Long-term Fish Community Monitoring in the Buffalo National River

Hope R. Dodd

Heartland Inventory and Monitoring Network

National Park Service

Inventory and Monitoring Networks

Provide scientifically reliable data on ecosystem health and processes to better manage natural resources

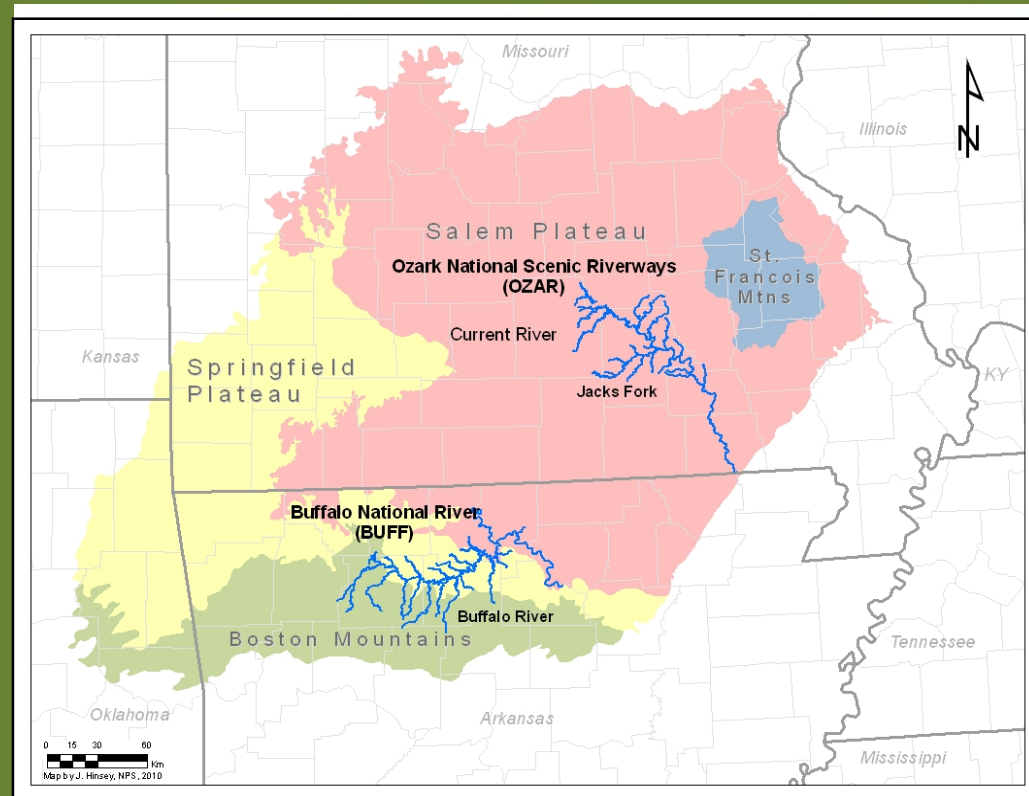## Heartland Network

- Midwest Region

- 3 Ecoregions
  - Tallgrass Prairie
  - Deciduous Forest
  - Ozark Highlands & Ouachita Mountains

- Buffalo National River (BUFF)
  - Upper: Boston Mountains
  - Middle & Lower: Springfield and Salem Plateaus

Monitoring Objectives

- Determine the status and temporal and spatial trends of fish communities within these parks

- Examine relationships between habitat and fish communities

- Correlate changes in fish communities and habitat with management regimes or land use changes
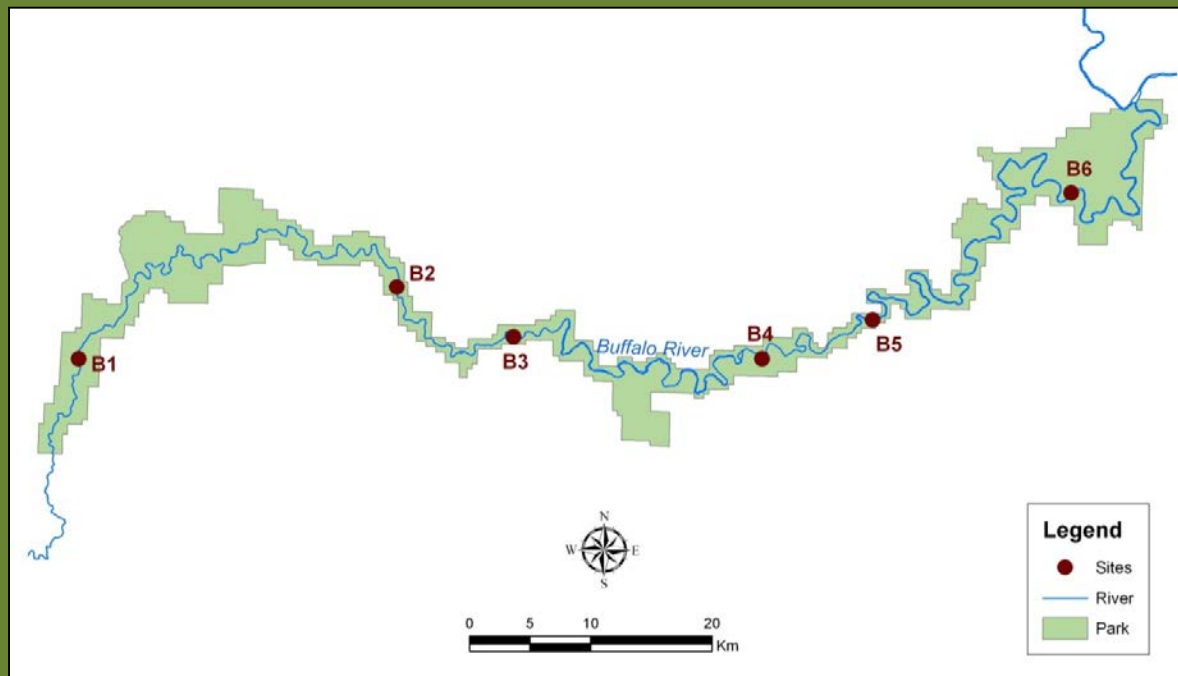
BUFF Reach Locations

Mainstem reaches:

2006- 2010: 6 randomly selected & spatially balanced sites, annually

2013-Present: same 6 sites, biennially

Tributary reaches:

2006-2010: 30 randomly selected tributaries on 5 yr rotation (6 tribs/yr)

2013-Present: 10 targeted tribs; 4 tribs, biennially; 6 tribs, every four years

Heartland Network, NPS
Data Collection

Fish

- Combination of Backpack, Towed barge, and Boat electrofishing gear
- Fish identified, counted, measured and weighed

