Evaluation of macroinvertebrate communities in restored (enhanced), re-established, and reference wetlands in North Carolina

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Part of an overall joint agency project:

Assess effectiveness of restoration techniques in supporting aquatic biota, ie. amphibians and macroinvertebrates

Data collected 2013-2015

- macroinvertebrate data 2013/2014

Closed Canopy Reference Sites (4)

Block O

Pulpwood Pond

Re-establishment/Mitigation Sites (4)

Parker Farms (oldest site - 17 years post-planting)

Dover Bay – 10 years post-planting

Open Canopy Reference Sites (4)

17 Frog Pond

Tiger Pond

Enhancement/ WRC Restoration Sites (4)

Closed-canopy Pond – 2009
Little Little Dismal Pond

Vegetation cleared with equipment - 2010

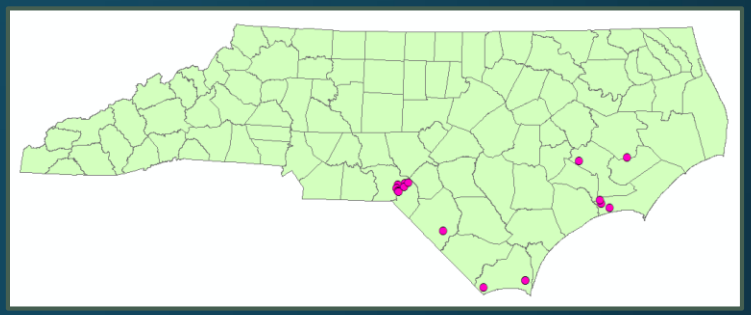
Summer controlled burn - 2011

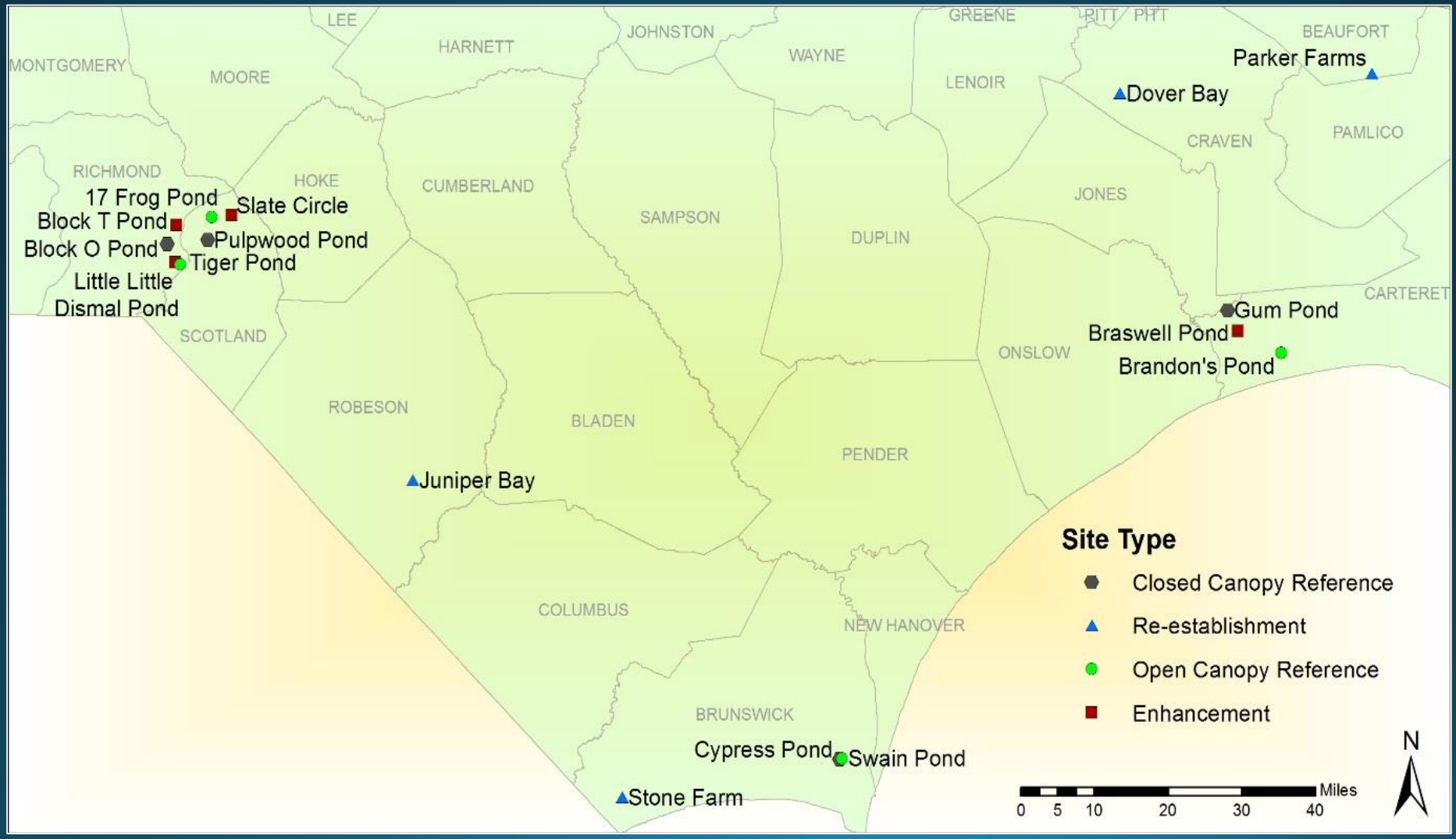
High-quality habitat
restored – 2011

Photos by Jeff Humphries

Enhancement/ WRC Restoration Sites (4)

Little Little Dismal -- Fall 2015




LEE
HARNETT
JOHNSTON
GREENE
PITT
PITT
BEAUFORT
MONTGOMERY
MOORE
WAYNE
LENOIR
Parker Farms
Dover Bay
CRAVEN
PAMLICO
RICHMOND
HOKE
CUMBERLAND
SAMPSON
DUPLIN
JONES
17 Frog Pond
Slate Circle
Block T Pond
Pulpwood Pond
Block O Pond
Tiger Pond
Little Little
Dismal Pond
CARTERET
Gum Pond
Braswell Pond
Brandon's Pond
SCOTLAND
ONSLOW
ROBESON
BLADEN
PENDER
Juniper Bay
COLUMBUS
NEW HANOVER
BRUNSWICK
Cypress Pond
Swain Pond
Stone Farm
Site Type
Closed Canopy Reference
Re-establishment
Open Canopy Reference
Enhancement
N
Miles
0 5 10 20 30 40

Macroinvertebrate sampling in spring 2013 & 2014

Sweeps, bucket samples

Bottomless bucket sampler

D-frame sweep net

Additional Data Collected

- rapid assessments (NC WAM,

  Ohio RAM)
- landscape setting
- vegetation structure, in wetland and buffer
- water quality meter

  (pH, specific conductivity, temp.)
- hydrology monitoring with wells
- amphibian sampling

