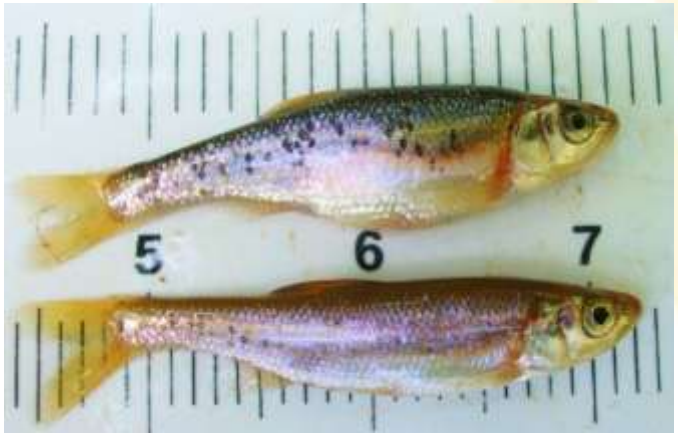


MULTI-METRIC INDEX FOR WEST VIRGINIA STREAMS

J. Todd Petty
Division of Forestry and Natural Resources
West Virginia University

March 27, 2013

WV NARRATIVE WQ STANDARD

(i) **balanced aquatic community** that is diverse in species composition;

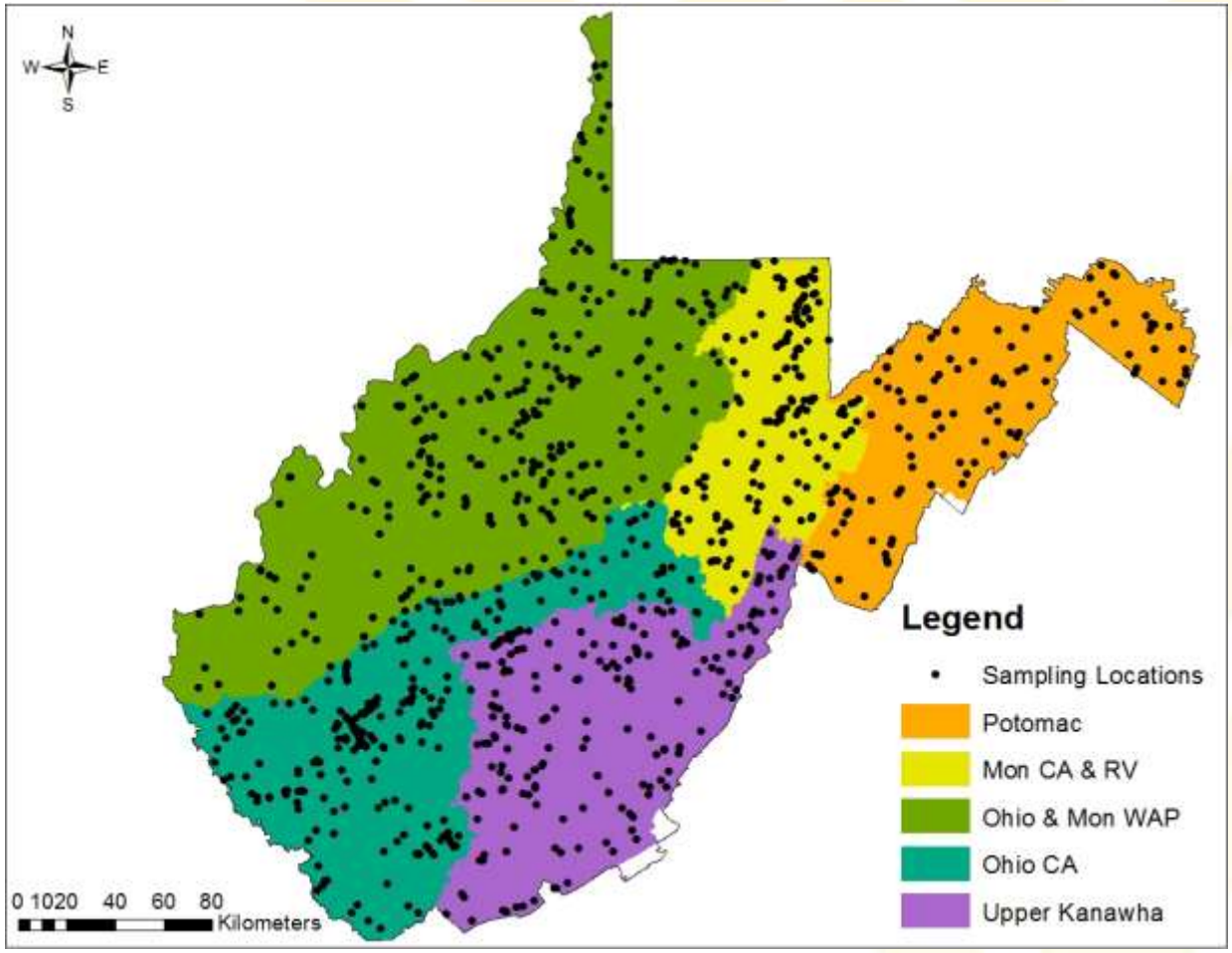
(ii) **appropriate trophic levels of fish**;

(iii) **invertebrate assemblages** sufficient to perform the biological functions necessary to **support fish communities** within the assessed reach or downstream.

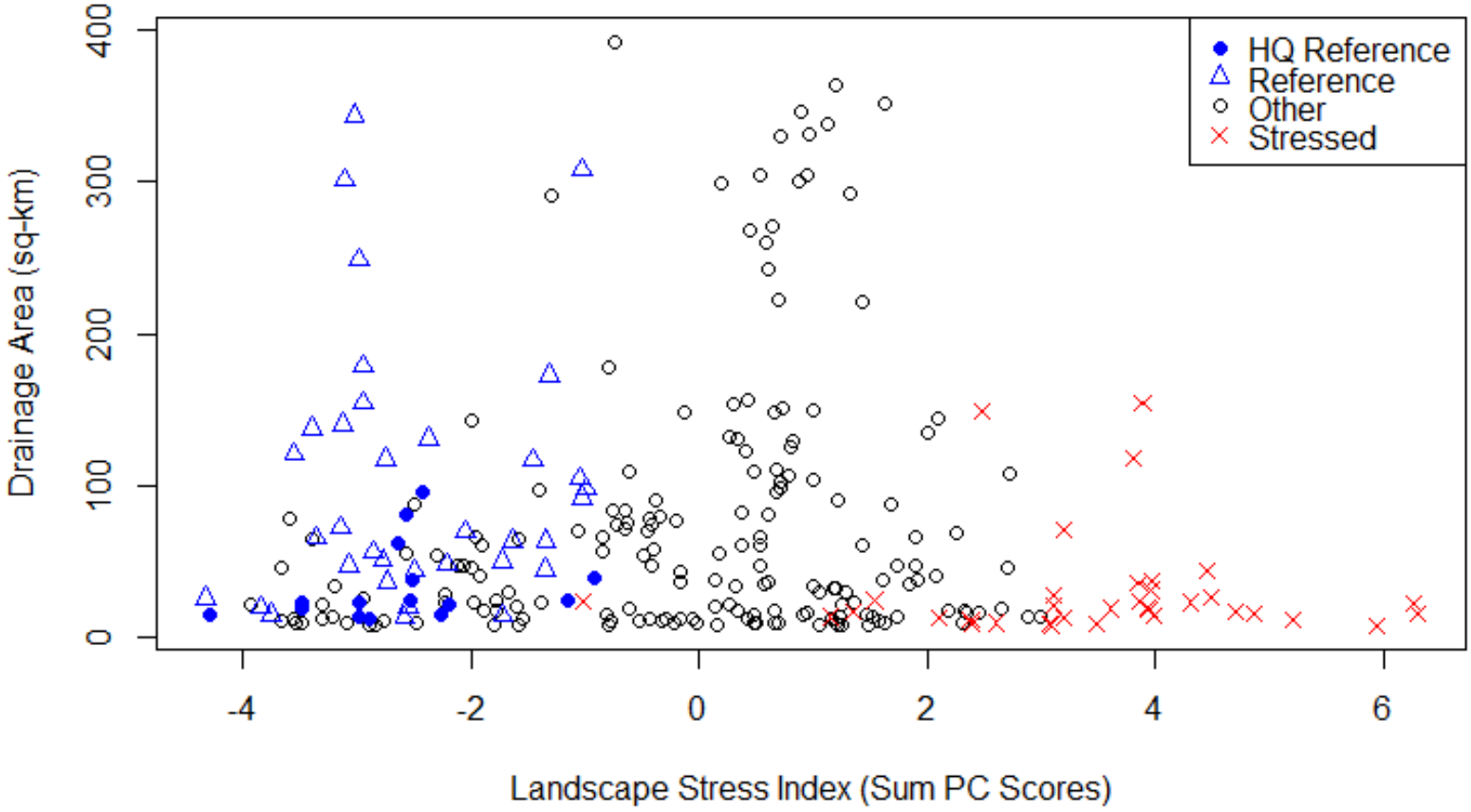
FISH IBI DEVELOPMENT

- Model regions
- Reference vs. stressed sites
- Modeling metric expectations
- Testing candidate metrics
- IBI scoring and response to stress
- Impairment thresholds
- Next steps

