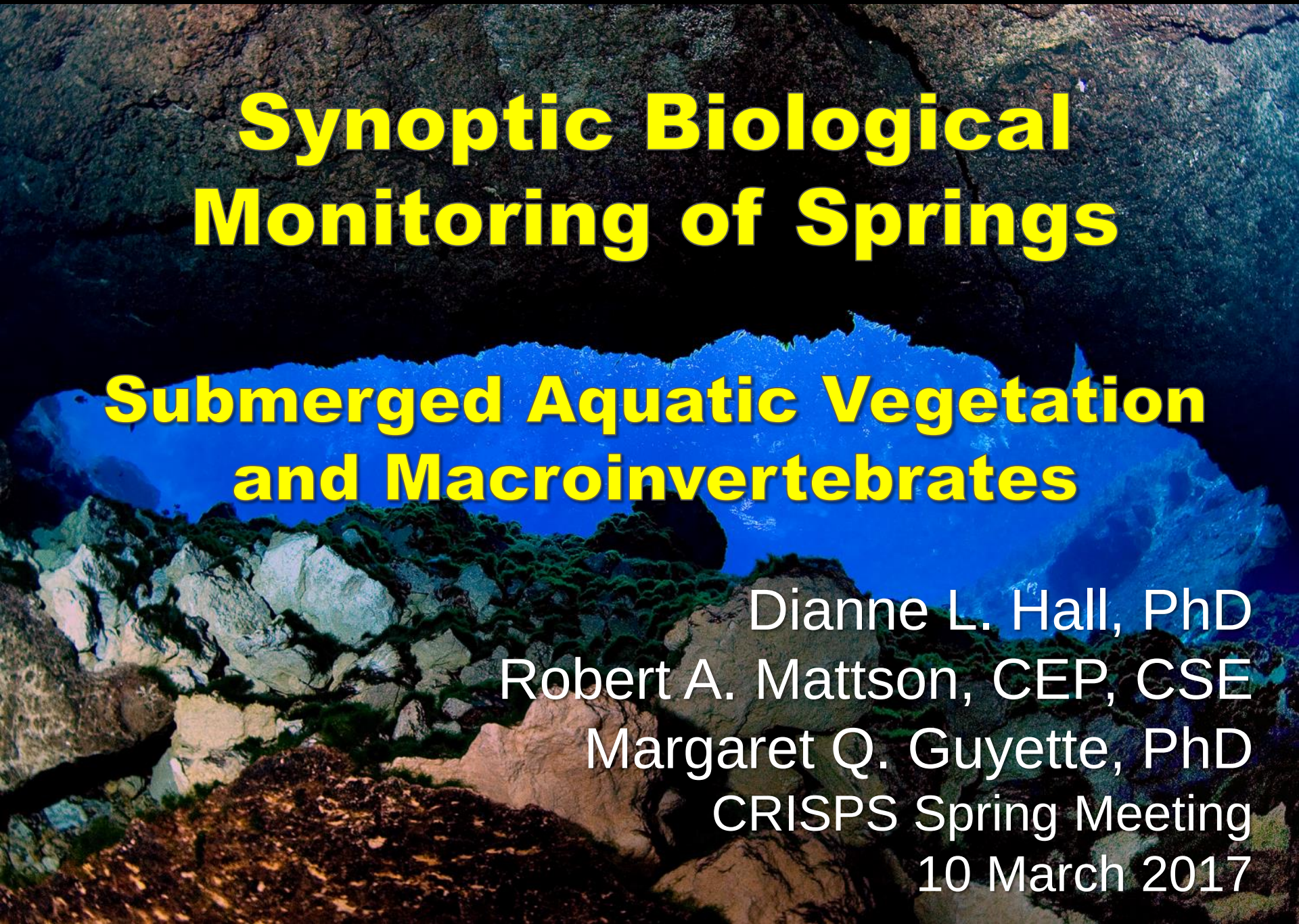


Synoptic Biological Monitoring of Springs

Submerged Aquatic Vegetation and Macroinvertebrates

