Multivariate Methodology Assessment

Final Report on the Mission and Aransas Rivers

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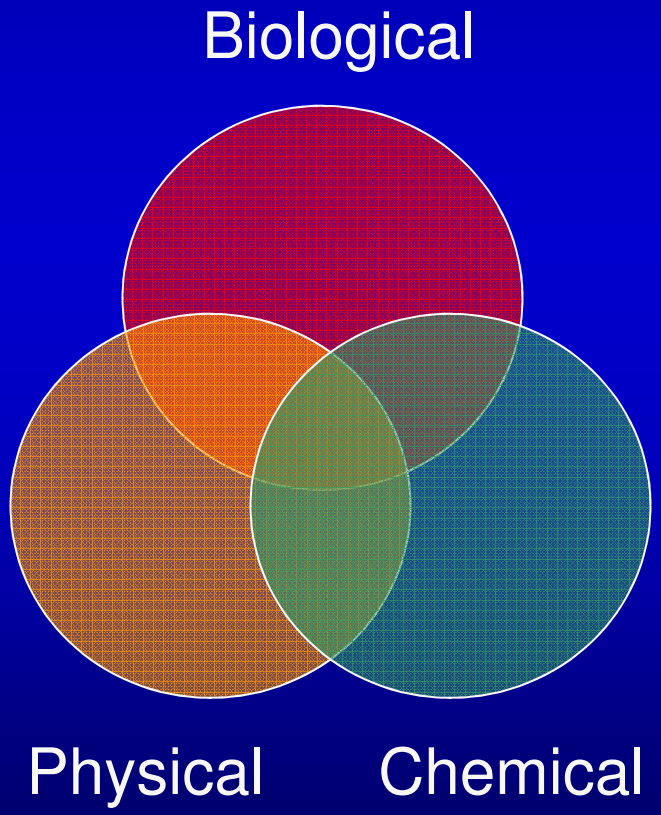
Janet Nelson

TPWD – Coastal Fisheries

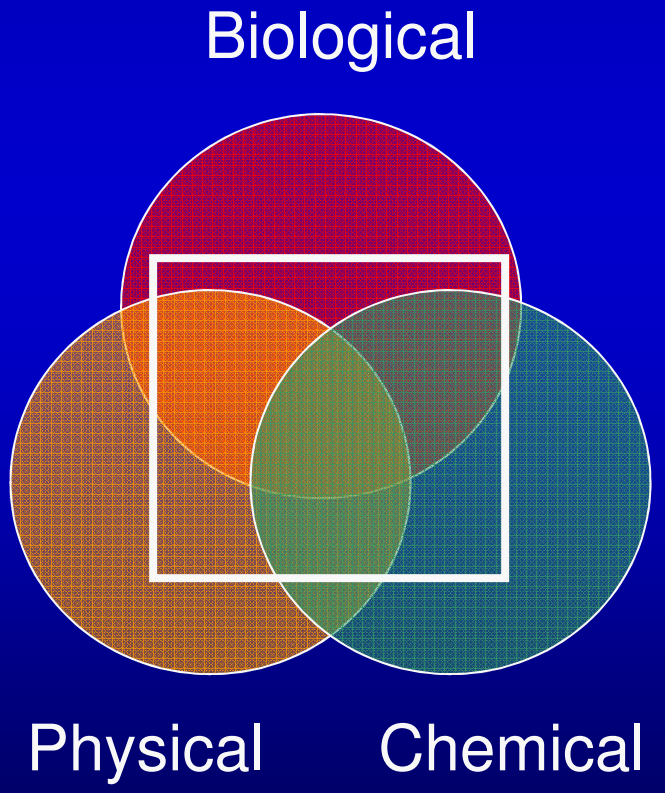
Scope of Work

- Physicochemical measurements
- Water and sediment quality
- Flow measurements
- Nekton and benthic sampling
- Instream and riparian habitat classification
- Land cover classification



Assessment Methodology

- Multivariate, community-based
  - Resemblance matrix
- Highly visual techniques
  - Cluster Analysis, MDS, PCA
- Analysis based on bootstrap permutations
  - ANOSIM, SIMPER, RELATE



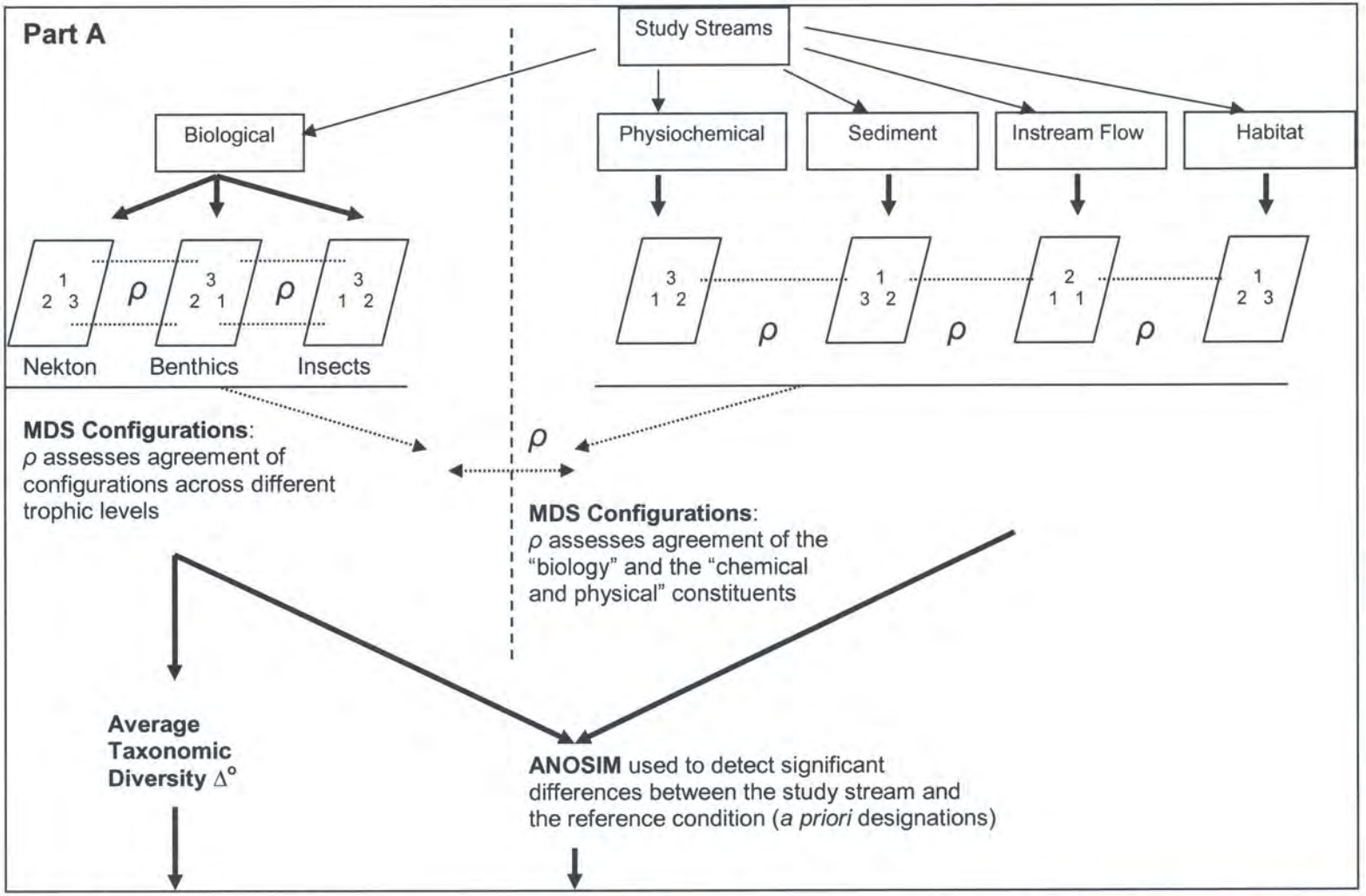
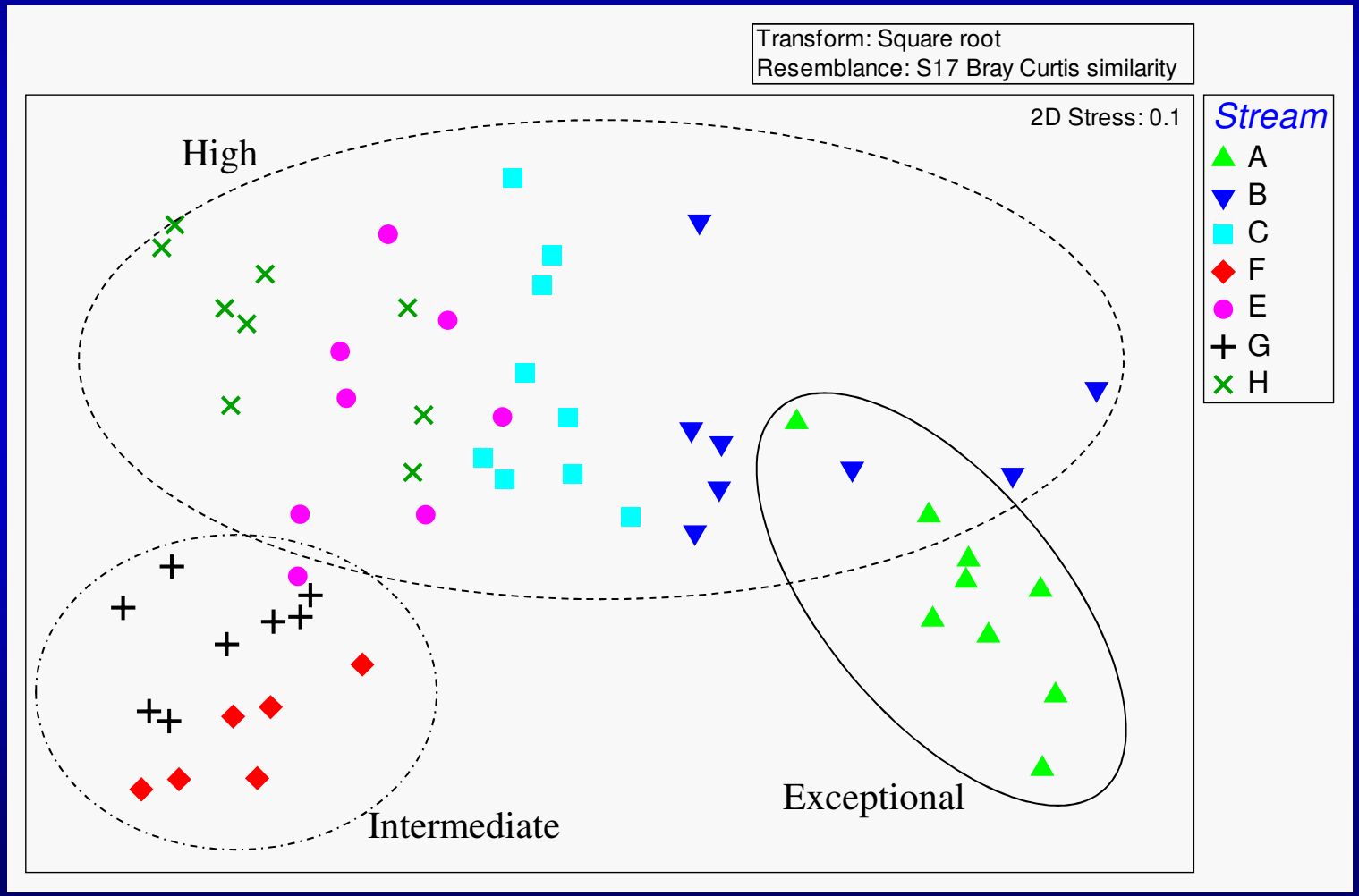
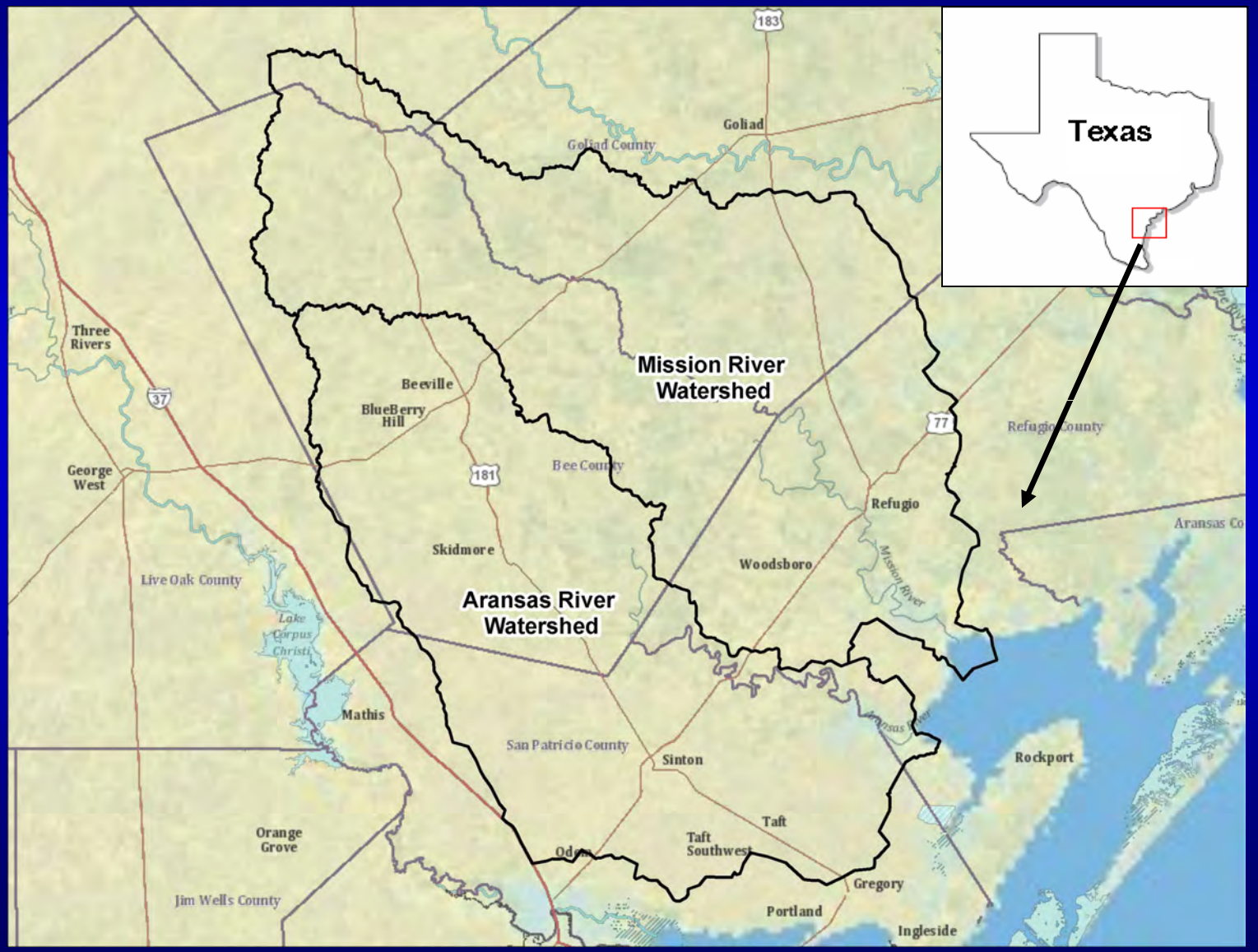


Figure 9. The process for assessing ecosystem health and determining biocriteria in tidally influenced streams.

