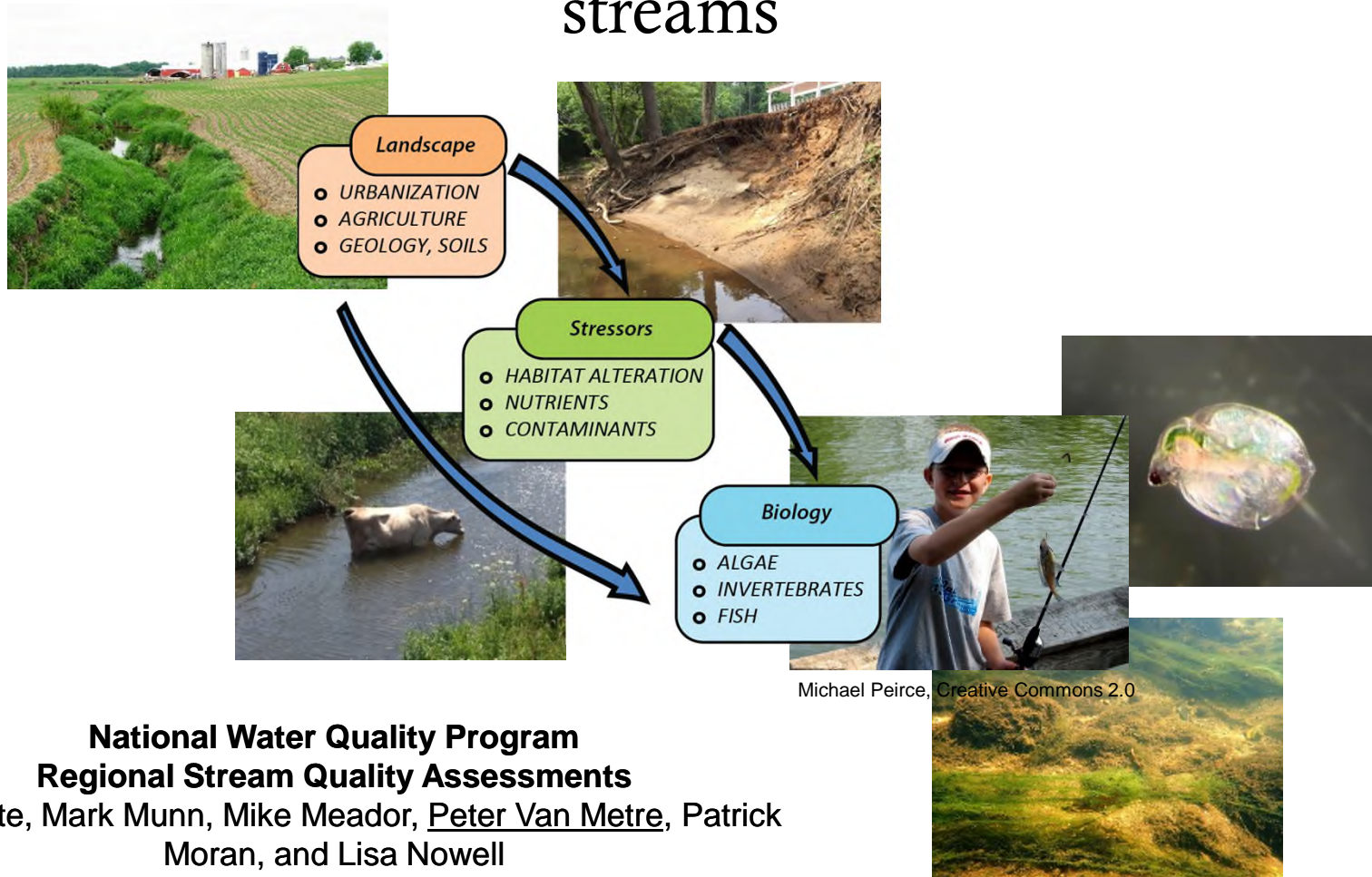


Contrasting multi-stressor effects on biological communities between urban and agricultural streams



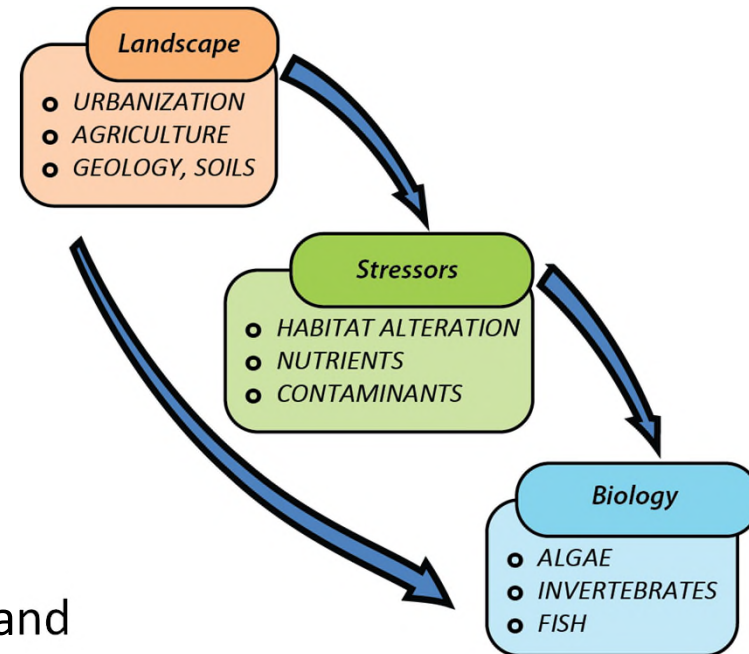
**National Water Quality Program
Regional Stream Quality Assessments**

Ian Waite, Mark Munn, Mike Meador, Peter Van Metre, Patrick Moran, and Lisa Nowell