Little Little Dismal, enhancement site

Macroinvertebrates

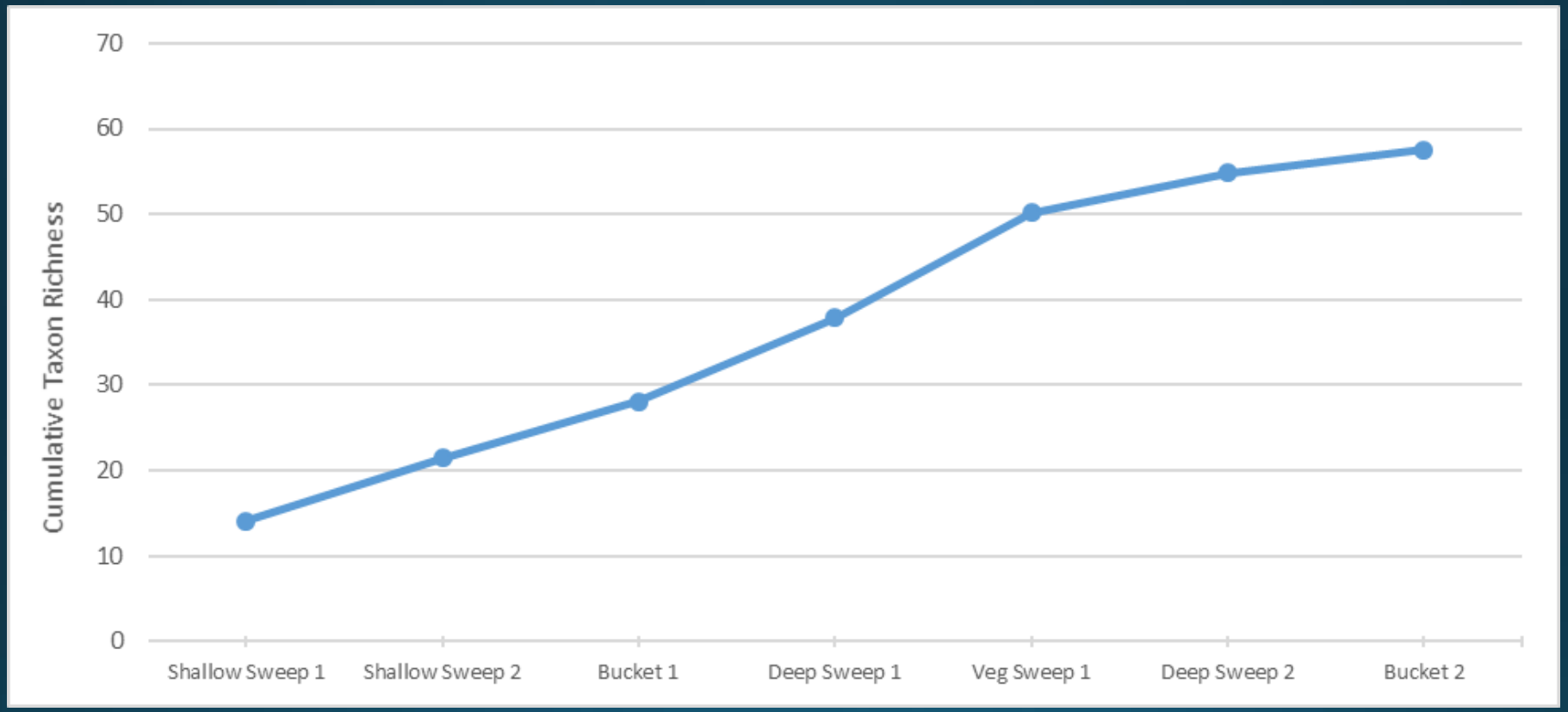
Larry Eaton

- 110 samples collected
  16 wetlands, 2 years
- 30,033 individuals (304 distinct taxa) identified – incredible # of expert manhours

Sampling method analysis

	Shallow Sweep 1	Shallow Sweep 2	Bucket 1	Bucket 2	Deep Sweep 1	Deep Sweep 2	Veg Sweep 1
2013							
17 Frog Pond	X	X	X				
Block O	X		X	X			
Block T	X	X	X				X
Brandon's Pond	X	X	X				
Braswell Ponds	X		X				
Cypress Pond	X	X	X		X	X	
Dover Bay	X		X	X	X	X	X
Gum Pond	X	X	X	X			
Juniper Bay	X	X	X	X	X		
Little Little Dismal	X	X	X		X	X	
Parker Farms	X	X	X	X			
Pulpwood Pond	X		X				
Slate Circle			X				
Stone Farm	X	X	X	X	X		X
Swain Pond	X		X	X	X	X	
Tiger Pond	X		X				
2014							
17 Frog Pond	X		X		X		
Block O	X		X				
Block T	X		X		X		
Brandon's Pond	X		X				
Braswell Ponds	X		X	X	X		
Cypress Pond	X		X		X		
Dover Bay	X		X		X		
Gum Pond	X		X				
Juniper Bay	X		X		X		
Little Little Dismal	X		X				
Parker Farms	X		X				
Pulpwood Pond	X		X		X		
Slate Circle	X		X				
Stone Farm	X		X	X	X		
Swain Pond	X		X		X		
Tiger Pond	X		X				