Theoretical MDS – Impaired Waterbody



Geographic Setting



Segment 2001
- 1 permitted discharger into the Tidal Segment,
- 2 permitted dischargers above the Tidal Segment

Mission River

1 = Upper

Mission 1

Mission 2

Mission 3

Upstream

Downstream

Segment 2003
- 4 permitted dischargers
  all well Upstream
- 5 permitted dischargers below the
  Tidal Segment via Chiltipin Creek

Aransas River

1 = Upper

Aransas 1

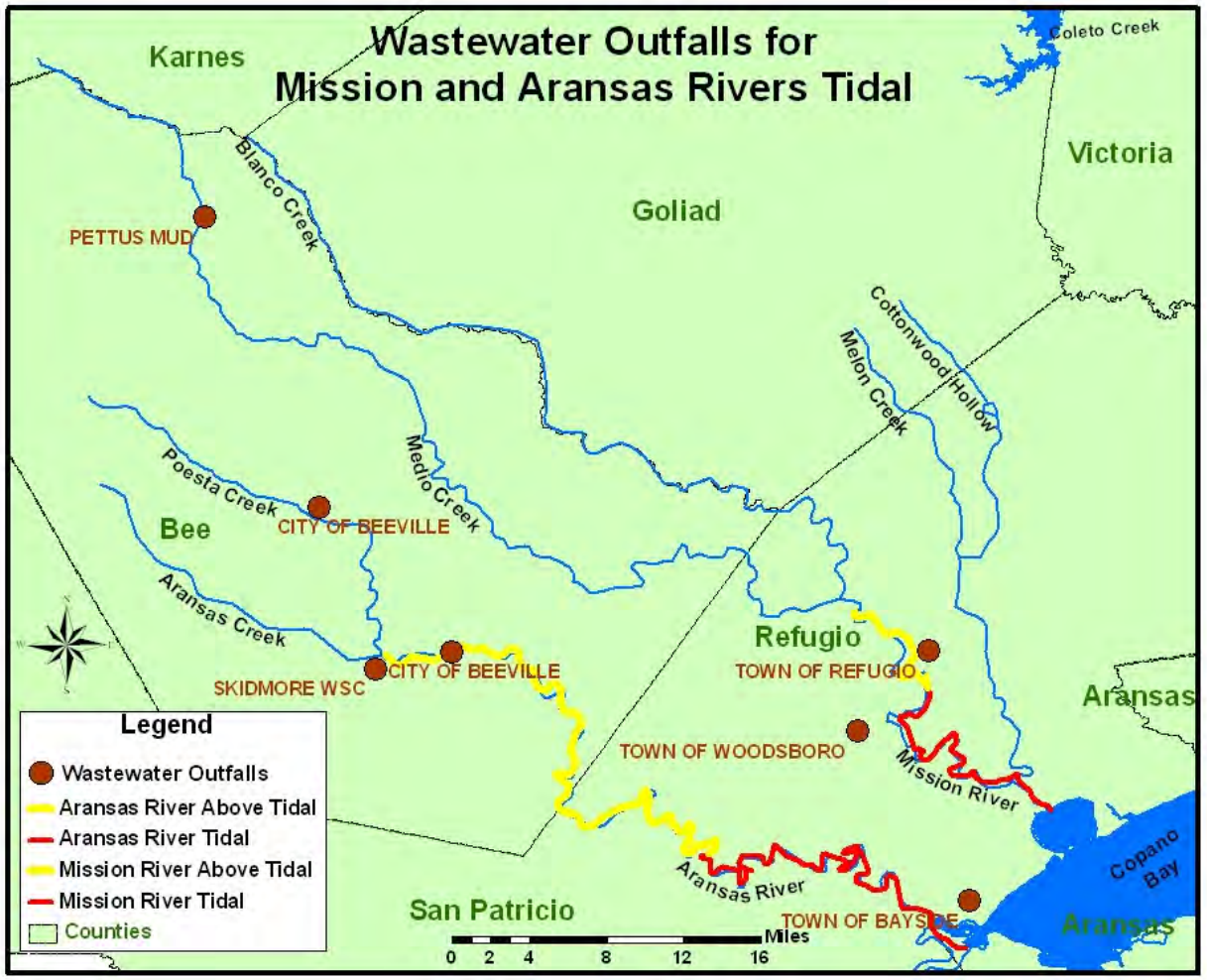
Aransas 2

Aransas 3

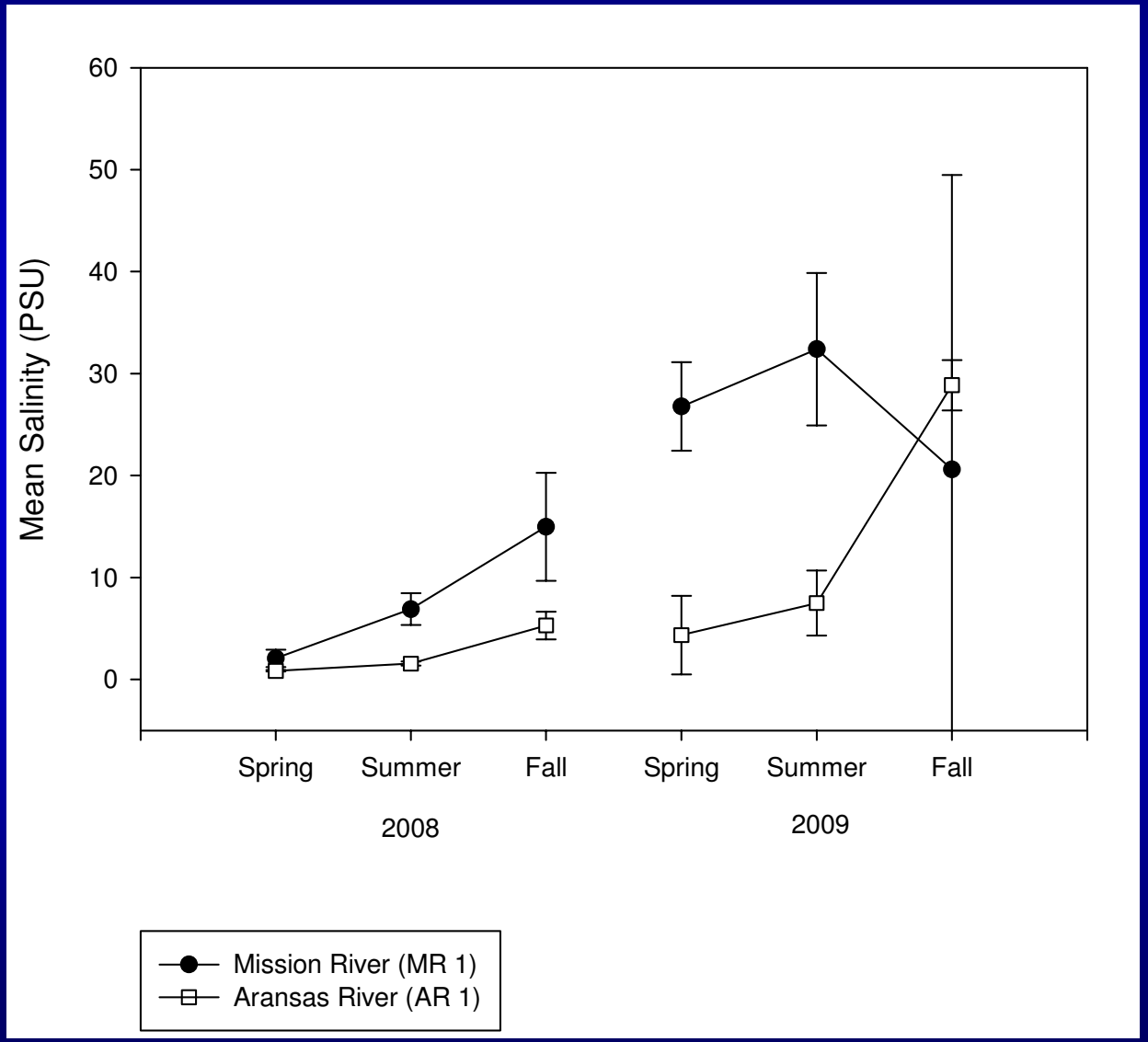
Upstream

Downstream

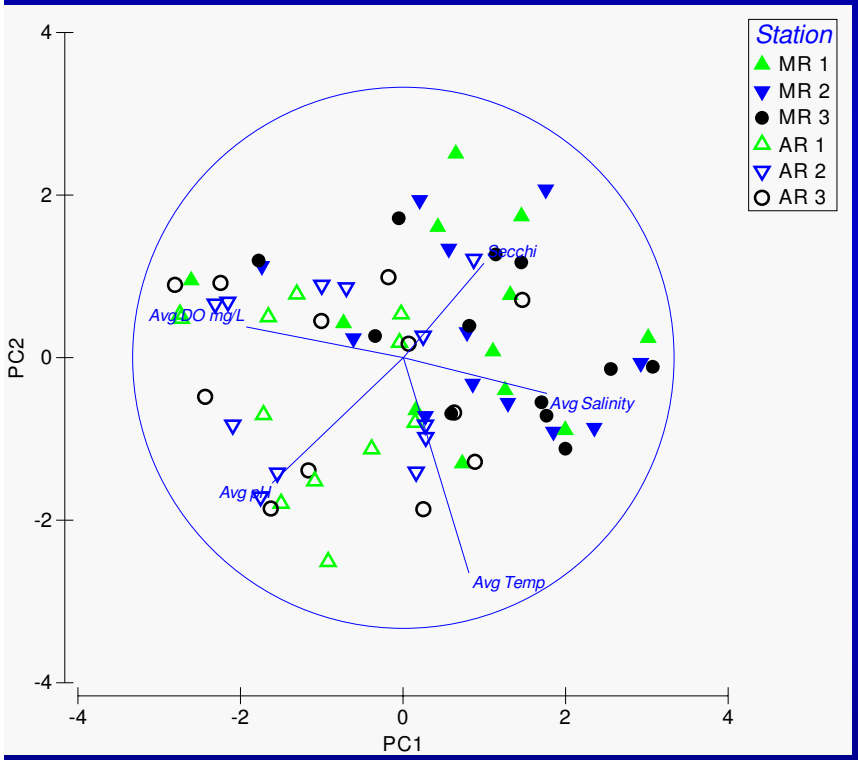
Wastewater Outfalls



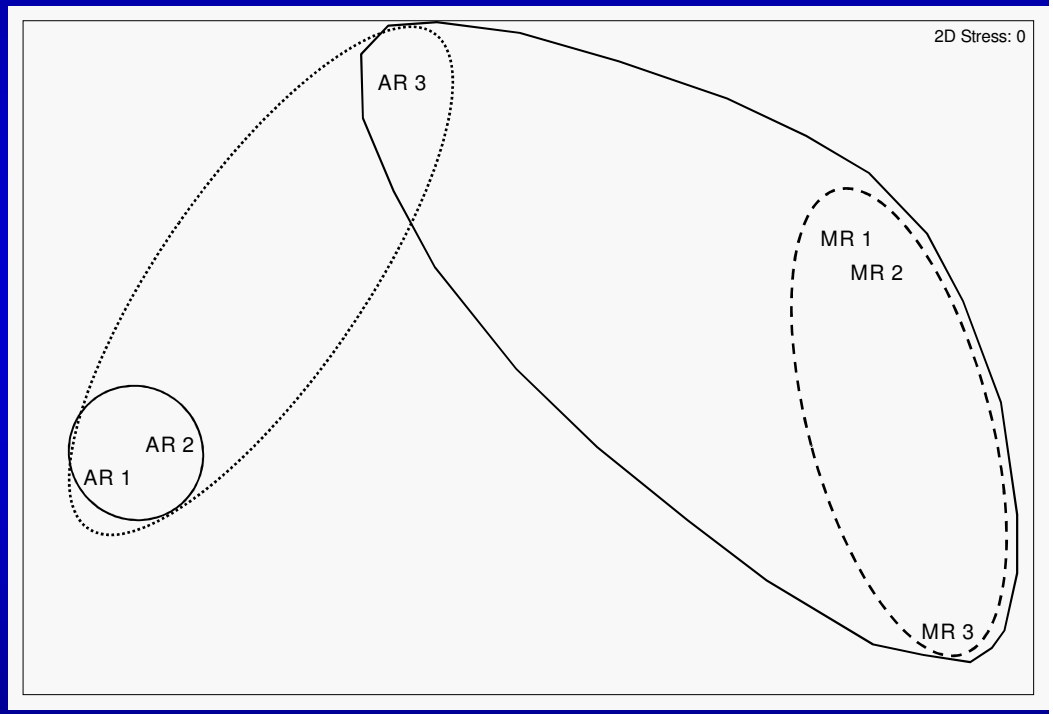
M-A Study = Drought



Water Column Profiles (Surface)

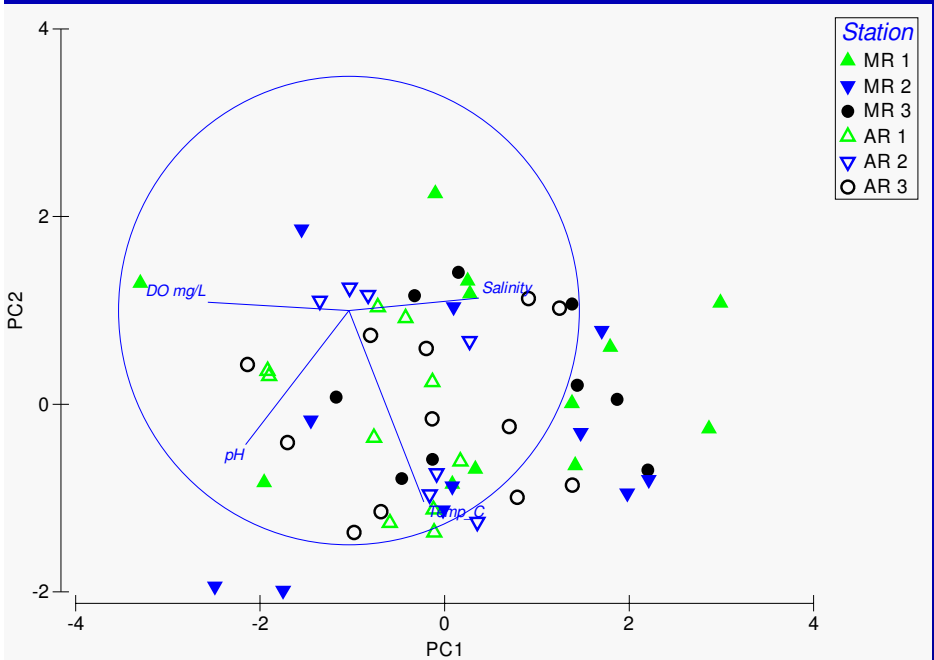


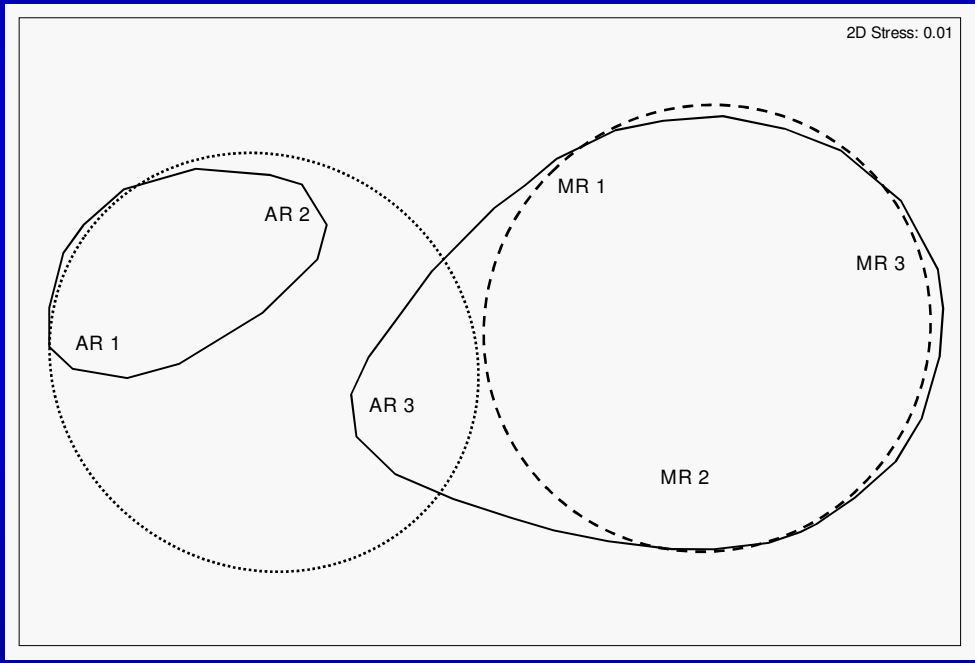
PCA Analysis



MDS Means Plot

DataSonde Deployments

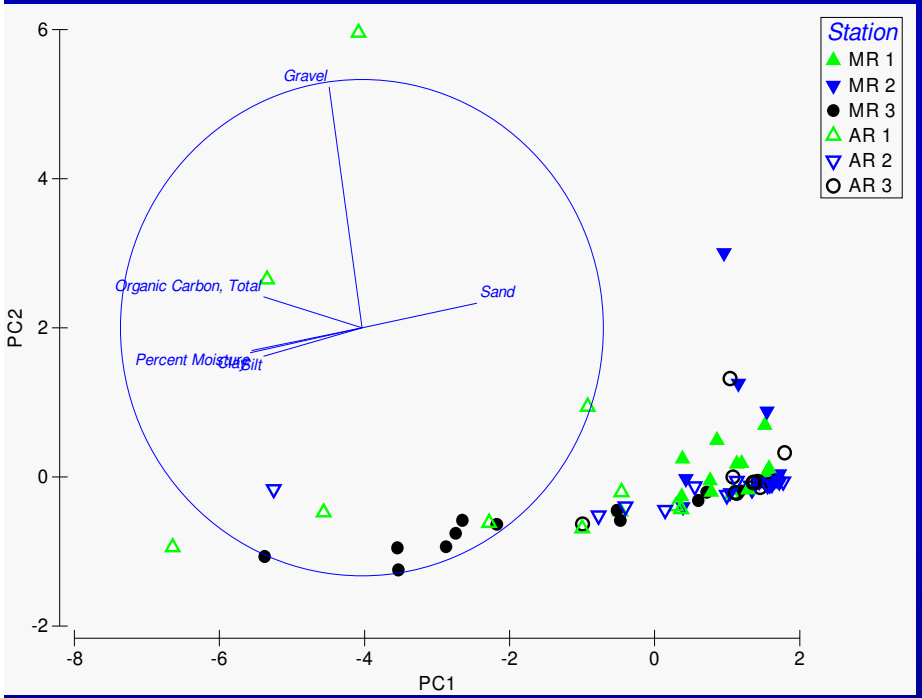




PCA Analysis

MDS Means Plot

Sediment Composition (Middle)



