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

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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)
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
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?
Questions?
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