Developing a Lake Index of Biotic Integrity

For use with benthic macroinvertebrates in NYS

Outline

- Background on NYS lake assessment
- Project design and methods
- Developing the IBI:
  - Defining lake types
  - Assessing biological component metrics
  - Draft IBI
- Conclusions and Next steps
NYS Lake Water Quality Assessments

- Two main programs
  - Lake Classification and Inventory (LCI)
  - Citizens Statewide Lake Assessment Program (CSLAP)

- Focused on water chemistry, invasive spp., and recreation etc…
NYS Lake Water Quality Assessments

- Lake programs lack a biological assessment component
- NYS has a 43 yr. legacy of stream/river bioassessment
Design and Methods

- Establish sampling and processing methods
- Pilot the implementation of these operating procedures
- Develop a multimetric index of biotic integrity (IBI)

- Beginning in 2008:
  - Sampled approximately 10-12 lakes/yr.
  - Stratified by depth, trophic state and disturbance
Design and Method

- 55 lakes sampled
- 8-12 locations / lake
- Composite benthic sample
  - Single habitat samples
- 300 organism subsample
  - Grided tray sort
  - Lowest taxonomic resolution
- Surface Water Chemistry
  - 1m depth over deep hole
Lake Classification and Chemical Stressors

- BEST – Bio-Env.
  - Selects the variable subset (BEST subset) in one matrix which best matches the multivariate pattern in another matrix.

```
<table>
<thead>
<tr>
<th>k</th>
<th>Best variable combinations (ρw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H₂S    %Org  Sal   ...</td>
</tr>
<tr>
<td></td>
<td>(.62)  (.54) (.53)</td>
</tr>
<tr>
<td>2</td>
<td>H₂S, Sal H₂S, MPD H₂S, %Org Sal, %</td>
</tr>
<tr>
<td></td>
<td>(.76)  (.67) (.65) (.60)</td>
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<tr>
<td>3</td>
<td>H₂S, Sal, MPD H₂S, Sal, %Org H₂S,</td>
</tr>
<tr>
<td></td>
<td>(.80)  (.75)</td>
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</tbody>
</table>
```
BEST

- 22 possible chemistry variables
  - Big 4, Nutrients, Color/Transparency, Solutes
  - Screened for redundancy (Ca, Cl, Mg, Na, SO$_4$, Silica)

- 5 variable subsets
  - $r = 0.324$ Cond., **Alkalinity**, Color, Secchi, Ammonium
  - $r = 0.321$ **Alkalinity**, Color, Secchi, Ammonium, Potassium
  - $r = 0.317$ **Alkalinity**, Color, Secchi, Ammonium

Lake Shoreline Disturbance......habitat?!?!
TITAN

- Threshold Indicator Taxa ANalysis (TITAN)
  - Detect changes in taxa distributions along env. Gradients
  - Uses taxonomic data to report stressor changepoint

- TITAN Results:
  - 40 mg/L (Alkalinity as CaCO$_3$)
  - 180 µmhos/cm (Conductance)
Lake Classification (Alkalinity and Landuse)

- High and Low Alkalinity
  - ≥ 40 mg/L CaCO$_3$

- Landuse - % Natural Cover
  - 80% for High Alkalinity
  - 90% for Low Alkalinity

- Specific Conductance
  - ≤ 180 µmhos/cm
Evaluating Metrics by Lake Type

- Literature review of previous lake IBI projects
  - Tested 32 benthic community metrics
  - Tolerance, Functional, Diversity, Abundance etc…..

- Evaluation of metrics followed Barbour et al. (1996)
  - Removed redundant metrics (correlation and scatter plots)
  - Sensitivity based on interquartile range (IQR) overlap
Evaluating Metrics

- Metrics assigned sensitivity values:
  - 0 pts. – Extensive overlap of IQR
  - 1 pt. – One median outside IQR
  - 2 pts. – Both medians outside IQR
  - 3 pts. – No overlap of IQRs

High Alkalinity Metrics

Sensitive Metrics
- COTE
- Density
- Percent Model Affinity (FFG)
- No. Diptera Taxa
- % Chironomidae Indiv.
- % Facultative Indiv.
- % Intolerant Taxa
- % Oligochaeta Indiv.
- Species Richness
- Total No. Indiv. / Species
Low Alkalinity Metrics

- % Tolerant Indiv.
- ETO/ETO+Chilo+Olig.
- No. Diptera Taxa
- Percent Model Affinity (FFG)
- Diversity

* Removed, Curst./Moll. ~ highly correlated with alkalinity
Final Lake Multimetrics
Some new data!
Next Steps

- Develop an extensive independent lake dataset for evaluation and adjustment of IBI’s — *Focus on shoreline disturbance and habitat*

- Begin integration of field, lab, and assessment methods into RIBS cycle and reporting??

- Working with TITAN to develop tolerance value metrics for lake specific macroinvertebrate taxa
Thank You

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