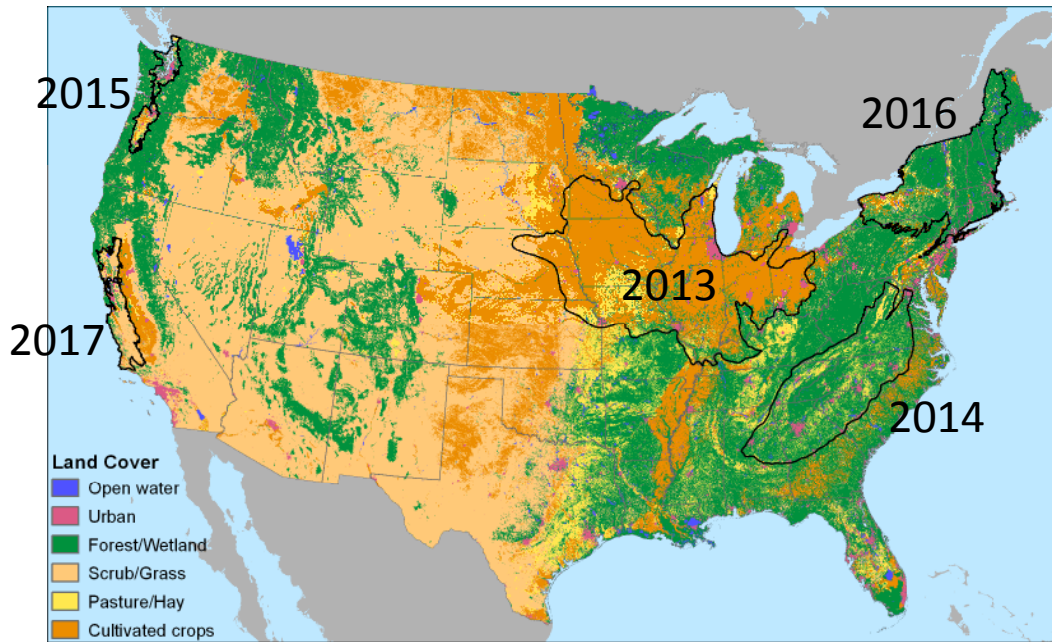
Objectives



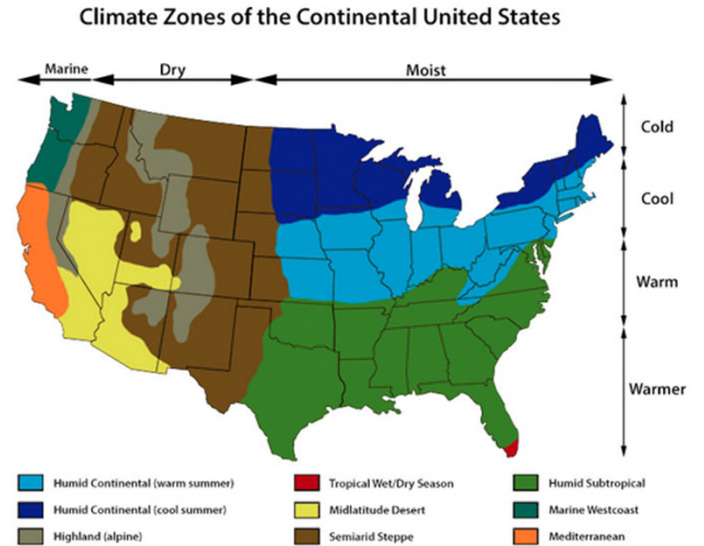
1. Determine the status of stream quality regionally.
2. Evaluate effects of instream stressors on biological communities.
3. Evaluate relations of stream quality to major landscape factors.
4. Develop statistical models and management tools to predict concentrations of stressors and ecological conditions in streams across the region.



RSQA regions

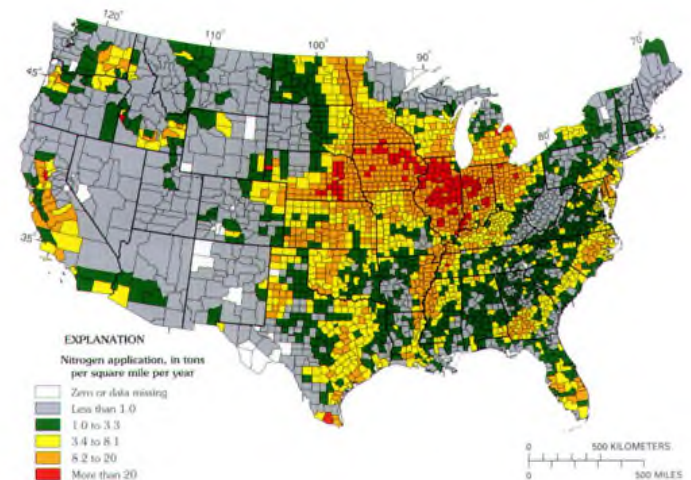
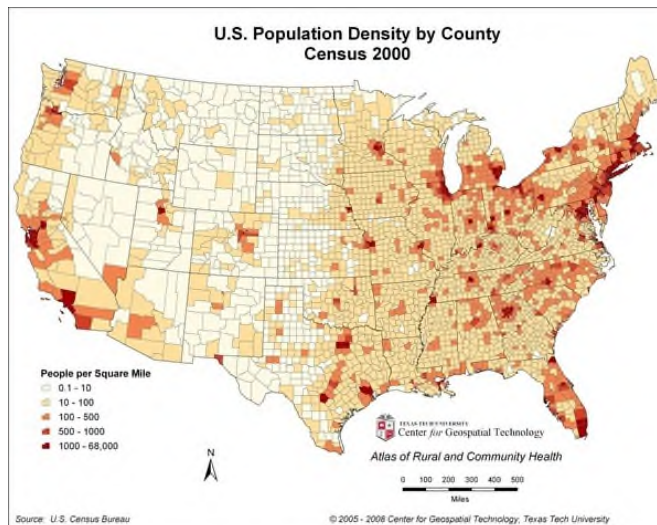