MODEL REGIONS



OHIO CA SITE TYPES



Ref PCA < -1.0; Stressed PCA > 2.0 or pH < 5.0
Reference Site = “Least-disturbed” sites across drainage area continuum

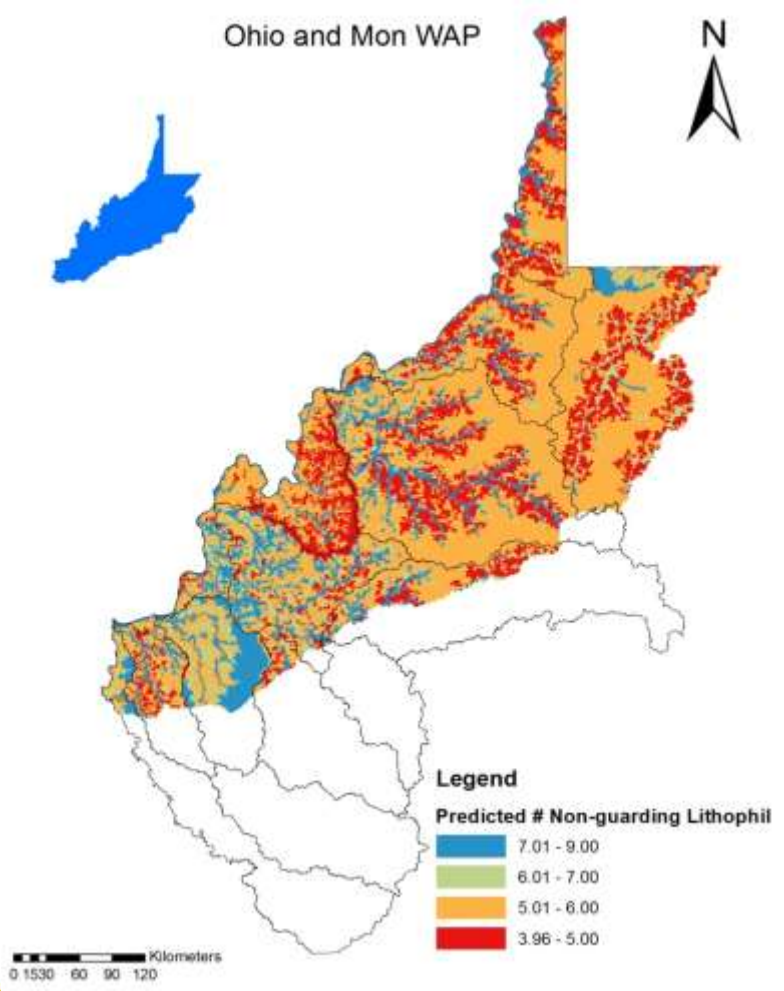
FISH METRIC EXPECTATIONS

- Expected metric value for a stream given natural landscape characteristics
- Boosted Regression Tree Modeling
- Reference Sites ONLY
- Natural variables: Drainage area, Elevation, Swim distance, Latitude and Longitude
- Var. Explained ≥ 0.25
- Adjusted metrics (Observed/Expected)

