Macroinvertebrates of Canals, Streams, and Wetlands of SW Florida: A Rapid Field Assessment and Multivariate Approach for Community Analysis and Identifying Indicator Taxa

David W. Ceilley[1] and Edwin M. Everham, III[2]

[1] Johnson Engineering Inc. Ft Myers, FL. [2] Florida Gulf Coast University

Abstract: Between 2002 and 2013 macroinvertebrate communities of wetlands, canals, and stream habitats of southwest Florida were collected using standardized techniques with D-frame dip nets from all major habitats for a period of one hour, which was found to approximate the asymptote of the species accumulation curve. Samples were field sorted using a white sorting tray, forceps and an eyedropper and preserved in 80% ethanol and returned for laboratory identification to the lowest practical taxonomic level using taxonomic keys for Florida and a 10x-60x stereo-zoom microscope. For most organisms we confirmed identification to genus or species and entered into to Excel and PRIMERv6 for univariate diversity metrics and multivariate analysis based on Bray-Curtis similarity, using hierarchical cluster analysis, SIMPROF, MDS, SIMPER, ANOSIM tools in PRIMERv6. We evaluated communities at canals and streams at Babcock Ranch in Charlotte and Lee Counties, the tributaries of Estero Bay in Lee County, and wetlands and canals of Picayune Strand, Fakahatchee Strand, and Florida Panther NWR in Collier County, FL. Macroinvertebrate communities from impacted wetlands were significantly different than reference wetlands based on random permutation tests in SIMPROF and ANOSIM. Reference sites showed high Bray-Curtis similarity and grouped tightly in the cluster analyses and MDS ordinations while impacted sites (wetlands and streams) showed high dissimilarity to reference sites and low similarity to other impacted sites. Restored wetlands exhibited macroinvertebrate community structure that were more similar to reference sites with trajectories in MDS ordination space indicating recovery of wetland functions. SIMPER analysis was used to identify species contributions to dissimilarity between groups and to identify indicator taxa for hydrologic restoration projects at both Picayune Strand and Babcock Ranch. Macroinvertebrate communities were found to respond very quickly to hydrologic restoration activities and therefore serve as performance measures of wetland restoration success. Macroinvertebrate communities were found to be significantly different between natural streams and canals in Lee and Charlotte Counties which was attributed to differences in habitat structure, water quality, and topography. Range extensions for several aquatic insects were documented from the aquatic faunal surveys between 2002 and 2013 at Babcock Ranch, Picayune Strand, Fakahatchee Strand and Florida Panther NWR. In the Estero Bay tributaries assessments, macroinvertebrate communities were associated with water quality and habitat structure. In the canals of Picayune Strand, macroinvertebrates were very similar to those found in borrow pit ponds with good water quality and significantly different from those collected from the various wetland habitats in adjacent lands. The use of rapid field assessment methods together with lab identification and multivariate analysis are proposed as a cost-effective approach for biological monitoring of aquatic habitats, identification of indicator taxa, and documenting changes in community structure over time in response to disturbance, water quality and restoration activities. Together these studies are believed to have implications for the development of wetland restoration performance measures and bio-criteria for canals and streams of the western Everglades ecoregion.

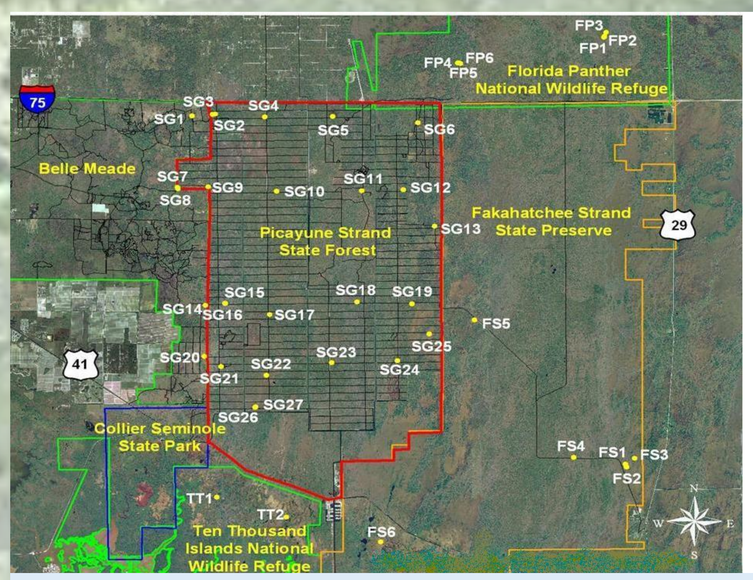
Primer v6 (Clarke and Gorley 2006)

