Characterization of Southern Florida Marsh Vegetation Using a Landscape Scale Random Sample: R-EMAP Phase III Vegetation Sampling.

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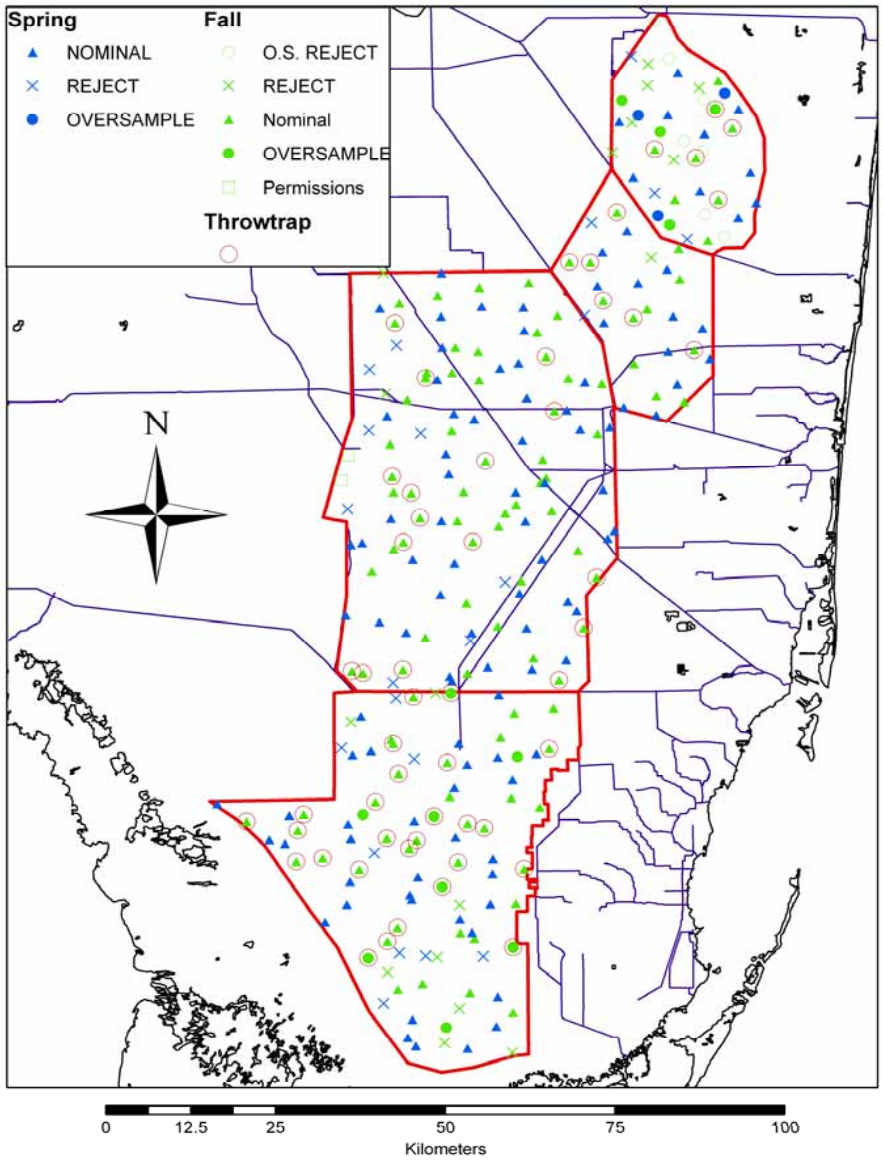
National Park Service
National Park Service
U.S. Department of the Interior

R-EMAP Sampling Design

- Sampled 111 sites in spring 2005, 119 sites in fall 2005, 230 total

- Parameters sampled at each site, where possible:
  - Biogeochemical (soil, surface and pore-water nutrients/mercury/physical parameters)
  - Plant species presence and vegetation mapping
  - Fish (fall only)
  - Invertebrates (fall only)
  - Periphyton (fall only)

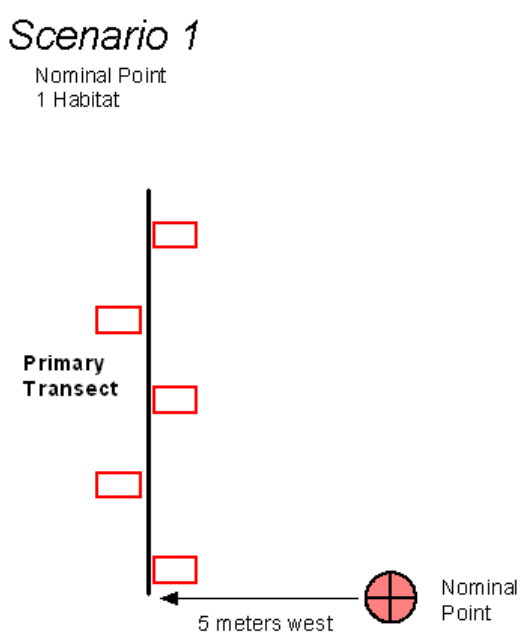


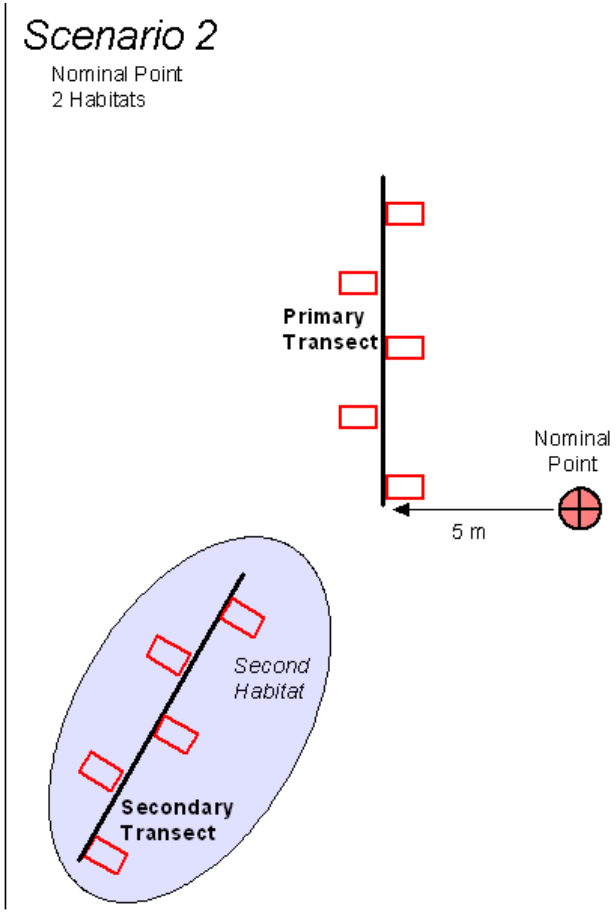
Plant Species Sampling

- Plant Community Analysis
- Exotic Plant Species Surveys
  - Survey on fly-in
  - Survey from helicopter pontoons

Plant Community Analysis:

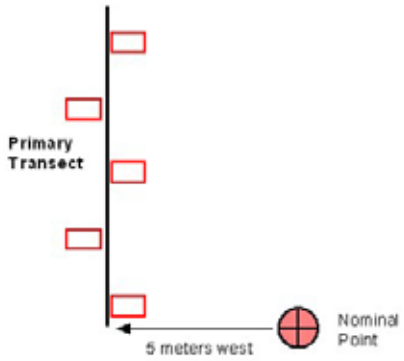
- Species presence in 20 (¼ m^2) quadrats distributed along 10 m N-S transect 5 m west of sampling point
- Additional transect to reflect additional diversity within 50m radius at site
- Sawgrass density counted and l x w of longest leaf measured in 3rd m^2





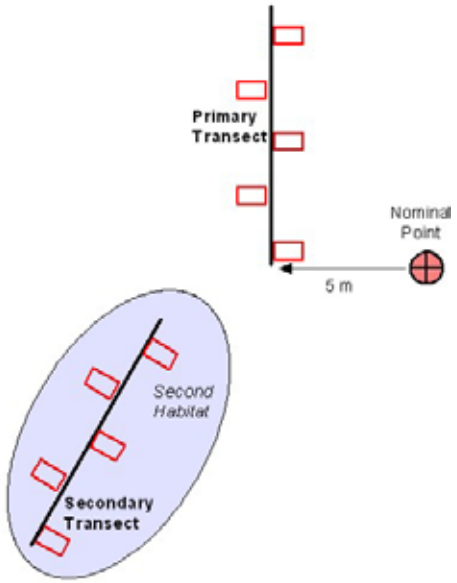
Scenario 1

Nominal Point
1 Habitat



Scenario 2

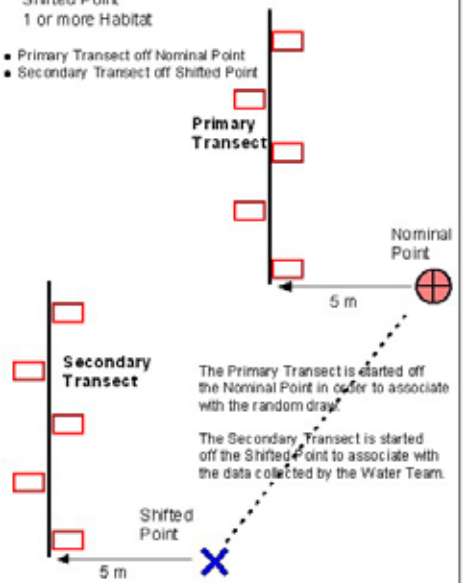
Nominal Point
2 Habitats



Scenario 3

Shifted Point
1 or more Habitat

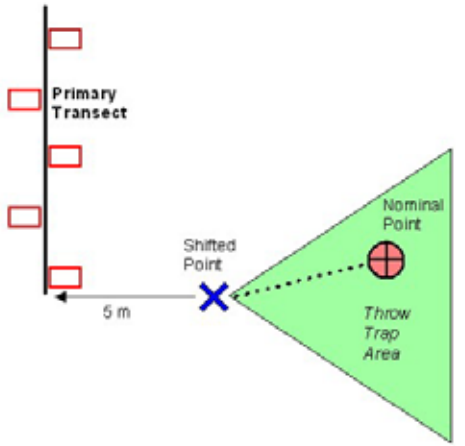
- Primary Transect off Nominal Point
- Secondary Transect off Shifted Point



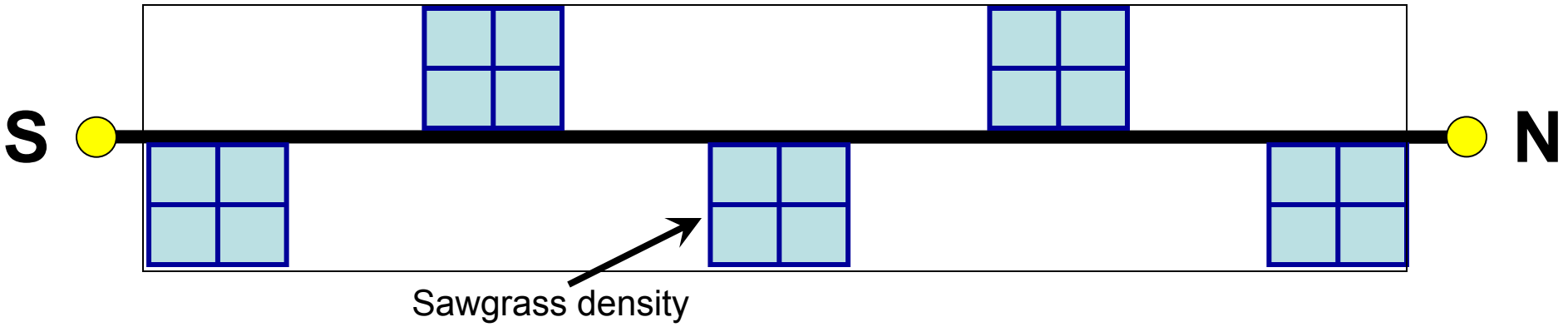
Scenario 4

Shifted Point
Nominal Point trampled

- Nominal Point trampled.
- Primary Transect from Shifted Point.
- Secondary Transect in 2nd Habitat (if present).