Climate



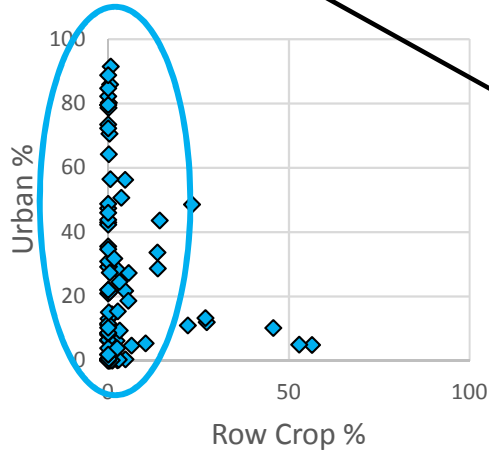
Cropland

Population

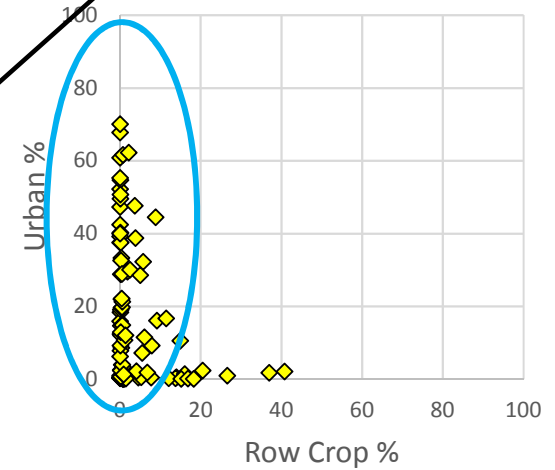


Land-use gradients

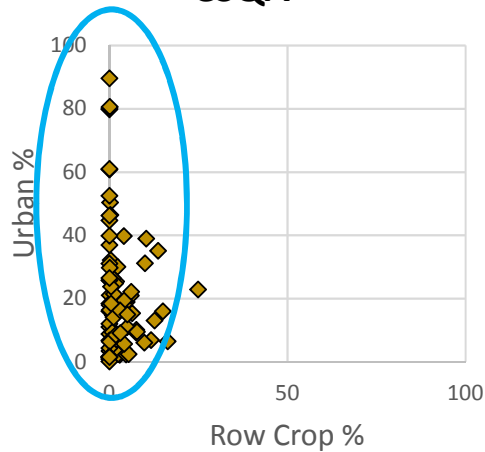
PNSQA



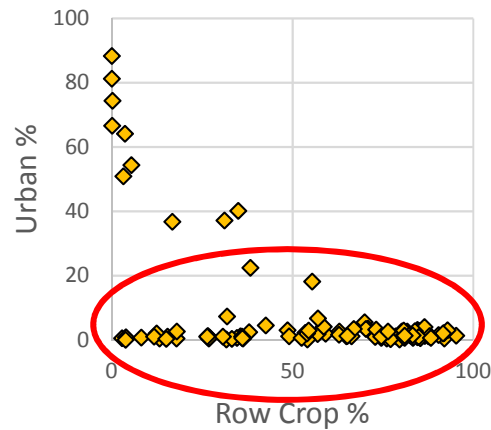
NESQA



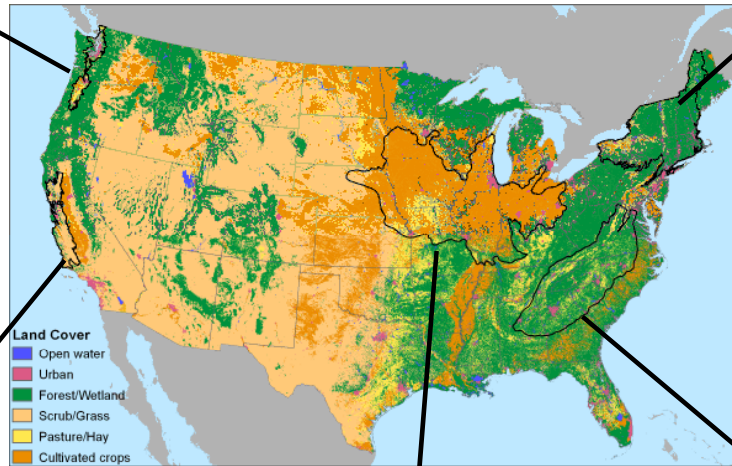
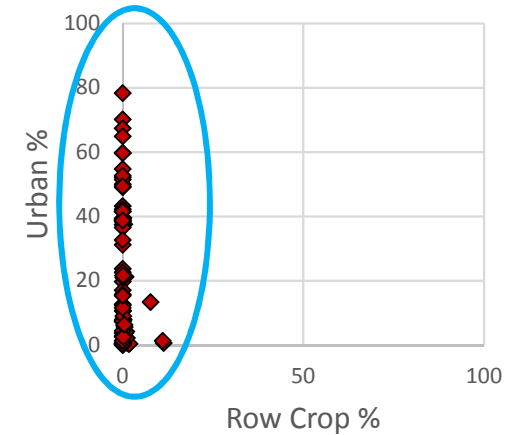
CSQA



MSQA



SESQA

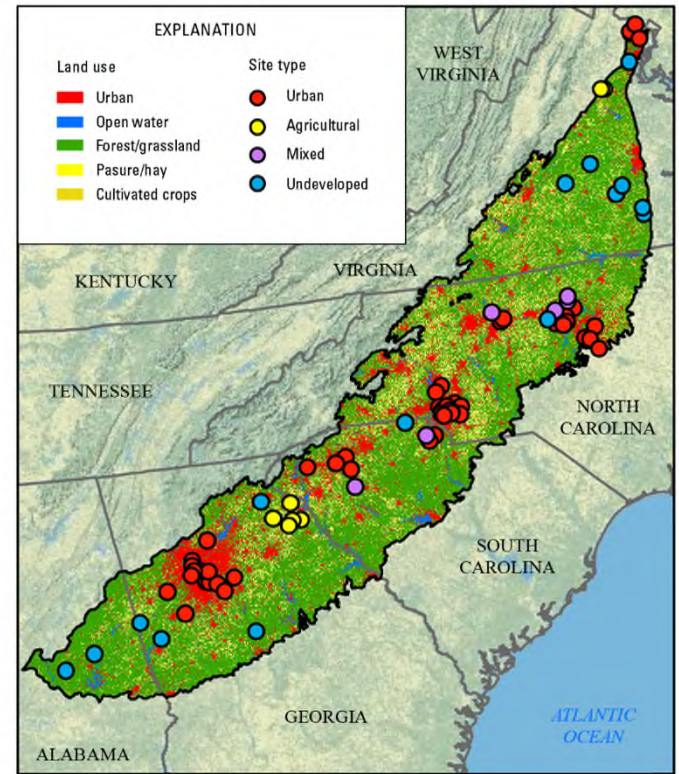
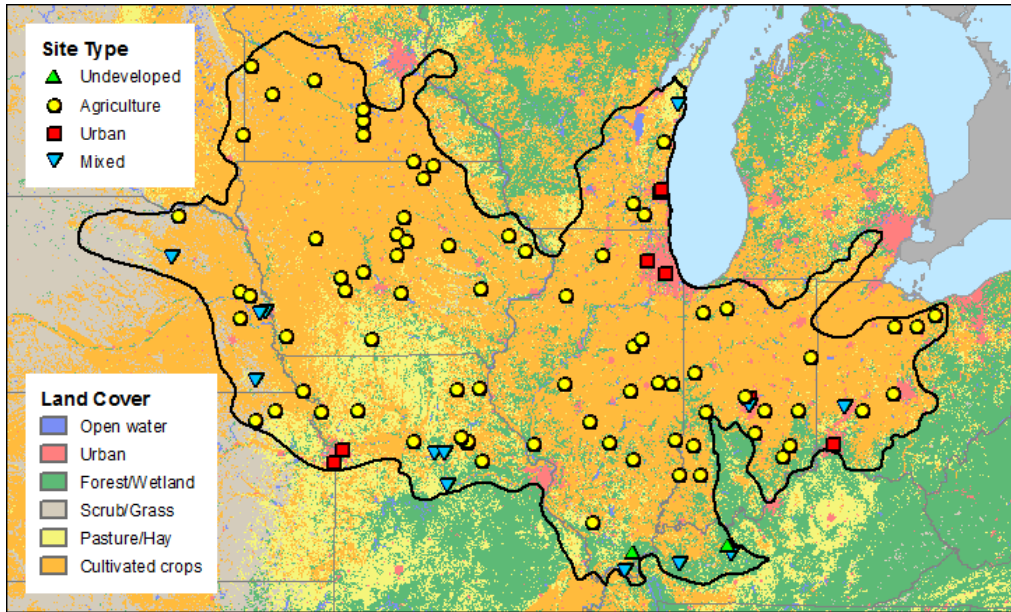


