Predicting Changes in Estuarine Submerged Aquatic Vegetation Distribution from Increased Freshwater Delivery

Thomas A. Frankovich[1], Frank Marshall[2], Mark Zucker[3], Steve Kelly[4], and James W. Fourqurean[1]

[1] Florida International University
[2] Cetacean Logic Foundation
[3] U.S. Geological Survey
[4] South Florida Water Management District

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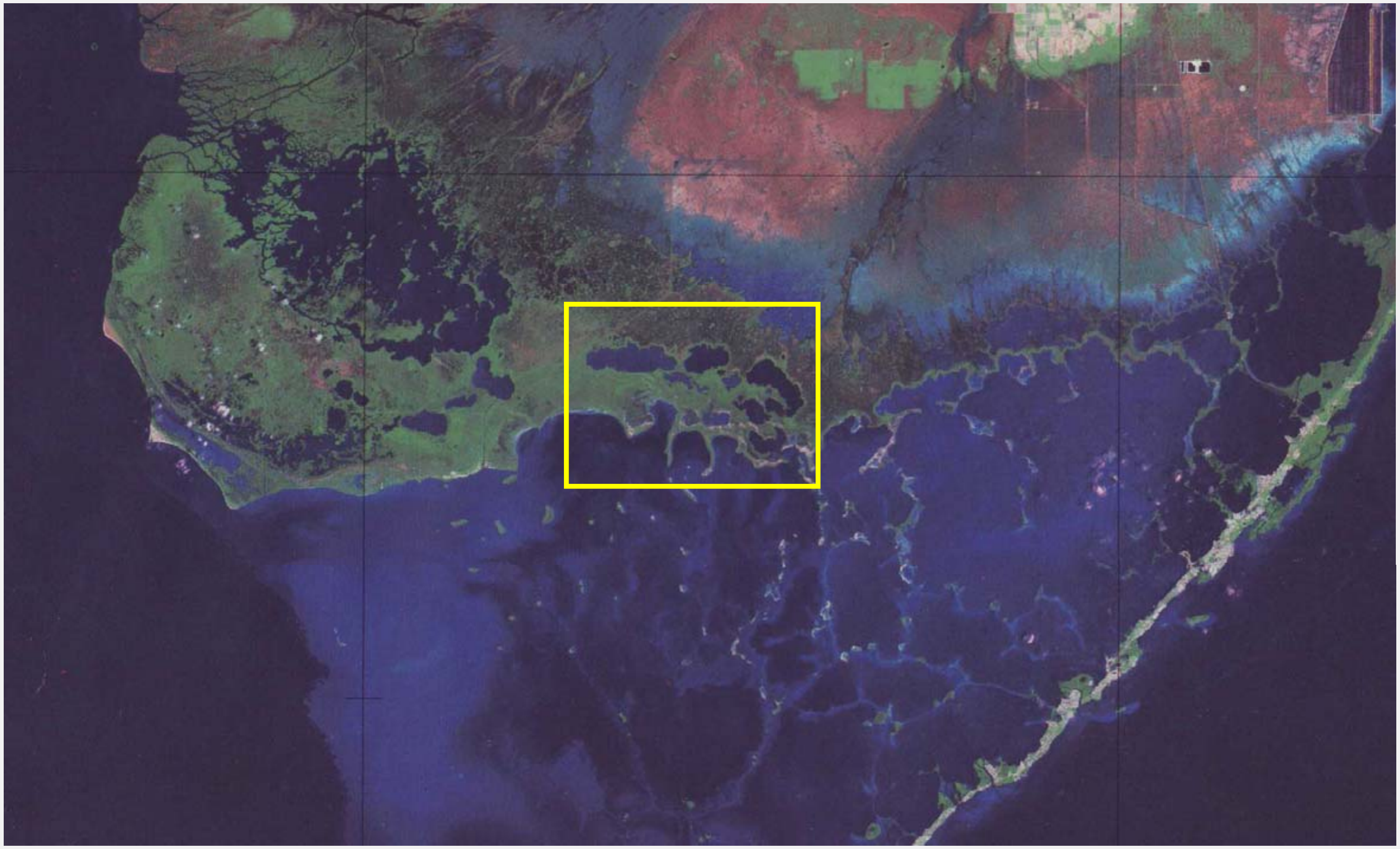
Bill Perry, NPS