20 (0.25) m^2 quadrats

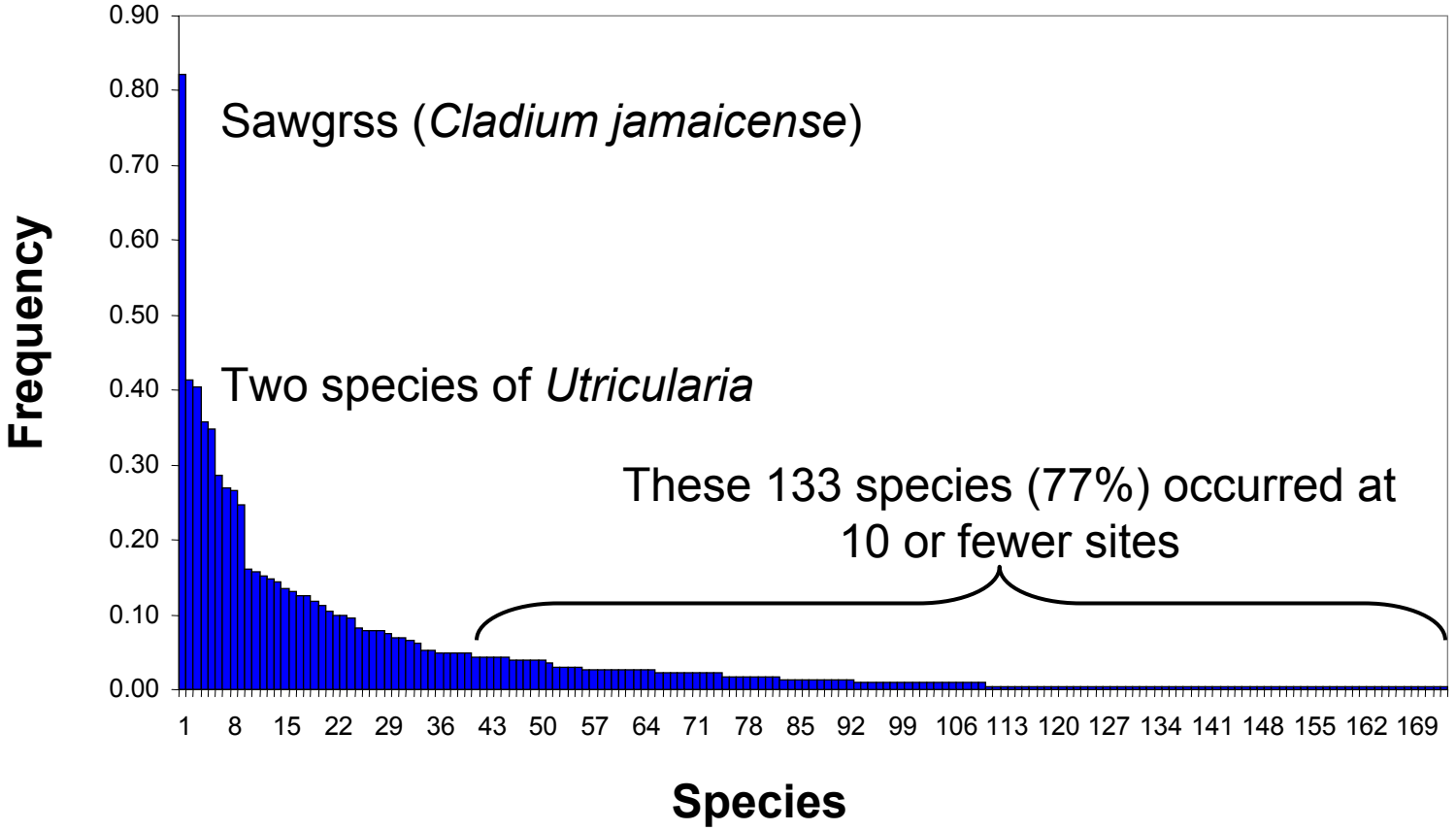


Plant Community Analysis

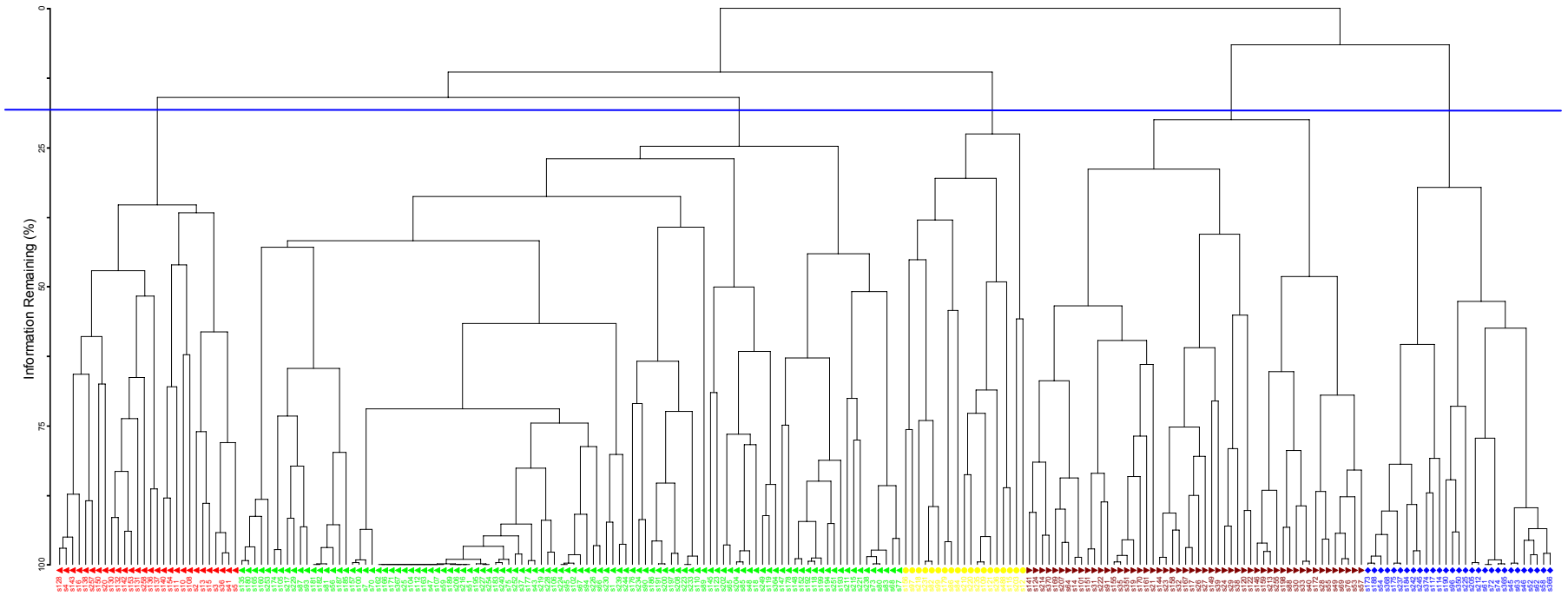
- 230 sites visited (111 spring, 119 fall)
  - 114 sites had transect 2
- 187 species encountered (including 4 unknowns)
  - 173 on transect 1
  - 106 on transect 2
  - 14 species present on transect 2 but not on transect 1

Species Occurrence, Transect 1

173 taxa distributed among
230 sites (111 spring, 119 fall)



Agglomerative hierarchical clustering of primary transect data: 5 groups recognized



Muhlenbergia (muhly)

Cladium (sawgrass)

Typha (cattail)

Eleocharis (spikerush)

Nymphaea (water lily)

Muhly group is most species rich:

28 sites, 47 species, 41 significant indicator species;
But note, also, sawgrass is present at 100% of these sites

Species	IV	%	p
Muhly group			
Muhlenbergia capillaris	89.1	89	0.0002
Panicum tenerum	59.1	75	0.0002
Centella asiatica	52.4	54	0.0002
Symphyotrichum bracei	48.5	50	0.0002
Pluchea rosea	44.6	54	0.0002
Rhynchospora microcarpa	36.7	57	0.0002
Solidago stricta	35.7	36	0.0002
Cassytha filiformis	35.6	36	0.0002
Schizachyrium rhizomatum	35.3	36	0.0002
Polygala grandiflora	32.1	32	0.0002

Sawgrass group is most common but is species poor:

102 sites, 7 species, 2 significant indicator species;

Species	IV	%	p
Sawgrass group			
Cladium jamaicense	34.8	100	0.0002
Cephalanthus occidentalis	13.3	19	0.0206

Spikerush group is next most abundant and diverse:

52 sites, 18 species, 8 significant indicator species;

Species	IV	%	p
Spikerush group			
Eleocharis cellulosa	68.8	92	0.0002
Bacopa caroliniana	60.9	75	0.0002
Rhynchospora tracyi	35.8	44	0.0002
Panicum hemitomon	34.3	60	0.0002
Sagittaria lancifolia	20.4	48	0.0094
Paspalidium geminatum	15.0	37	0.0194
Rhynchospora inundata	10.8	13	0.024
Justicia angusta	13.5	27	0.0344

Water lily group has floating-leaved and submerged or free-floating aquatics

29 sites, 10 species, 6 significant indicator species, including 3 rootless, aquatic bladderwort species

Species	IV	%	p
Water lily group			
Nymphaea odorata	74.0	100	0.0002
Utricularia purpurea	55.0	90	0.0002
Utricularia gibba	43.7	79	0.0002
Eleocharis elongata	35.6	41	0.0002
Nymphoides aquatica	25.4	34	0.0002
Utricularia foliosa	31.3	72	0.0004

