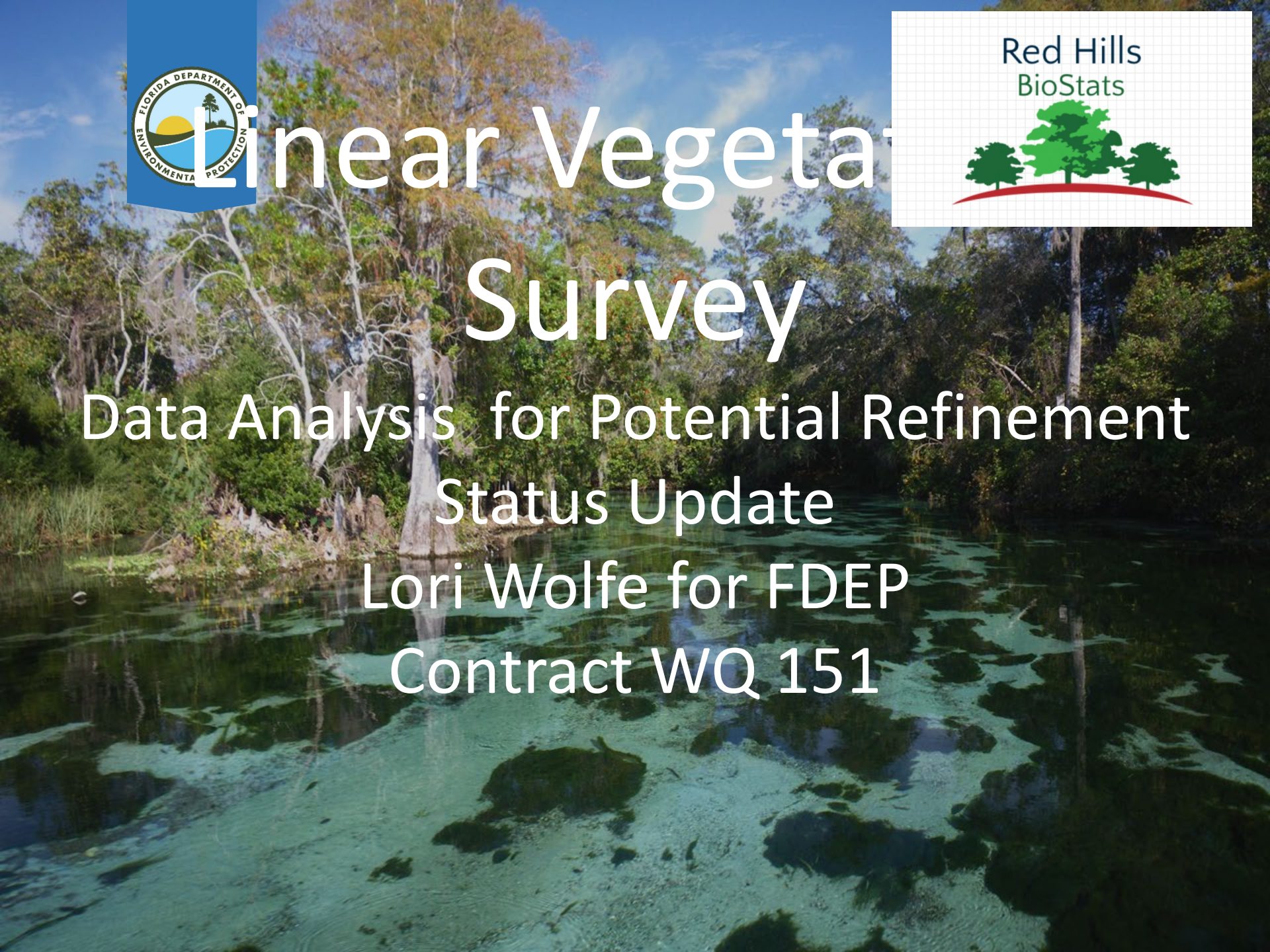


Linear Vegetation Survey

Data Analysis for Potential Refinement

Status Update

Lori Wolfe for FDEP

Contract WQ 151

Background

- LVS is a **rapid screening tool** to determine how closely a stream's flora resembles that of a minimally disturbed condition
- **100m** stream reach
- **ID all emergent, floating and submersed taxa** every 10m, and % cover of all taxa
- **Minimum 2m²** to conduct assessment
- Two metrics: **Average CC score** and **% FLEPPC exotics**, both weighted by occurrence

