

# Hurricane Irma Effects on Biscayne Bay Nearshore Epifaunal Communities and Their Habitat



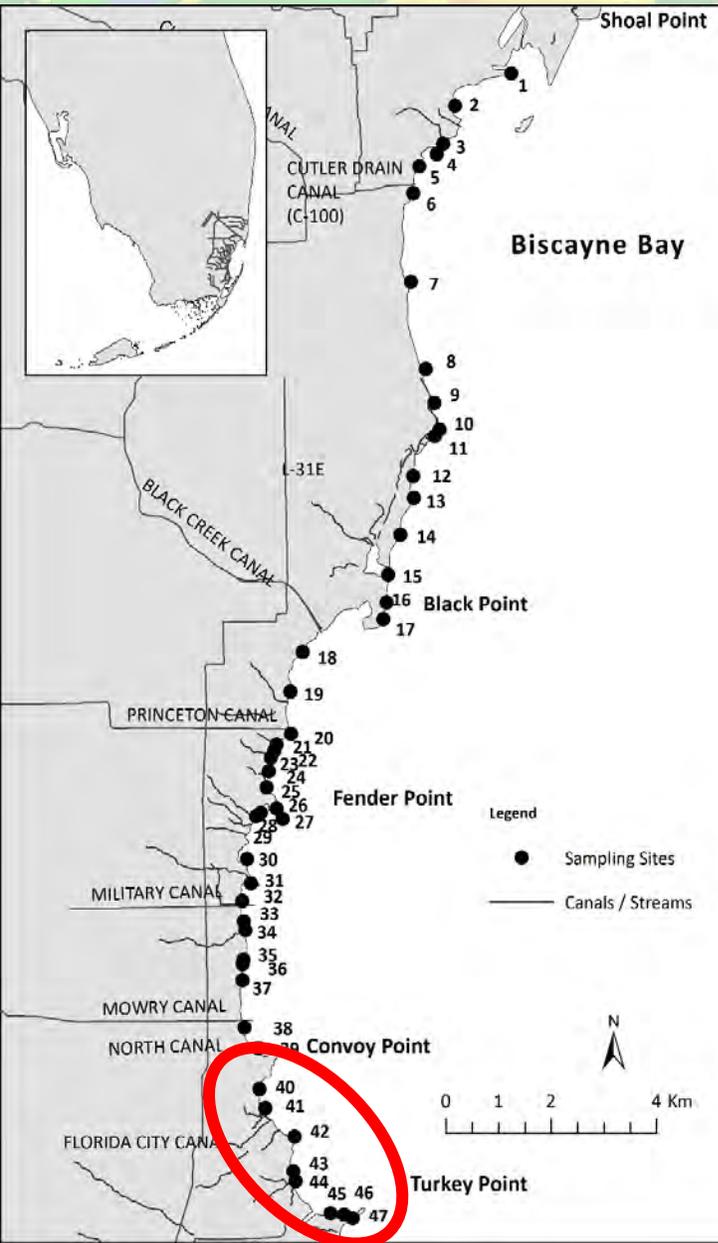
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BBRRCT March Meeting (3-21-18)

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# Introduction to IBBEAM Epifauna



Water quality / physical conditions  
YSI Multimeter: Temperature,  
Specific Conductance,  
Salinity, DO, pH  
Water Depth / Sediment Depth  
Light Attenuation in Water Column

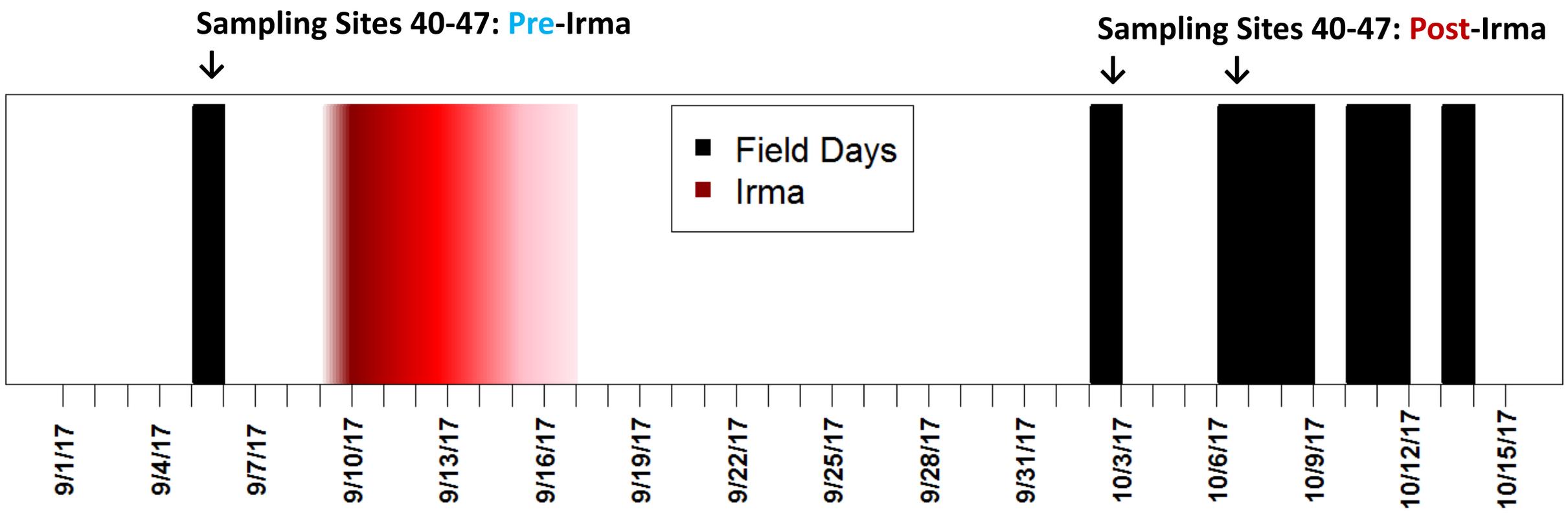


Throw trapping of to assess epifaunal  
communities:  
species occurrence and density  
3 replicate 1 m<sup>2</sup> collections



Benthic habitat assessment: SAV  
species composition and % cover  
10 replicate 0.5 m<sup>2</sup> quadrats