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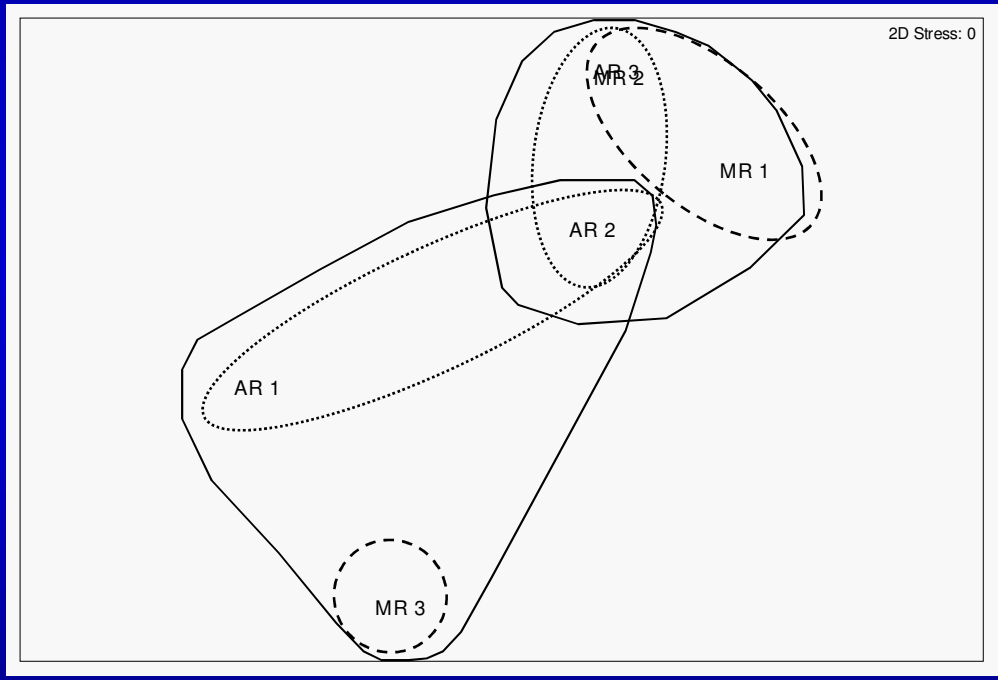
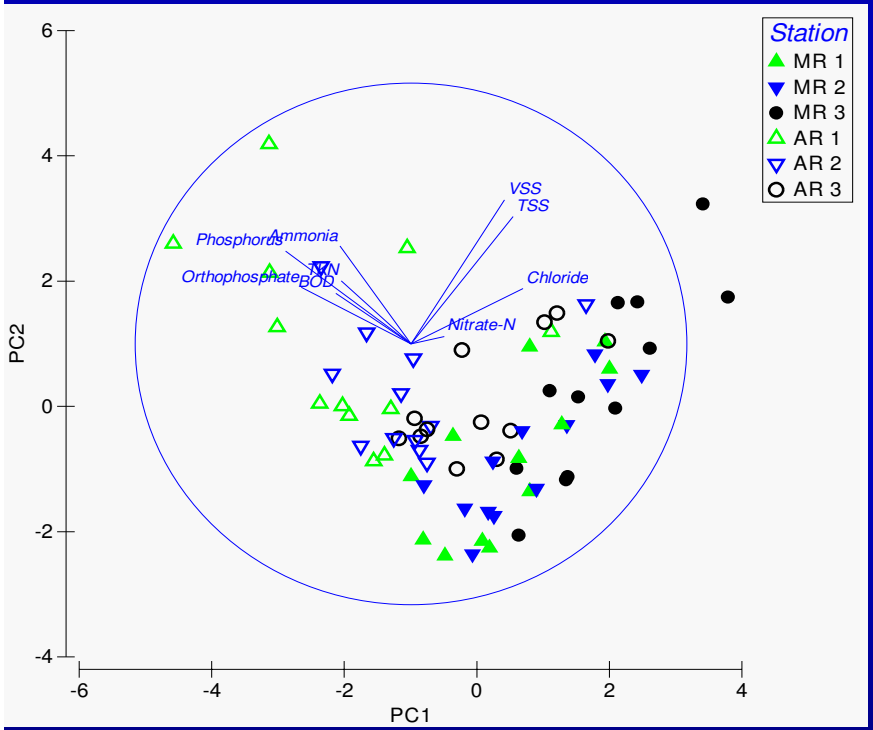
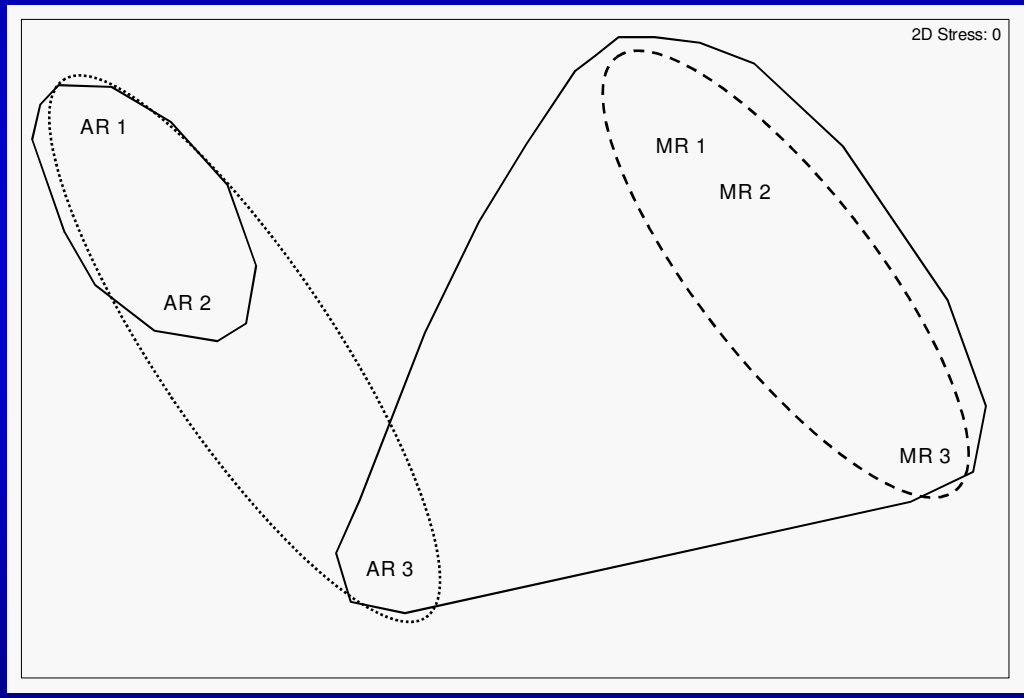