Sampling

- **Water Quality**
 - Weekly samples at all sites: pesticides, glyphosate, nutrients, major ions, sediment, organic carbon
 - Selected weeks: mercury, pharmaceuticals, OWI
 - POCIS: pesticides, pharmaceuticals
- **Sediment**
 - Metals, PAHs, organohalogens, hormones, radionuclides
 - Toxicity to *Hyalella*, chironomus
- **Habitat**
 - Continuous stage/flow and temp
 - Reach habitat
- **Ecology**
 - Algae, invertebrates, fish

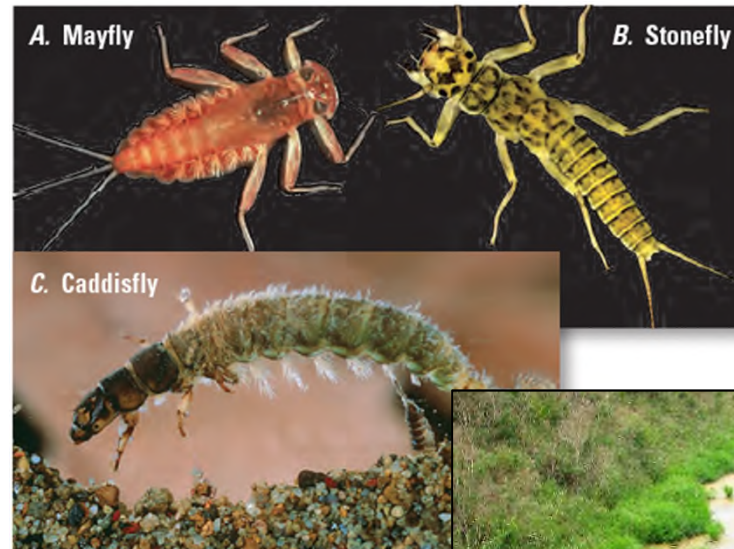


Contrasting Urban and Ag Effects

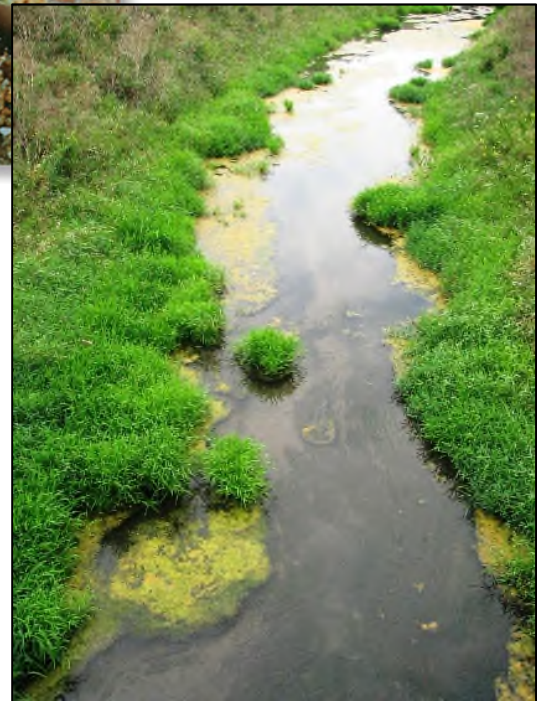


Boosted Regression Tree Models: Invertebrate Metrics

Midwest



Ephemeroptera,
Plecoptera, and
Trichoptera



Waite and Van Metre, *Freshwater Sciences*, 2017

	CV R ²	Variable	VI
EPT Richness	0.40	NH3	21
		d84 Substrate	18
		Pyrethroids.deg - P	16
		Stream Flow	16
		Sinuosity	15
		Wet Width Var	14
Tolerant Taxa Richness	0.40	NH3	22
		Velocity	21
		Wet Width Med	18
		Rip Disturbance	15
		Embeddedness	13
		DO Min Daily	11
MMI	0.44	Velocity	15
		Rip Complexity	14
		d84 Substrate	14
		Embeddedness	13
		NH3	13
		DO Max Daily	12
		Pyrethroids.deg - P	10
		Wet Width Var	8

Variable Class
Basic water quality
Nutrients
Contaminants
Habitat
Flow or flow alt.
Other

