Changes in Phytoplankton Community Composition and Biovolume During Prolonged Drought

By Tiffany Brown and Mary Xiong

Bay-Delta Science Conference

November 17, 2016

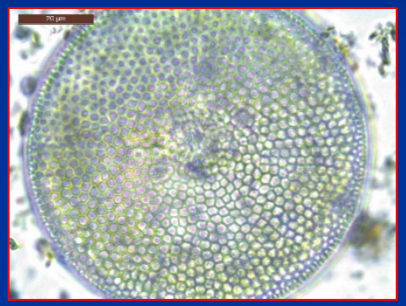
Who’s awesome?

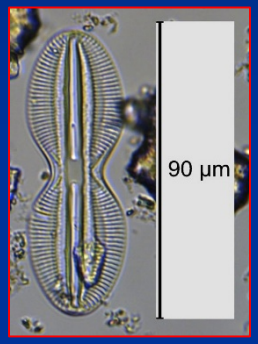
You’re awesome!

Mary Xiong

Phytoplankton in the Estuary

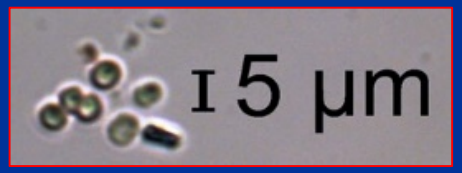
- Diatoms



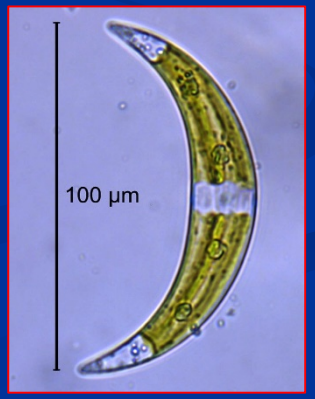


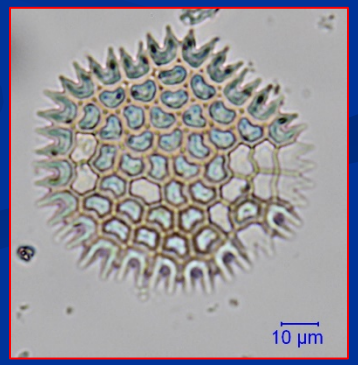
- Flagellates

- Cyanobacteria



- Green Algae

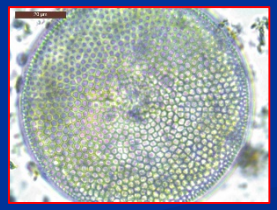




Importance of Phytoplankton

- Base of food web
- Diatoms and flagellates good sources of HUFAs
- Important HUFAs are EPA and DHA

  - Diatoms rich in EPA



  - Dinoflagellates rich in DHA

  - Cryptophytes rich in both

Importance of Phytoplankton

- Growth of invertebrate and vertebrate larvae strongly correlated with HUFA content of their food
- High abundances of diatoms and flagellates = better food
- Some phytoplankton can negatively affect water quality
- Species assemblages vary with water year type

Environmental Monitoring Program

- Sampling the Delta and SF Estuary since 1975
- Sampling occurs monthly
- Phytoplankton samples collected from 1 meter depth and analyzed

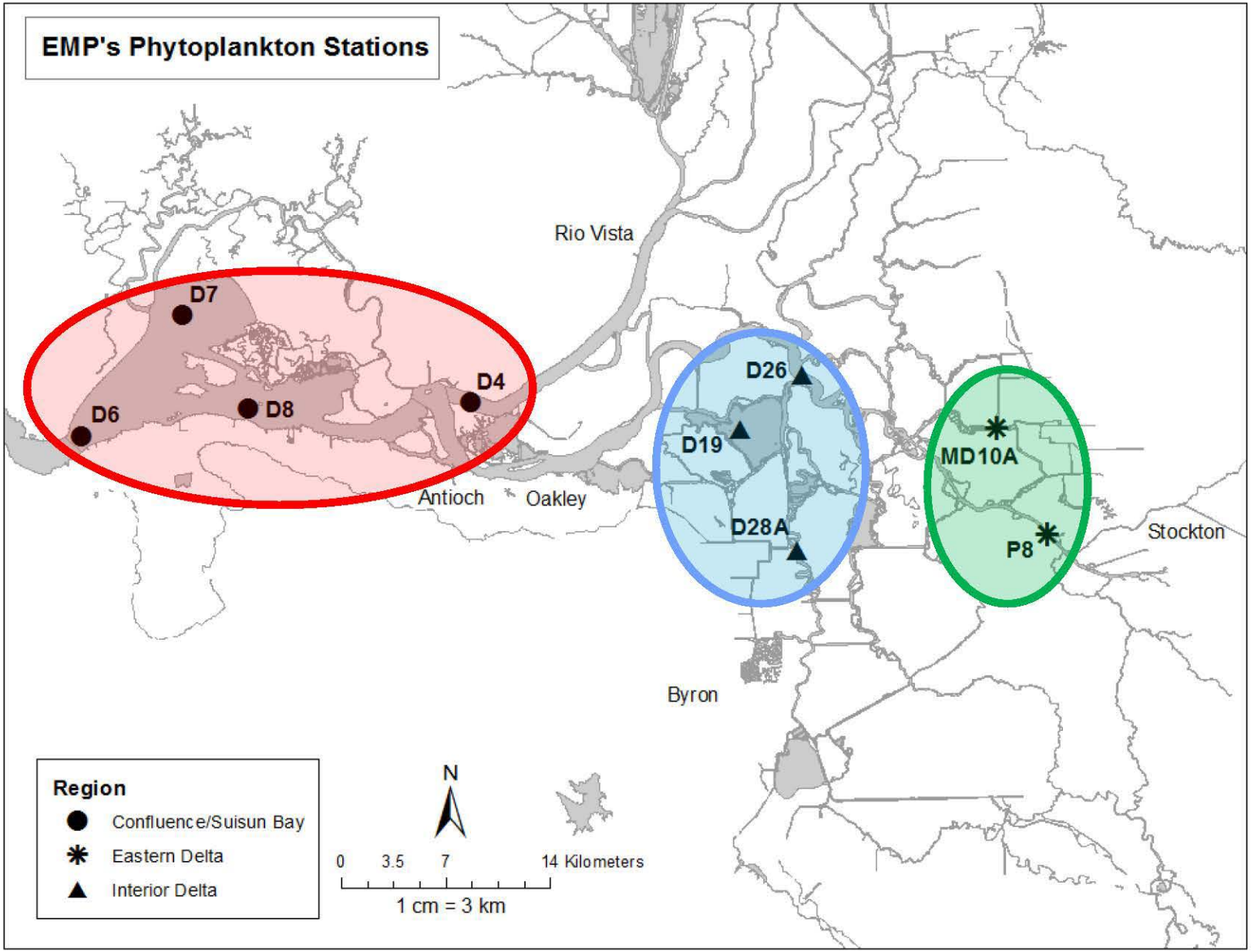
Methods

- Regional approach based on station location
- Comparing organisms per mL vs. biovolume
- Seasonal vs. annual differences; 2014 vs. 2015
- Statistical analyses using PRIMER software—ANOSIM and SIMPER

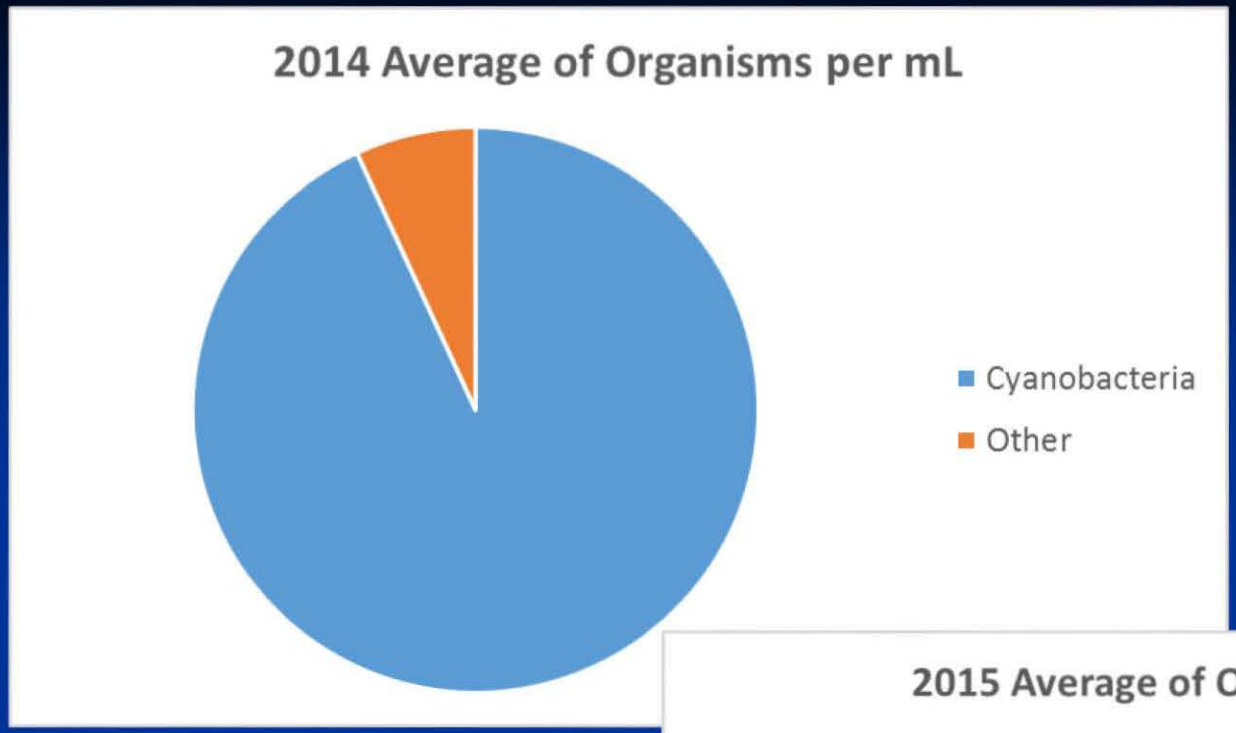
Methods

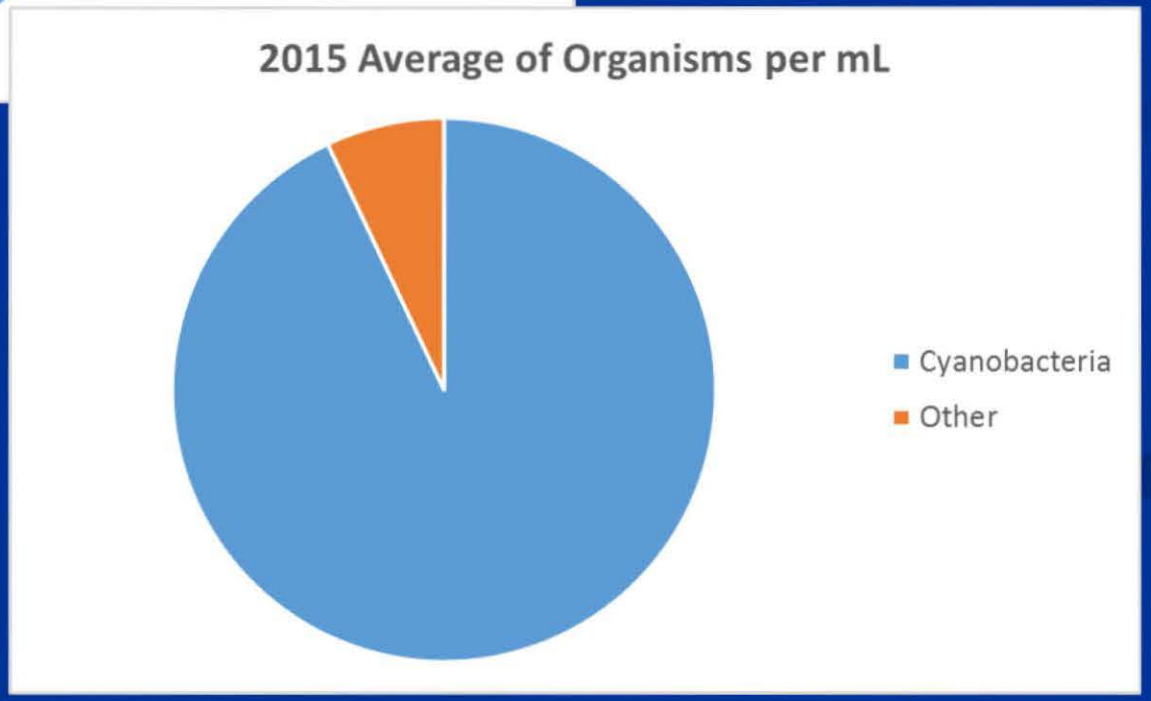
Statistical Analyses

- ANOSIM: Analysis of Similarities
  - R statistic between 0 and 1
- SIMPER: Similarity Percentages
  - Determines which species are responsible for differences between groups
- NMDS: Non-metric multi-dimensional scaling
  - Non-parametric ordination technique

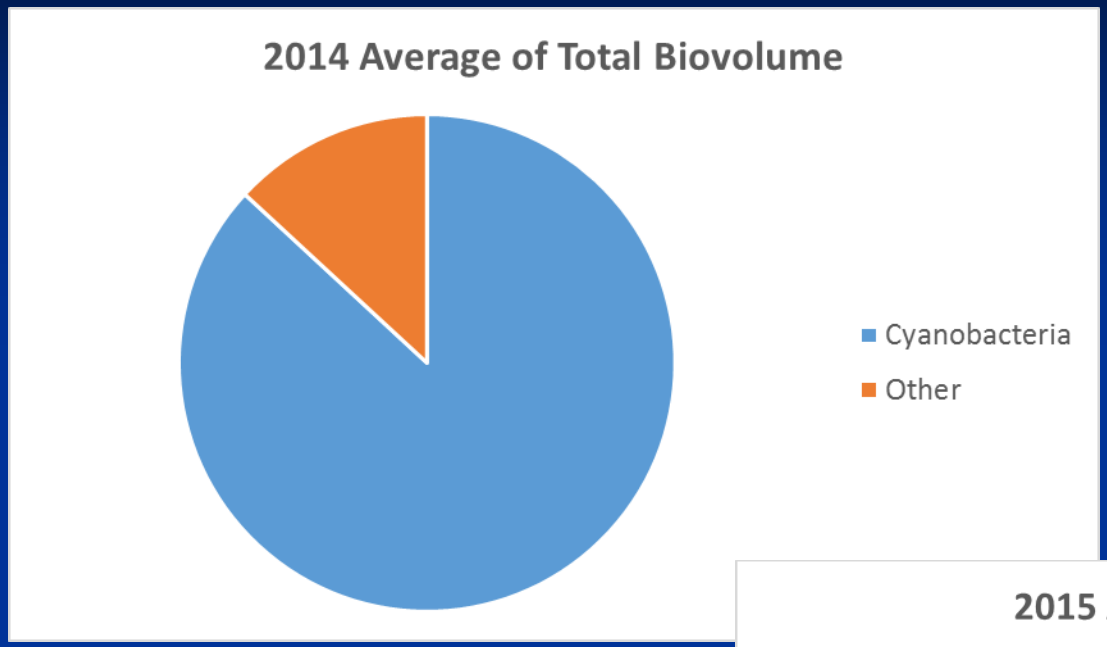

EMP's Phytoplankton Stations
Rio Vista
D7
D4
D6
D8
D26
D19
D28A
MD10A
P8
Antioch
Oakley
Stockton
Byron
Region
Confluence/Suisun Bay
Eastern Delta
Interior Delta
N
0
3.5
7
14 Kilometers
1 cm = 3 km

Results
Organisms per mL

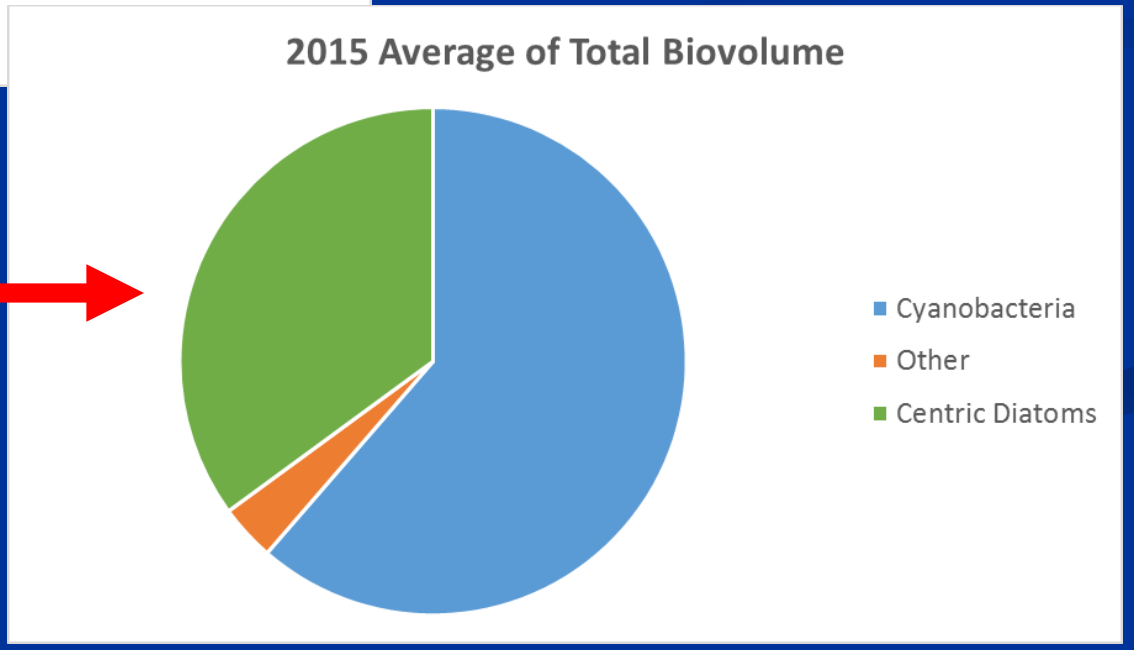

2014 Average of Organisms per mL
Cyanobacteria
Other


2015 Average of Organisms per mL
Cyanobacteria
Other

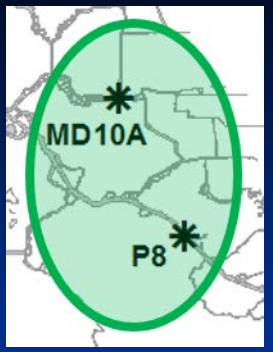
But what about biovolume? Different story….

