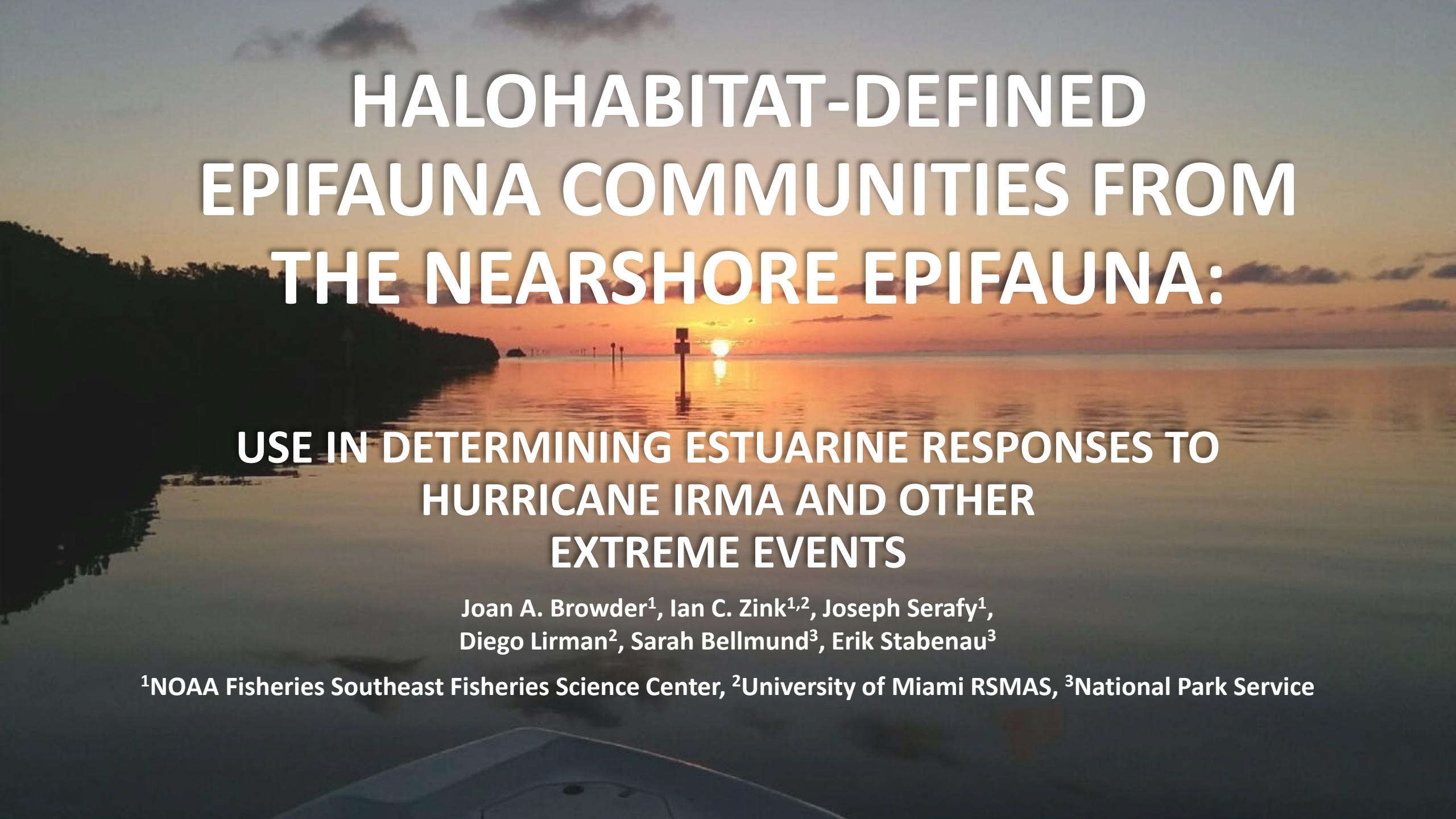

HALOHABITAT-DEFINED EPIFAUNA COMMUNITIES FROM THE NEARSHORE EPIFAUNA:

USE IN DETERMINING ESTUARINE RESPONSES TO HURRICANE IRMA AND OTHER EXTREME EVENTS

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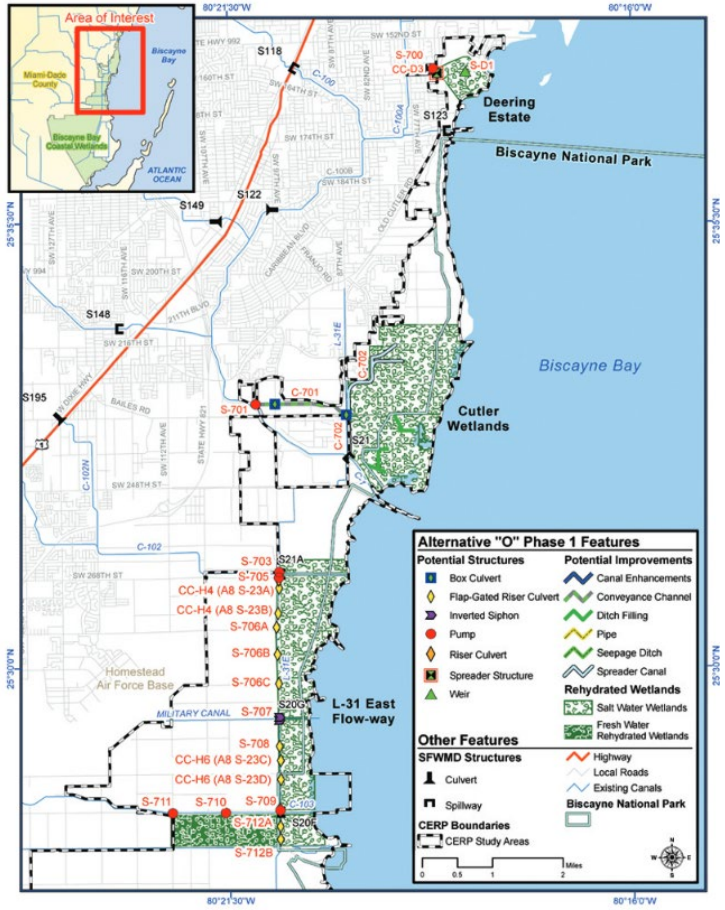
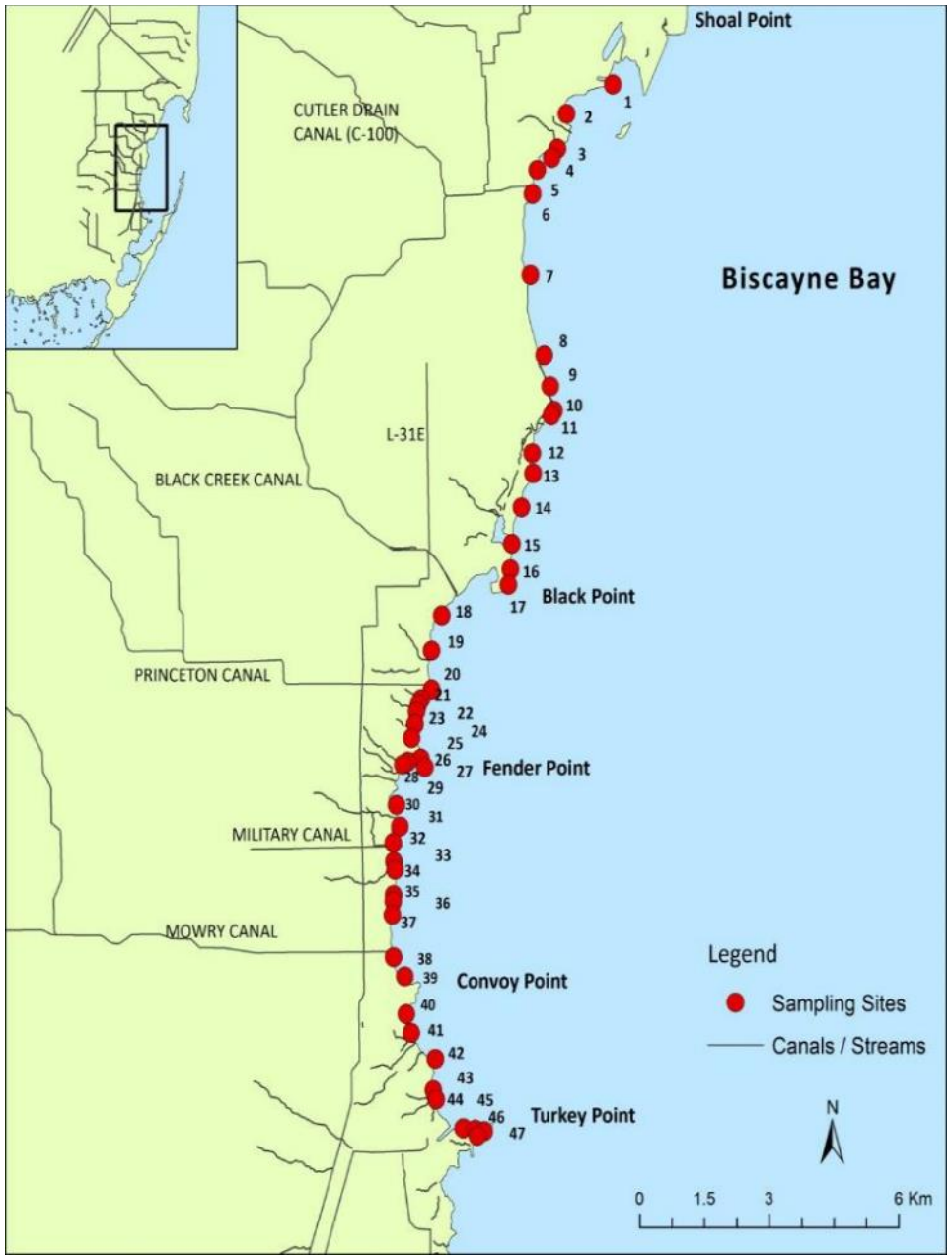
Ecological Feedback for Adaptive Management of CERP and BBCW

CERP intent: "getting the water right (quantity, quality, timing, distribution)" for Greater Everglades ecosystem.



BBCW intent: improving the timing and spatial distribution of fresh water inflow to Biscayne Bay.

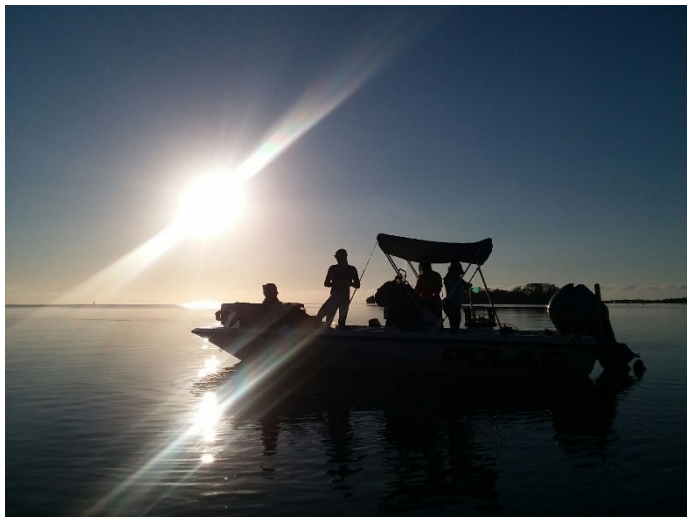
Dashed line delineates footprint of BBCW Project 'O'.