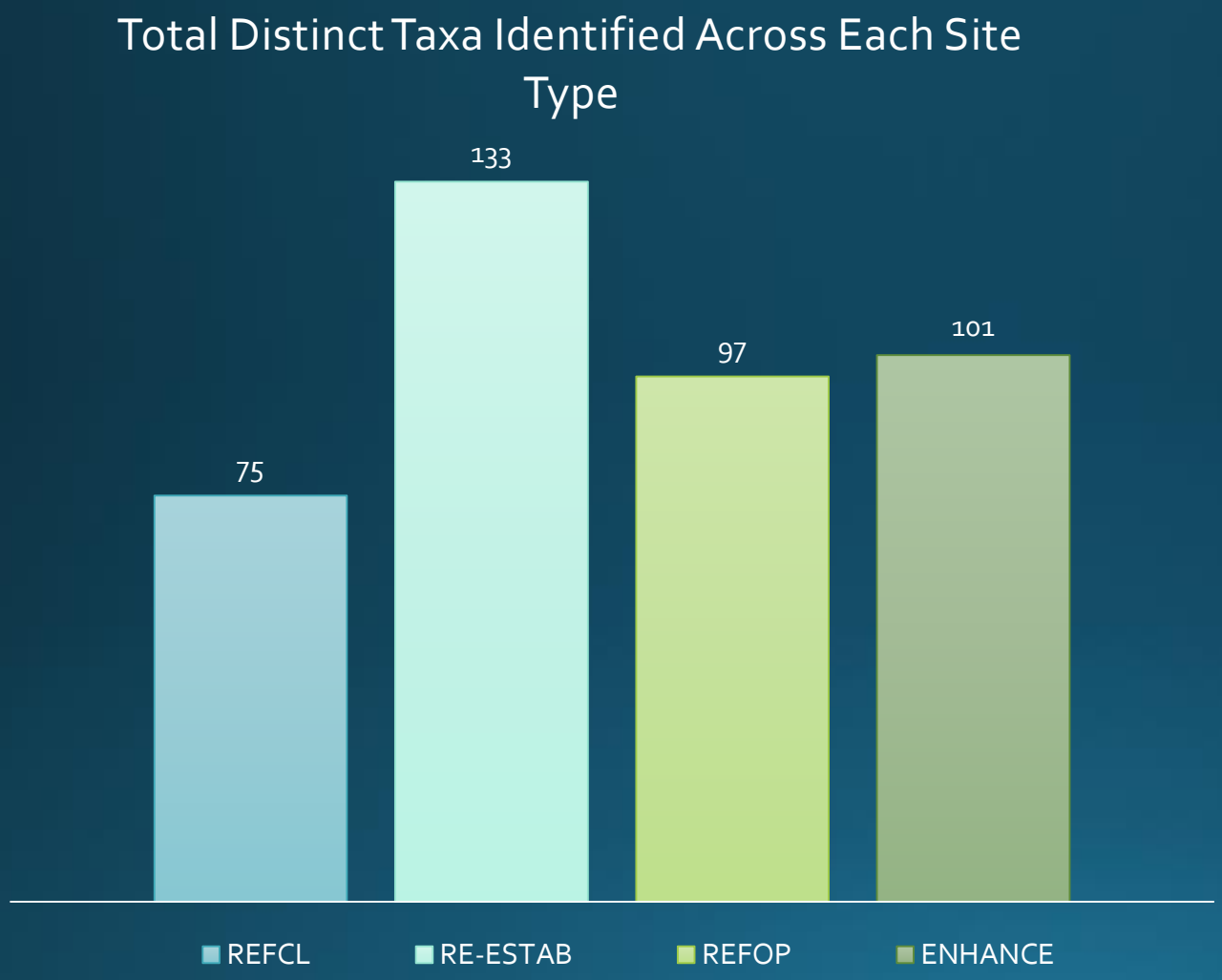
Sampling method analysis



Recommended sampling protocol –
at least 2 sweeps, 1 bucket, deep sweep where possible
Buckets useful for density analysis

For site statistics, combined one bucket sample, 1 shallow sweep (1x per yr, spring)
(full taxa lists are in report appendix)