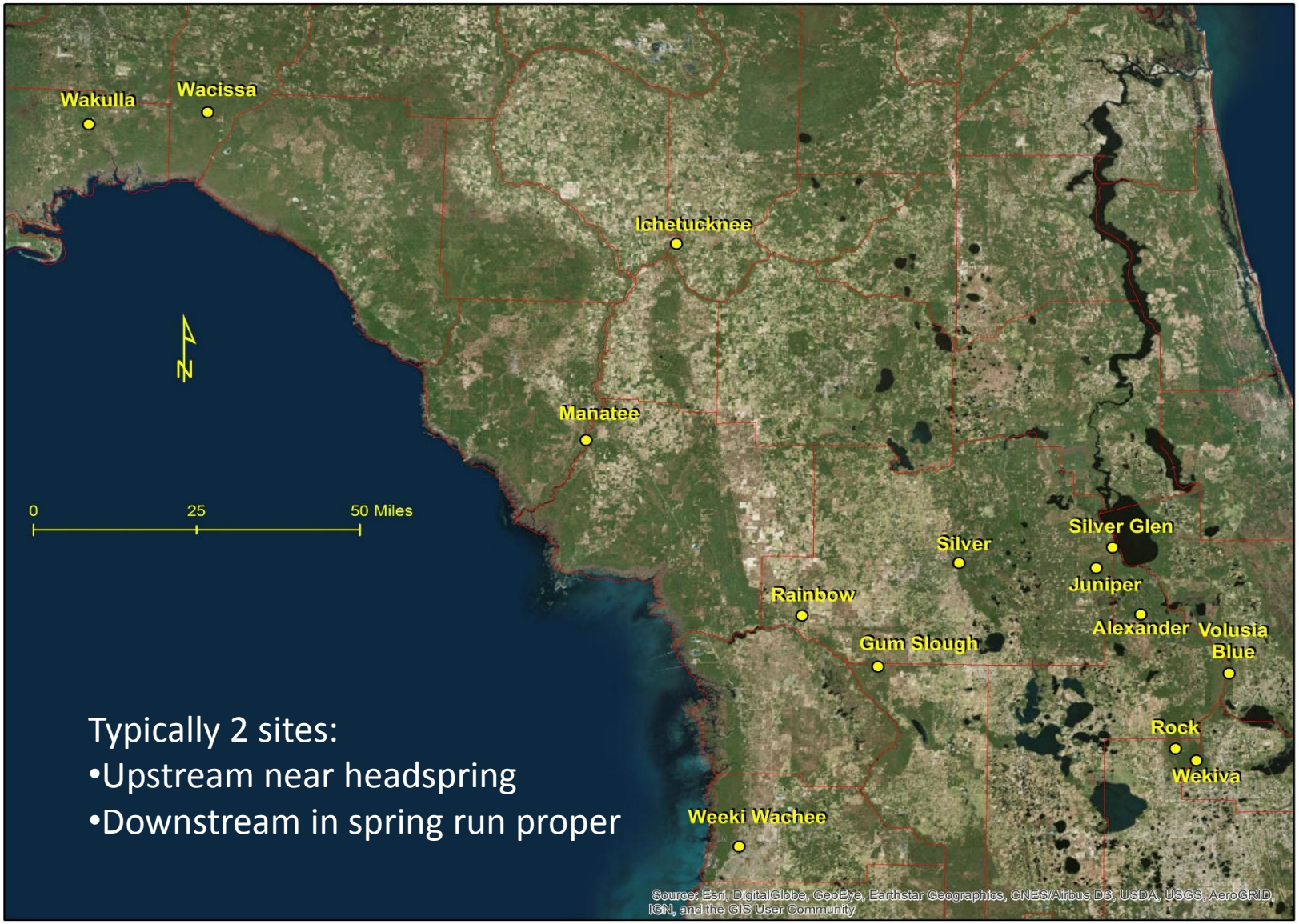
Dianne L. Hall, PhD
Robert A. Mattson, CEP, CSE
Margaret Q. Guyette, PhD