Application in NNC

- Department uses reference stream nutrient thresholds in combination with floral measures
- Floral measures are LVS, RPS, and chlorophyll *a*
- Currently: If mean CC score is <2.5, AND % FLEPPC taxa is >25%, for two consecutive, temporally independent samples in a waterbody, it represents an imbalance of flora and NNC are not achieved
- LVS thresholds based on limited reference site approach; DEP has collected extensive data and upgraded database since adoption of NNC

Purpose of Study

- Evaluate relationships between the LVS metrics and human disturbance (including nutrient enrichment)
- Explore whether additional or alternate metrics should be used in the method (multimetric approach)
- Better understand the plant community structure and its physical and chemical drivers (multivariate)
- Should we change what the method looks like, and how and where we use it?

LVS Dataset

- LVS AVG CC and % FLEPPC metrics
- LVS % cover and dominance assignment
- LVS taxa lists and attributes
- Field collected pchem: DO, Cond, temp, pH
- HA (and components)
- RPS Canopy Cover
- Lab water chemistry: nutrients, chlorophyll, metals, color, TSS, TDS, turbidity, TOC

LVS Dataset

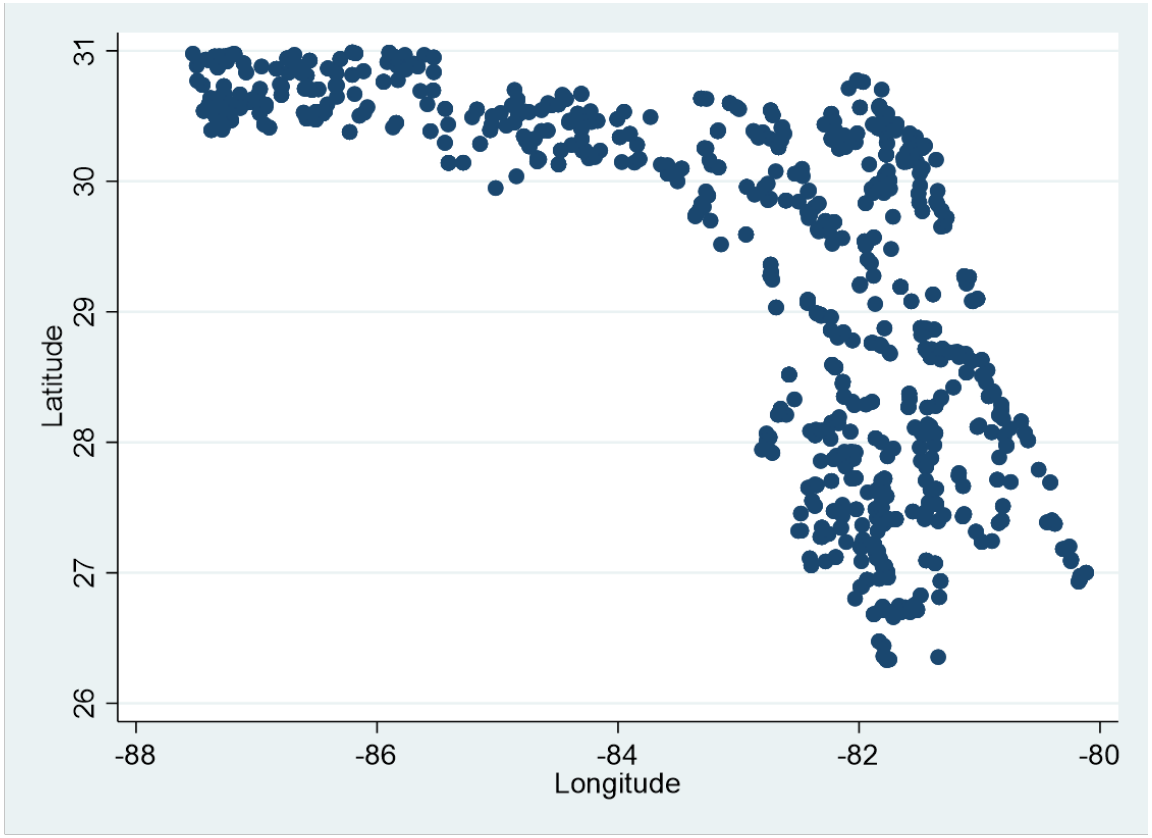
The final (original) data set has 1164 stream samples