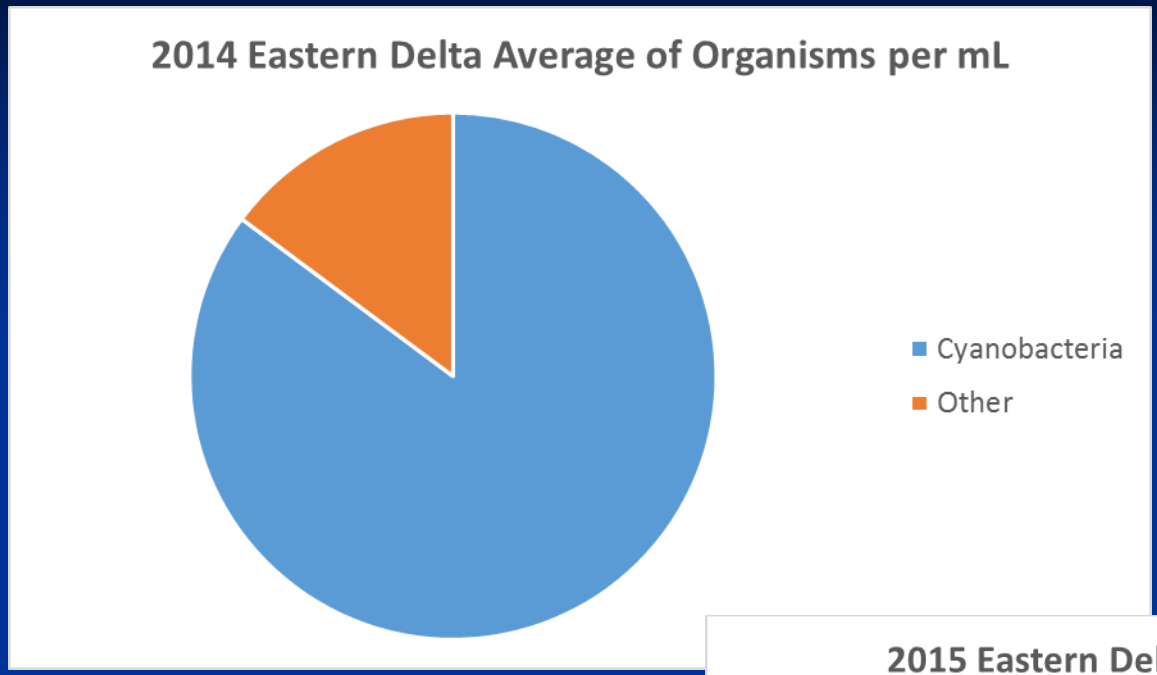


More diatom biovolume in 2015

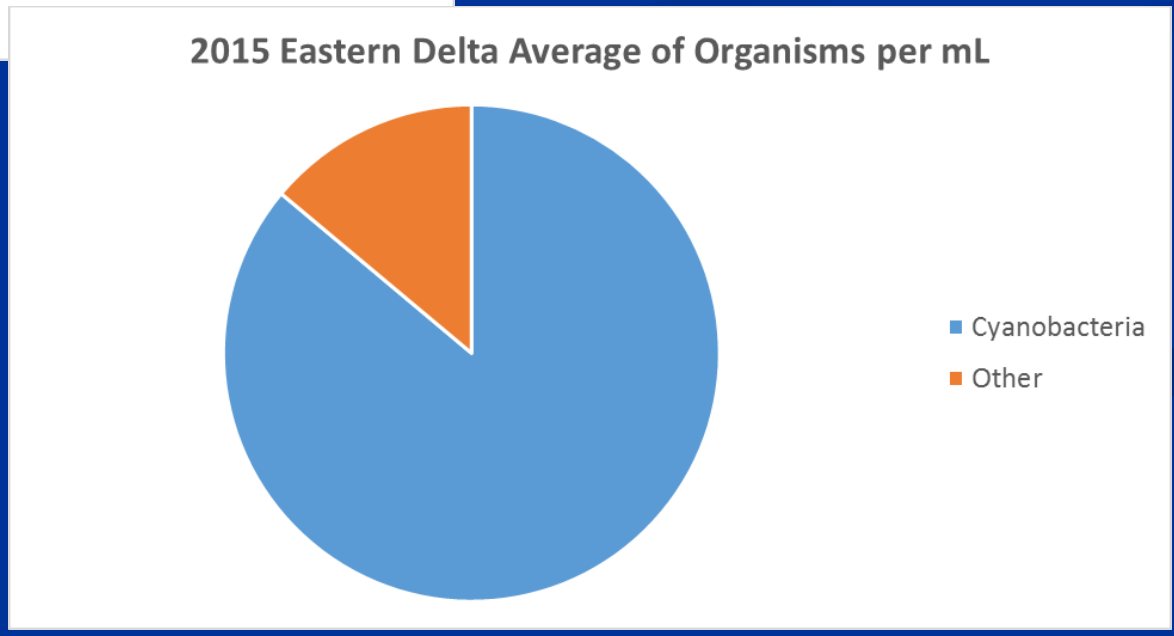


Regional Analyses—Eastern Delta

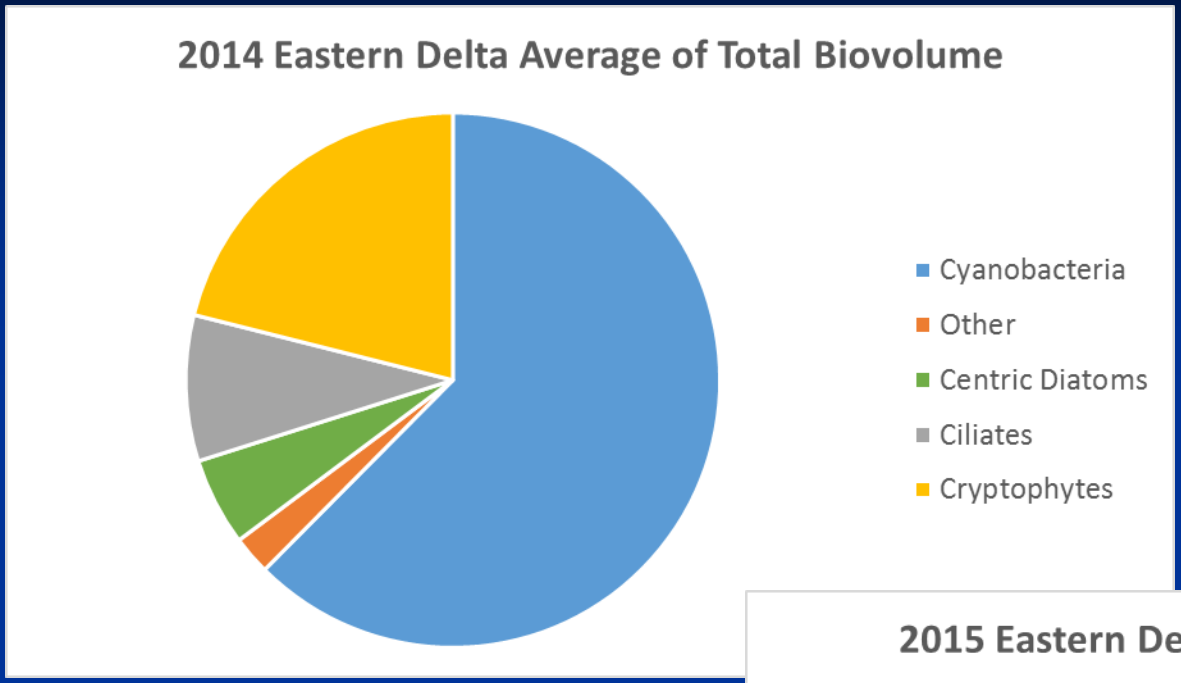


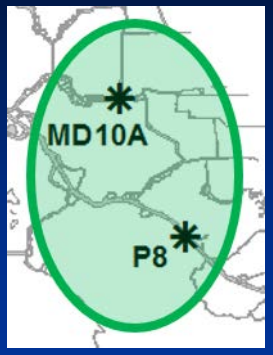


Organisms per mL: no change

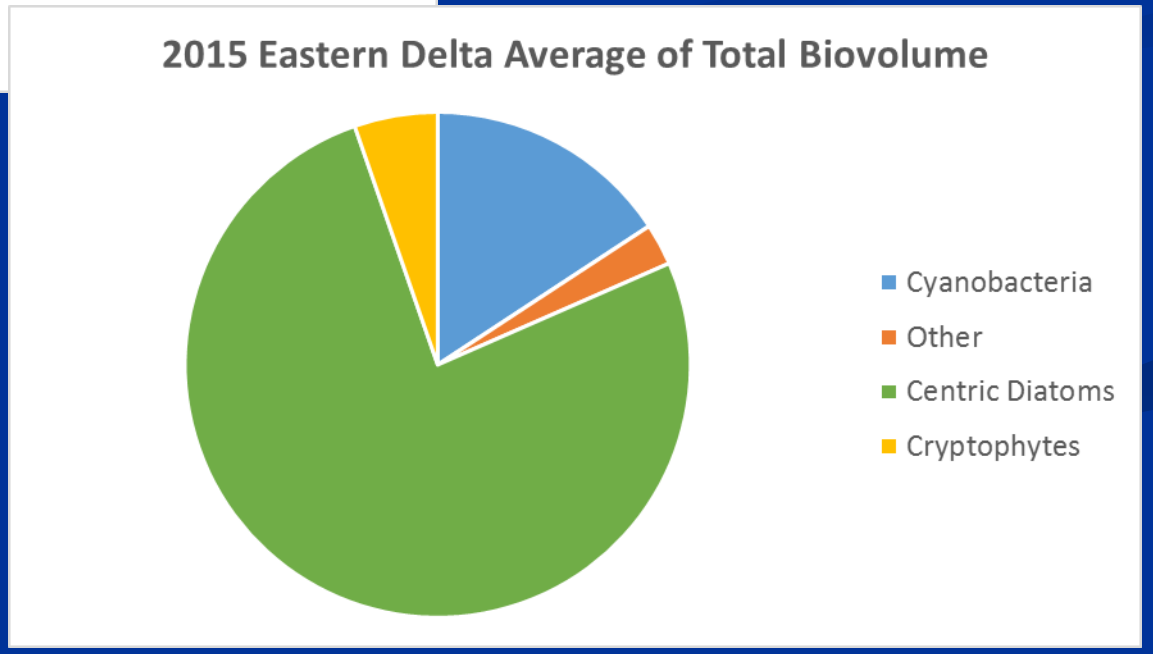


Regional Analyses—Eastern Delta





More diversity in biovolume



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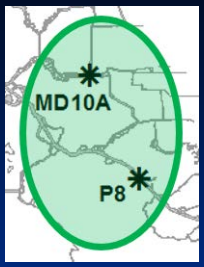
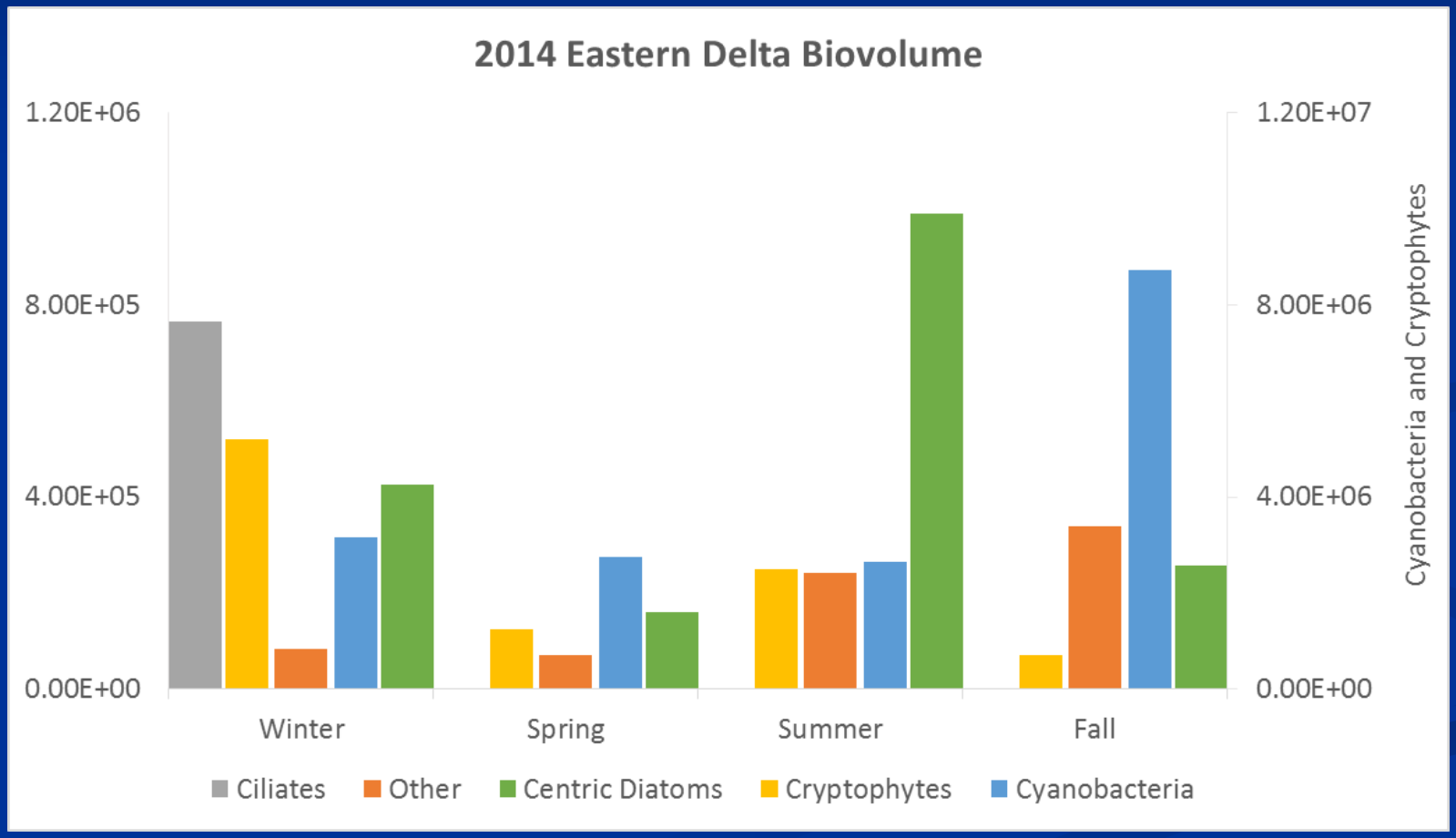
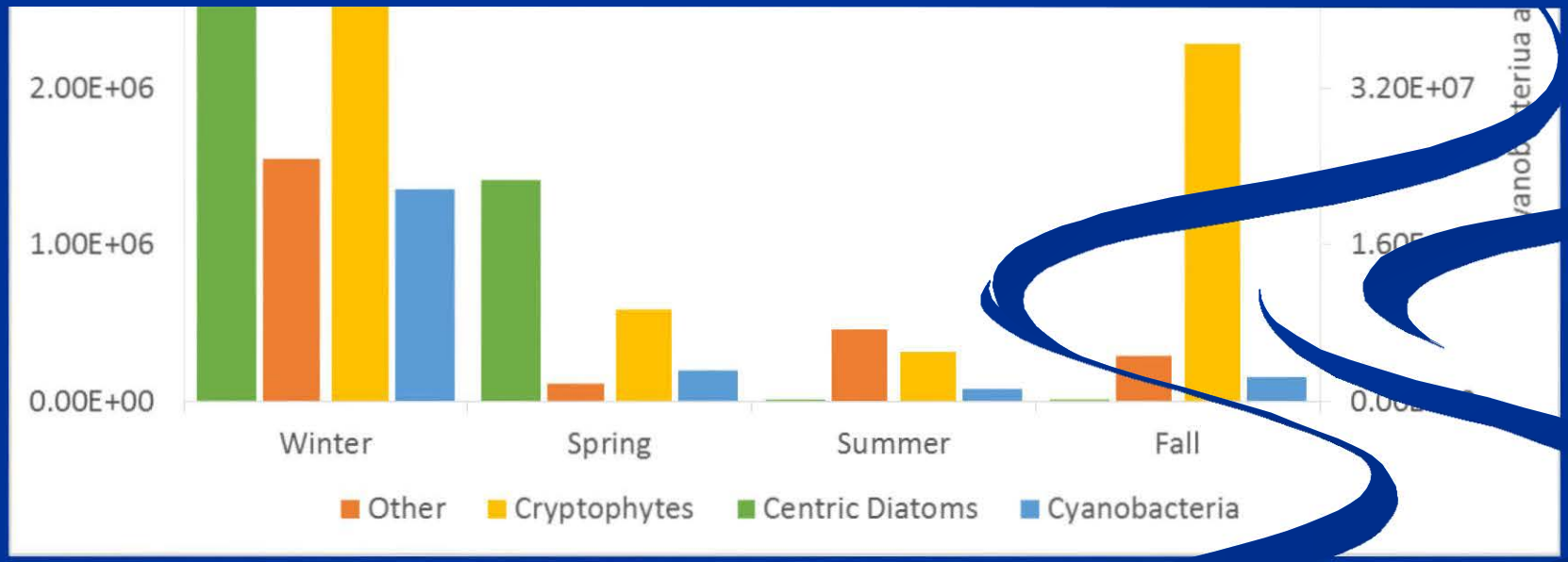


Any seasonal differences? You betcha!



2014

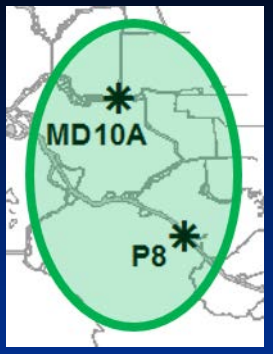
Regional Analyses—Eastern Delta