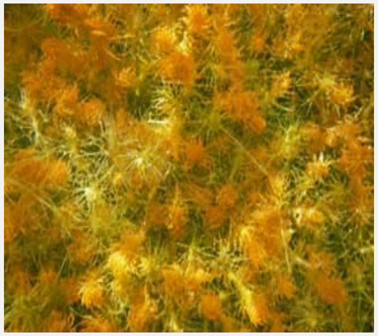
Where are the Mangrove Lakes?



The Mangrove Lakes are located in the mangrove estuaries between Florida Bay and the Everglades marsh

The Mangrove Lakes are :

Shallow (1.8m max) with extensive SAV beds (historically)



Chara hornemannii

Ruppia maritima and American coots

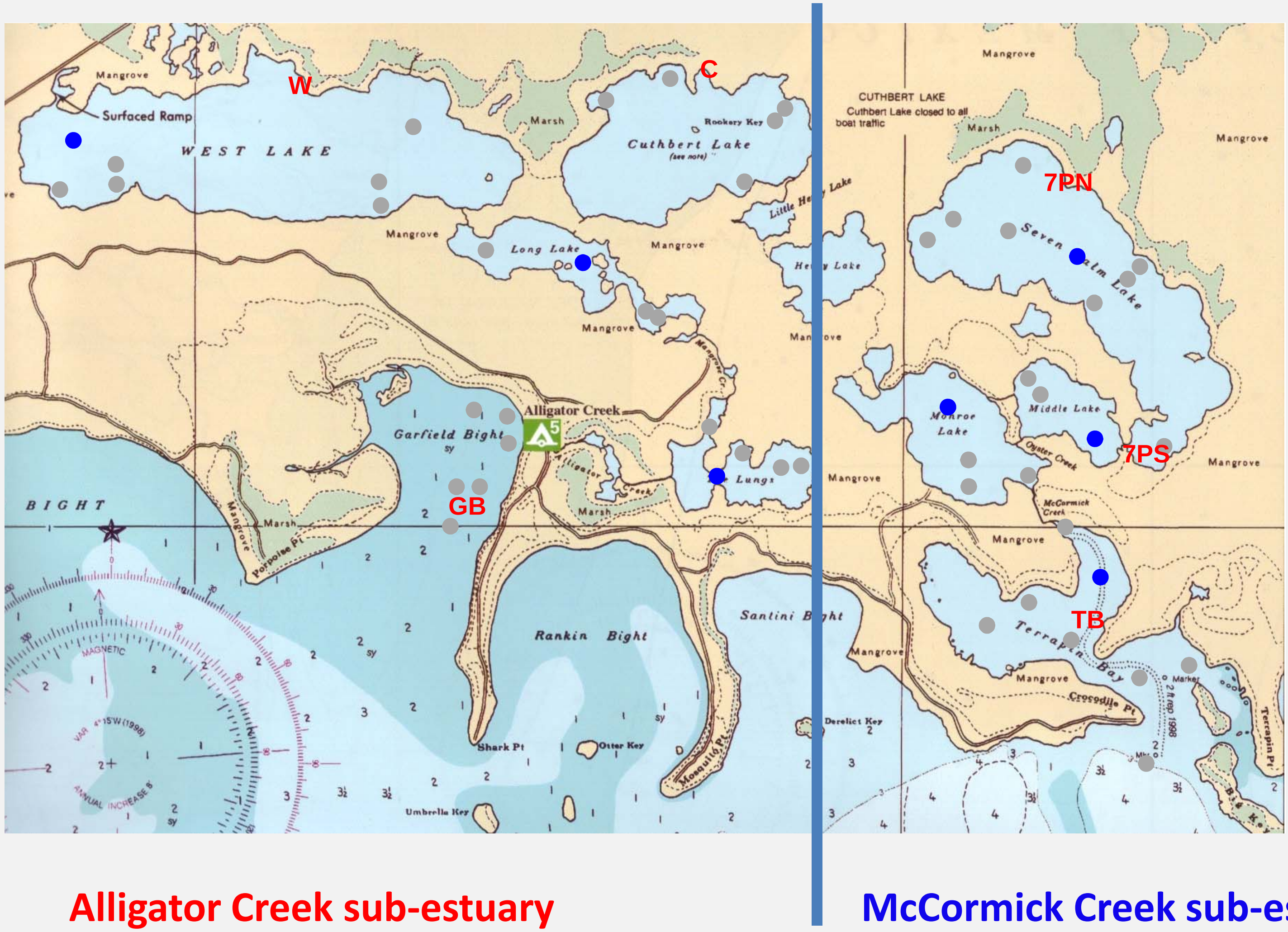
Wintering ducks

Ecosystems affected by reduced freshwater inflows exhibiting:

- estimated 20-30 psu mean salinity increase (McIvor et al. 1994)
- persistent phytoplankton blooms (up to 130 µg Chl a L^{-1})
- reduced SAV cover

The Mangrove Lakes are critical habitats once characterized by extensive SAV beds