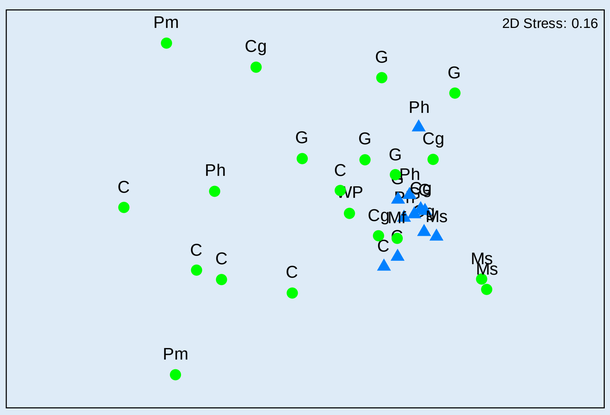
Univariate Diversity Metrics;

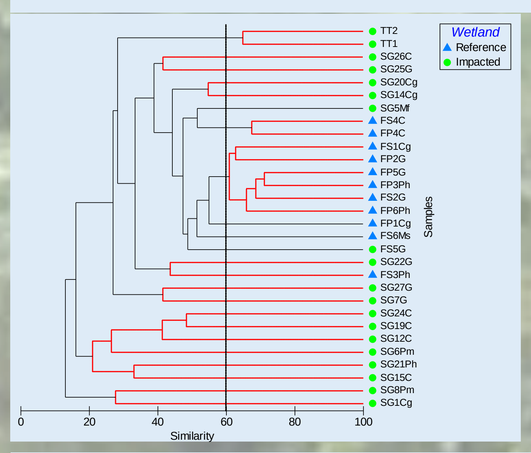
- Species Richness
- Pielou's Eveness
- Simpson's Index
- Shannon Diversity

Multivariate Analysis

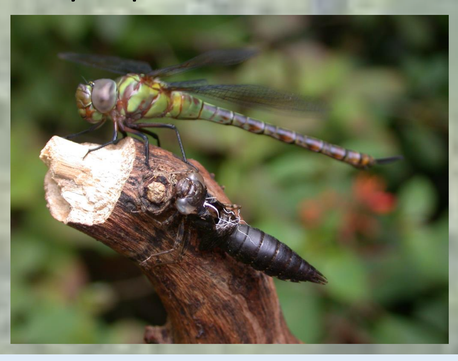
- Bray-Curtis Similarity (species assemblages)
- Hierarchical Agglomerative Cluster Analysis
- MDS ordination
- SIMPROF test: significance of clusters
- SIMPER test: rank species contributions
- ANOSIM test: (multivariate analog of ANOVA)







Hydroperiod Indicators



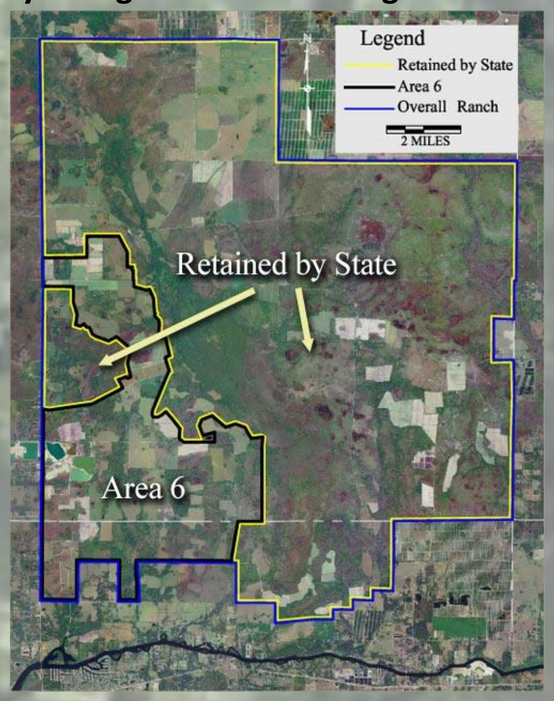
Picayune Strand Restoration Project: PSRP Baseline 2005-07

- Timed (1-hour) dip net sampling, picking substrates, and field sorting & Lab ID to lowest practical taxa level. (qualified & experience aquatic ecologists)
- Cypress (C) , cypress graminoid (Cg), wet prairie (G), hydric pine (Ph/Pm), and marshes (Mf or Ms) .
- 32 impacted sites in Picayune Strand & 11 reference sites in Fakahatchee, Florida Panther NWR, & 10,000 Islands NWR
- Sampled 3 times/year during wet season for two years
- 7,123 individual macroinvertebrates identified: 6 Classes, 20 Orders, 57 families, and 182 taxa
- Significant difference between impacted & reference wetlands; Several indicator species were identified for monitoring restoration success through time (Ceilley 2008).