The epifauna community along south-central Biscayne Bay's western shoreline is sampled by IBBEAM for RECOVER'S Monitoring Assessment Plan.

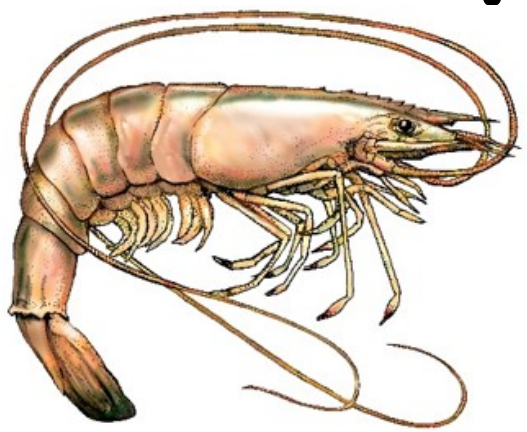
Developing epifauna indicators of restoration

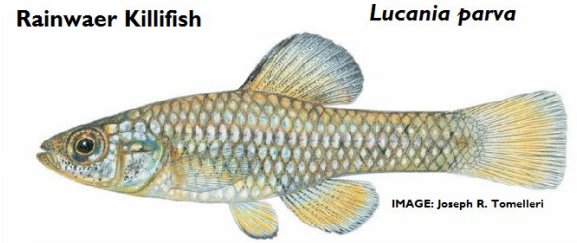
- **Focus: small fishes and decapod crustaceans**
- **Sampling with 1 m^2 throw trap as adapted by Mike Robblee**
- **3 throws @ 47 locations sampled semiannually (dry/wet)**

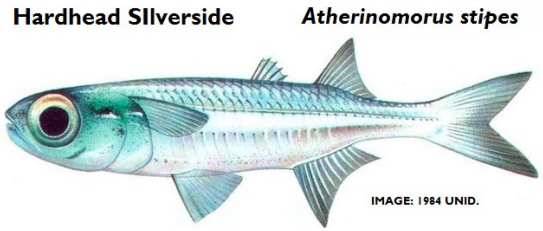


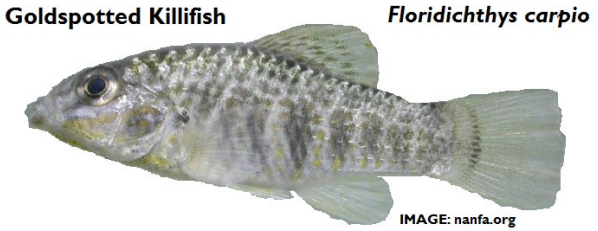
Taking a community approach

- **70 fish taxa**
- **59 decapod-crustacean taxa**
- **Combined data from 47 sites**
- **Data for 12 years, 2007 - 2018**
  - **12 x 2 = 24 year-seasons**