MDS Means Plot

Water Quality Measurements

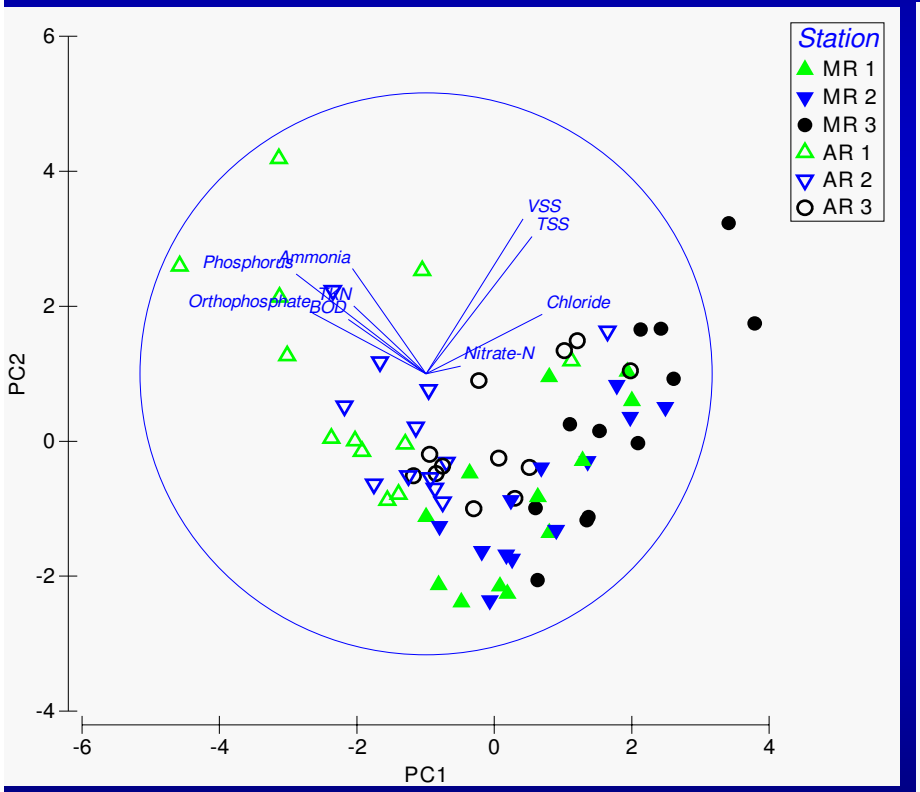


PCA Analysis

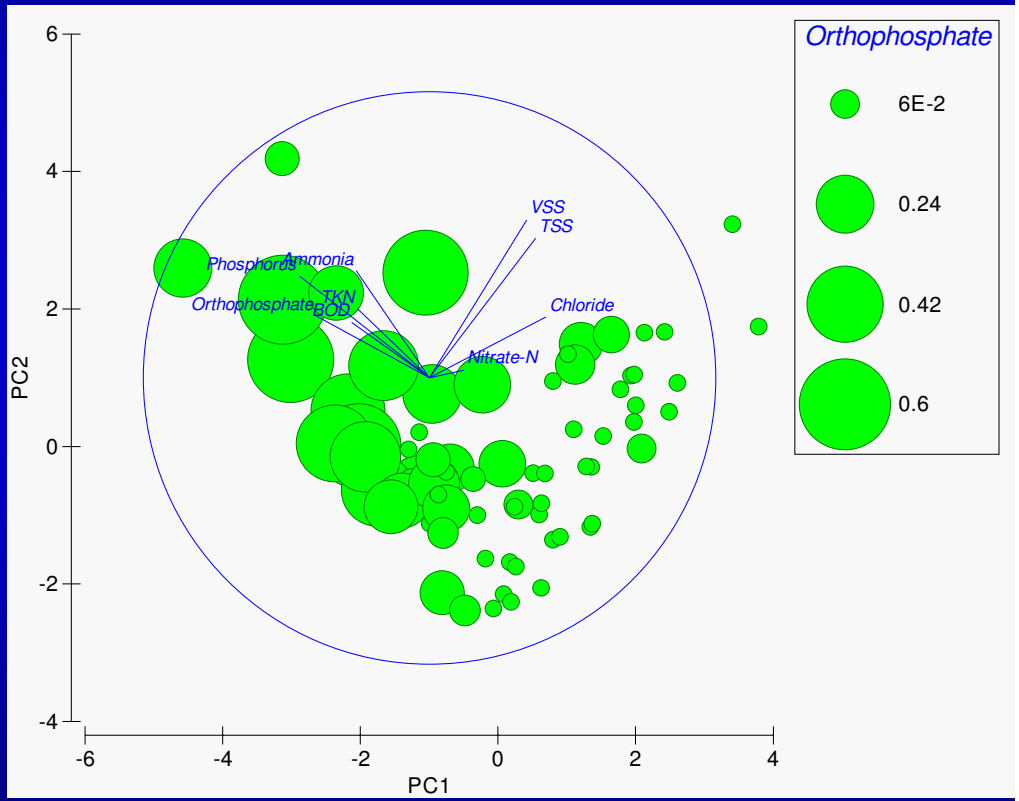


MDS Means Plot

Water Quality Measurements

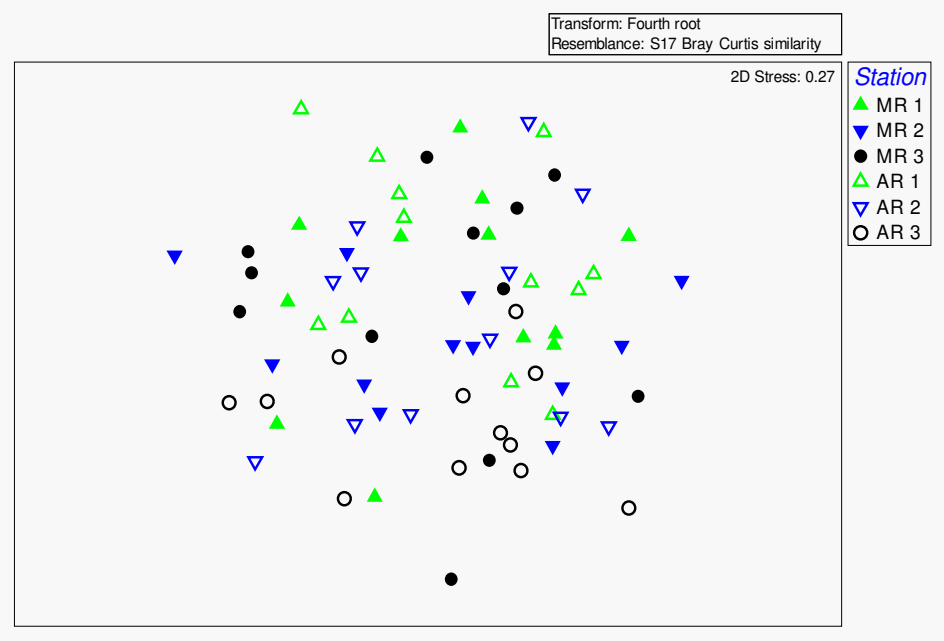


PCA Analysis

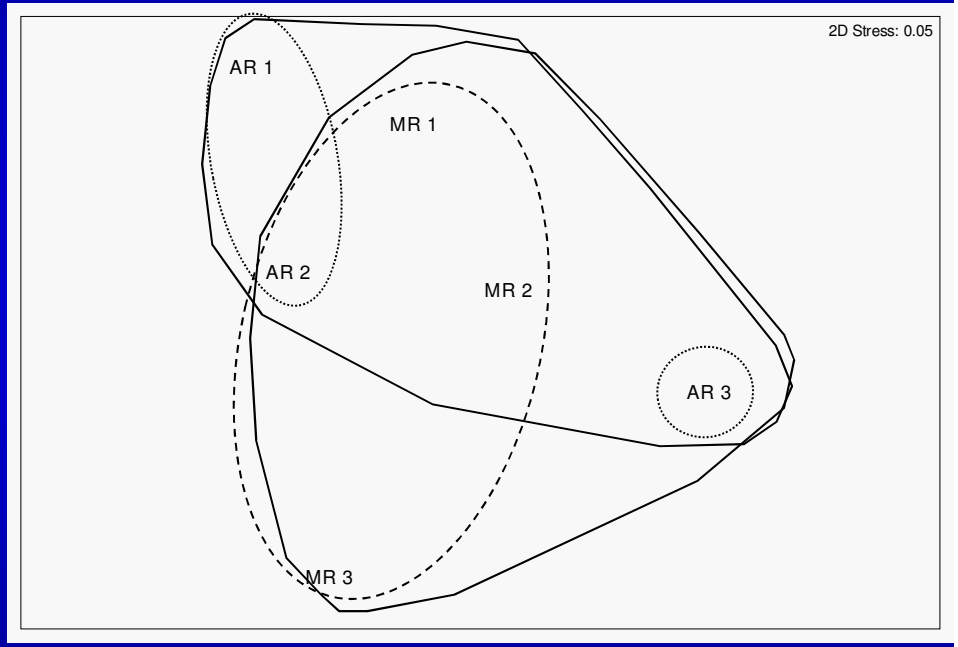


Orthophosphate Overlay

Nekton – Bag Seines

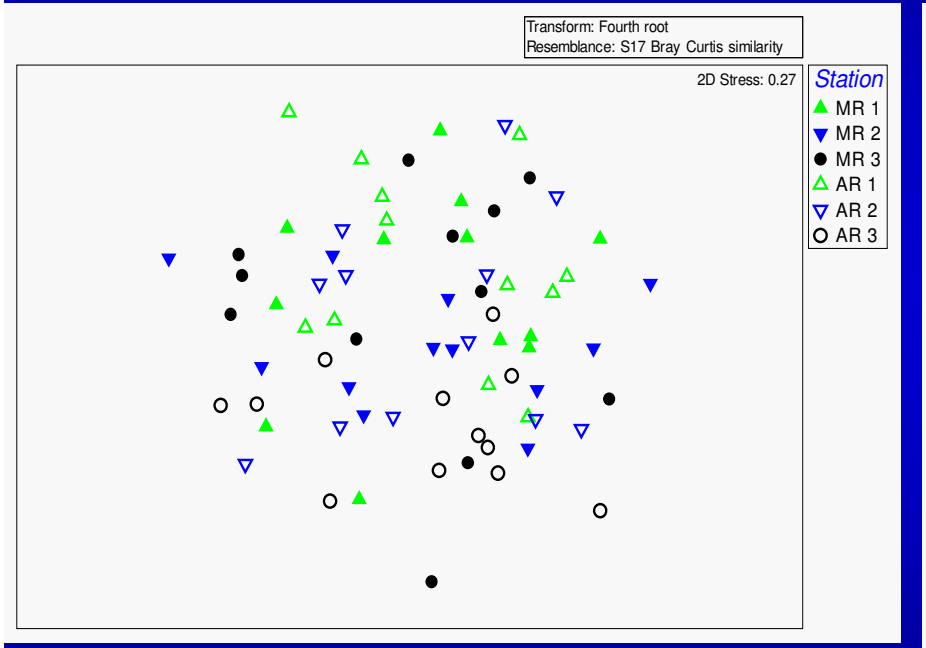


MDS Configuration

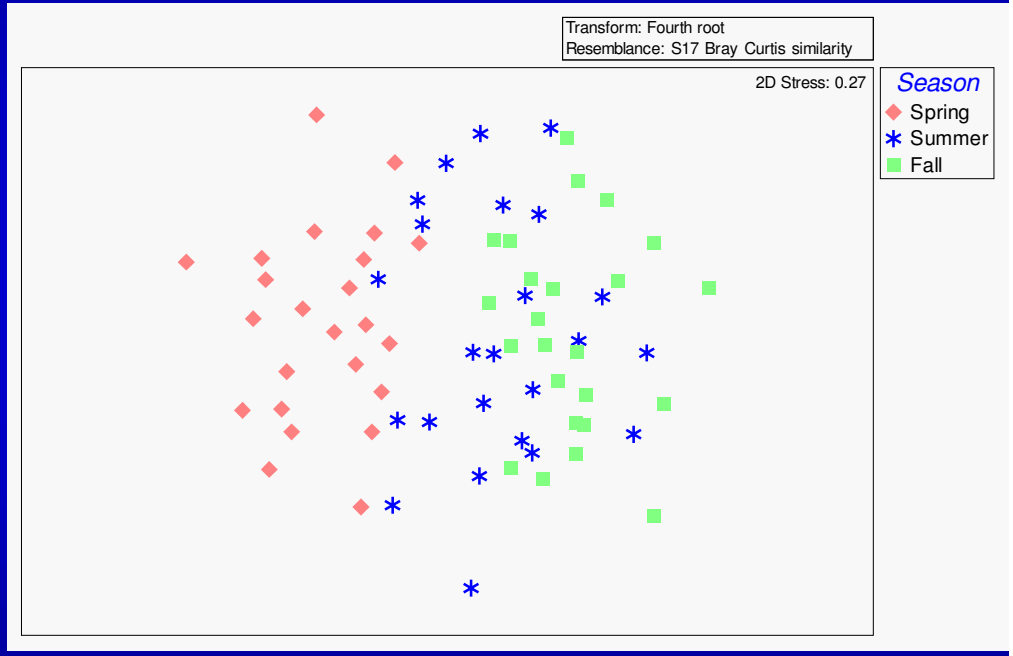


MDS Means Plot

Nekton – Bag Seines

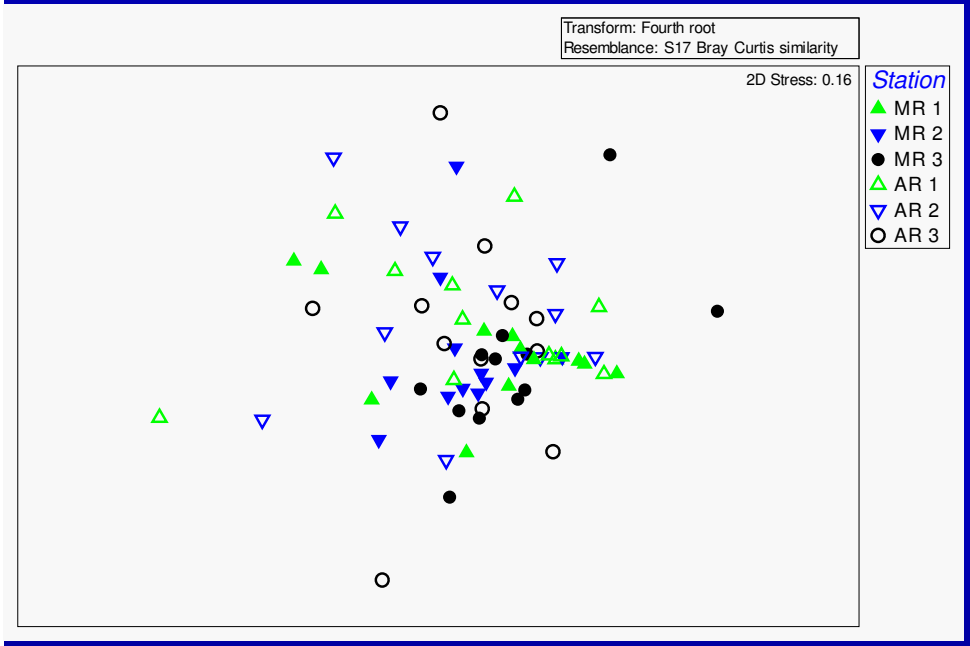


MDS Configuration



Seasonality

Nekton - Trawls



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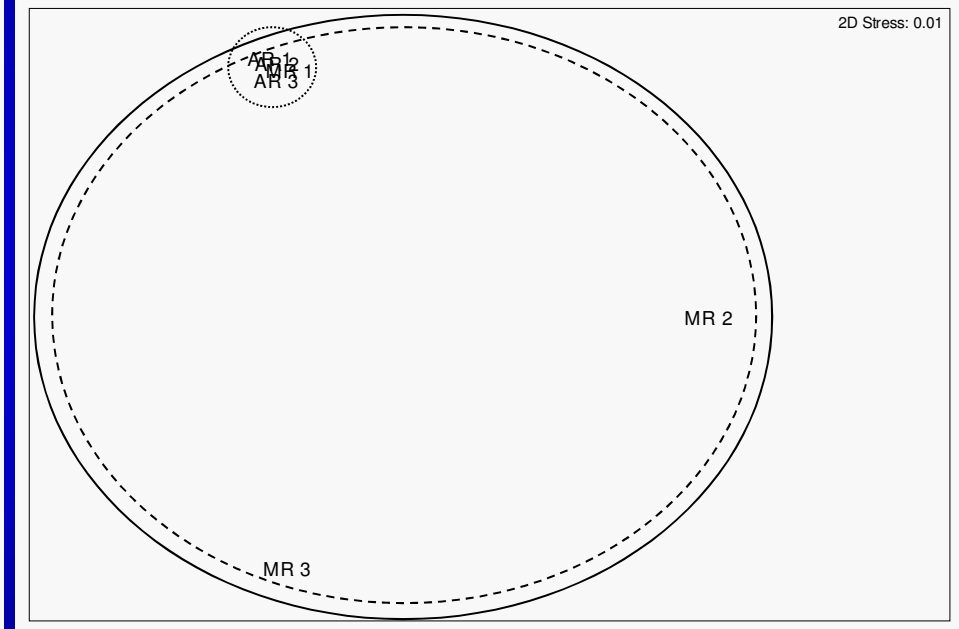
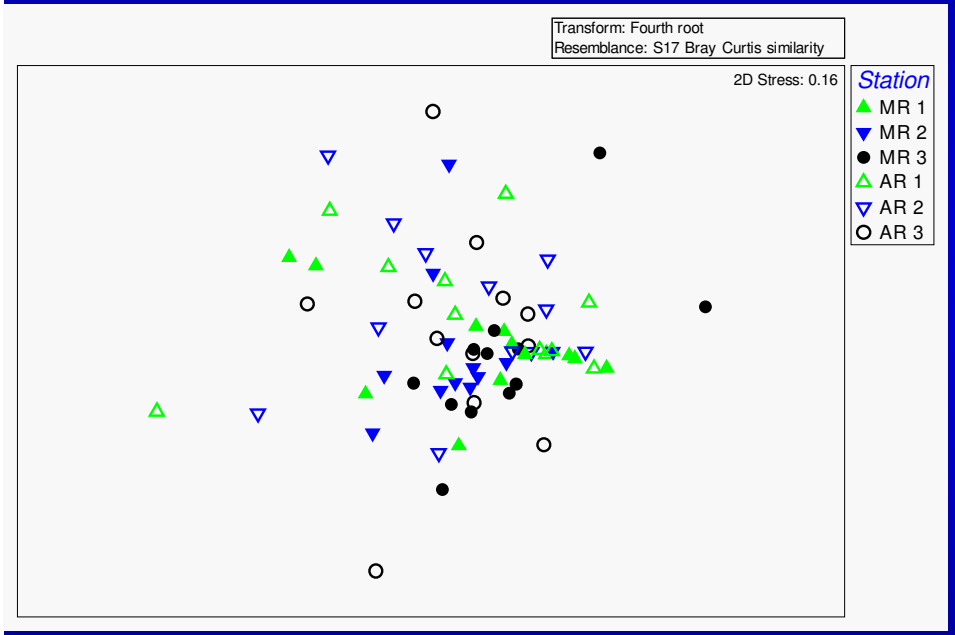
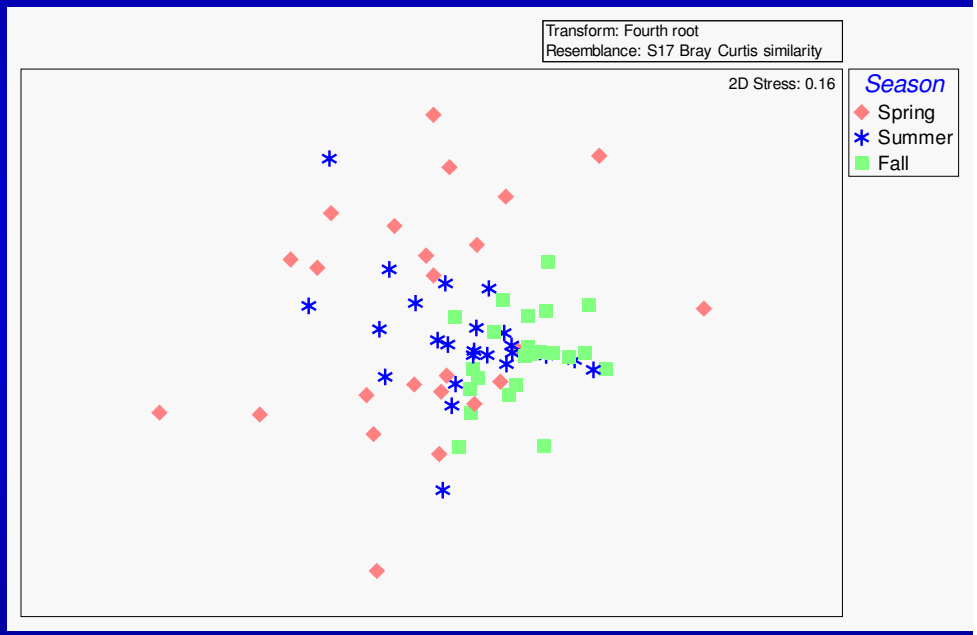


MDS Means Plot

Nekton – Trawls

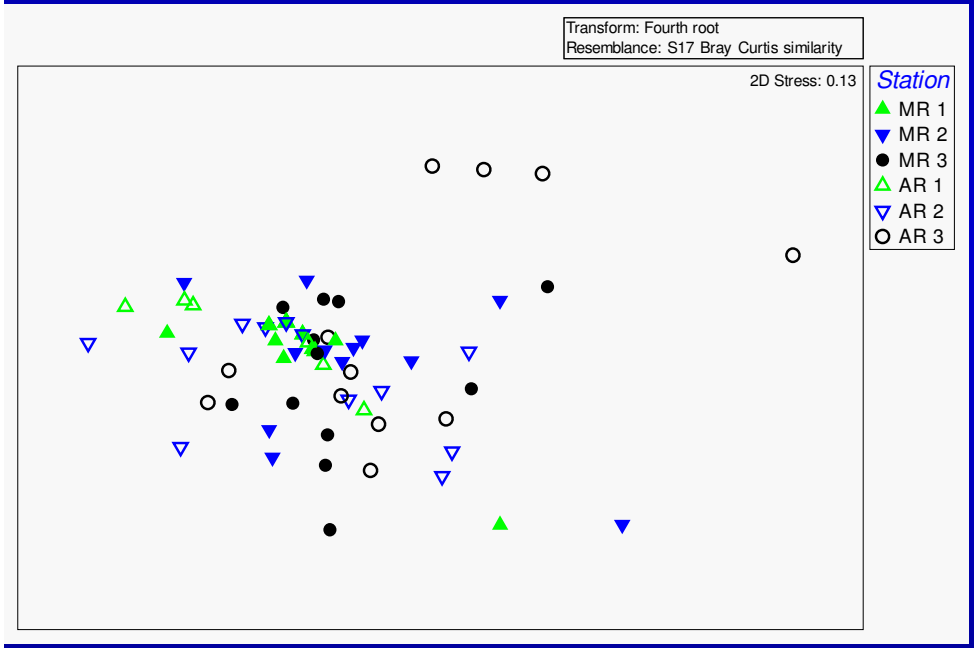


MDS Configuration



Seasonality

Benthic Inverts (Middle)