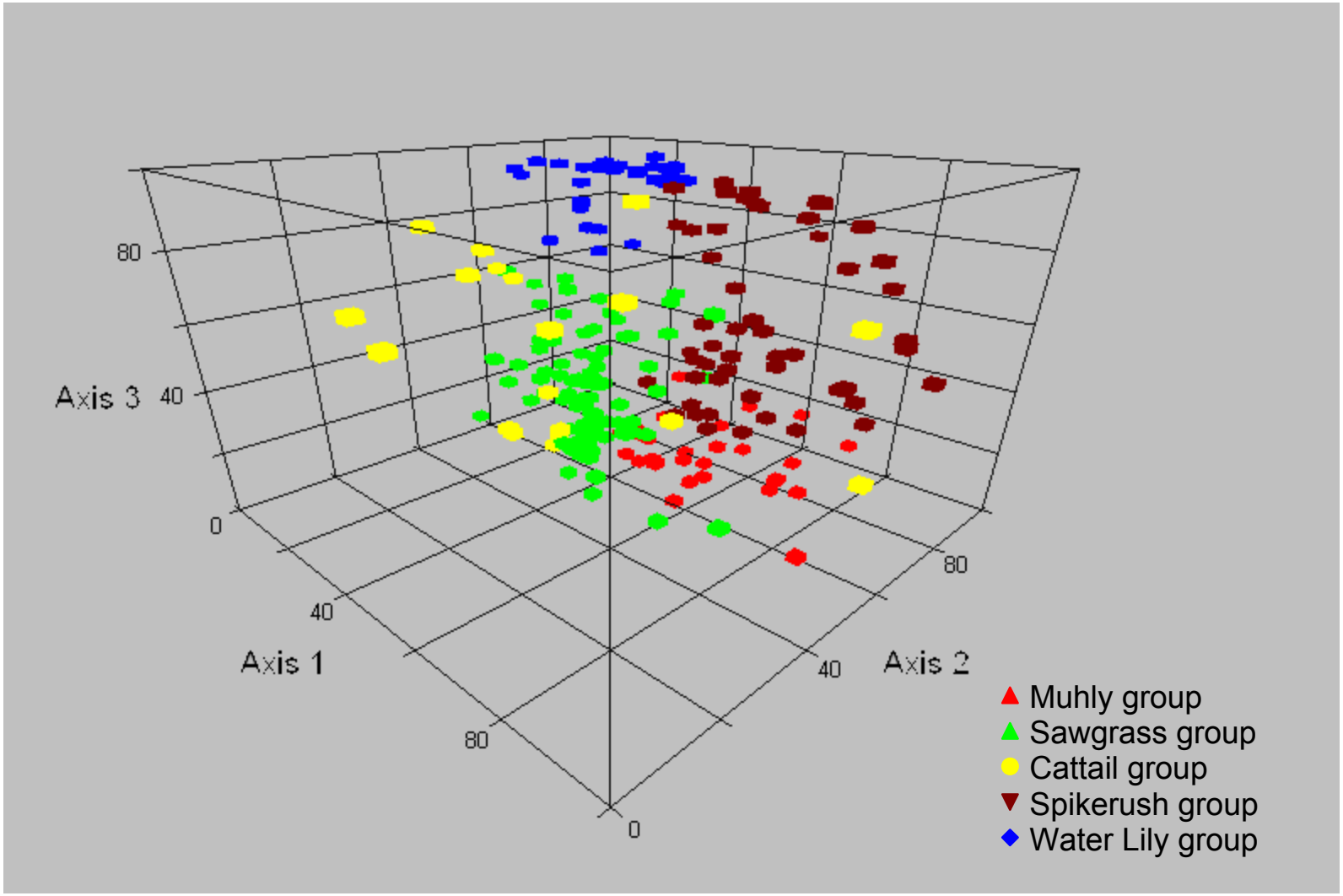
Cattail group is least abundant

19 sites, 10 species, 6 significant indicator species, including exotics, shrubs and vines

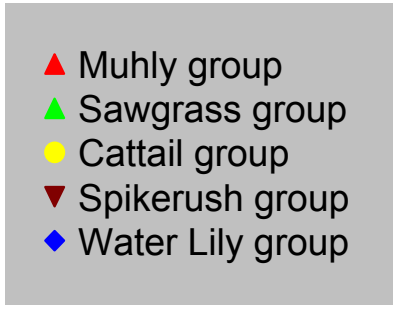
Species	IV	%	p
Cattail group			
Typha domingensis	88.8	95	0.0002
Polygonum hydropiperoides	43.3	47	0.0002
Salix caroliniana	25.1	26	0.0002
Sarcostemma clausum	12.6	16	0.0056
Salvinia minima	9.0	11	0.0172
Pontederia cordata	16.1	26	0.02

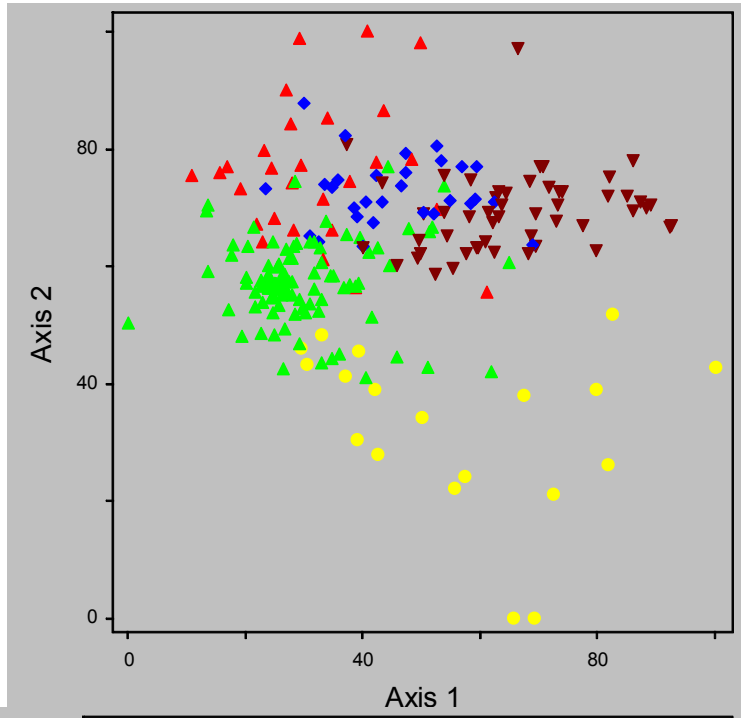
NMS Ordination of Sites:

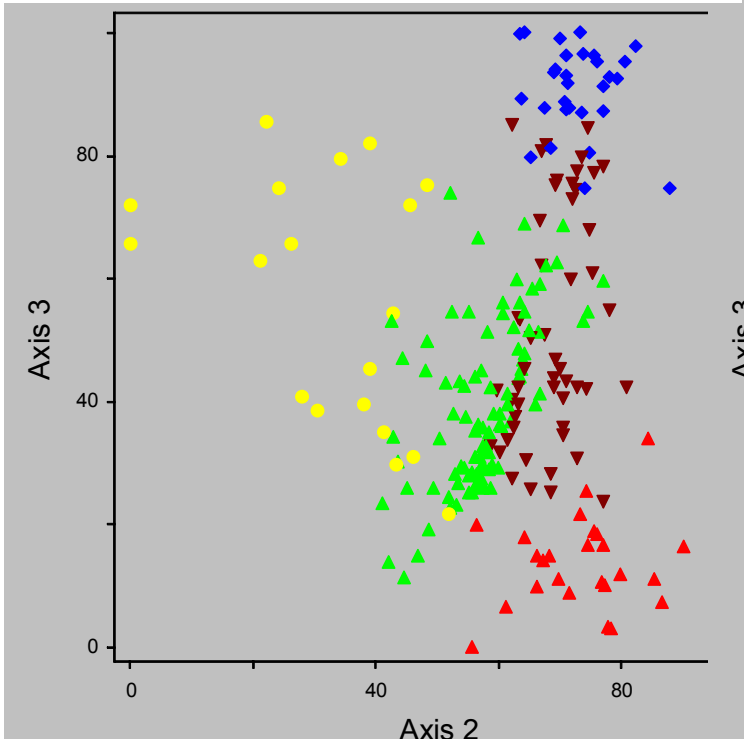
3Dimensions with 80% of information; groups separate but with overlap

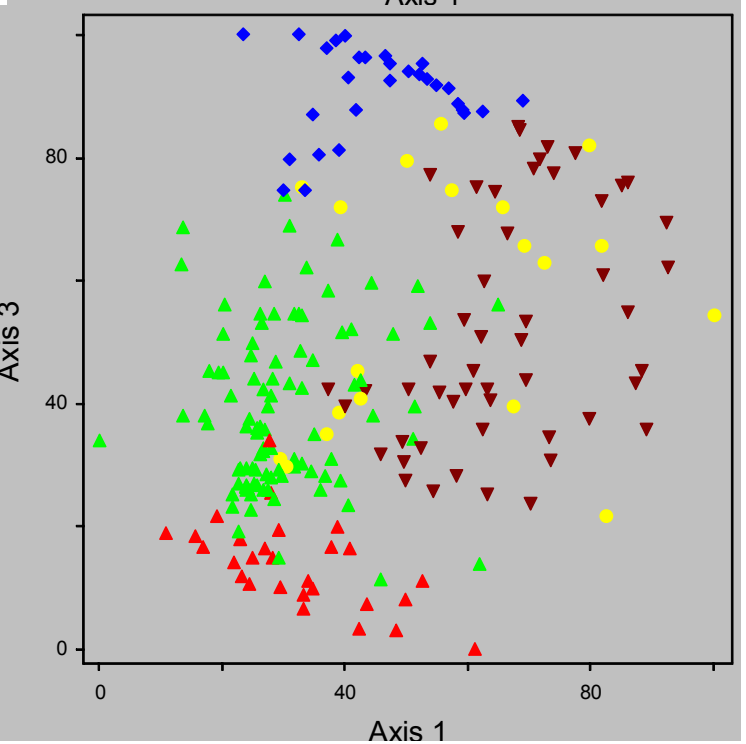


- Muhly group is very distinct;
- Cattail group is dispersed;
- Sawgrass, spikerush and water lily groups overlap but occupy different sectors of ordination space.