Water quality

- Water temperature, pH, Specific Conductance, Dissolved Oxygen, Turbidity
- Collected in conjunction with fish sample at site
- Collected during 2-3 week period of fish monitoring at 3 locations
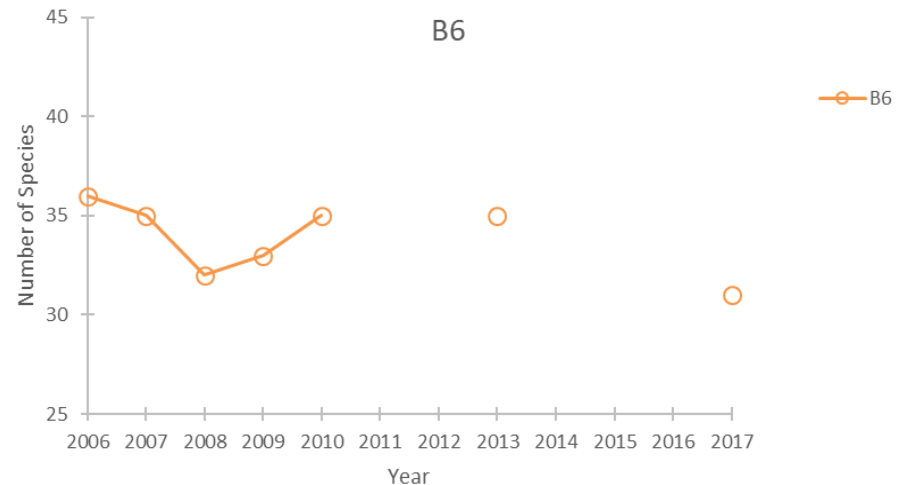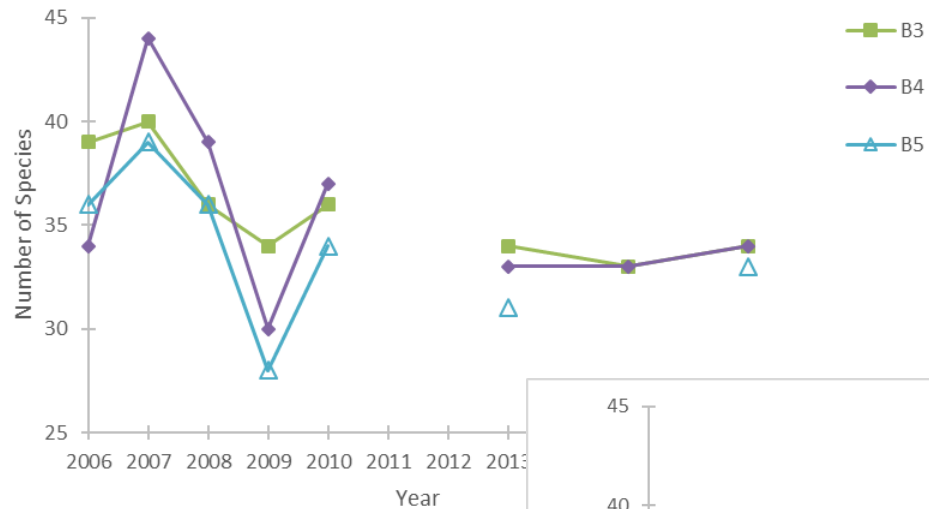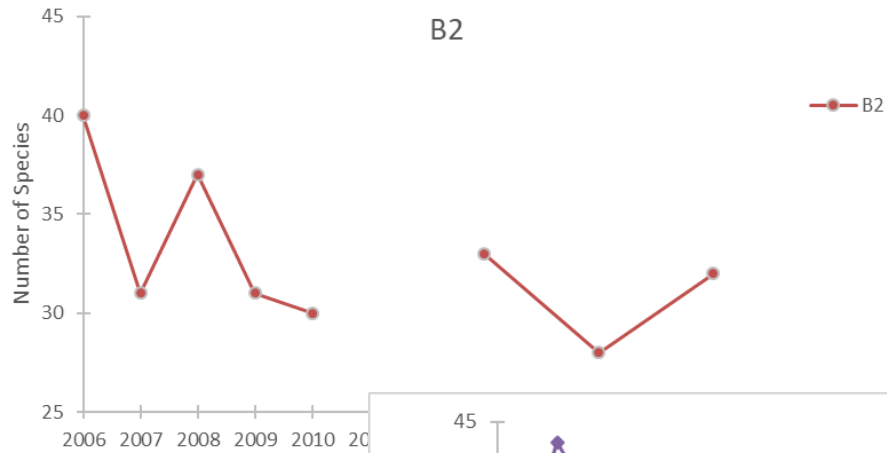
Physical Habitat

- 11 transects, 3 points per transect
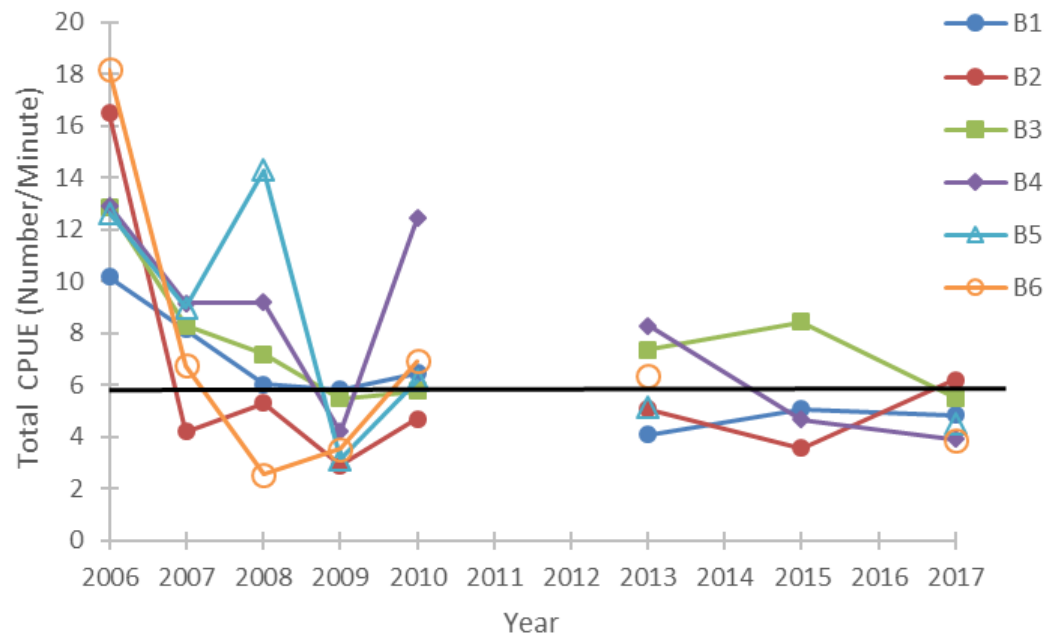- In-stream channel morphology characteristics and fish cover
- Bank stability & riparian cover

