

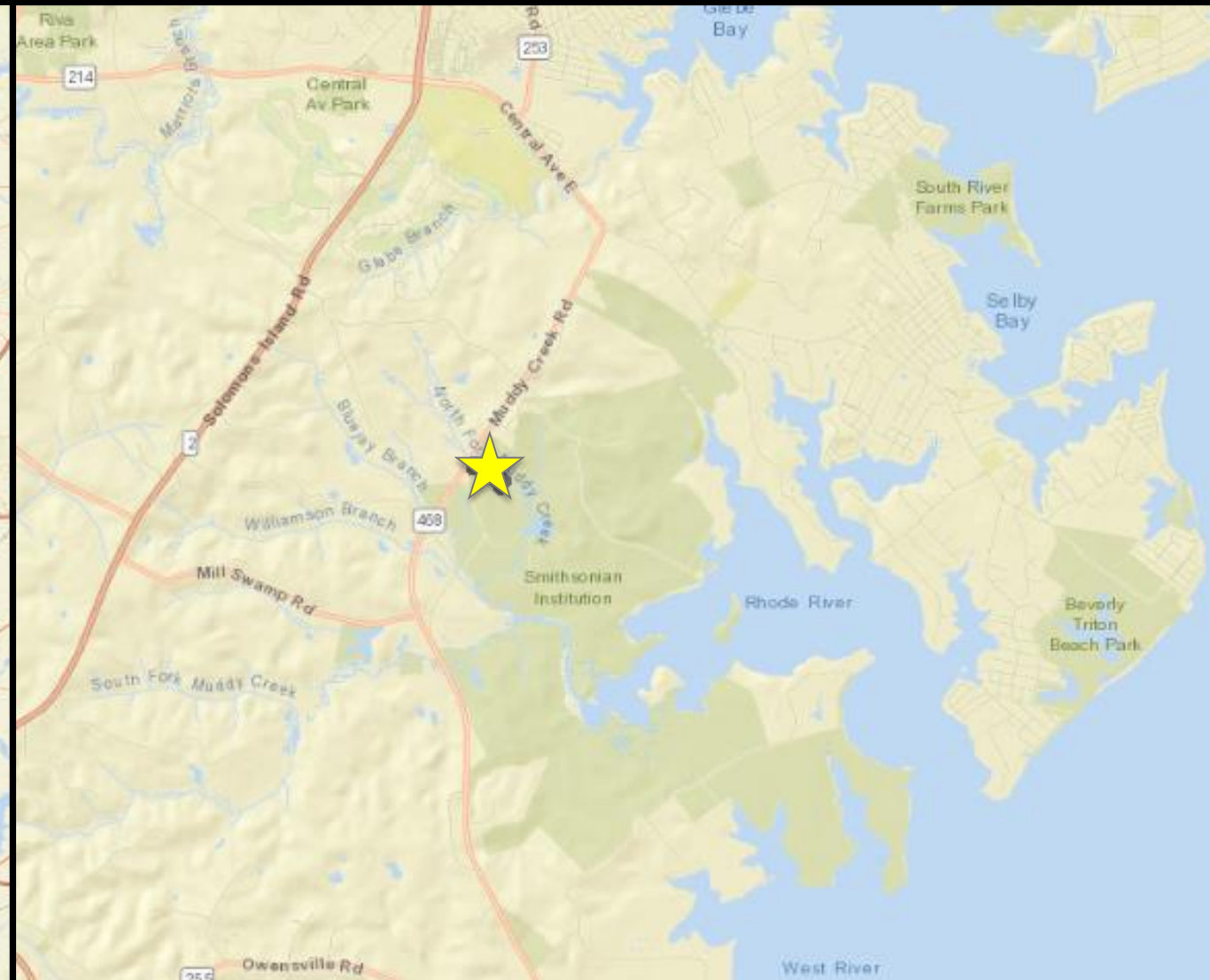
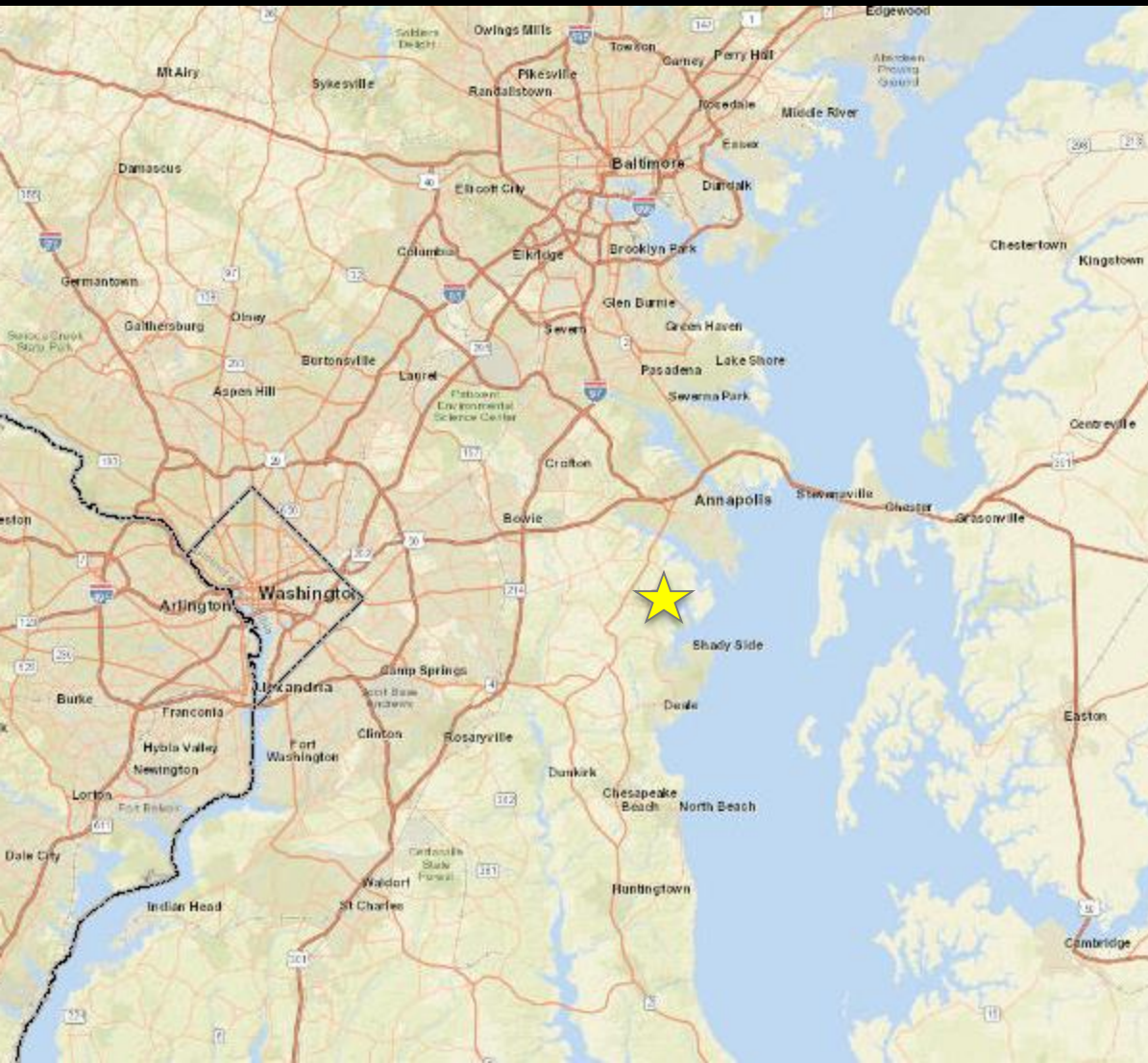
Effects of Muddy Creek RSC Restoration on Water Quality and Benthic Macroinvertebrates