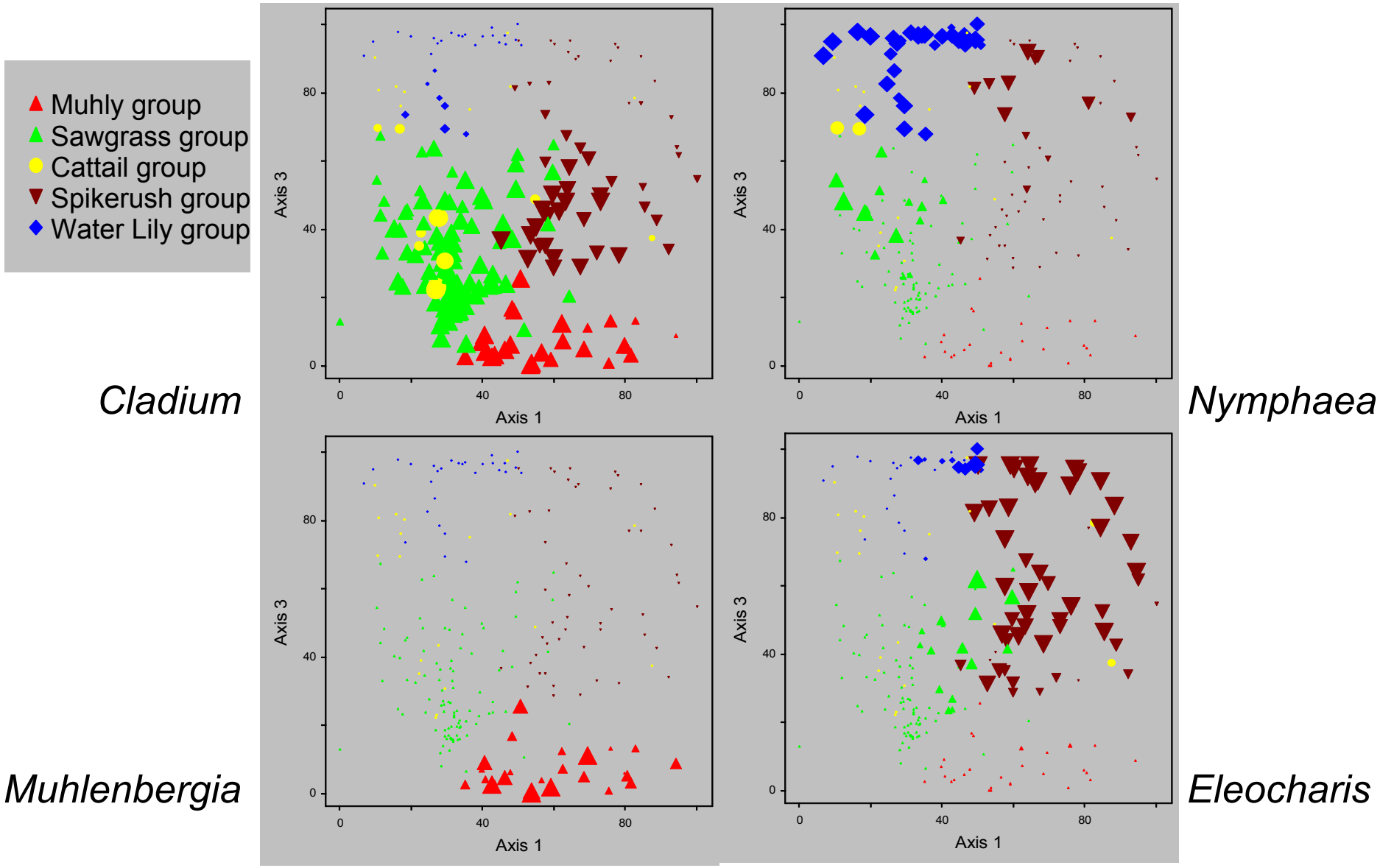








Species distributions among clusters reflect both overlap and distinctions among groups



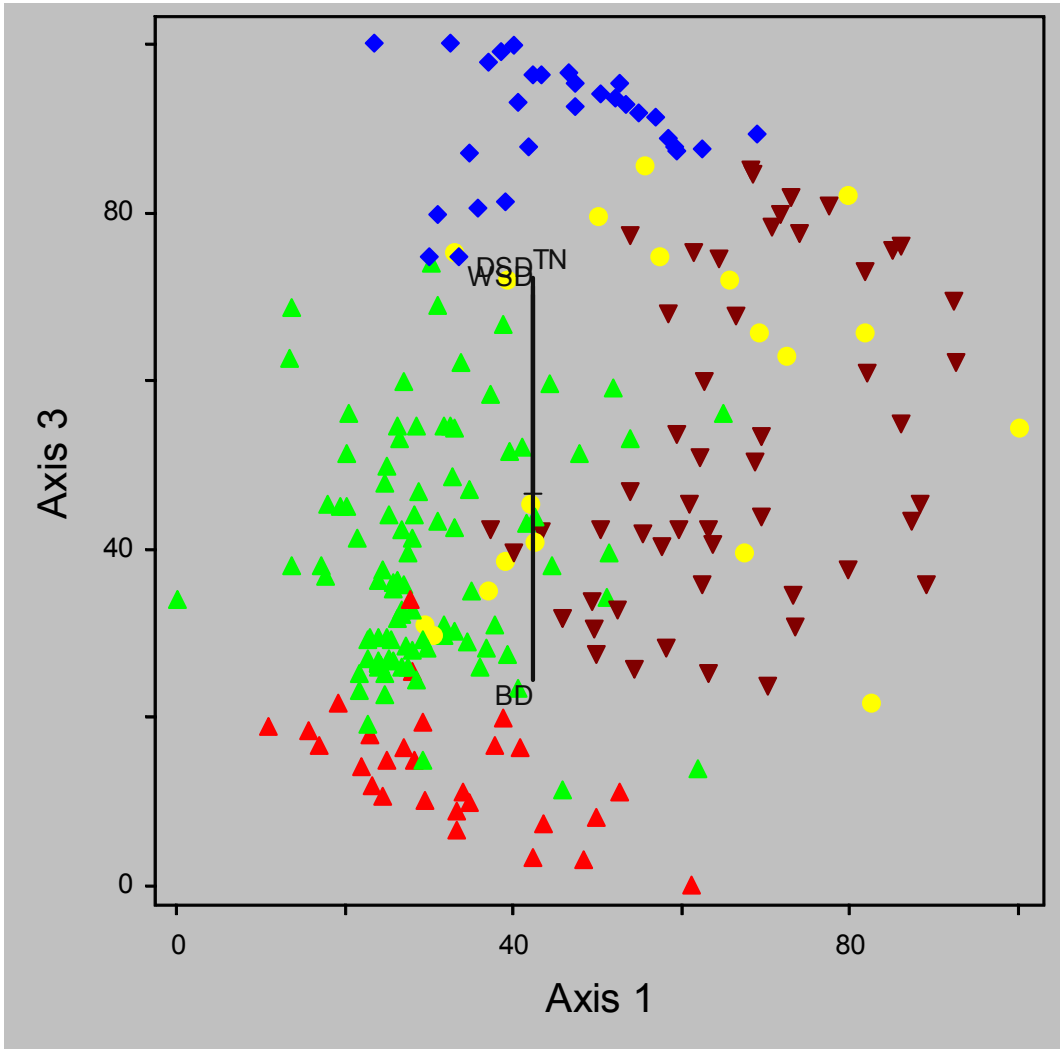
Cladium

Nymphaea

Muhlenbergia

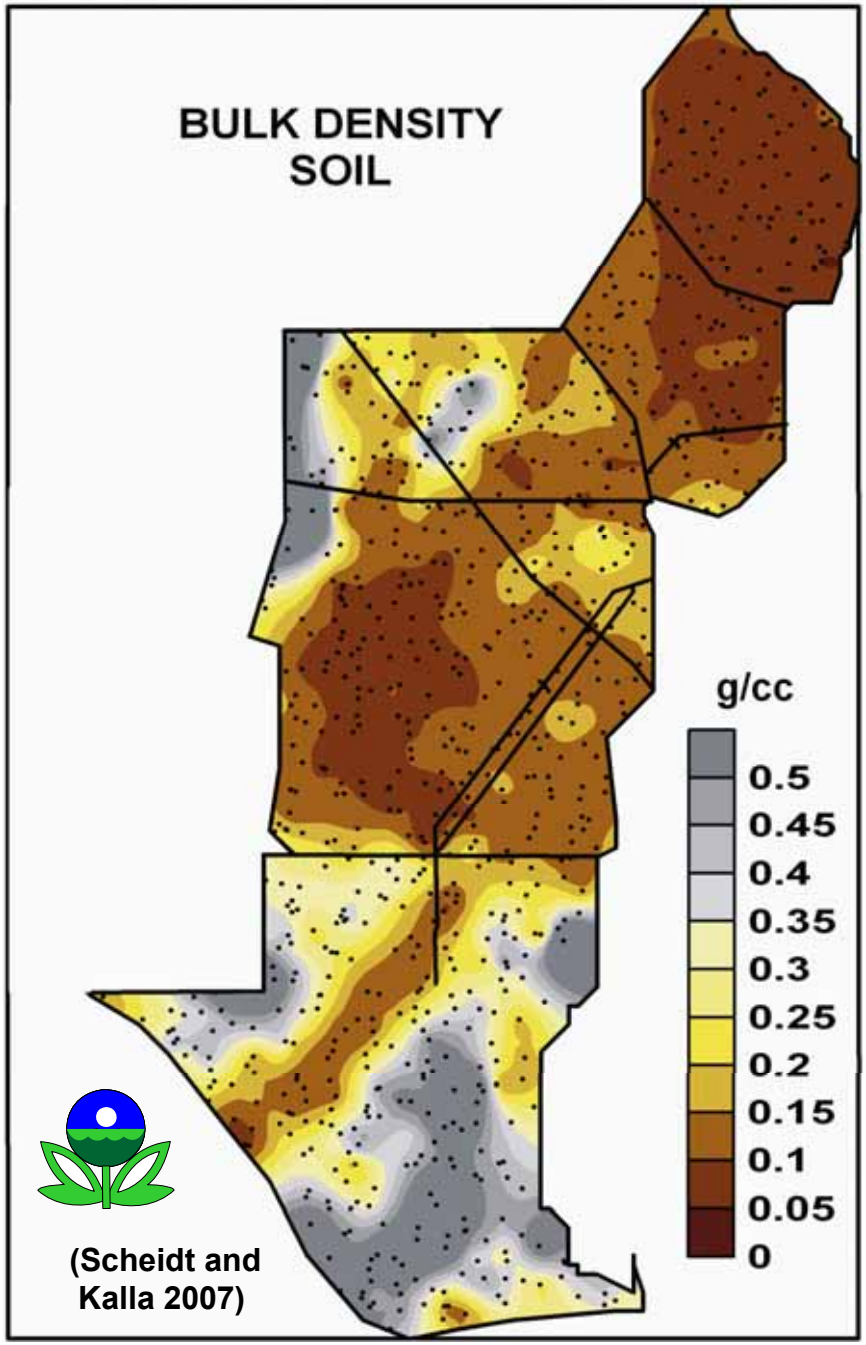
Eleocharis

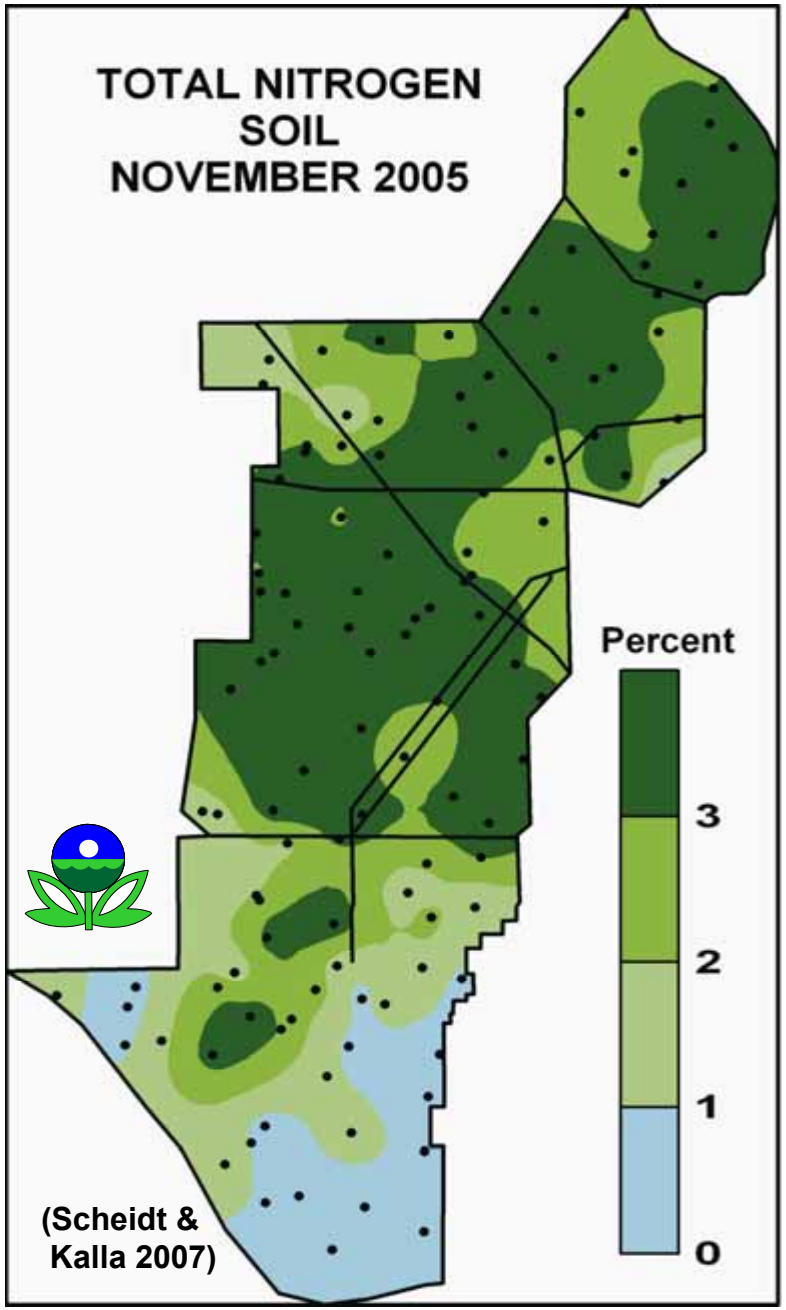
Four environmental variables, $r^2 > 0.20$, correlate most strongly to a single axis