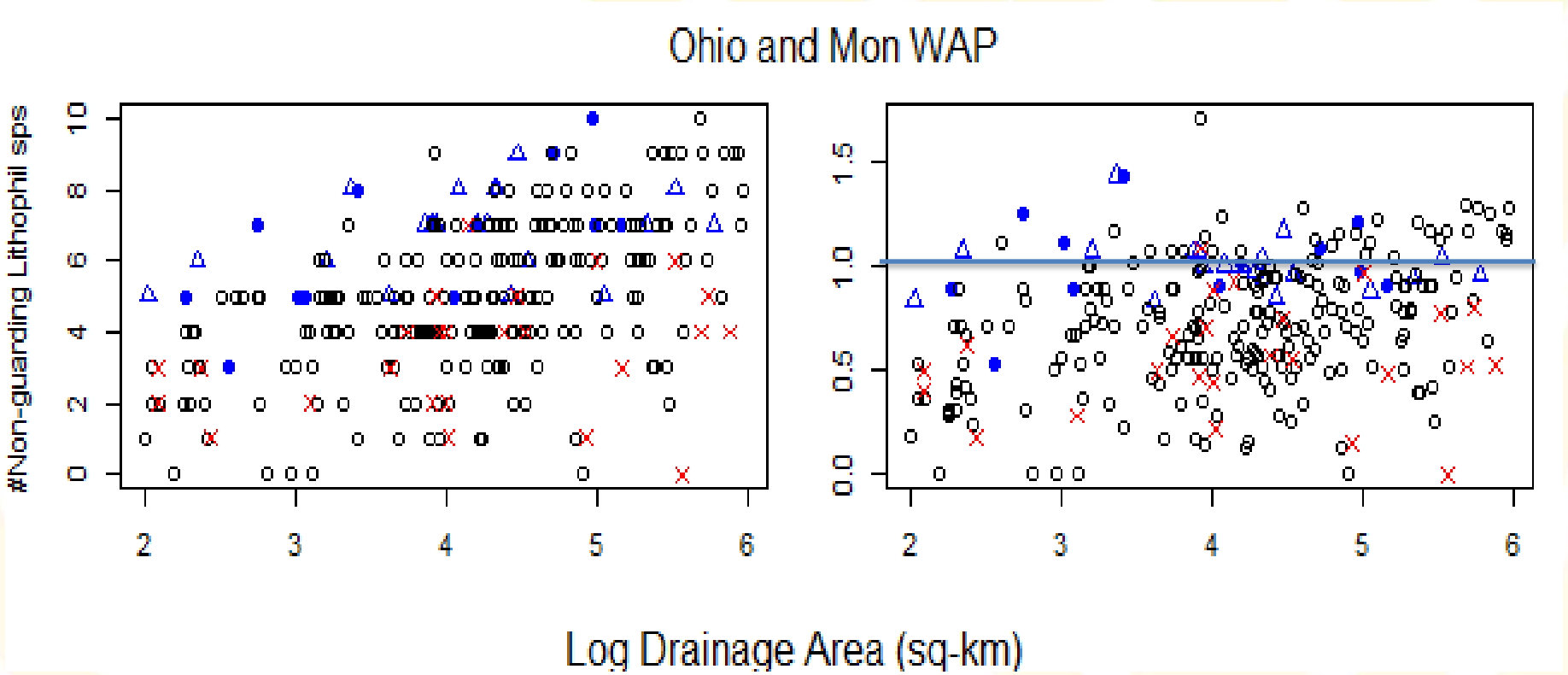
OHIO CA BRT RESULTS

Metric	Drainage Area (sq-km)	Swim Distance (km)	Elevation (m)	Latitude (°)	Longitude (°)	Var. Explained
NUMSPEC	30.87	13.04	51.82	1.95	2.31	0.77
NUMSPECT	48.89	12.77	32.60	4.17	1.56	0.83
NUMNATSP	26.88	11.89	56.81	2.01	2.38	0.78
NUMNATSPT	41.52	13.17	39.36	4.35	1.60	0.83
NUMDMSC	33.44	10.69	47.90	5.89	2.07	0.77
NUMBENT	33.46	8.73	51.17	3.19	3.44	0.74
NUMBENTT	48.69	11.05	26.19	9.46	4.59	0.81
NUMBENTS	33.08	9.26	52.23	3.33	2.10	0.75
NUMNATCYP	23.71	16.65	53.66	2.23	3.73	0.75
NUMRGSPAWN	19.77	4.85	66.96	5.91	2.51	0.66
NUMNGLITHO	31.03	10.23	48.03	2.27	8.44	0.77
PTOLERANT	40.42	11.45	10.74	26.44	10.94	0.72
PPISCINV	60.22	9.24	16.34	12.65	1.56	0.76
PPISCINVT	55.59	4.46	4.23	23.66	12.05	0.58
PPISCINVS	42.08	11.72	25.53	15.05	5.61	0.53
PNGPISCINV	52.99	8.98	25.54	10.59	1.89	0.79
POMNIHERB	55.20	11.04	12.75	17.07	3.92	0.75
POMNIHERBS	43.82	12.49	20.97	17.44	5.27	0.87
PRGSPAWN	26.09	14.11	34.09	19.38	6.30	0.87
PSPECT	54.19	4.92	4.81	23.75	12.31	0.60

OHIO/MON WAP


Ohio and Mon WAP
N
Legend
Predicted # Non-guarding Lithophil
7.01 - 9.00
6.01 - 7.00
5.01 - 6.00
3.96 - 5.00
Kilometers
0 1530 60 90 120

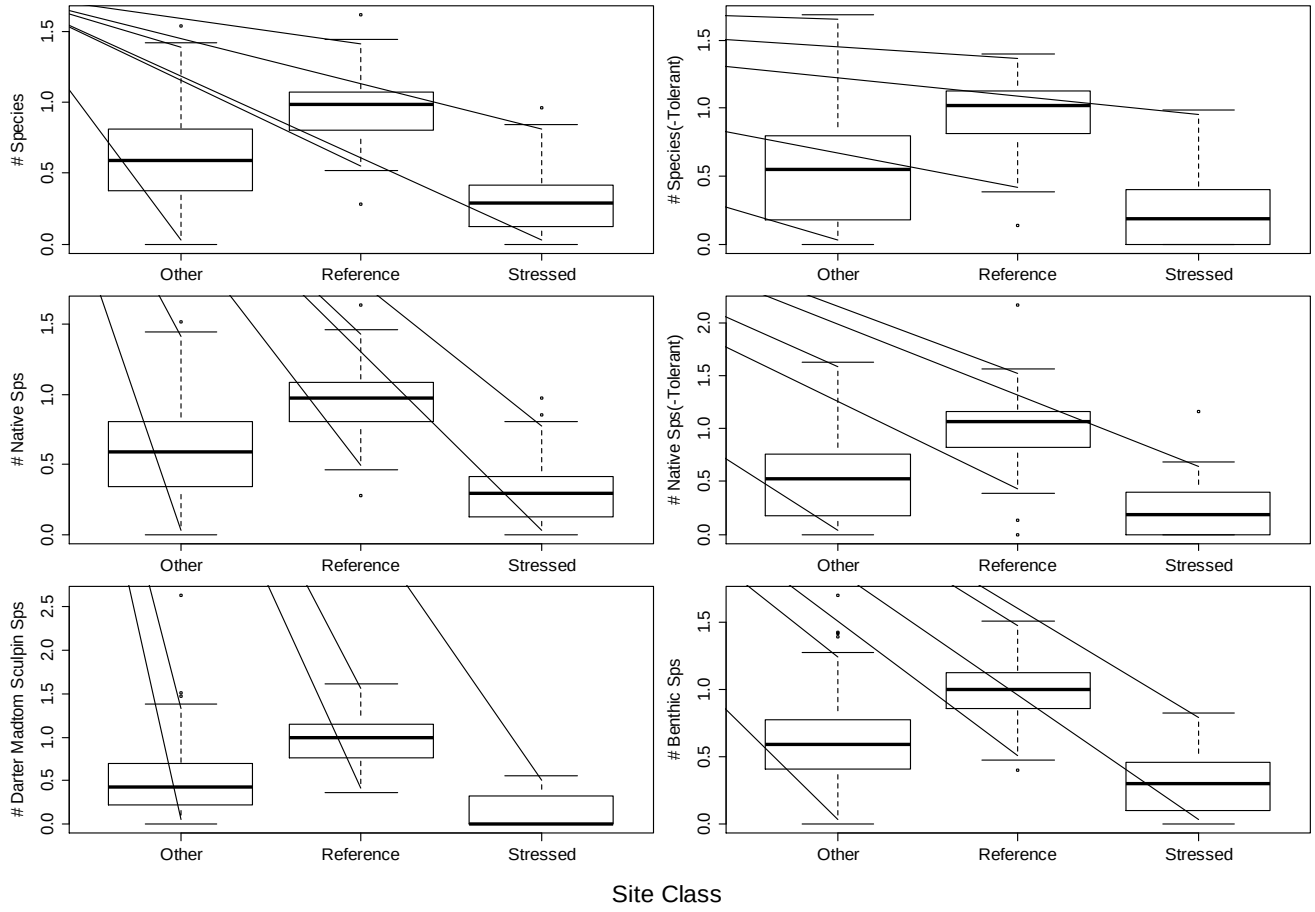
OHIO/MON WAP BRT RESULTS



TESTING CANDIDATE METRICS

- Correlation with Human disturbance
  - pH, conductivity, Habitat score, PC axes
  - Structure density, surface mining, agriculture, development, & forest
- Discrimination Efficiency
  - Boxplots examined for separation between reference and stressed sites
- Redundancy
  - Strong correlation with other metrics