2015

But are they statistically significant?

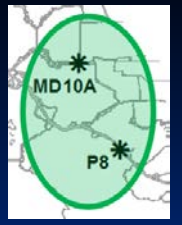
Regional Analyses—Eastern Delta



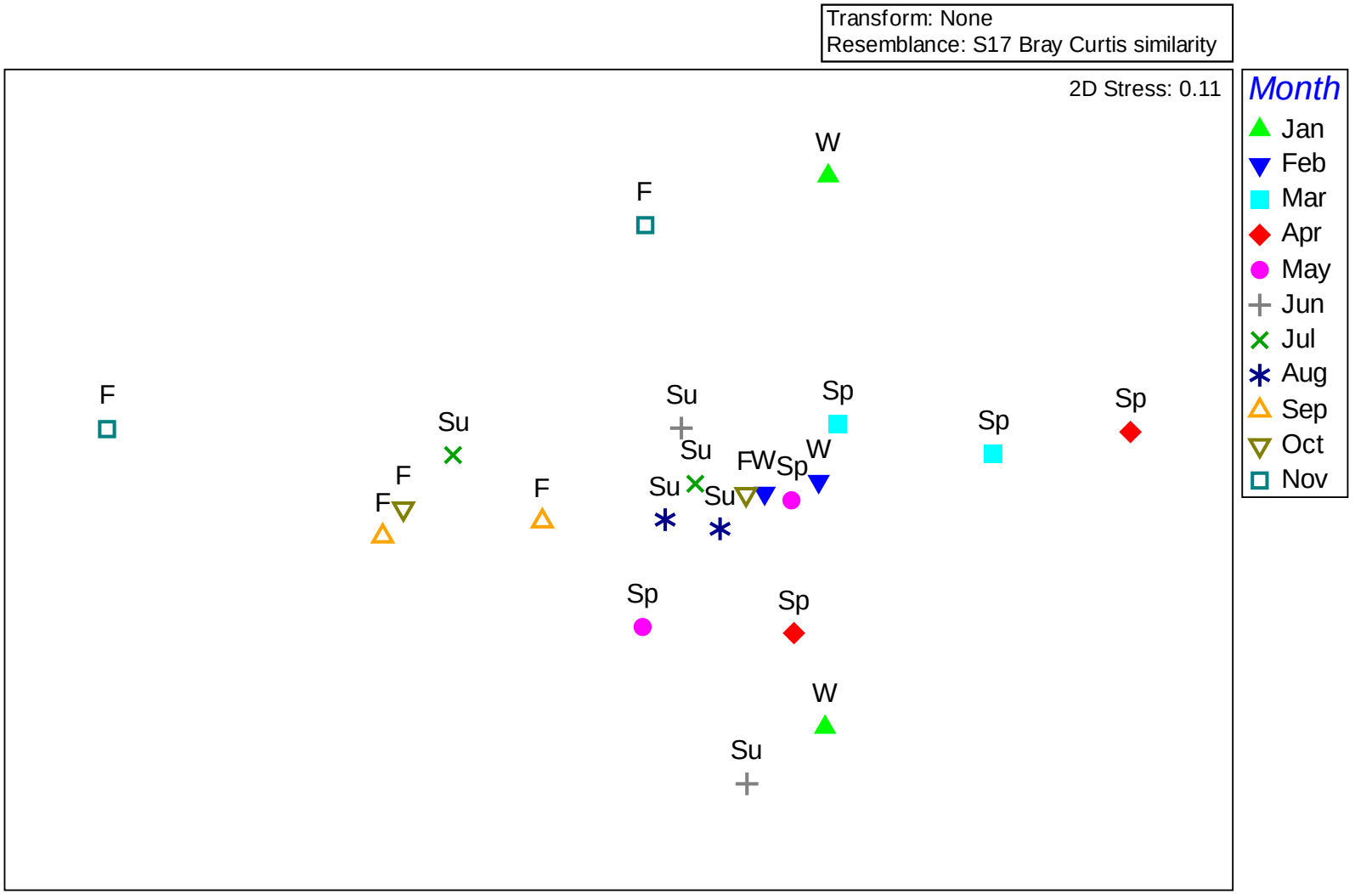
ANOSIM Results

- No differences between years (2014 vs. 2015)
- Some seasonal differences within years, but weakly so
  - 2014: spring vs. fall (R = 0.348, p = 0.01)
  - 2015: winter vs. summer (R = 0.346, p = 0.009)

Regional Analyses—Eastern Delta



2014 NMDS



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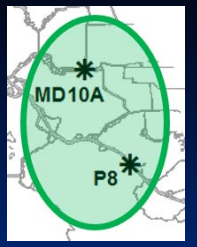
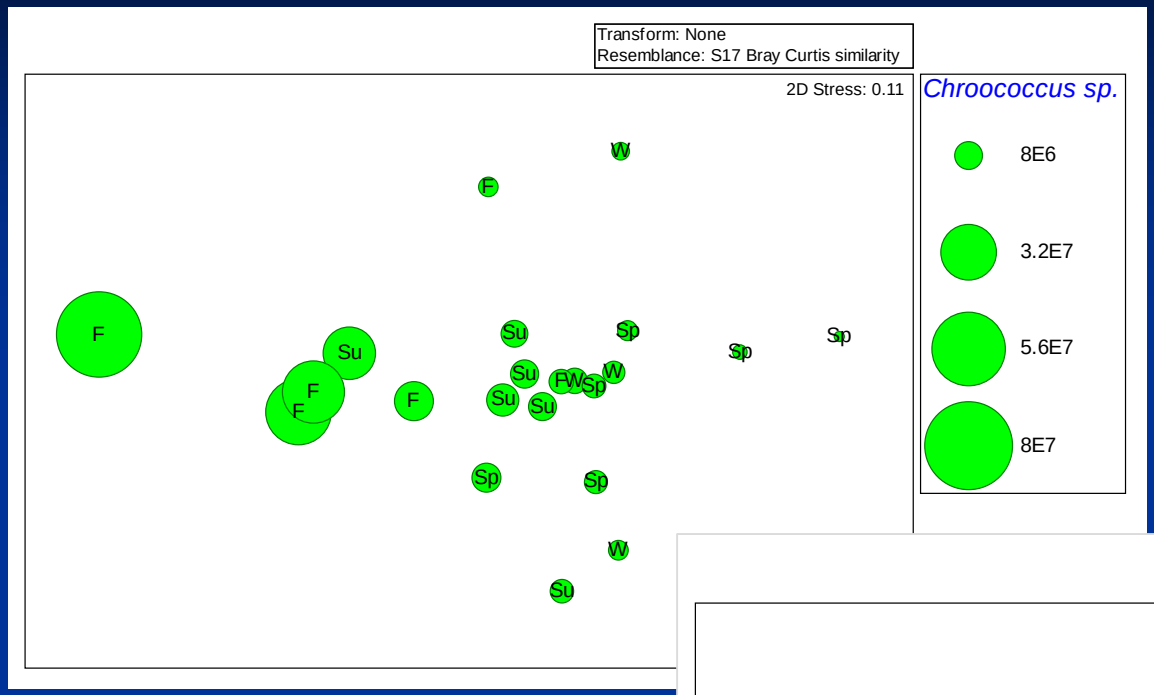
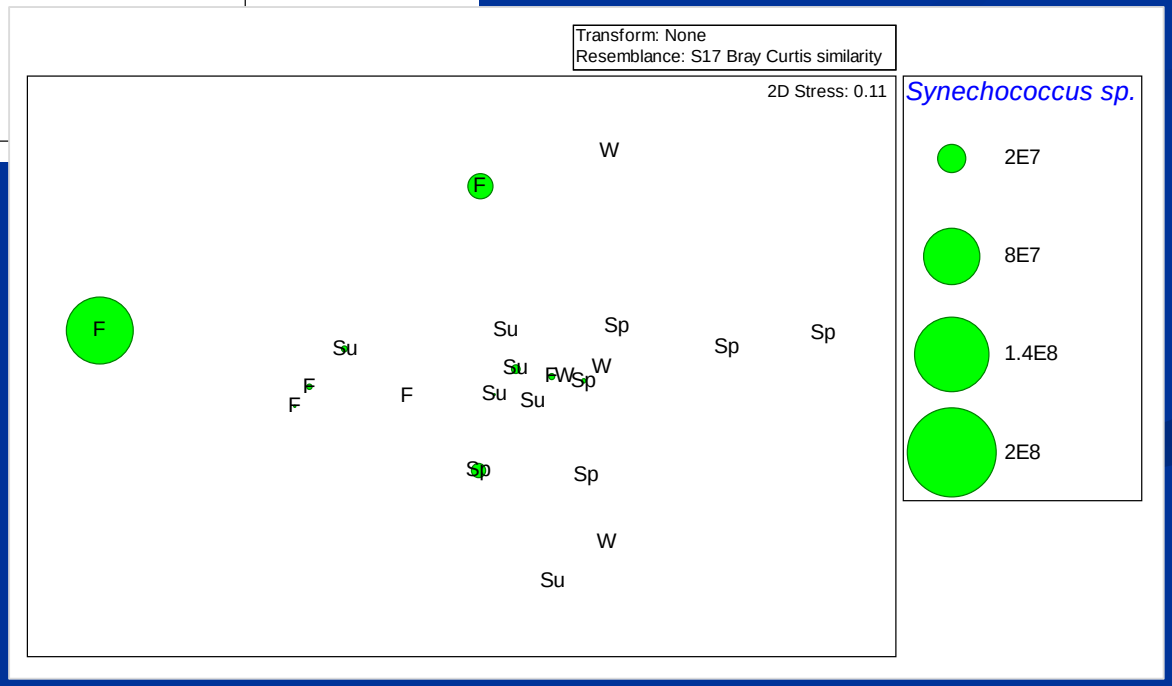
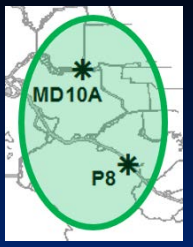