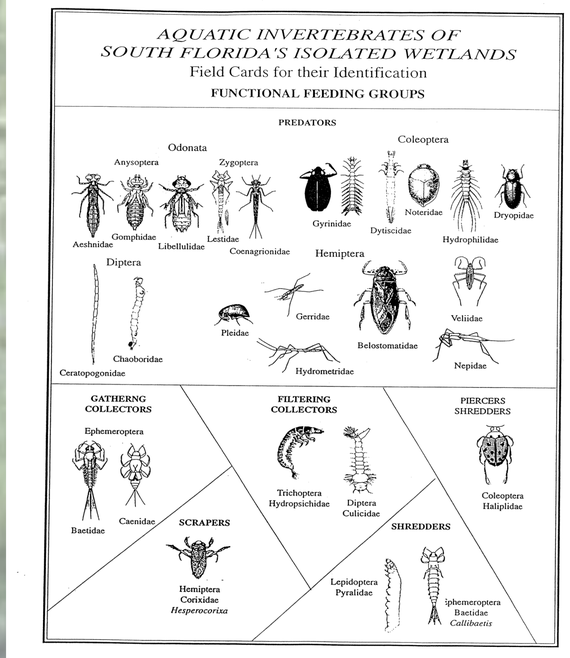
Rationale for Using Macroinvertebrates in the Assessment of Aquatic Habitat

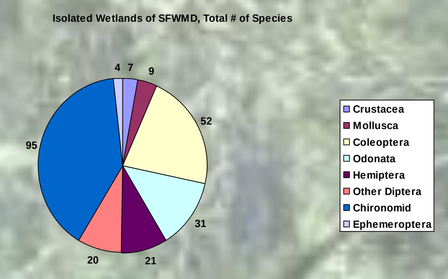
1. Important trophic linkages (CERP models) & multiple functional feeding groups
2. History as stream condition & WQ indicators (Florida SCI, IBI, Bio-recon)
3. Community sensitivity: hydrology and habitat change
4. Indicator species: (WQ, hydroperiod, habitat)
5. Cost-effective, simple & repeatable methods

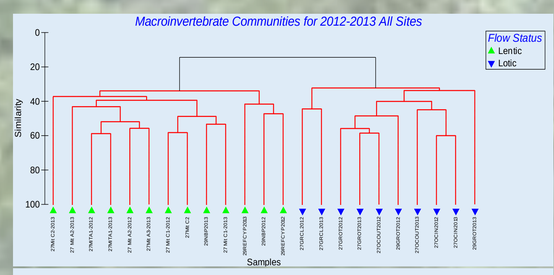
Babcock Ranch Purchase in 2006
Hydrologic Restoration began in 2012

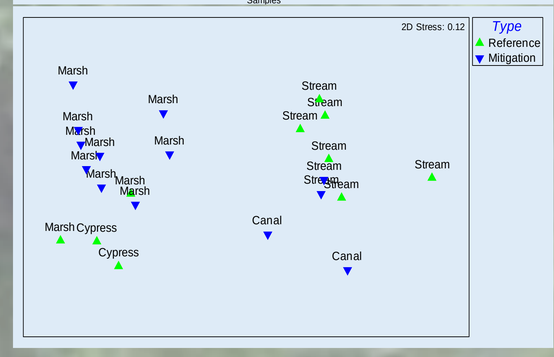


Similarity Percentage (SIMPER) Test & differences between Streams and Canals at Babcock Ranch

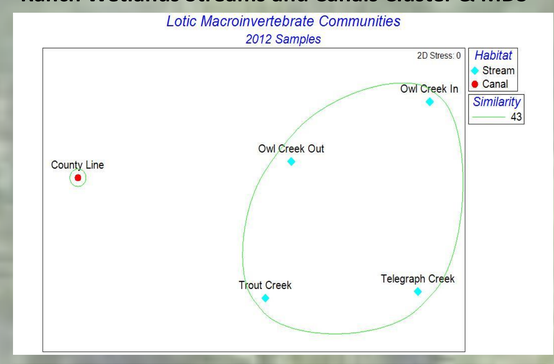








Macroinvertebrate Community Analysis at Babcock Ranch Wetlands Streams and Canals Cluster & MDS



SIMPER Results	Stream	Canal		
Species	Av.Abund	Av.Abund	Contrib%	Cum.%
Melanoides tuberculata	0	3.87	7.53	16.49
Corbicula	0.25	3	5.37	21.86
Stenacron sp.	1.15	3.87	5.23	27.09
Dineutus	2.75	0	5.2	32.29
Pseudocloeon sp.	3.19	1.73	4.58	36.87
Hyalella group	2.29	0	4.23	41.1
Stenelmis sp.	2	0	3.72	44.82
Caenis spp.	3.23	5	3.5	48.33
Tanypodinae	0.6	2.24	3.14	51.47
Palaemonetes	1.58	0	3.03	54.5
Stenonema exiguum	1.52	0	2.81	57.32
Simulium sp.	1.33	0	2.75	60.07
Enallagma cardenium	1.77	3.16	2.69	62.75
Hirudinea	1.28	0	2.3	65.06
Eupera cubensis	1.25	0	2.3	67.35
Arigomphus pallidus	0	1	1.95	69.3

Red Font = Non-native Taxa
Blue Font = DEP Sensitive Taxa