DISCRIMINATION – OHIO CA



METRICS RETAINED IN IBI

Adj. Total Richness – Tol

Adj. Benthic Richness

Adj. Cyprinid Richness

Adj. Darter-Madtom-Sculpin Richness

Adj. Rock-Gravel Spawner Richness

Adj. Non-Guarding Lithophil Richness

% Tolerant

% Invertivore - Piscivore

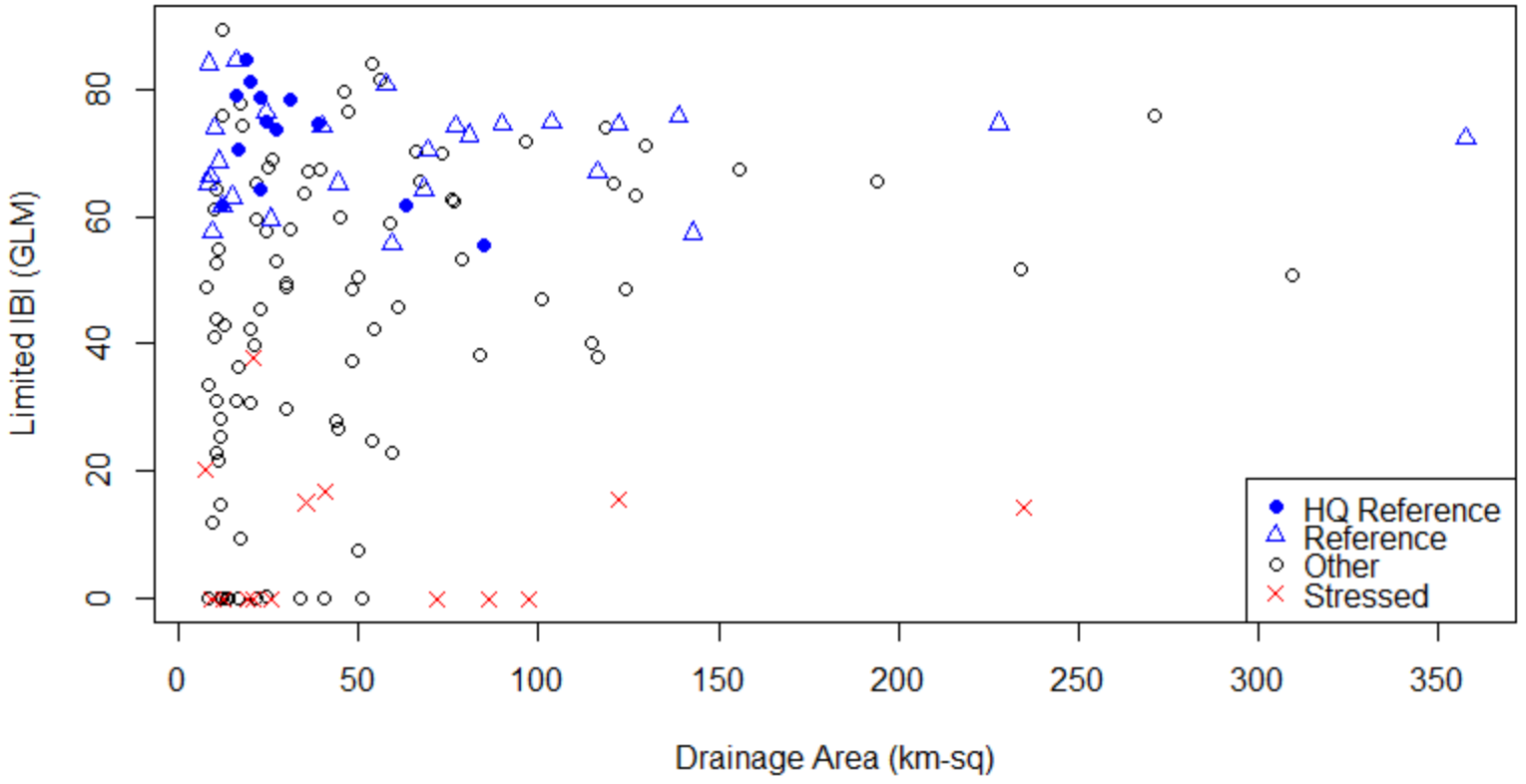
Shannon Weaver Trophic Index

METRIC SCORING

- 95th percentile of all sites set as ceiling
- 5th percentile of all sites set as floor
- Continuous linear scoring in between
- Same process as GLIMPSS