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Project Location

Edgewater, MD
Anne Arundel County
Atlantic Coastal Plain
West River Watershed



Muddy Creek Background



Before



Sand and
Woodchips

During

- 450-meter section of North Branch Muddy Creek on SERC property was restored in January 2016 using an RSC restoration.
- Performed by Underwood and Associates, LLC.
- Deeply incised channel, high public visibility, reduce sediments and nutrients.
- Goal: Regain floodplain connection.

April 2007

Techniques used to restore Muddy Creek

- Raised streambed with sand and woodchips
- Constructed riffles
- Floodplain reconnection using perpendicular berms

Flow

Image: U.S. Geological Survey

Feb 2017

Floodplain Connectivity Accomplished



Image: U.S. Geological Survey

Restored Pool – Mar 2018



Restored Riffle - Mar 2018



Automated Samplers and Sondes

North Branch Muddy Creek

Bluejay Branch

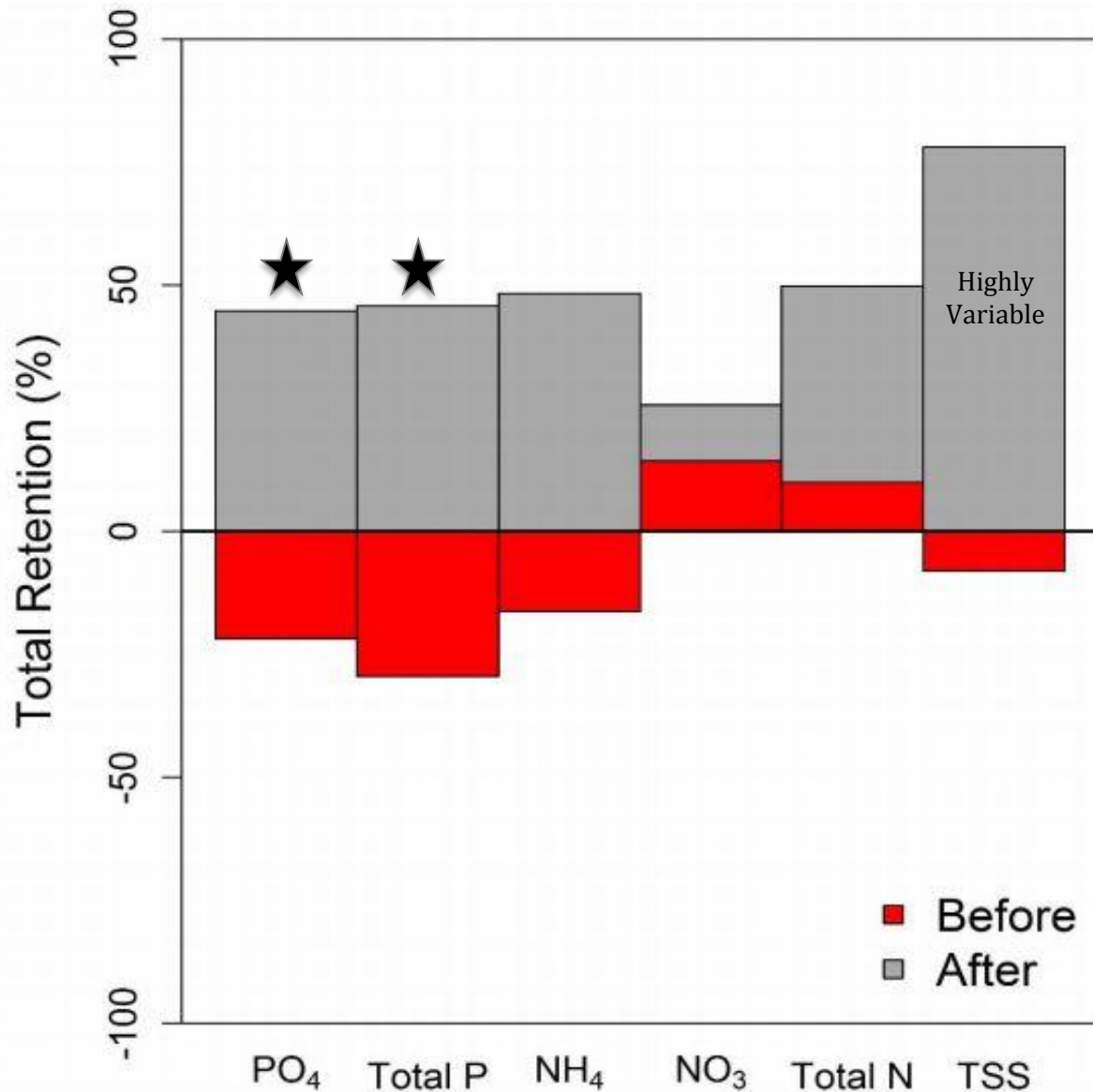
Legend:

- Adjacent Control (Red dot)
- Upstream Control (Green dot)
- Restoration (Blue dot)

Inset map of Maryland showing the study area in the western part of the state.

- Water Quality monitoring above/below began March 2015
- Dissolved oxygen monitoring began January 2016
- Biological monitoring began in March 2014
- 9 Benthic Macroinvertebrates Sites
- 2 years of pre- and 2 years of post-restoration biological data
- WQ Monitoring – SERC
- Macroinvertebrates – MD DNR

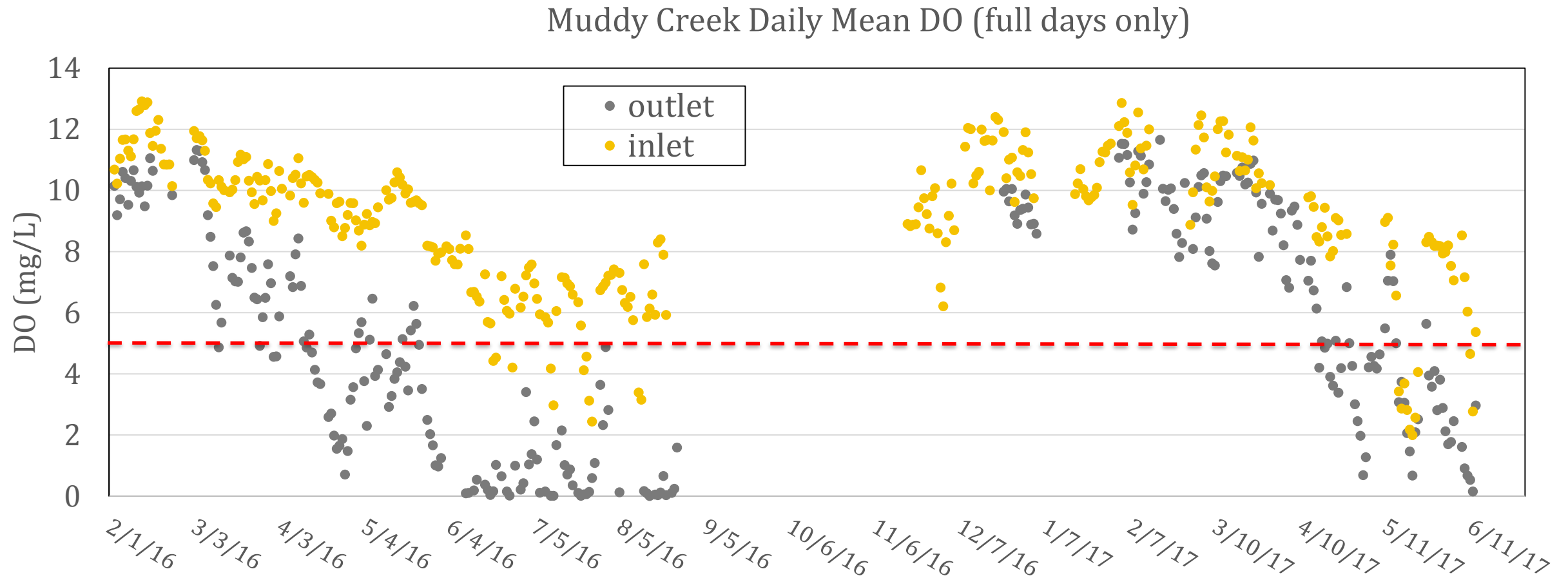
Percentage of Inflow Retained Before and After Restoration



- Load in – load out = amount retained
- % Retention = amount retained/load in X 100
- Statistically Significant reduction in PO₄ and TP only ($p < 0.05$) – RIA, despite % retention showing large increases.
- No significant reduction in NH₄, NO₃, TN, TSS ($p > 0.05$) - RIA
- TSS loads were highly variable