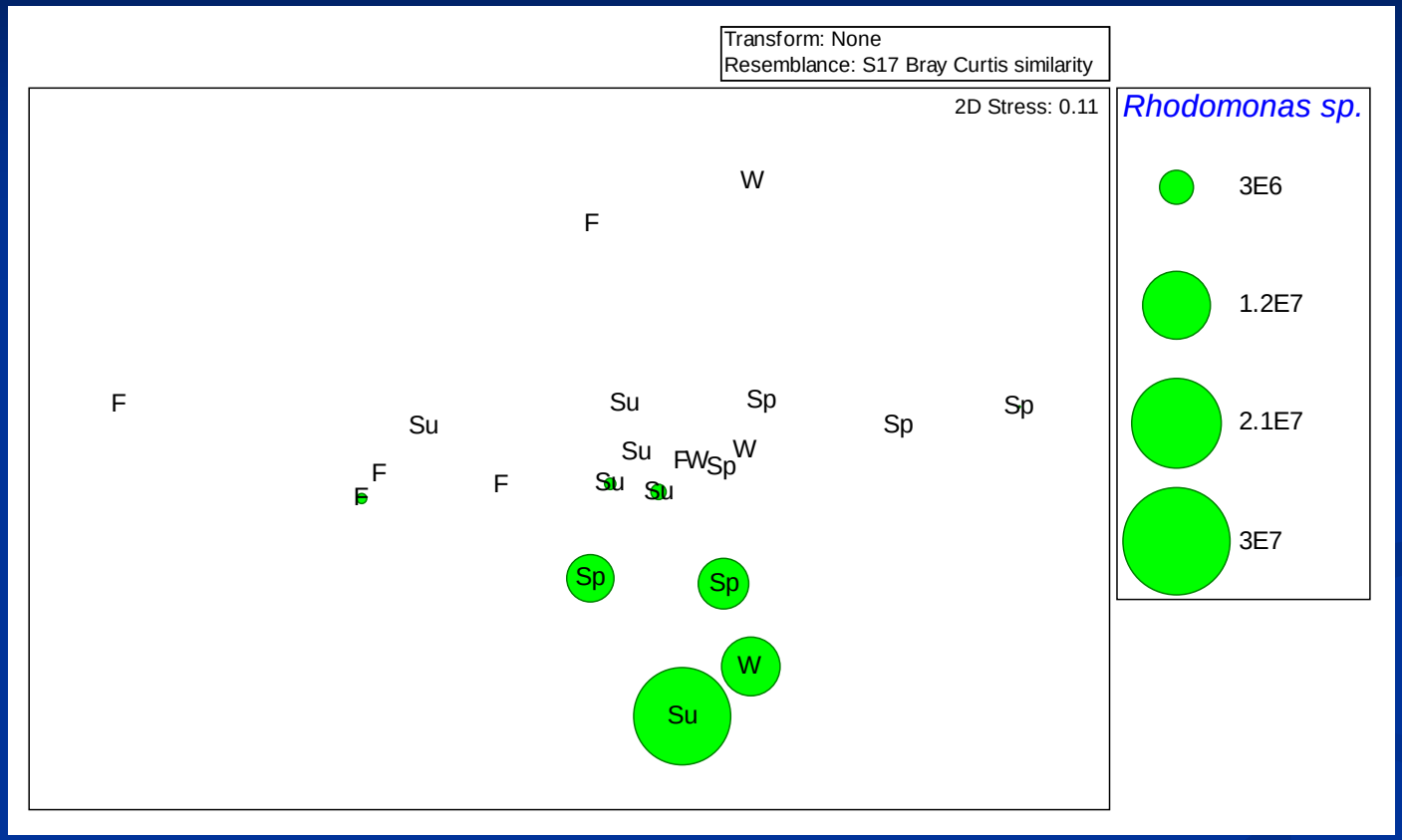




2014

Regional Analyses—Eastern Delta





2014

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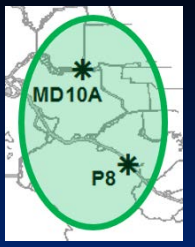
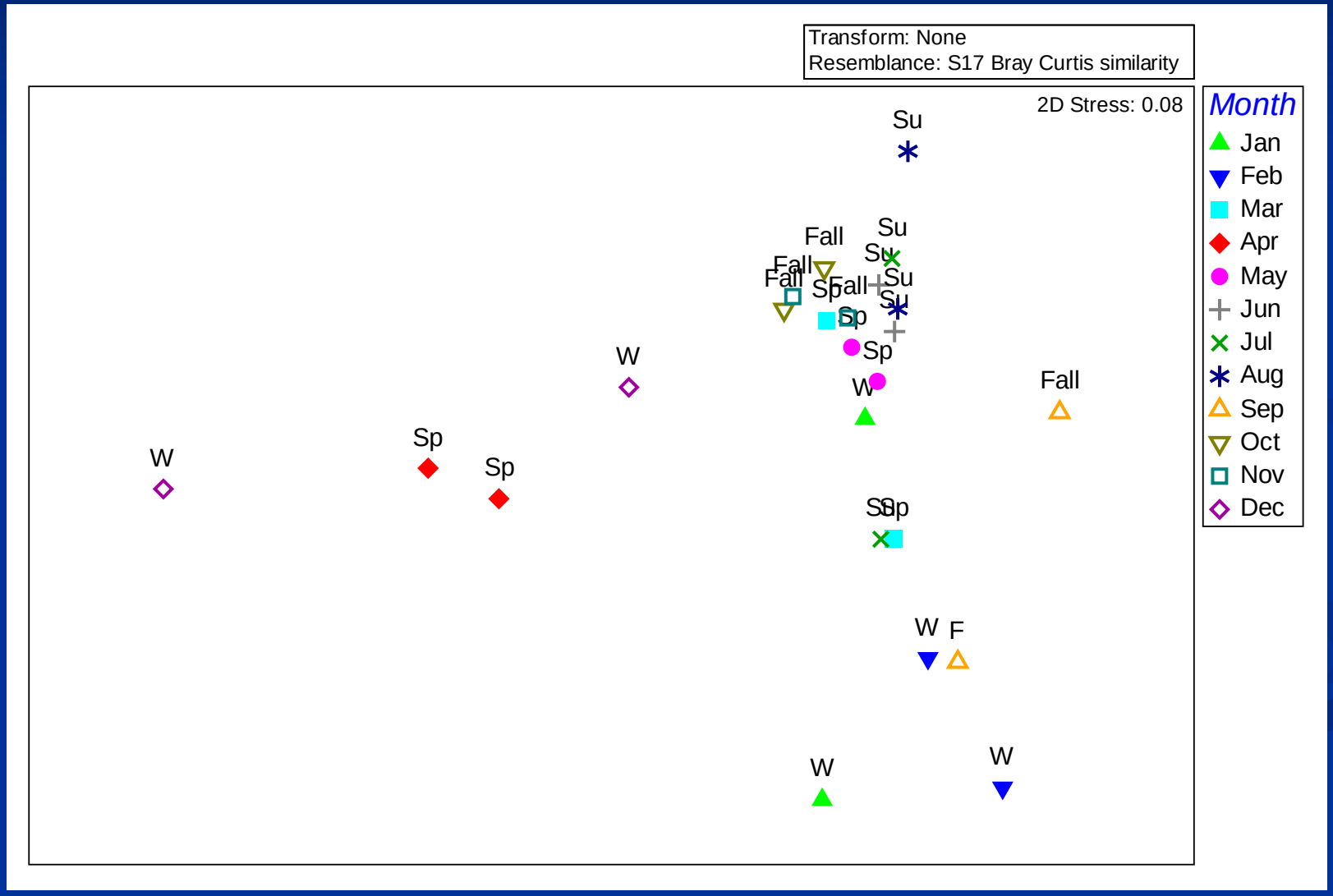


2015 NMDS



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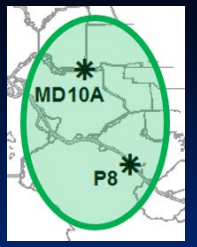
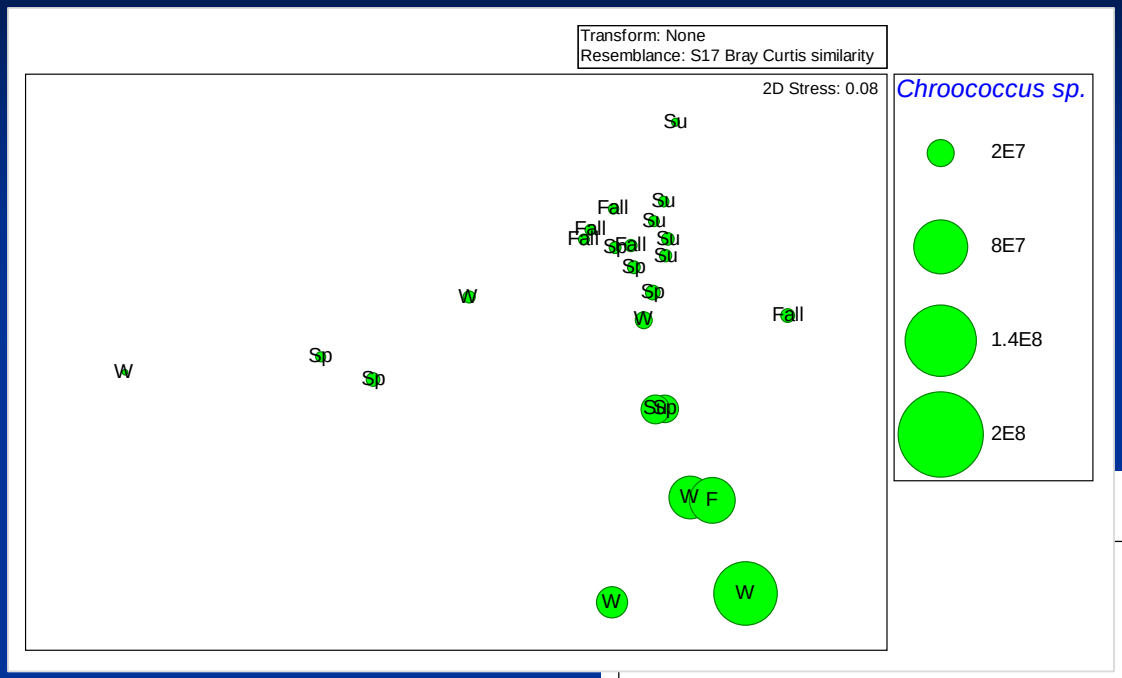
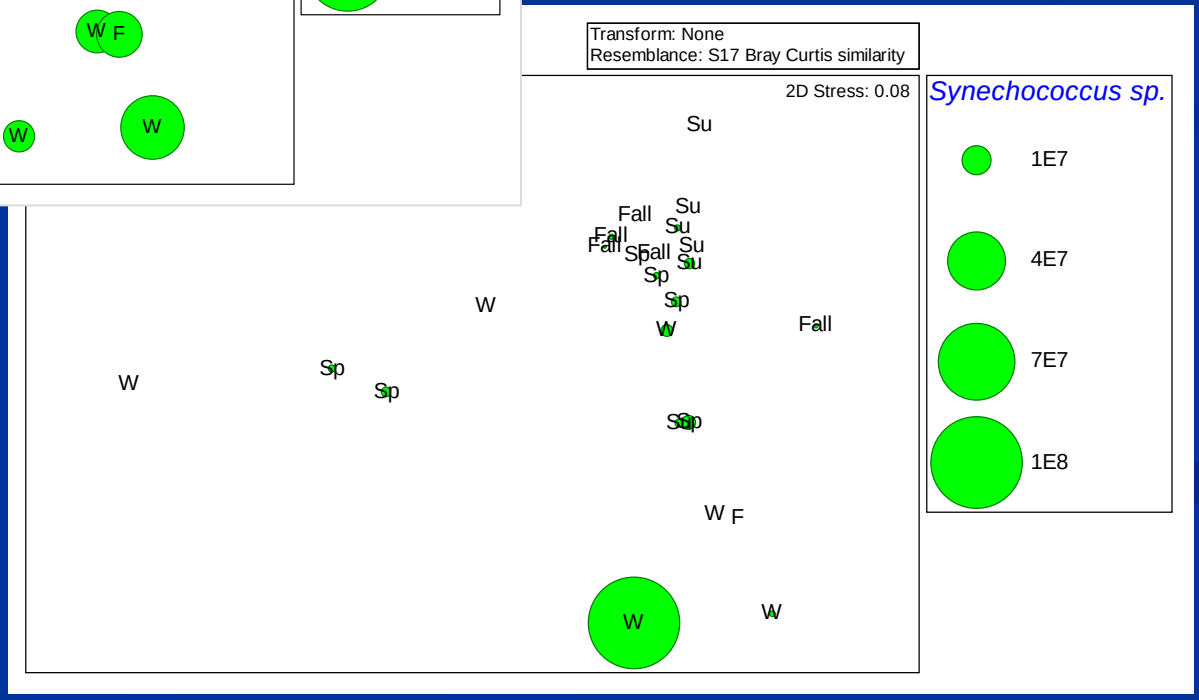
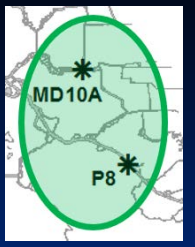