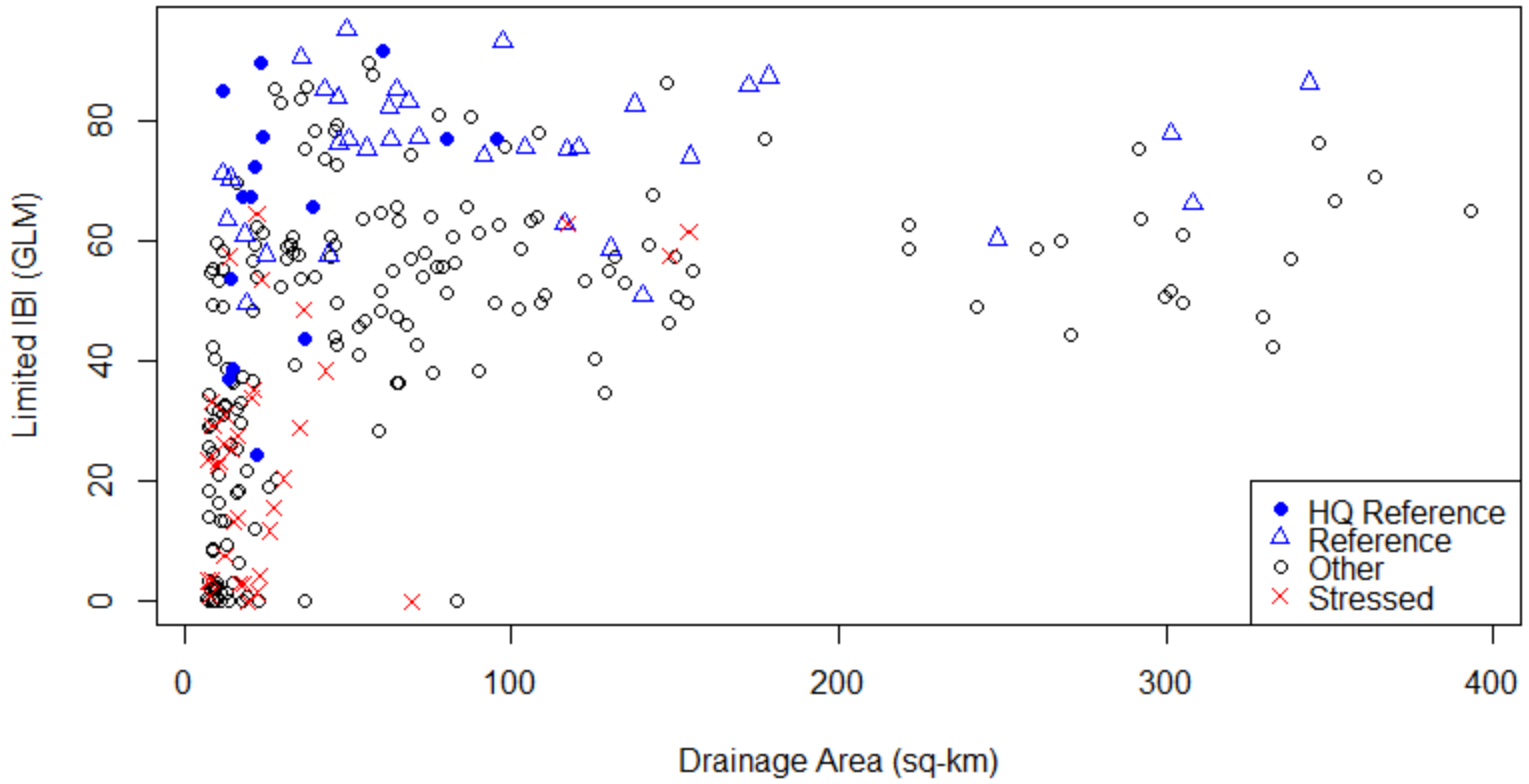
IBI VS. DRAINAGE AREA

Mon CA/RV



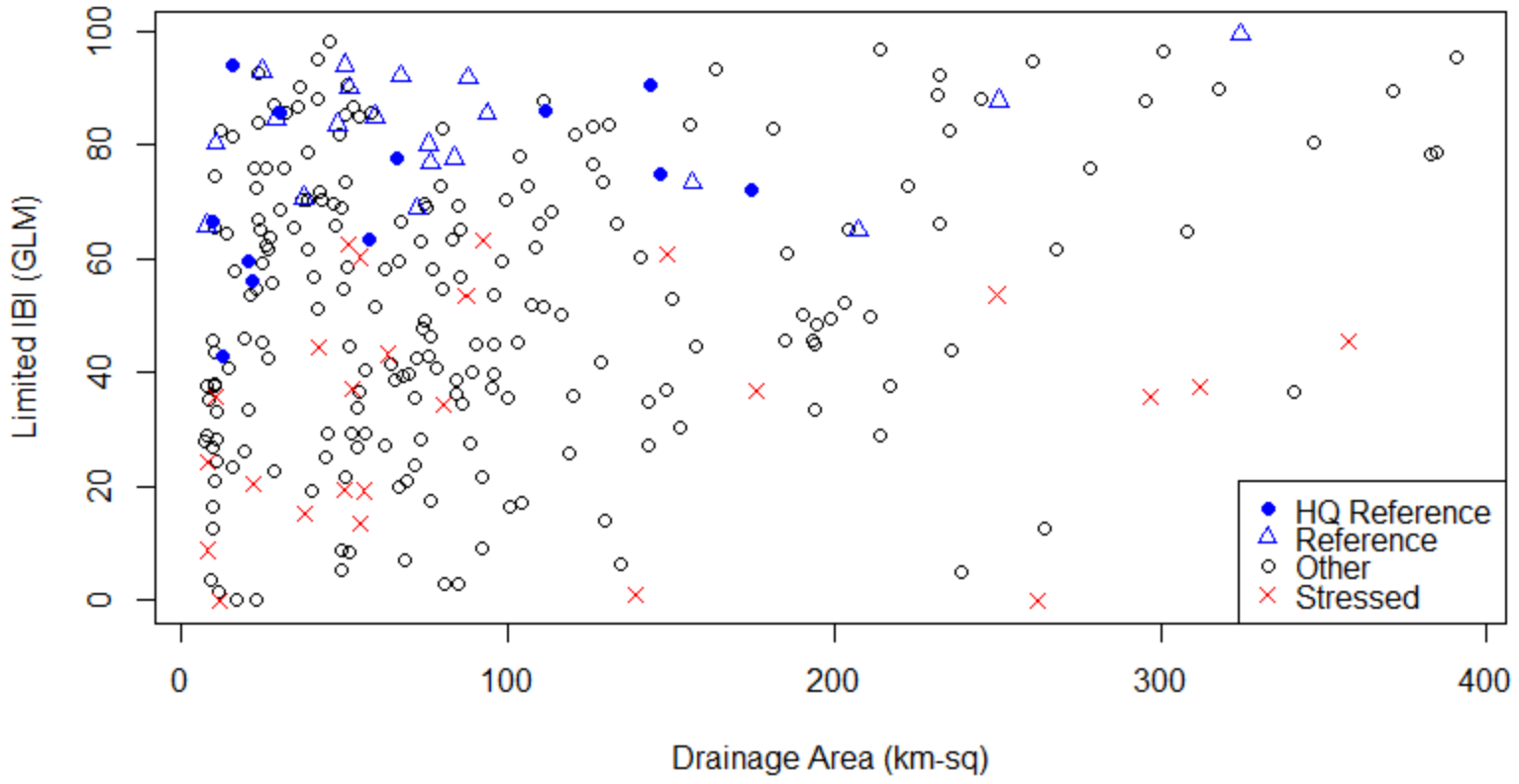
IBI VS. DRAINAGE AREA

Ohio CA



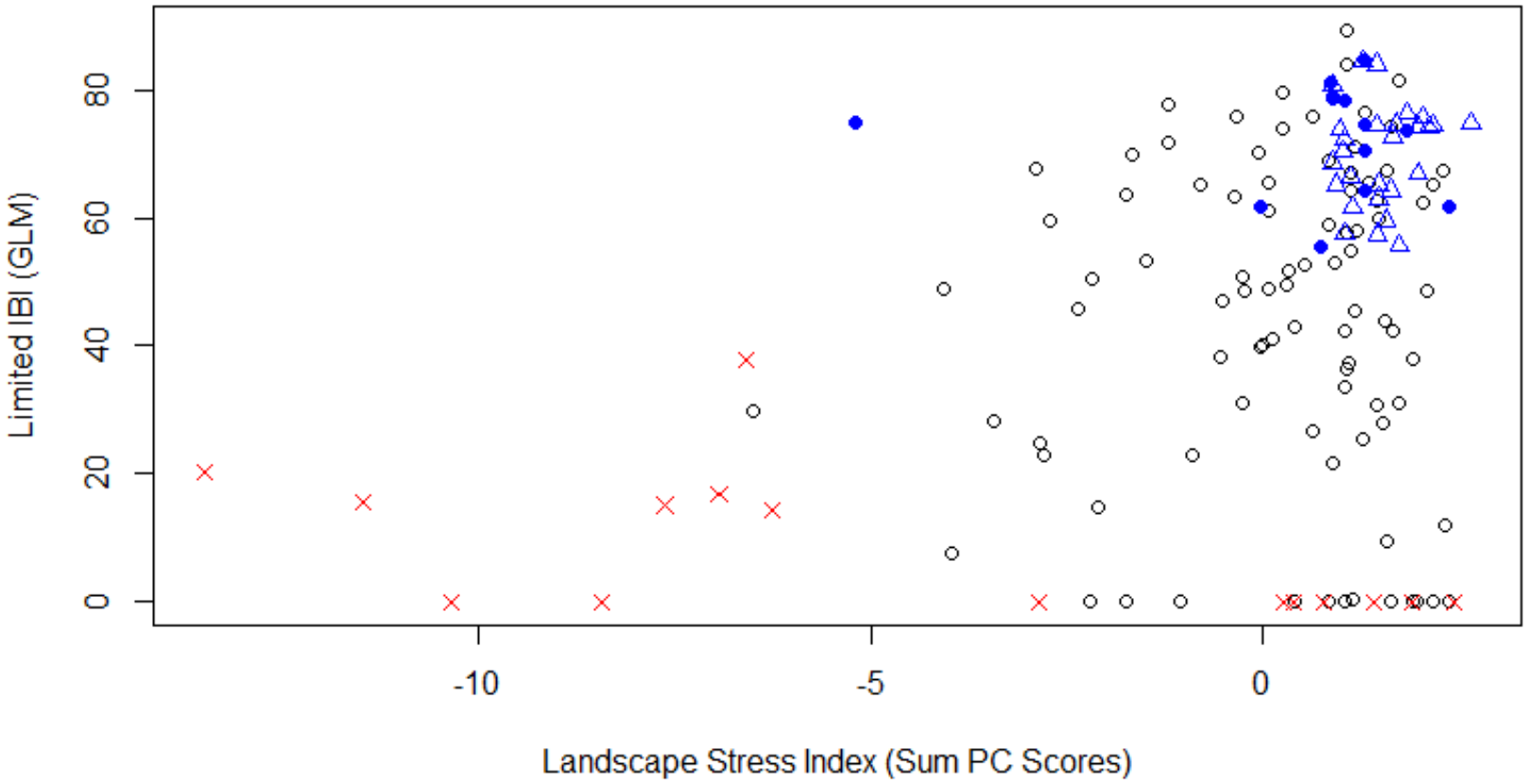
IBI VS. DRAINAGE AREA

Ohio/Mon WAP



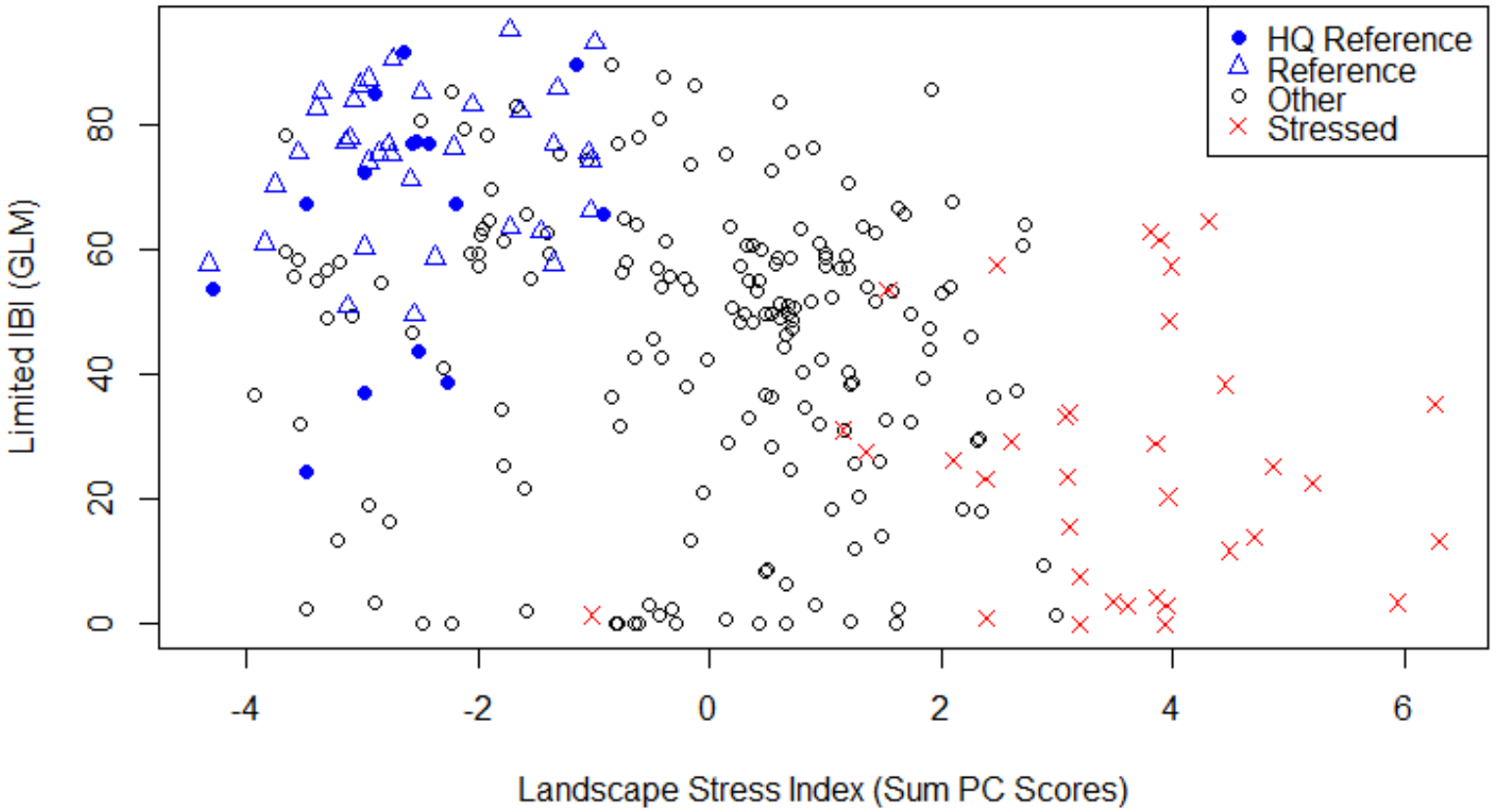
IBI RESPONSE TO STRESS

Mon CA/RV



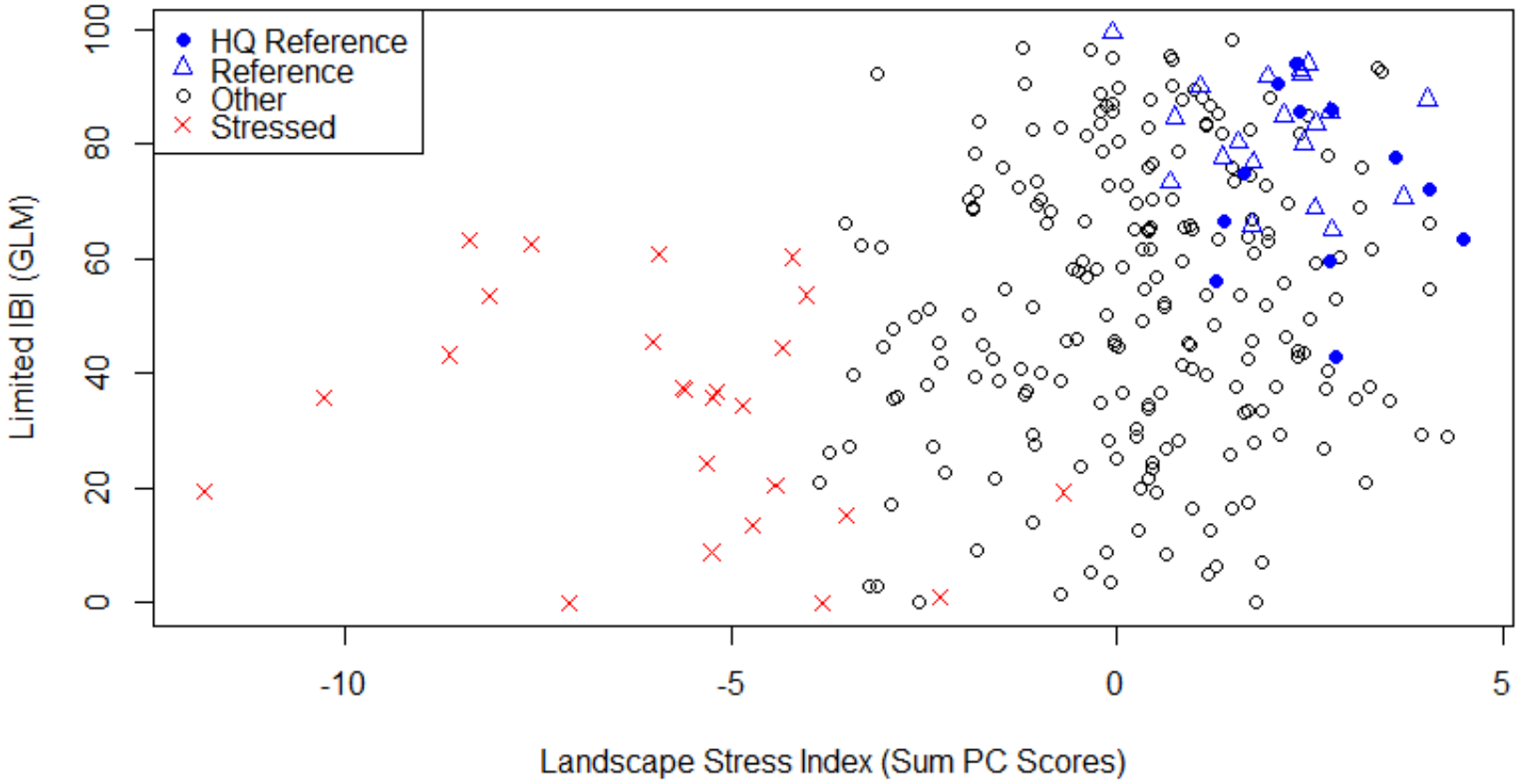
IBI RESPONSE TO STRESS

OHIO CA