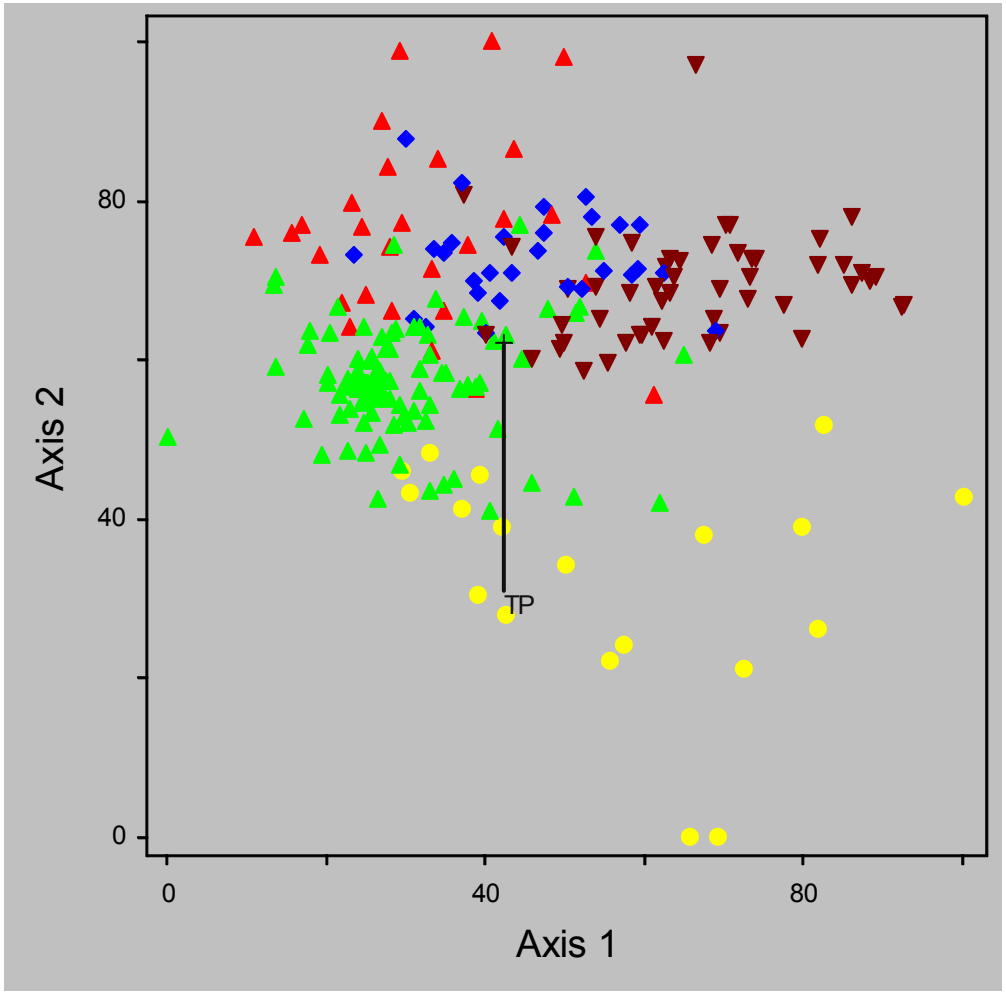
- **Soil Variables**
  - Thickness
  - pH
  - Bulk Density*
  - Ash Free Dry Weight*
  - Total P
  - Total N*
  - Total C*
- **Hydrology Variables**
  - Wet Season Water Depth*
  - Dry Season Water Depth*
  - Average Hydroperiod
  - No. Week-long Drydowns

▲ Muhly group
▲ Sawgrass group
● Cattail group
▼ Spikerush group
◆ Water Lily group


BULK DENSITY
SOIL
g/cc
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
(Scheidt and
Kalla 2007)


TOTAL NITROGEN
SOIL
NOVEMBER 2005
Percent
3
2
1
0
(Scheidt &
Kalla 2007)

But Total P in soil correlates to another axis, $r^2 = 0.309$



- **Soil Variables**
  - Thickness
  - pH
  - Bulk Density
  - Ash Free Dry Weight
  - Total P*
  - Total N
  - Total C
- **Hydrology Variables**
  - Wet Season Water Depth
  - Dry Season Water Depth
  - Average Hydroperiod
  - No. Week-long Drydowns

▲ Muhly group
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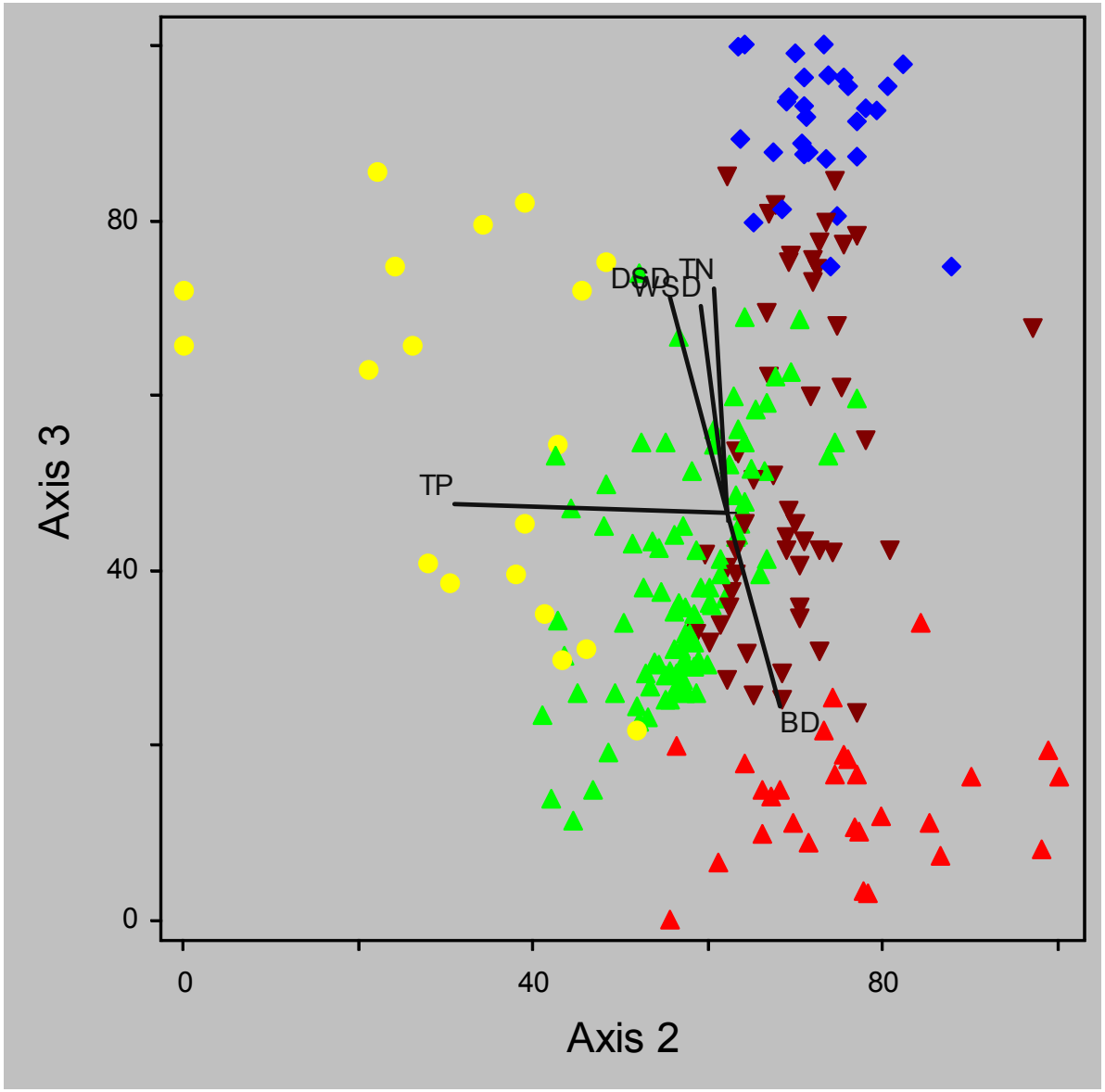
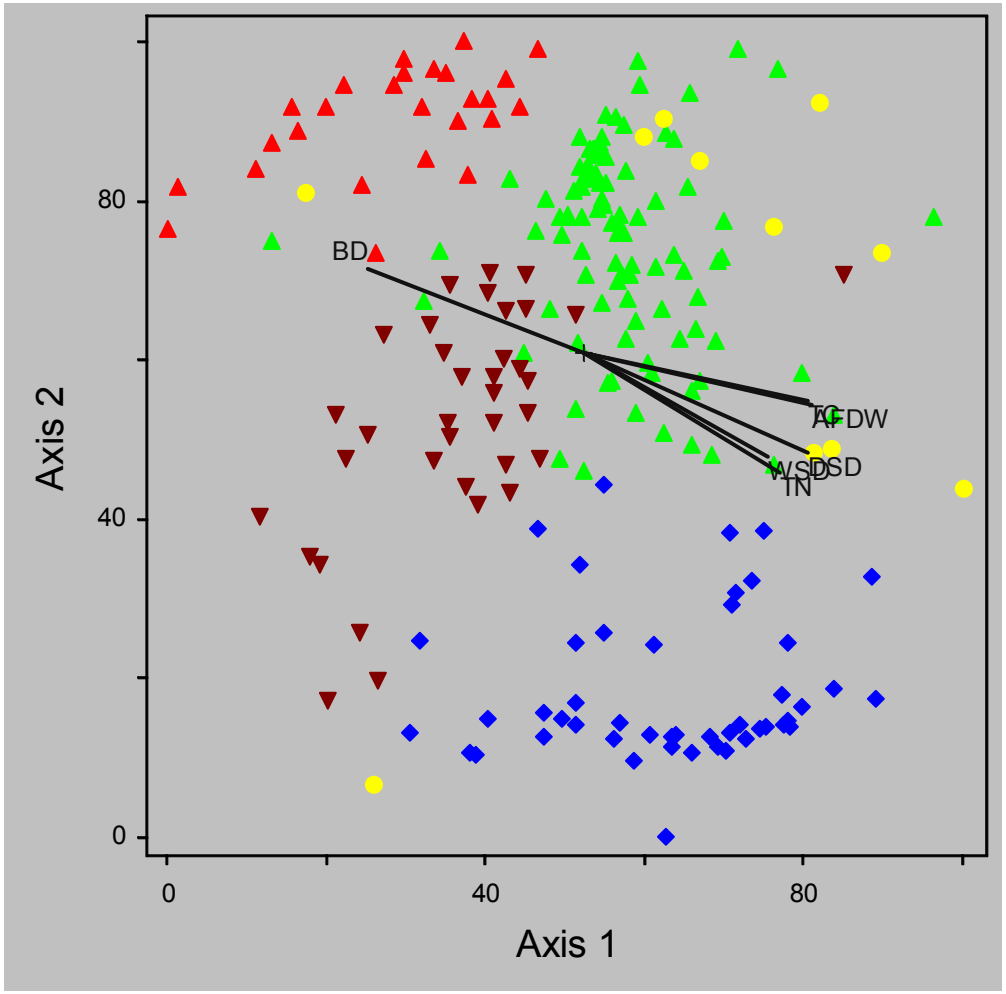
Combined correlations for the environmental variables are seen in the third dimension