Study Sites



Alligator Creek sub-estuary

McCormick Creek sub-estuary

SAV and WQ monitoring since 2006

Sites used in habitat requirement model, Salinity sondes

SAV and WQ measures

SAV % cover, quarterly
- by species

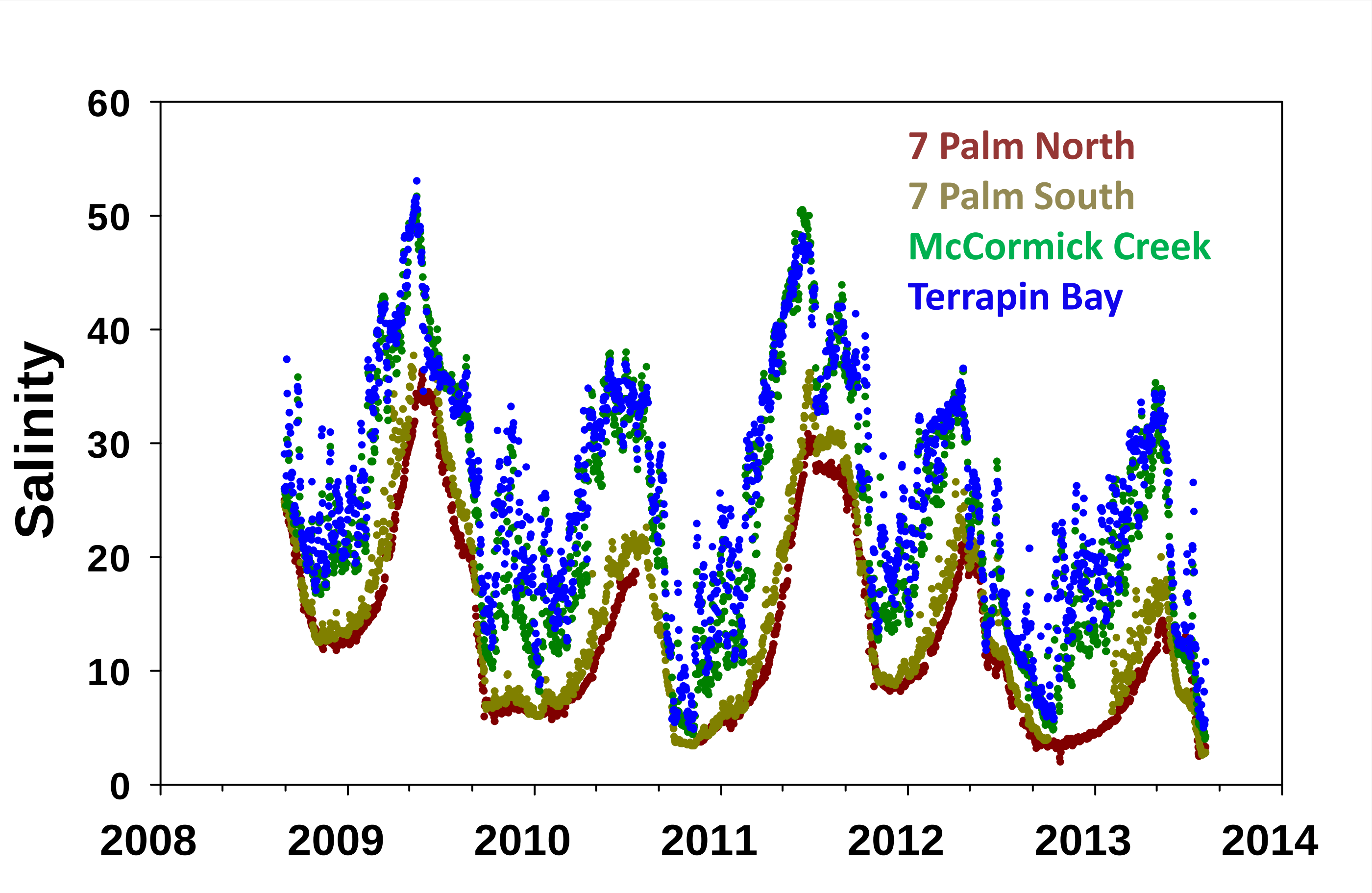
Sediment Depth

WQ monitoring, monthly to bi-monthly
- temperature, salinity
