IBBEAM

Integrated Biscayne Bay Ecological Assessment and Monitoring Program

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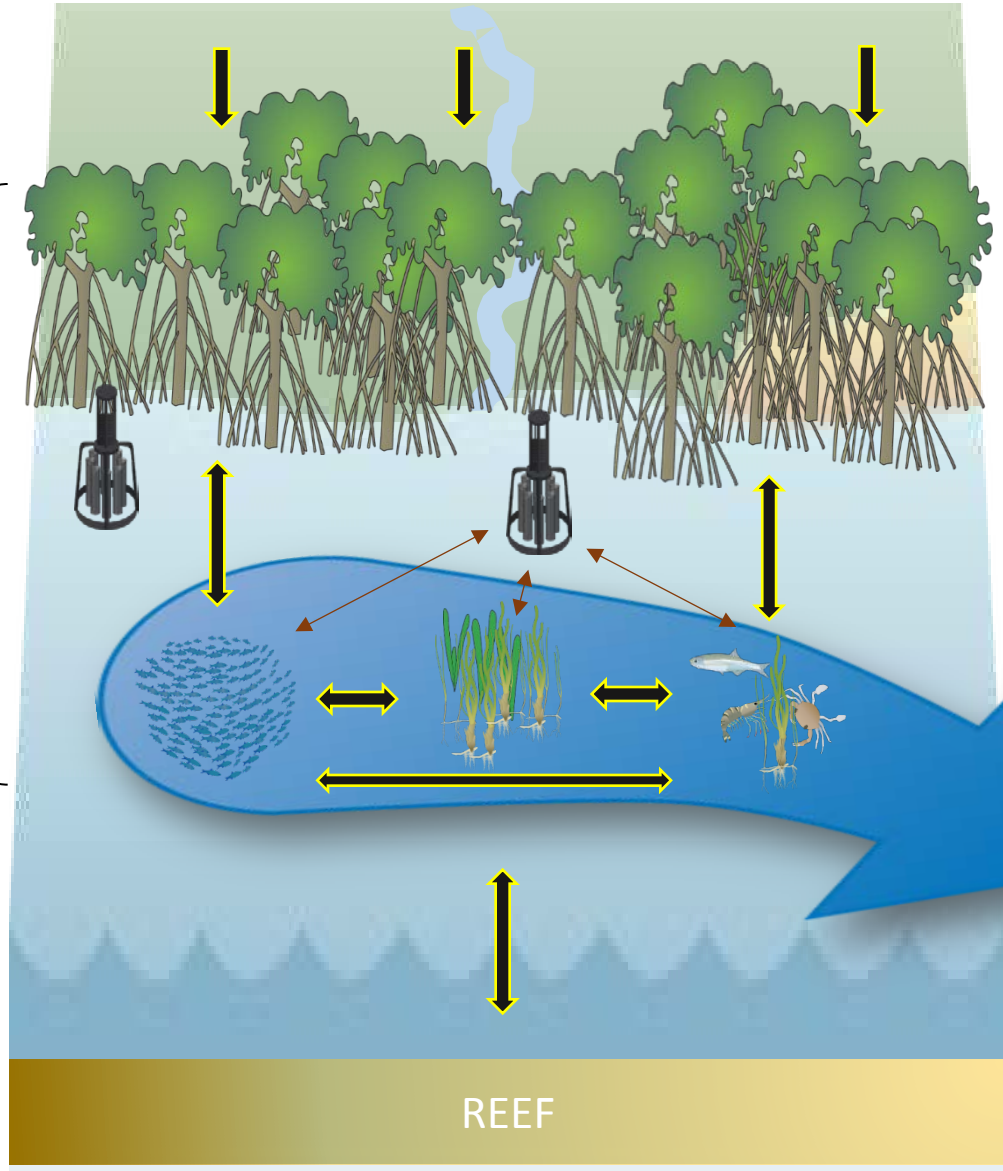
An integrated Ecosystem needs an integrated monitoring approach!!