- **Soil Variables**
  - Thickness
  - pH
  - Bulk Density*
  - Ash Free Dry Weight
  - Total P*
  - Total N*
  - Total C*
- **Hydrology Variables**
  - Wet Season Water Depth*
  - Dry Season Water Depth*
  - Average Hydroperiod
  - No. Week-long Drydowns

▲ Muhly group
▲ Sawgrass group
● Cattail group
▼ Spikerush group
◆ Water Lily group

Removing outliers removes TP as a significant correlate, reduces axes to 2D, changes species composition of the cattail group and classifies more sites in the water lily group

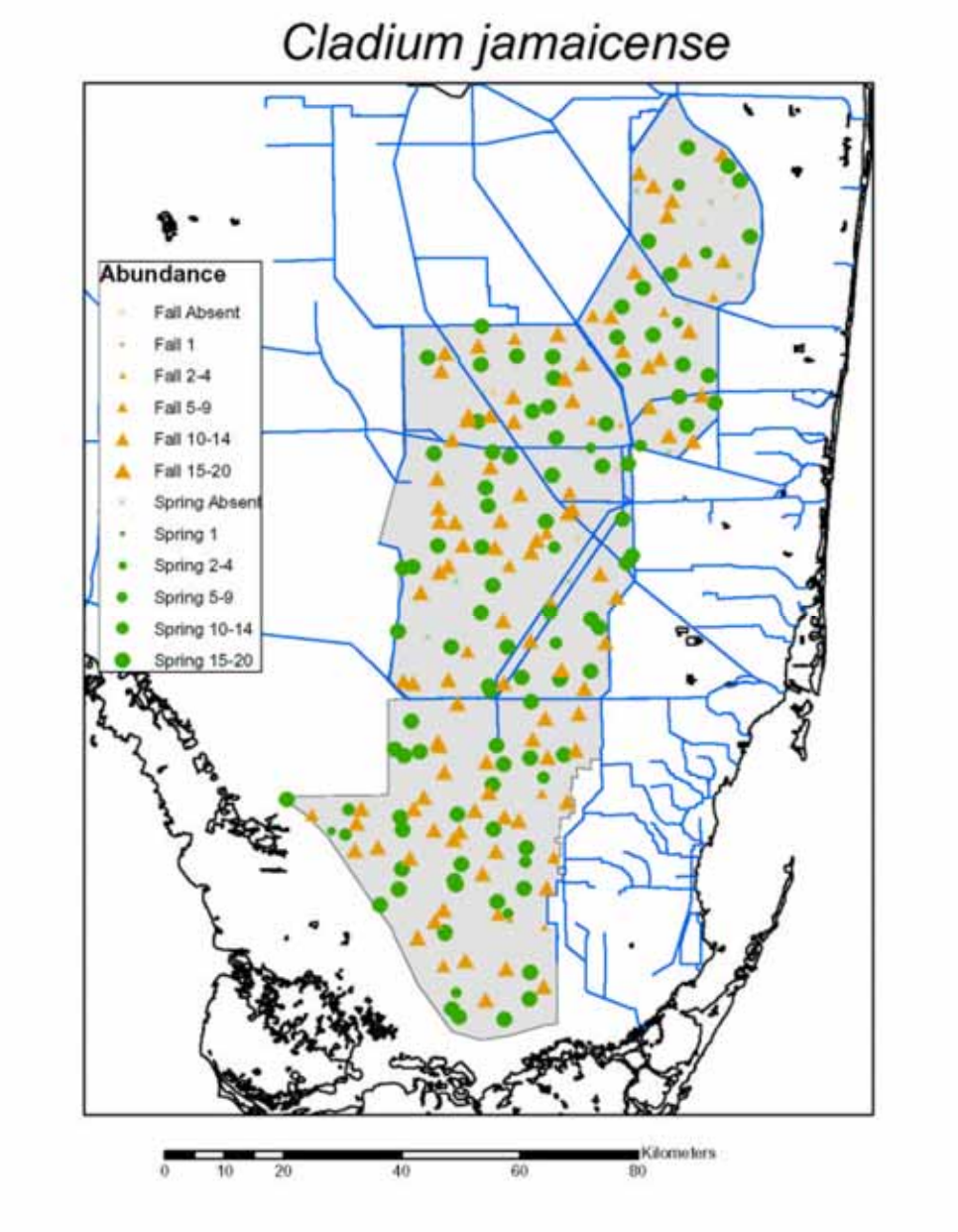


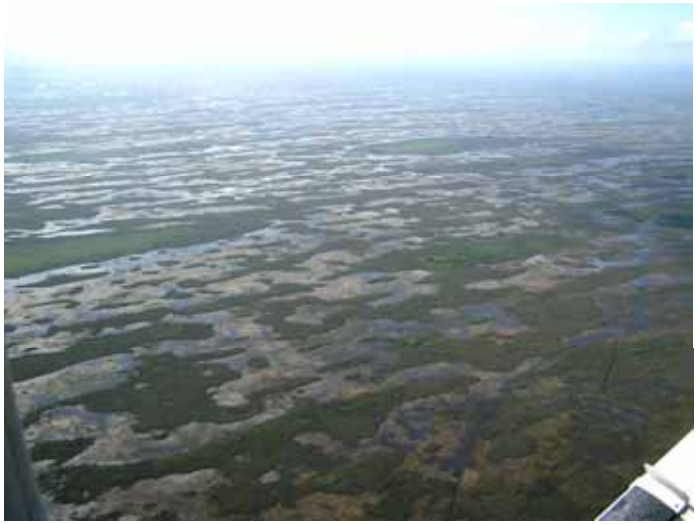
- **Soil Variables**
  - Thickness
  - pH
  - Bulk Density*
  - Ash Free Dry Weight*
  - Total P
  - Total N*
  - Total C*
- **Hydrology Variables**
  - Wet Season Water Depth*
  - Dry Season Water Depth*
  - Average Hydroperiod
  - Maximum Hyrdroperiod
  - No. Week-long Drydowns

▲ Muhly group
▲ Sawgrass group
● Cattail group
▼ Spikerush group
◆ Water Lily group

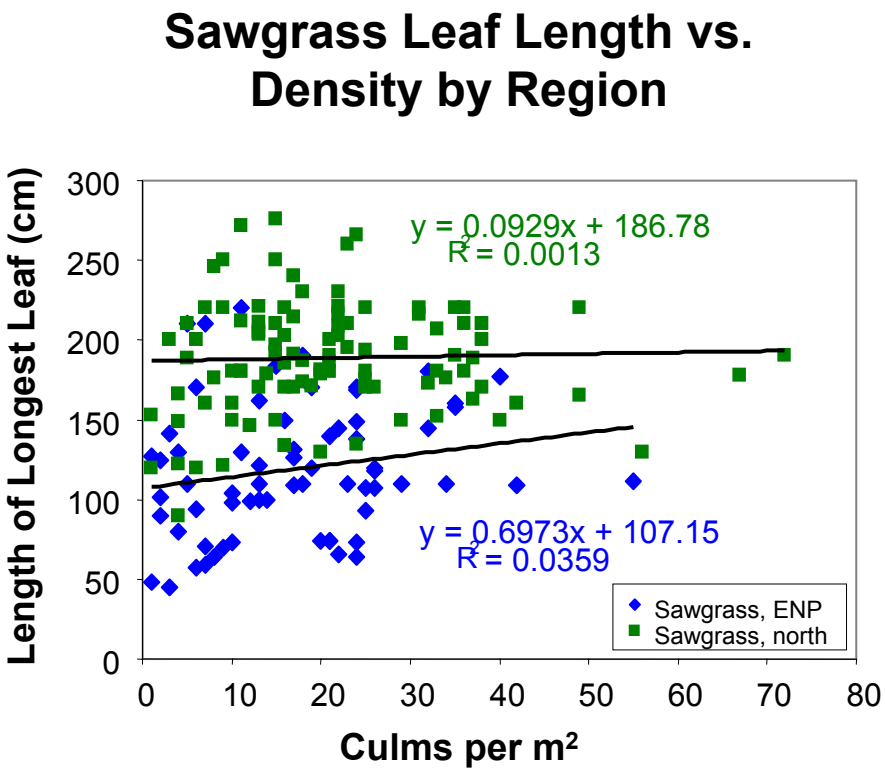
Species Distributions Across the Landscape

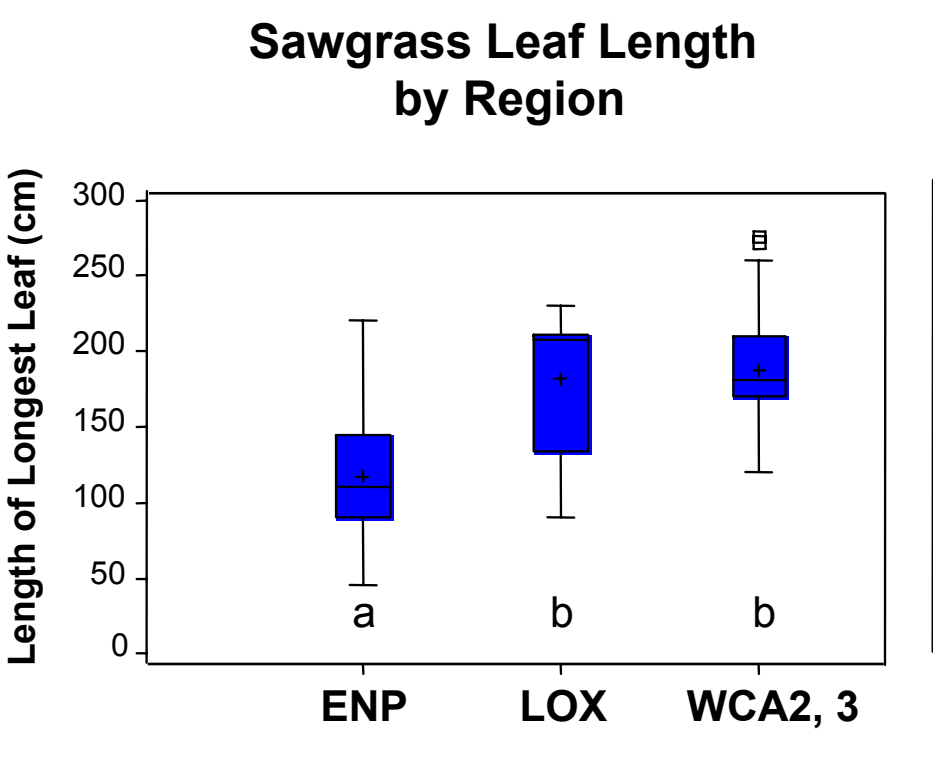
The Everglades is the River of (Saw)Grass