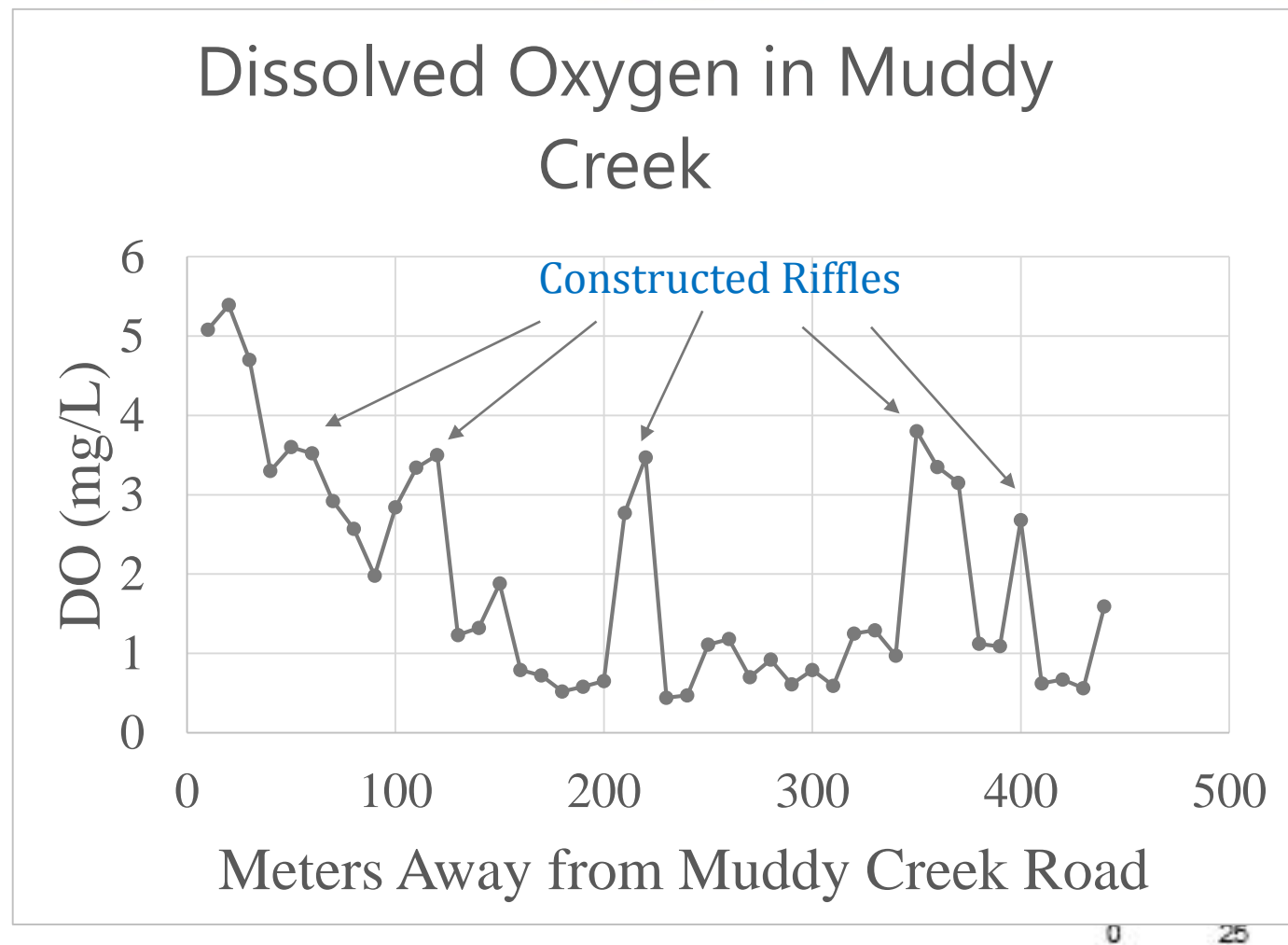
Credit: Tom Jordan, Joshua Thompson (SERC)
Data Updated January 2018

