"A Macroinvertebrate Predictive (RIVPACS) Model for Wadeable Streams of the Western Allegheny Plateau"

- Sheila H. North, M.S. Student

- Ohio University, EEB Program/BIOS Dept

- US EPA STAR Project Funds,'06-'08

Aquatic insects are indicators of stream health

Biomonitoring (A Global Perspective)

- Ohio (early 20th century), US (CWA)
- Europe, Australia, UK: predictive, *probability-based* models such as the *River Invertebrate Prediction and Classification System* (RIVPACS)
- Key U.S. scientists strongly recommend testing a RIVPACS-type model for U.S. application in stream restoration techniques
- US EPA & state agencies beginning to use…more exploratory modeling needed!!!

Recently Developed U.S. Predictive Models

- CA (Hawkins et al 2000)
- MAH & NC (Van Sickle et al 2005)
- OR (Van Sickle et al 2006)
- WY (Hargett et al 2007)
- OH* (fish – Knapp et al 2005; inverts – Hawkins et al, unpublished)

What is a Predictive Model?

- Observed:Expected (O/E) ratio based on local reference site taxa (presence/absence – thus no predefined guild categories)

- Localized stressor discrimination

- A potentially powerful means of describing spatial variation

Why Predictive Modeling?

- Grounded in ecological niche theory

- Taxa replacements (as conditions change)

- Biological assemblages inherently variable in both temporal & spatial settings

- "Biological Integrity" & "Reference Condition" difficult to define

- *EPT not reliable for all impacts!!!*

Methodology

- Macroinvertebrate WAP dataset (presence/absence) acquired from OEPA (1982-2005) for WAP reference site taxa (H/D sampling, genus/species level – 191 taxa at Pc>0.0; 43 taxa at Pc>0.5)

- 80 single-sample reference site sites used for model development; 24 replicate samples selected for model evaluation

- Rare taxa omitted for initial cluster analysis; re-inserted into model for DFM and O:E

Continued…

- Hierarchical, polythetic, agglomerative cluster analysis (PC Ord v4.0) with Sorenson (Bray-Curtis) distance and flexible beta group linkage method (B=-0.25)

- Eight classes @ 38% distance remaining; 6-17 WAP reference sites each

- PCA to reduce # of hydrologic variables

- Stepwise DFM to reduce # variables (identify "predictors") followed by Non-Stepwise DFM on final set
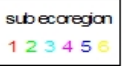
STAR Macro Soren Wards Minus Rare Ref 7 10 07

Distance (Objective Function)
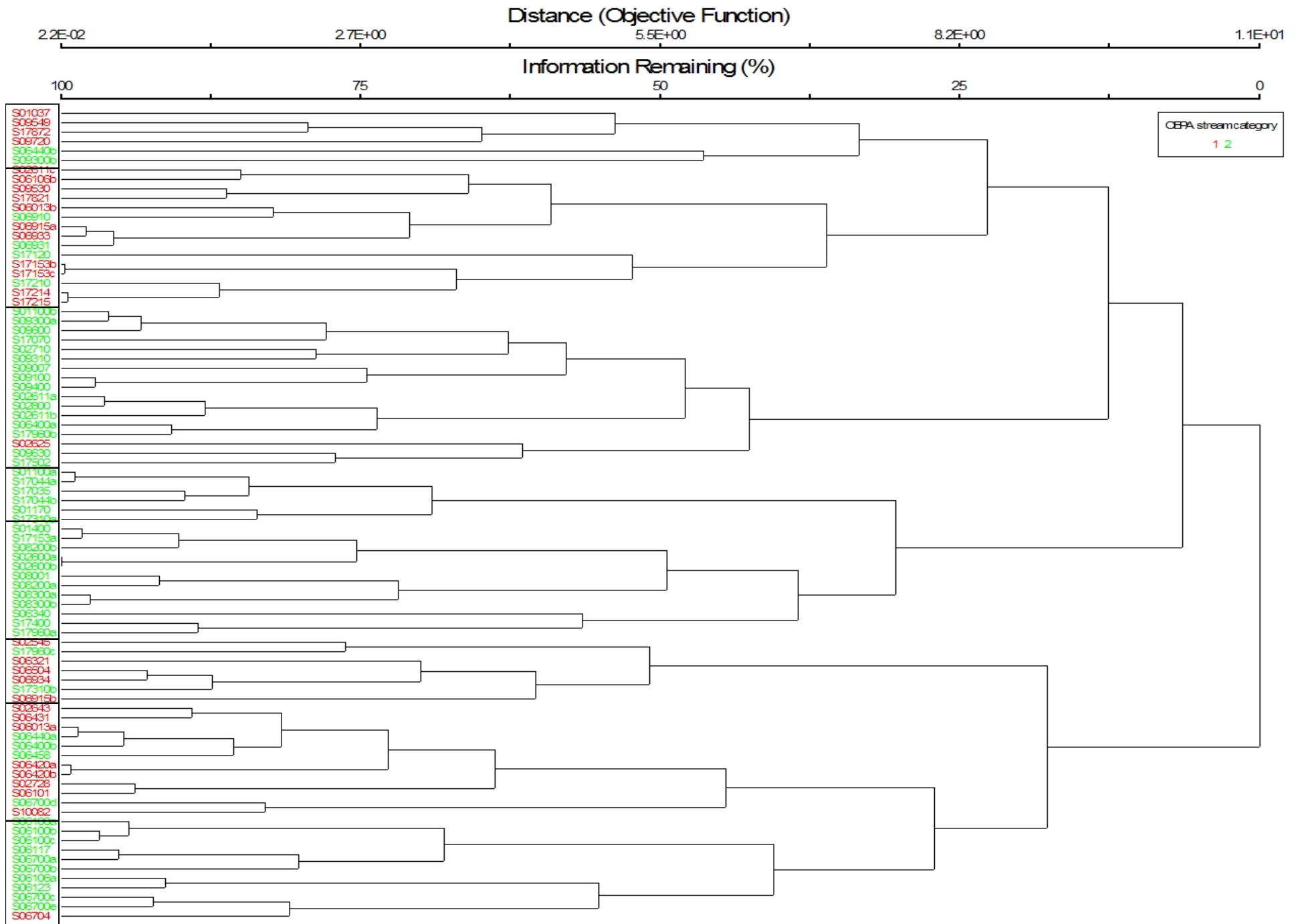
Information Remaining (%)