Macroinvertebrate Richness/Diversity

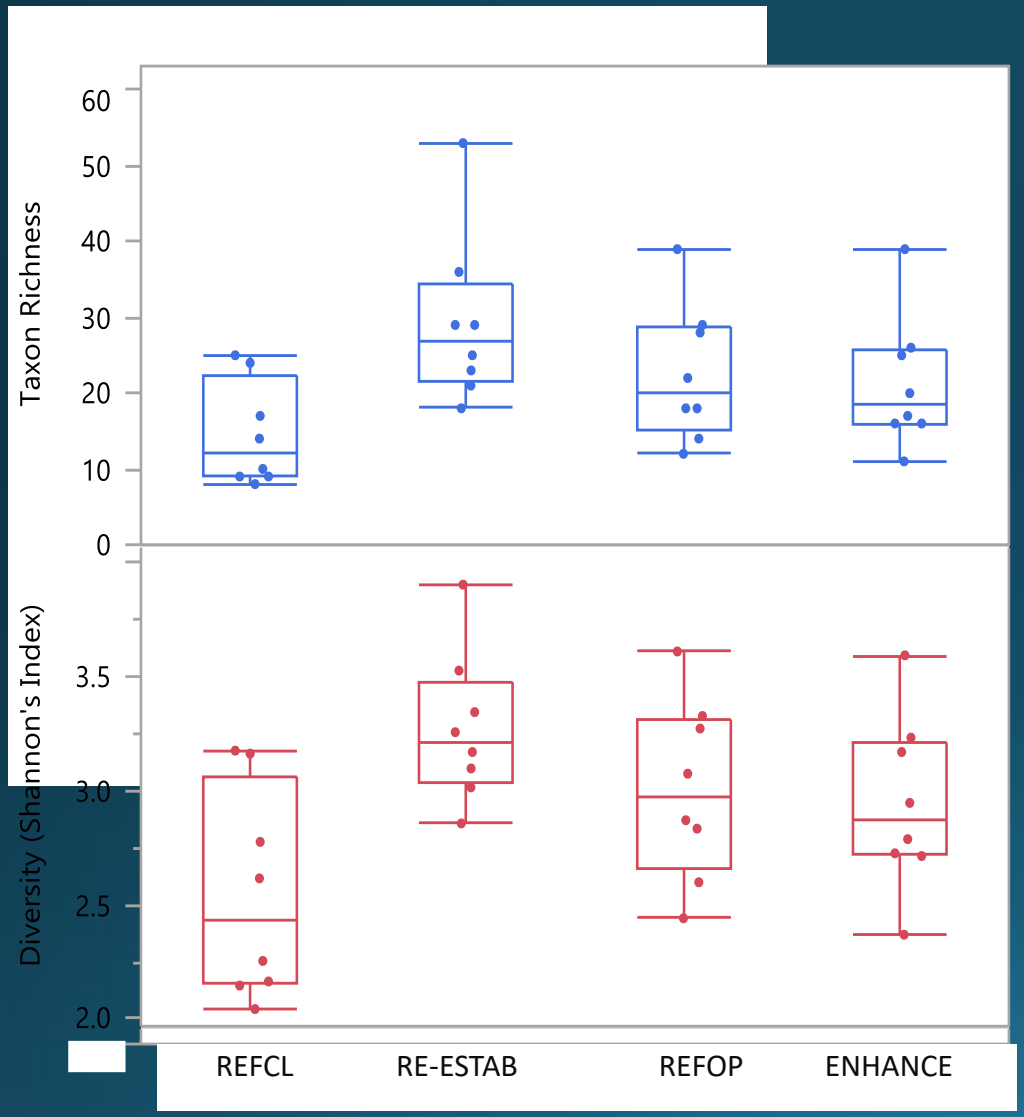


- Most abundant groups across all sites
  - Ostracoda
  - Copepoda
  - Isopoda*
  - Amphipoda*
  - Diptera
  - Odonata
  - Coleoptera