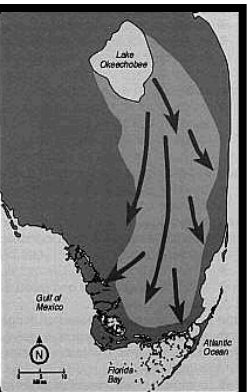
IBBEAM



WATER MANAGEMENT

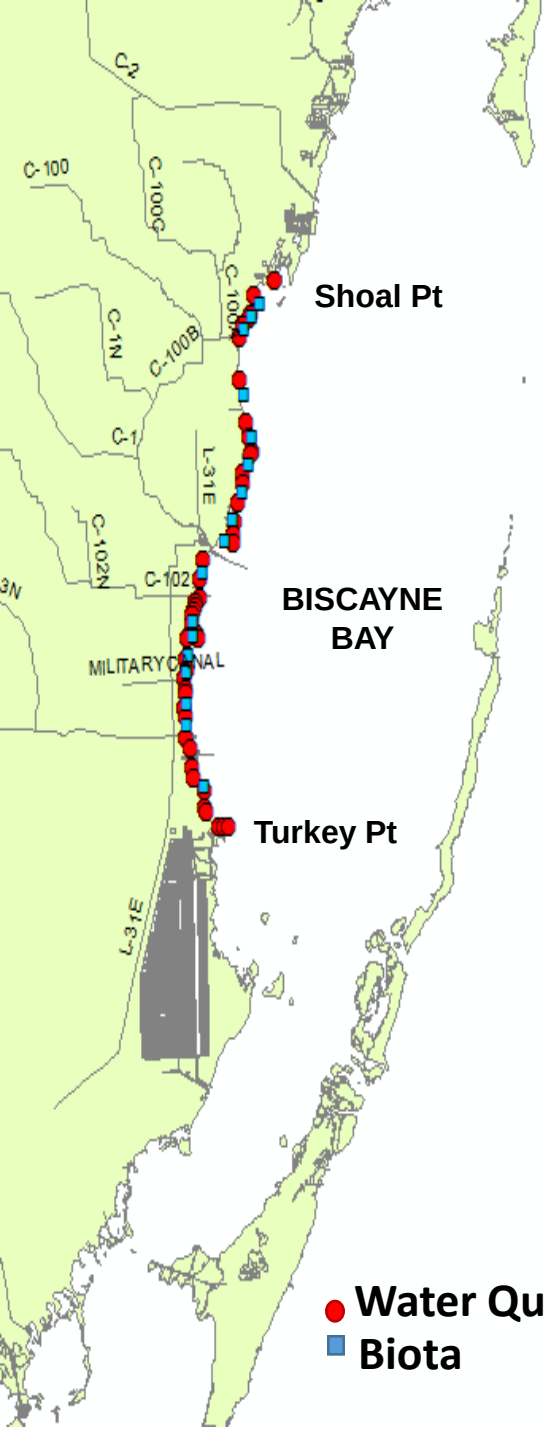
FRESH WATER / SALINITY

BIOTIC RESPONSES

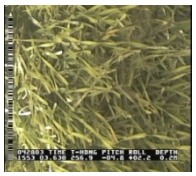


Direct Link to Ecosystem Services

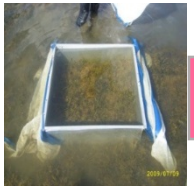
IBBEAM 47 CO-LOCATED SITES



Water Quality



SAV



Epifauna

Mangrove Fish

CERP
Comprehensive Everglades Restoration Plan

RECOVER
Restoration Coordination Verification

MAP
Monitoring and Assessment Plan

CERP

Get the Water Right

SALINITY GOALS FOR BISCAYNE BAY

Modify Freshwater flows TO:

1) Expand the Spatial Extent of mesohaline/estuarine conditions

2) Expand the Temporal Extent of mesohaline conditions

3) Reduce salinity fluctuations

4) Decrease frequency of hyperhaline events

ECOLOGICAL GOALS FOR BISCAYNE BAY

Improve salinity patterns along the shoreline TO:

1) Increase nearshore seagrass cover

2) Increase the cover of *Halodule and* reduce the over-dominance of *Thalassia*

3) Increase abundance and diversity of fish and invertebrate species associated with estuarine habitats

IBBEAM PRODUCTS

WE COLLECT AND DEVELOP:

SPATIALLY AND TEMPORALLY DETAILED BASELINES FOR KEY BIOTA

INTEGRATED ECOLOGICAL INDICATORS OF SALINITY PATTERNS

NOVEL SALINITY METRICS

USED TO:

Parameterize Salinity and Hydrodynamics Models

Determine status and trends

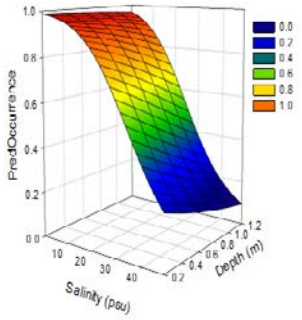
Enable before-after comparisons
- **storms,**
- **temp anomalies,**
- **CERP projects!**

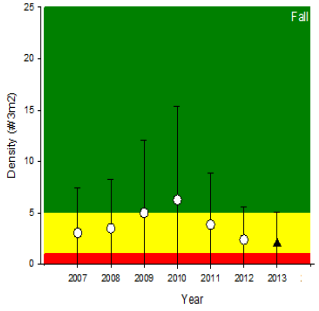
Develop performance measures for Adaptive Management

Build Habitat Suitability Models that can mesh with hydrodynamic models

Support Scenario Testing

Produce and Publish Strong Science in Support of CERP !!!