Boosted Regression Tree Models: Invertebrate Metrics

Midwest

Southeast

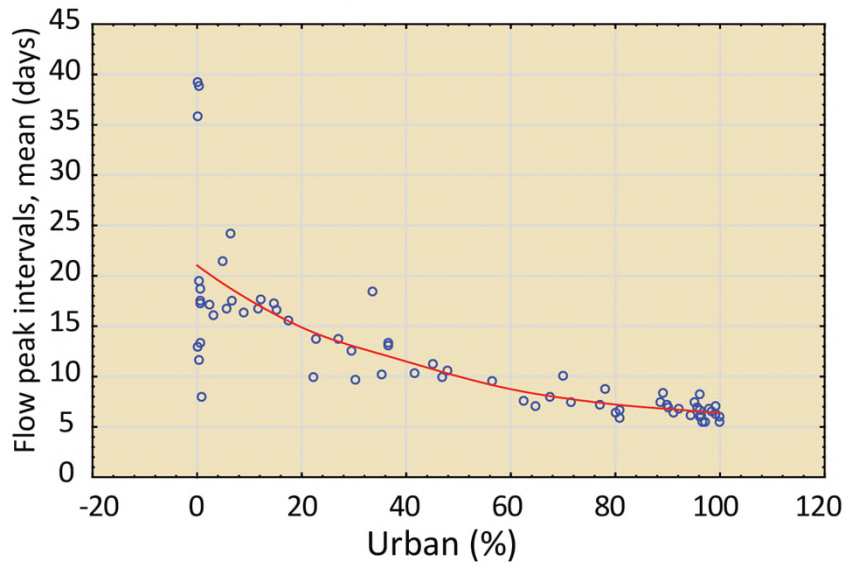
	CV R ²	Variable	VI	
EPT Richness	0.40	NH3	21	
		d84 Substrate	18	
		Pyrethroids.deg - P	16	
		Stream Flow	16	
		Sinuosity	15	
		Wet Width Var	14	
Tolerant Taxa Richness	0.40	NH3	22	
		Velocity	21	
		Wet Width Med	18	
		Rip Disturbance	15	
		Embeddedness	13	
		DO Min Daily	11	
MMI	0.44	Velocity	15	
		Rip Complexity	14	Variable Class
		d84 Substrate	14	Basic water quality
		Embeddedness	13	Nutrients
		NH3	13	Contaminants
		DO Max Daily	12	Habitat
		Pyrethroids.deg - P	10	Flow or flow alt.
		Wet Width Var	8	Other

	CV R ²	Variable	VI
EPT-H Richness	0.65	DO Min Daily	34
		Flow peak intervals	19
		Fungicides – P	14
		# Pesticides det – W	13
		TN median	12
		Fipronil – W	8
Observed/Expected taxa (O/E)	0.48	Flow peak intervals	27
		Fipronil – W	24
		PAH in sediment	19
		Fungicides – P	16
		DO Min Daily	14
Total Richness	0.62	Insecticide deg – P	32
		Sediment TEC	26
		# Pesticides det – W	21
		Insecticides – W	11
		Flow peak intervals	10