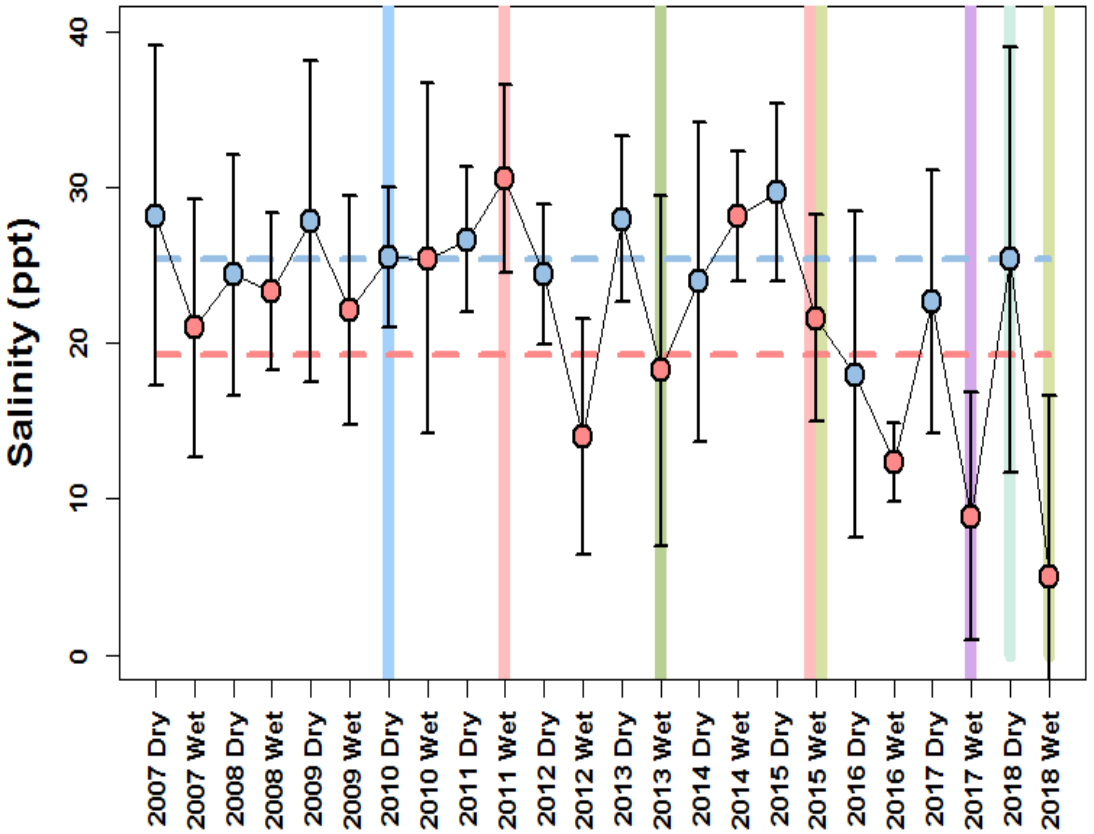




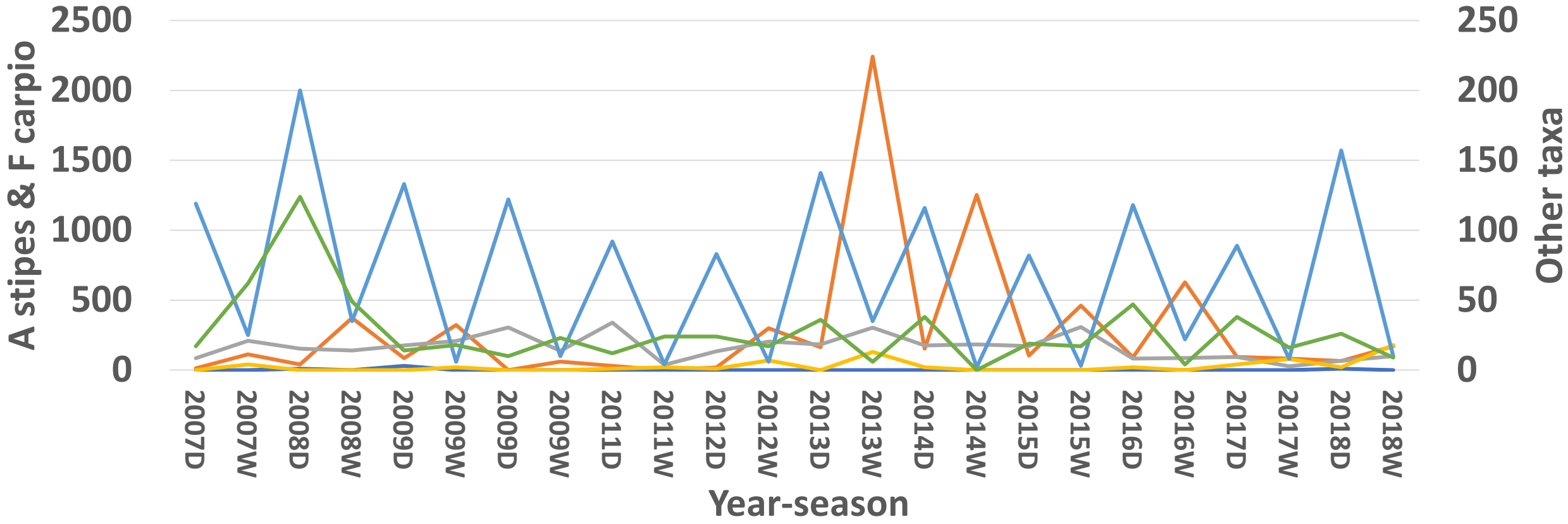


POR disturbance events affecting Biscayne Bay

Year	Season	Event	Salinity factor?
2010	Dry	Cold snap	
2011	Wet	Hypersalinity	Yes
2013	Wet	Microalgal bloom	
2015	Wet	Hypersalinity	Yes
2015	Wet	Sargassum intrusion	
2017	Wet	Hurricane Irma	Yes
2018	Dry	Post hurricane	
2018	Wet	Sargassum intrusion	



Abundance time series of many individual species are difficult to interpret



Hypothesis: Classifying species by their halohabitat can help quantify community responses to disturbance events in which salinity change is a factor

- **Fish and decapod crustacean species were assigned to halohabitat type based on the median salinity of their distribution in samples collected from 2005 through 2018.**

Seven halohabitat groups in our modification of the Venice system

	Salinity	
Halohabitat	Low limit	High limit
Hyperhaline	40.01	0
Euhaline high	35.01	40
Euhaline low	30.01	35
Polyhaline high	24.01	30
Polyhaline low	18.01	24
Mesohaline	5.01	18
Oligohaline	0.51	5

Multivariate analyses were performed on halohabitat-classified data for fish and decapods in combined and separated datasets.

- **Number of taxa and number of individuals each year-season from 2007 through 2018 were separately enumerated by halohabitat group.**