*Isopoda & Amphipoda virtually absent from REFOP sites

- Mollusca mainly just on RE-ESTAB sites (higher pH)
- Mayflies only on RE-ESTAB and ENHANCE sites, not reference

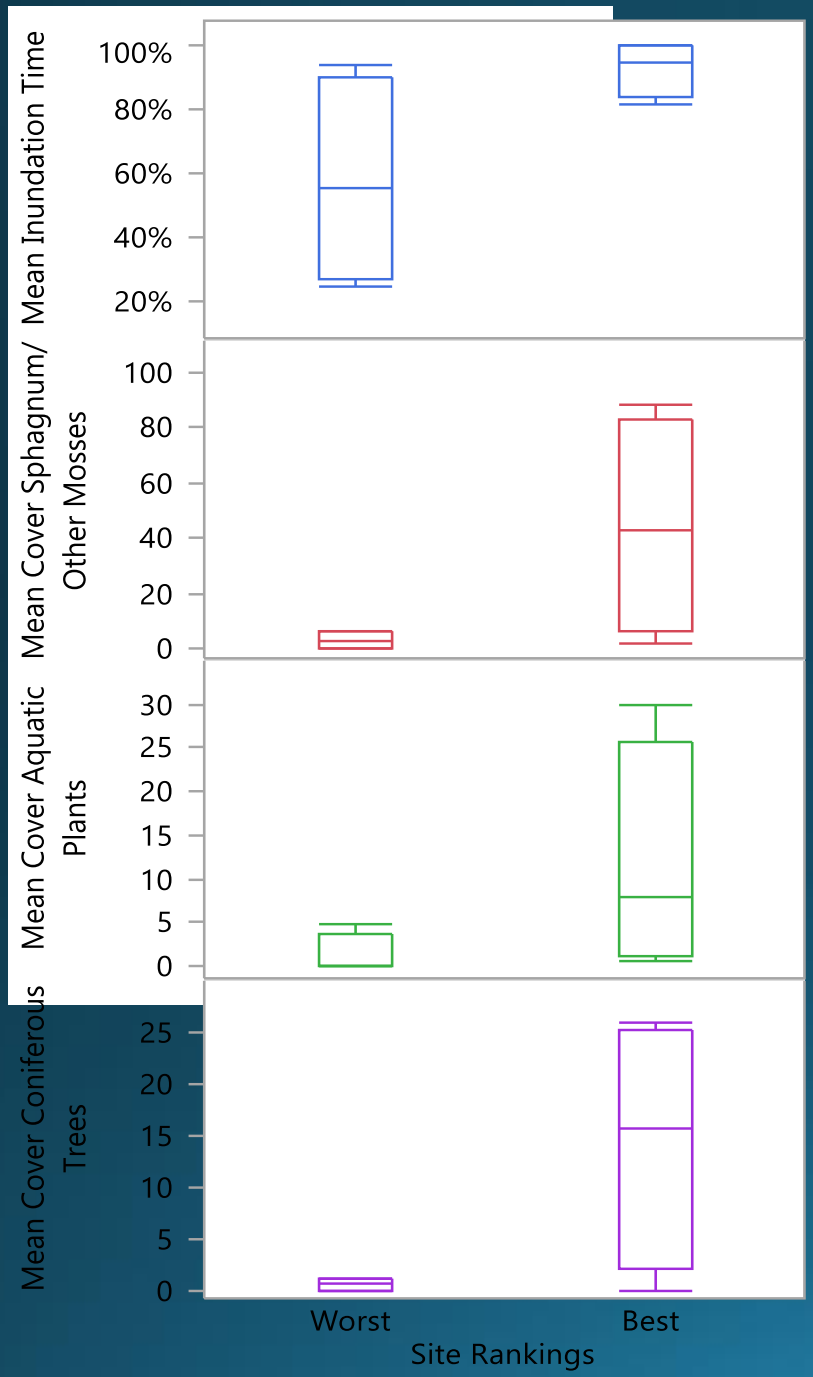
Macroinvertebrate Richness/Diversity on Individual Sites