- TotN, TotP, Phytoplankton chl-a
- Light attenuation (K_d), water depth ⟶ %Light@bottom
- Turbidity, CDOM

Hourly water temperature, Salinity, and water level
- datasondes in West Lake, Cuthbert Lake, 7 Palms Lake

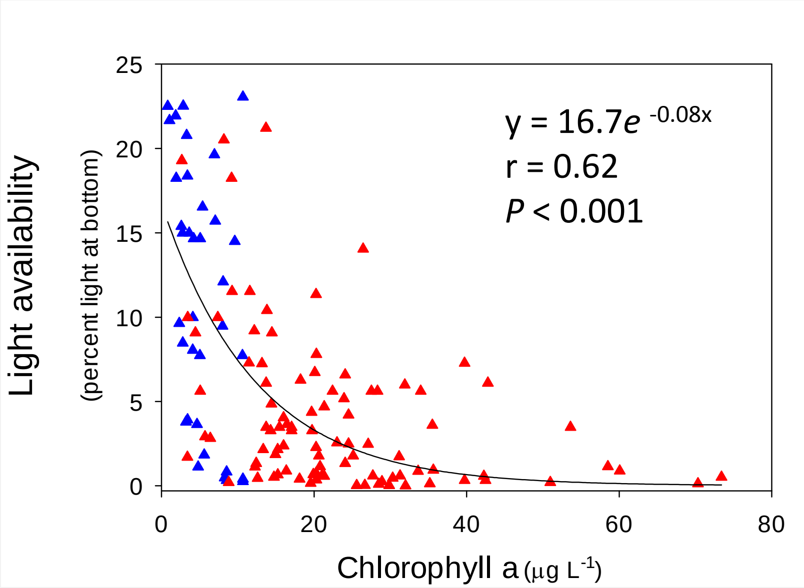
SAV cover, Sediment depth, %Light@bottom
used in habitat requirement model