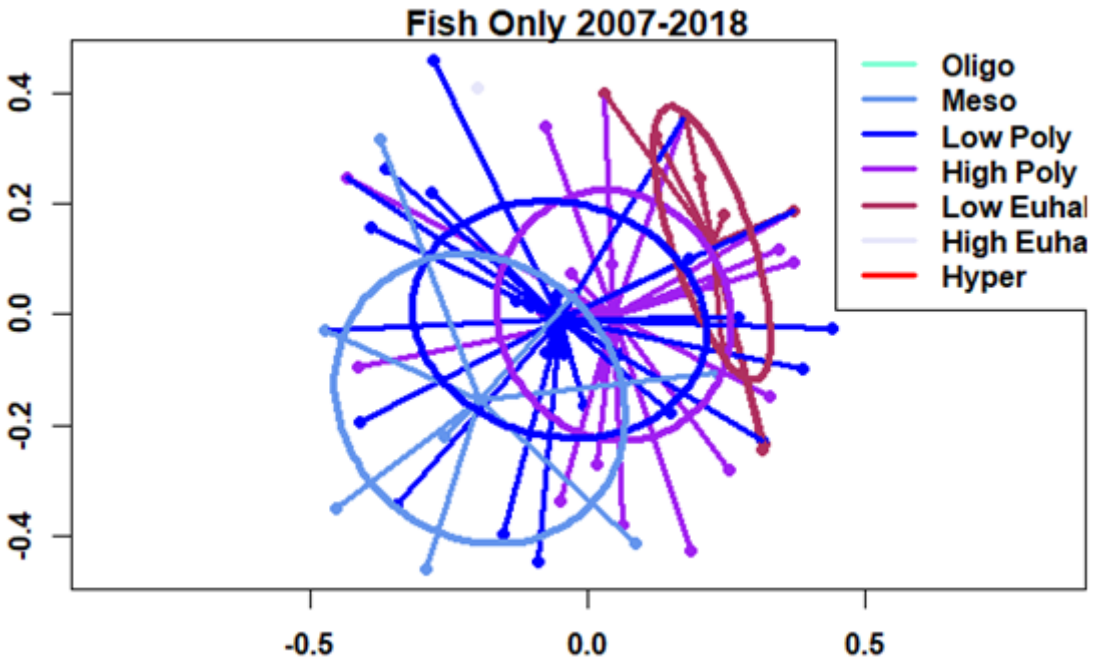
Number of species, by halohabitat

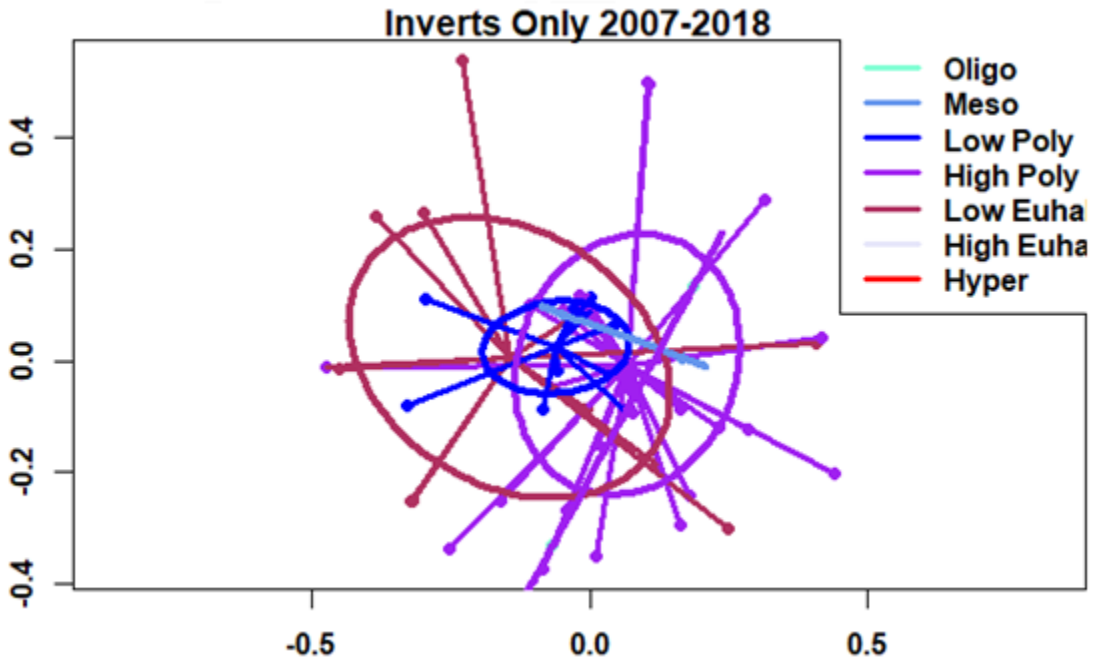
Halohabitat	Fish	Decapod crustaceans	Both
High Euhaline	1	0	1
Low Euhaline	9	12	21
High Polyhaline	24	32	56
Low Polyhaline	28	11	39
Mesohaline	8	2	10
Oligohaline	0	2	2
Total	70	59	129

Abundance, by halohabitat

Halohabitat	Fish	Decapod crustaceans	Both
High Euhaline	1	0	1
Low Euhaline	37	1,400	1,437
High Polyhaline	10,669	23,353	34,022
Low Polyhaline	35,923	1,447	37,370
Mesohaline	86	37	123
Oligohaline	0	14	14
Total	46,716	26,251	72,967