Mainstem – Species Richness
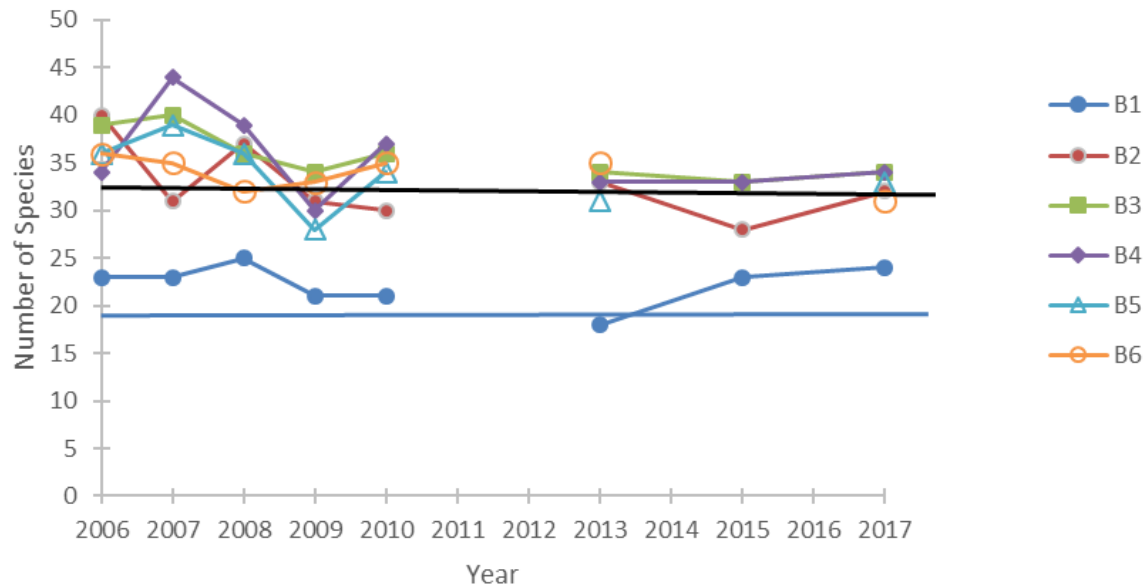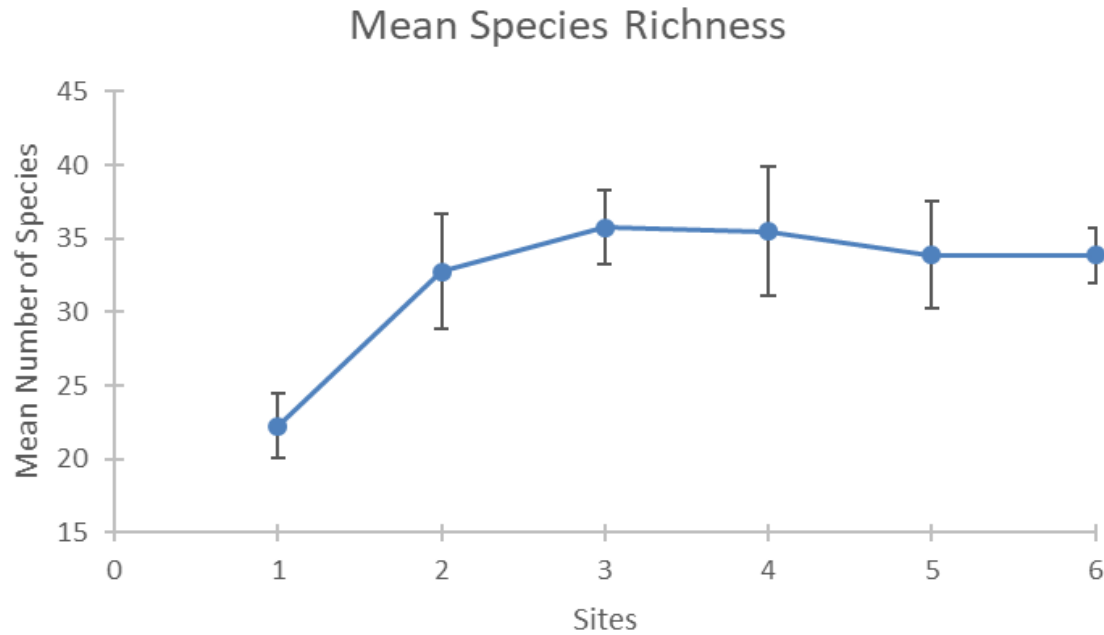
Mainstem – Species Richness

Mainstem – Abundance
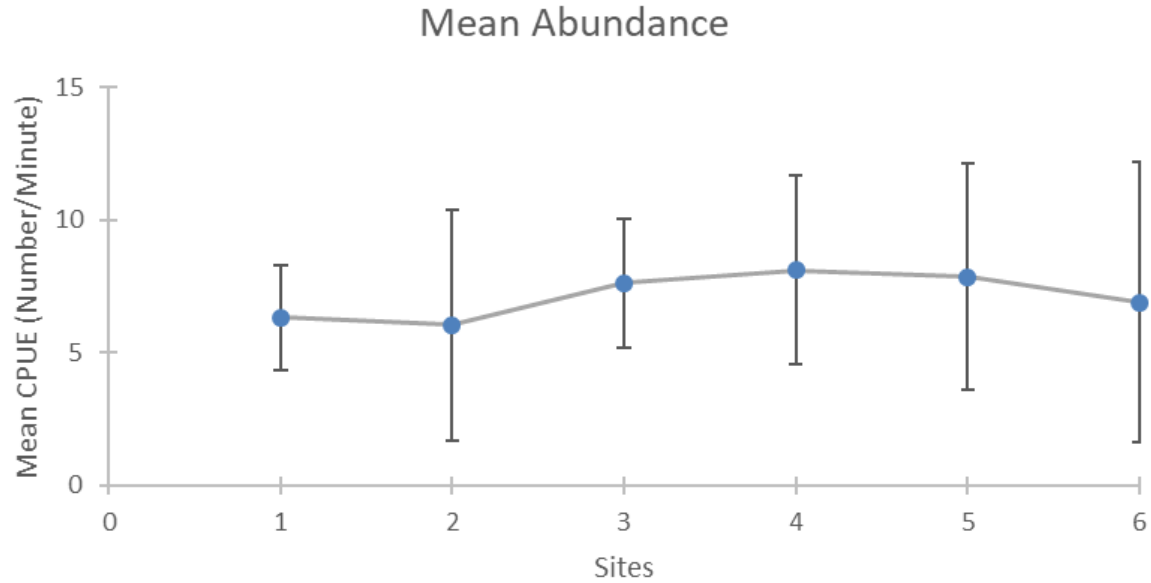