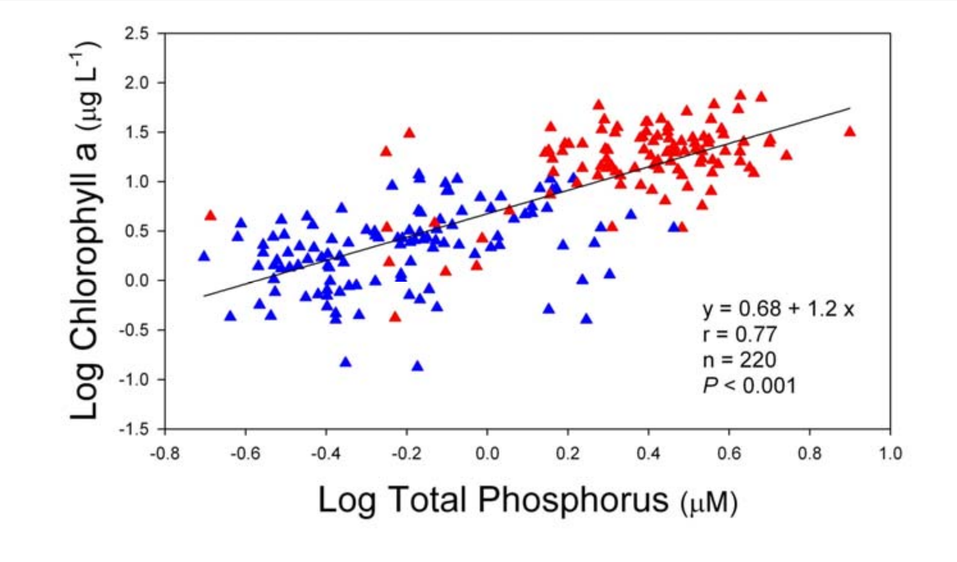
Salinity Climate



Salinity varies along estuarine gradient and exhibits pronounced seasonality

Light and Nutrient Climate

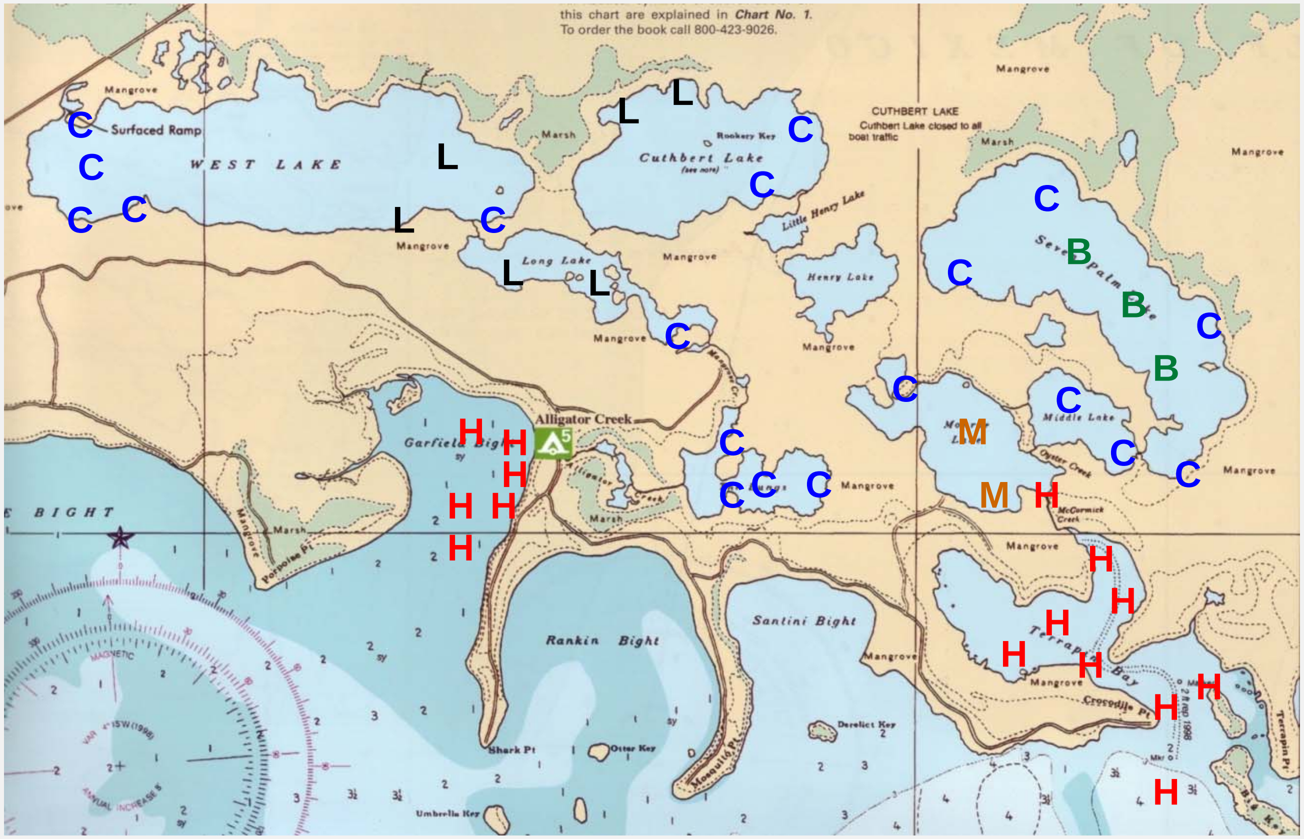




Alligator Creek sub-estuary
McCormick Creek sub-estuary

Distinct differences in light availability, nutrients, and phytoplankton abundance between sub-estuaries.

Community group spatial distribution



Chara occurs in upstream lakes, *Halodule* occurs in coastal embayments

Mix and Bedrock communities only in McCormick sub-estuary.

Low SAV (mud bottom) confined to western drainage

Community and Habitat analyses – data matrix construction

Data matrix construction

Time period: August 1 2008 – April 30 2014

Variables: SAV cover, Salinity (mean, CV), %Light, Sed. Depth, TN, TP, and Chl a

Water year seasonal means calculated for each variable (y):

Year (xxxx), Season, (SS) Site, Variable mean (y)

Seasons: Early Wet (May – Jul), Late Wet (Aug – Oct),
Early Dry (Nov – Jan), Late Dry (Feb - Apr)

Cases with missing seasonal means removed

86 complete cases available for community and habitat analyses

Identification of SAV community groups

Cluster and Similarity Profile tests (SAV cover data only) identified 5 groups:

- *Chara* (high cover)
- *Halodule / Batophora* (high cover)
- Hard bottom (low cover)
- Unvegetated/low *Ruppia* cover soft bottom
- Low *Chara / Halodule* mix

Habitat requirement model – Discriminant Function Analysis (DFA)

Stepwise DFA

Sed. Depth, mean salinity, salinity CV, %Light
entered into model

Completed model:

Sed. Depth, %Light, mean salinity selected by model as useful in discriminating community groups

67% of cases correctly classified to community groups versus 20% accuracy expected by chance

DFA was successful in relating environmental habitat variables to SAV community groups

Relative importance of habitat variables in DFA

	Correlation Sed. Depth	Correlation % Light	Correlation mean Salinity	% of variance
DF1	0.97	0.30	0.37	74.3
DF2	0.07	0.95	0.21	18.6
DF3	-0.23	-0.05	0.91	7.1