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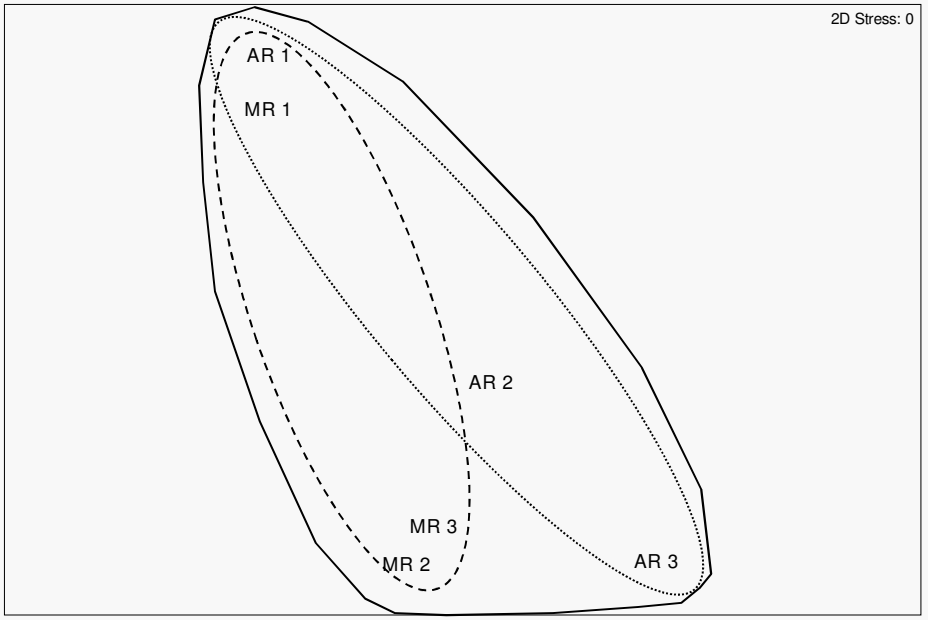
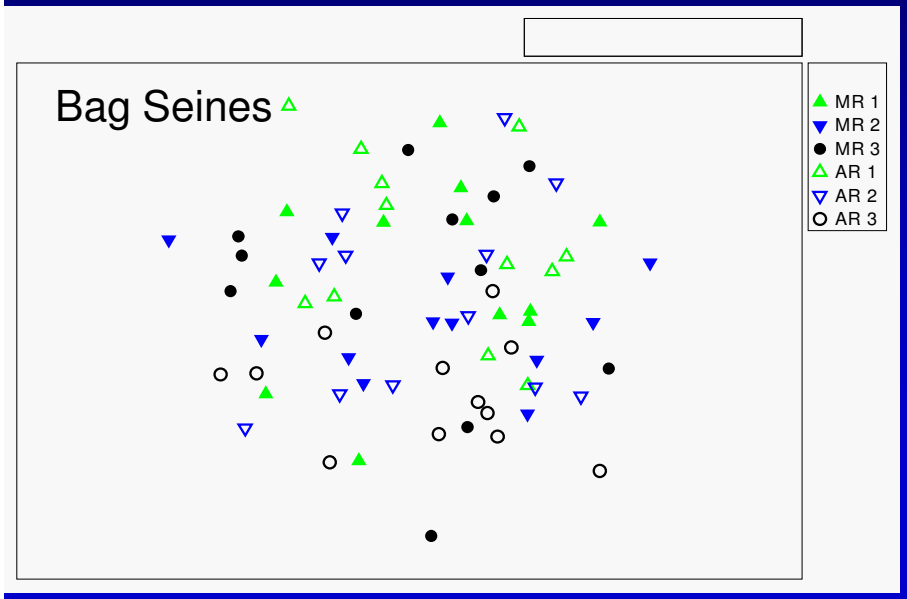
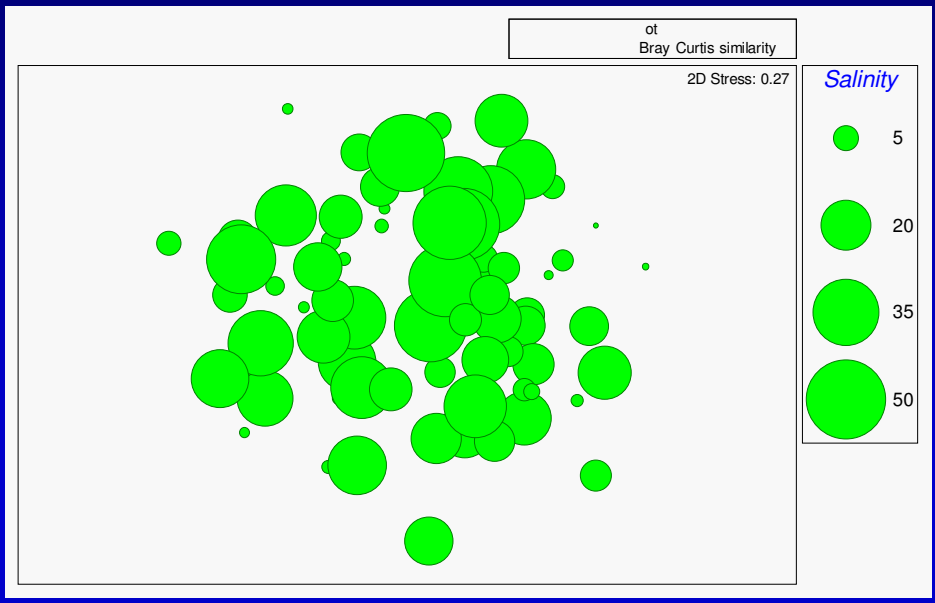
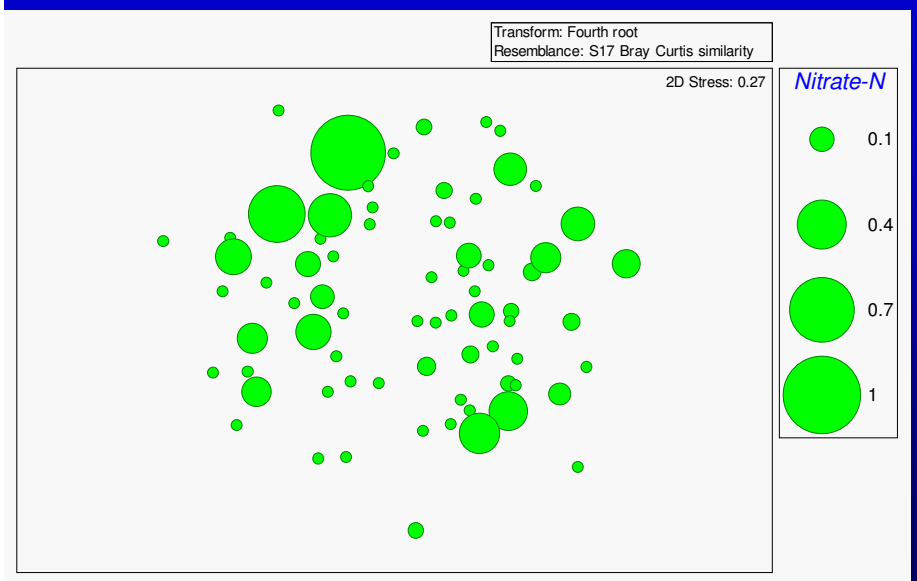


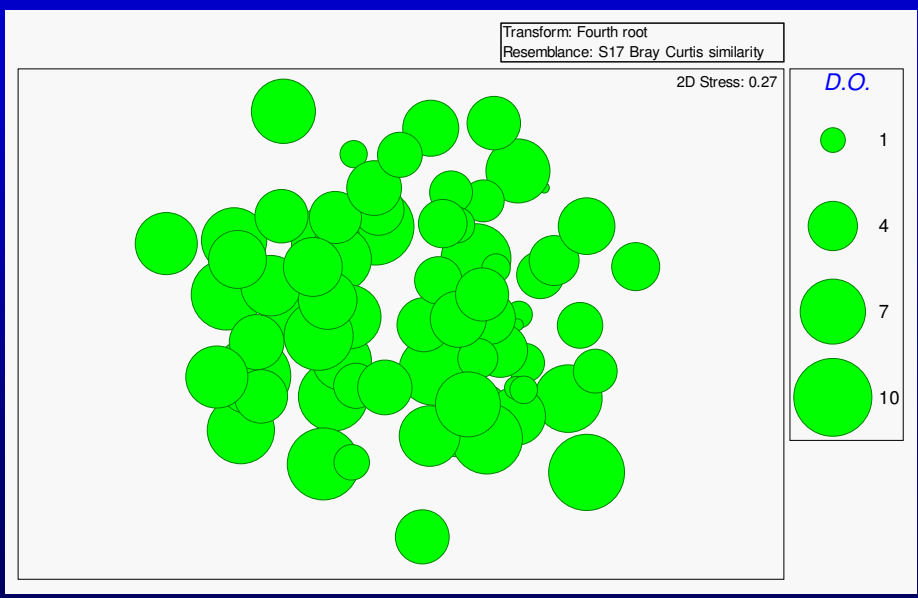
MDS Means Plot

MDS : Data Overlays









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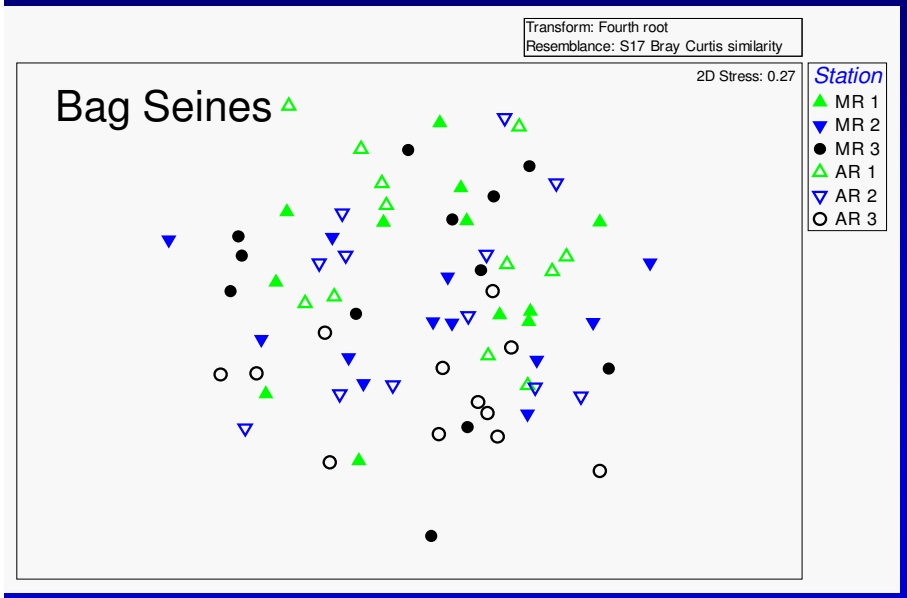
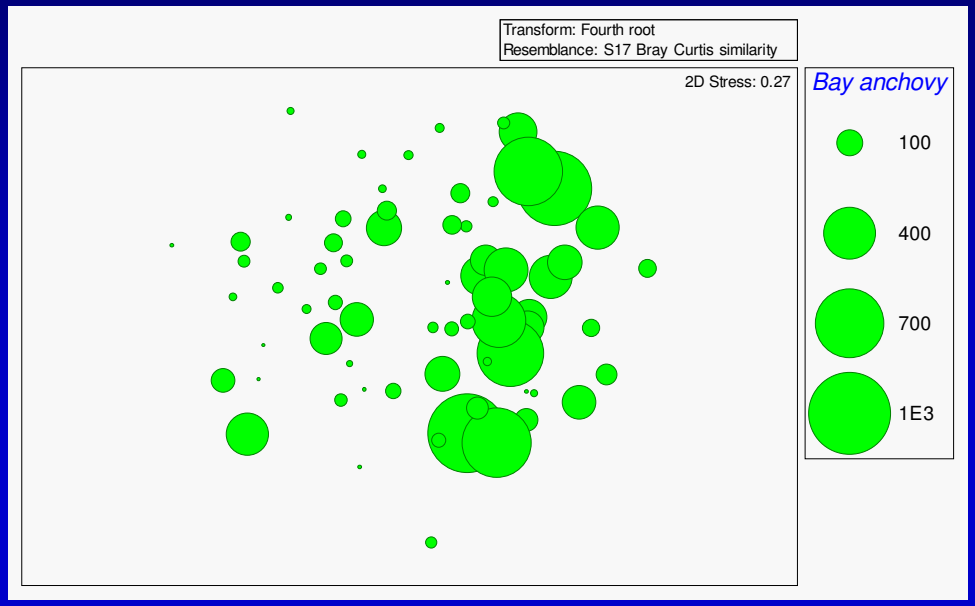
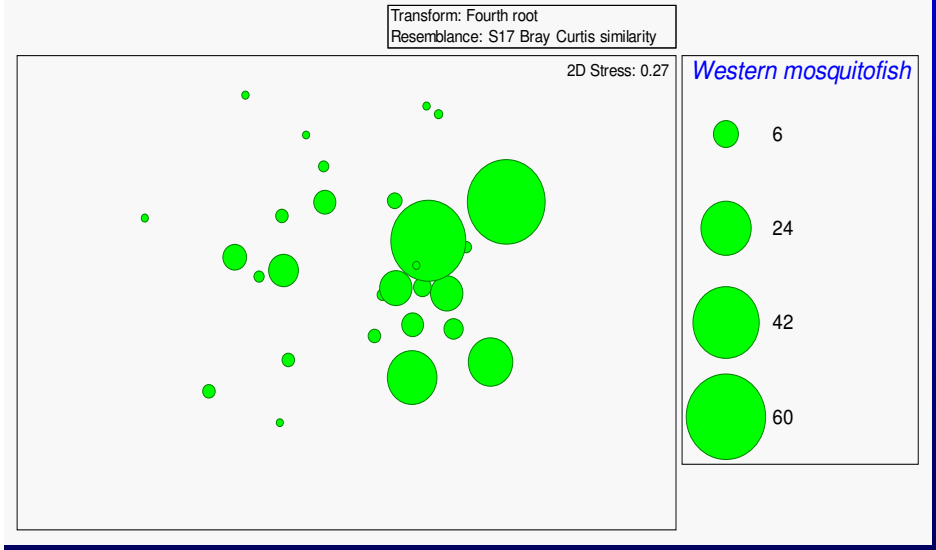
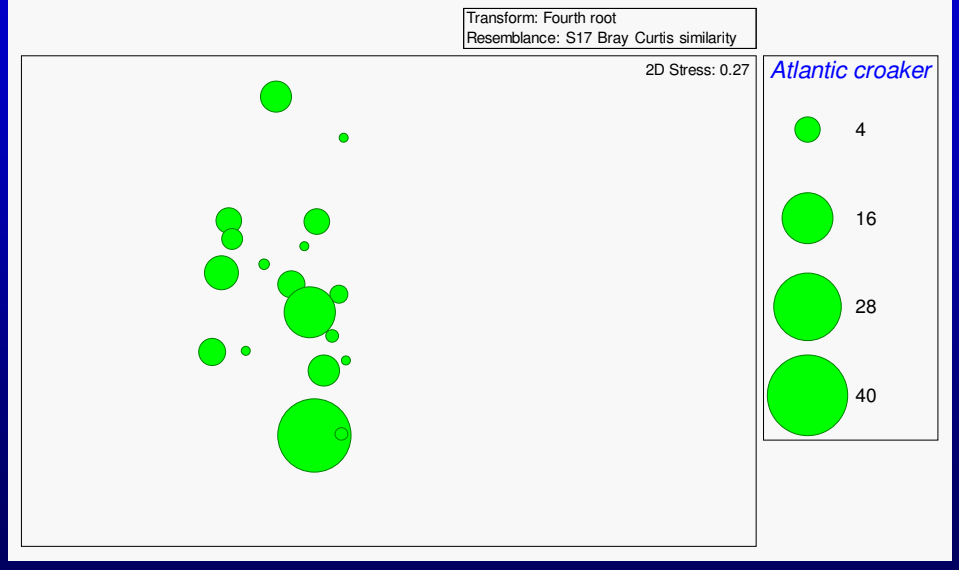
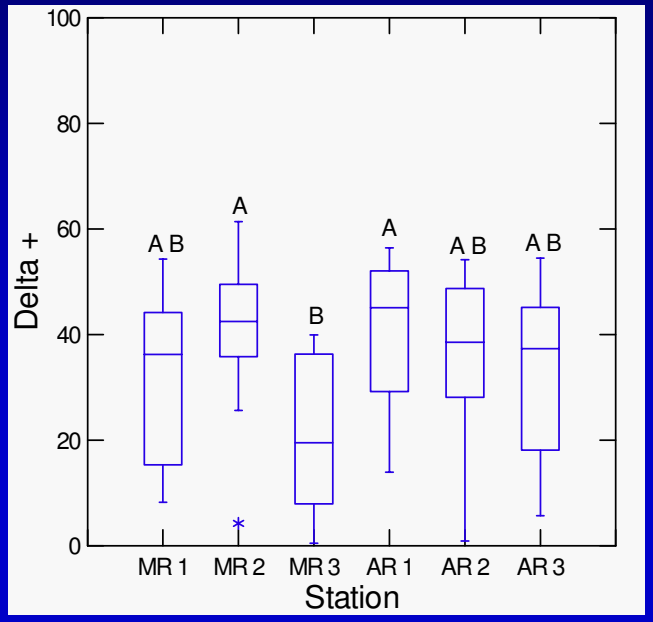