CRISPS Spring Meeting
10 March 2017

Project Purpose

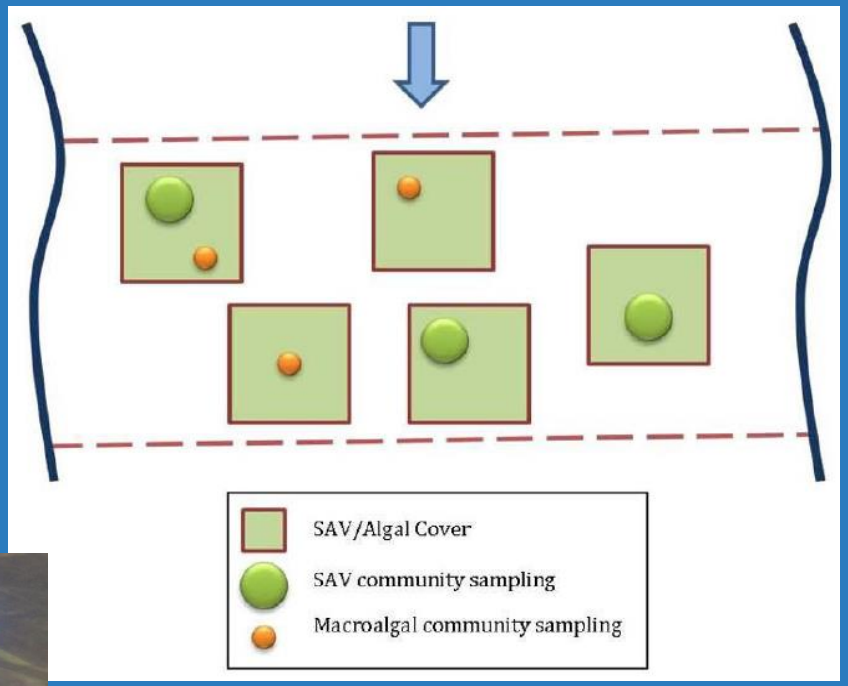
- Field study of 14 selected springs with long-term stream flow and water quality data
- Collection of biotic data focusing on flora and macroinvertebrate fauna to assess current ecological conditions
- Associate biotic data with water chemistry (e.g. specific conductance, dissolved oxygen) and physical drivers (e.g., current velocity, canopy cover) to establish baseline data for future studies

Spring Locations



Field sampling

Physicochemical (PC) parameters were collected along sampling transects six different times during 2015 and biological parameters were collected twice, once in the Spring and again in the Fall.



Submerged aquatic vegetation (SAV) & macroalgae cover was estimated in five $1m^2$ quadrats. Three biomass collections for each community and their attendant macroinvertebrate (MI) fauna were taken with a modified Hess sampler.

Physicochemical (PC) Variables

- Canopy cover
- Water depth
- Water temperature
- Specific conductance
- pH
- Dissolved oxygen
- Turbidity
- Stream width
- Current velocity

Current Analyses

- Focused on relationships among PC variables, SAV composition (based on biomass), and macroinvertebrate composition from samples taken with the modified Hess sampler
- Springs without SAV were not analyzed
- Samples analyzed separately for the Spring and Fall to avoid seasonal differences
- PRIMER (Plymouth Routines in Multivariate Ecological Research) statistical software version 7
- Software specifically developed to analyze arrays of species-by-sample data from community ecology studies without assumptions as to the form of the data. Relationships are based on resemblance matrices.