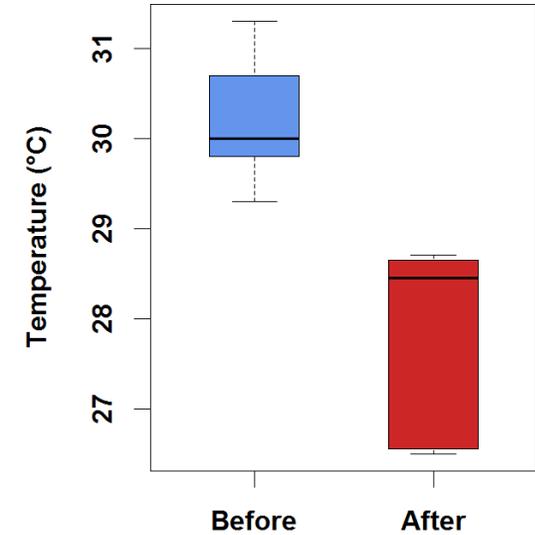
# Fall 2017 Sampling & Irma: Timeline



# Before and After: Physical Conditions

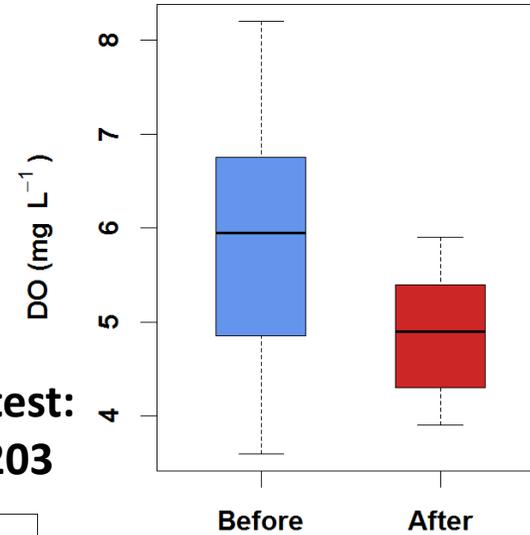
Paired, two tailed t-test:

$$t_{df=7} = 4.07, p = 0.0047$$



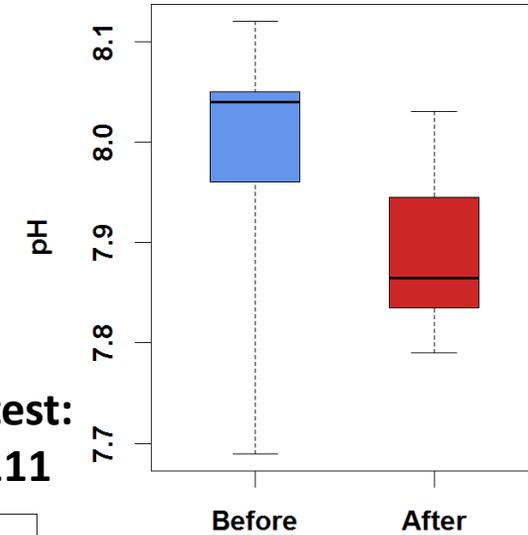
Paired, one tailed t-test:

$$t_{df=7} = 2.49, p = 0.0209$$



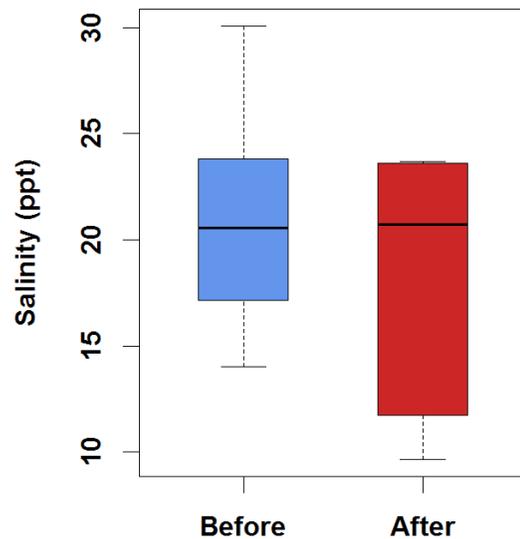
Paired, two tailed t-test:

$$t_{df=7} = 2.77, p = 0.0279$$



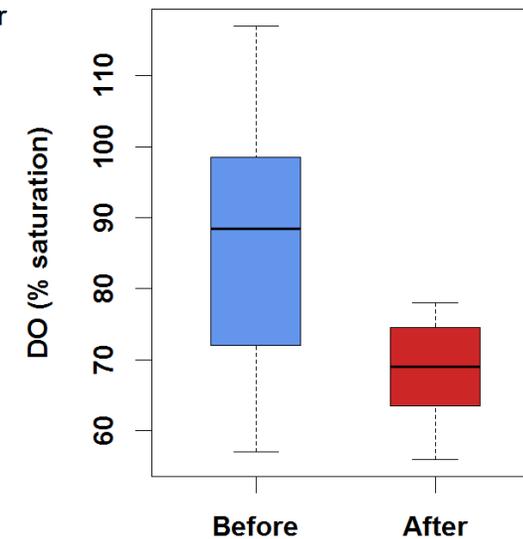
Paired, one tailed t-test:

$$t_{df=7} = 2.51, p = 0.0203$$

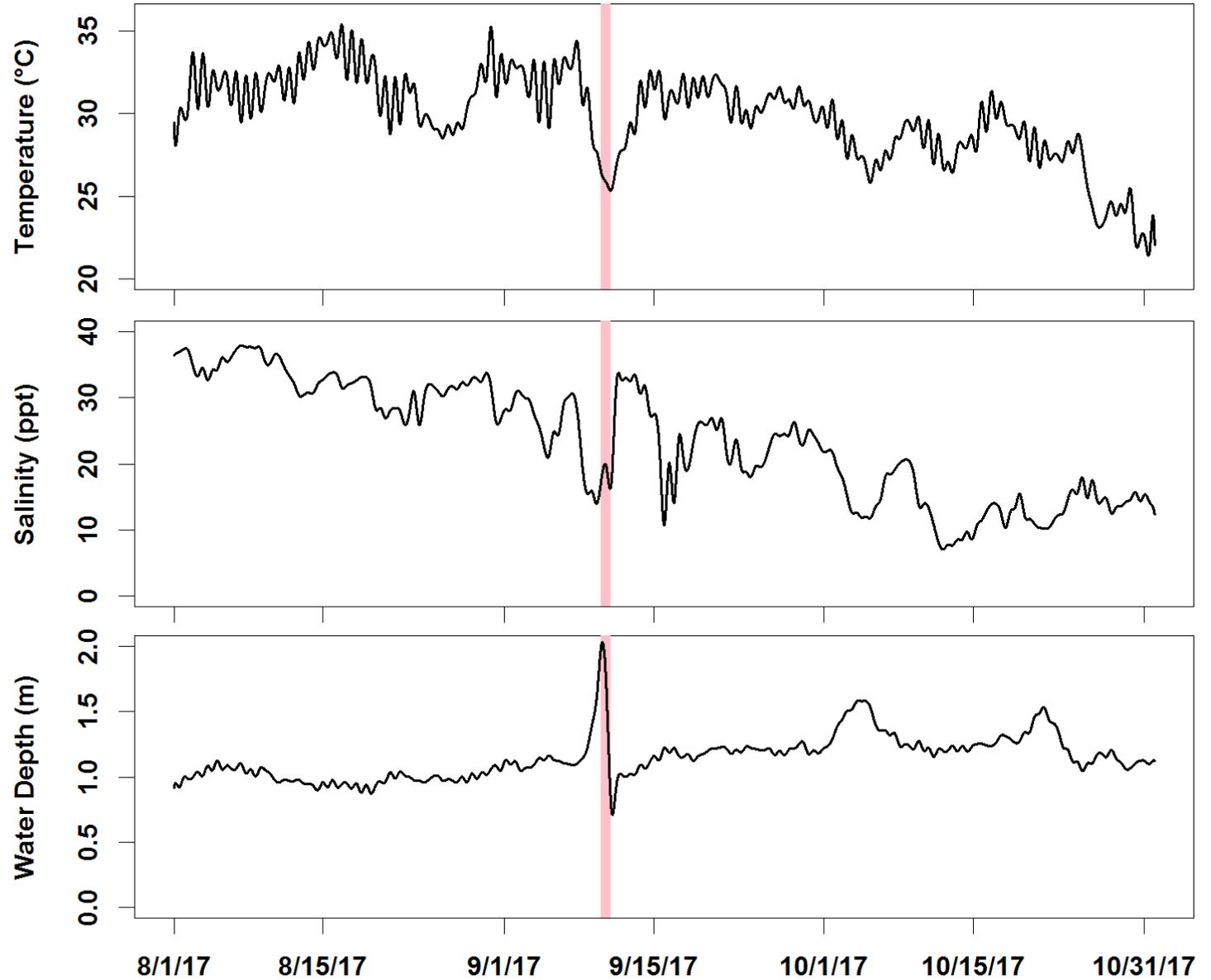


Paired, one tailed t-test:

$$t_{df=7} = 2.93, p = 0.0111$$

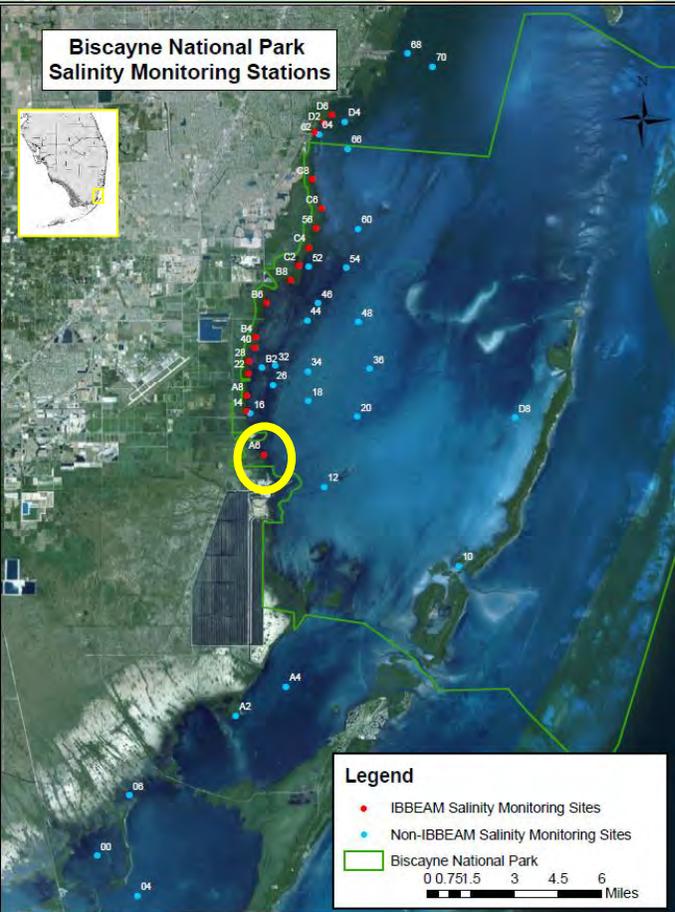


# Before and After: Salinity Logger

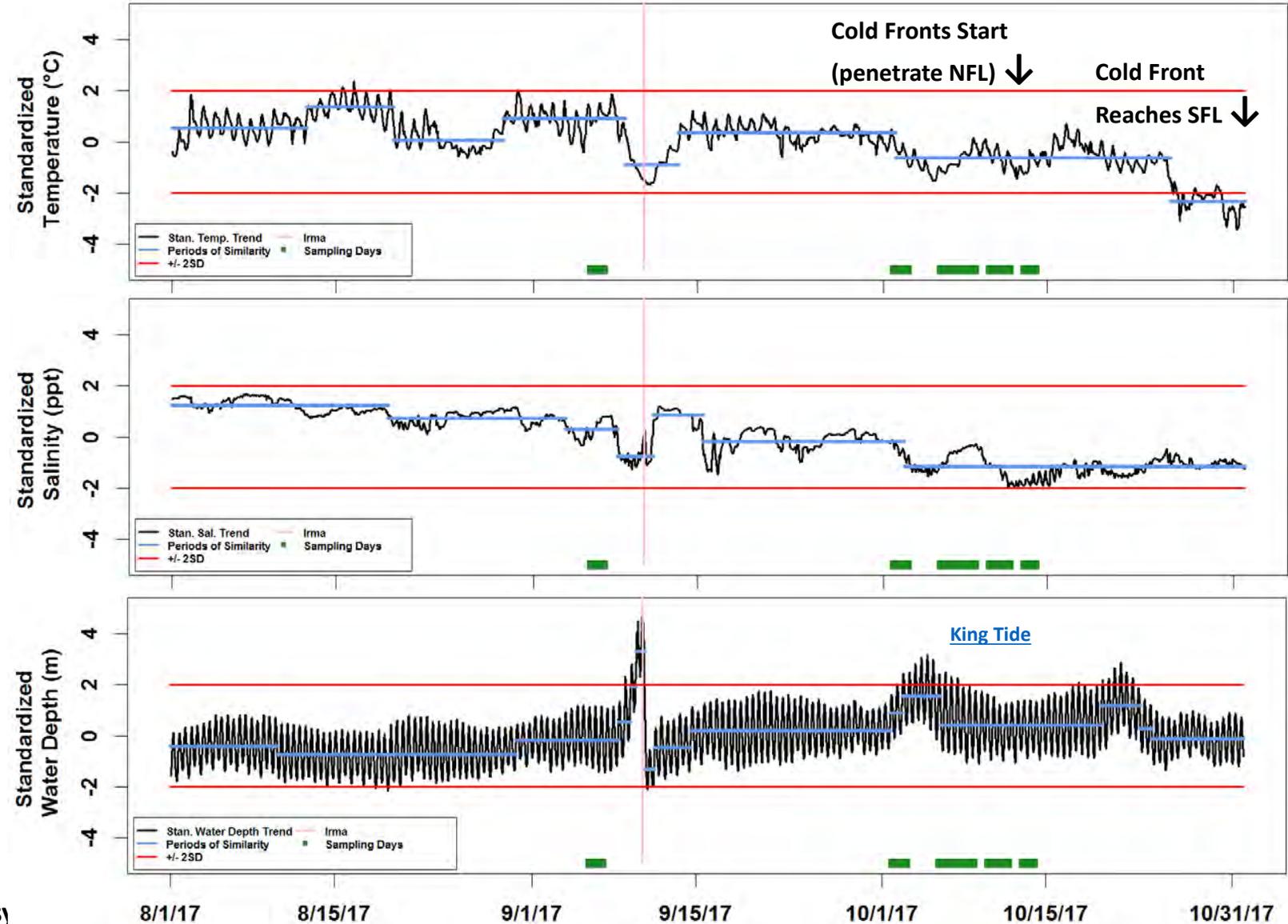


Data courtesy of BNP

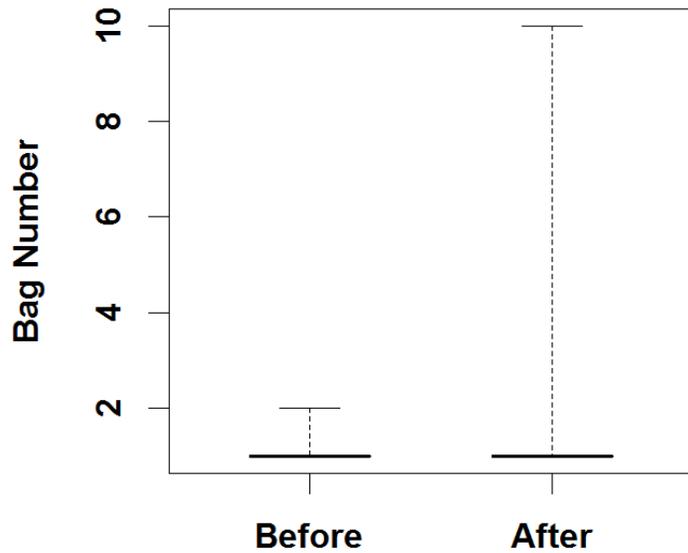
# Before and After: Salinity Logger



## Change Point Analysis Reveals Periods of Similarity:



# Before and After: Detritus Deposition



Paired, One-Way Rank-Sum Test:  
 $V = 1, p < 0.0520$



↑ Shoreline (Rickenbacker Causeway) seagrass deposition 2 days after passage of Hurricane Donna 1960 (Thomas et al. 1961)

↓ Shoreline (Virginia Key) seagrass deposition 11 days after passage of Hurricane Irma (IZink)

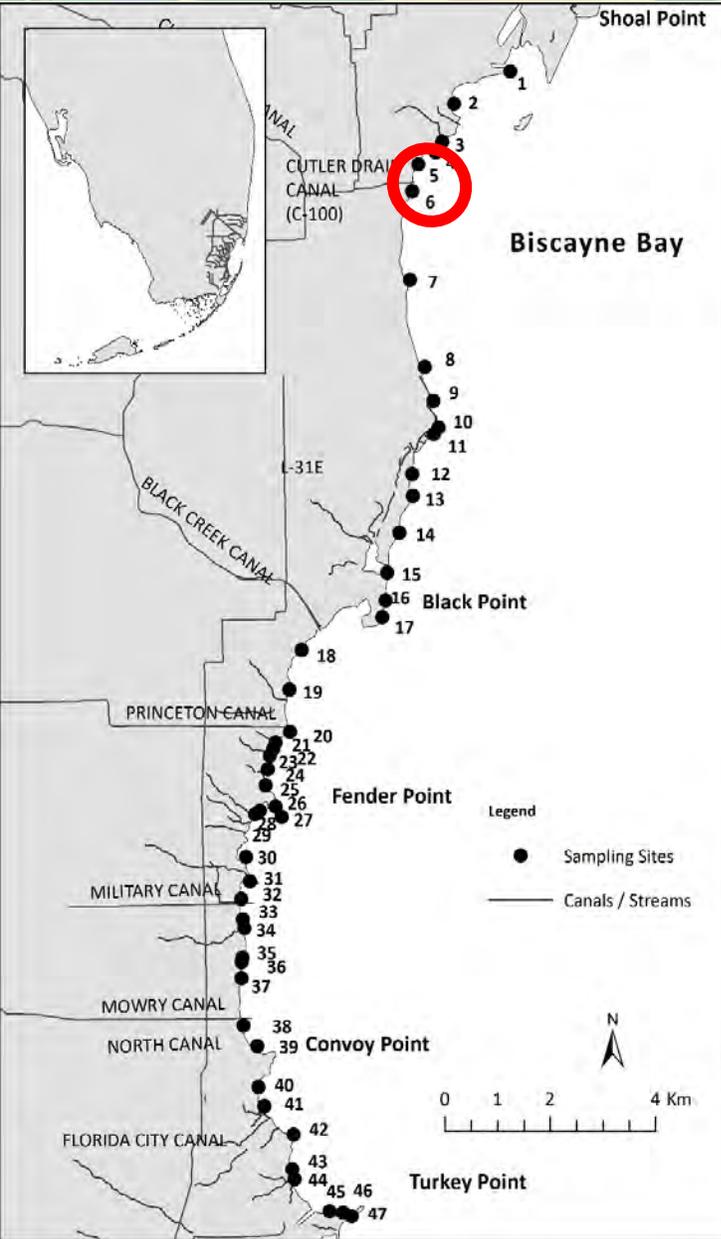


← Defoliated mangroves (West Lake Boardwalk, Everglades NP) 25 days after passage of Hurricane Irma (IZink)