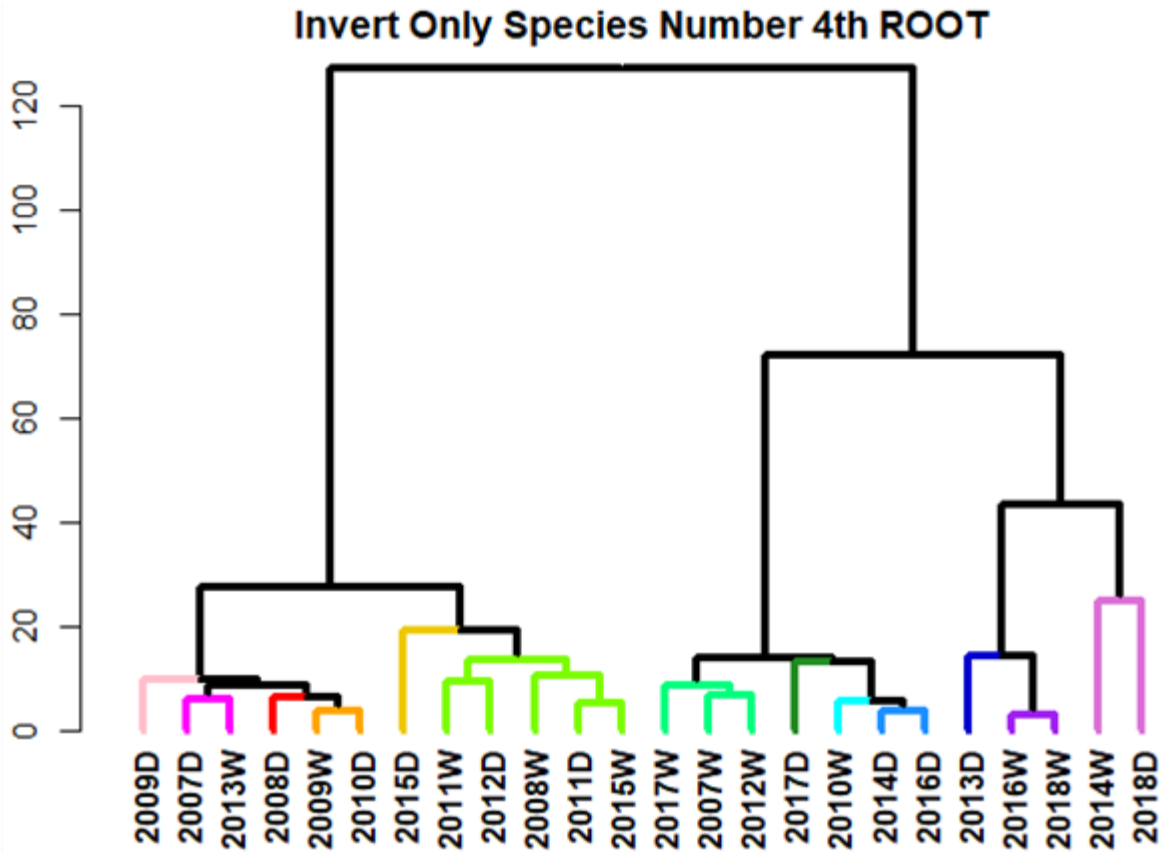
nMDS plots of 4th-root species abundance grouped by halohabitat