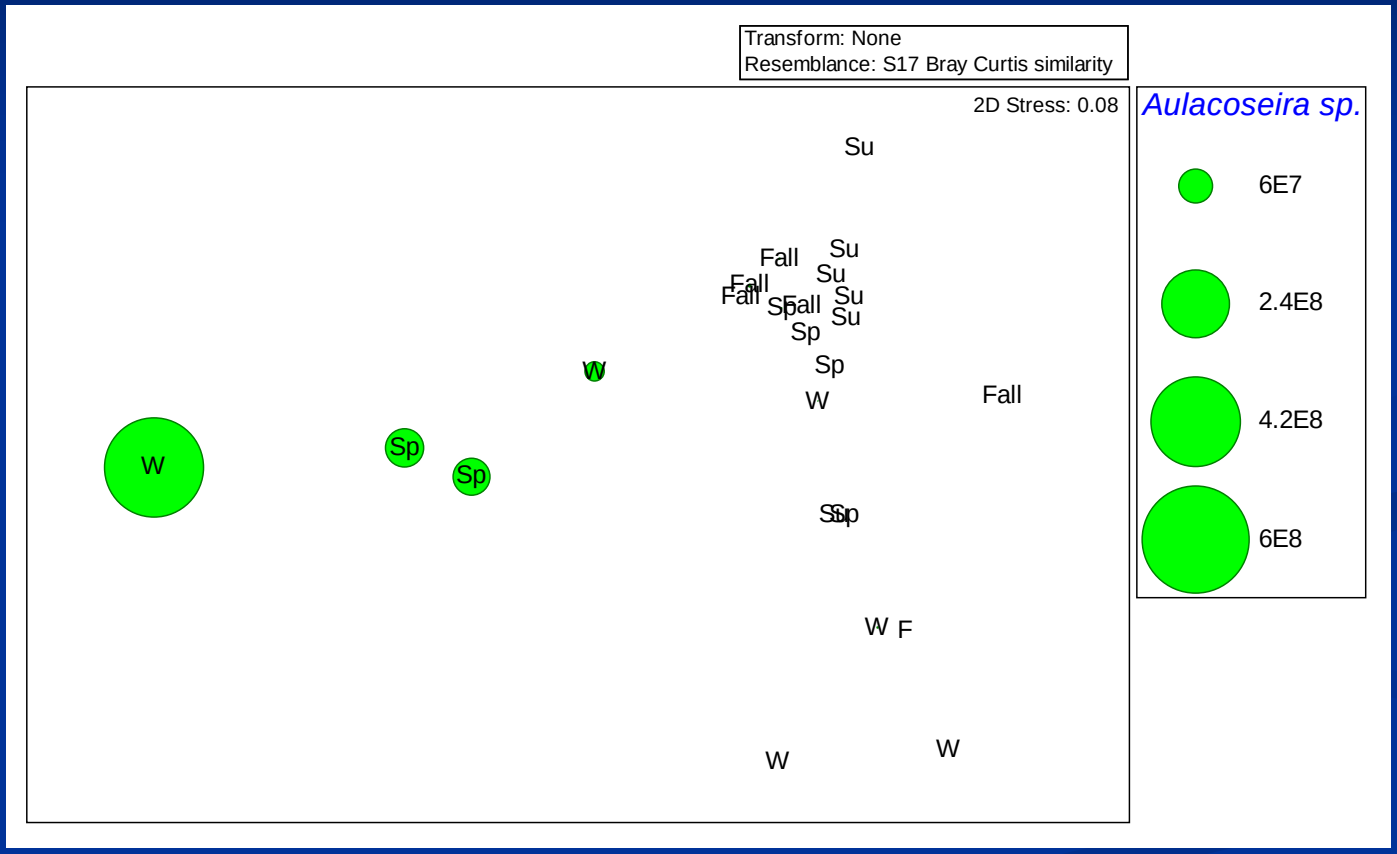




2015

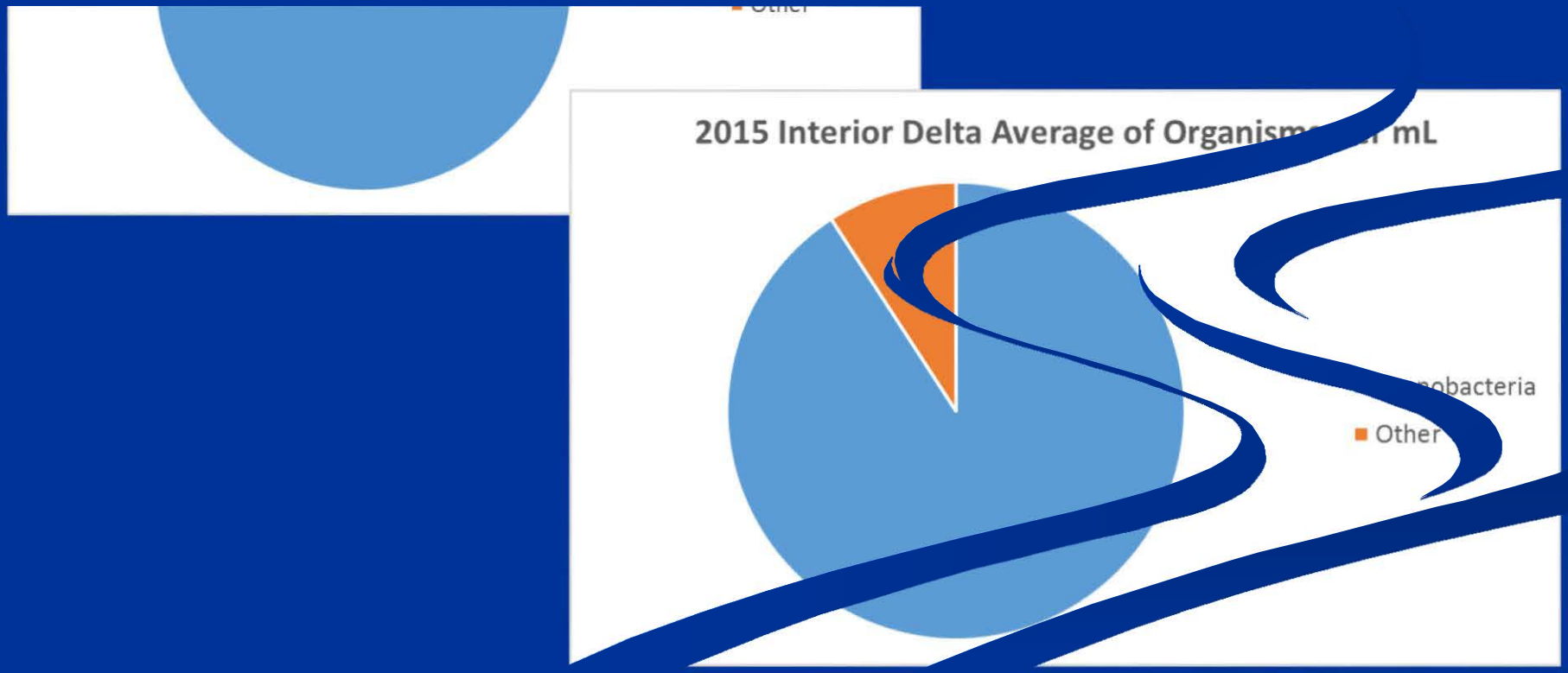
Regional Analyses—Eastern Delta





2015

Regional Analyses—Interior Delta



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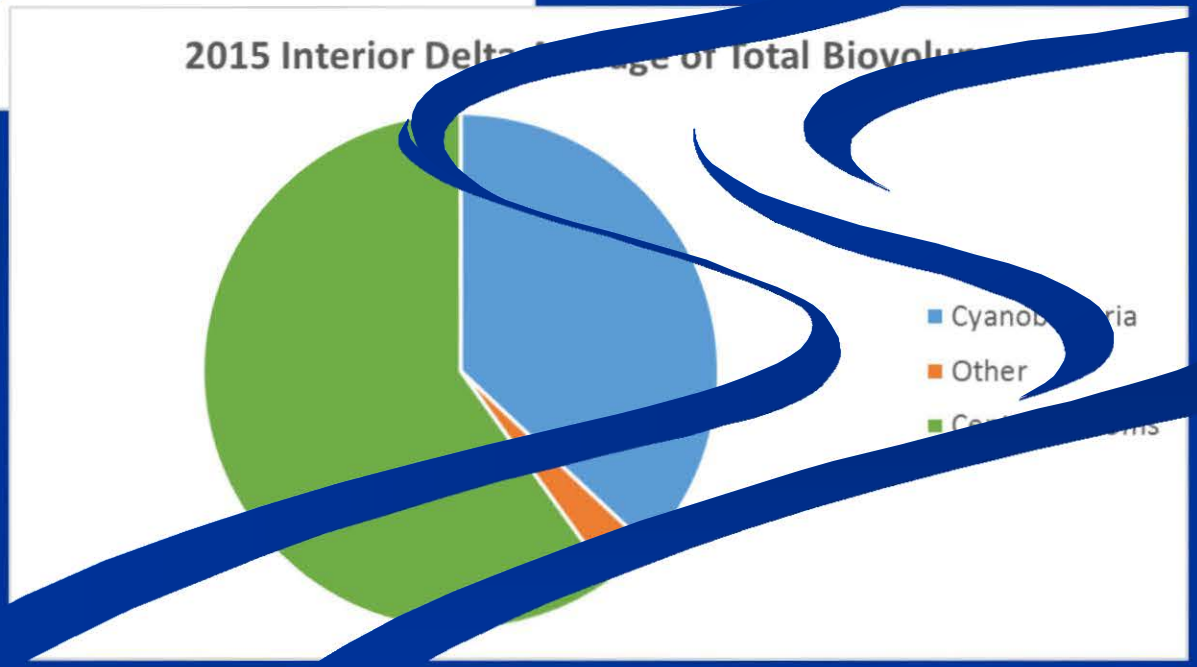

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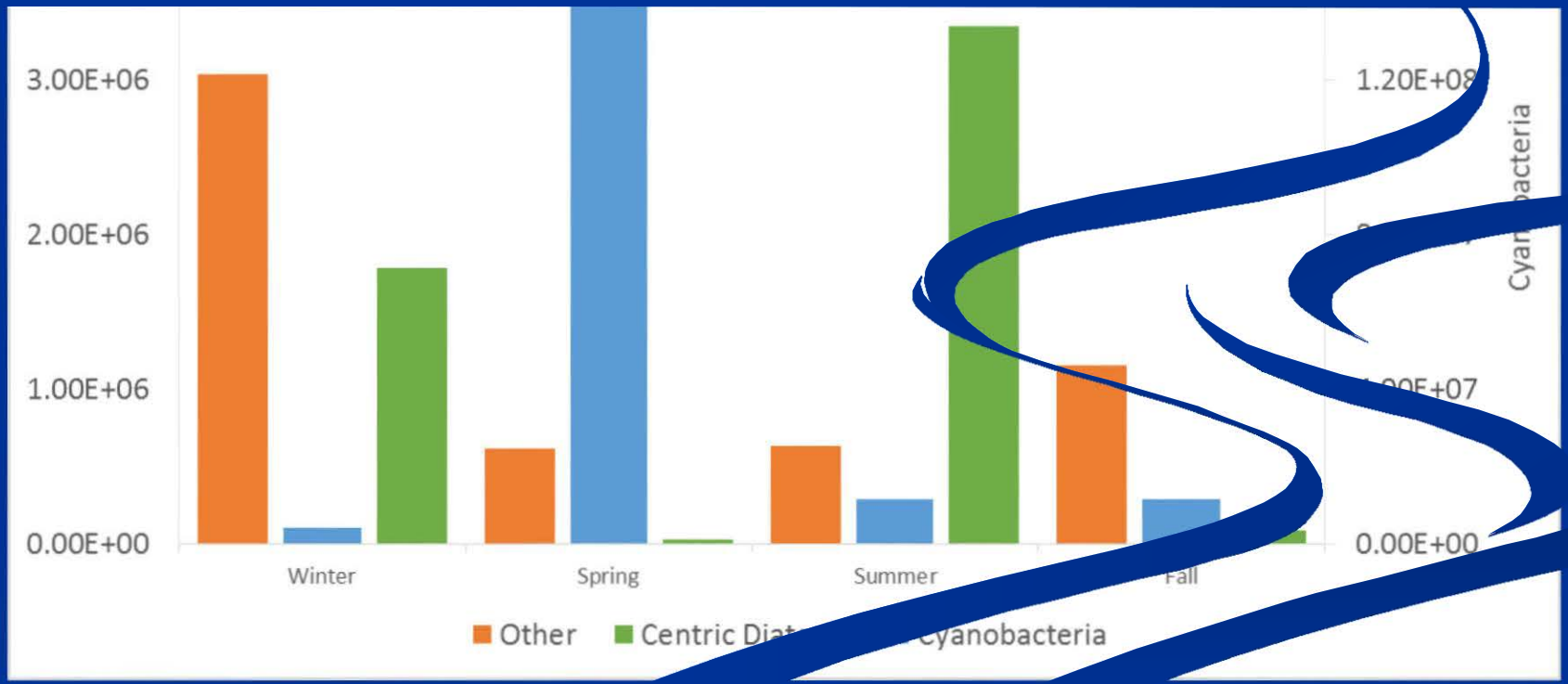

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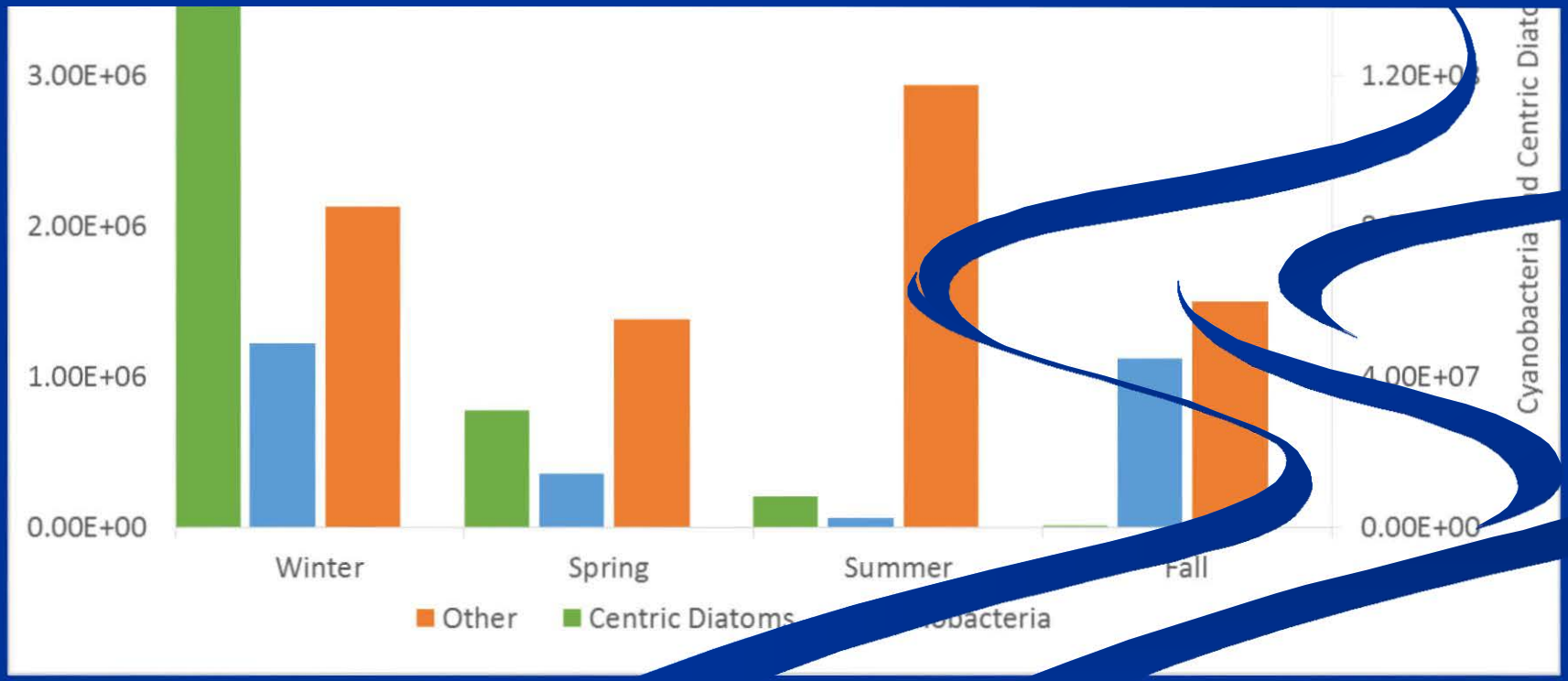

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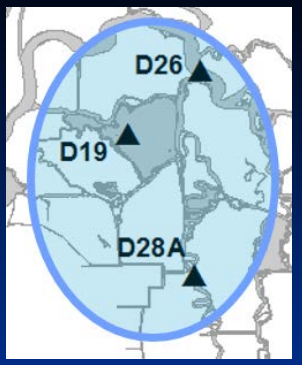
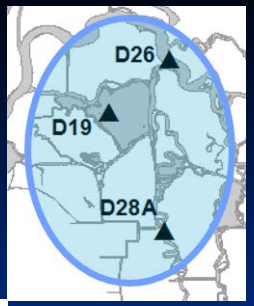


ANOSIM Results

- No differences between years (2014 vs. 2015)

- Seasonal differences within years
  - 2014: winter vs. summer (R = 0.526, p = 0.003)
  - 2014: winter vs. fall (R = 0.546, p = 0.006)
  - 2015: winter vs. summer (R = 0.342, p = 0.003)

Regional Analyses—Interior Delta



2014 NMDS

Transform: None
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.09

Month
Jan
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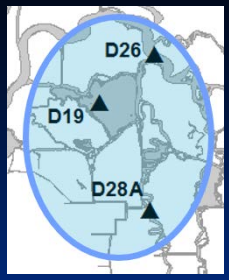
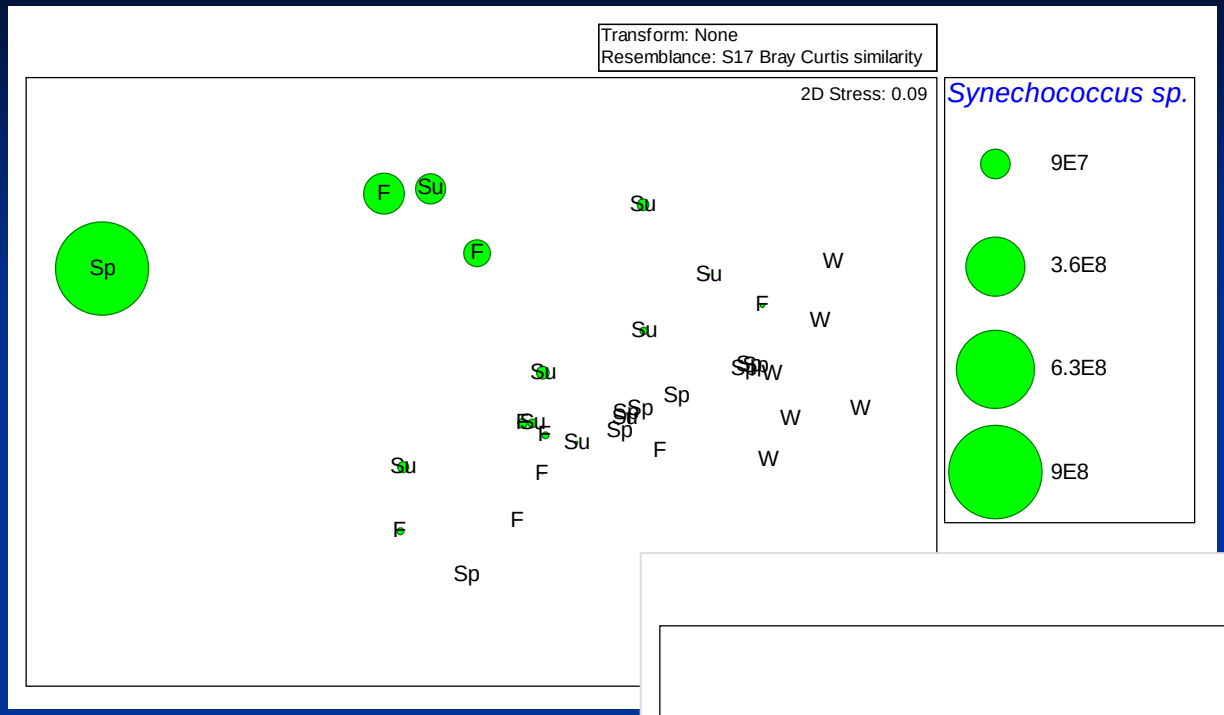
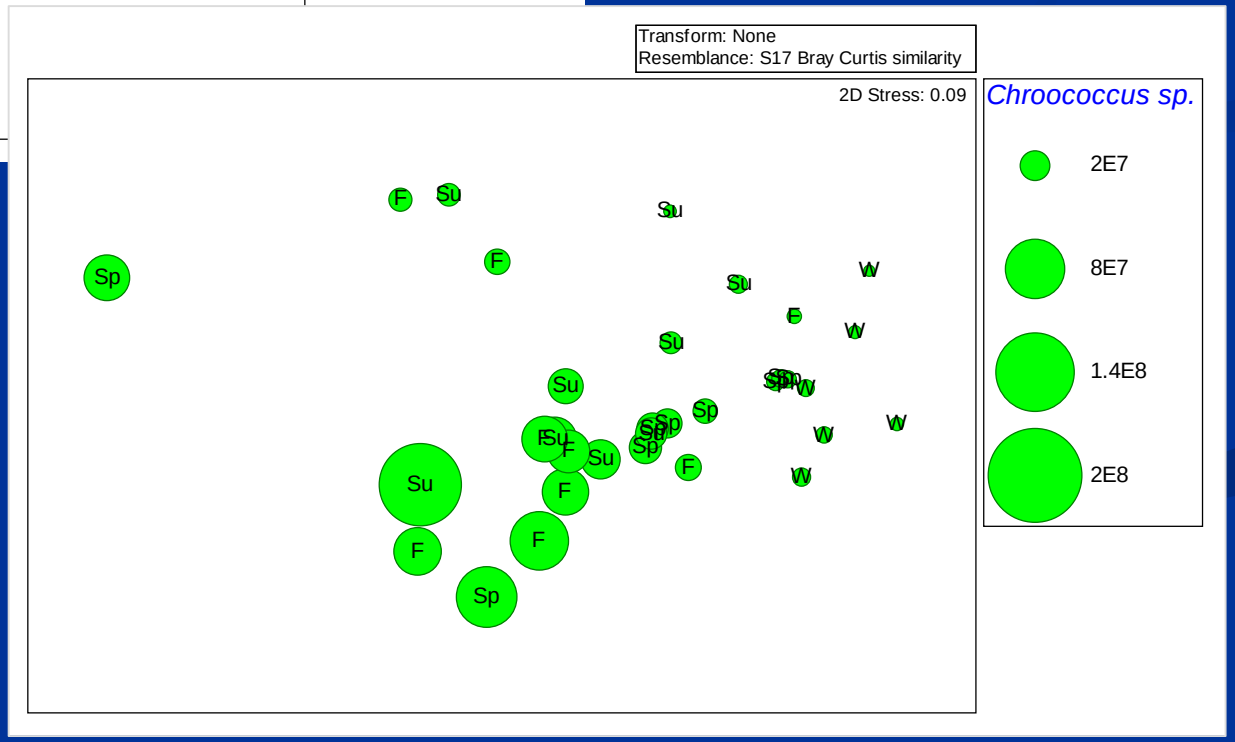
Regional Analyses—Interior Delta