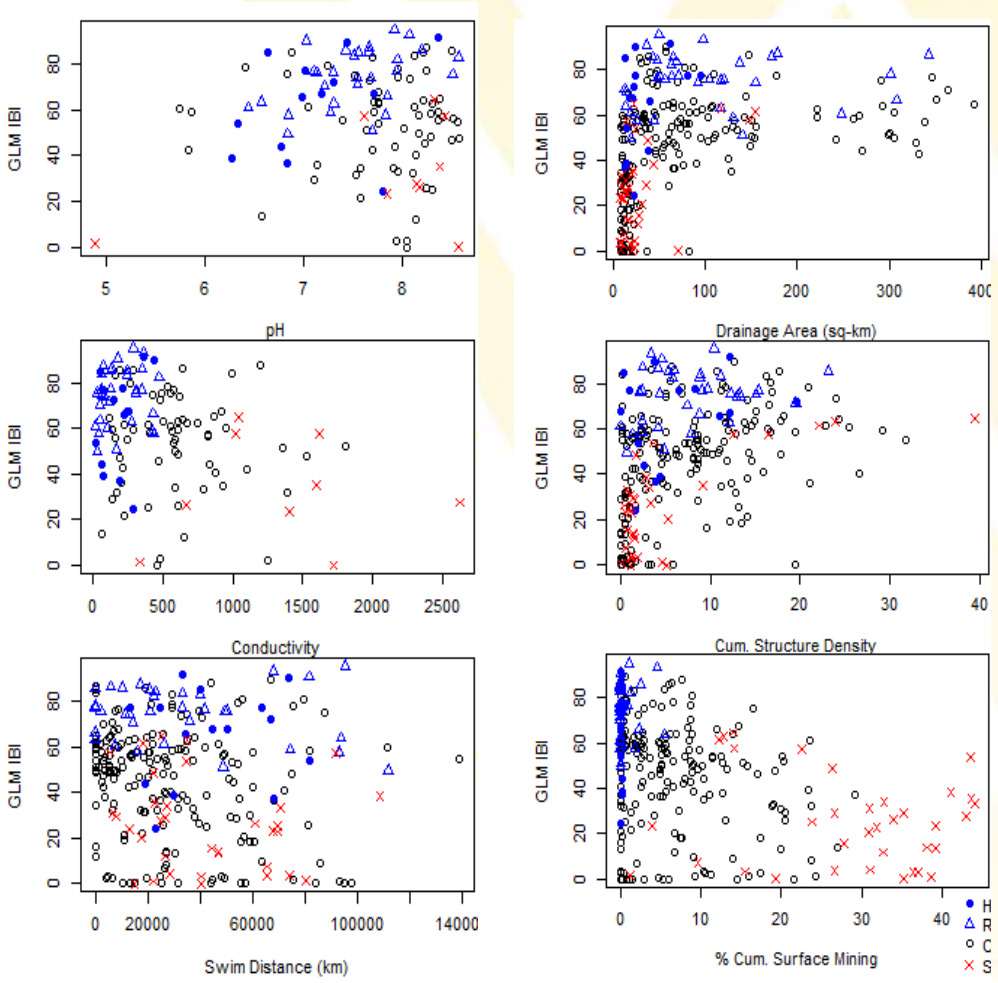


IBI RESPONSE TO STRESS

Mon / Ohio WAP

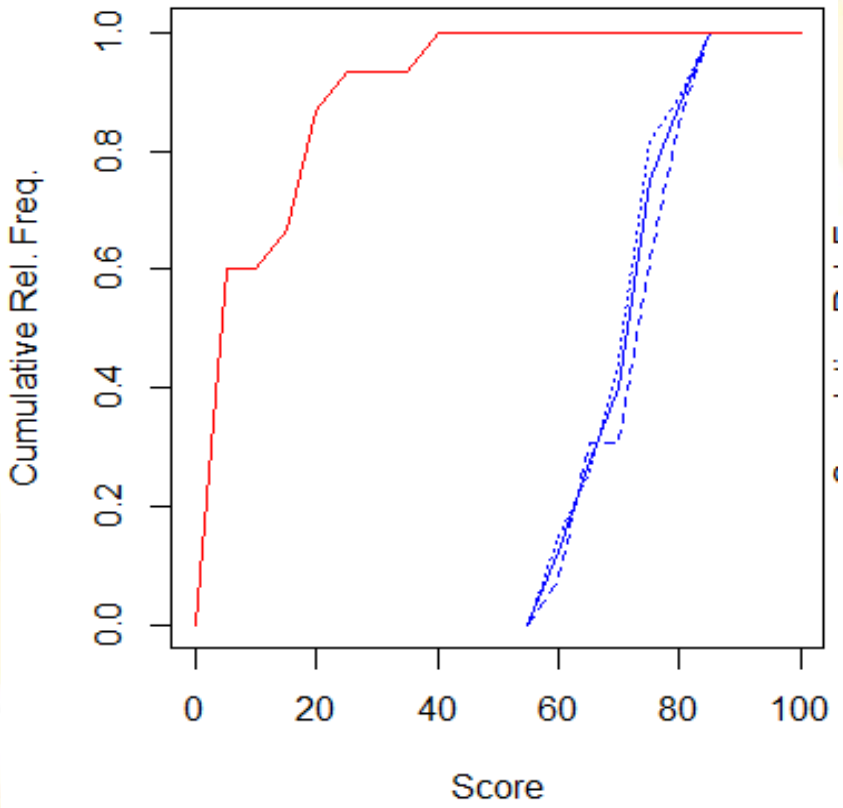


OHIO CA IBI VS. ENVIRONMENT

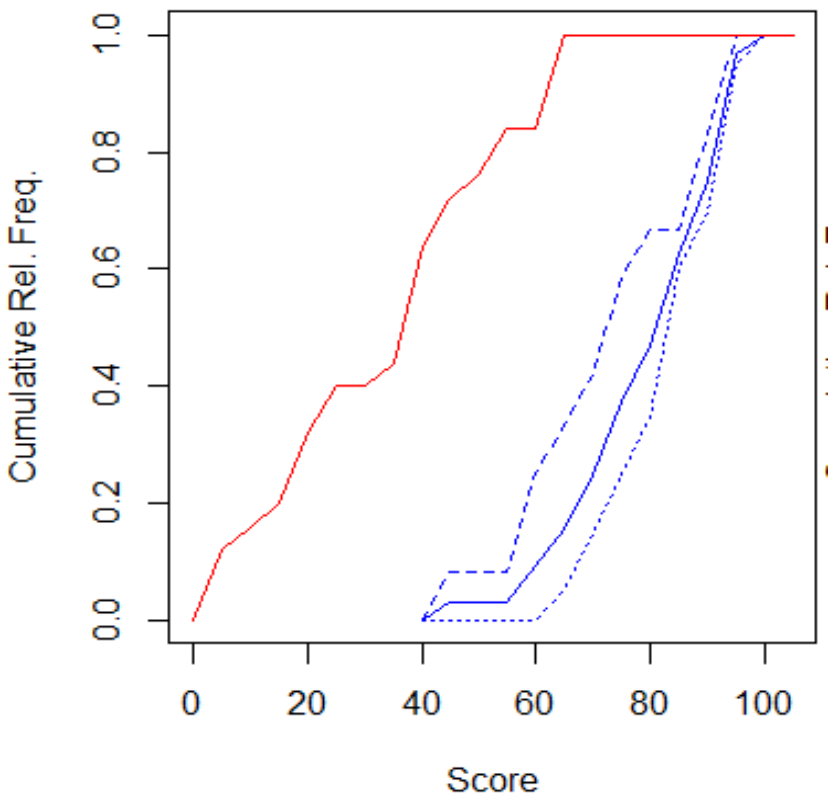


IMPAIRMENT THRESHOLDS

Mon CA/RV



Ohio/Mon WAP



IMPAIRMENT THRESHOLDS

Site Type	Mon CA / RV		Ohio CA		Ohio /Mon WAP	
	5th	25th	5th	25th	5th	25th
HQ Reference	59.3	64.1	33.2	48.9	50.1	62.3
Reference	57.4	64.7	55.7	64.9	65.8	76.0
All Reference	57.3	64.2	41.1	63.1	57.9	70.2

DISCUSSION

- **Strengths**
  - DA continuum
  - Model regions
  - Include Trophic Structure
  - Discriminating
  - Reasonably responsive to stress
  - Not redundant with WVSCI or GLIMPSS
- **Weaknesses**
  - Metric adjustments are complicated
  - Variation across regions
  - Brook Trout streams