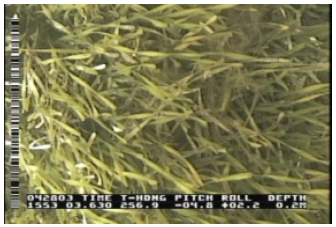
IBBEAM INDICATORS

Selection Guidelines:

Abundant
Representative
Ecologically, Commercially, or Recreationally Important
Responds to Salinity
Linked to CERP

Water quality	SAV	Epifauna	Mangrove Fish

• Salinity Index:
  • Mesohaline
  • Hyperhaline
  • Variability
  • Salinity Regime Suitability
	• Halodule and Thalassia:
	  • Percent Covert
	• Canopy Height
	• Spatial Extent
	• Dominance
		• Occurrence and Density of:
		  • Goldspotted killifish
		  • Pink shrimp
		  • Gulf pipefish
		  • Palaemonetes spp.
			• Occurrence and Density of:
			  • Goldspotted killifish
			  • Yellowfin mojarra
			  • Grey snapper



SALINITY METRICS

17 YSI probes
15-min data

TARGETS

↑ ***Mesohaline** – Proportion (P) of days with salinity ≥ 5 <18 psu*

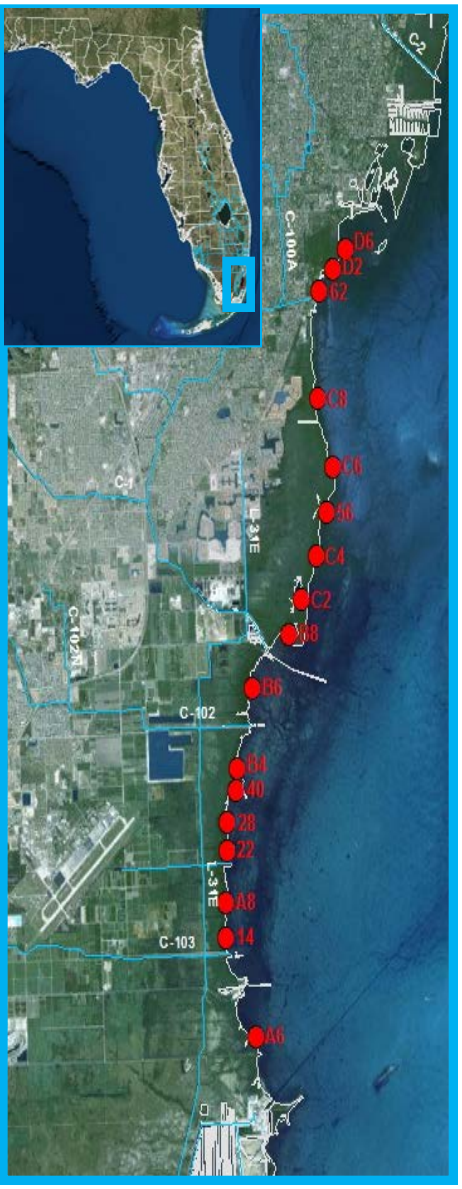
↓ ***Variability** – Proportion of days where salinity range is >5 psu per day*

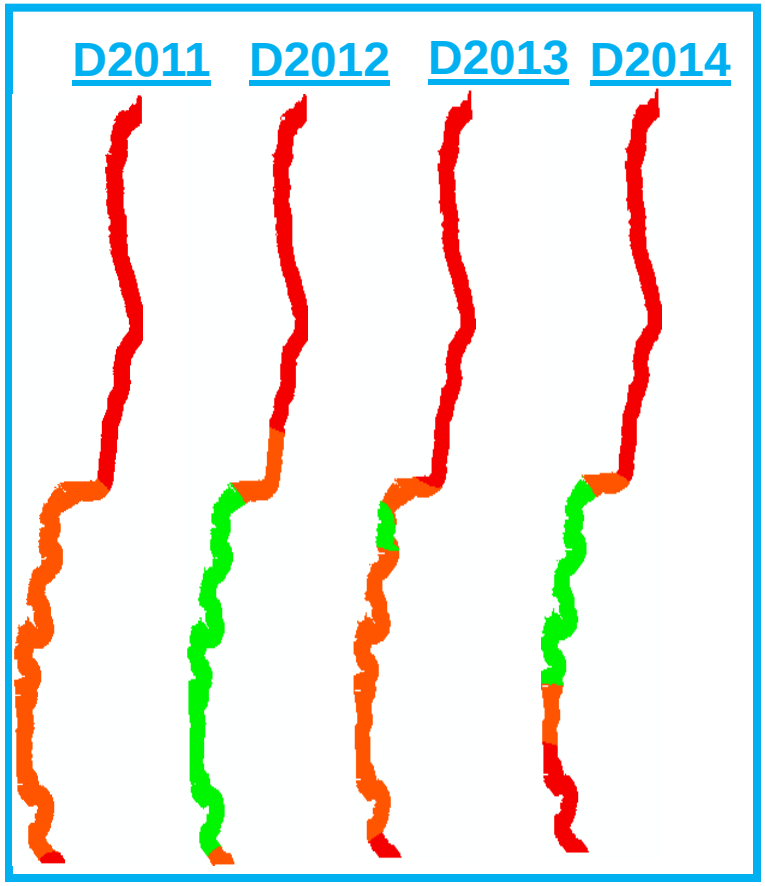
↓ ***Hyperhaline** – Proportion of days with salinity > 40 psu*

↑ ***Mesohaline Duration** – P of days with uninterrupted mesohaline conditions*

↓ ***Hyperhaline Duration** – P of days with uninterrupted hyperhaline conditions*

MESOHALINE INDEX (5-18 psu)