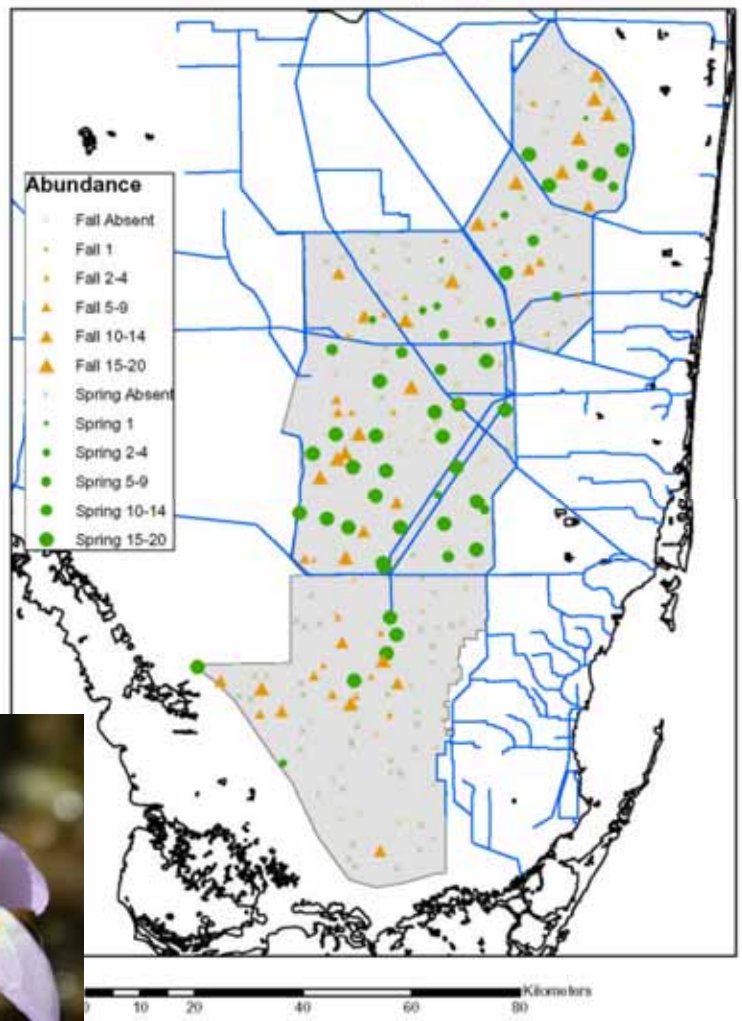
Sawgrass morphology and culm density have unimodal (not bimodal) distributions; morphology but not density varies across the landscape