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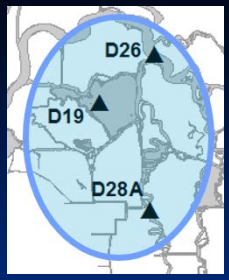
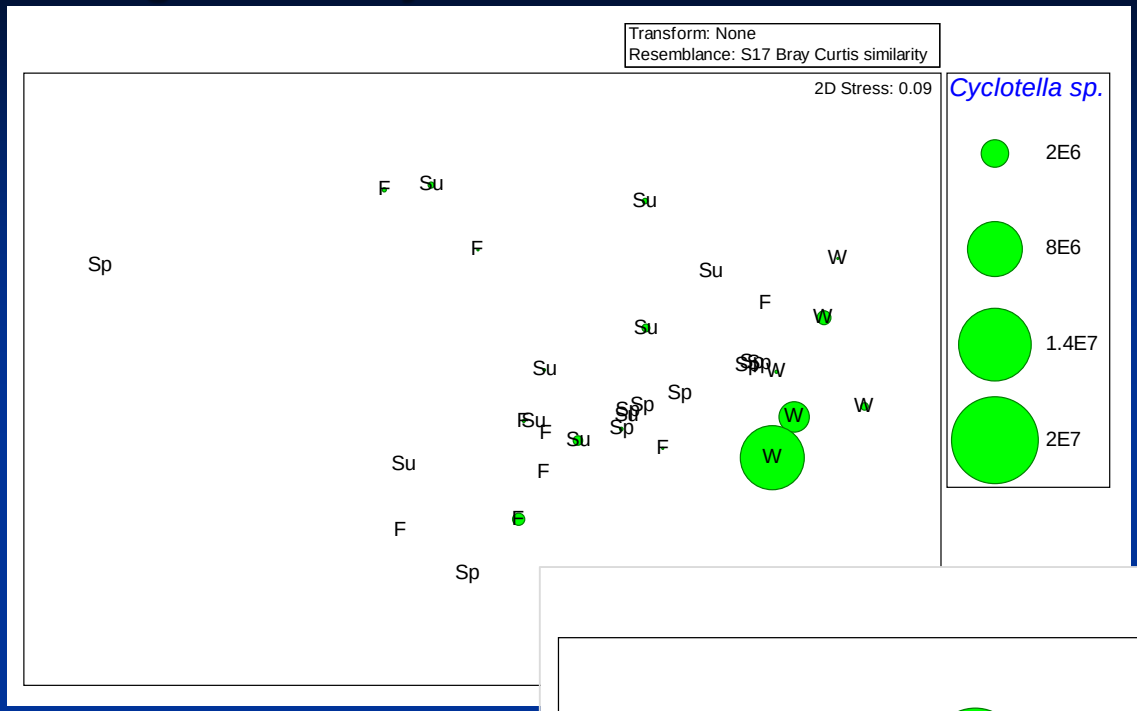
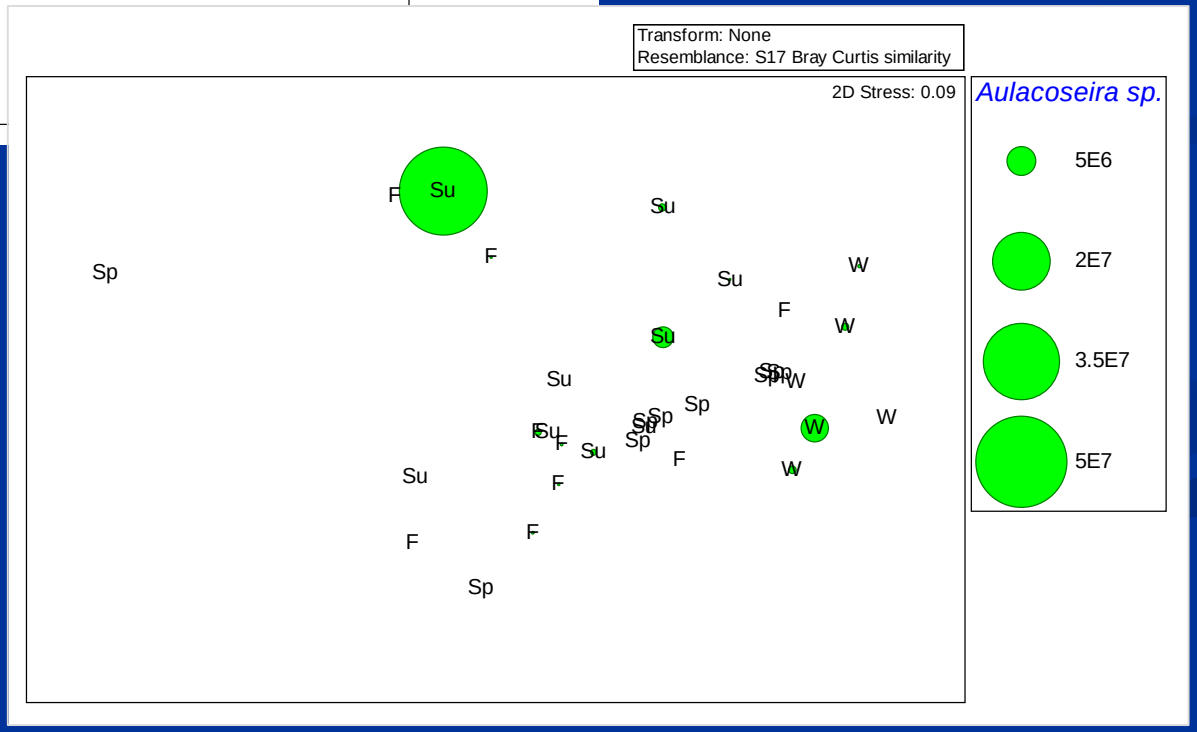
Regional Analyses—Interior Delta

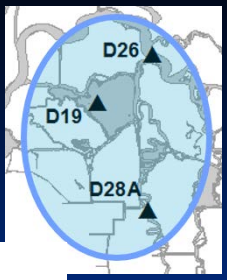






2014

Regional Analyses—Interior Delta



2015 NMDS

Transform: None
Resemblance: S17 Bray Curtis similarity

2D Stress: 0.09

Month
Jan
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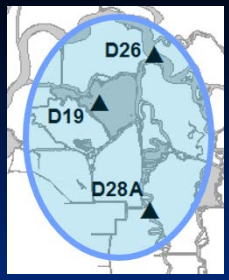
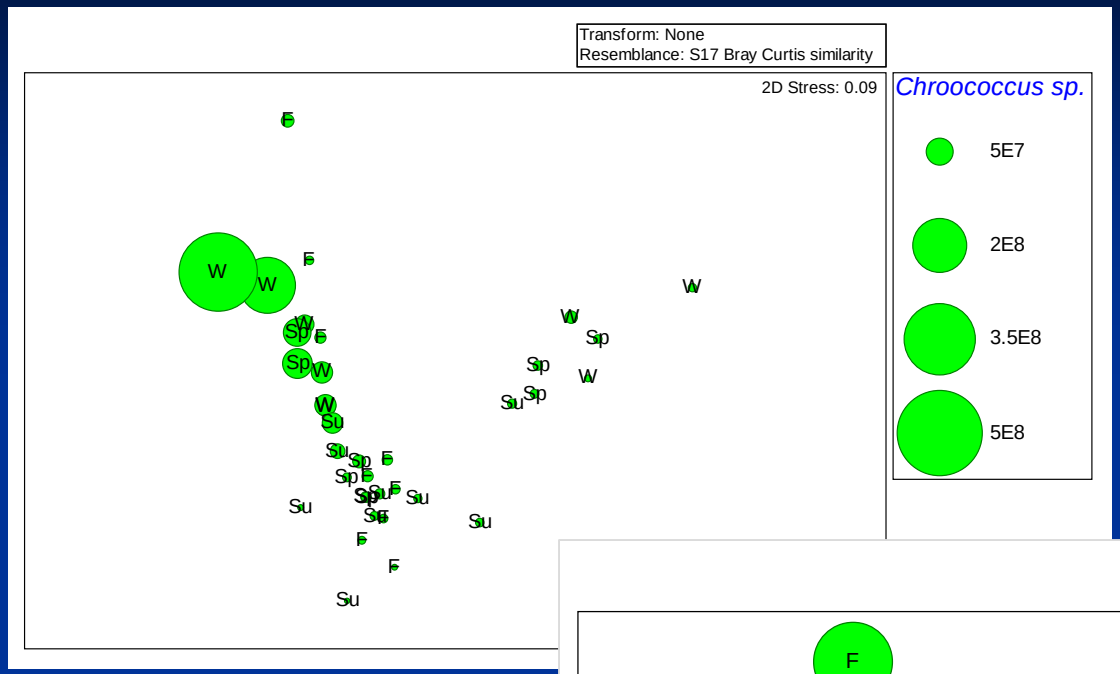
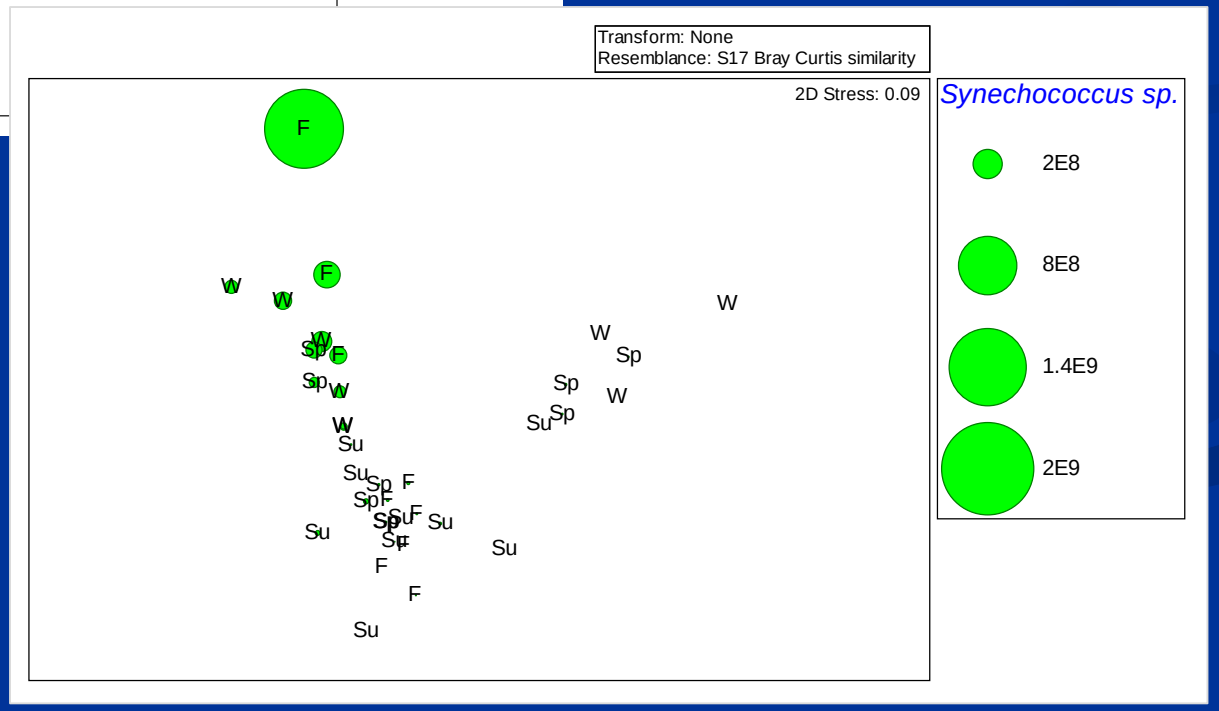
Regional Analyses—Interior Delta