Dissolved Oxygen Concentrations Above and Below Restoration



- Maryland DO water quality criterion = 5 mg/L

Dissolved Oxygen Profile of Muddy Creek - July 19th 2016

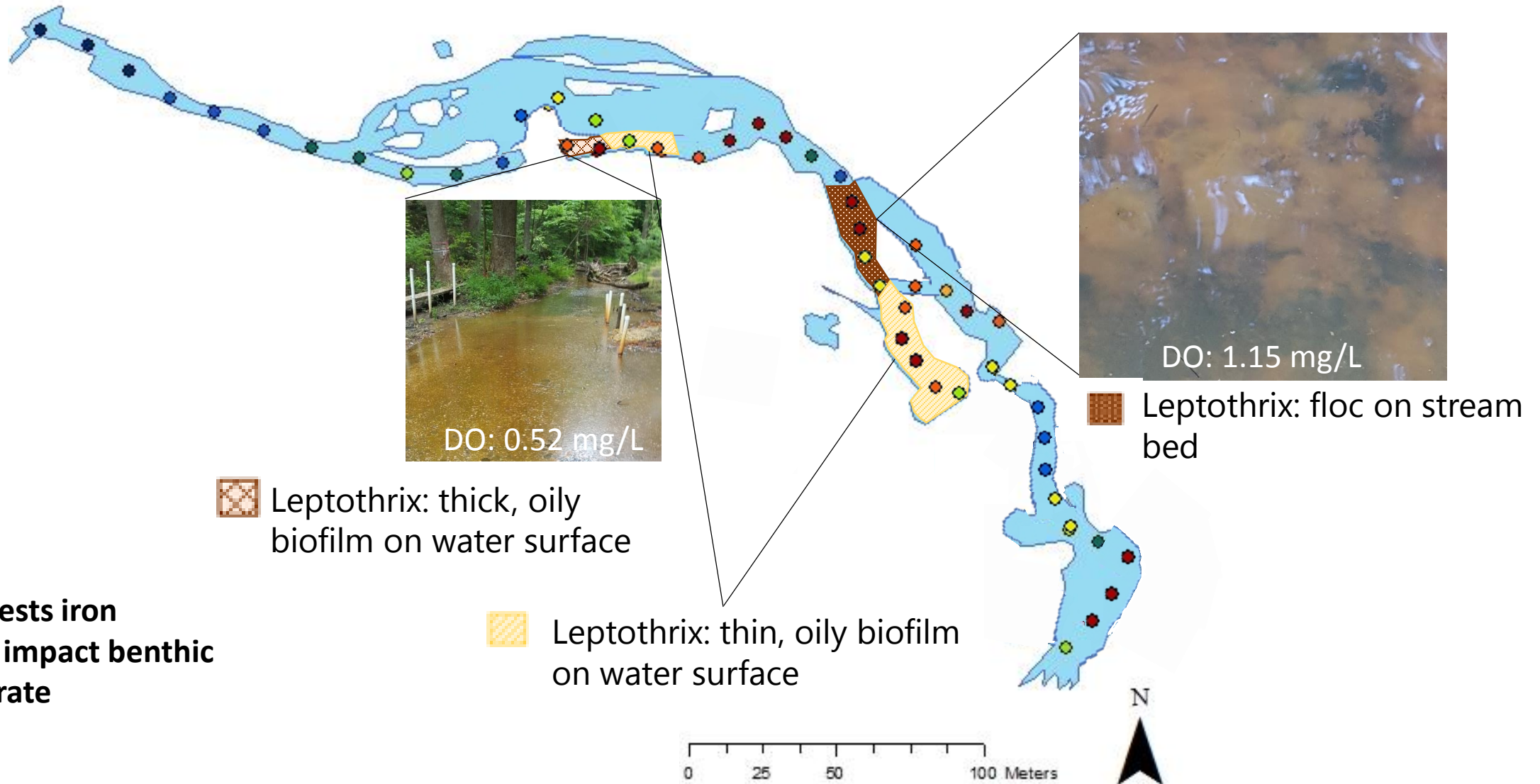


Credit: Lauren Mosesso (SERC)

0 25 50 100 Meters



Leptothrix Distributions in Muddy Creek



Literature suggests iron flocculent may impact benthic macroinvertebrate assemblages.

Benthic Macroinvertebrate Sampling Methods

- Samples collected within 75m sites using a 540 μm D-net during the Spring Index Period (Mar 1 – Apr 30) between 2014 and 2017.
- 20 1ft² jabs were taken within each site to represent diversity of habitat. Most stable, lotic habitats are preferred – more productive.
- Minimum of 100 randomly selected individuals from each sample were identified to genus when possible– used to calculate Benthic IBI

Pre	N=6
Post	N=6
Upstream	N=12
Adjacent	N=8



Benthic Index of Biotic Integrity (BIBI)

	Thresholds		
<u>Metric Score</u>	<u>5</u>	<u>3</u>	<u>1</u>
Number of Taxa	≥ 22	14 – 21	< 14
Number of EPT Taxa	≥ 5	2 – 4	< 2
Number of Ephemeroptera Taxa	≥ 2	1 – 1	< 1
Percent Intolerant Urban	≥ 28	10 – 27	< 10
Percent Ephemeroptera	≥ 11	0.8 – 10.9	< 0.8
Number of Scraper Taxa	≥ 2	1 – 1	< 1
Percent Climbers	≥ 8	0.9 – 7.9	< 0.9

- Indices of biotic integrity (IBIs) are calculated based on metrics that are indicative of stream health, as evidenced by impacts on the biotic community.
- Raw values found for each metric are given a score of 5, 3, or 1 (5 best, 1 worst). All metric scores are summed and then averaged to obtain the final BIBI score that ranges from 1.0 to 5.0.