<2 m2 688 samples (no taxa matrix)

≥2m2 476 samples (taxa matrix, 325 taxa), reduced to **305 samples**, **289 taxa**)

Stream Samples

- Scatterplot of Latitude vs Longitude
- Shows coverage of "Stream" data across the state
- Includes LT 2 sqm and GE 2 sqm



Analysis-Multimetric

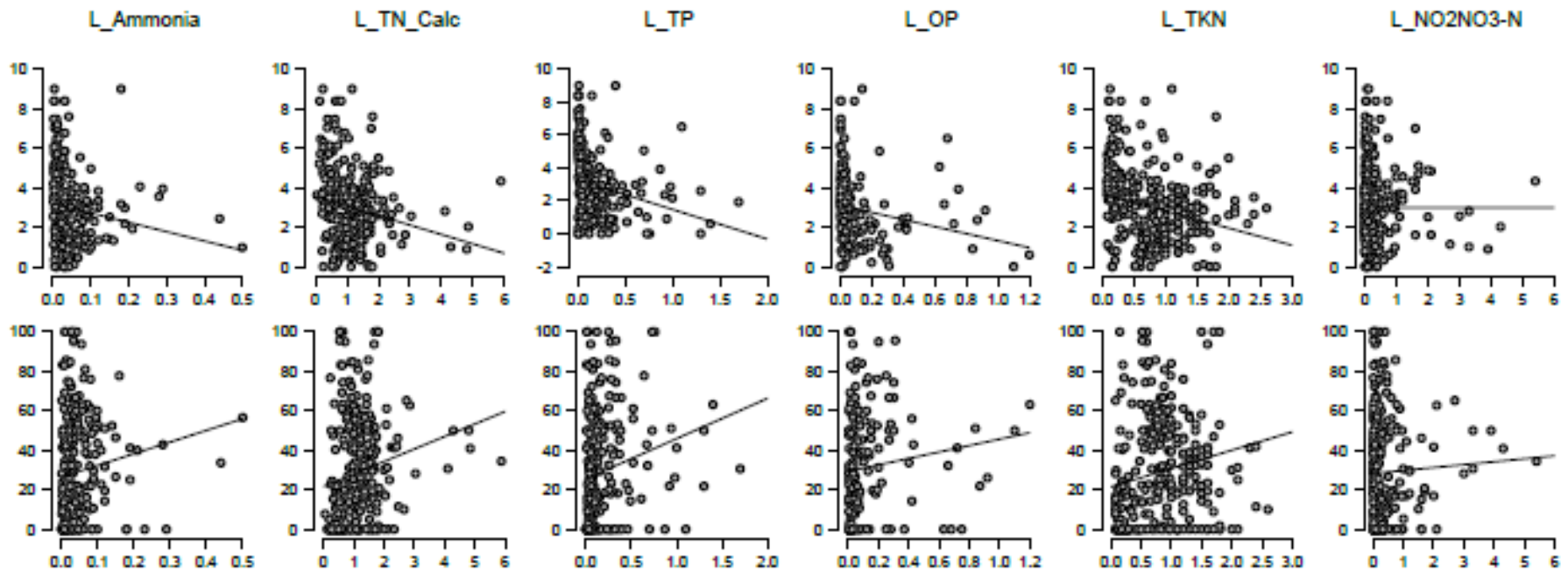
Step 1-develop human disturbance gradient (HDG): test relationship between the two existing metrics and candidate HDG variables

HDG Categories and candidate variables :

Landscape/habitat	Pchem	Nutrients	Light	Other
LDI (r=-0.52*)	DO	TN	Canopy Cover	Alkalinity
%Anthro Land Use	pH	TKN	TSS	Chlorophyll
Habitat Assessment (r=0.35*)	Spec cond	Nitrate/Nitrite	TDS	
% Urban	Temp	Ammonia	TOC	
	Turbidity	**TP (r=-0.46*)**		
	Color	Ortho P		