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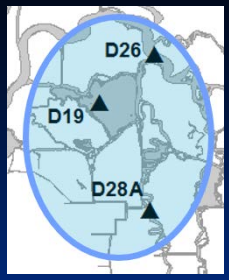
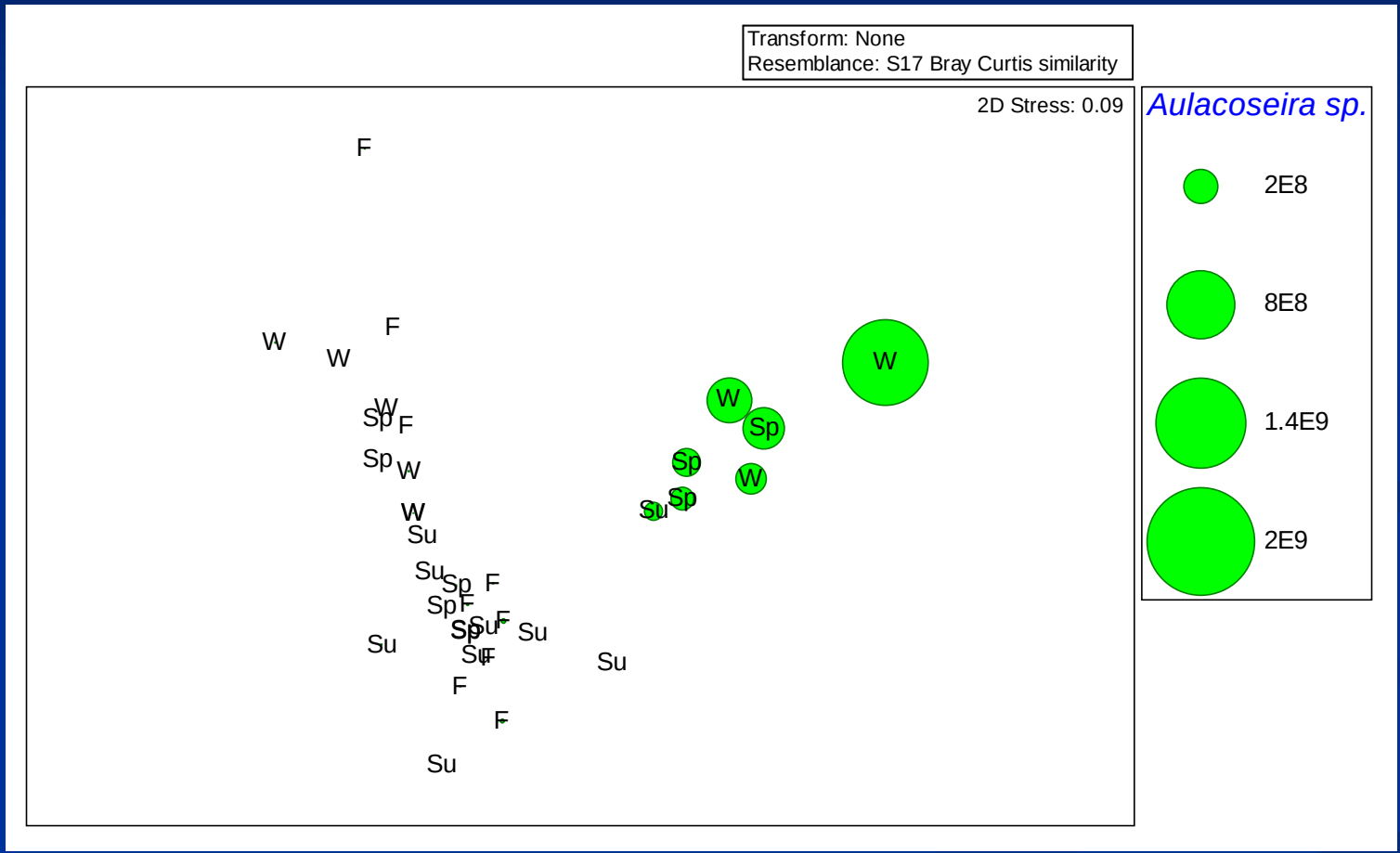
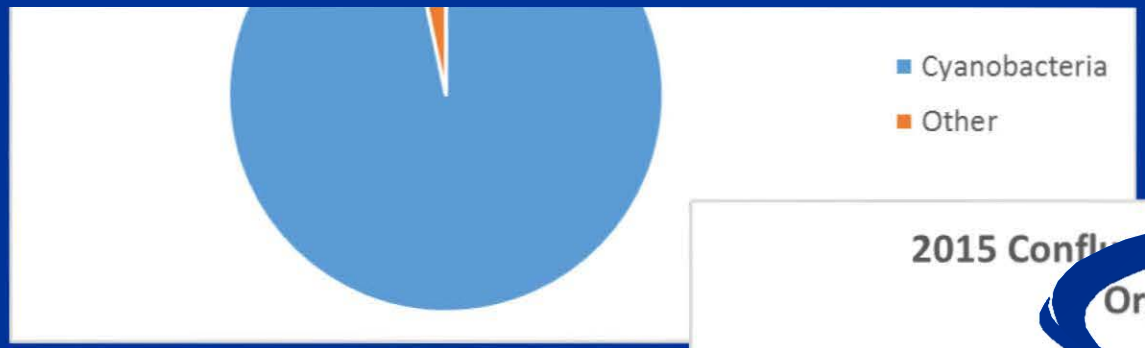
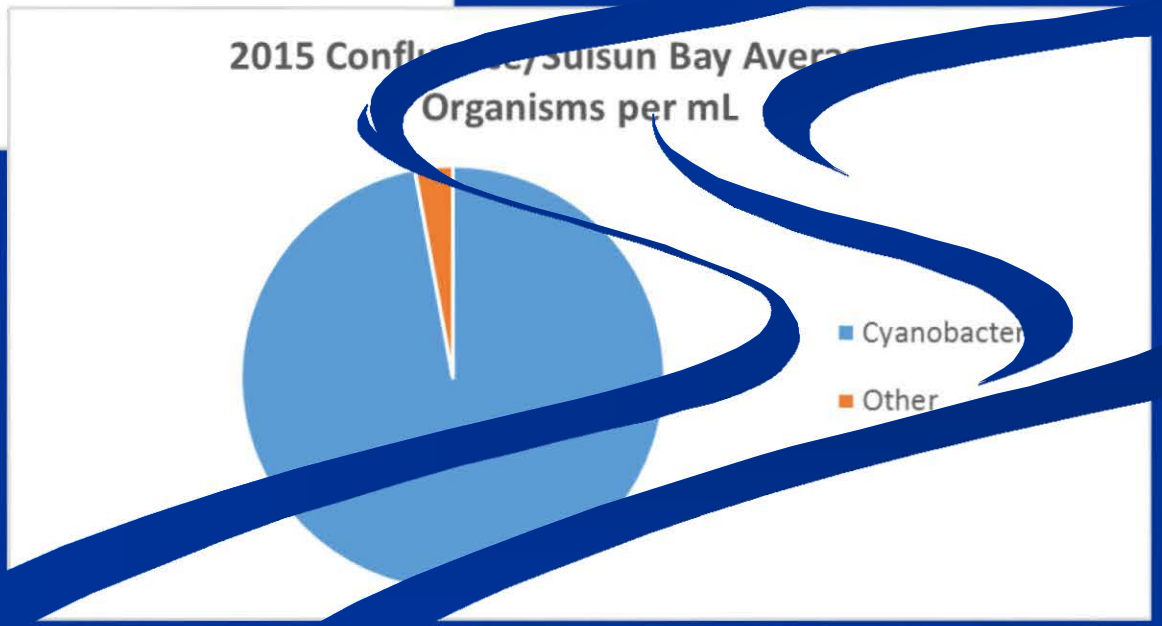




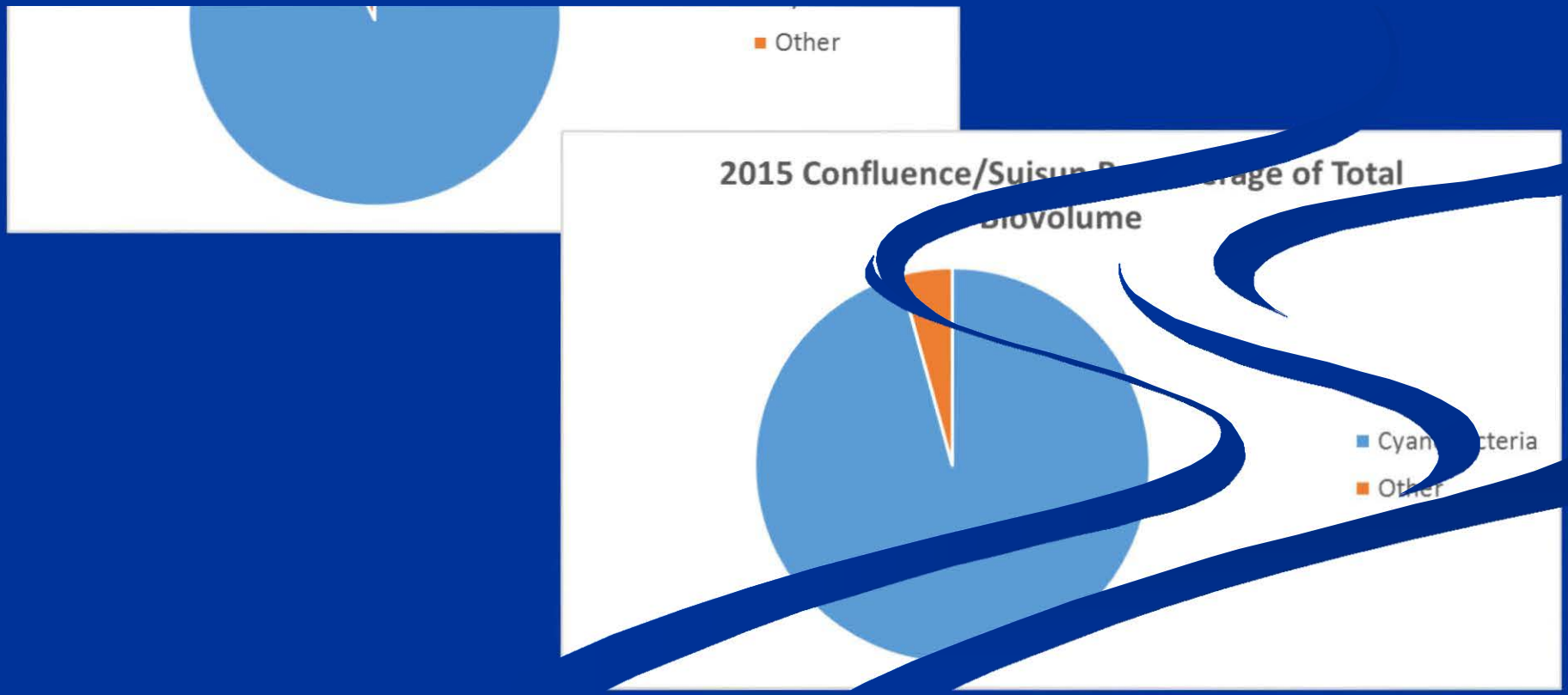
2015

Regional Analyses—Confluence & Susiun Bay

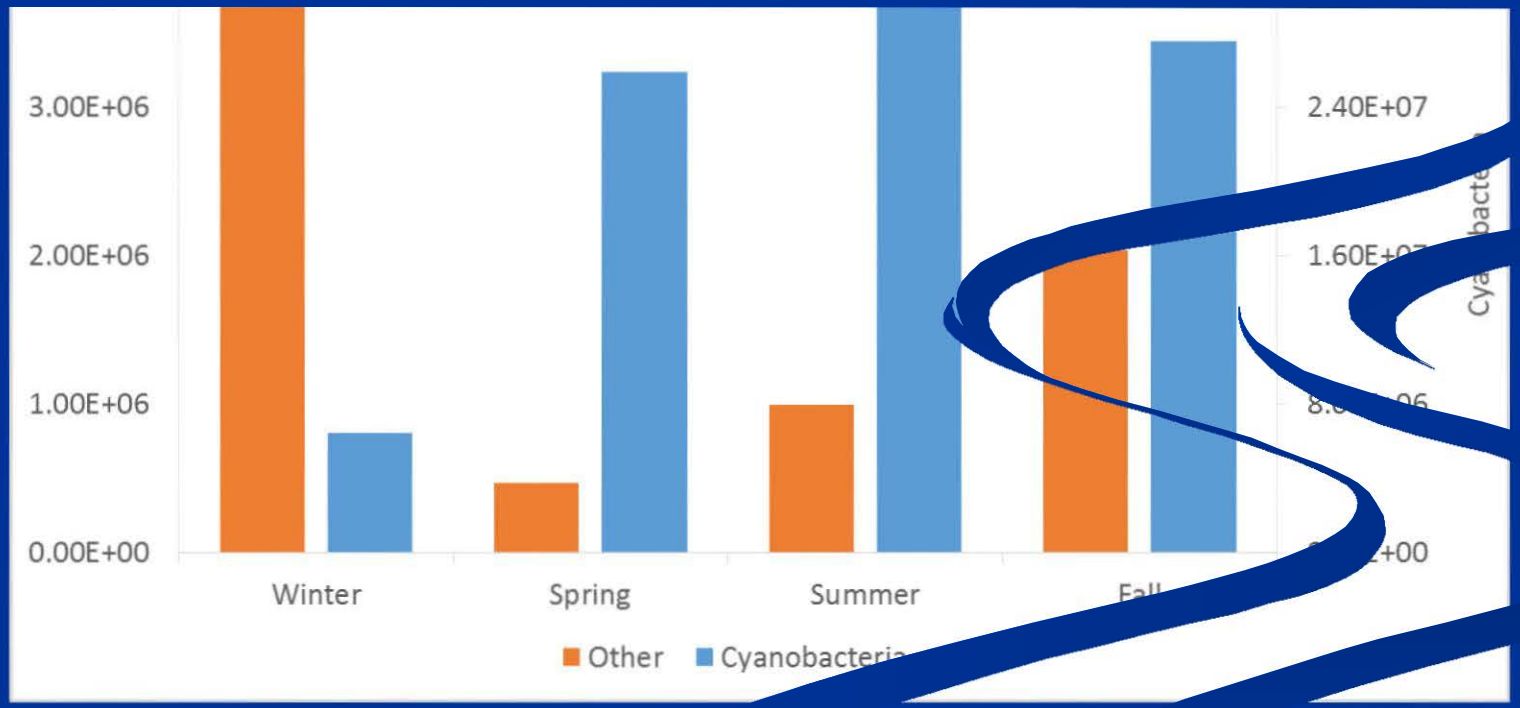




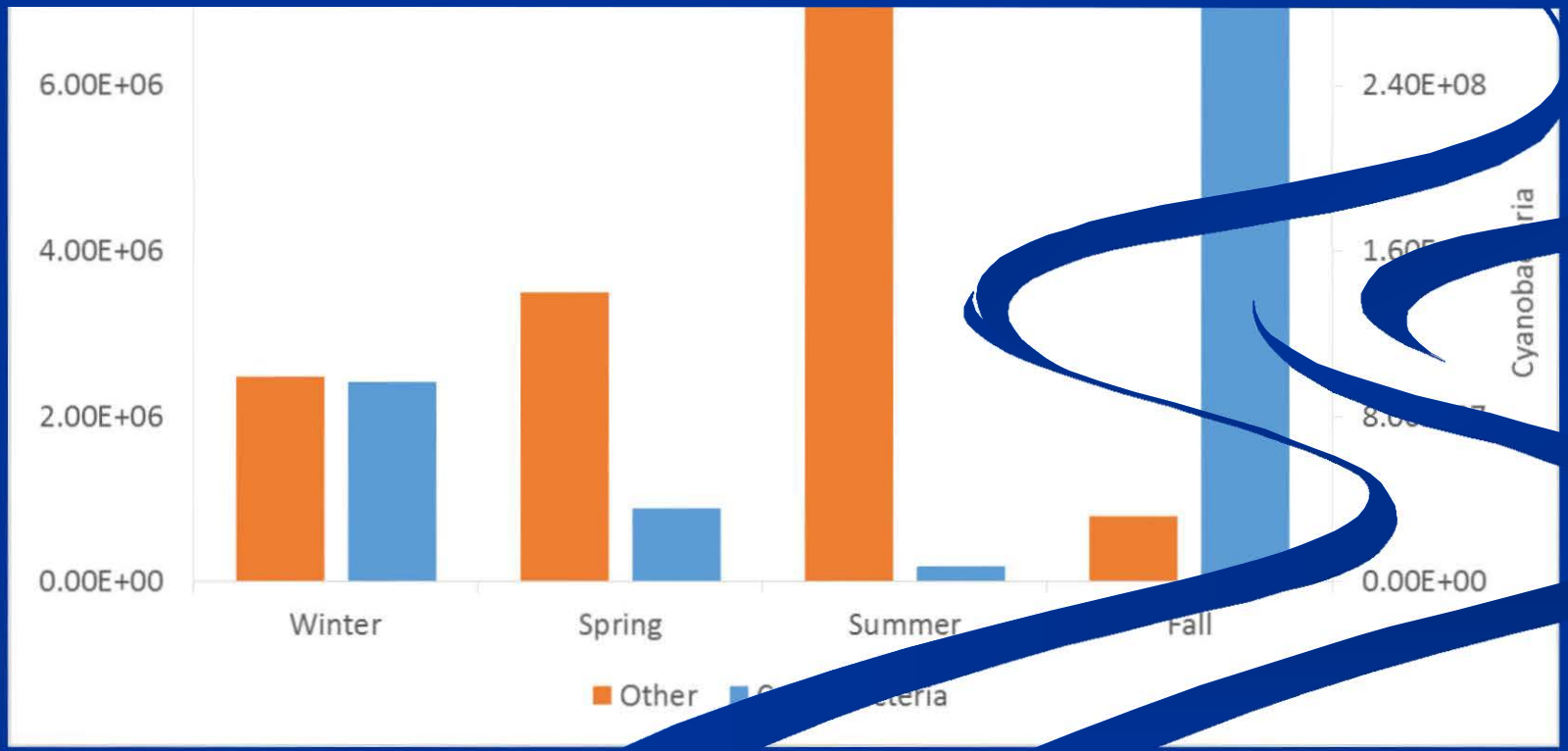
Regional Analyses—Confluence & Suisun Bay