- Several taxa were found on RE-ESTAB sites, & not other site types
  (worms, 2 beetle families)
- RE-ESTAB sites had higher abundance, richness, diversity, and density of macroinvertebrates (permanent water)

Ranking sites best to worst

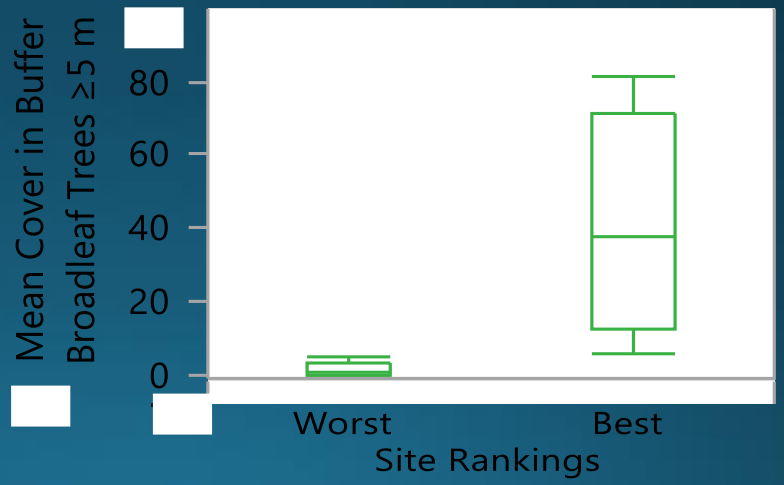
	Site Name	Site Type	Average of Total Macro Abundance	Average of Macro Taxon Richness	Abundance Rank	Richness rank	Mean Rank
Best sites	Block T Pond	ENHANCE	2123	32.5	1	3	2
	Swain Pond	REFOP	492	33.5	4	2	3
	Dover Bay	RE-ESTAB	432	37	7	1	4
	Parker Farms	RE-ESTAB	711	24	3	6	4.5
Middle sites	Cypress Pond	REFCL	325	24.5	9	5	7
	Juniper Bay	RE-ESTAB	237.5	32.5	11	4	7.5
	Brandon's Pond	REFOP	373	23.5	8	7	7.5
	Pulpwood Pond	REFCL	1169.5	12.5	2	14	8
	Braswell Ponds	ENHANCE	449	16.5	6	11	8.5
	Stone Farm	RE-ESTAB	273.5	23.5	10	8	9
	Block O Pond	REFCL	459.5	12	5	15	10
	Little Little Dismal Pond	ENHANCE	183.5	22.5	12	9	10.5
Worst sites – no RE-ESTAB sites	17 Frog Pond	REFOP	95.5	17	14	10	12
	Tiger Pond	REFOP	125.5	16	13	12	12.5
	Slate Circle	ENHANCE	80	13.5	15	13	14
	Gum Pond	REFCL	60	9	16	16	16



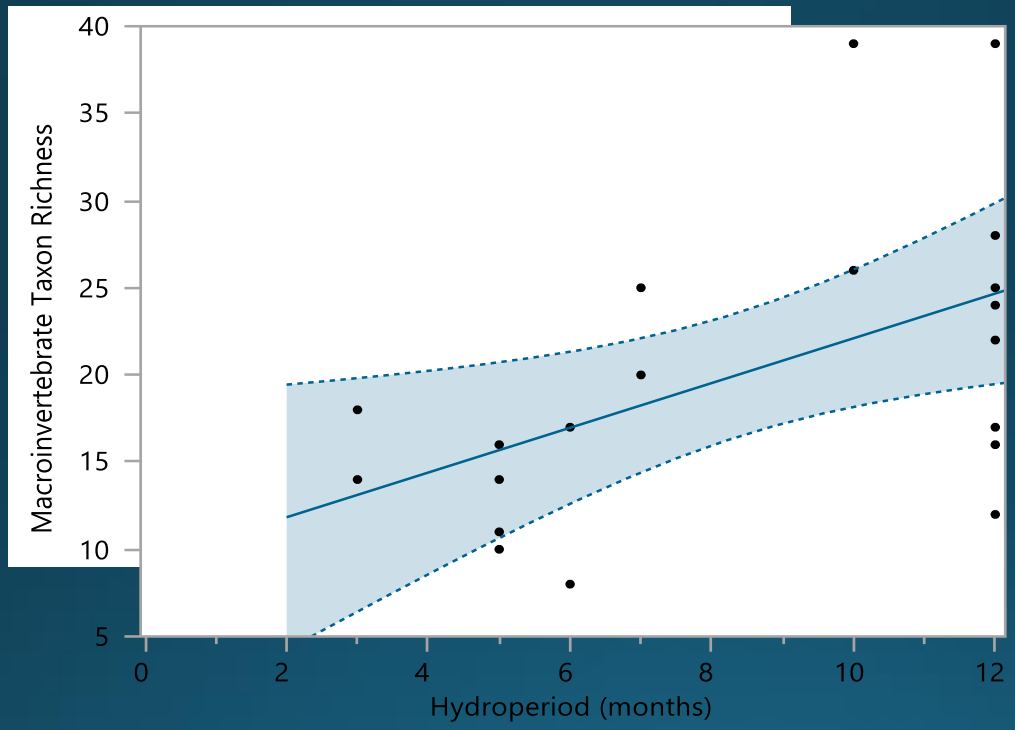
What's the difference?