* Correlation coefficients are Spearman's rho, correlation is with AVG CC, p<.001

Average CC and FLEPPC vs. Nutrients



Pearson Correlations

		Avg_CofC	FLEPPC_Pct	L_Ammonia	L_TN_Calc	L_TP	L_OP	L_TKN	L_NO2NO3-N
Avg_CofC	Pearson's r	—							
	p-value	—							
	Upper 95% CI	—							
	Lower 95% CI	—							
FLEPPC_Pct	Pearson's r	−0.76***	—						
	p-value	< .001	—						
	Upper 95% CI	−0.73	—						
	Lower 95% CI	−0.82	—						
L_Ammonia	Pearson's r	−0.14*	0.12*	—					
	p-value	0.01	0.03	—					
	Upper 95% CI	−0.03	0.24	—					
	Lower 95% CI	−0.25	0.01	—					
L_TN_Calc	Pearson's r	−0.19***	0.17**	0.14*	—				
	p-value	< .001	0.00	0.01	—				
	Upper 95% CI	−0.08	0.28	0.25	—				
	Lower 95% CI	−0.30	0.06	0.03	—				
L_TP	Pearson's r	−0.24***	0.18**	0.12*	0.20***	—			
	p-value	< .001	0.00	0.03	< .001	—			
	Upper 95% CI	−0.13	0.29	0.23	0.31	—			
	Lower 95% CI	−0.34	0.07	0.01	0.09	—			
L_OP	Pearson's r	−0.19**	0.12	0.10	0.16*	0.97***	—		
	p-value	0.01	0.10	0.16	0.02	< .001	—		
	Upper 95% CI	−0.05	0.26	0.24	0.30	0.98	—		
	Lower 95% CI	−0.32	−0.02	−0.04	0.02	0.96	—		
L_TKN	Pearson's r	−0.25***	0.19**	0.37***	0.49***	0.24***	0.16*	—	
	p-value	< .001	0.00	< .001	< .001	< .001	0.02	—	
	Upper 95% CI	−0.14	0.29	0.46	0.57	0.34	0.30	—	
	Lower 95% CI	−0.36	0.07	0.27	0.39	0.13	0.02	—	
L_NO2NO3-N	Pearson's r	−0.00	0.04	−0.14*	0.71***	0.03	0.04	−0.27***	—
	p-value	0.99	0.52	0.02	< .001	0.59	0.52	< .001	—
	Upper 95% CI	0.11	0.15	−0.02	0.76	0.14	0.18	−0.17	—
	Lower 95% CI	−0.11	−0.08	−0.25	0.65	−0.08	−0.11	−0.38	—

* p < .05, ** p < .01, *** p < .001

Analysis-Multimetric

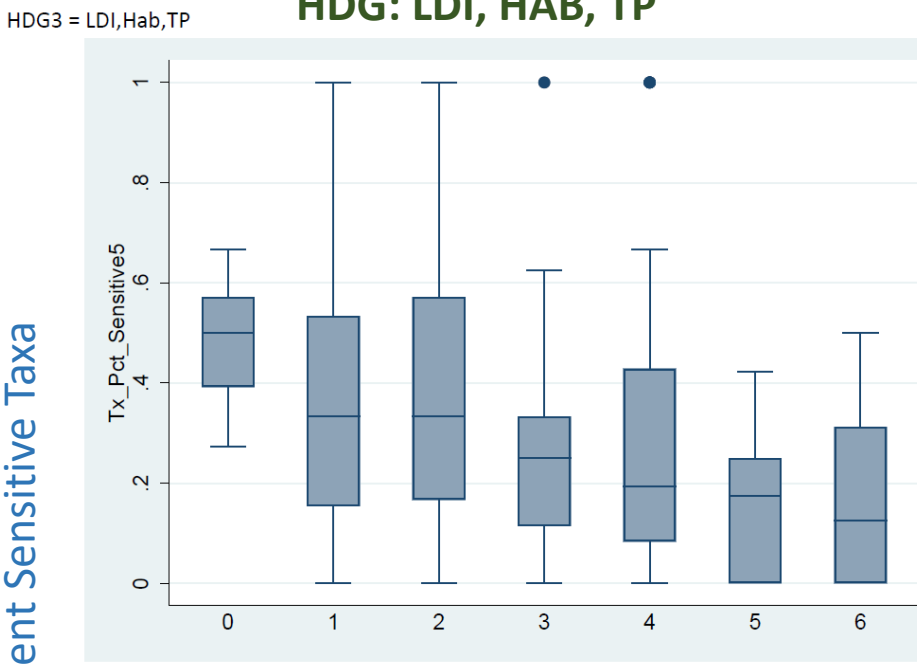
Step 2-use HDG to evaluate potential new LVS metrics (and existing)