SAV taxa

- *Ceratophyllum demersum**
- *Chara* spp.*
- Charophyte*
- *Hydrilla verticillata*
- *Najas guadalupensis*
- *Potamogeton illinoensis*
- *Potamogeton pectinatus*
- *Sagittaria kurziana*
- *Vallisneria americana*

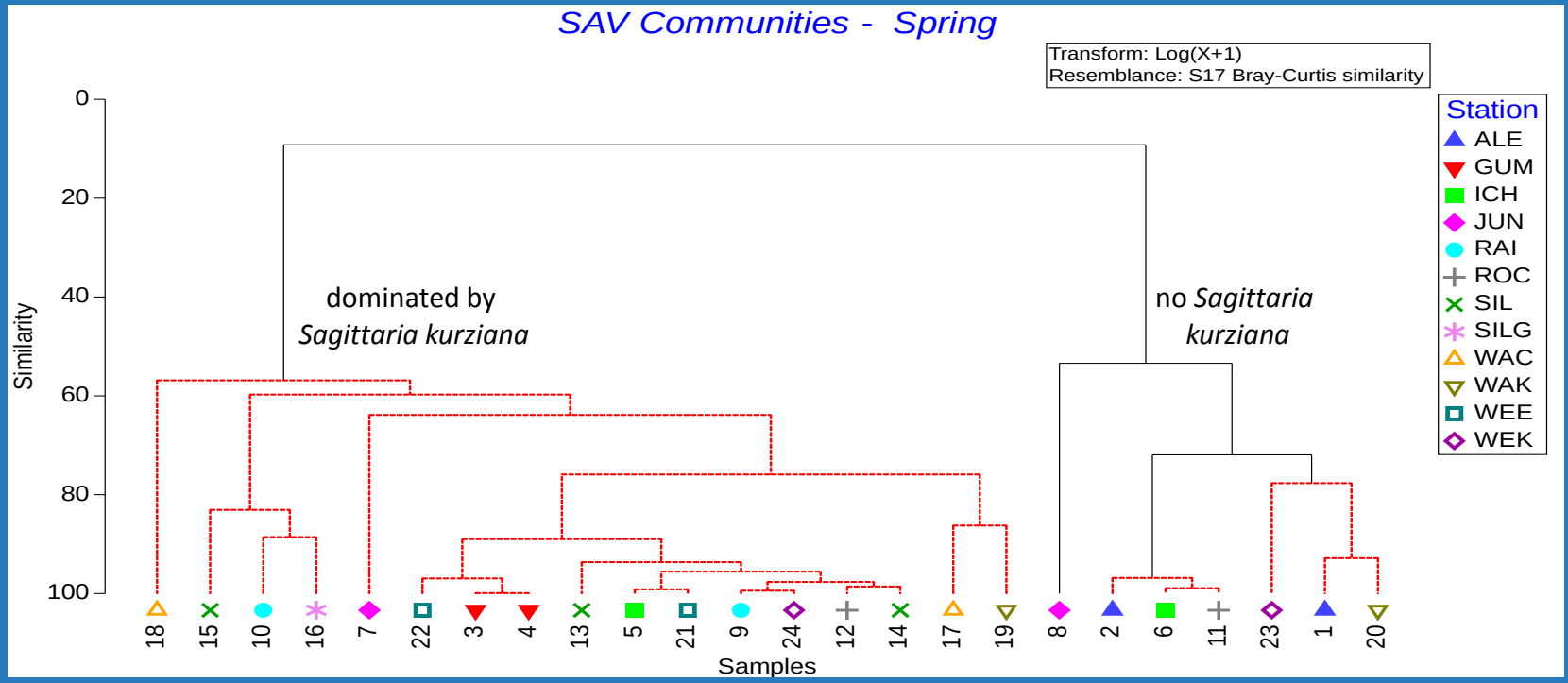
* Removed from analyses because constituted <3% of the total biomass on any transect

SAV
(per transect)

Spring		
	Dry weight (g)	Richness
Minimum	26	1
Maximum	2,742	3
Mean	904	2
Median	776	1
Fall		
	Dry weight (g)	Richness
Minimum	380	1
Maximum	3,802	4
Mean	1,431	2
Median	1,386	1

Cluster Analysis - Spring

w/SIMPROF groups*



*Groups connected by red lines are not significantly different.