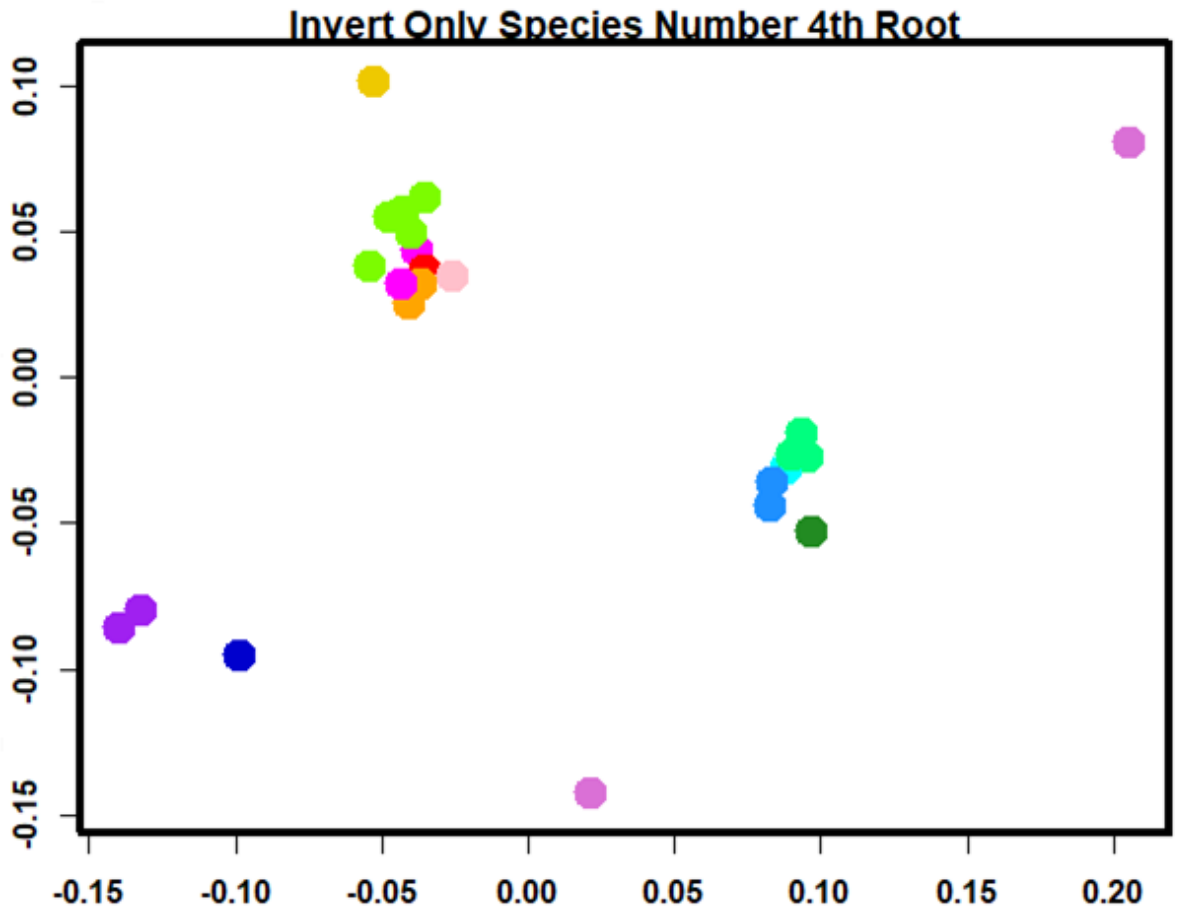




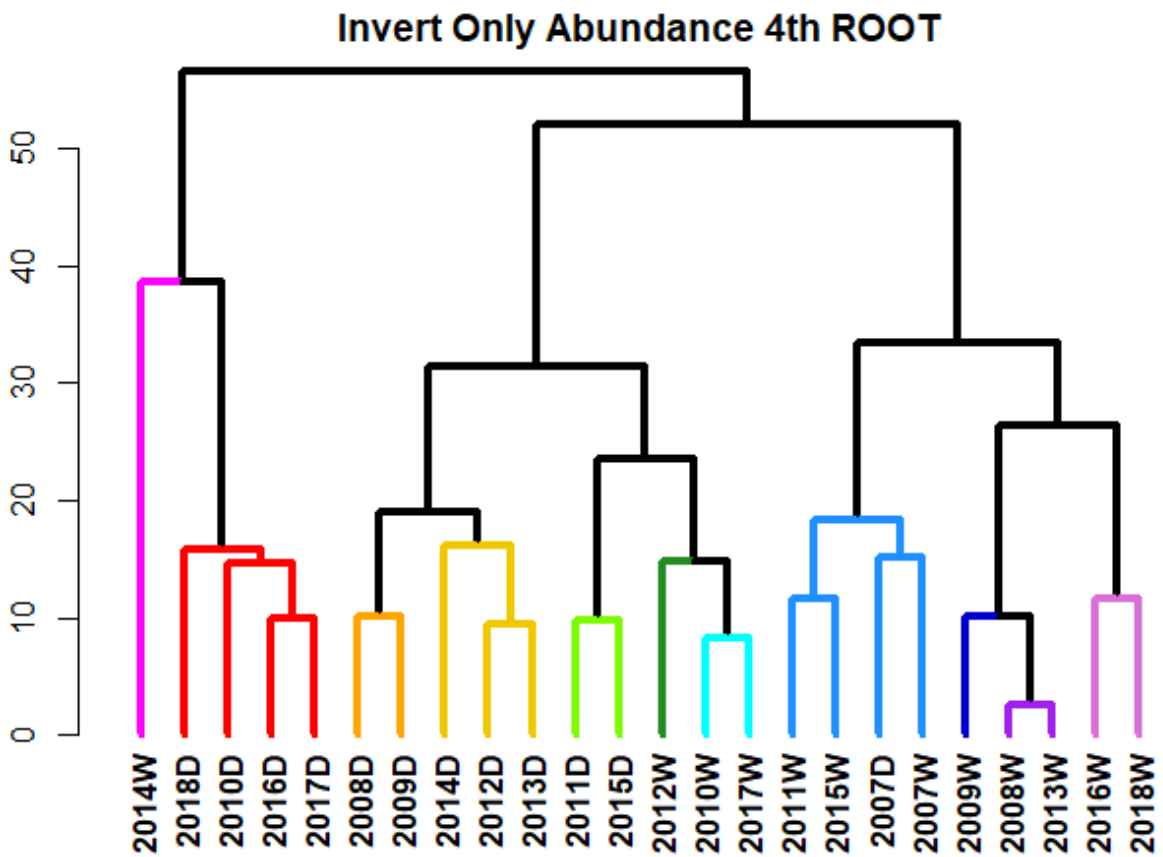
Groupings were based on time series of year-season species abundance.

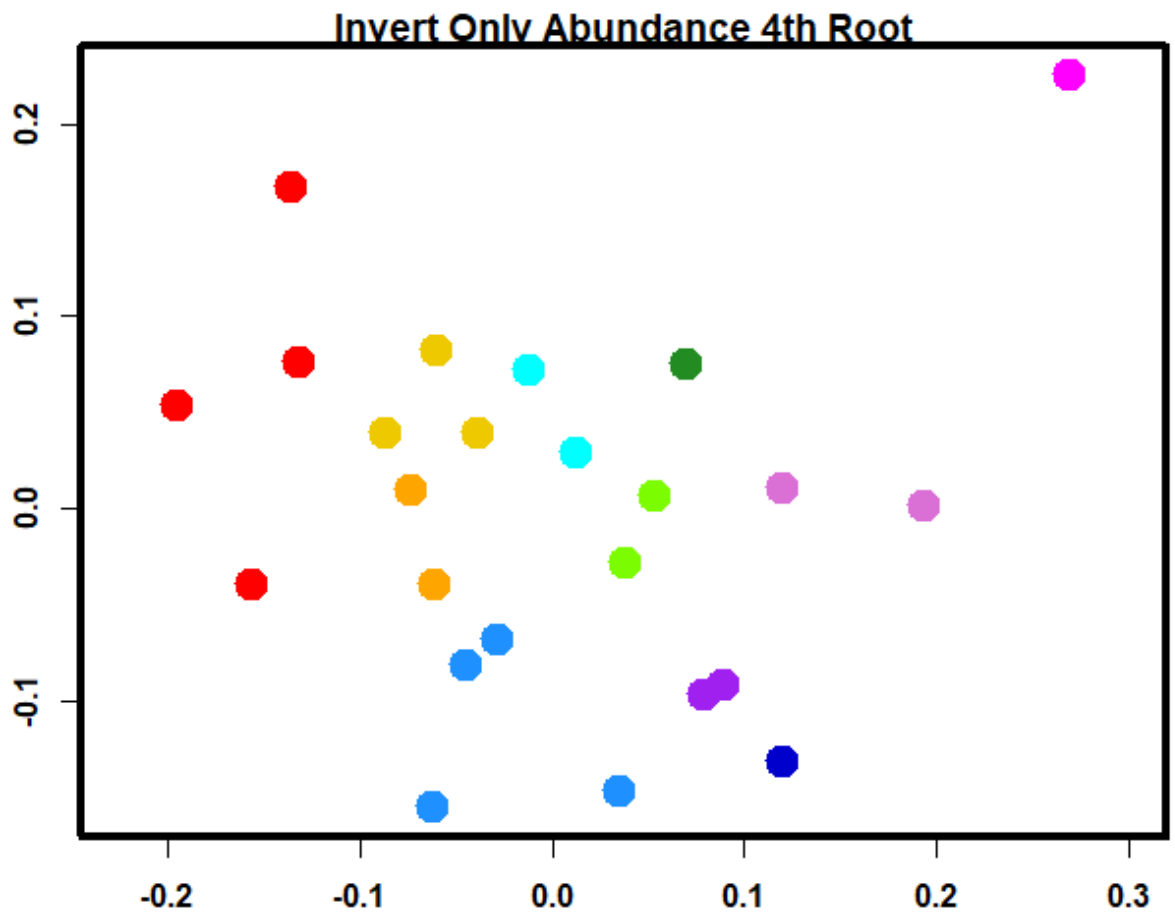
Dendrogram and nMDS plot: year-seasons clustered by number of decapod species in halohabitat groups