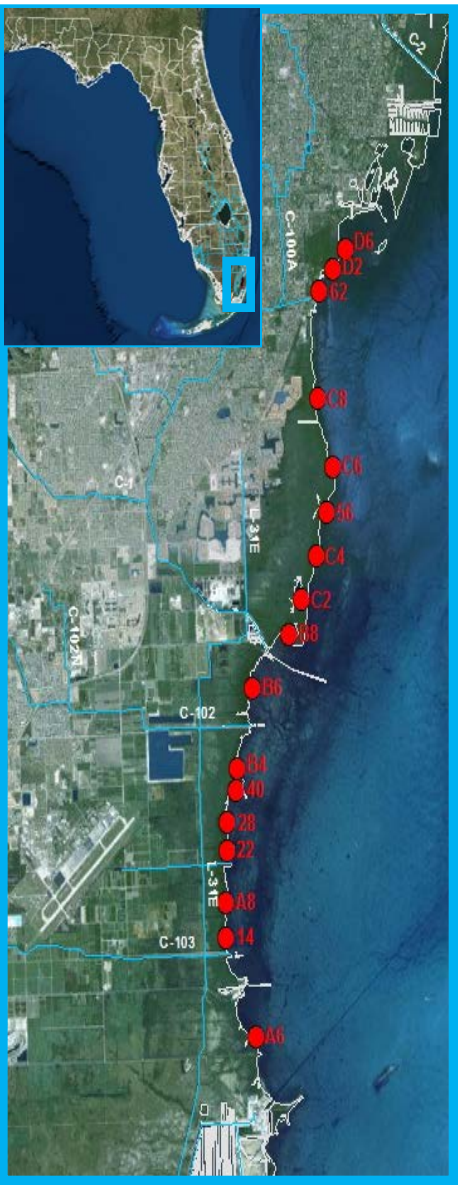


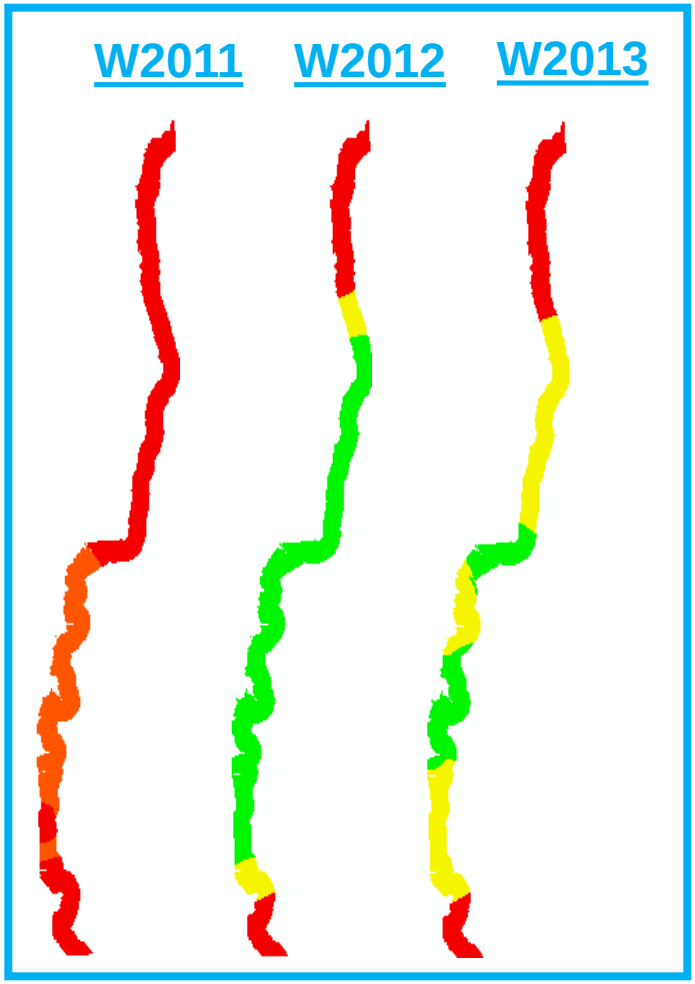
WYR	2011	2012	2013	2014
CYR	2010/11	2011/12	2012/13	2013/14
Month	Nov-Apr	Nov-Apr	Nov-Apr	Nov-Apr
Season	Dry	Dry	Dry	Dry
D6	0.000	0.003	0.000	0.000
D2	0.000	0.006	0.000	0.000
62	0.000	0.020	0.000	0.003
C8	0.000	0.032	0.000	0.008
C6	0.003	0.035	0.000	0.000
56	0.003	0.043	0.001	0.008
C4	0.002	0.054	0.000	0.014
C2	0.037	0.088	0.007	0.106
B8	0.047	0.135	0.011	0.168
B6	0.137	0.399	0.439	0.430
B4	0.137	0.541	0.202	0.420
40	0.135	0.532	0.172	0.398
28	0.108	0.432	0.116	0.335
22	0.115	0.455	0.110	0.294
A8	0.118	0.419	0.138	0.241
14	0.134	0.566	0.220	0.132
A6	0.036	0.180	0.008	0.028

- *In comparison to Reference Site*
  (Max mesohaline index value = 0.299 in dry season)