7 sites had no *Sagittaria kurziana*

14 sites had no *Vallisneria americana*

3 sites had both

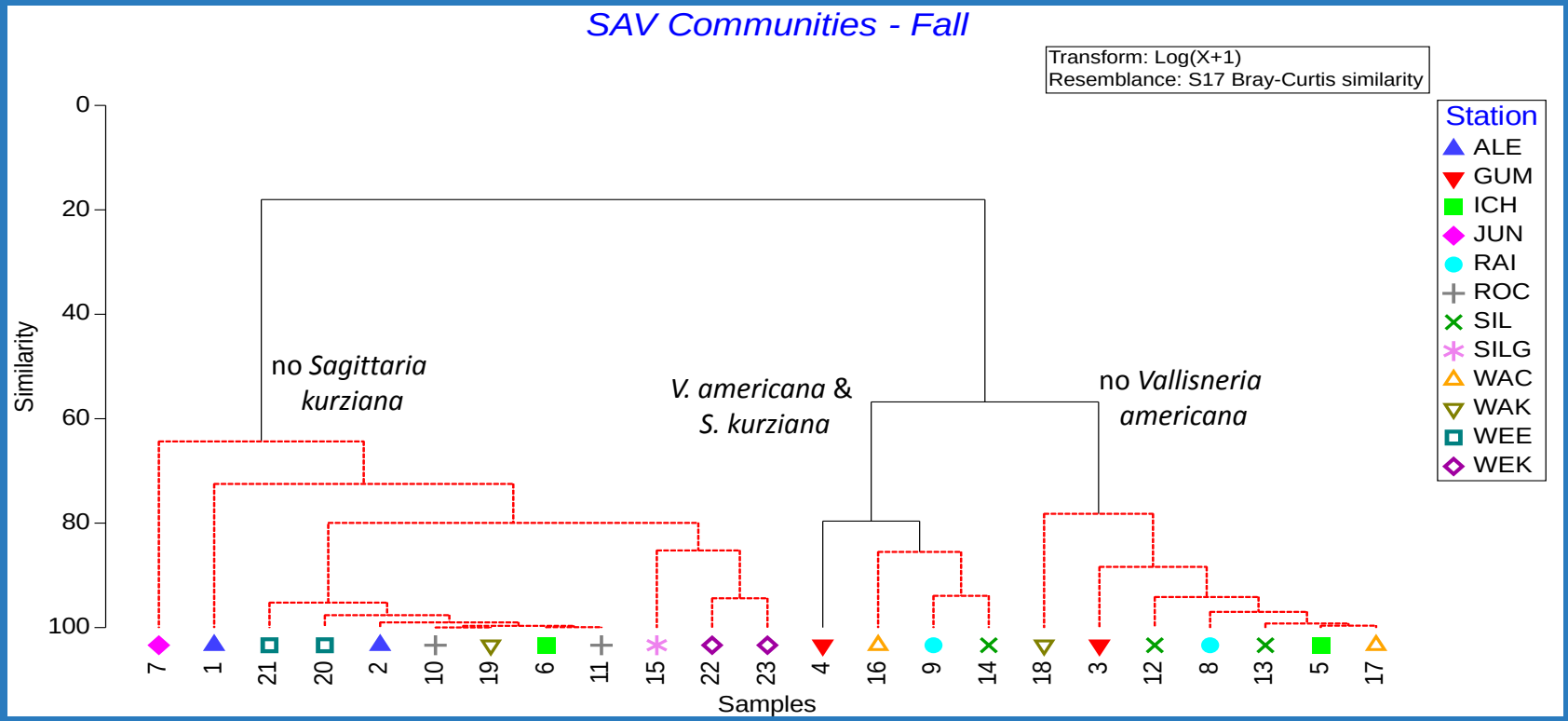
Jun-D is dominated by *Potamogeton pectinatus*

Ale-D, Ich-U and Roc-U have 100% *V. americana*

Wek-U, Wak-D and Ale-U have over 87% *V. americana*

Cluster Analysis - Fall

w/SIMPROF groups*



*Groups connected by red lines are not significantly different.