Potential Metrics Tested

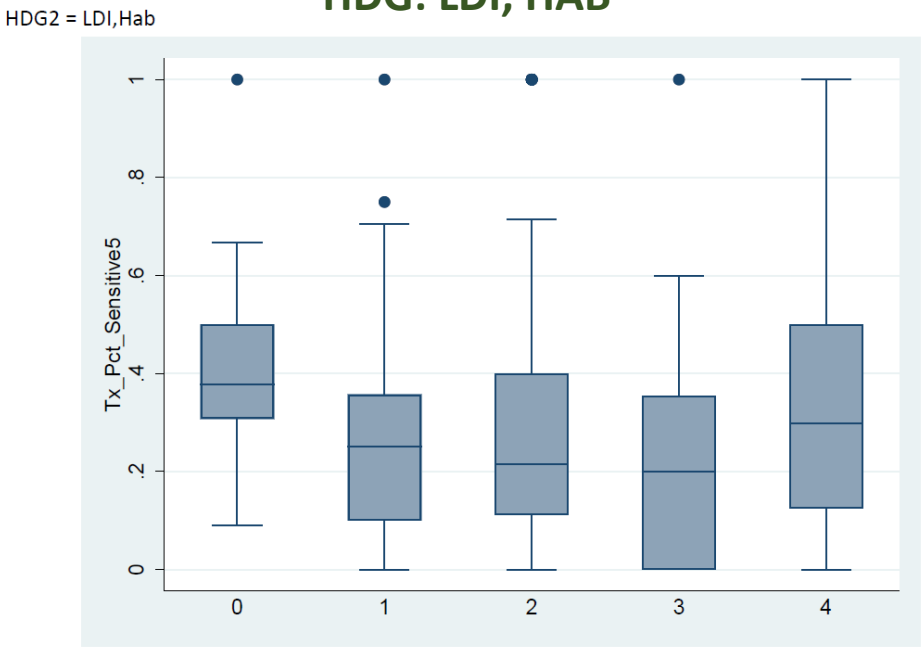
- Total Taxa
- % Native
- % Sensitive (CC=5)
- % Sensitive (CC=4)
- % Tolerant
- Maximum Dominant CC
- Shannon Diversity
- Brillouin Diversity
- Average CC
- % FLEPPC