Sites with lots of macros have:

- more water longer
  - (sphagnum moss)
  - (aquatic plants)
- coniferous trees
- broadleaf trees in wetland buffer
- emergent plant cover

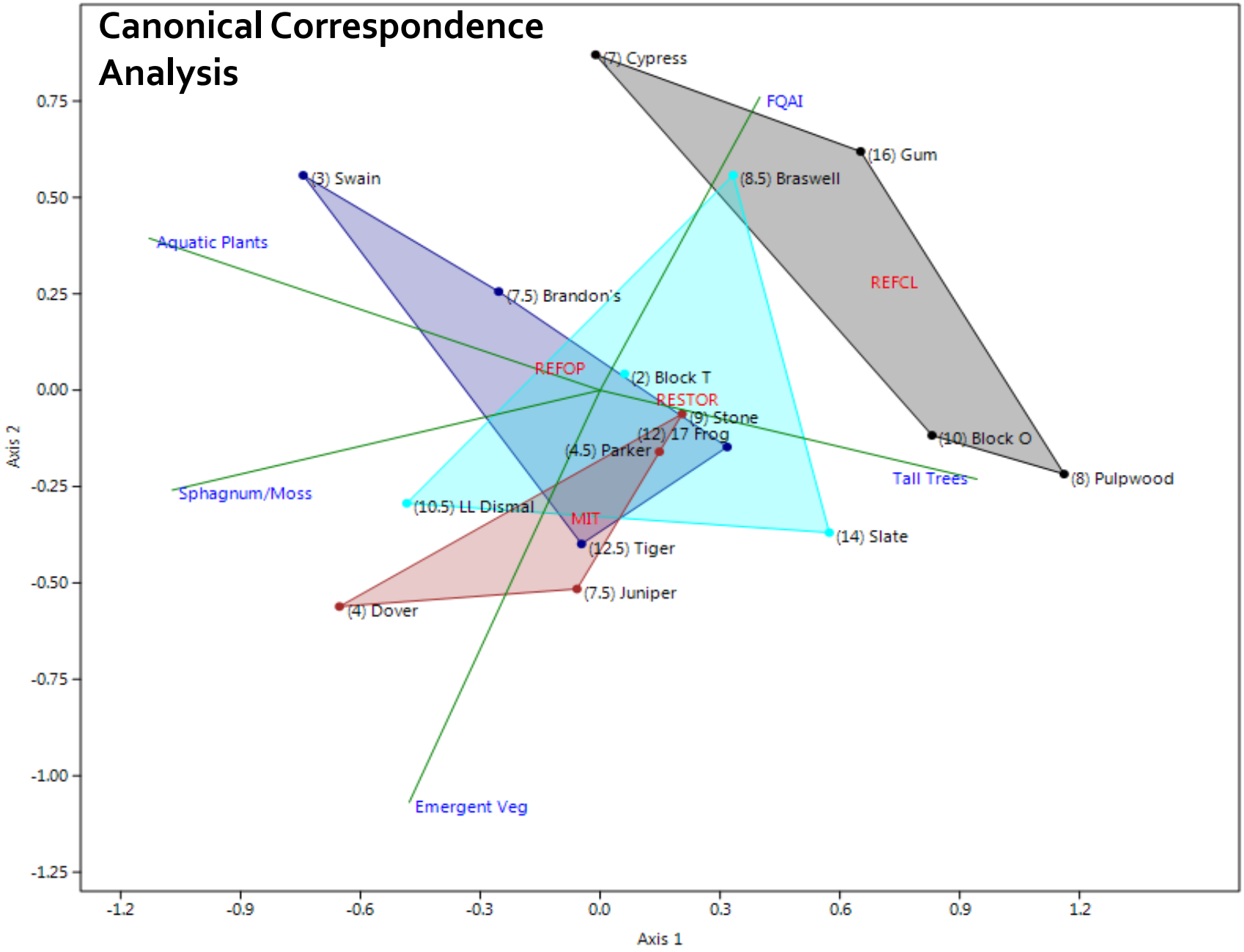


Taxon richness increased with longer hydroperiods in wetlands without fish

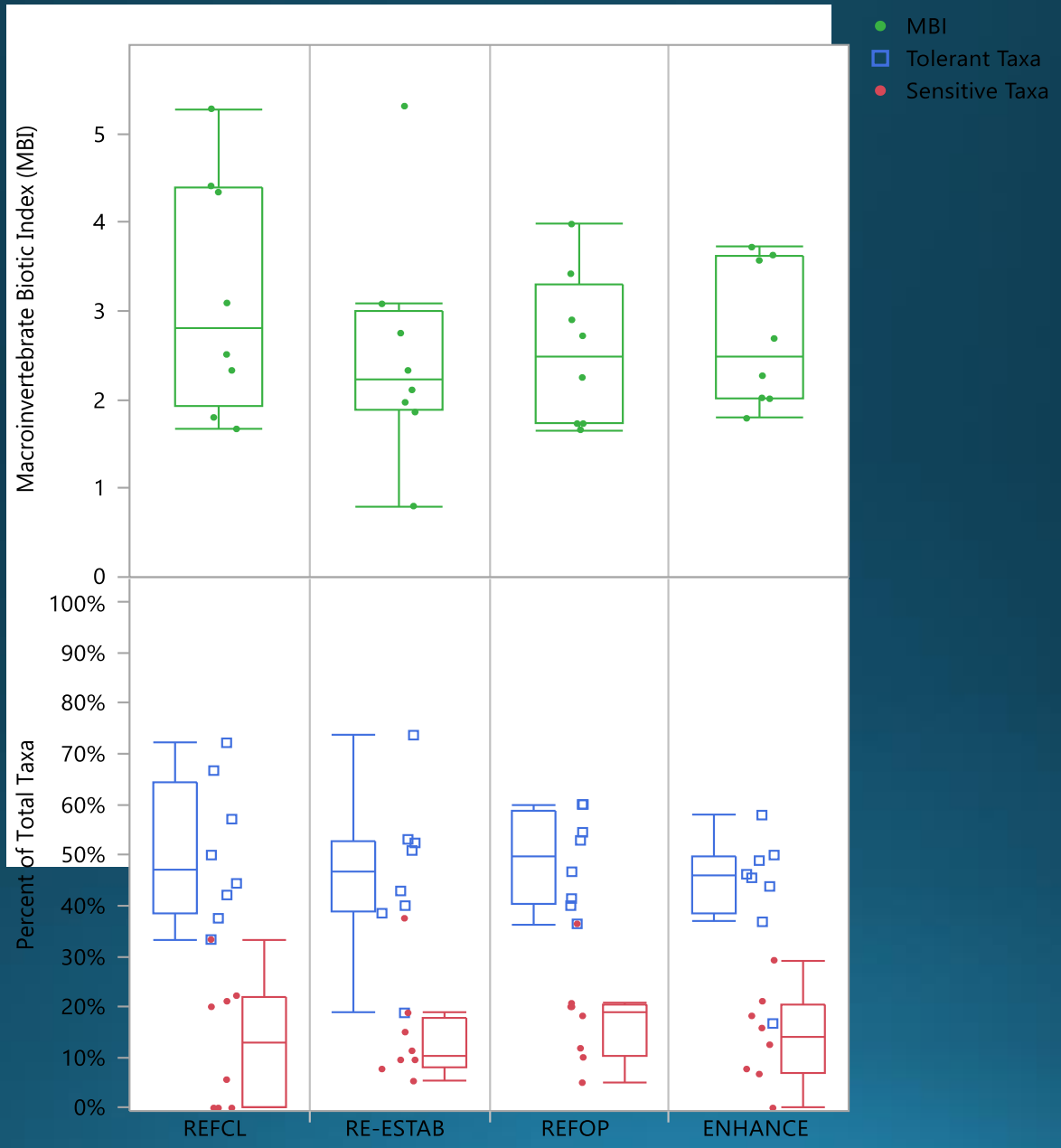


*some taxa benefit from fish; some do not

Canonical Correspondence Analysis



Macroinvertebrate Biotic Index (MBI)



Batzer et al. (2004) concluded that wetland taxa are generalists adapted to, and tolerant of, environmental variation (Danks and Rosenberg 1987, Euliss et al. 1999, Tangen et al. 2003). Variation in macroinvertebrate richness and abundance was only weakly explained by environmental variables.

Dry summer 2013

Wet summer 2014

Brandon's Pond – Croatan National Forest

Take Home Messages

- Sweeps with a bucket sample recommended for sampling
- Open canopy wetlands provided better habitat than closed canopy reference sites
- Emergent vegetation and litter input is important for macroinvertebrates
- Re-established wetlands contained taxa not found in other wetland types (mayflies and molluscs)
- Wetland taxa are more adapted to changing conditions

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