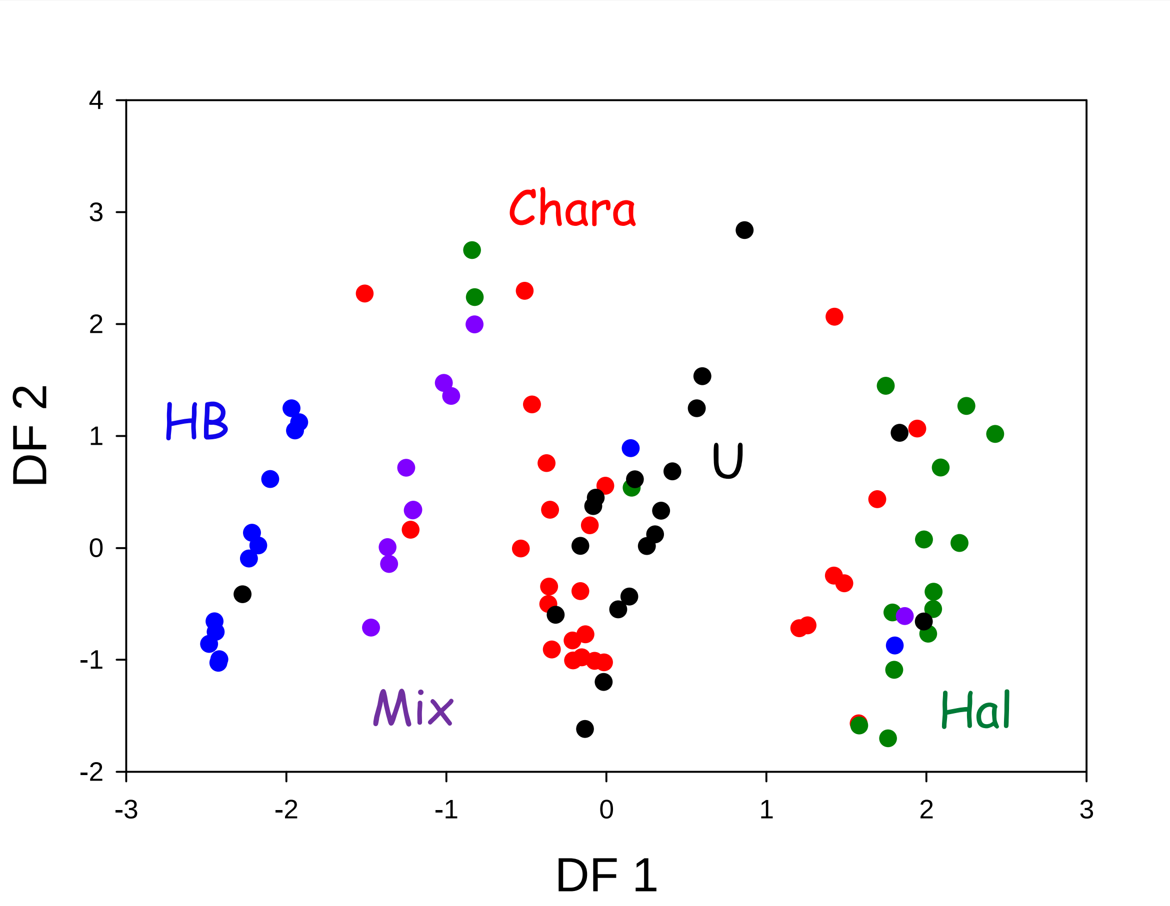
Sediment Depth >> %Light at bottom and mean Salinity in accounting of variance in DF model

Classification accuracy of individual SAV groups

SAV group	Prior Prob. (%)	Correctly Classified (%)	Highest % Incorrect group
1 *Chara*	31	59	4
2 *Halodule/ Batophora*	19	81	4
3 Hard bottom	16	79	1, 2, 5
4 Unvegetated	22	79	2
5 Low *Chara/ Halodule* Mix	12	30	3, 4

Model classification of all SAV groups better than chance.
Poor classification of Mix group may reflect inequilibrium.

DFA ordination plot



Increasing Sediment depth → , r = 0.97

Sediment depth dominates separation of SAV groups
Relationships with light and salinity are distorted!

Conclusions/ Next Steps

1 Remove hard bottom sites from data matrix

2 Add additional cases, focusing on salinity, salinity CV, and light

3 Rerun model with new data matrix

4 Use discriminant functions to produce predictive model of future SAV groups

5 Construct new data matrix with new salinity and light climates predicted for anticipated increases in freshwater deliveries.

6 Run predictive model to predict changes in SAV distribution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