12 sites had no *Sagittaria kurziana*
7 sites had no *Vallisneria americana*
4 sites had both
Gum-D has no *Hydrilla verticillata*

Bio-Env Analysis

- Compares resemblance matrix among sites based on SAV community composition with resemblance matrix among sites based on PC variables and gives best correlation between SAV and PC variables.

- SAV community shows low correlation (R = 0.294) with specific conductance, current velocity and dissolved oxygen in Spring and very low correlation (R = 0.1) with specific conductance and stream width in the Fall.

SAV Summary

- Sites tend to be dominated by either *Sagittaria kurziana* or *Vallisneria americana*
- Both species are rarely found together in significant abundance
- Differences in the SAV communities of sites are only weakly correlated with PC variables, regardless of season
- However, specific conductance was associated with SAV composition, in both seasons

Macroinvertebrates

	Spring	Fall
Total number of taxa collected	196	171
Number of common* taxa	34	40
% common taxa	17	23

*common taxa constitute ≥ 3% of the total abundance on any single transect

Common Macroinvertebrate Taxa

Taxa	Spring	Fall
mayfly	3	3
caddisfly	6	7
midge (Chiro.)	9	9
amphipod	3	3
dance fly	1	0
leech	1	2
snail	4	2
water mite	1	1
tanaid	1	1
grass shrimp	1	0
moth	1	1
black fly	1	1
riffle beetle	1	1
worm	1	9

Macroinvertebrate Diversity
(per transect)

Spring			
	Abundance	Richness	Diversity (FLSA)
Minimum	162	25	4.43
Maximum	18,723	64	11.96
Mean	4,916	43	7.57
Median	2,915	44	7.55

Fall			
	Abundance	Richness	Diversity (FLSA)
Minimum	240	26	3.53
Maximum	10,470	54	12.63
Mean	3,112	38	7.05
Median	2,769	38	6.79

Analysis of Similarity
(analogue of ANOVA)

ANOSIM showed no significant differences among sites based on abundance, richness or diversity, regardless of season.