Mainstem - Abundance of Taxa Groups
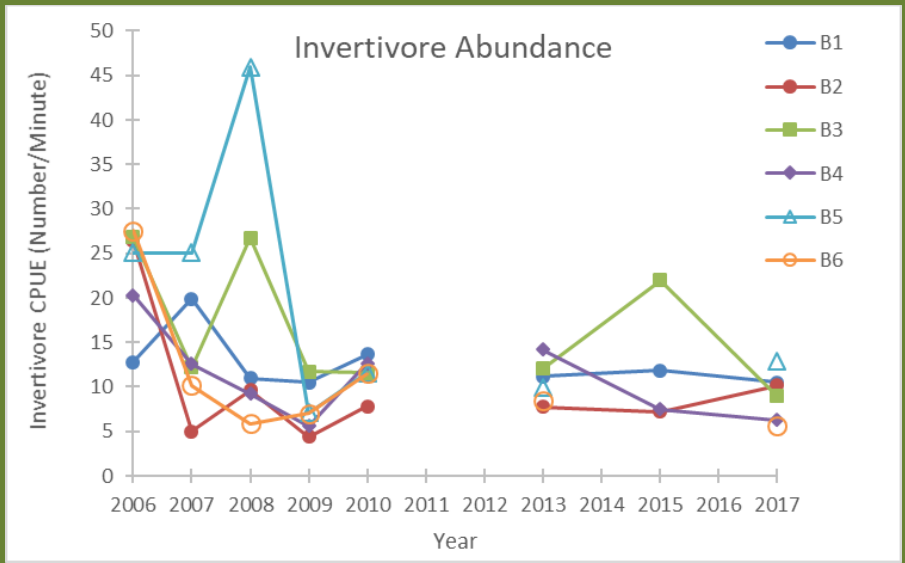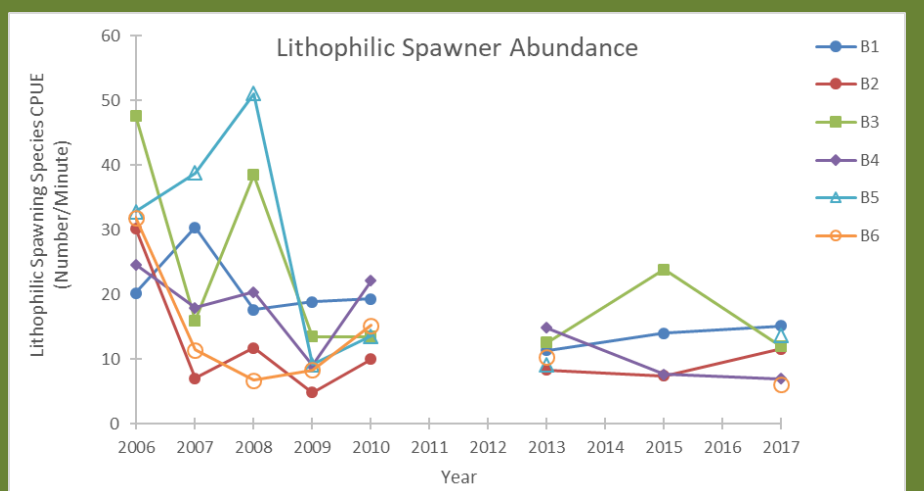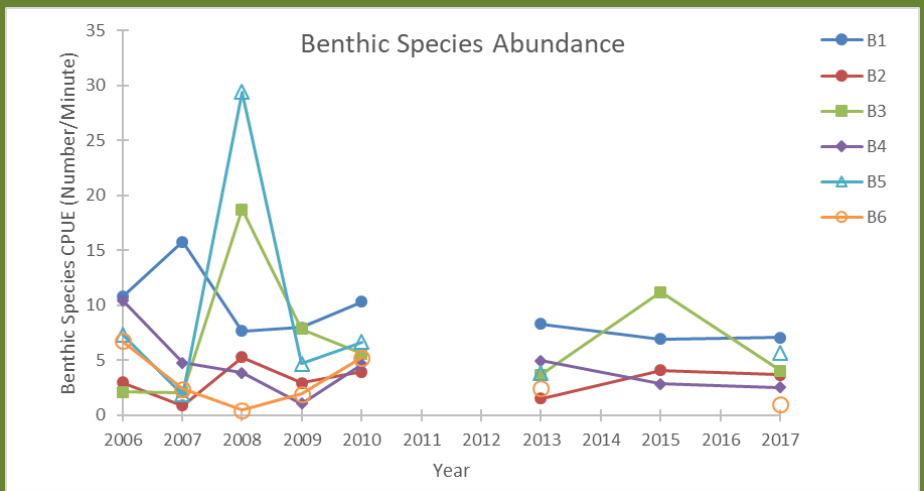
Spatial/Temporal Patterns and Habitat Correlations at Mainstem Sites

