality Monitoring Funding Partners (pre-2015)
South Florida Water Management District, Miami-Dade County,
31 municipalities of Miami-Dade County, FDEP, NOAA,
(Miami-Dade WQMP)
Florida Inland Navigation District (FIND);
National Oceanic and Atmospheric Administration (NOAA)



Biscayne Bay Watershed

- Bay is between 0.25 – 8 miles wide and ~35 miles long
- Highly urbanized Watershed
  - 938 square miles (includes regions of southern Broward Co.)
  - M-D population ~2.5 million people
- Mixed & Mosaic Land use
  - Residential (low-dense), commercial, industrial, institutional, agricultural.
- Highly Managed & Regulated Water Control (flood control, water supply, Ag)
  - 16 major gates/structures controlling flow and discharge of freshwaters to the bay



Presentation Overview

Introduction to the Biscayne Bay Watershed

Water Quality in Biscayne Bay

Recent unprecedented events

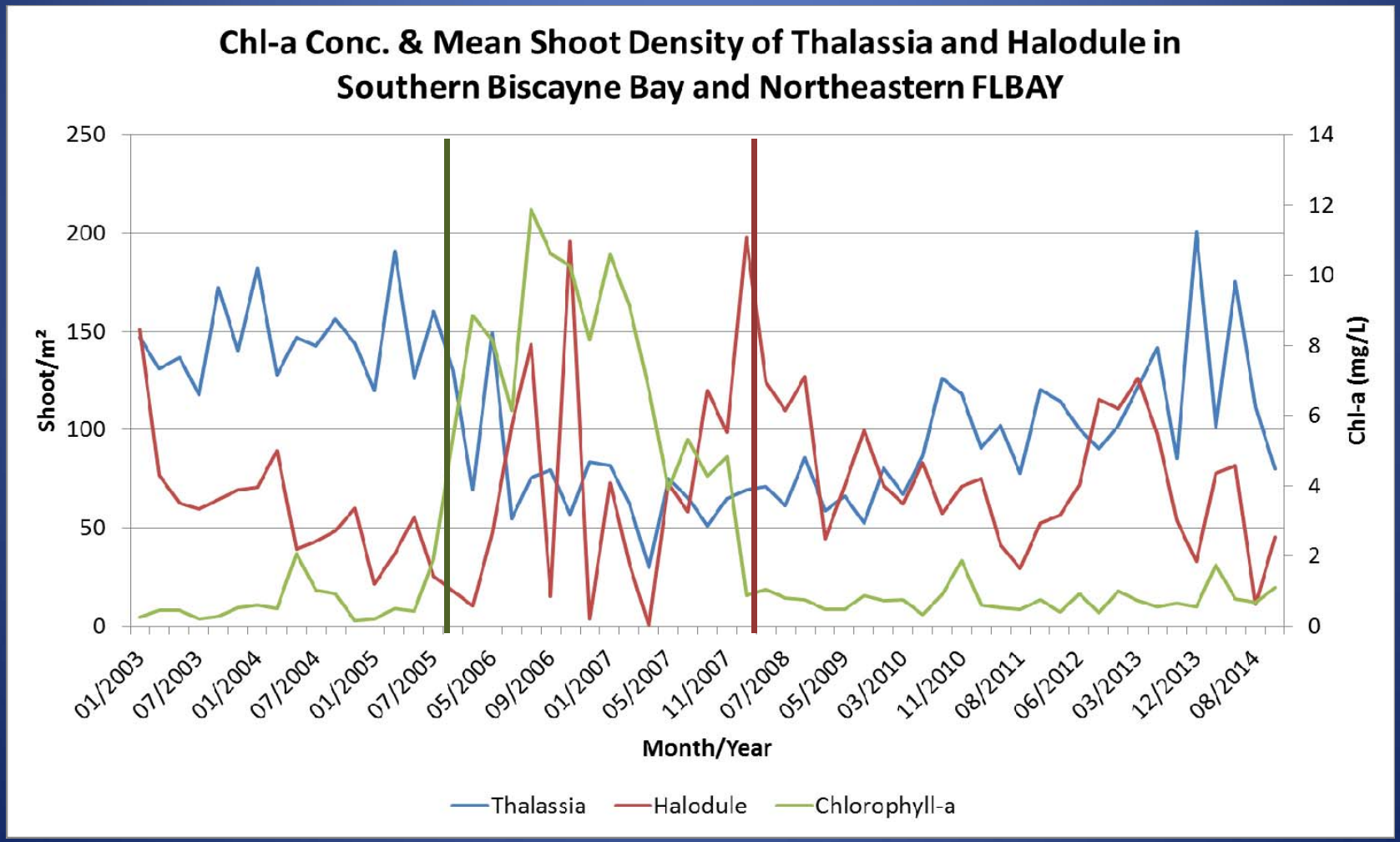
What's at Stake

Summary

Recovery of Benthic Resources in Southern Biscayne Bay and Northeastern Florida Bay

Up to 73% decrease in shoot densities in some basins

7 years and still counting!



Seagrass Impacts Associated with the *Anadyomene* Bloom

- During the pre-bloom and bloom development (2000-2009) period, the average Total Seagrass (TSG) coverage in the area was an 51 km².
- Average TSG coverage dropped to 31 km² during the peak of the bloom (2010-2014), a decline of 63%.

	NCI Bloom Total Area (60 Km²)		
	Pre-Bloom	**Bloom Development**	**Bloom**
	2000-2004	2005-2009	2010-2014
Average Total Seagrass Coverage Area (Km²)	50.6	51.1	18.7