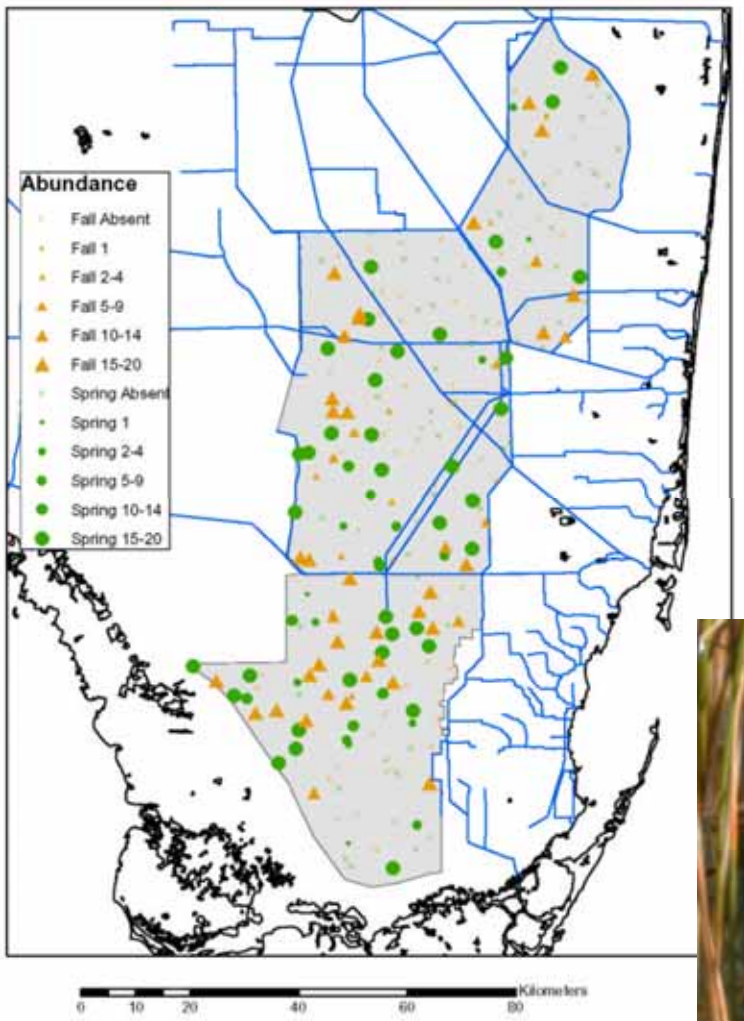


Other common species are unevenly distributed

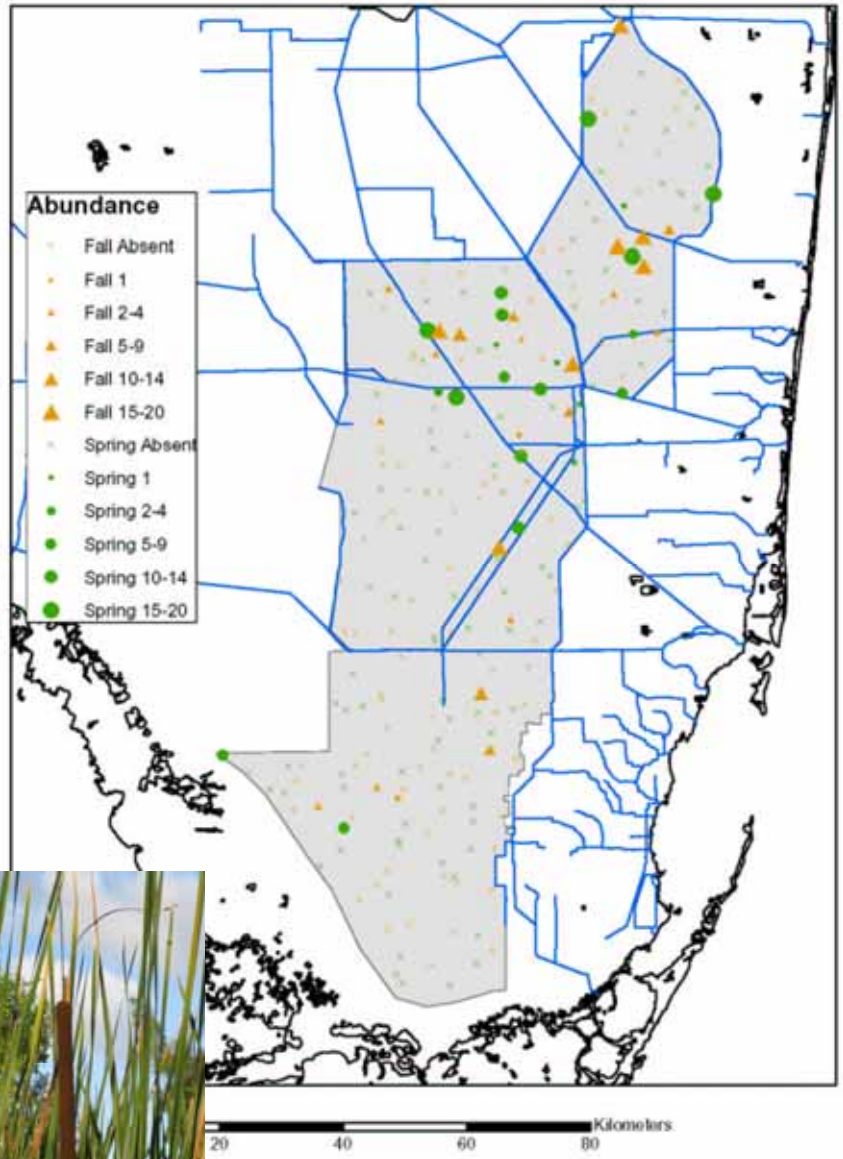
Utricularia purpurea



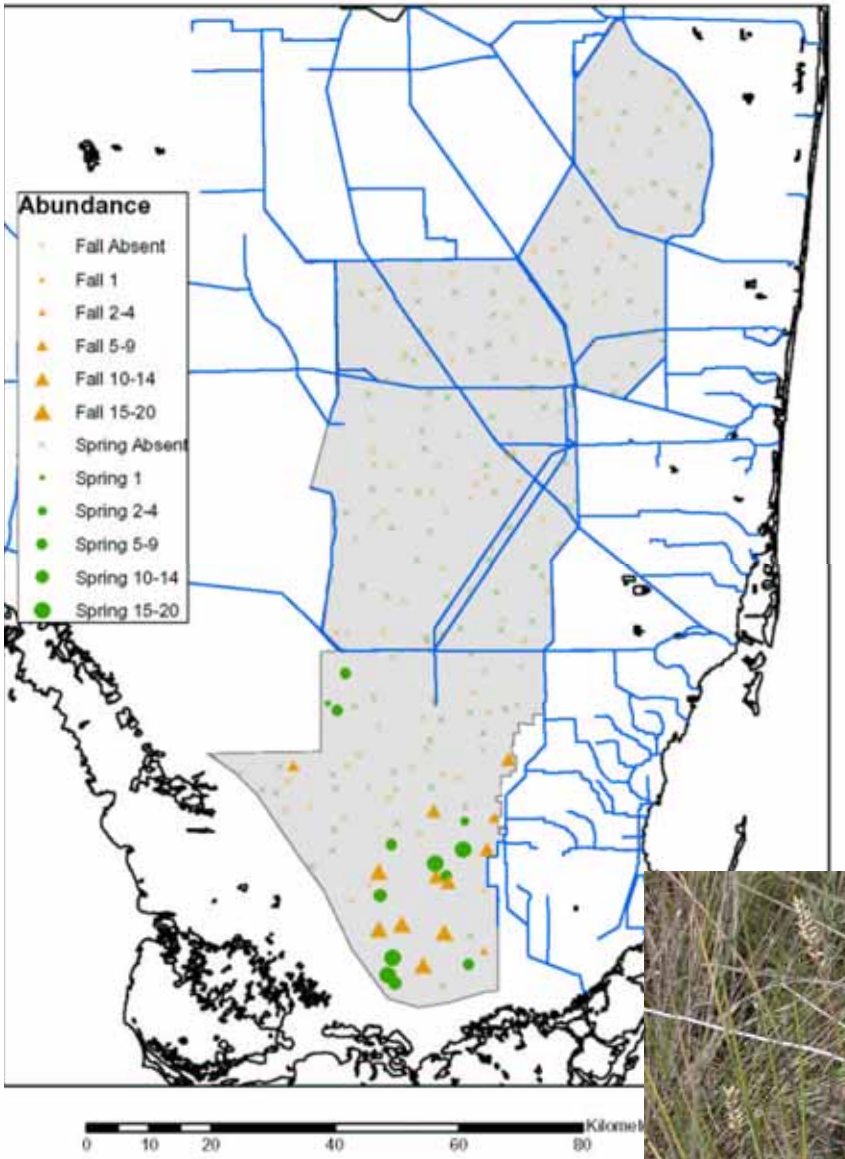
Eleocharis cellulosa



Typha domingensis

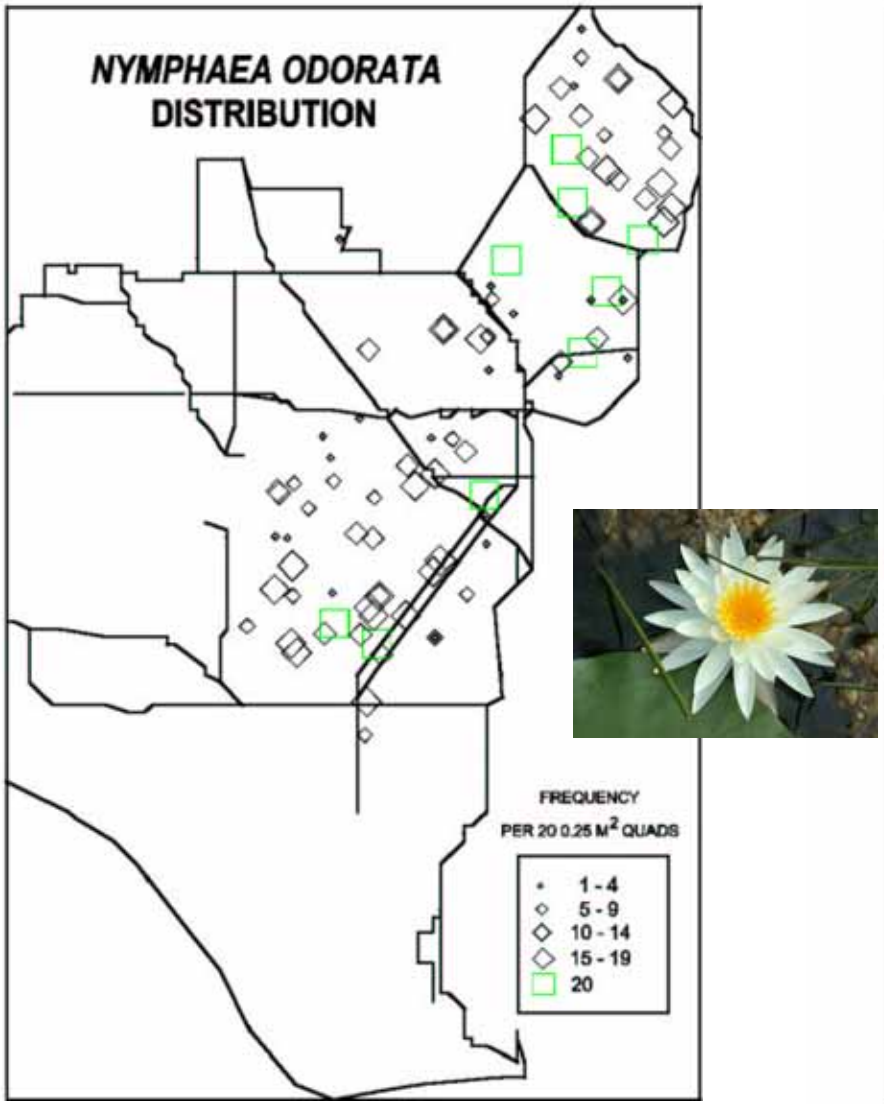


Muhlenbergia capillaris

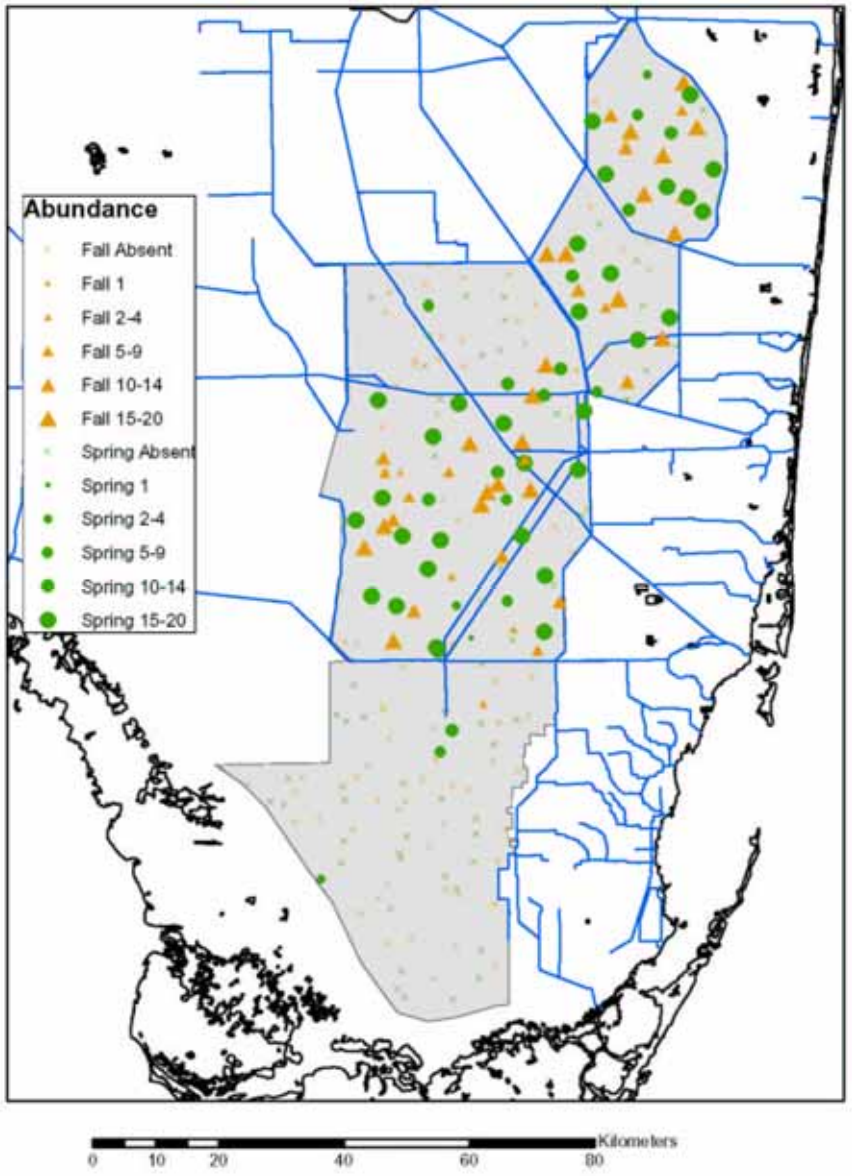


White water lily is sparse in ENP

1999



2005

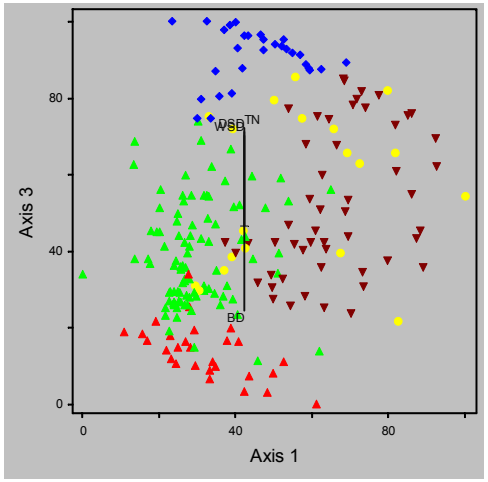


Conclusions

- Everglades marsh plant associations can be broadly delimited into 5 communities that separate out along a hydrologic gradient

- The muhly and water lily groups are distinct and form the end-points of this environmental gradient; muhly and water lily make good indicator species for these groups.

- The other species associations show lots of overlap and grade into each other along the hydrologic gradient

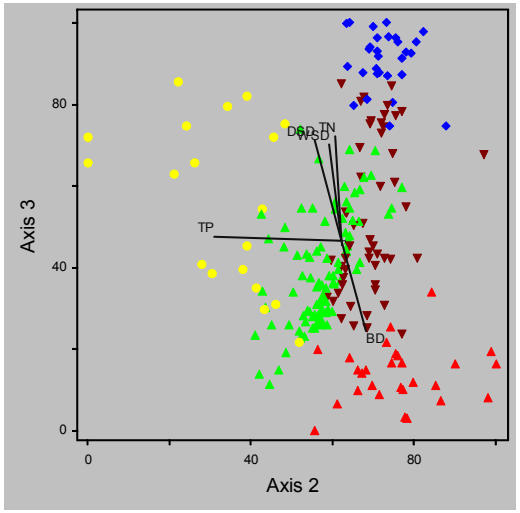


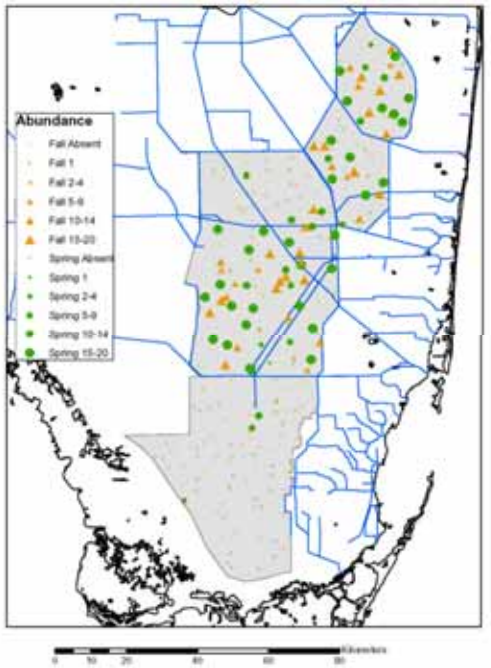
Conclusions

- A cattail association varies along a separate environmental gradient that correlates with soil TP; this association has sites that are both natural and nutrient impacted.

- Sawgrass shows broad tolerances of hydrological and biogeochemical conditions and is present and abundant throughout the entire Everglades, whereas other species have more restricted distributions.

- Both water lily distribution and sawgrass morphology reflect on a landscape scale the drier, shallower environment in ENP as compared to the WCAs; these conditions should change with restoration.





Acknowledgements

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- Morris Flexner, Chris Decker, and the rest of the EPA plant sampling team
- The Institute for Regional Conservation