Nonmetric Multidimensional Scaling (NMS)

- BUFF Mainstem sites for 2006-2010

- Used individual species catch (log transformed); unknowns and hybrids were removed

- 3 preliminary runs to determine dimensionality

- Final NMS used Sorenson distance measure with 250 iterations

- 27 habitat parameters
  - Correlation Coefficient of 0.5 (P-value $\leq$ 0.03) used as threshold for inclusion in ordination plots

BUFF NMS
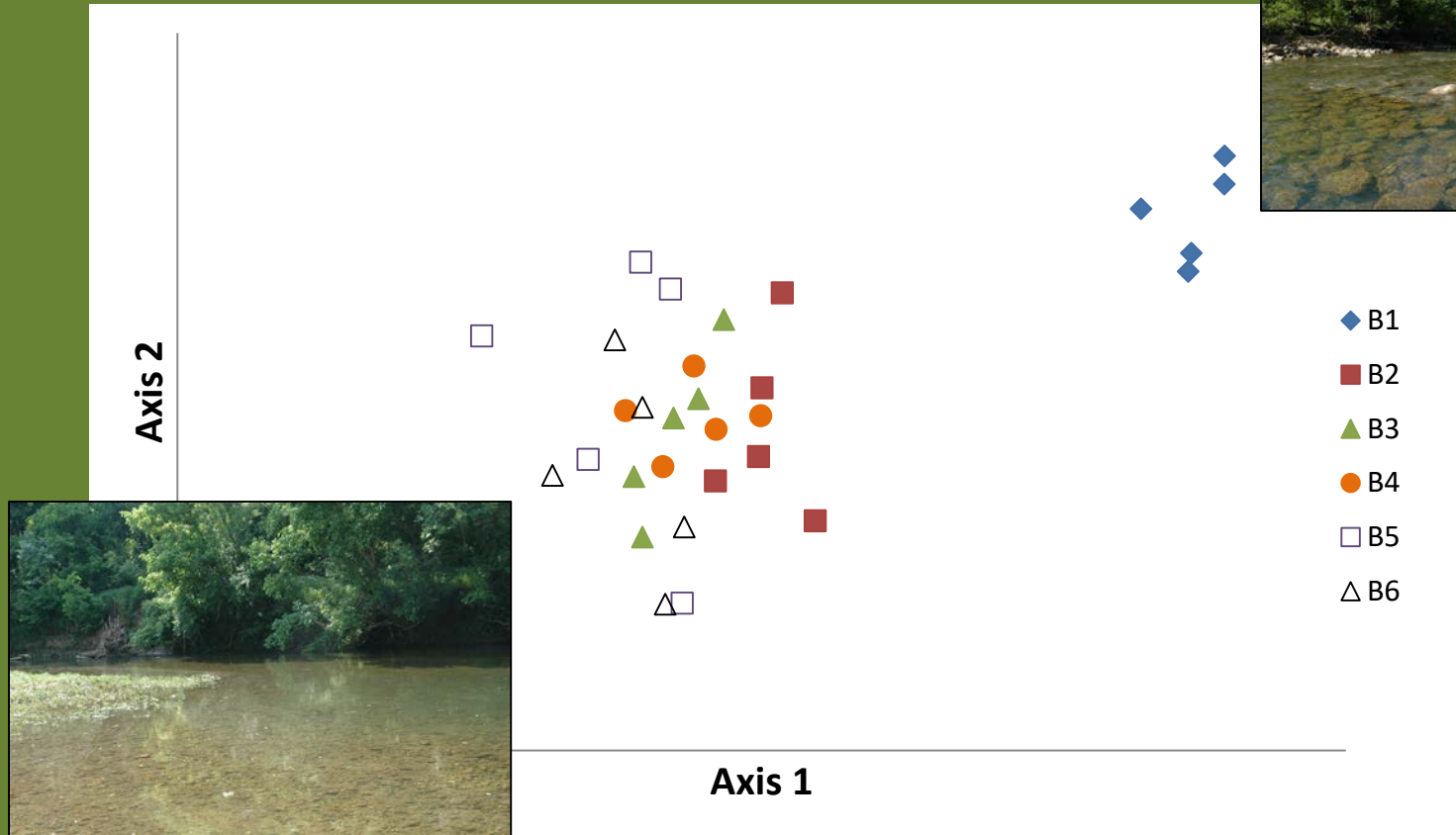
- Preliminary NMS showed upstream-most site (B1) separated out from the remaining sites

- B1 site located in the Boston Mountains region characterized by sandstone/shale, large substrate and low conductivity (<100 uS/cm)

- B1 site removed from final NMS and subsequent analyses

BUFF NMS (excluding B1)