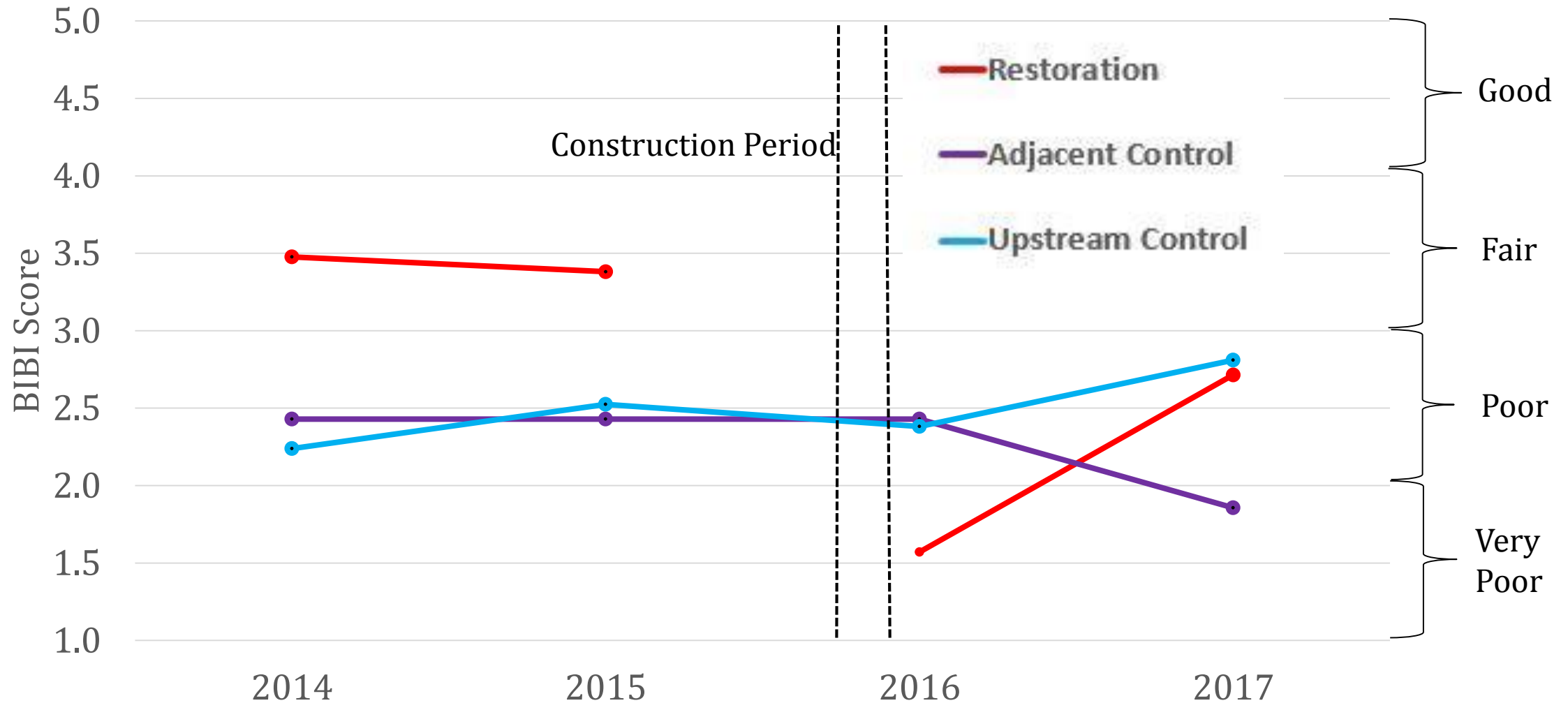


IBI Score	Narrative Ranking
4.0 – 5.0	Good
3.0 – 3.9	Fair
2.0 – 2.9	Poor
1.0 – 1.9	Very Poor