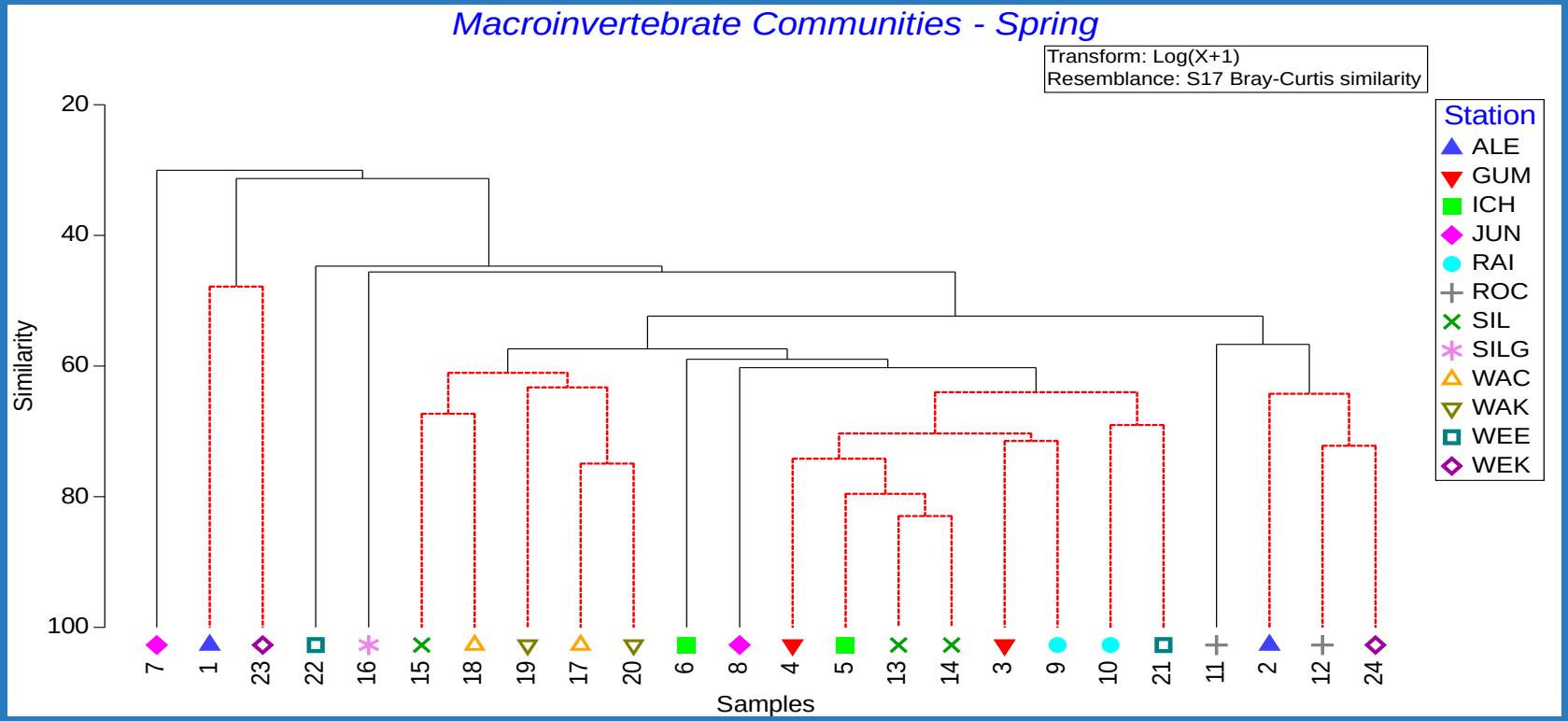
However, in the Spring, the highest diversities were found at downstream sites (9 of 11 sites)

In the Fall, the lowest abundances were found in downstream sites

(7 of 11 sites)

Cluster Analysis – Spring

w/SIMPROF groups*



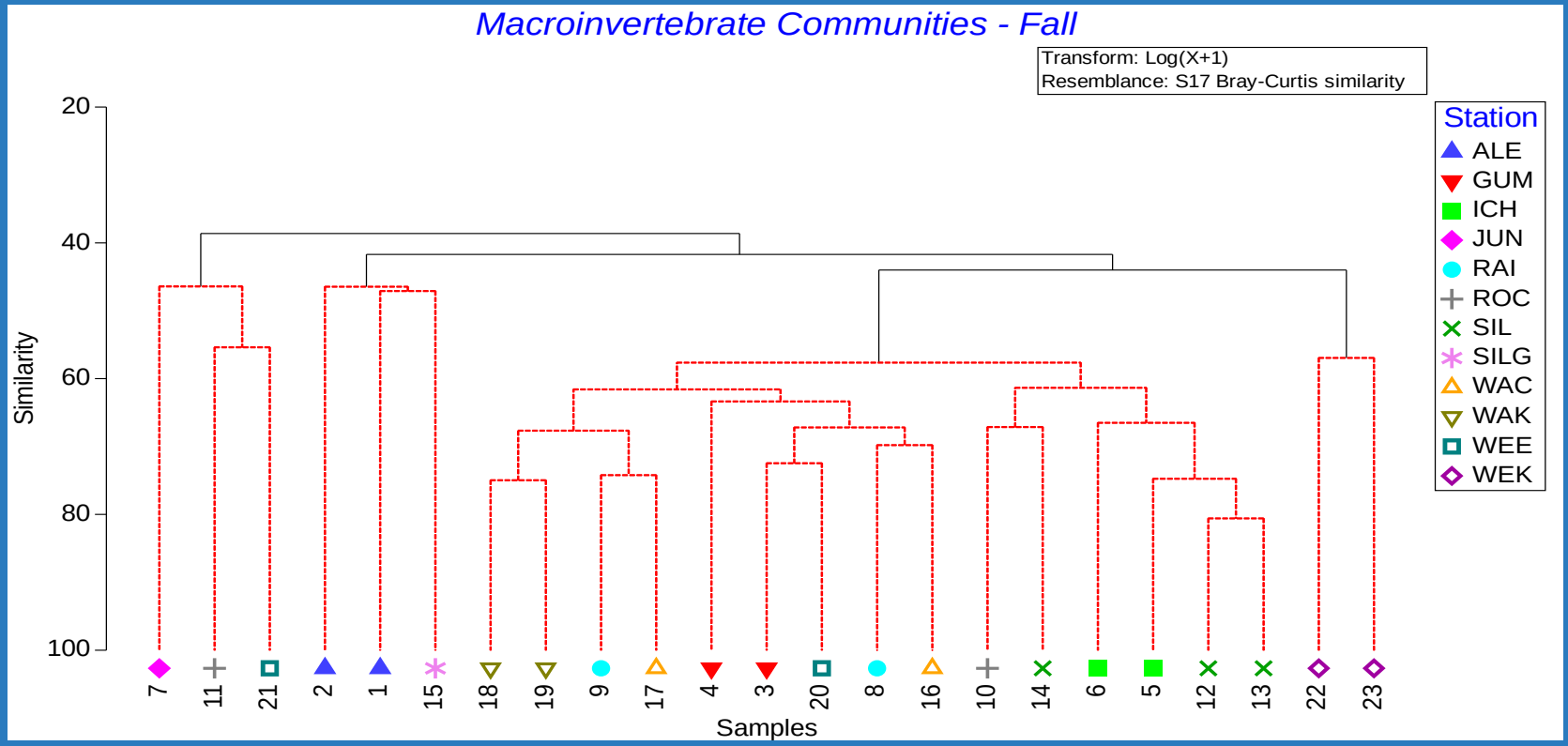
*Groups connected by red lines are not significantly different.