All Y Axes Percent Sensitive Taxa

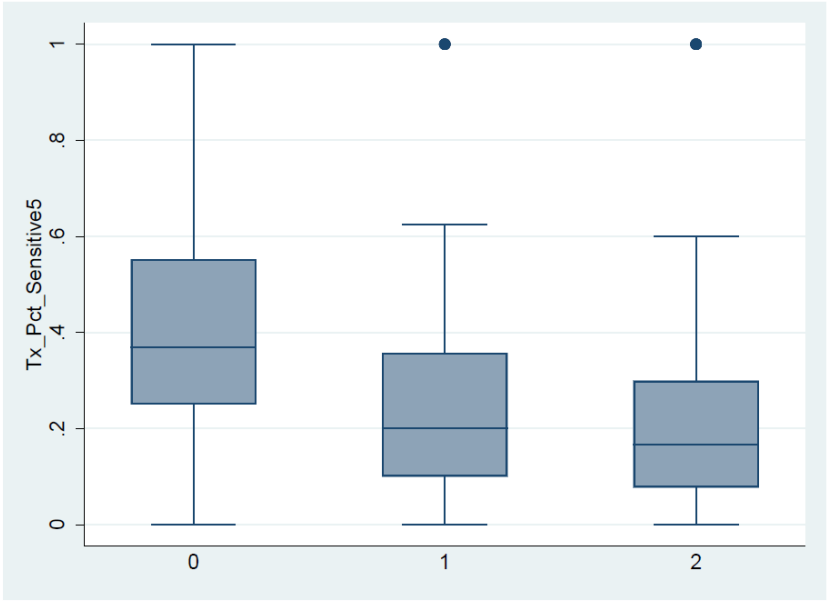
HDG: LDI, HAB, TP



HDG: LDI, HAB



LDI only



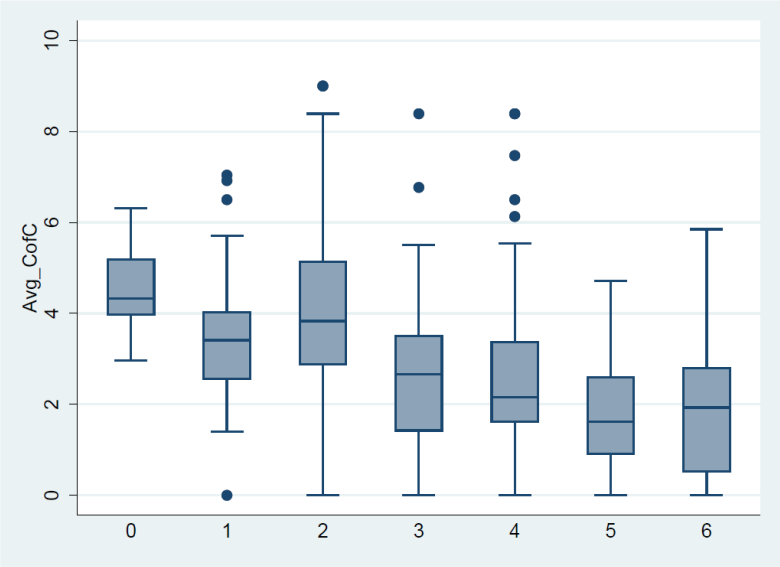
- *Examples are % Sensitive vs iterations of HDG*
- ***Takeaway: LDI alone is a better indicator of human disturbance than other HDG iterations***