STAR Macro Soren Wards Minus Rare Ref 7 10 07

Possible "Predictor" Variables
(reduced via DFM/DFA)

Drainage Area; River Mile; Q302 (30 day low-flow with 2 yr R.I., cfs); QP75 (high-flow potential, cfs); Level IV Sub-ecoregion; Stream Category (Headwater or Wadeable); SVI (Stream Variability Index, USGS); QHEI Score (Overall); Substrate; Instream Cover; Channel Morphology; Riparian/Erosion; Pool/Current; Riffle/Run; Stream Gradient (USGS Topo) ; Lat/Long

Results….

Selected Predictor Variables

- QP75*

- Latitude

- Level IV Sub-Ecoregion

- Julian Day

- Stream Variability Index
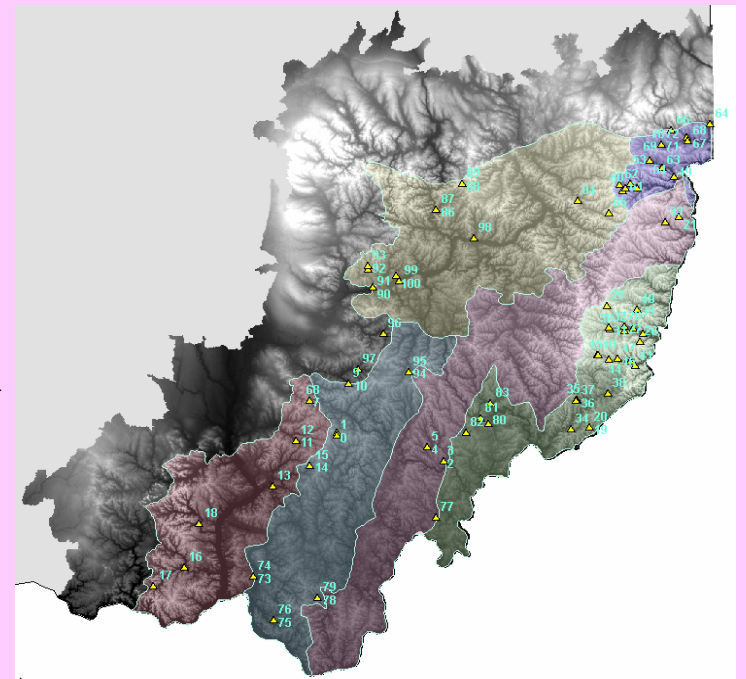
More Methodology

Calculated…

1) taxon frequencies for each cluster;
2) weighted frequencies;
3) Probabilities of Capture for each taxon;
4) Observed:Expected ratios (per site); and
5) Model validation using 24 replicate year samples.

Model Accuracy (thus far)

- DFA correctly classified 72 of 80 reference sites

- O:E ratios normally distributed for both model and validation reference sites

- O:E Standard Deviations:

0.20 (model)

0.12 (validation)

Impaired Sites
(Next steps, Spring 2008)

- Update hydrology data (USGS Streamstats)
- Classify impaired sites according to predictor data (discriminant functions)
- O:E ratio calculation
- Compare ratio distributions (impaired to reference)
- Types of WAP impairment?

Thanks to the EPA STAR Project Team, OU Faculty, OEPA, Chuck Hawkins, John VanSickle, etc...

Questions?
- Sheila H. North
- Tel (360) 601-1462
- OU/BIOS/EEB
- Athens, OH
- sn197796@ohio.edu