Stress = 14.81

Instability = 0.0000

$R^2_{axis\ 1}$ = 0.477

$R^2_{axis\ 1+2}$ = 0.612

$R^2_{axis\ 1-3}$ = 0.722
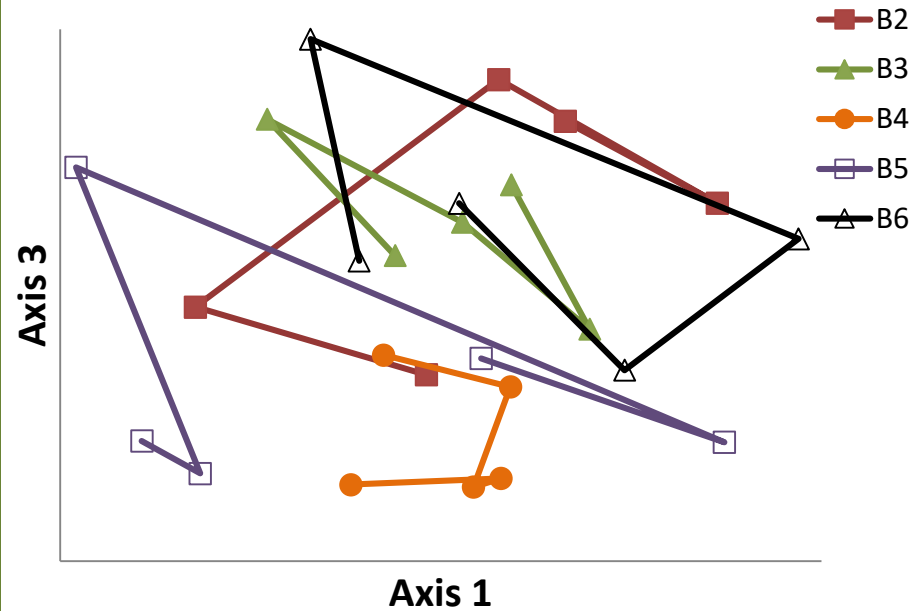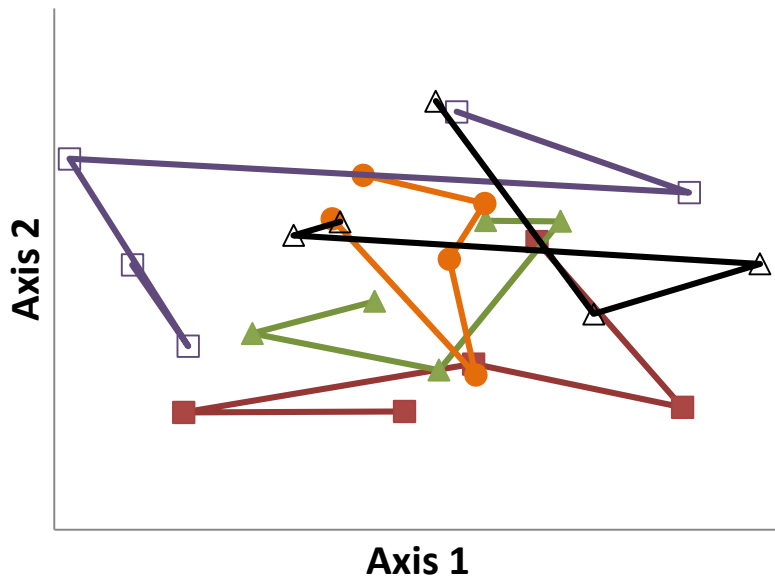
BUFF NMS by Year
(excluding B1)
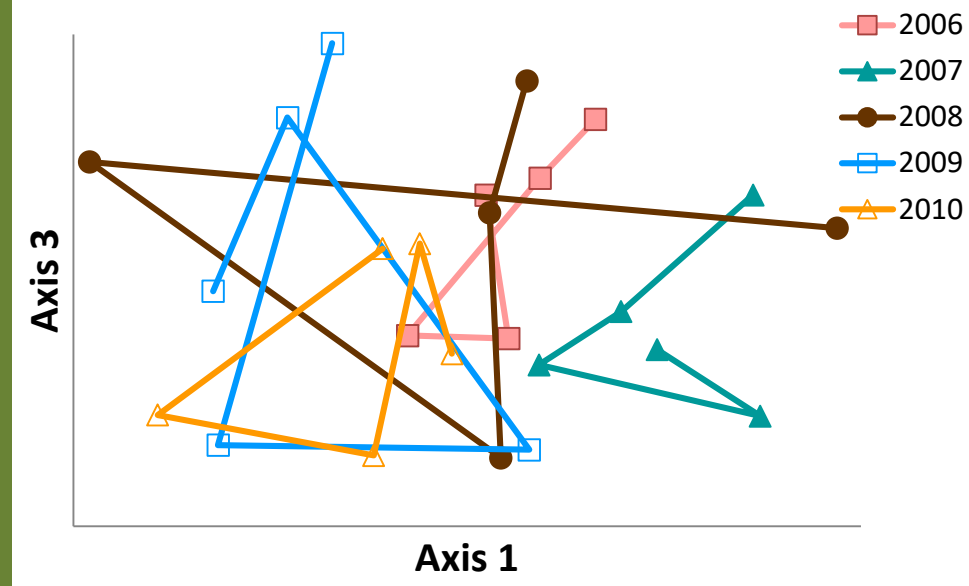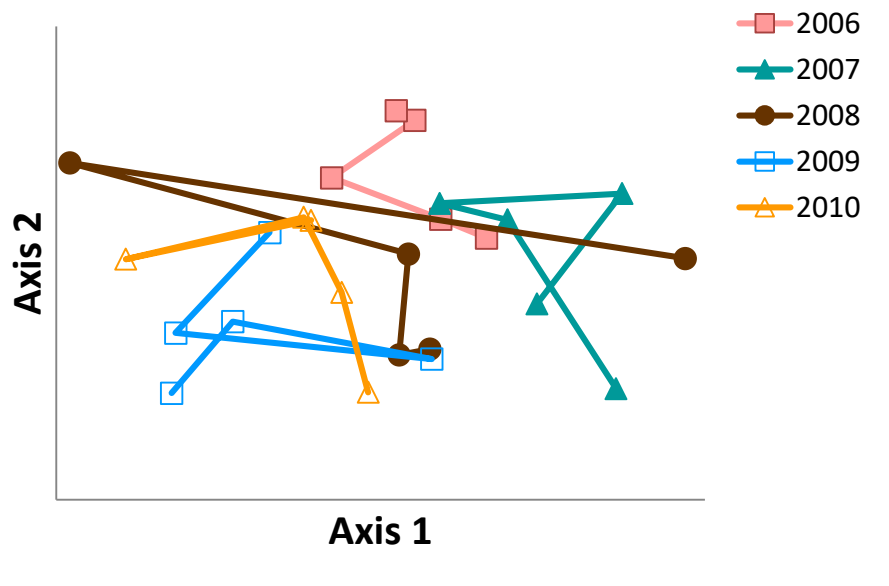
BUFF NMS with Habitat Vectors
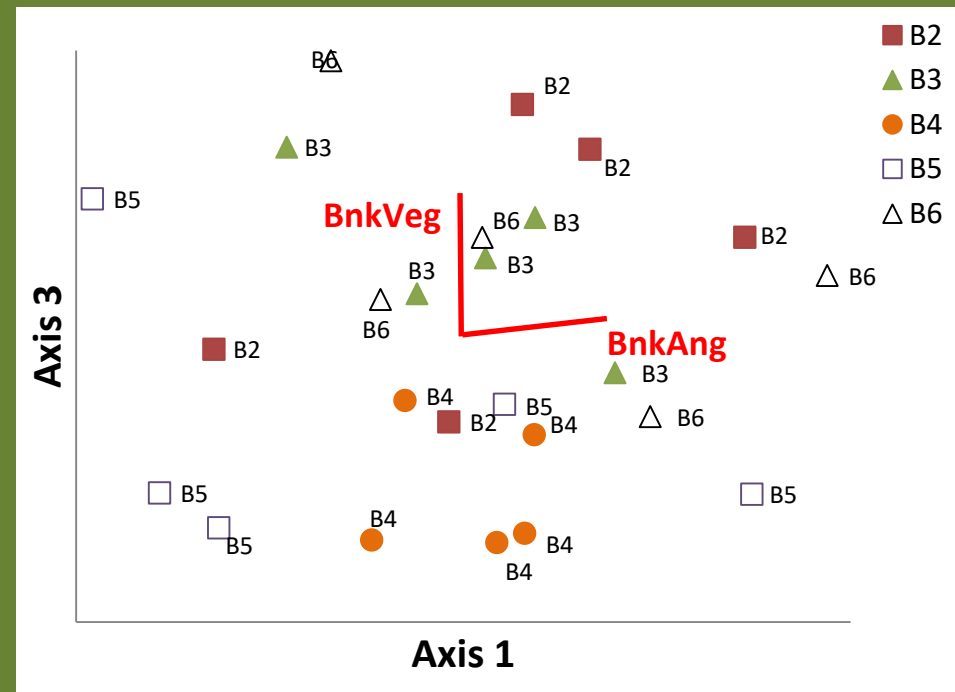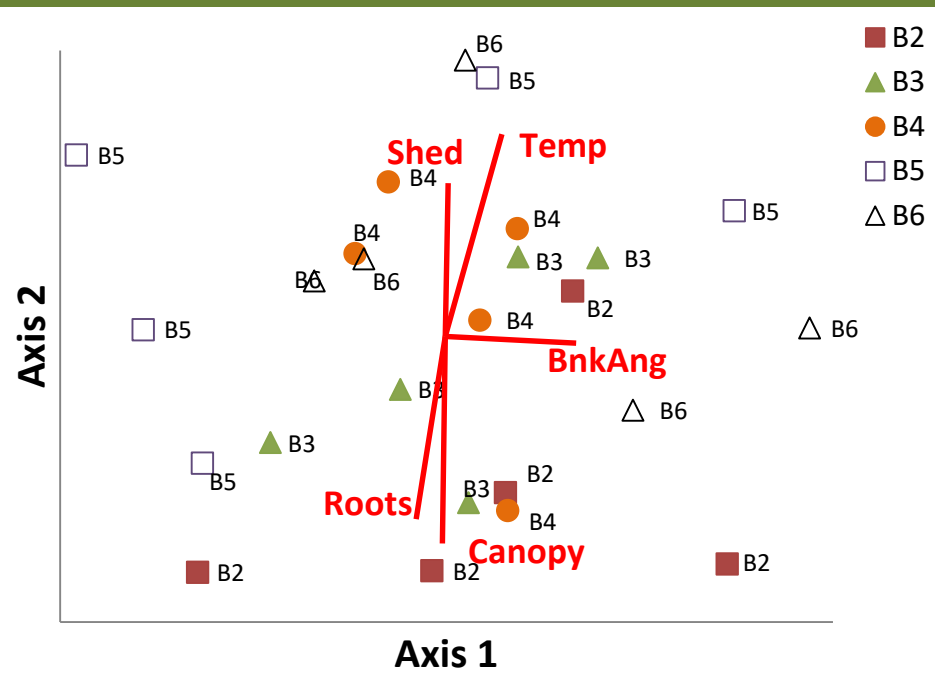
*R value ≥ |0.5| used as threshold