Color	MI
	Max Value
	50%
	Min Value

MESOHALINE INDEX (5-18 psu)





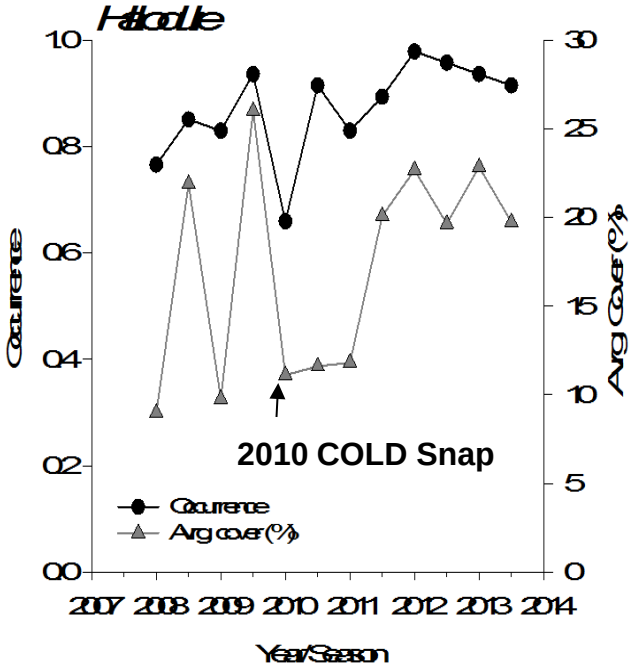
WYR	2012	2013	2014
CYR	2011	2012	2013
Month	May-Oct	May-Oct	May-Oct
Season	Wet	Wet	Wet
D6	0.012	0.078	0.072
D2	0.005	0.072	0.075
62	0.019	0.248	0.216
C8	0.024	0.338	0.220
C6	0.032	0.579	0.383
56	0.070	0.646	0.445
C4	0.088	0.651	0.498
C2	0.186	0.688	0.418
B8	0.063	0.778	0.721
B6	0.366	0.666	0.534
B4	0.280	0.738	0.564
40	0.371	0.827	0.732
28	0.228	0.778	0.586
22	0.246	0.722	0.600
A8	0.190	0.605	0.512
14	0.212	0.568	0.535
A6	0.064	0.219	0.086

Color	MI
	Max Value
	50%
	Min Value

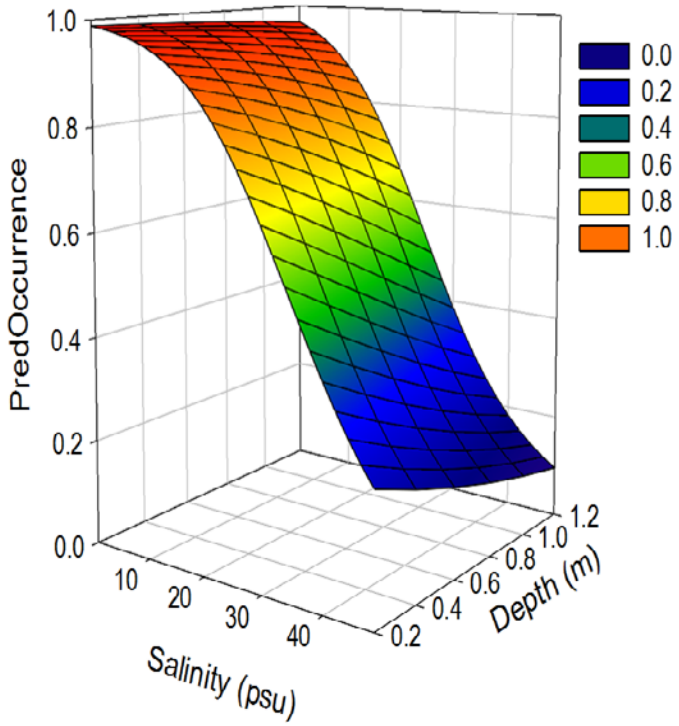
- *In comparison to Reference Site*
  (Max mesohaline index value = 0.818 in wet season)

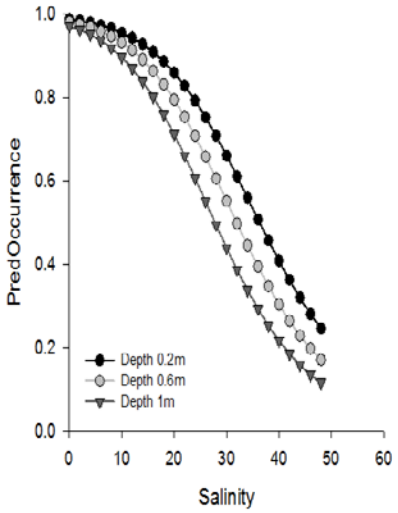
SUBMERGED AQUATIC VEGETATION (SAV) → *Halodule*

