Comparison of Random and Road – Accessible Stream Sites

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Potential Costs:

- Desktop recon / Landowner(s) contacts
- Site recon
- Sampling visits
- Landowner denials / non-responses
- Using more transportable sampling gear
Assessment of wadeable stream resources in the Driftless Area ecoregion in western Wisconsin using a probabilistic sampling design

Driftless Area Ecoregion

- 20% of WI land area
- 8,800 mi. perennial streams
$600 million in direct spending on trout angling in Driftless Area each year*

*Source: North Star Economics Inc.*
Study Design:

• One ecoregion
• Unequal probability sample; 60 streams
• Random and “bridge” reach sampled on each
• Stream dropped if Strahler order difference >1
• Reach 35 x MSW; > 10 MSW from roadways
• Phys, chem, bio parameters (n=35)
Driftless Area fourth order stream
<table>
<thead>
<tr>
<th>Field Parameters Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Habitat</strong></td>
</tr>
<tr>
<td>Buffer width</td>
</tr>
<tr>
<td>Width / Depth ratio</td>
</tr>
<tr>
<td>Total pool length</td>
</tr>
<tr>
<td>% Fine sediment</td>
</tr>
<tr>
<td>Sinuosity</td>
</tr>
<tr>
<td>Bank erosion</td>
</tr>
<tr>
<td>% Sand / Silt / Clay</td>
</tr>
<tr>
<td>Distance between bends</td>
</tr>
<tr>
<td>Total riffle length</td>
</tr>
<tr>
<td><strong>Chemistry</strong></td>
</tr>
<tr>
<td>Kjeldahl N</td>
</tr>
<tr>
<td>NH$_3$</td>
</tr>
<tr>
<td>NO$_3$ + NO$_2$</td>
</tr>
<tr>
<td>Transparency</td>
</tr>
<tr>
<td>D.O. % saturation</td>
</tr>
<tr>
<td>Dis. Phosphorus</td>
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<tr>
<td>Total Phosphorus</td>
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<tr>
<td>Conductivity</td>
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<tr>
<td>D.O. conc.</td>
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<tr>
<td>Temperature</td>
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<tr>
<td>pH</td>
</tr>
<tr>
<td><strong>Biology</strong></td>
</tr>
<tr>
<td><strong>Invertebrates</strong></td>
</tr>
<tr>
<td>Species richness</td>
</tr>
<tr>
<td>% EPT (indiv.)</td>
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<tr>
<td>% EPT (genera)</td>
</tr>
<tr>
<td>% shredders</td>
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<tr>
<td>HBI</td>
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<tr>
<td>% scrapers</td>
</tr>
<tr>
<td>Shannon’s Div. Index</td>
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<tr>
<td><strong>Fish</strong></td>
</tr>
<tr>
<td>Species richness</td>
</tr>
<tr>
<td>No. intolerant species</td>
</tr>
<tr>
<td>% brook trout</td>
</tr>
<tr>
<td>No. fish captured</td>
</tr>
<tr>
<td>% top carnivores</td>
</tr>
<tr>
<td>IBI</td>
</tr>
<tr>
<td>% tolerant individuals</td>
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<tr>
<td>% stenotherms</td>
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</tbody>
</table>
Sample Population Results:

- Of candidate sites, 71 dropped
- Total of 58 streams (116 sites)
- Distance between random and bridge sites: 100m – 2.3km (mean: 700m)
- 21% of stream population (1st orders - mostly) not near roadways
Data Analyses:

- Random and bridge site correlations
- T-tests of weighted sample means
- CDFs of weighted samples
Results: random and bridge site correlations

- 18 of 35 field parameters presented
- Physical, chemical, biological examples
- Best-fit line black, 1:1 line green

Field Parameter

\[ R^2 = \]

![Graph showing correlation between random and bridge sites with an R² value of 0.8292.](image-url)
Random and Bridge Site Relationships (Habitat)

- **Stream Width (m)**: $R^2 = 0.93$
- **Water Depth (m)**: $R^2 = 0.70$
- **Width / Depth Ratio**: $R^2 = 0.33$
- **Sediment Depth (m)**: $R^2 = 0.49$
- **Width Bare Soil in Buffer**: $R^2 = 0.55$
- **Total Pool Length (m)**: $R^2 = 0.003$, $p = 0.70$
Random and Bridge Site Relationships

(Chemistry)

- Water Temperature (°C): $R^2 = 0.83$
- Dissolved Oxygen (mg/L): $R^2 = 0.57$
- Transparency (cm): $R^2 = 0.76$
- Nitrate + Nitrite (mg/L): $R^2 = 0.87$
- Total Phosphorus (mg/L): $R^2 = 0.78$
- Dissolved Phosphorus (mg/L): $R^2 = 0.90$
Random and Bridge Site Relationships

(Biology)

- Invert. Species Richness: $R^2 = 0.50$
- Hilsenhoff's Biotic Index: $R^2 = 0.63$
- Invert. Shannon's Index: $R^2 = 0.59$
- % Scrapers: $R^2 = 0.45$
- Fish Index of Biotic Integrity: $R^2 = 0.71$
- Fish % Tolerant Individuals: $R^2 = 0.49$
Results: Correlation Averages

- Habitat: $R^2 = 0.50$
- Biology: $R^2 = 0.56$
- Chemistry: $R^2 = 0.78$
Results: paired t-tests* of weighted means of random and bridge sites populations

• No significant differences between random and bridge site populations at $\alpha = 0.05$
Results: Population Condition Estimates

- Weighted means of sample population data
- Cumulative Distribution Function (CDF) plots
- Kolmogorov-Smirnov test
- Red lines random sites data, black are bridge sites
- Stippled lines are 95% CIs
Population Condition Estimates (Biology)

Hilsenhoff’s Bio. Ind.

Fish IBI

% EPT

Fish % Stenotherms

Invert. Spp. Richness

% Tolerant Fish
Overall Results

- Correlation coefficients significant (except pool habitat)
- No significant differences in t-tests of weighted means
- Significant overlap of CDFs, no differences based on K-S
Caveats and Considerations:

• Land cover / land use heterogeneity
• Road density
• Less road access to first order streams
Conclusions:

• What was learned?
• What difference does it make?
• What does it mean for this audience?
Questions?
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Random and Bridge Sites Relationships (all ecoregions)

Stream Width (m)

R² = 0.89

Fish Index

R² = 0.73

Phosphorus (mg/L)

R² = 0.77

Bridge

Random