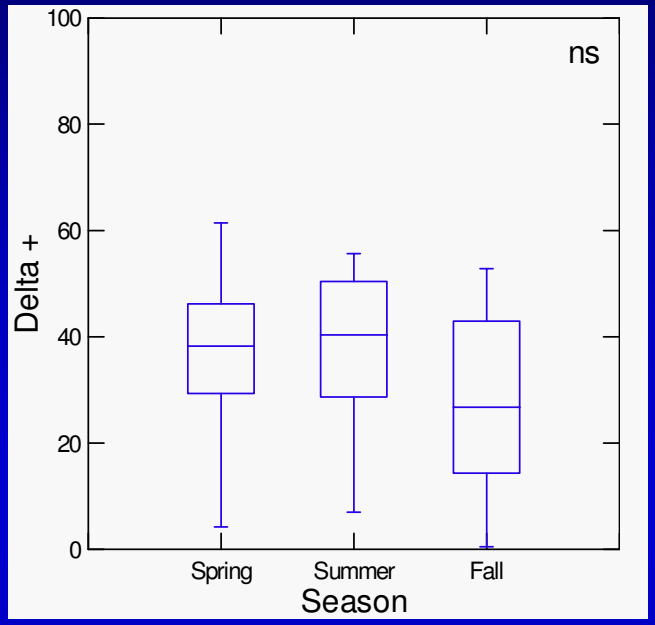


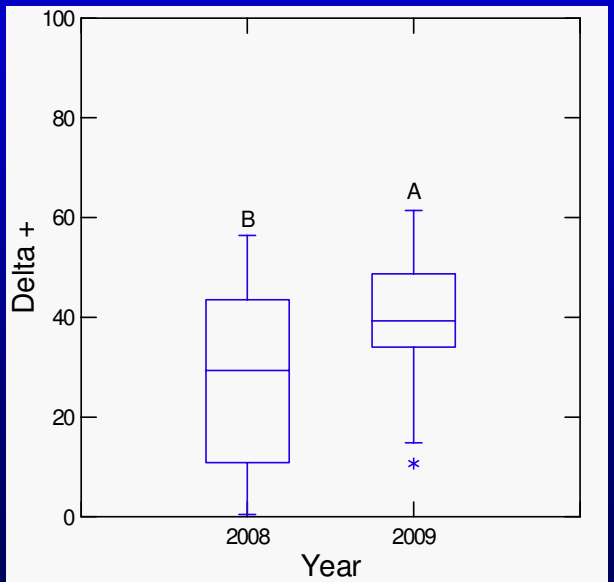




Taxonomic Diversity



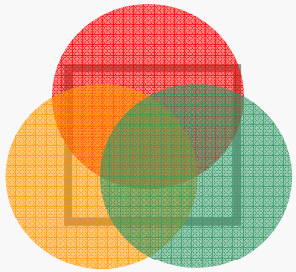




Bag Seine Collections

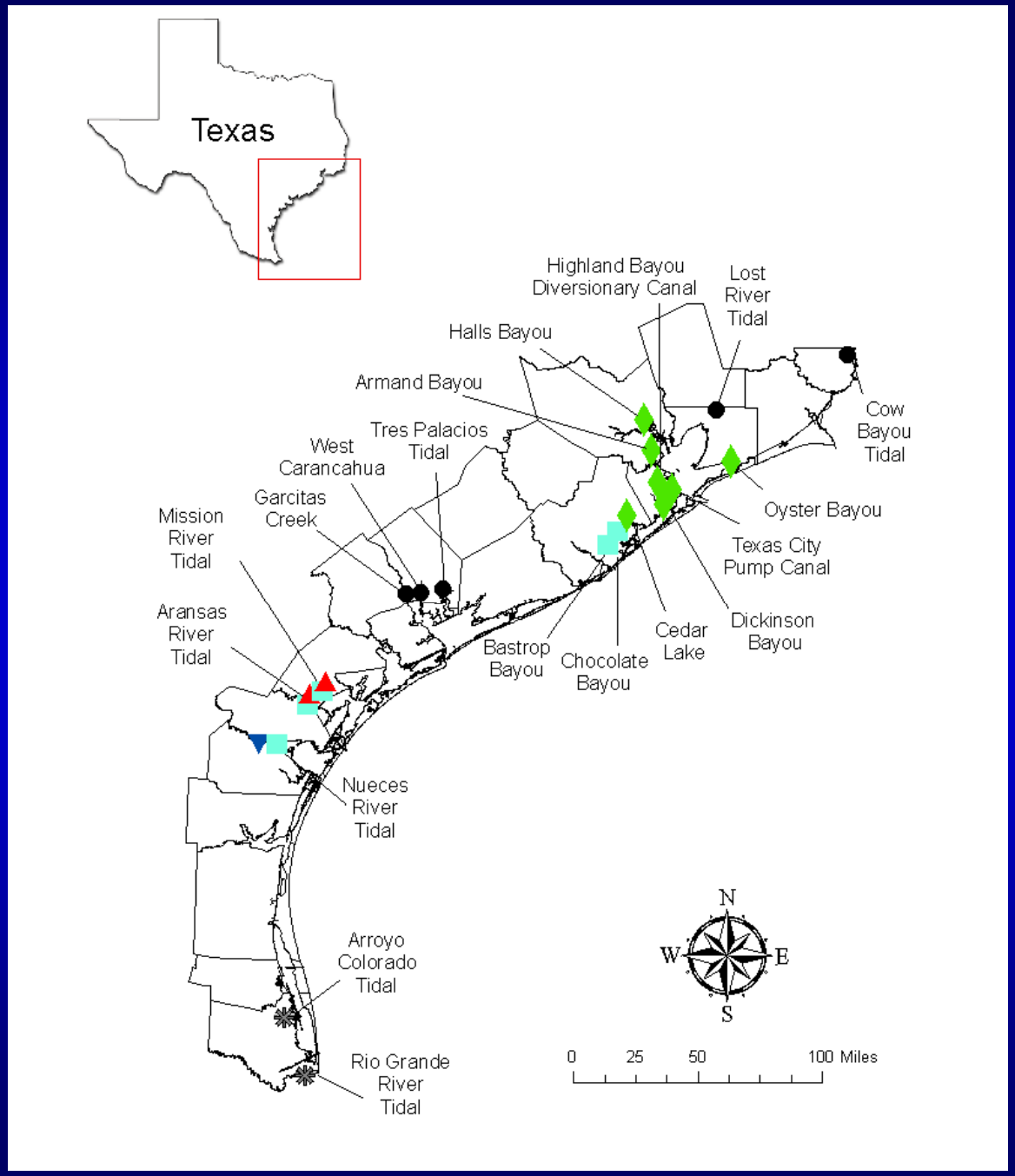
Agreement Among the MDS Configurations

	Bag Seine	Trawl	Benthic Infauna	Water Column Profile	Water Chemistry
Bag Seine	___				
Trawl	0.158*	___			
Benthic Infauna	0.099	0.230*	___		
Water Column Profile	0.125*	0.230*	0.033	___	
Water Chemistry	0.063	0.024	-0.033	**0.471****	___
Sediments	-0.002	0.051	-0.148	0.084	0.276*

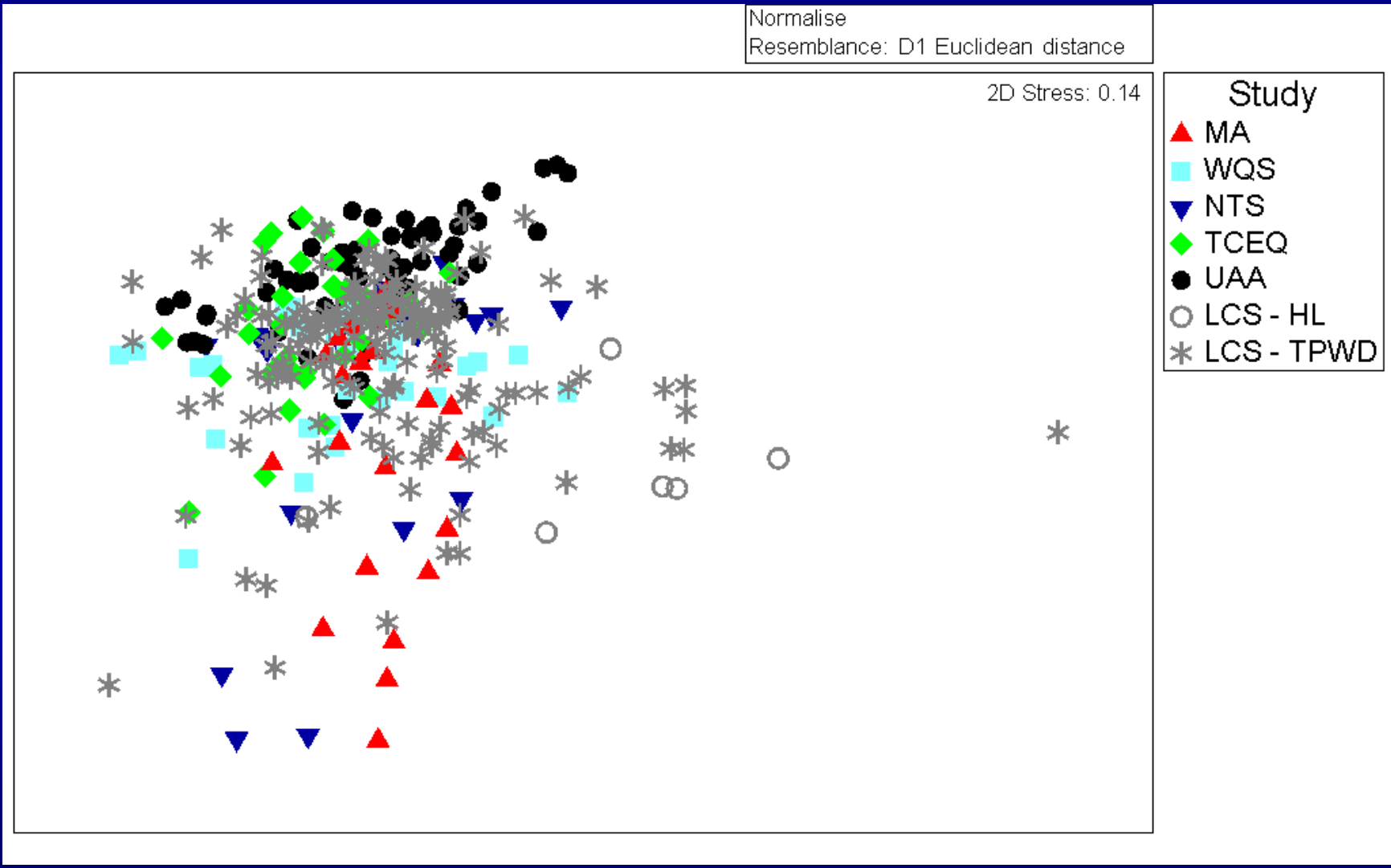


Probability of obtaining a larger correlation coefficient by random chance (based on 1,000 permutations) denoted by: * = prob. < 0.01, ** = prob. < 0.001. Significant correlations ($\rho_s > 0.3$) identified in bold.

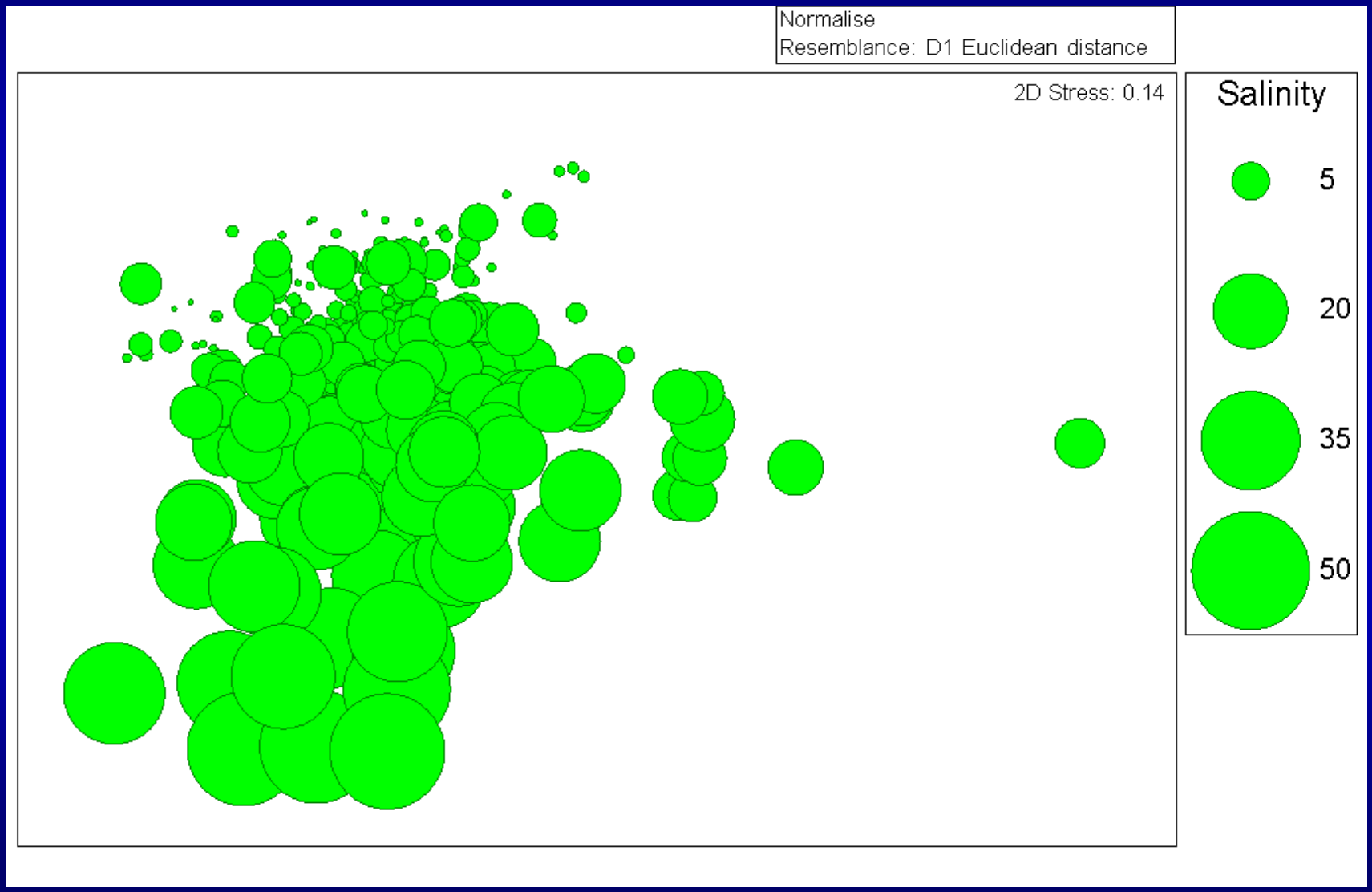

NO
AKE


Texas
Highland Bayou Diversionary Canal
Lost River Tidal
Halls Bayou
Armand Bayou
Cow Bayou Tidal
Tres Palacios Tidal
West Carancahua
Garcitas Creek
Mission River Tidal
Oyster Bayou
Texas City Pump Canal
Aransas River Tidal
Dickinson Bayou
Cedar Lake
Bastrop Bayou
Chocolate Bayou
Nueces River Tidal
N
W
E
S
Arroyo Colorado Tidal
Rio Grande River Tidal
0
25
50
100 Miles