Tributaries – Species Richness

2006-2010
30 Randomly Selected
6 tribs/yr
Subset kept as targeted tribs

2006-2017
Targeted Tribs Only
  Biennial Panel: 4 Tribs
  4-yr Panels: 6 Tribs

Tributaries – Abundance

2006-2010
30 Randomly Selected
6 tribs/yr
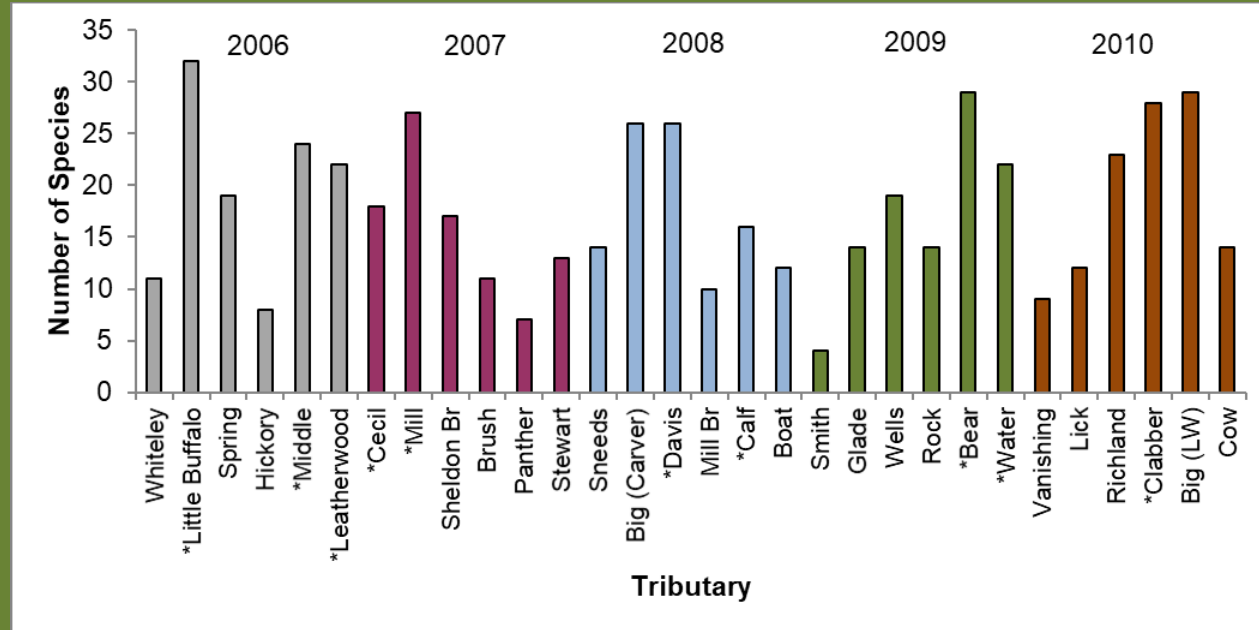
2006-2017
Targeted Tribs Only
  Biennial Panel: 4 Tribs
  4-yr Panels: 6 Tribs
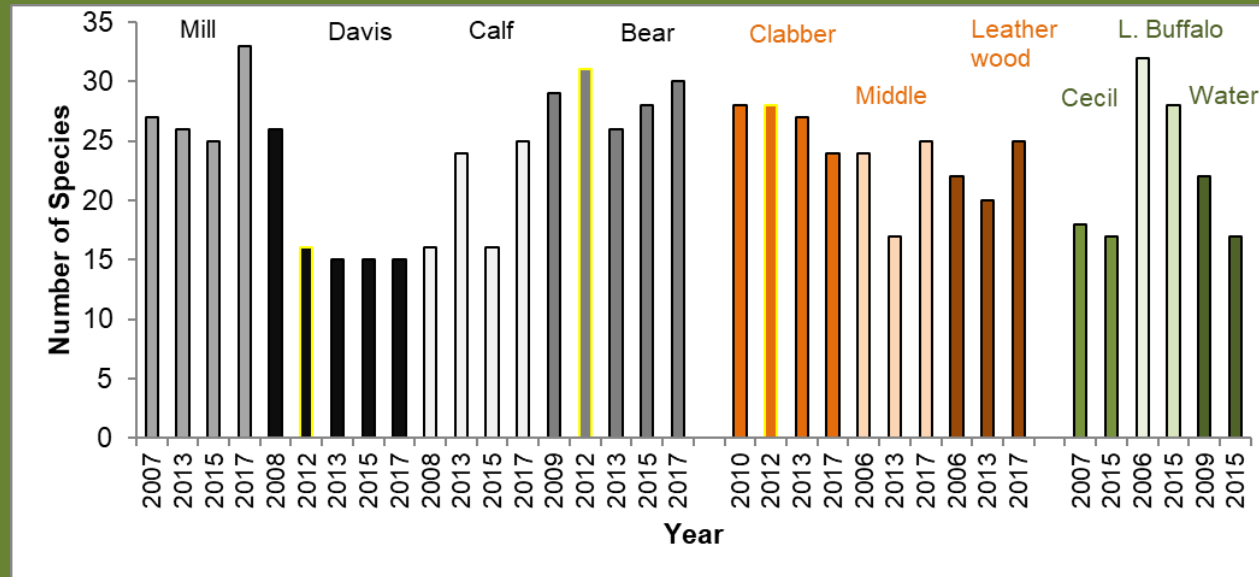
Big Creek at Carver
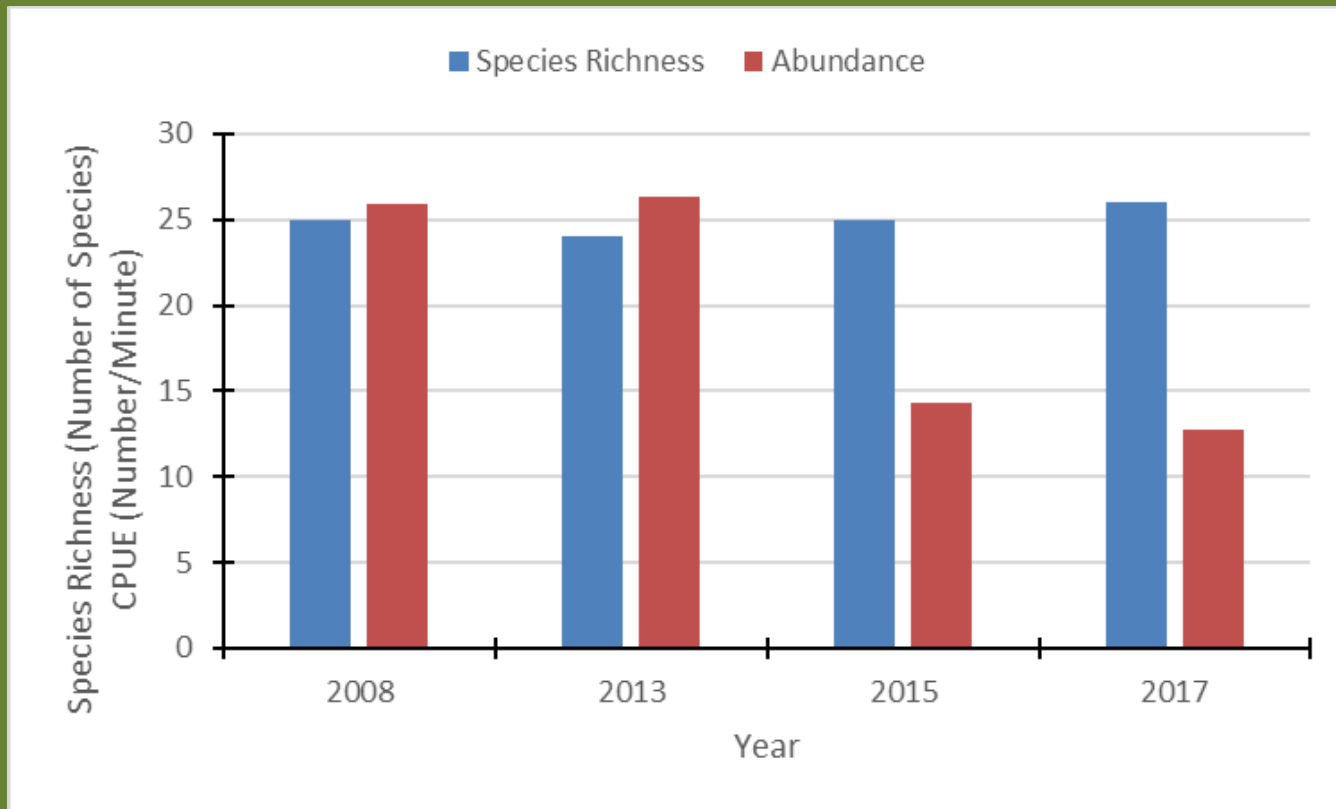
Decline in Abundance of four species:
    Ozark minnow (Intolerant, Herbivore)
    Longear sunfish (Moderately tolerant, Insectivore)
    Rainbow darter (Moderately tolerant, Insectivore)
    Stoneroller spp. (Tolerant, Algivorous)

Increase in Abundance of: Yoke darter (Intolerant, Insectivore)

Aquatic Community Vulnerability Study

USGS/NPS Monitoring Program funded project
    University of Missouri graduate student – Jacob Schwoerer
Fish and Invertebrate data sets
7 parks: 4 Ozark Highlands, 3 Central Plains
    BUFF - 6 Mainstem sites: 2006-2010 & 2013

Objectives:
1. Assess community variability
   a. Determine baseline spatial and temporal variability
   b. Determine habitat, location, climate variables linked to variability

2. Assess community vulnerability
   a. Develop community-based vulnerability assessment
   b. Determine areas of heightened vulnerability

ASSESSING THE VULNERABILITY OF STREAM COMMUNITIES AND THE CONSISTENCY
AND USE OF BIOTIC INDICES IN LEAST-DISTURBED STREAMS

A Thesis
presented to
the Faculty of the Graduate School
at the University of Missouri-Columbia

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
JACOB M. SCHWOERER
DR. CRAIG PAUKERT, THESIS SUPERVISOR
MAY 2016
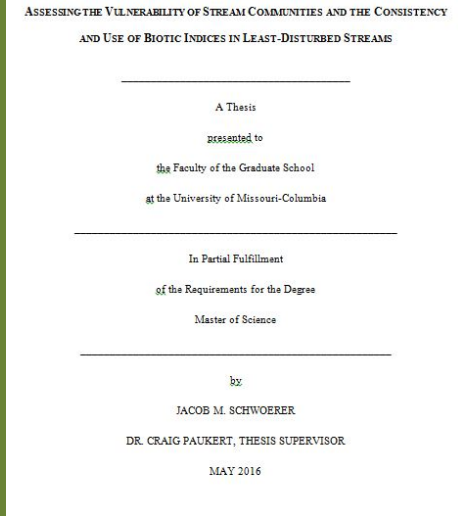
Fish Community Vulnerability Scoring

Vulnerability Score (range: 0-5)

Habitat Degradation-lithophilic spawners or benthic invertivores = 1; 0

Flow Modification- require steady or variable yet predictable flow = 1; 0

Temperature Increase- cool- and cold-water species = 1; 0

Dispersal Ability- poor dispersers: *Fundulidae*, *Cottidae*, and *Percidae* =1; 0

Reoccurrence- 1 - proportion of years species was present (range: 0 to 1)