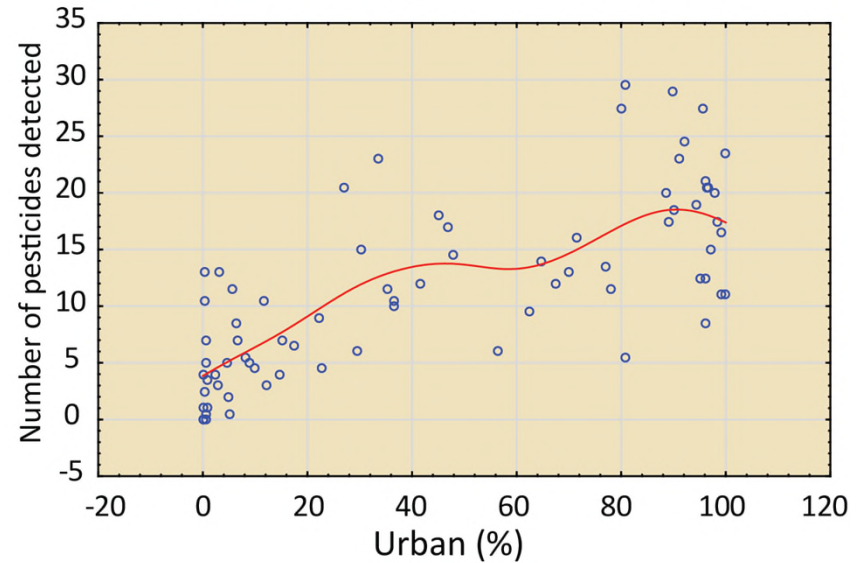
Waite et al., *STOTEN*, 2019

Urban land use drives SESQA stressors

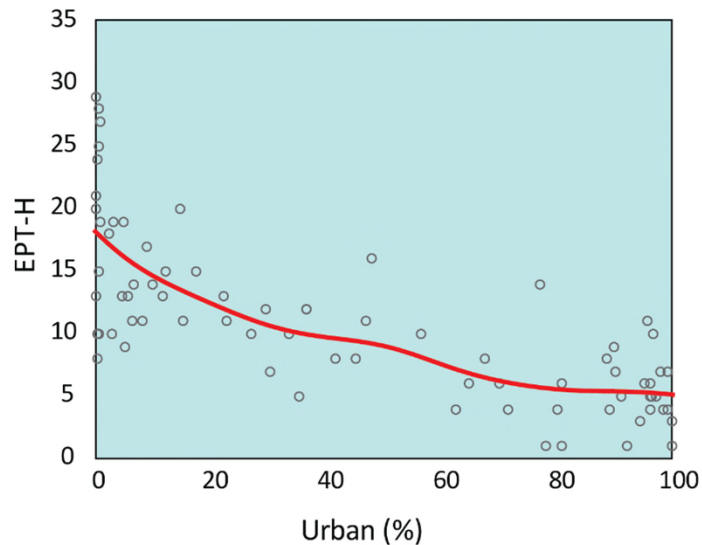
Flow peak intervals, mean



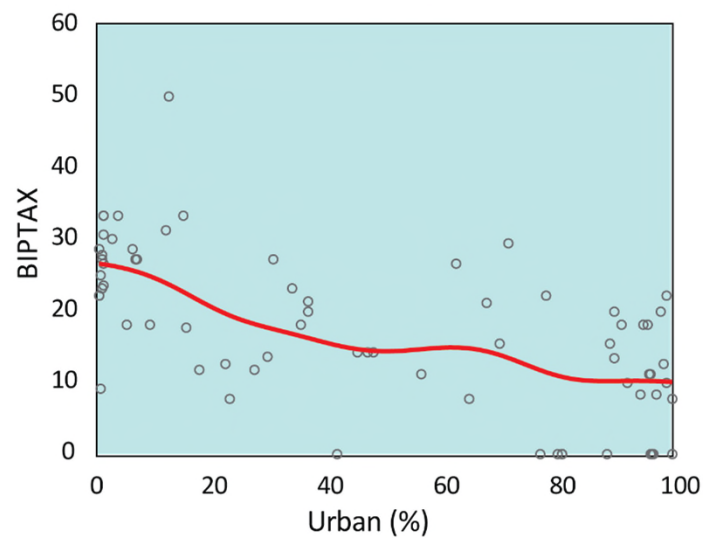
Number of pesticides detected



Invertebrates

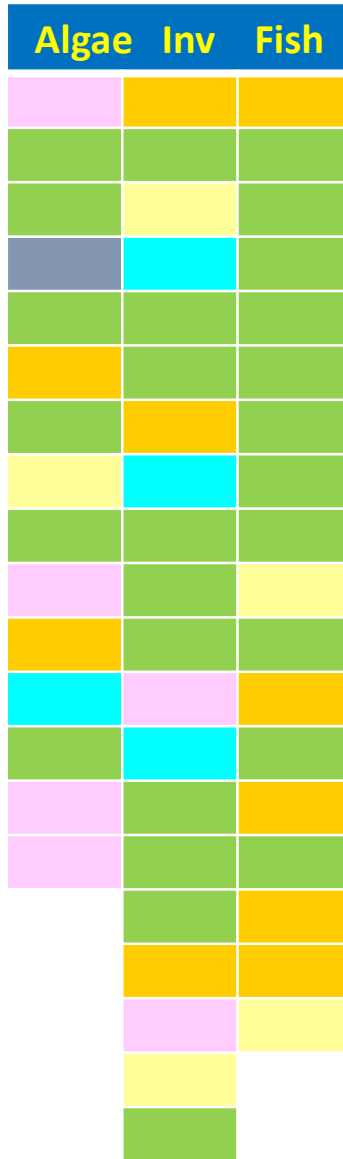
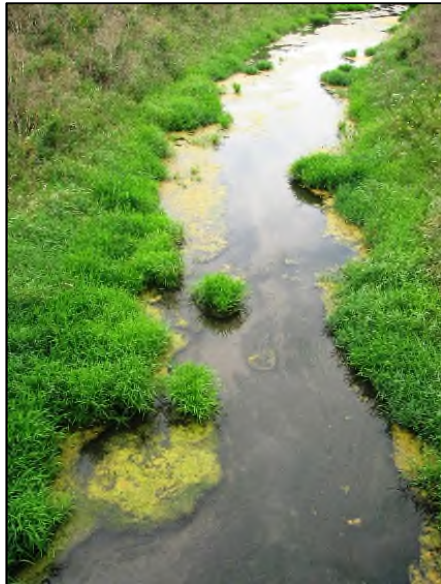