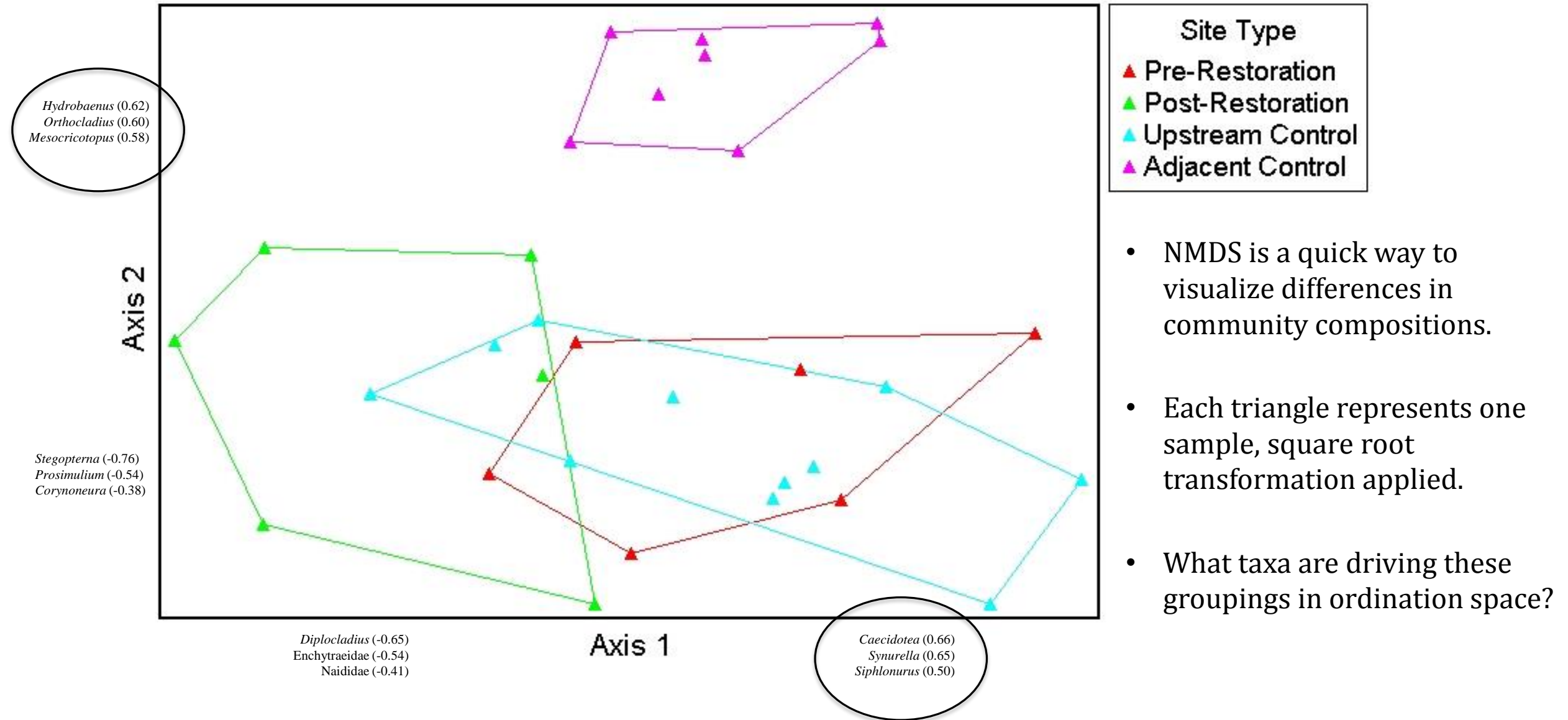


Siphonurus sp.
~ 5%

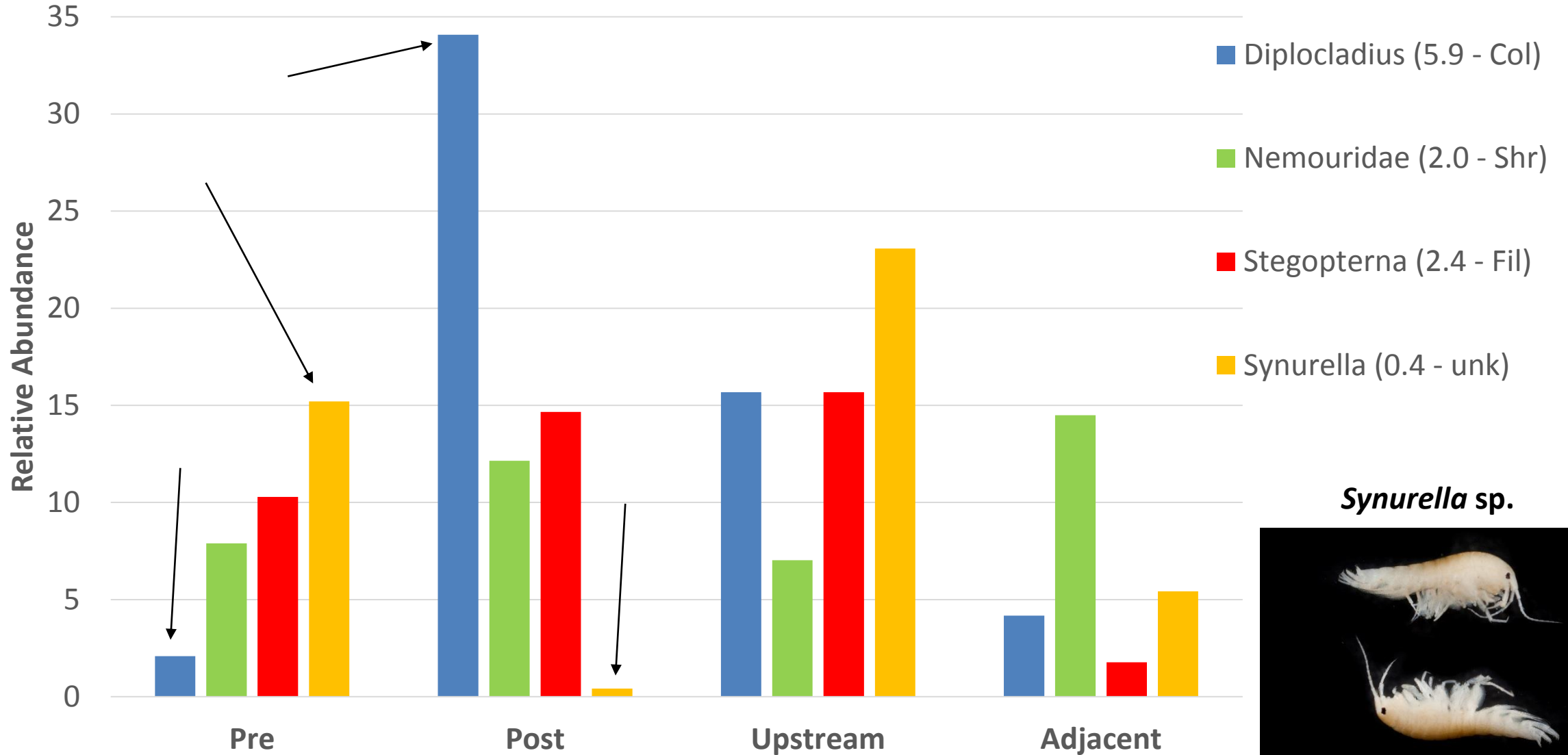
Average BIBI Scores



Non-Metric Multidimensional Scaling Graphics



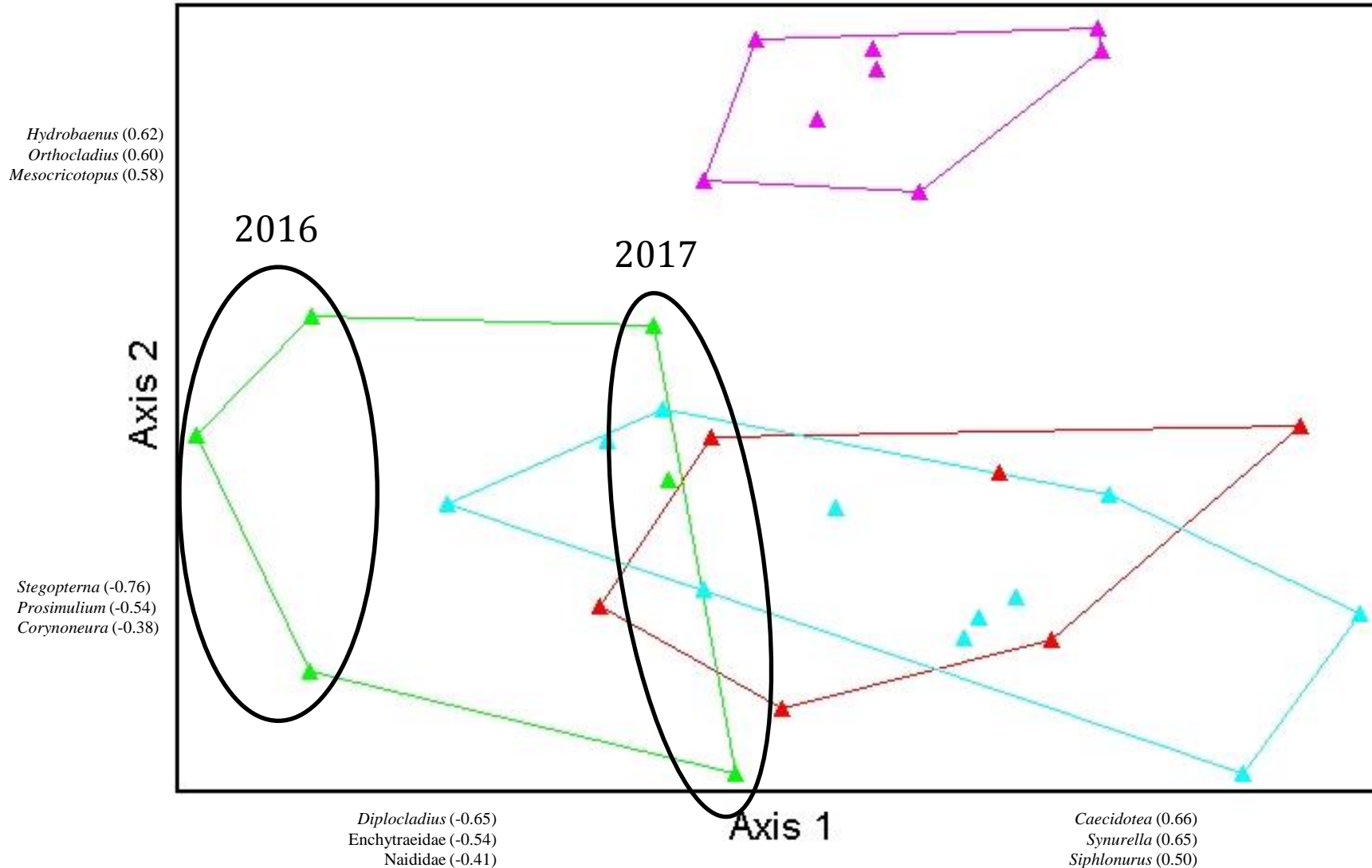
Most Dominant Taxa



Synurella sp.