Species A Vulnerability

Species B Vulnerability

Species C Vulnerability

Species D Vulnerability

Species E... Vulnerability

Community Vulnerability (Mean Species Vulnerability Scores)
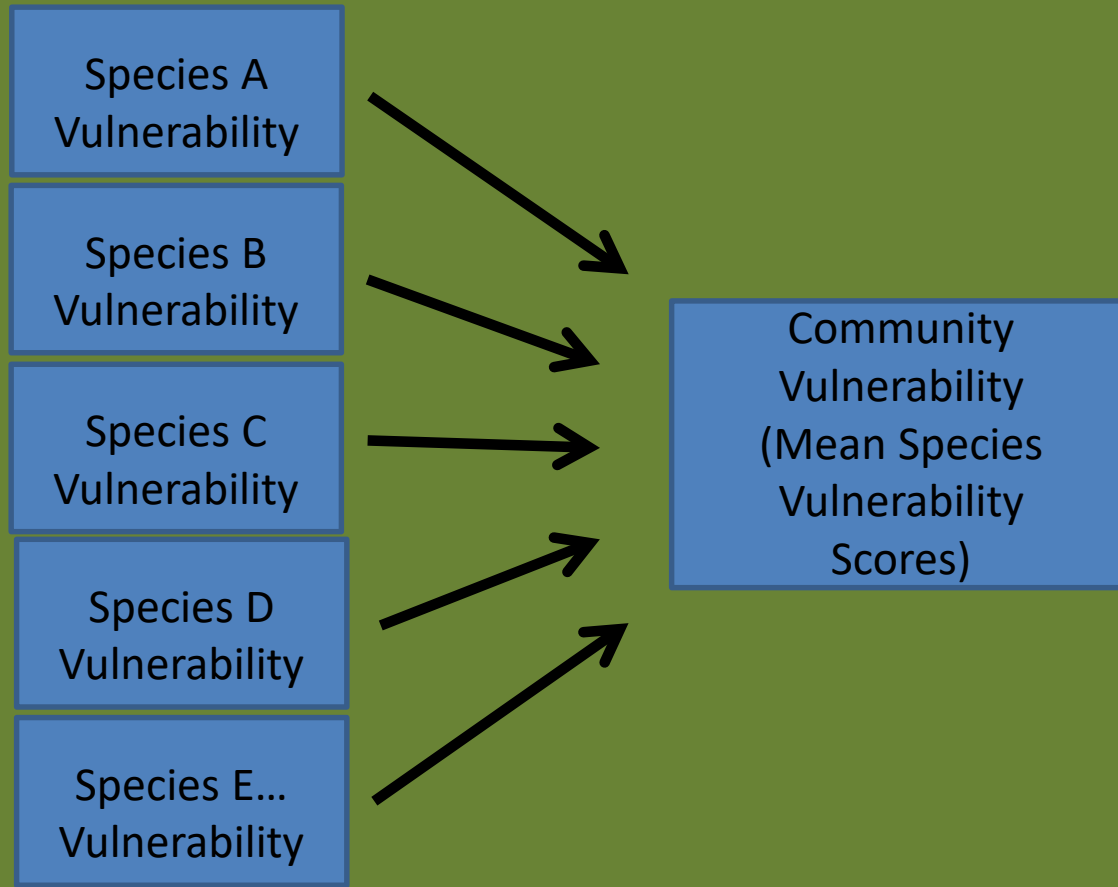
Fish Species Vulnerability Scores - BUFF

- 54 spp. collected

- 75% present each year (2006-2010, 2013)

- Scores ranged: 0-4
  60% spp. scored 2-3

Scientific Name	Common Name	Habitat	Temperature	Flow	Dispersal	Reoccurance	Vulnerabiltiy
Ichthyomyzon fossor	Least Brook lamprey	1	1			0.83	2.83
Lepomis humilis	Orangespotted sunfish	1				0.83	1.83
Oncorhynchus mykiss	Rainbow trout	1	1	1		0.83	3.83
Ictalurus punctatus	Channel catfish			1		0.67	1.67
Notemigonus crysoleucas	Golden shiner			1		0.67	1.67
Gambusia affinis	Mosquitofish					0.67	0.67
Moxostoma macrolepidotum	Shorthead redhorse		1	1		0.67	2.67
Micropterus salmoides	Largemouth bass			1		0.50	1.50
Moxostoma carinatum	River redhorse	1		1		0.50	2.50
Ichthyomyzon castaneus	Chestnut lamprey	1	1	1		0.33	3.33
Semotilus atromaculatus	Creek chub	1	1			0.33	2.33
Noturus flavater	Checkered madtom	1		1		0.17	2.17
Percina caprodes	Logperch	1			1	0.17	2.17
Etheostoma euzonum	Arkansas saddled darter	1	1		1	0	3
Etheostoma zonale	Banded darter	1			1	0	2
Cottus carolinae	Banded sculpin	1		1	1	0	3
Notropis amblops	Bigeye chub	1	1			0	2
Notropis boops	Bigeye shiner	1	1			0	2
Moxostoma duquesnei	Black redhorse	1		1		0	2
Fundulus olivaceus	Blackspotted topminnow	1	1		1	0	3
Lepomis macrochirus	Bluegill			1		0	1
Pimephales notatus	Bluntnose minnow		1			0	1
Labidesthes sicculus	Brook silverside					0	0
Notropis percobromus	Carmine shiner					0	0
Luxilus pilsbryi	Duskystripe shiner	1	1			0	2
Pylodictis olivaris	Flathead catfish			1		0	1
Percina evides	Gilt darter	1	1		1	0	3
Moxostoma erythrurum	Golden redhorse	1		1		0	2
Lepomis cyanellus	Green sunfish			1		0	1
Etheostoma blennioides	Greenside darter	1			1	0	2
Nocomis biguttatus	Hornyhead chub	1	1	1		0	3
Lepomis megalotis	Longear sunfish		1	1		0	2
Lepisosteus osseus	Longnose gar			1		0	1
Hypentelium nigricans	Northern hog sucker	1	1	1		0	3
Fundulus catenatus	Northern studfish				1	0	1
Etheostoma spectabile	Orangethroat darter	1	1		1	0	3
Ambloplites constellatus	Ozark bass		1	1		0	2
Erimystax harryi	Ozark chub	1				0	1
Noturus albater	Ozark madtom	1		1		0	2
Notropis nubilus	Ozark minnow	1	1			0	2
Cottus hypselurus	Ozark sculpin	1	1	1	1	0	4
Notropis ozarcanus	Ozark shiner	1				0	1
Etheostoma caeruleum	Rainbow darter	1	1		1	0	3
Noturus exilis	Slender madtom	1	1	1		0	3
Micropterus dolomieu	Smallmouth bass			1		0	1
Phoxinus erythrogaster	Southern redbelly dace		1			0	1
Etheostoma punctulatum	Stippled darter	1	1		1	0	3
Luxilus chrysocephalus	Striped shiner	1				0	1
Notropis telescopus	Telescope shiner	1	1			0	2
Notropis greenei	Wedgespot shiner	1				0	1
Cyprinella galactura	Whitetail shiner					0	0
Ameiurus natalis	Yellow bullhead			1		0	1
Etheostoma juliae	Yoke darter	1	1		1	0	3

Fish Community Vulnerability - BUFF

Site	Habitat	Temp	Flow	Dispersal	Vulnerability (5)	
			Fish			
BM01	64	57	39	29	**2.62**	High % Cool/Cold spp. Poor dispersers
BM02	65	44	49	26	2.58	
BM03	62	40	45	24	2.51	
BM04	64	47	44	29	2.59	
BM05	65	44	44	28	2.54	
BM06	62	40	48	26	2.52	
BUFF	64	47	45	25	1.95	

- Use vulnerability scores to prioritize areas of the river for management or detailed study
- Trait scores provide insight into environmental factors that have greater affect on fish communities

Questions?