Dendrogram and nMDS plot: year-seasons clustered by abundance of all species in halohabitat groups





Results of backward-elimination PERMANOVA models

Species number by halohabitat: 4th root transform

Factor	Fish	Decapod	All
Season	0.002	0.073	0.001
Sampling shift		0.037	0.052
Sargassum		0.063	
Cold snap	0.092		

Abundance by halohabitat: 4th root transform

Factor	Fish	Decapod	All
Season	0.019	0.001	0.004
Sampling shift	0.009	0.092	0.016
Hypersalinity		0.062	0.017

What to conclude?
The good and the puzzling

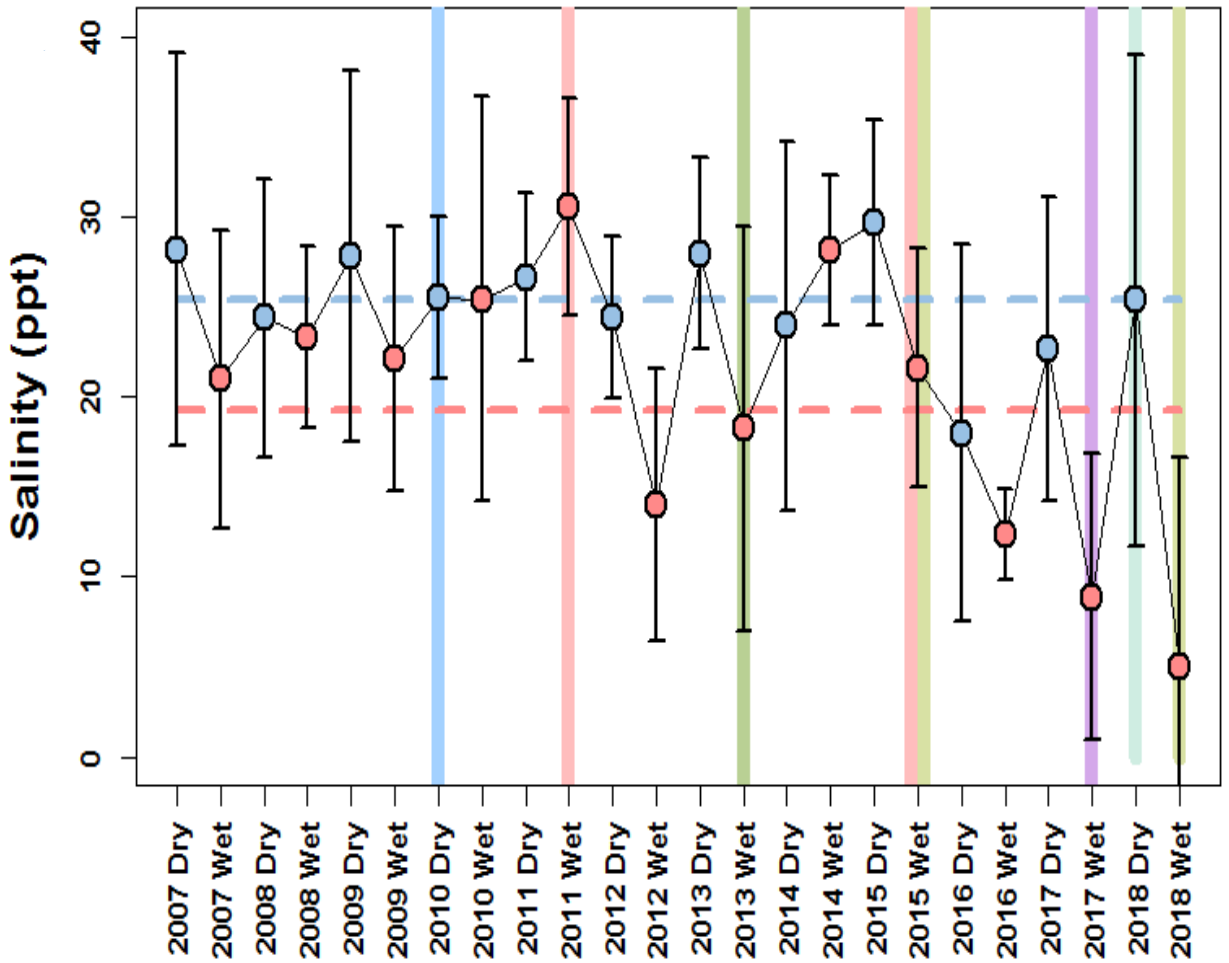
Good:

- **Significant relationships with season**
- **Significant relationships with sampling shift**
- **Significant relationships of decapod species abundance and all species abundance with hypersalinity**

Puzzling:

- **Why no discernable impact of Hurricane Irma?**
- **Why does Sargassum show up as significant?**
- **Why aren’t significant events consistent between fish and decapods?**

Some answers to our questions may lie here.




Thank you to
RECOVER, USACE,
and SFWMD