→ Seagrass deposition (Flamingo, Everglades NP) 25 days after passage of Hurricane Irma (IZink)



# Before and After: Algal Bloom



Filamentous algal bloom just off C-100 (Cutler Drain) canal mouth



# Before and After: Epifaunal Species

## Unique Pre-Irma Taxon

1	Lagodon rhomboides
2	Gobiidae spp
3	Anarchopterus criniger
4	Chasmodes saburrae
5	Syngnathus scovelli
6	Libinia dubia
7	Lutjanus griseus
8	Panopeus herbstii
9	Panopeidae spp
10	Farfantepenaeus brasiliensis
11	Hippolyte obliquimanus
12	Thor spp
13	Thor manningi
14	Hippolyte zostericola

## Shared Pre- and Post-Irma Taxon

1	Opsanus beta
2	Floridichthys carpio
3	Lucania parva
4	Gobiosoma robustum
5	Atherinomorus stipes
6	Callinectes similus
7	Farfantepenaeus duorarum
8	Farfantepenaeus spp
9	Hippolyte spp
10	Palaemonetes intermedius
11	Gerreidae spp
12	Palaemonetes spp
13	Paguroidea spp

## Unique Post-Irma Taxon

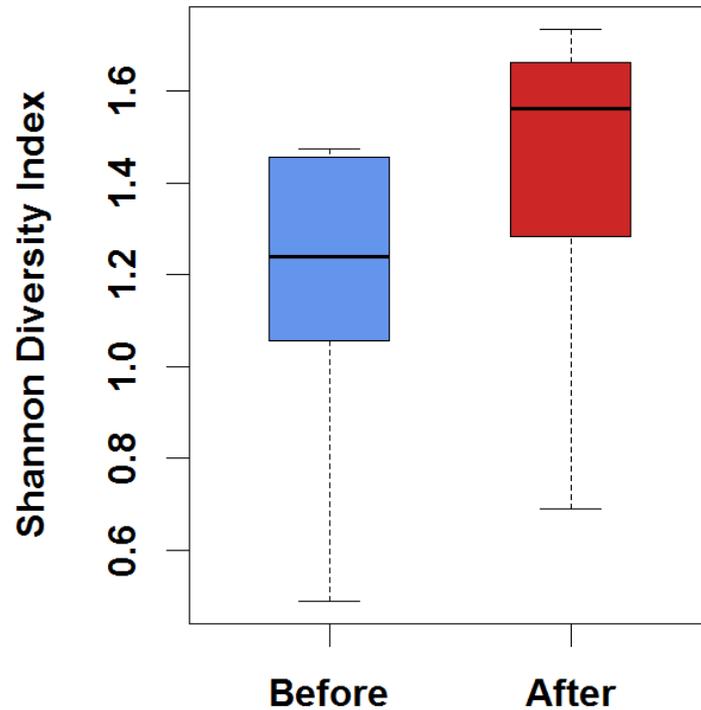
1	Callinectes sapidus
2	Panopeus simpsonii
3	Hippolyte pleuracanthus
4	Alpheus viridari

One would think the number of unique taxa prior to Hurricane Irma would yield differing species diversity...

# Before and After: Epifaunal Species

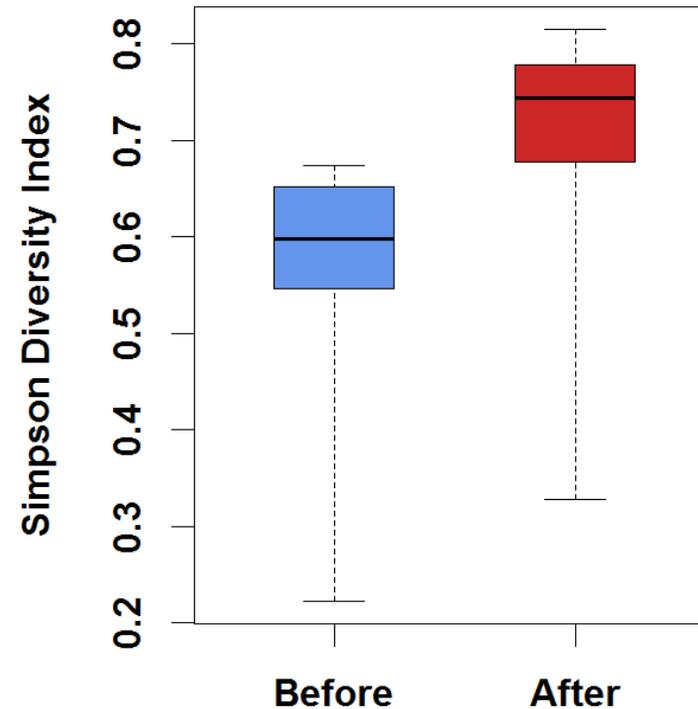
Paired, two tailed t-test:

$$t_{df=7} = -1.44, p = 0.1918$$



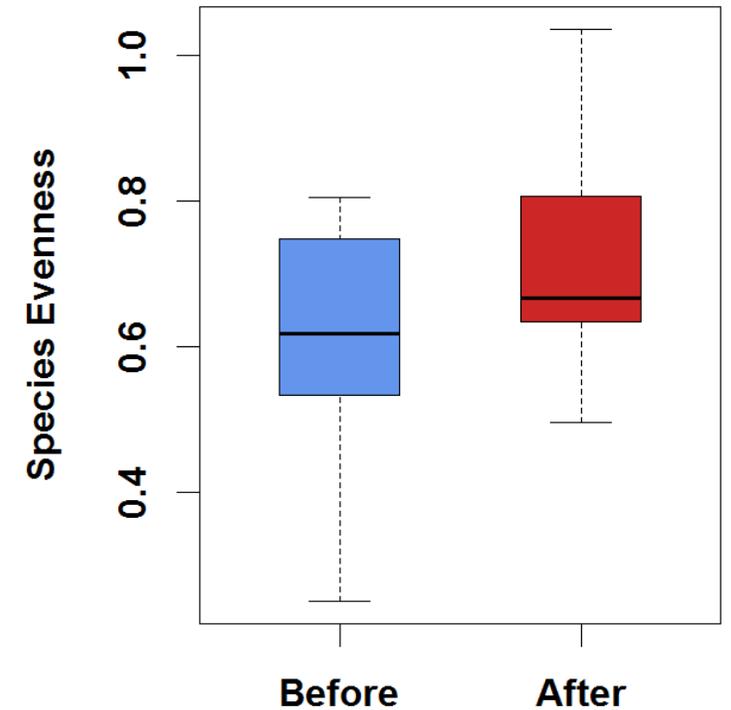
Paired, two tailed t-test:

$$t_{df=7} = -1.50, p = 0.1772$$



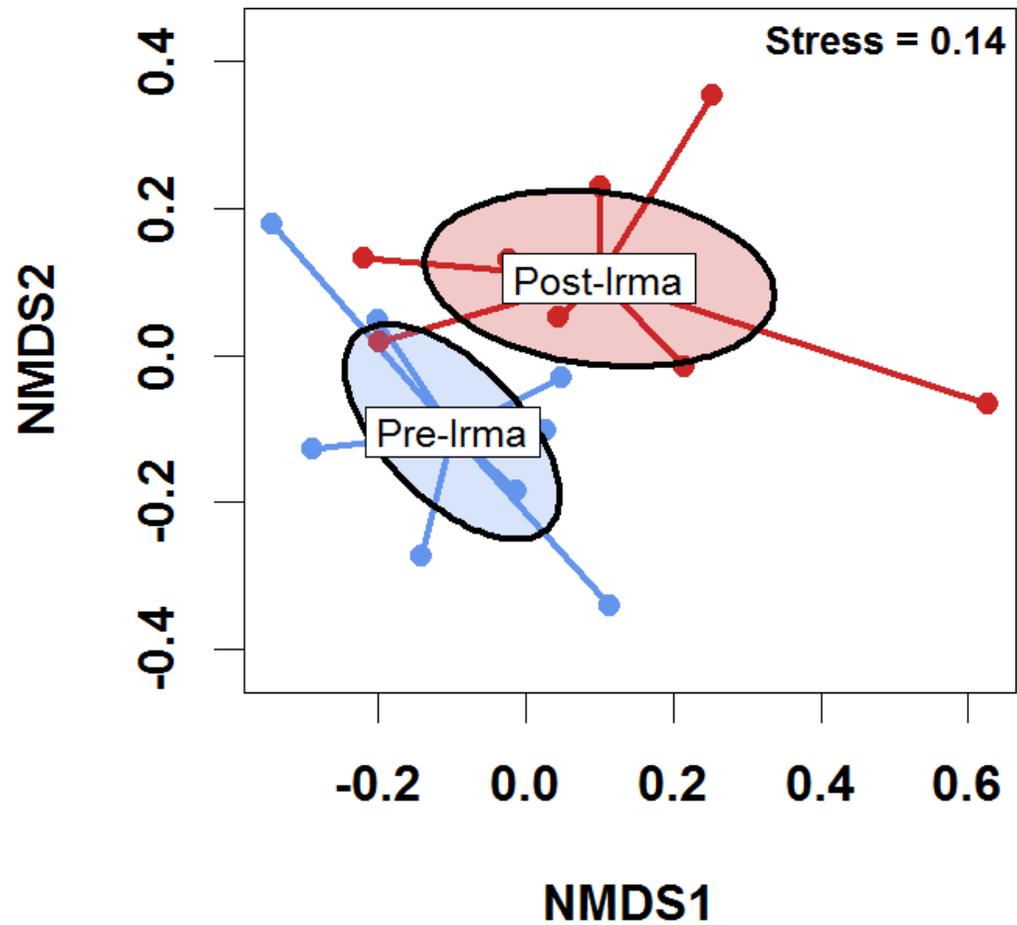
Paired, two tailed t-test:

$$t_{df=7} = -1.13, p = 0.2939$$



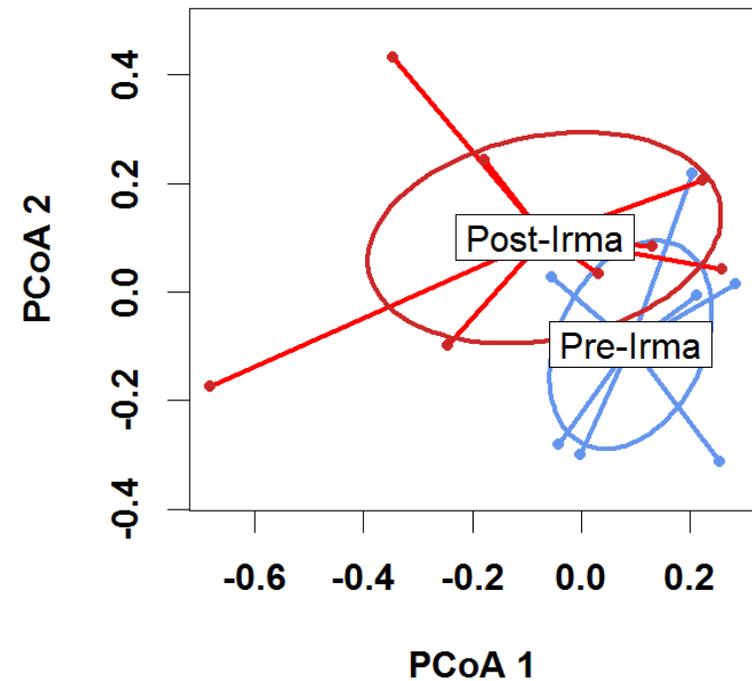
Simple non-parametric tests shown; linear models which account for sample site were also non-significant ( $p > 0.05$ )

# Before and After: Epifaunal Species



Multivariate Analysis of Variance:  $F_{1,14} = 2.61$ ,  $p = 0.016$ ,  $R^2 = 0.16$