Average CC vs iterations of HDG

All Y Axes AVG CC

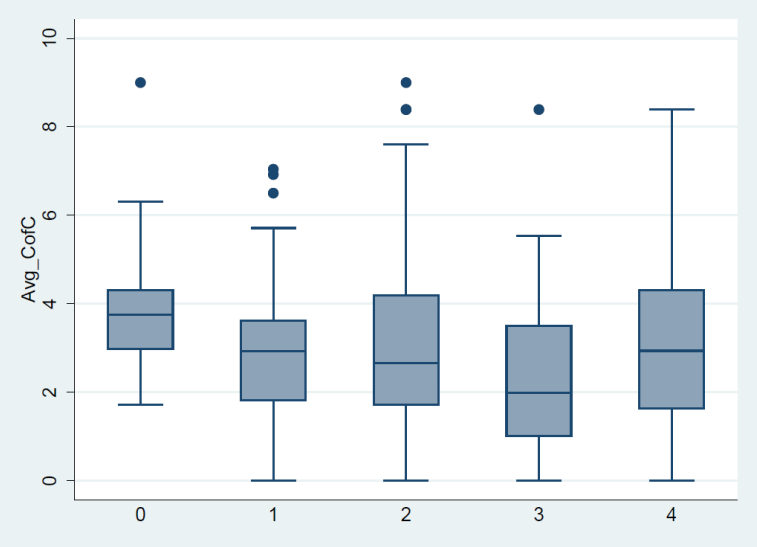
HDG: LDI, HAB, TP

HDG3 = LDI, HA, TP

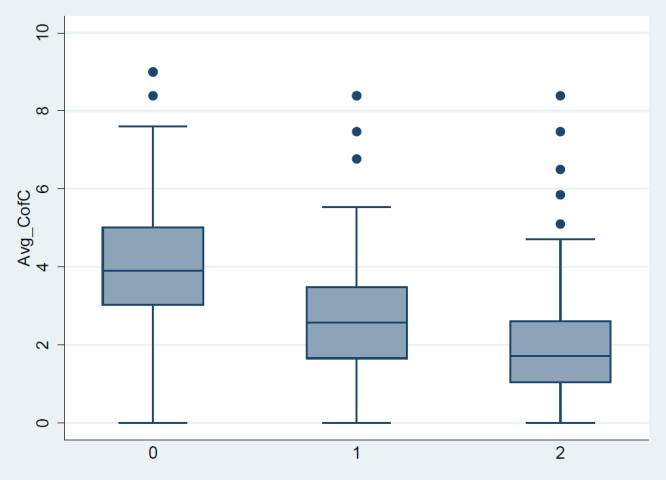


HDG: LDI, HAB

HDG2 = LDI, HA



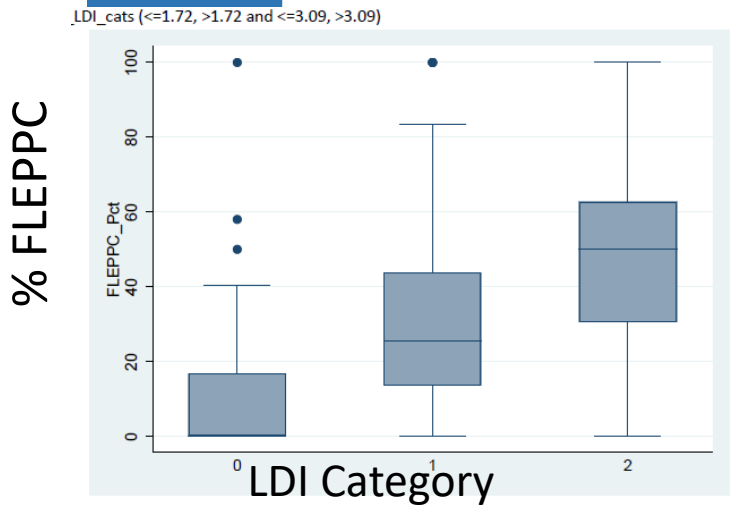
SBIO_LDI_cats (<=1.72, >1.72 and <=3.09, >3.09)