Fish

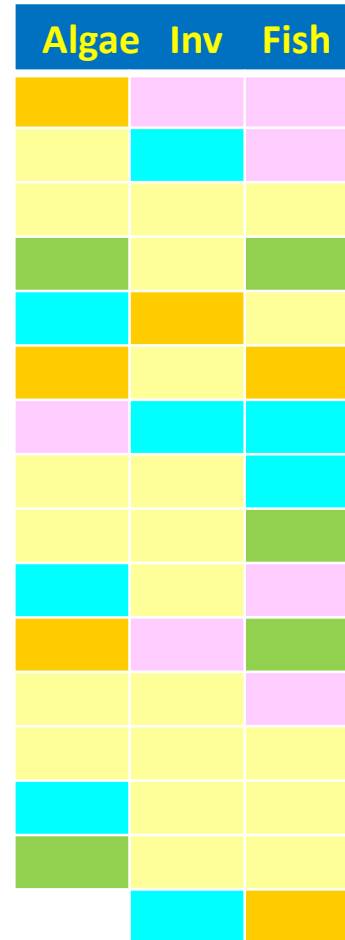


Stressor Comparison

Midwest



57% habitat

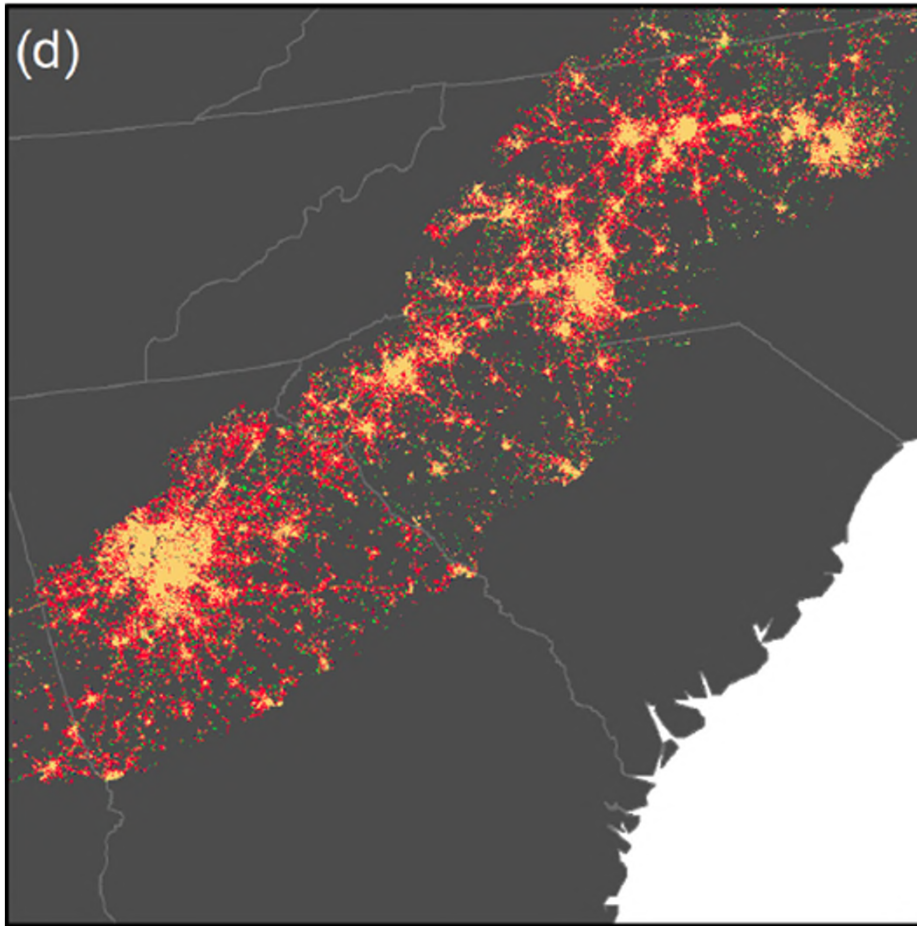


45% contaminants

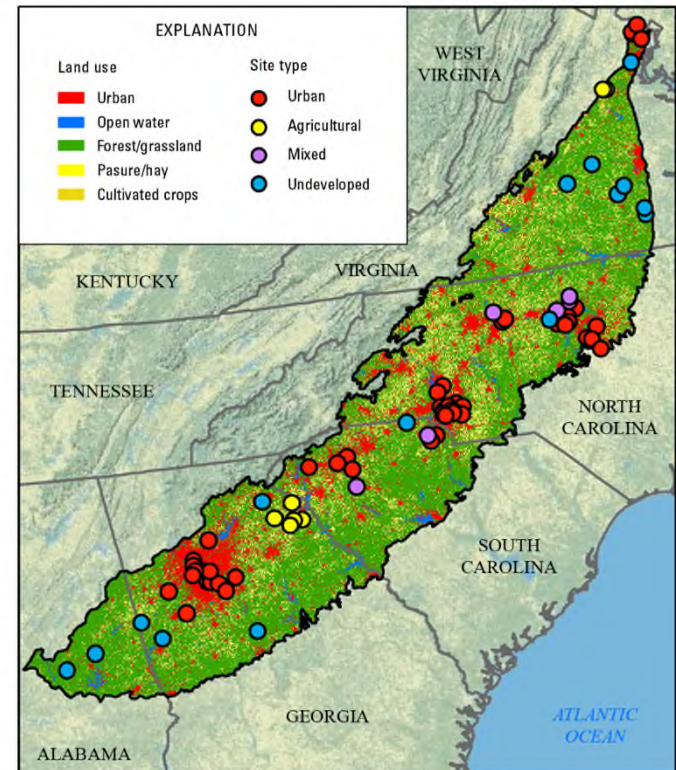
Southeast



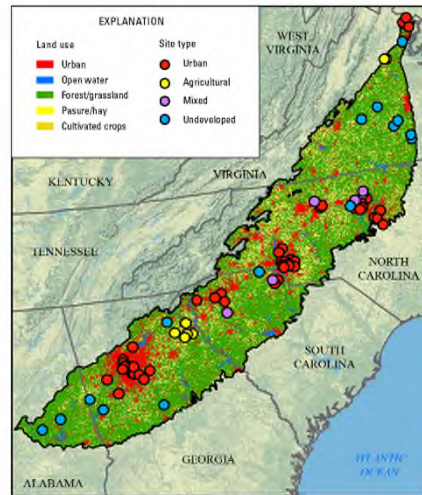
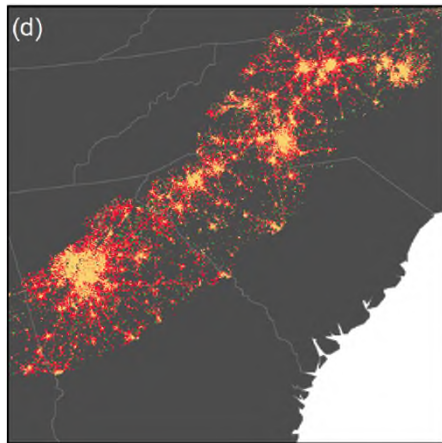
SESQA Forecasting urban expansion



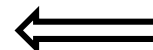
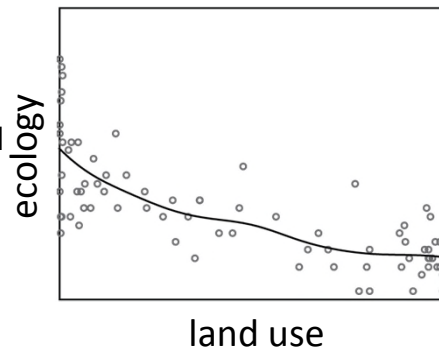
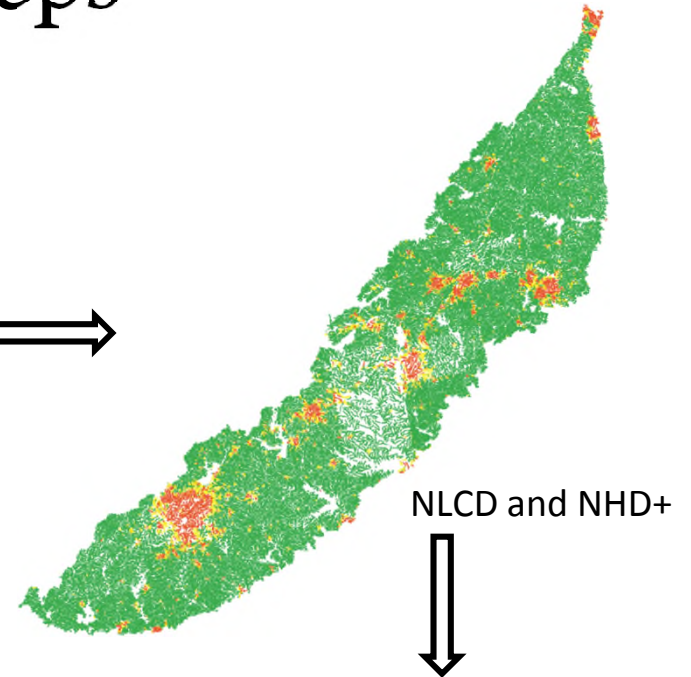
Yellow = urban 2009 Red = urban 2060