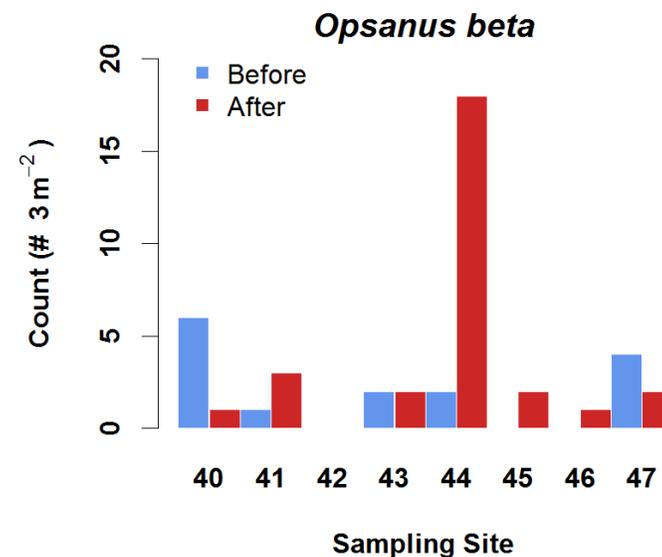
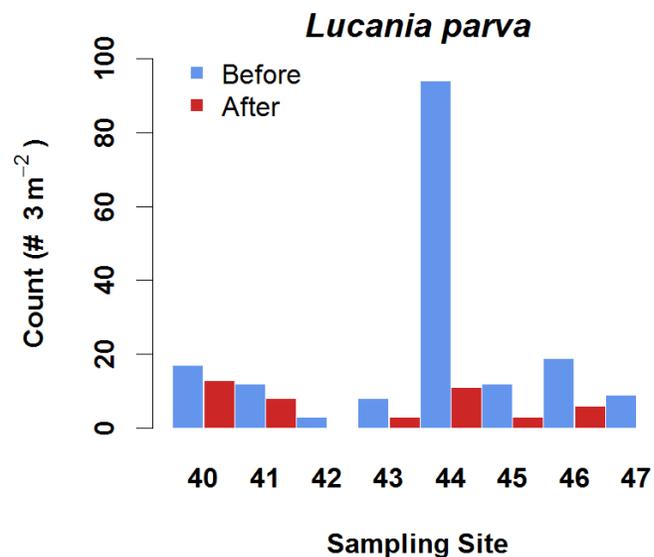
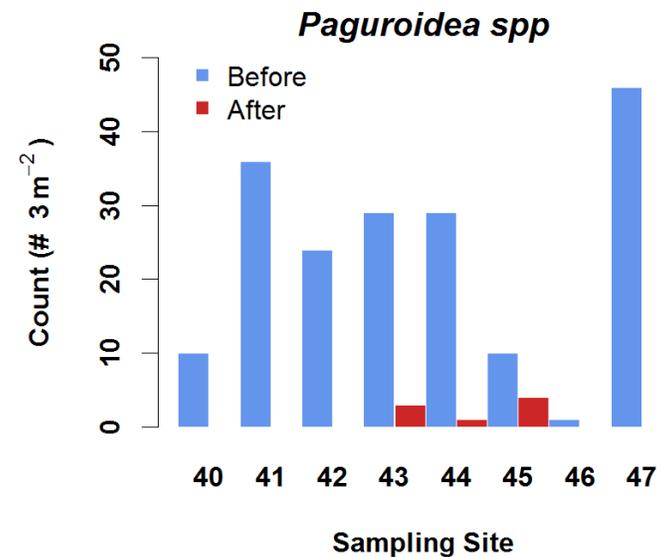
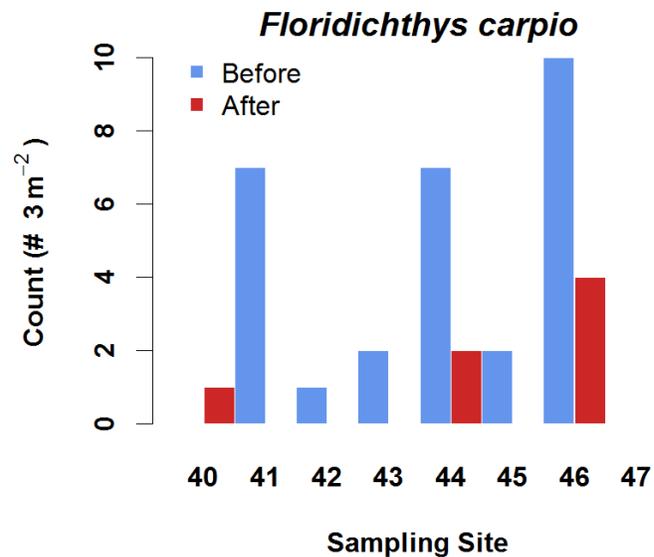
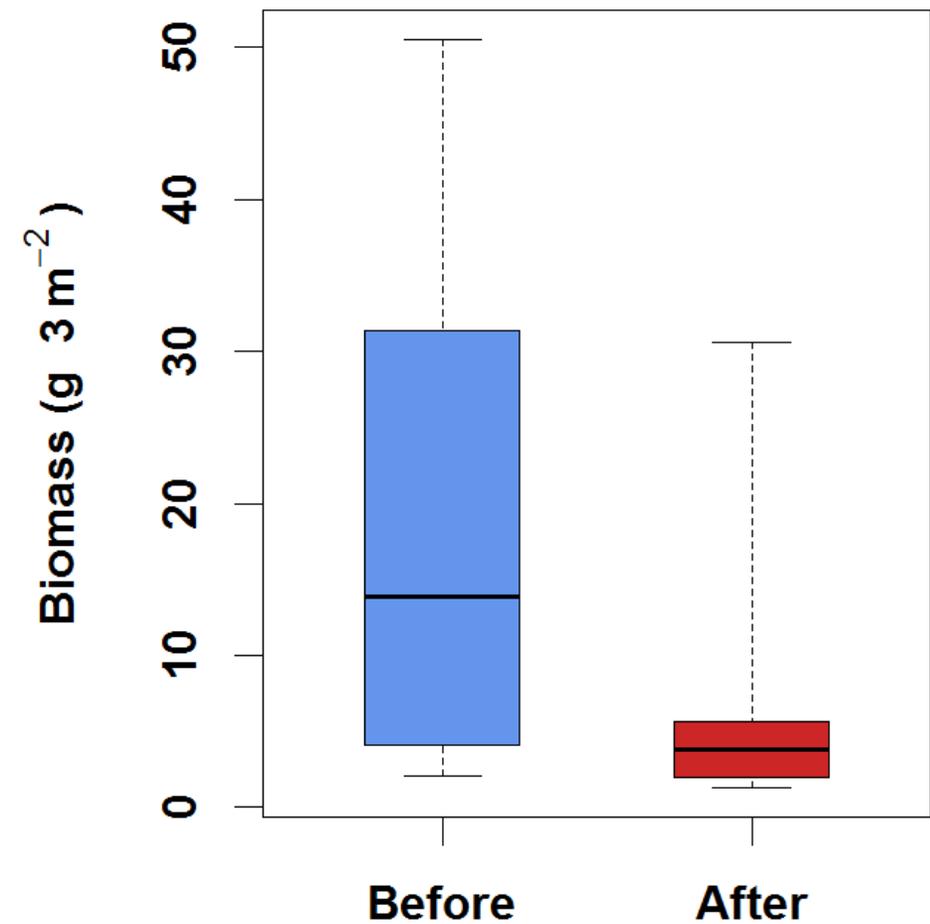
Pre-Post Hurricane Factor Alone was Significant;  
Temperature, Salinity, DO, pH did not explain the difference