Temporal Trajectory



Bio-Physical Relationships



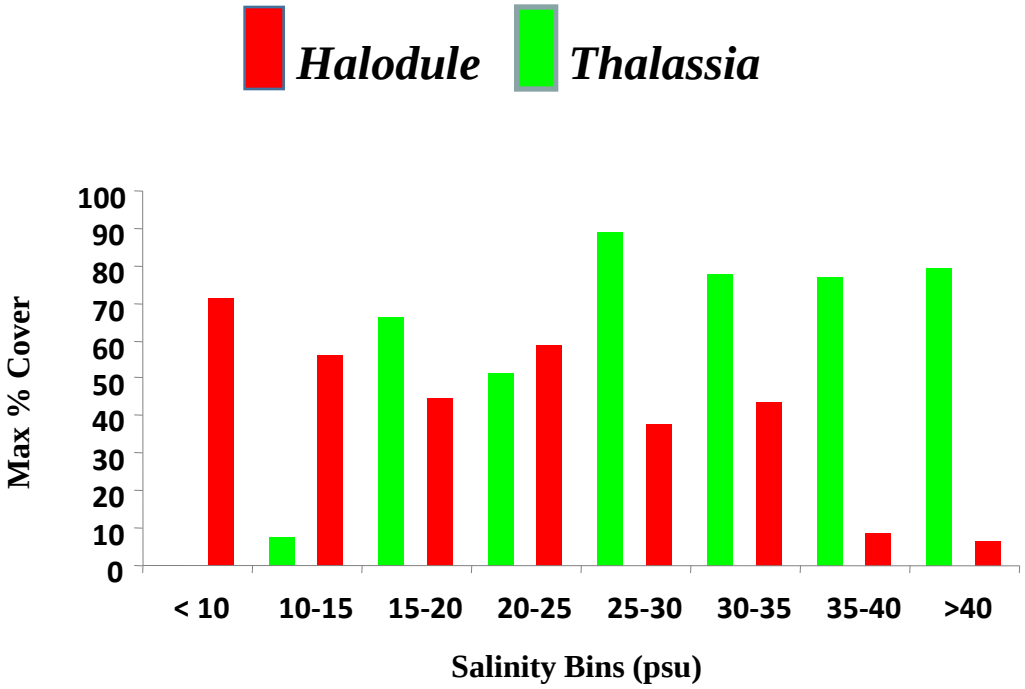


Multiple Regression Approach:

Halodule Occurrence = **Sal** * Depth * Temp * **Sal²** * Depth² * Temp²

$p \leq 0.05$

Goal: Increase SG cover by creating Mesohaline conditions …….

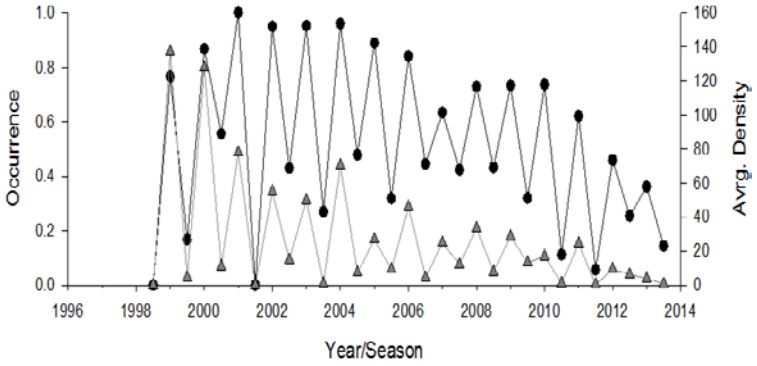


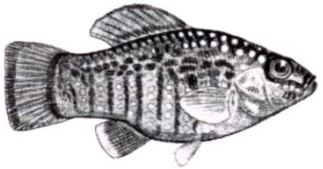
The combined mean cover of *Thalassia* and *Halodule* when both species are present (23%) is higher than the cover when only one of the species is present (17.4 % for *Thalassia* and 19.7 for *Halodule*)

Creating salinity climates that are conducive to the co-occurrence of both species is one way to achieve the goal of increased seagrass cover

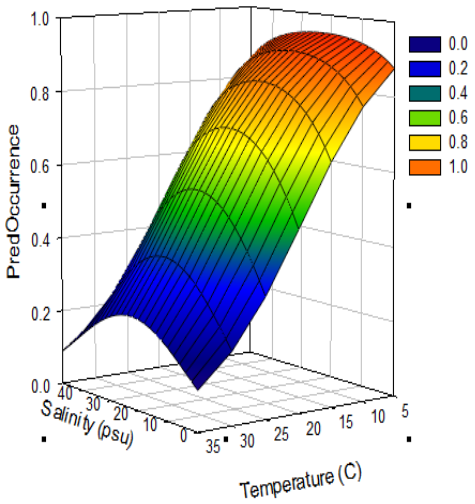
MANGROVE FISH (MF) → Goldspotted killifish