Regional Analyses—Confluence & Suisun Bay

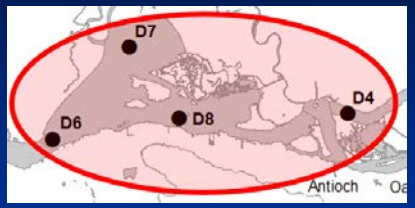


Regional Analyses—Confluence & Suisun Bay



Regional Analyses—Confluence & Susiun Bay

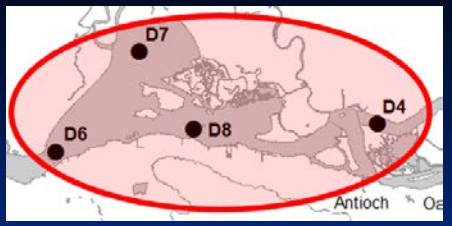
ANOSIM Results



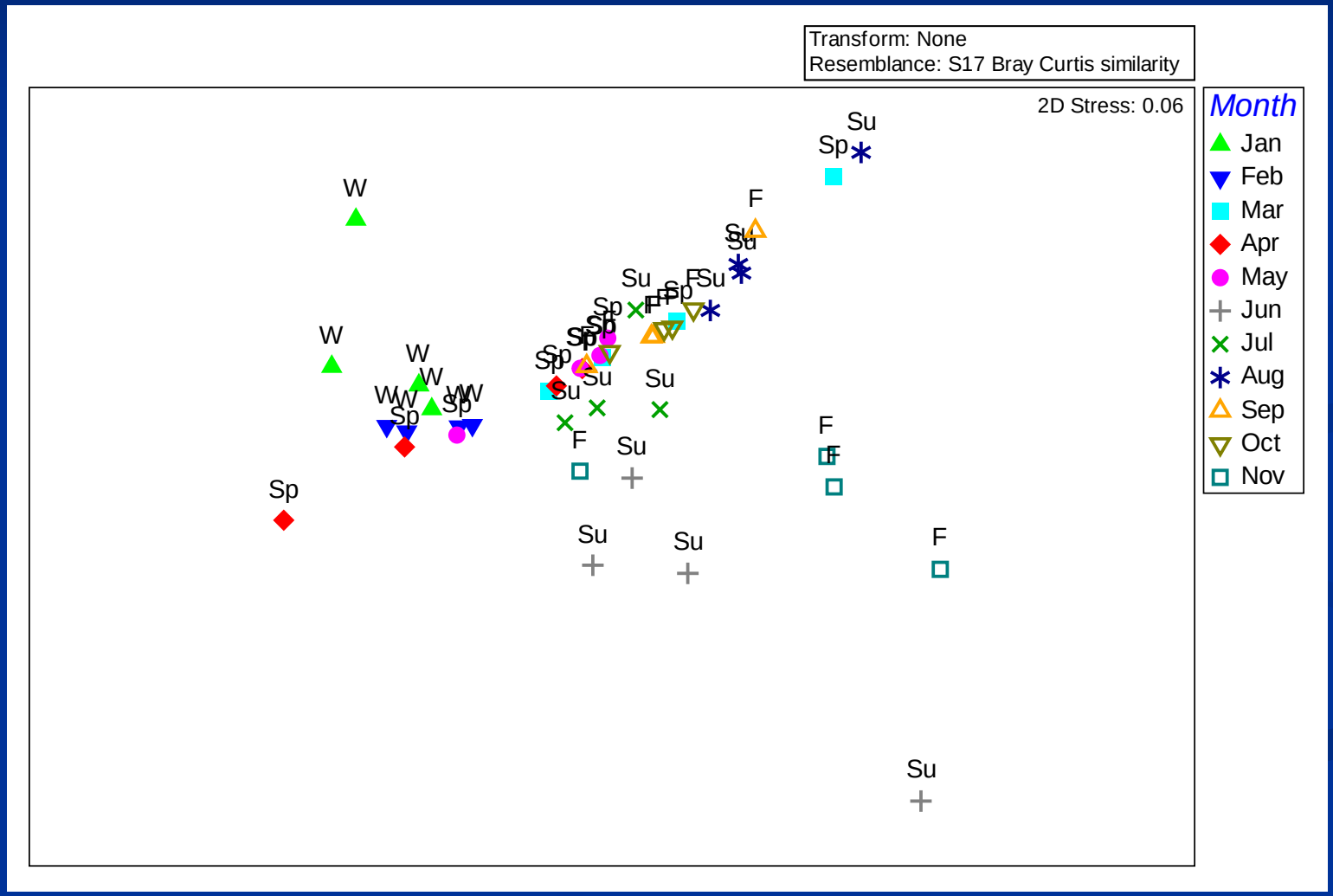
- No differences between years (2014 vs. 2015)

- Seasonal differences within years
  - 2014: winter vs. everything!
    - Vs. spring: R = 0.0305, p = 0.004
    - Vs. summer: R = 0.509, p = 0.001
    - Vs. fall: R = 0.705, p = 0.001
  - 2015: no significant seasonal differences

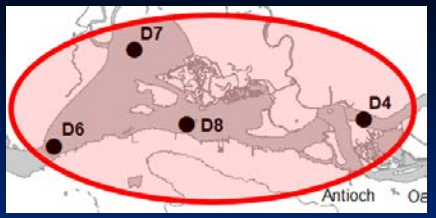
Regional Analyses—Confluence & Suisun Bay

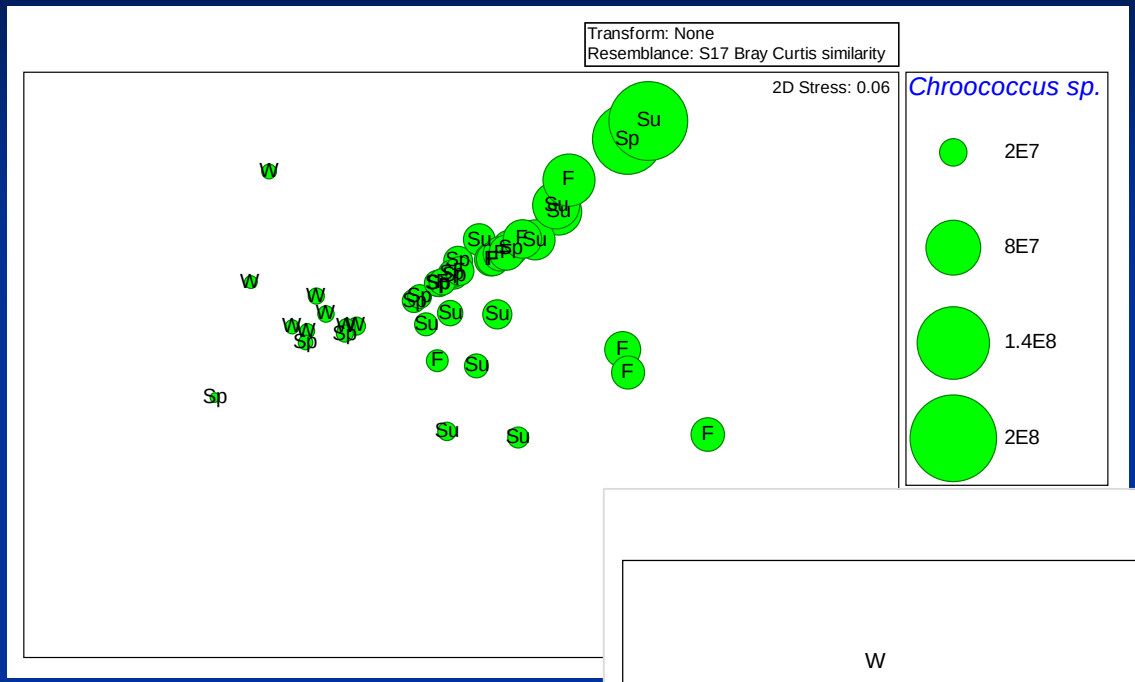


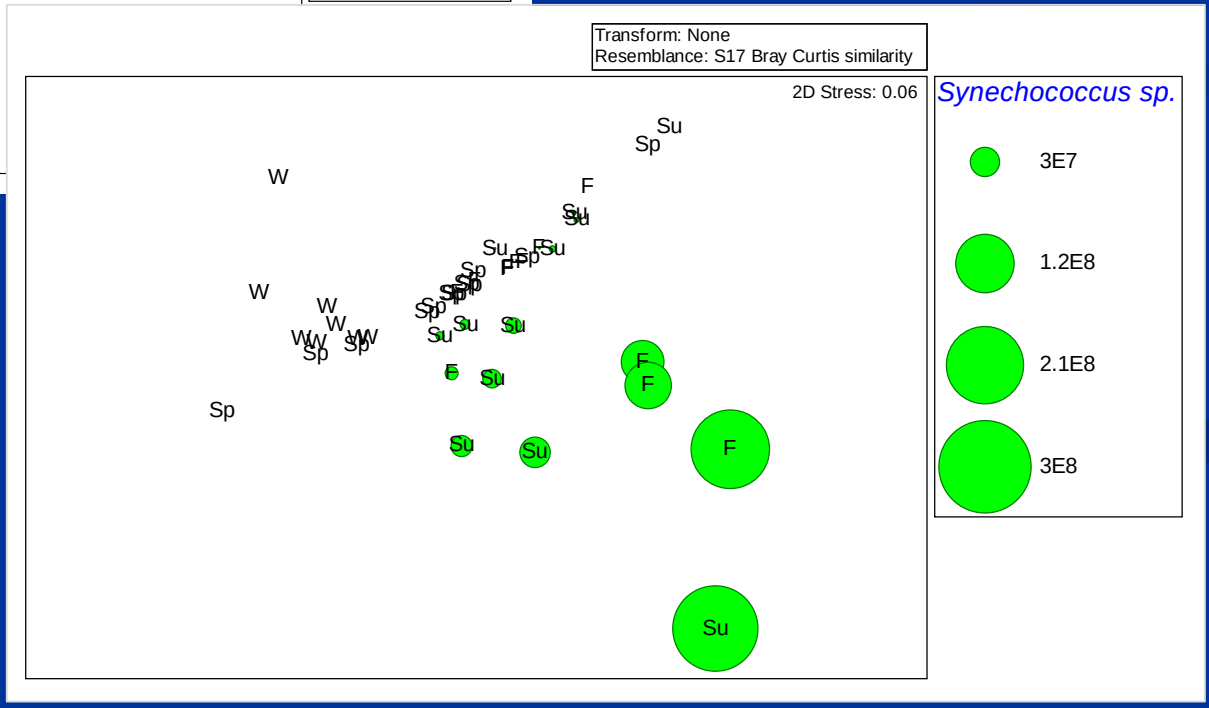
2014 NMDS



Regional Analyses—Confluence & Suisun Bay

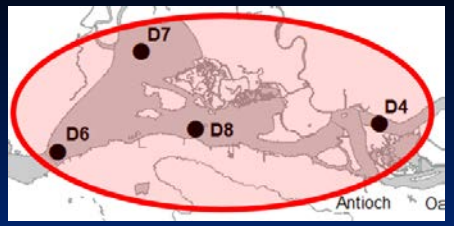


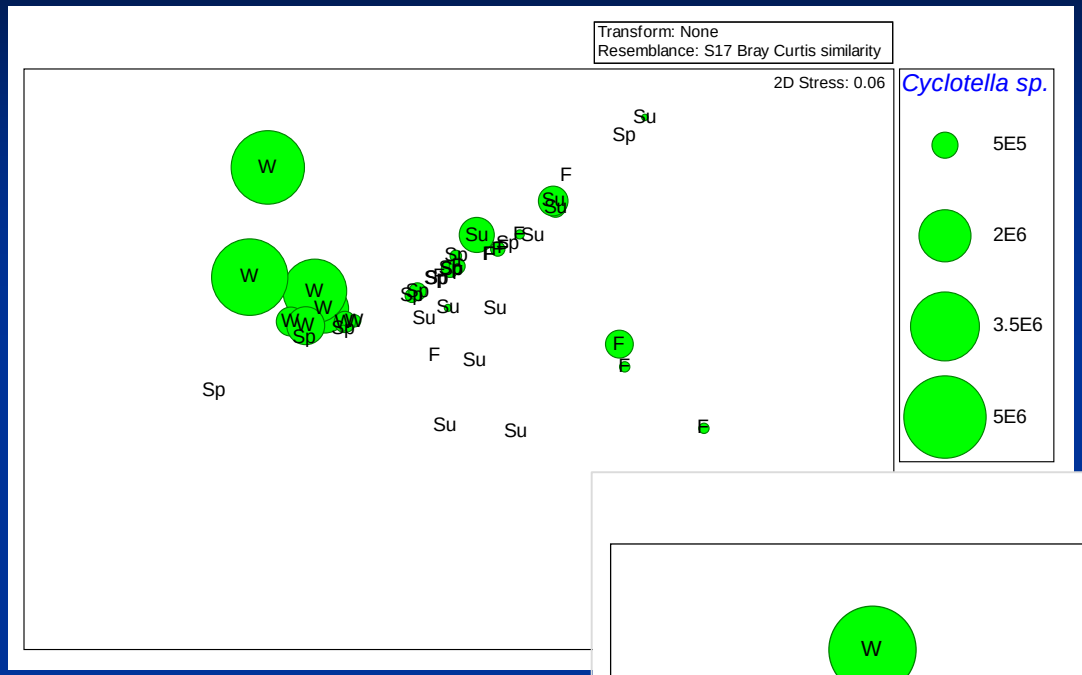


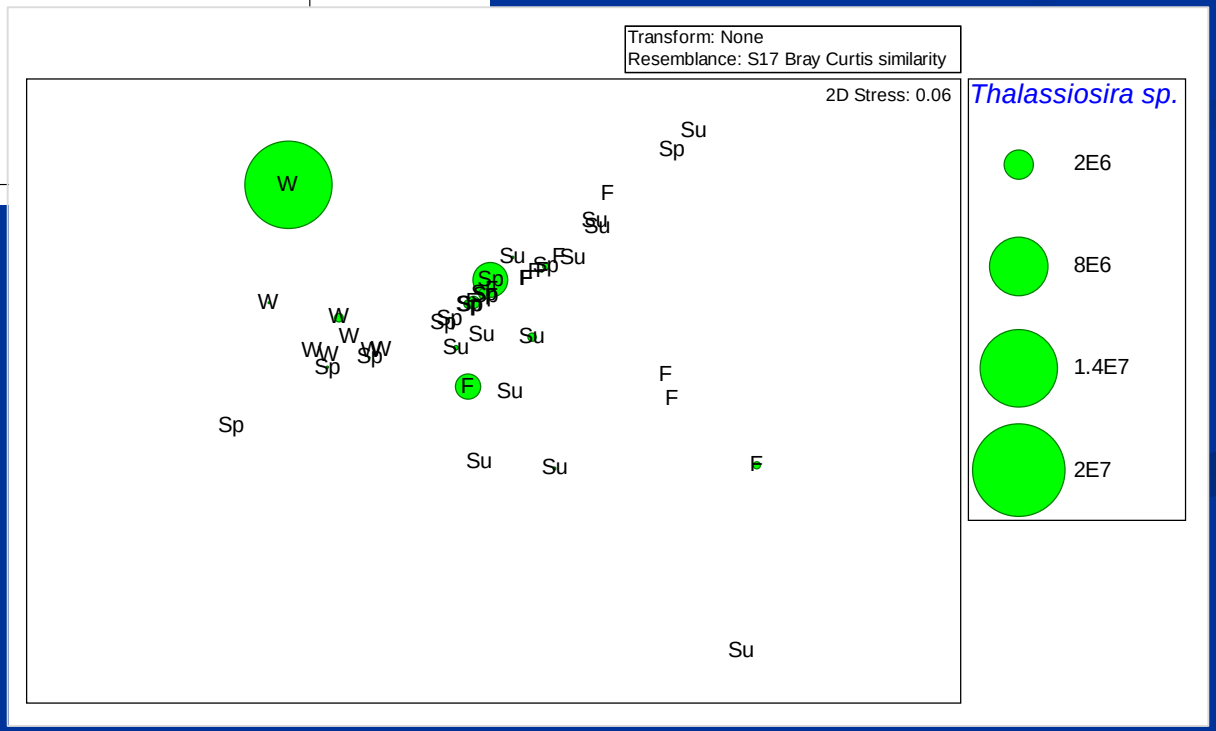


2014

Regional Analyses—Confluence & Suisun Bay







2014

Summary

- Important to track biovolume along with count data
- Years with similar hydrologic conditions have very different phytoplankton biovolumes
- Changes in upstream biovolume didn’t occur downstream
- Drought is the “new normal,” but not clear what the new normal will be for phytoplankton

Thank you!