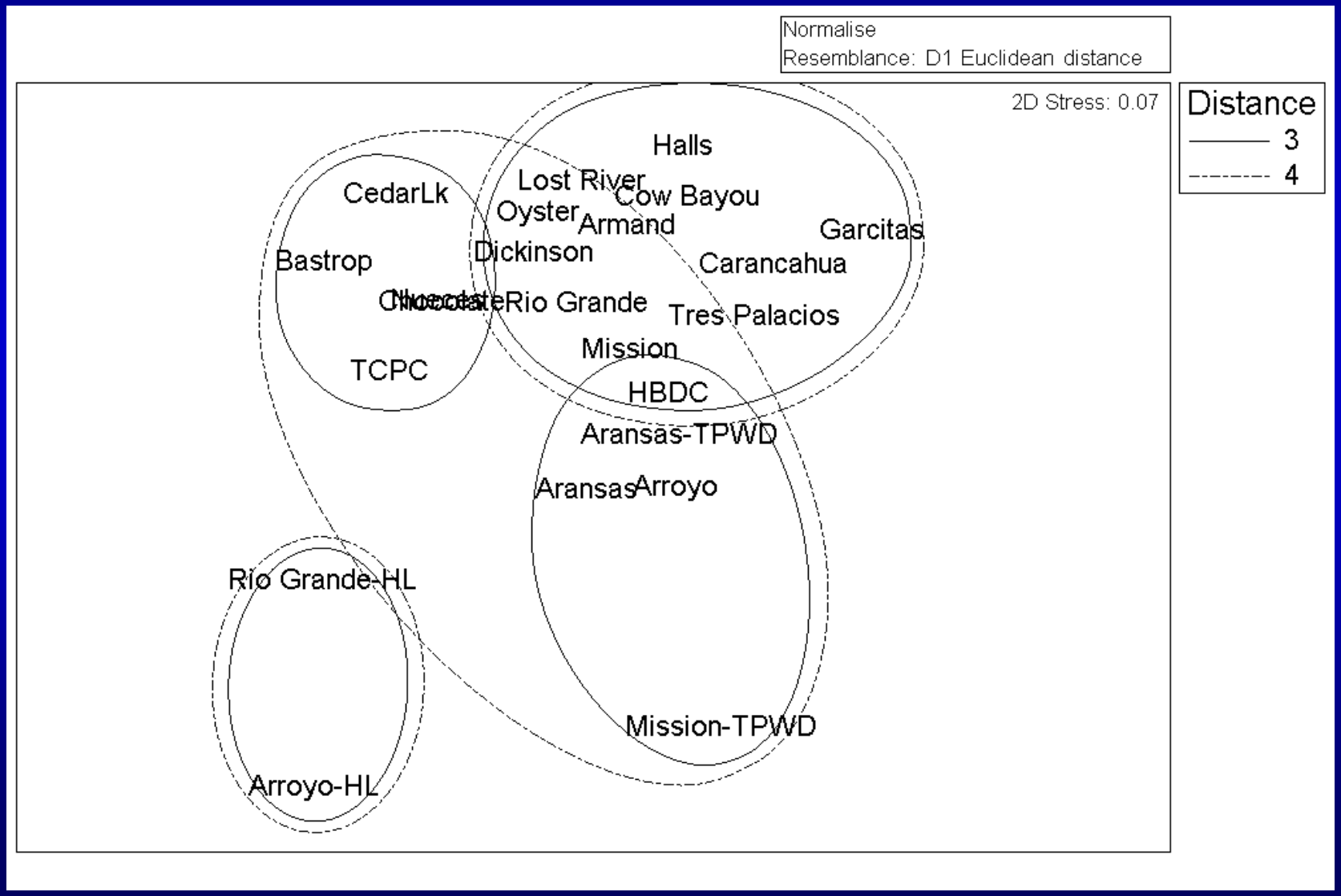
Routine Field Parameters



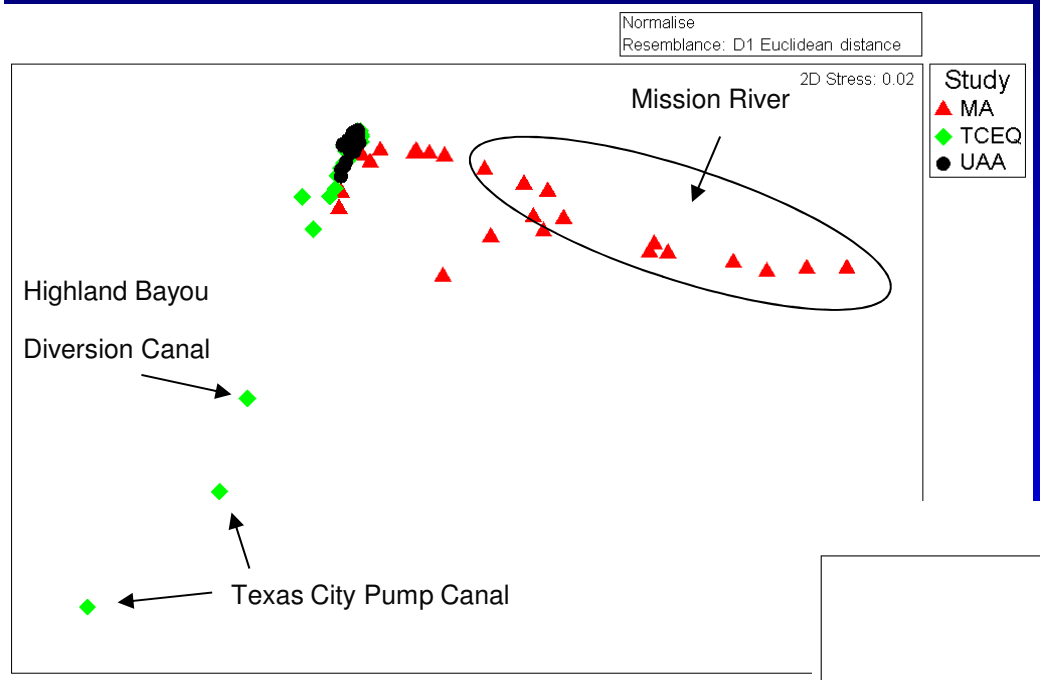
Routine Field Parameters

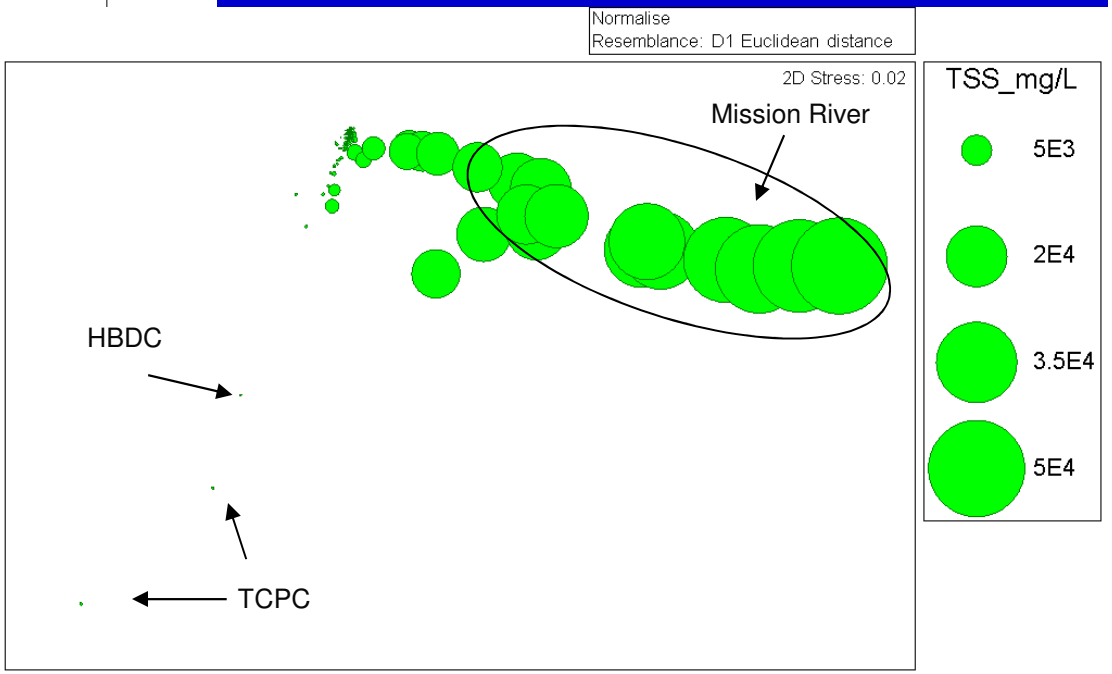


MDS Means Plot

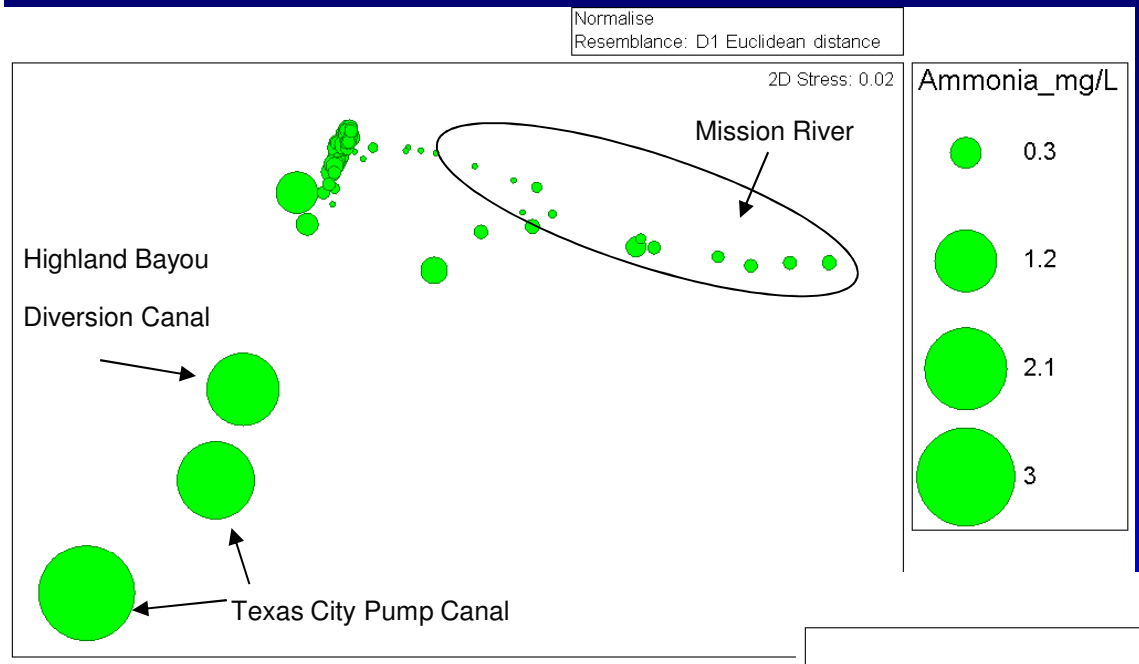


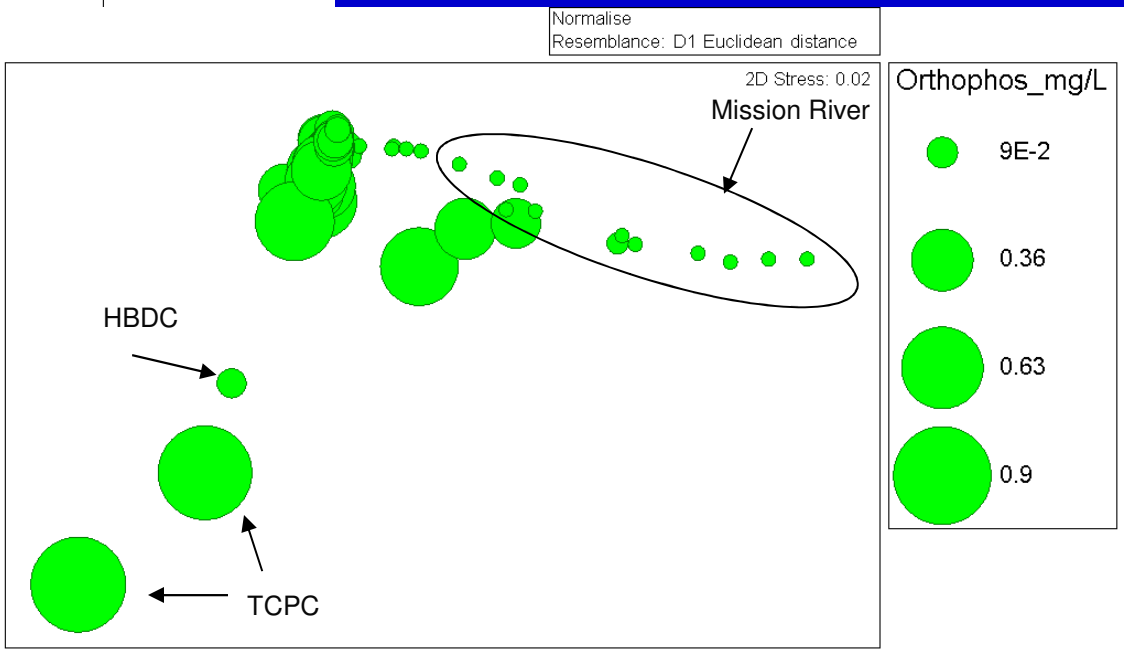
Water Chemistry



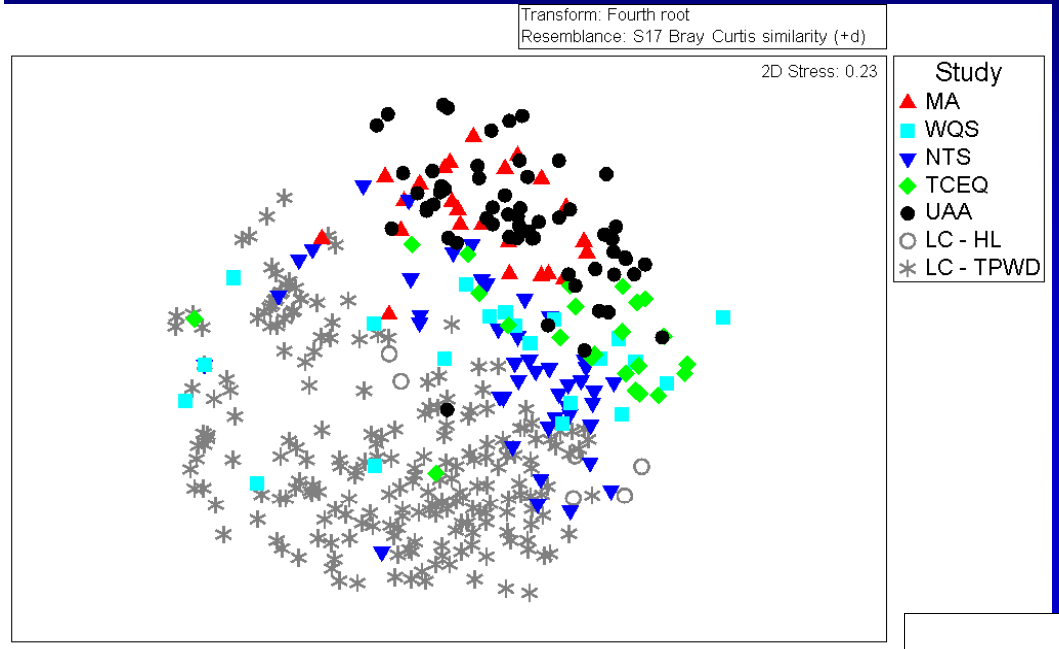


Water Chemistry

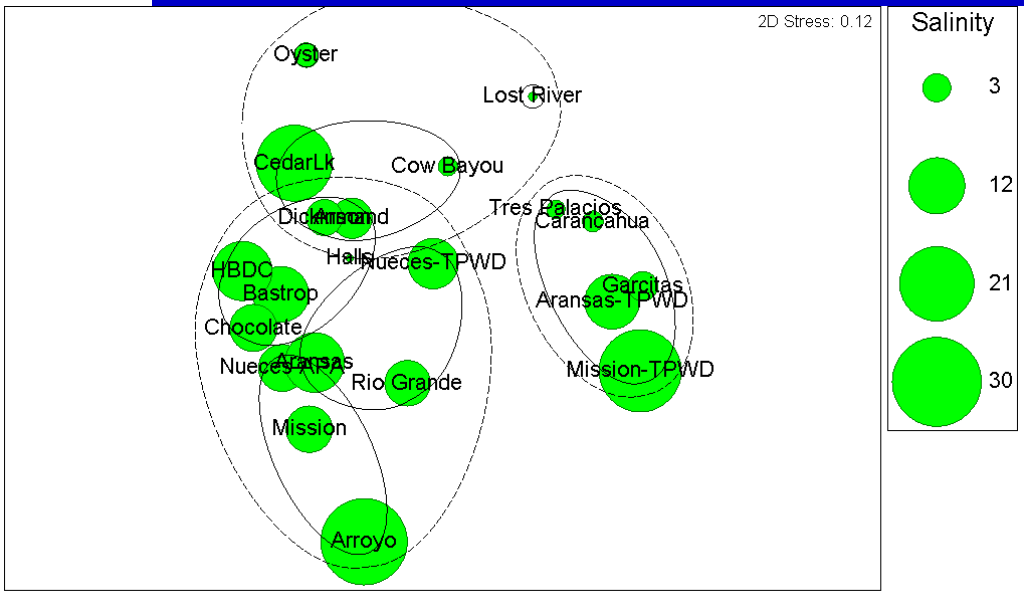


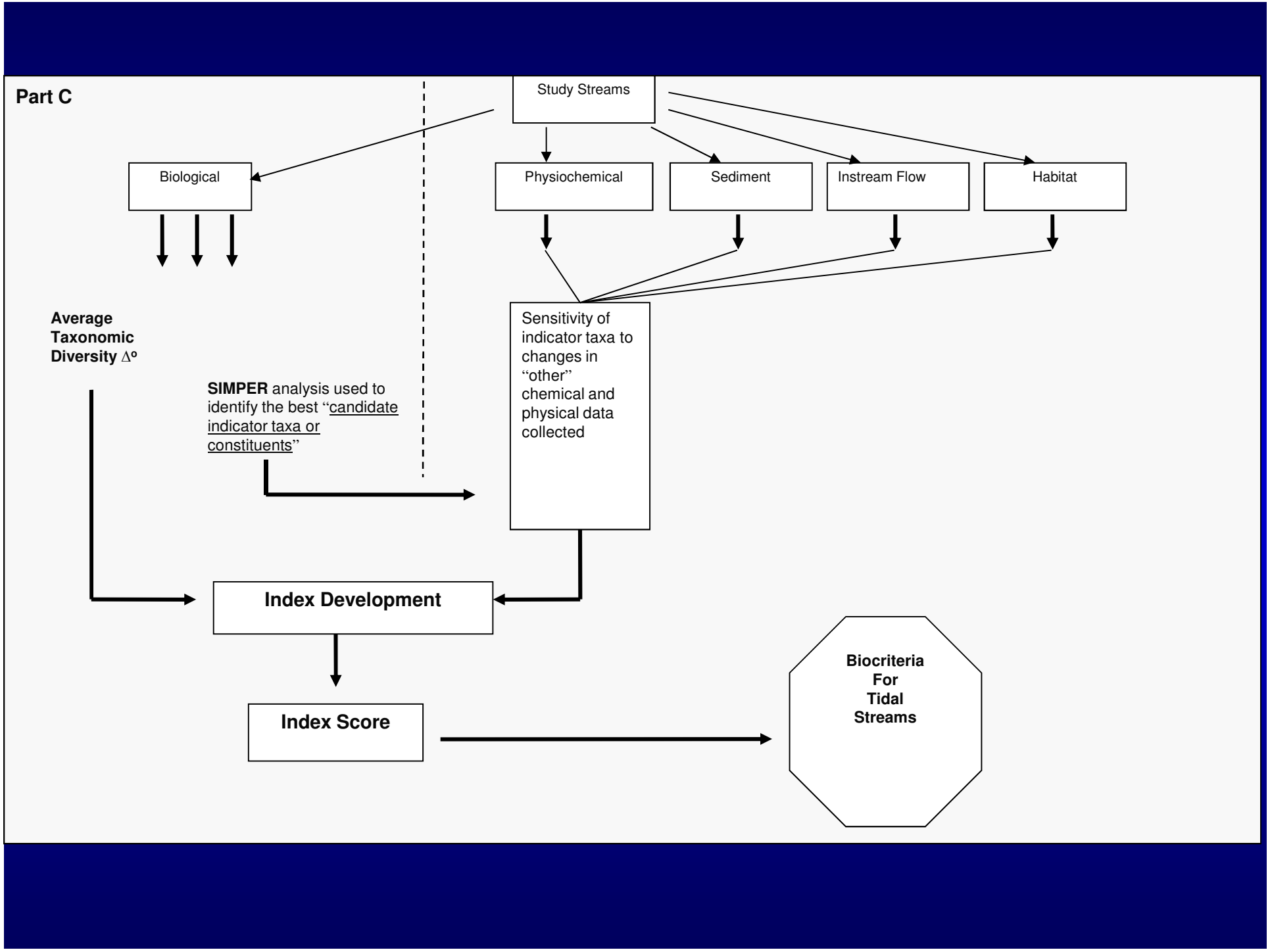


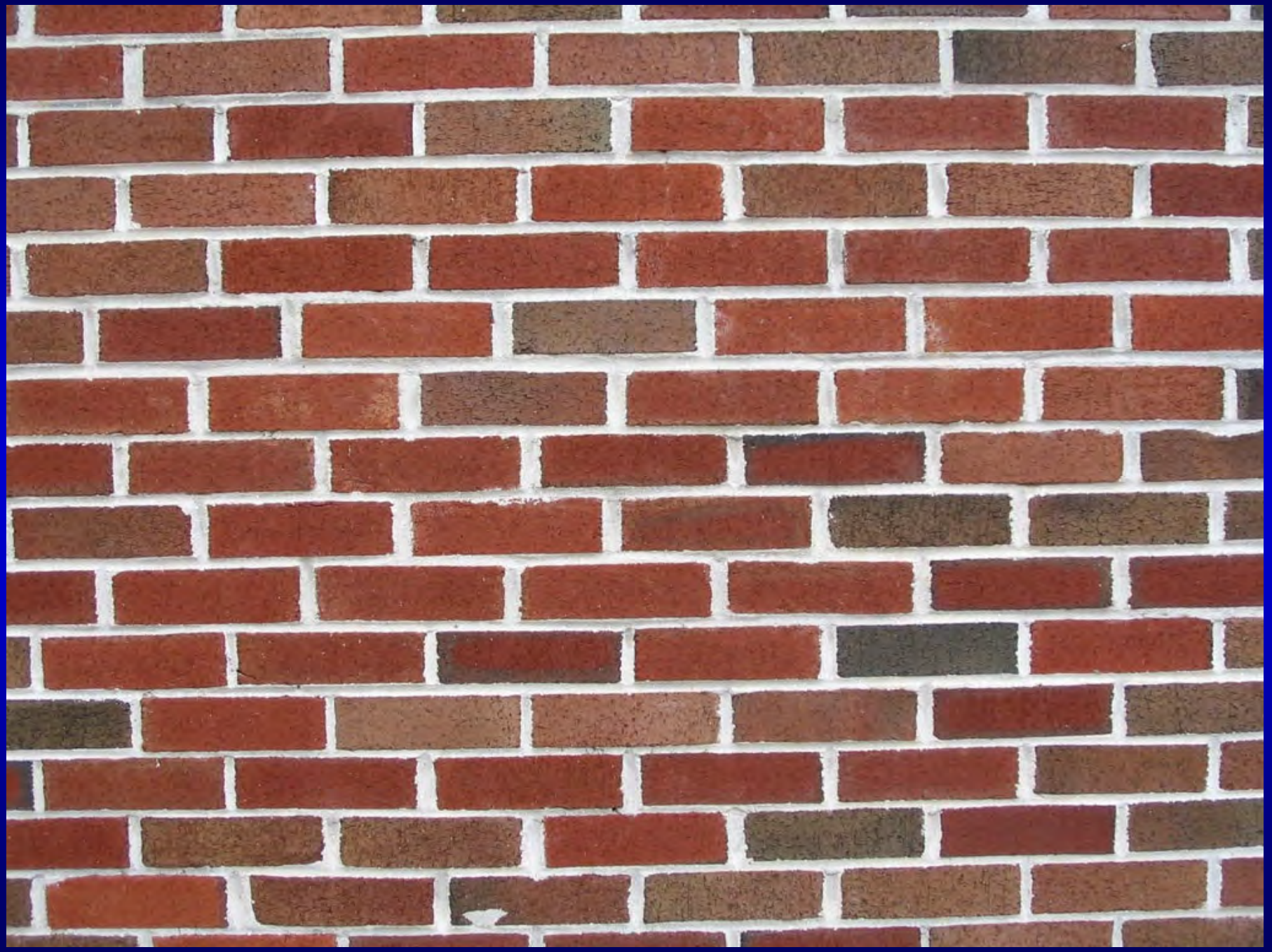
Trawl Collections



Summer Season Collections




Part C
Study Streams
Biological
Physiochemical
Sediment
Instream Flow
Habitat
Average Taxonomic Diversity Δ°
SIMPER analysis used to identify the best "candidate indicator taxa or constituents"
Sensitivity of indicator taxa to changes in "other" chemical and physical data collected
Index Development
Index Score
Biocriteria For Tidal Streams



Coast-wide Nekton Abundance Patterns in Seines

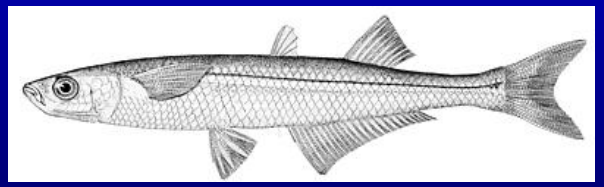
Bay anchovy

Grass shrimp

Gulf menhaden

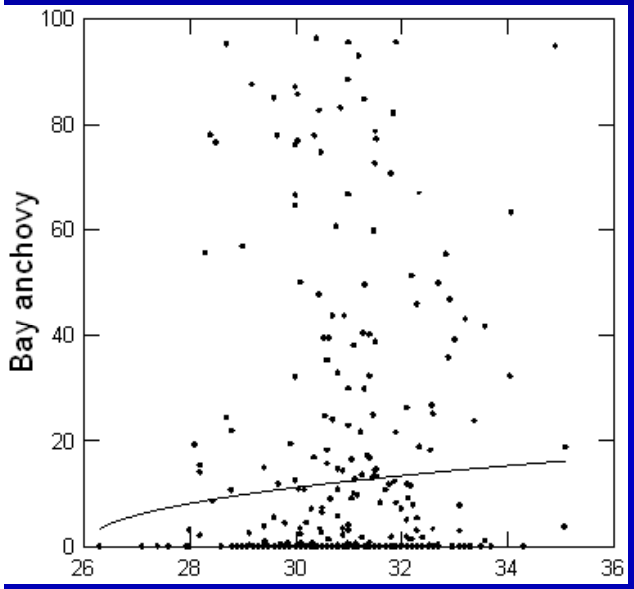
Brown shrimp

White shrimp

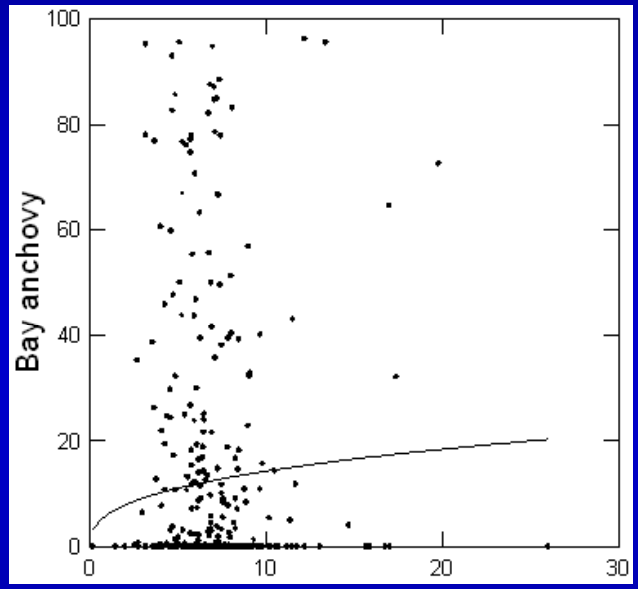


Silversides

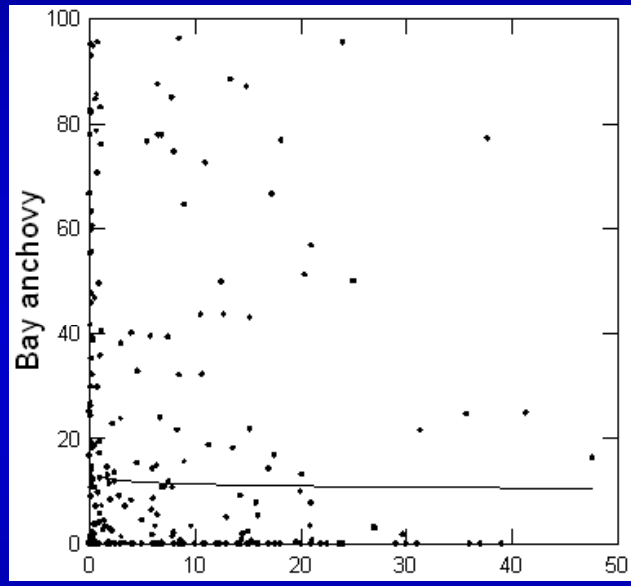
Relationships to Env. Variables



Temperature



Dissolved Oxygen



Salinity

*** Normalized Abundance

Trend line = Nonlinear form $E[y] = a * x^b$