Note that outlier groups are spring sites located along the St. Johns River, with the exception of Wee-D and Ich-D.

Non-metric Multidimensional Scaling (NMDS) results agree with cluster analysis; 2D stress = 0.17

Cluster Analysis – Fall

w/SIMPROF groups*



*Groups connected by red lines are not significantly different.

Note that outlier groups are spring sites located along the St. Johns River (SJR), with the exception of Wee-D. Roc-U is the only SJR site that is not an outlier.

NMDS results agree with cluster analysis; 2d Stress = 0.16

Bio-Env Analyses

- Compares resemblance matrix among sites based on macroinvertebrate (MI) community composition with resemblance matrices among sites based on PC variables or SAV community and gives best correlation between MI and PC or SAV matrices.

- PC variables: MI community shows moderate correlation (R = 0.499) with specific conductance, current velocity, dissolved oxygen and SAV biomass in Spring and moderate correlation (R = 0.670) with specific conductance and current velocity in the Fall.

- SAV community: MI community shows low correlation (R = 0.377) with a mixture of *Hydrilla verticillata*, *Potamogeton illinoensis* in Spring and moderate correlation (R = 0.524) with *Sagittaria kurziana* in the Fall.

Macroinvertebrate summary

- MI communities in springs are comprised by many taxa that occur at very low abundances
- MI composition among spring sites are significantly different and some of those differences may be due to the proximity to the SJR (these groups may need to be analyzed separately)
- Specific conductance and current velocity are associated with MI community composition, regardless of season
- In the Fall, *Sagittaria kurziana* is associated with MI community composition

More Data to Analyze

- Macroalgae biomass and composition and its attendant MI fauna
- PC data from other sampling events not associated with the biotic sampling
- Epiphytic algal biomass and composition
- MI feeding guilds, behavior guilds, tolerance groups, and other calculated diversity indices
- Velocity profile data
- Integration of long-term velocity and discharge data
- Integration of long-term nutrient level data
- Relationships among all the data and with other data from springs

Thank you

www.sjrwmd.com/springs