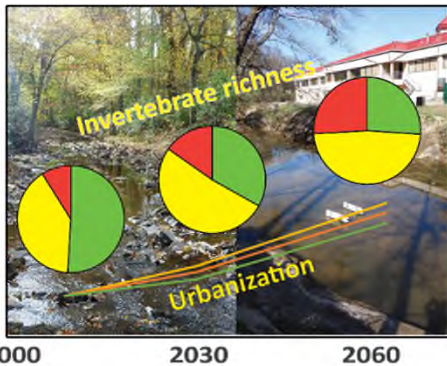
Forecasting steps

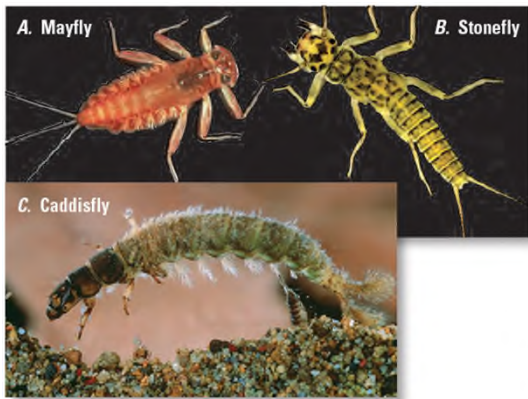


2009, 2030, and 2060

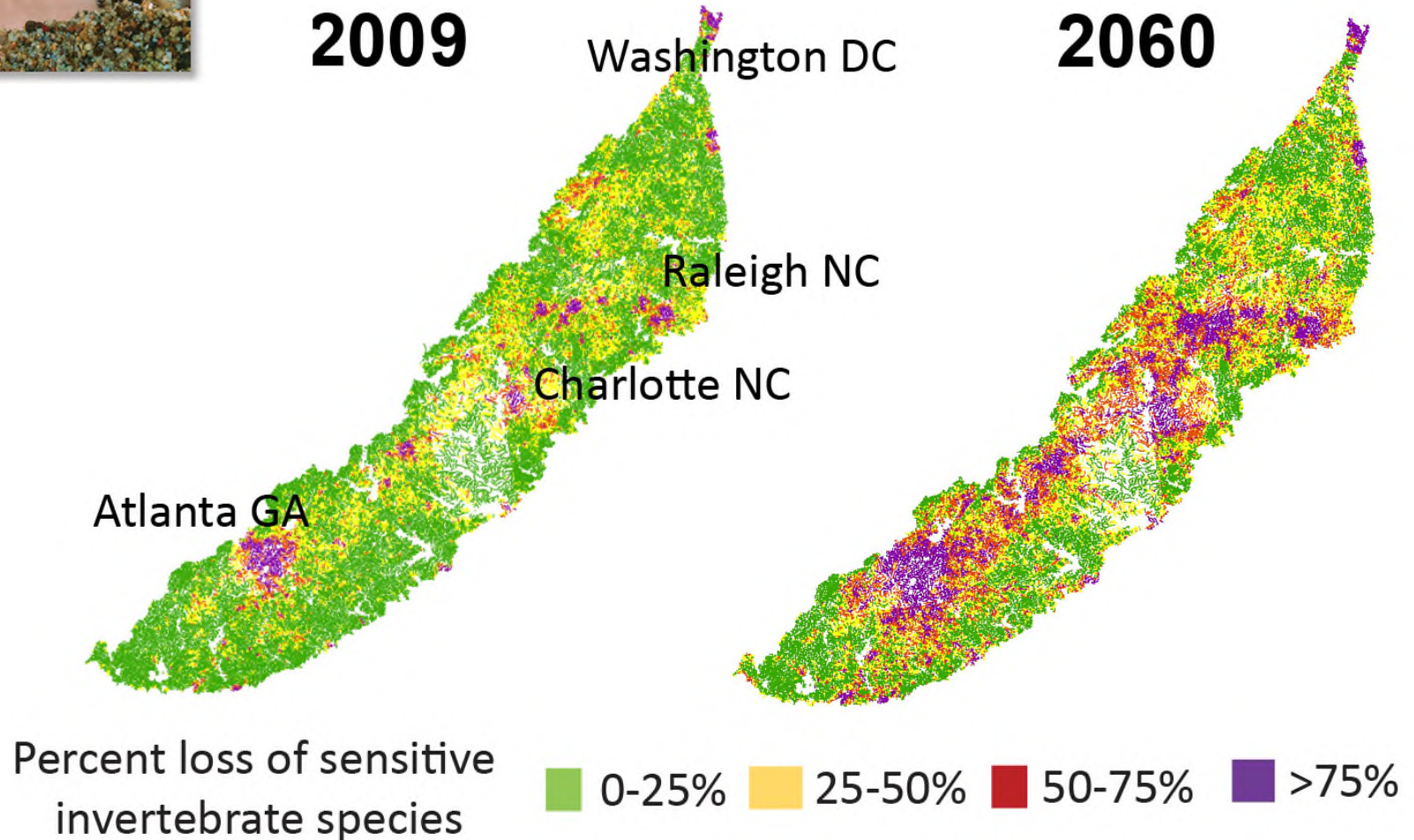


	A	B	C	D	E	F	G	H	I
	OBJECTID	CNAME	LENGTHM	FTYPE	Shoal Length	Permeability	BasinArea_km2	TotalUrban9030	TotalForest9030
1	3088	8500805	0.048	StreamRiver	46.28460987	2	0	0	0
2	4440	8542979	0.100	StreamRiver	105.1214311	2	0	0.38	0
3	13496	8600782	0.126	StreamRiver	127.7801080	2	0	0	0
4	14328	8679159	0.049	StreamRiver	49.12016211	2	0	0.06	0
5	10015	8696153	0.048	StreamRiver	48.17971491	2	0	0.23	0
6	17496	8694789	0.158	StreamRiver	158.2304744	2	0	0	0
7	18119	8710515	0.089	StreamRiver	89.48792809	2	0	5.39	0
8	13201	1294029	0.189	StreamRiver	189.9224771	2	0	0	0
9	20405	8724975	0.087	StreamRiver	86.77820707	2	0	3.14	0
10	20424	8727311	0.101	StreamRiver	101.3693887	2	0	2.6	0
11	23181	8757843	0.162	StreamRiver	161.9687678	1	0	0	0
12	23113	1050906	0.141	StreamRiver	141.1484605	2	0	0	0
13	24017	8777809	0.087	StreamRiver	86.53191346	2	0	0	0
14	25873	8780599	0.162	StreamRiver	161.7281578	2	0	13.24	0
15	27687	8895444	0.103	StreamRiver	103.2718720	1	0	3.86	0
16	29615	8891286	0.174	StreamRiver	174.0382903	1	0	98.33	0
17	29679	8891288	0.180	StreamRiver	180.0931316	1	0	98.33	0
18	29193	8891104	0.115	StreamRiver	115.2725725	1	0	190	0
19	30983	8874528	0.057	StreamRiver	56.00017241	1	0	0.17	0
20	38127	9223287	0.075	StreamRiver	75.11909057	1	0	0.76	0
21	38189	9221777	0.163	StreamRiver	163.6512548	1	0	96.8	0
22	38201	9221713	0.099	StreamRiver	99.07806477	1	0	2.3	0
23	39934	9201957	0.047	StreamRiver	46.94180503	1	0	0.11	0
24	40707	9189716	0.177	StreamRiver	177.4318871	1	0	0	0
25	41793	9750976	0.135	StreamRiver	135.1872205	1	0	43.41	0





Invertebrate EPT-H



But keep in mind the actual stressors...

	CV R ²	Variable	VI
EPT-H Richness	0.65	DO Min Daily	34
		Flow peak intervals	19
		Fungicides – P	14
		# Pesticides det – W	13
		TN median	12
		Fipronil – W	8
Observed /Expected taxa (O/E)	0.48	Flow peak intervals	27
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		DO Min Daily	14
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		Sediment TEC	26
		# Pesticides det – W	21
		Insecticides – W	11
		Flow peak intervals	10



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pcvanmet@usgs.gov

<http://webapps.usgs.gov/RSQA/>
<http://water.usgs.gov/nawqa/>