Algae as a Tool for Ecological Assessment and Management in Florida Coastal and Marine Ecosystems

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NOAA HABITAT FOCUS

CONTRIBUTIONS OF DATA FROM SFWMD, BNP, MD-DERM
II. Evaluating the Effects of Extreme Weather Events and Emergency Operations

Study Goals:

1. Assess impact of Hurricane Irma and emergency freshwater inflows from coastal structures on Biscayne Bay water quality
Hurricane Irma
(08/30 – 09/16/2017)

Infrared loop of Hurricane Irma

Source: The Weather Channel

Most Powerful Atlantic Hurricane in History!

- 185 mph max. winds for 37 hours
- 200 mph max. wind gusts
- 914 hPa lowest pressure
- 29 mi eye diameter
- 650 mi max diameter

Source: NOAA
Hydrological and Atmospheric Conditions during Hurricane Irma

**Daily Aver. Rainfall & Temperature**
- Mean Sea Level
- Biscayne Bay
- Aver. 41.6 – 55.8 mph
- Max. 71.2 mph

**Daily Aver. Wind & Wind Gusts**
- Virginia Key
- 4.6 in
- 4.99 ft
- 5.36 ft

Rainfall Data Source: NEXRAD
Wind and Temperature Data Source: NOAA
Source: Coastal Emergency Risk Assessment
Source: Wachnicka et al. 2019
A total of 81 Monitoring Sites

- 33 SFWMD/NOAA
- 30 Miami Dade DERM
- 18 Biscayne National Park

Photo Source: SFWMD
Methods

Continuous Data Recording
- 15 min interval temperature & salinity recordings

Spatial & Temporal Water Quality Measurements
- Sampling in canals & near shore during outgoing tides
- Physical water parameters (temp., sal., turb., pH, DO)
- Inorganic nutrients

Chemotaxonomy & Microscopy
- Relative abundance of major phytoplankton classes
- Phytoplankton biomass (chl a)
- Identification of common taxa
• Total aver. daily inflow increased by ~44% in the 20-day period following the Hurricane

• The largest increase in total aver. daily inflow after the Hurricane occurred in the South-Central Bay (~224% increase)
Spatial & Temporal Changes in Inshore Salinity

Daily Average Flow (m³/s)

Salinity

Site

0 4.5 9 13.5 18 22.5 27 31.5 36 40.5 45
Spatial & Temporal Changes in Nitrogen Concentration

- Significant regional and intra-annual differences in water quality following Hurricane Irma
2. Post-Hurricane Eutrophication of Biscayne Bay

Functional Linkages Between Hydrology, Nutrient Inputs & Phytoplankton Blooms After the Hurricane

August 2017 (3 weeks before Hurricane Irma)

September 2017 (2 weeks after Hurricane Irma)

• Concentration of algal biomass in North & South Biscayne Bay was sig. higher than in other parts of the Bay (ANOVA; p < 0.05)

Wachnicka et al. (2019)
Post-Irma Changes in Algal Biomass

September 2017
(2 weeks after Hurricane Irma)

November 2017
(9 weeks after Hurricane Irma)

January 2018
(18 weeks after Hurricane Irma)
Spatial & Temporal Changes in Algal Dynamics Near Shore

- Algal biomass was significantly higher in September than in November and January ($p < 0.05$)
- Temp., $\text{NO}_x$ and $\text{PO}_4$ explained most of the variation in phytoplankton community structure
- Cyanobacteria were gradually outcompeted by diatoms

Wachnicka et al. (2019)
Changes in Relative Abundance of Phytoplankton Classes in Canals & Near Shore

September 2017
(2 weeks after Hurricane Irma)

November 2017
(9 weeks after Hurricane Irma)

January 2018
(18 weeks after Hurricane Irma)

Biscayne Bay

Relative Abundance (%)

<10 <20 <30 <40 <50 <60 >=60
Conclusions

• No evidence of a long-term water quality decline or hurricane-induced algal blooms was observed

• Biscayne Bay is resilient to pulse disturbances like hurricanes. Water quality and phytoplankton communities returned to the pre-disturbance conditions within < 6 months
Estuaries and Coasts Journal Special Issue:

“Impact of 2017 Hurricanes on Estuaries and Coasts in the Caribbean and the Gulf Coast States”

Coming Soon!!!

Lead Guest Editor: Anna Wachnicka (SFWMD)
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