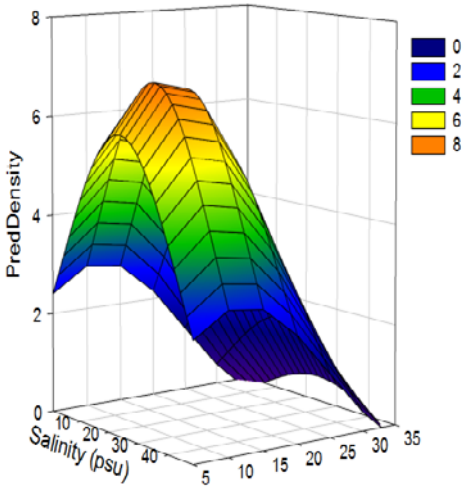
Temporal Trajectory

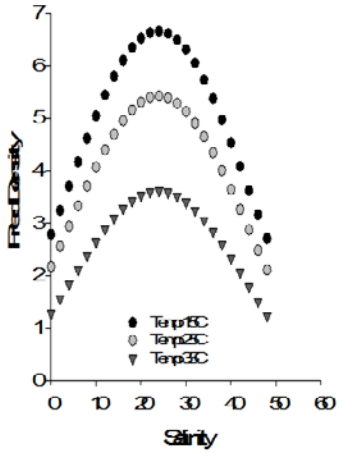


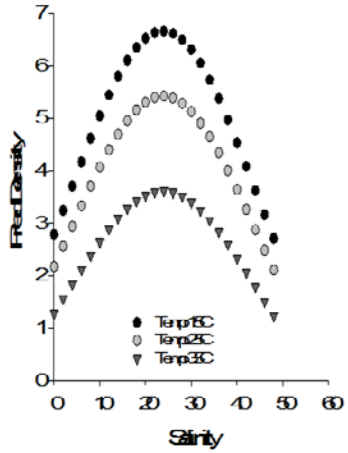


Bio-Physical Relationships







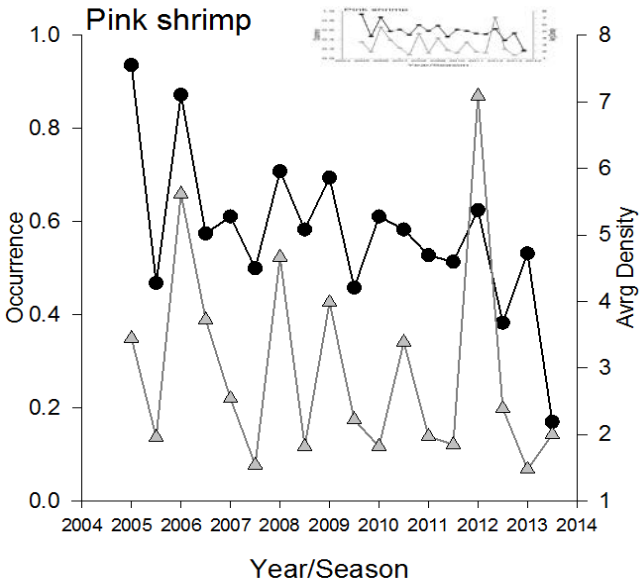


Occurrence/Density = **Sal** * Depth * Temp * **Sal²** * Depth² * Temp²

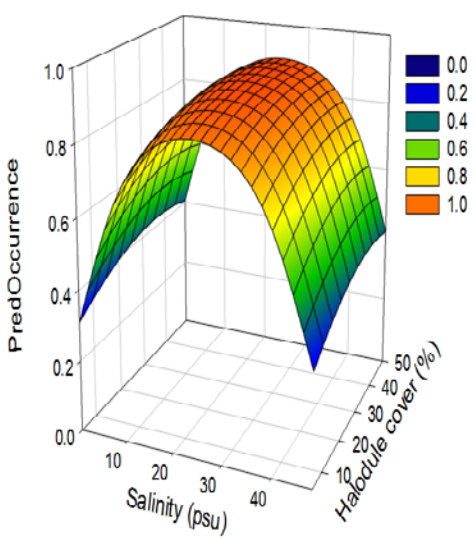
p ≤ 0.05

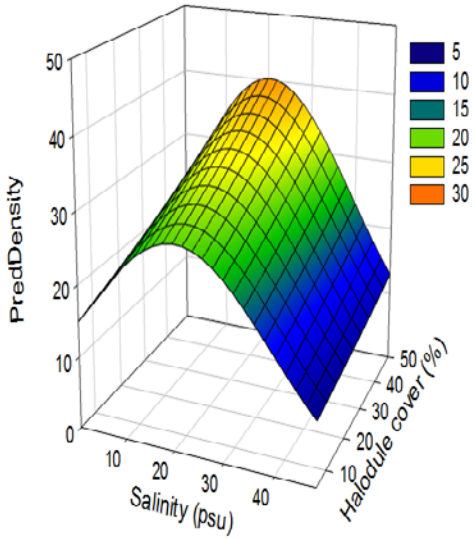
EPIFAUNAL COMMUNITY (EPI) → Pink Shrimp

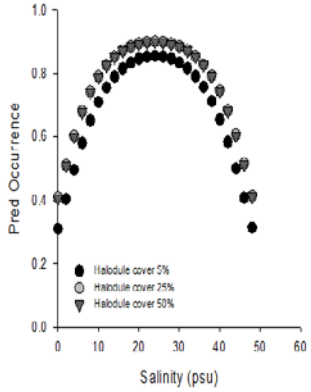
Temporal Trajectory

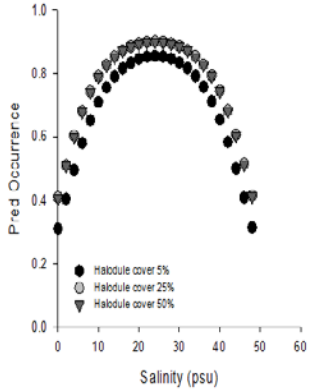


Bio-Physical Relationships







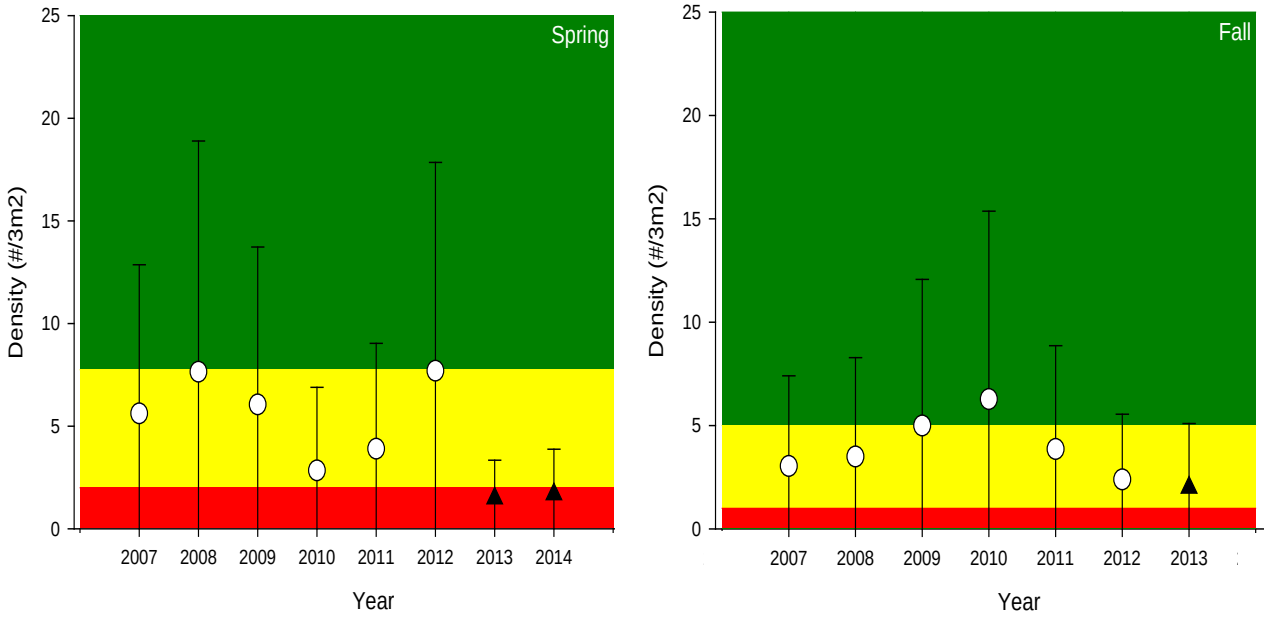


Occurrence/Density = **Sal** * Depth * Temp * Canopy * Hal * Thal ***Sal²** * Depth² * Temp² * Canopy² * Hal² * Thal²

p ≤ 0.05

EPIFAUNAL COMMUNITY (EPI) → Pink Shrimp

Stop-light pink shrimp status



SECTION OF '2014 ECOLOGICAL INDICATORS REPORT'

SUMMARY

SAV

- Habitat suitability models incorporating CYR 2008-2015 data reflect an affinity for low salinity by *Halodule* and high salinity by *Thalassia that is reflected in their spatial distribution*.
- Current models suggest that increased mesohaline conditions, a desired target of CERP, will increase overall seagrass abundance and support co-dominance by *Halodule* and *Thalassia*.

SUMMARY

Epifaunal Community

- No clear historical patterns of expansion or contraction of the focal species.
- Salinity is a significant factor for focal epifaunal species goldspotted killifish, gulf pipefish, *Farfantepenaeus* and *Palaemonetes* spp.
- Negative linear relationships with salinity were apparent for seagrass-associated goldspotted killifish and *Palaemonetes* spp. abundances, whereas dome-shaped parabolic relationships with salinity were apparent for gulf pipefish and *Farfantepenaeus* abundances
- *Halodule* cover had a positive influence on abundance of each of the four focal species.

SUMMARY

Mangrove Fish

- The time series for mangrove-associated goldspotted killifish suggests an overall, general decline from CYR 2006 through CYR 2015. The decrease in density is particularly pronounced.
- The temporal trajectory of mangrove-associated gray snapper shifted from a slightly negative trend from CYR 1998 - 2005 to a markedly positive trend thereafter.
- No clear patterns of historical expansion or contraction of the three focal species.
- Parabolic abundance-salinity relationships for mangrove-associated goldspotted killifish and yellowfin mojarra emerged with maximum abundances at intermediate (20-25 psu) salinity levels. In contrast, gray snapper habitat suitability was positively linearly correlated with salinity.