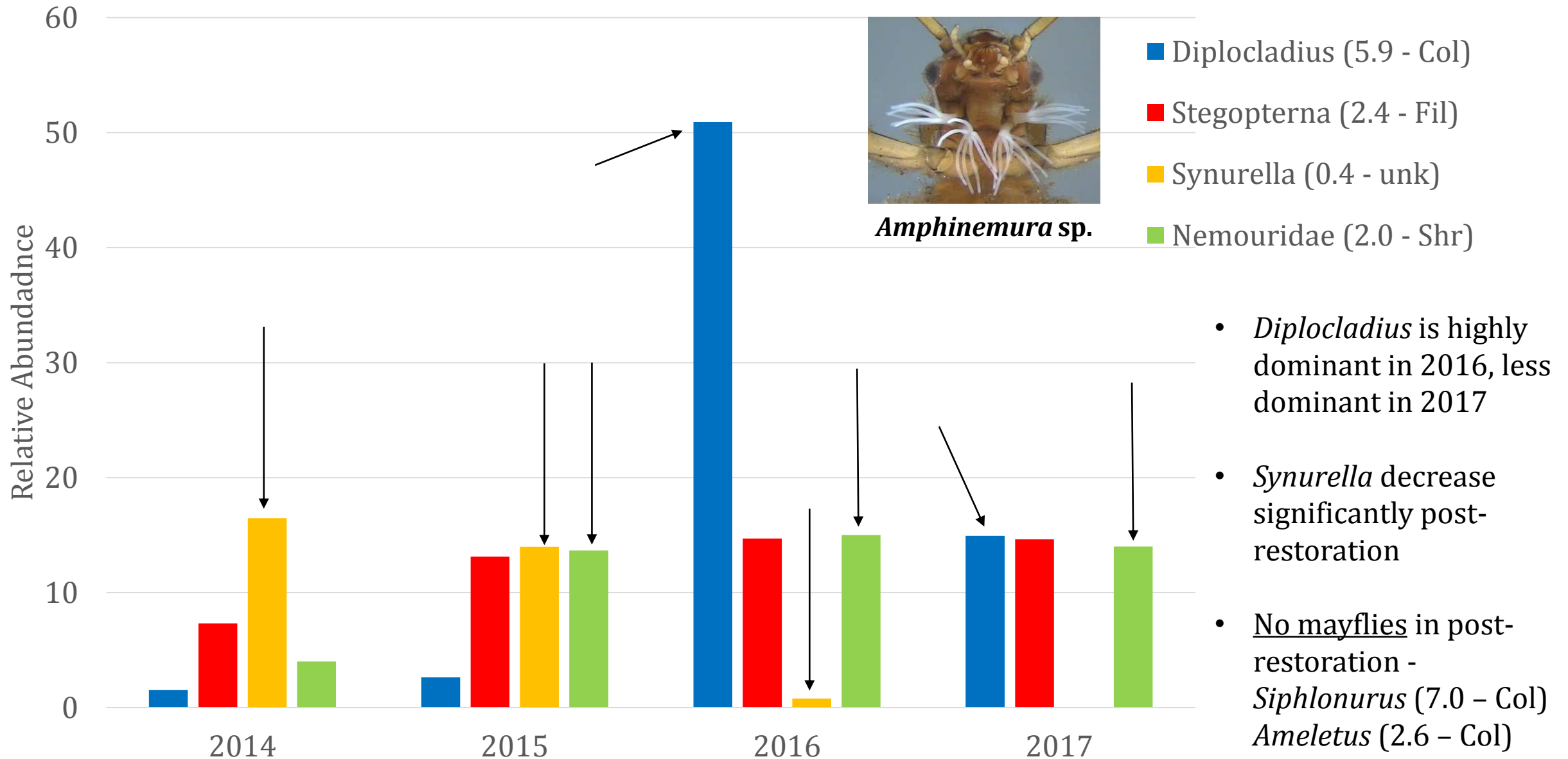


Post-Restoration Comparison



- 2017 post-restoration communities more closely resemble upstream control and pre-restoration communities.
- Early indication of a shift towards pre-restoration assemblages?

Post-Restoration Taxonomic Changes



Feb 2017

2017 Post-Restoration Site Comparison

BIBI: 3.00
18.4% Nemouridae
Site 103

BIBI: 2.71
24.3% Nemouridae
Site 102

BIBI: 2.42
0.0% Nemouridae
94% Diptera
Site 101

Flow



Image: U.S. Geological Survey

Conclusions

- Percent retention of most nutrients was significantly higher post-restoration.
- Dissolved oxygen is lower in the outlet compared to the inlet, iron flocculent and lentic conditions are partly responsible.
- 2017 post-restoration bug data suggests some ecological recovery since 2016. But some taxa have not yet recolonized post-restoration (mayflies, amphipods).
- Two upstream sites in RSC have higher BIBI scores; percentages of Nemouridae (intolerant stonefly) are significantly higher at these sites.
- Too early to determine if macroinvertebrates have responded positively or negatively.



Acknowledgements



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