Coast-wide Nekton Abundance Patterns in Trawls

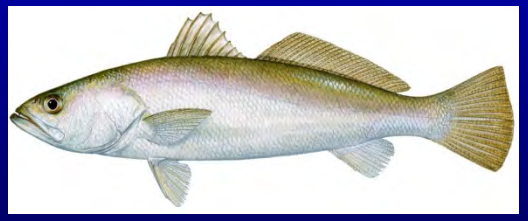
Bay anchovy

Gulf menhaden

Blue catfish

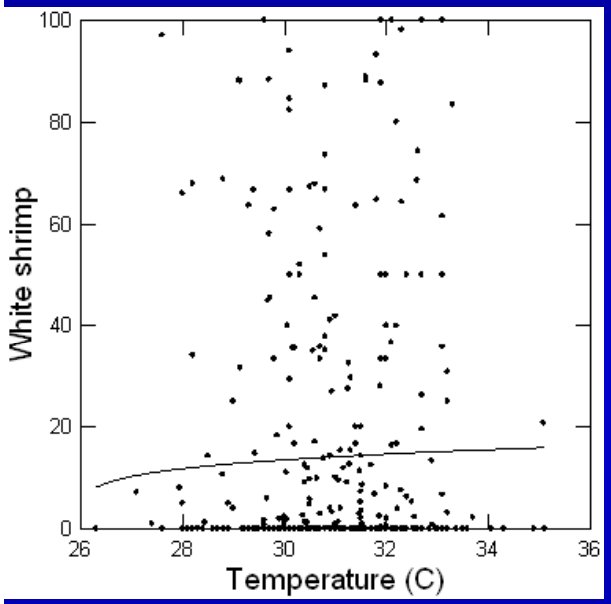
White shrimp

Atlantic croaker

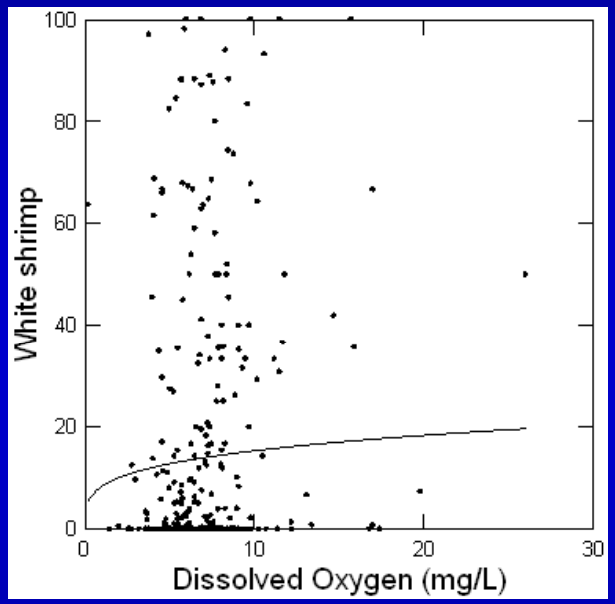


Silver seatrout

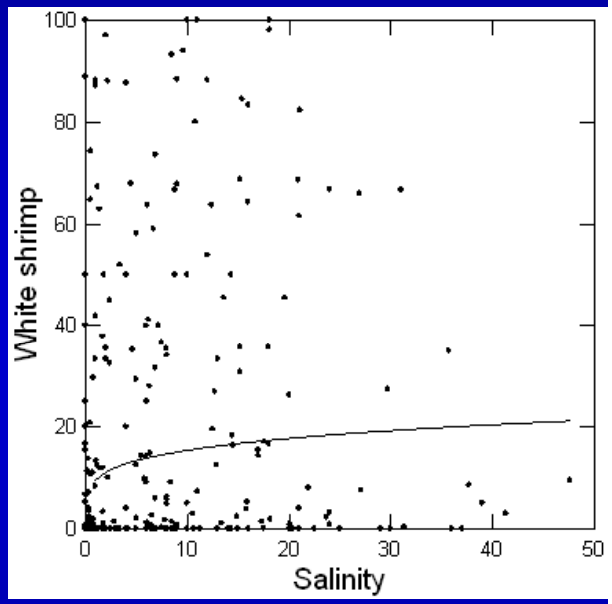
Relationships to Env. Variables



Temperature



Dissolved Oxygen



Salinity

Summary (M/A Study)

- Watershed characteristics (=Salinity) appears to be the dominant factor structuring biological communities
  - Pattern consistent across the multiple levels of ecological integrity measured for a number of studies
  - Even accounting for extreme drought conditions
- Lowermost Stations had the most “distinct” nekton communities
  - Gear dependent
  - Agrees with the Habitat assessment

Summary (M/A - Coastal)

- Benthic Communities (and Aquatic Inverts) responded less to Salinity
  - Dominated by opportunistic taxa and species defined as “ubiquitous” – flooding event re-sets
- Dissolved Oxygen less important than Salinity in structuring the biological communities
  - Many estuaries with seasonal hypoxia are some of the most productive systems for fisheries
- The extreme euryhaline / physiological abilities of the nekton almost precludes a spatially applicable “IBI”

Summary (M/A – Coastal)

- _____