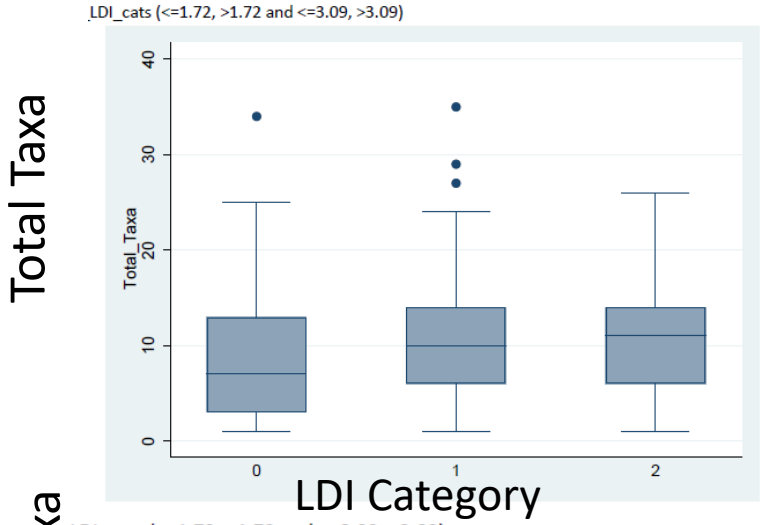


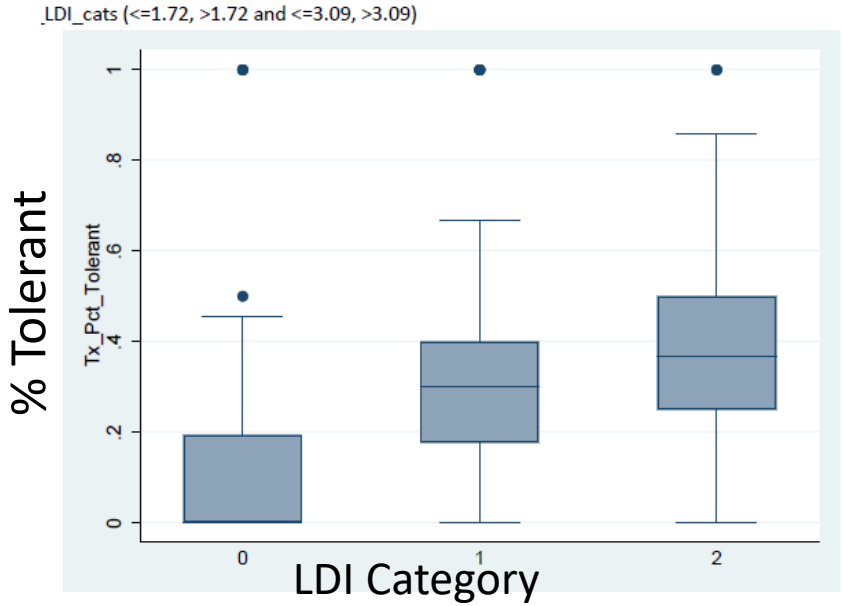
LDI only

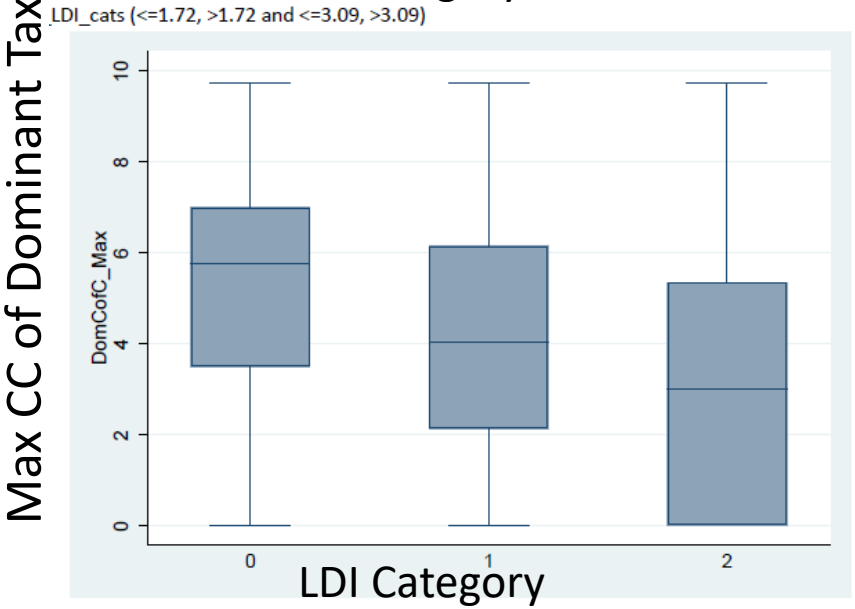
- *Examples are AVG CC vs iterations of HDG*
- ***Overall, AVG CC was best performing biological variable, and % FLEPPC was similar***

Various metrics vs. LDI by category









Analysis-Multivariate

***Step 1**--Do sites group based on their biological structure (taxonomic composition)?*

- *Bray-Curtis similarity, flexible grouping and SIMPROF (in Primer)*

***Step 2**--Which environmental factors are driving that community structure?*

- *nMDS, Principal Components Analysis*

Preliminary findings:

- *Panhandle West region is different taxonomically*
- *This difference not clearly associated with nutrients (or other environmental variables)*

Additional Work

In Progress

- *Additional data (2016-2019, and some filled gaps); total of 762 >2m², and 1168 <2m²*
- *Can the Kieffer physiography categories (highlands, flatwoods, karst) OR trophic status (autotrophic vs. heterotrophic) explain whether a site is ≥2m², <2m², or variable?*
- *When sites are grouped by their spring influence—springs-dominated, springs-influenced, or no influence, is there a stronger signal between AVG CC or % FLEPPC and nutrients?*
- *Investigate "within site variability" using sites that have multiple samples. For example, the coefficient of variation, range, etc. for the nutrient variables to see how variable they are.*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