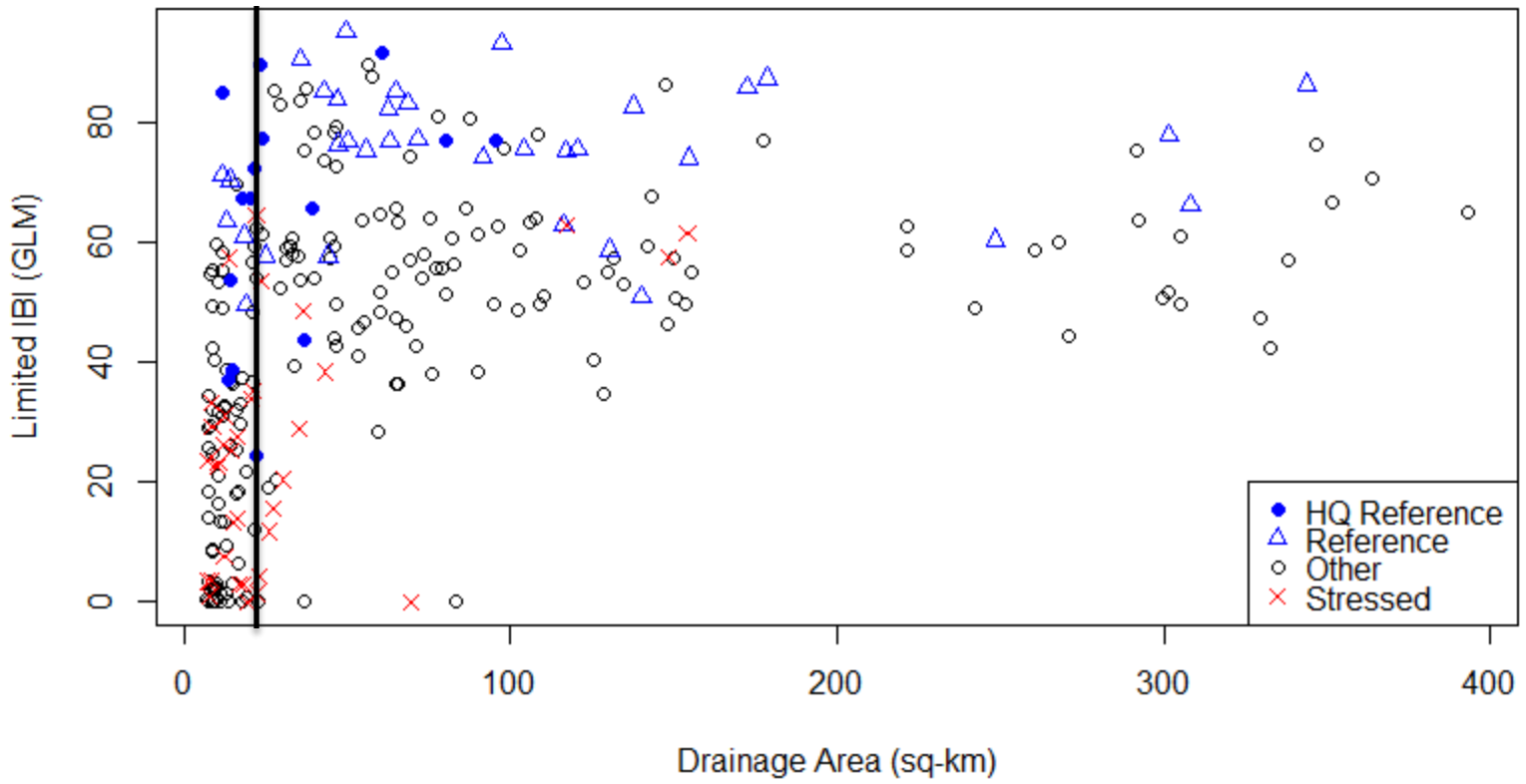
NEXT STEPS

- Complete UK and Pot model regions.
- Validation sampling.
- Integration of IBI with WVSCI to identify impaired waterbodies.
  - Drainage area weighted importance

    (WVSCI > 15km2 < IBI)

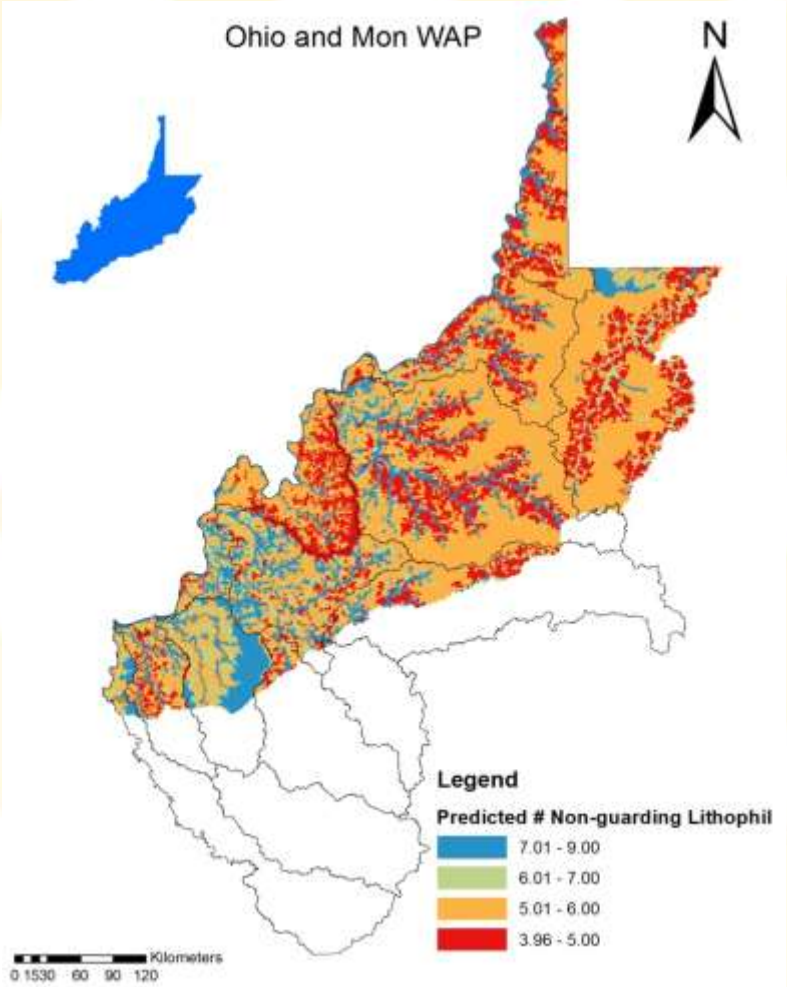
IBI VS. DRAINAGE AREA

Ohio CA

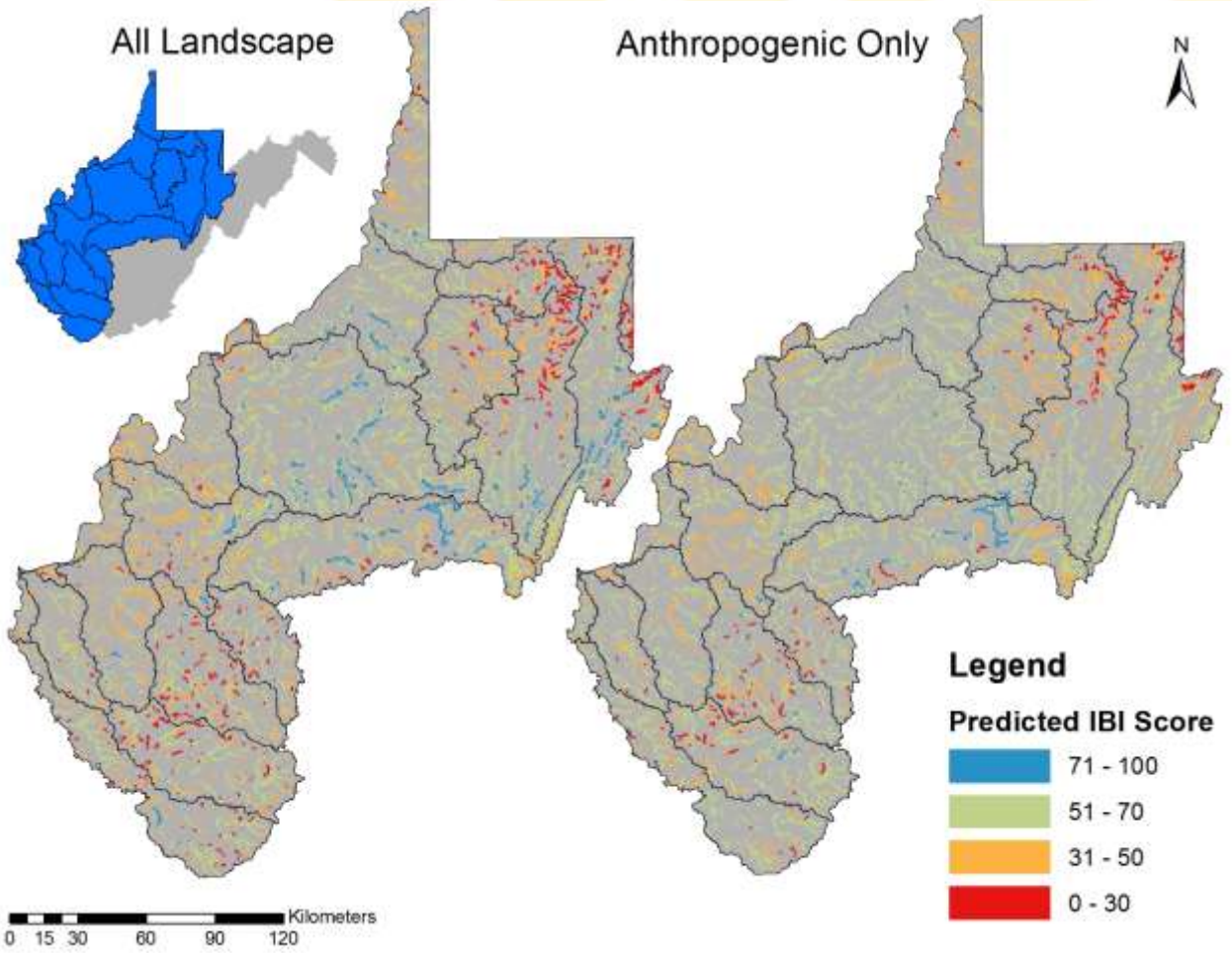


SPATIALLY EXPLICIT METRIC EXPECTATIONS

Web/GIS analytical support tool: site-specific metric expectations in absence of stress, automated IBI calculations, automated database updating.



EXPECTED IBI SCORES



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