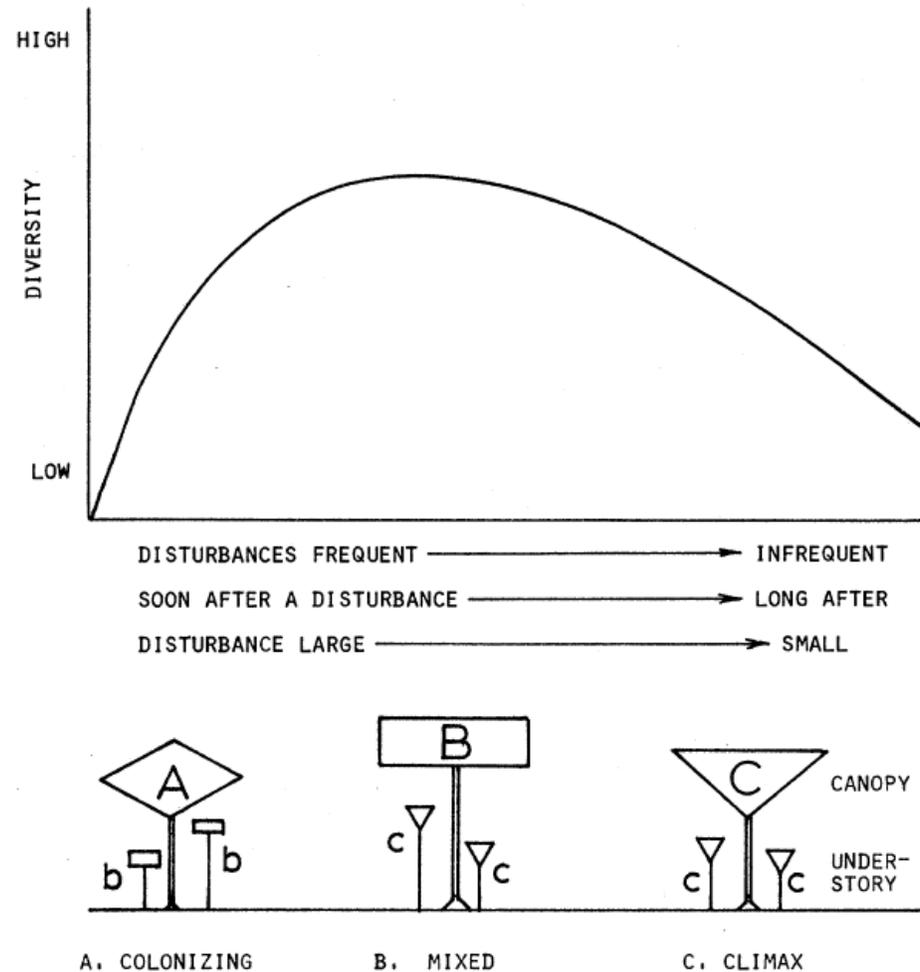
Beta-dispersion (measure of multivariate variance):  
 $F_{1,14} = 0.55$ ,  $p = 0.4713$

# Before and After: Epifaunal Biomass

Paired, one tailed rank-sum test:  
 $V = 4, p = 0.0273$



# A Comment on Ecological Theory



Is this disturbance **'BAD?'**

**...not likely. But layer natural disturbance with anthropogenic disturbance (altered nutrient regimes, altered freshwater delivery, etc...) and realize compounded ecological impacts**

Figure 1: Connell 1978 Diversity in Tropical Rainforests and Coral Reefs

# Summary: Before-After Habitat

- Reduced temperature: one month between sampling events
- Reduced salinity: high rainfall, flood control/water mgmt.
- Reduced DO and % Sat.: decomposition of materials in nearshore; not solely other physical changes
- Reduced pH: decomposition of materials in nearshore and freshwater inflow (tannic water?)
- Other habitat attributes = non-sig. diff. (light penetration, water depth, sediment depth)
- Nearshore detritus deposition: smothering, water quality

# Summary: Before-After Epifauna

- Continuous data reveals changes in environmental conditions: physiological stress from rapid temperature and salinity changes along with storm surge = concurrent stressors
  - ex: ~ 3 days temp from 35.96 to 25.47°C;
  - ~ 1 day sal from 30.77 to 14.64 ppt
- **Tidal surge: likely pushed a number of 'weaker' species inshore** (onto normally dry land) Tabb and Jones 1962: Hurricane Donna
- Other mortality caused by siltation Robins 1957
- Multivariate analyses needed to identify altered epifaunal community; non-**sig. change in 'simple' diversity measures**
- Reduced biomass could influence higher trophic levels

# Further Work

- Determine the group of species that drove observed pre-post hurricane community difference
- Compare post-Irma Wet Season 2017 data (i.e., sites 1-47): spatiotemporal analysis of biomass/abundance reductions and altered communities
- Further investigate continuous salinity logger data; animations of salinity, temperature, and water depth

These studies are crucial to help explain inter-annual variability in IBBEAM monitoring data!

# Acknowledgements

- Field technicians: Jordi Robles, Jane Carrick, Stephanie Schopmeyer, Rich Karp
- Continuous logger data courtesy of Biscayne National Park
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- And your time...

