Reference sites and reference condition for Biological Condition Gradient (BCG) development

Portland
1 May, 2012
## Collaborators

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<thead>
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<th>Name</th>
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<tbody>
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<td>Minnesota PCA</td>
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<td>Kayla Bowe</td>
<td>Red Lake Band of Chippewa, DNR</td>
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<td>Joel Chirhart</td>
<td>Minnesota PCA</td>
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<td>U. Wisconsin Stevens Point</td>
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<td>Fond du Lac Band of Lk. Superior Chippewa</td>
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<td>Daniel Helwig</td>
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<td>Benjamin Lundeen</td>
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<tr>
<td>Michael Miller</td>
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<td>John Sandberg</td>
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<td>Kurt Schmude</td>
<td>U. Wisconsin Superior</td>
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<td>Nancy Schuldt</td>
<td>Fond du Lac Band of Lk. Superior Chippewa</td>
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<td>James Snitgen</td>
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<td>Jen Stamp</td>
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The Biological Condition Gradient

- Conceptual model of ecological knowledge and theory to describe changes with increasing stress
- Practical application/calibration uses combination of empirical information and professional judgment and experience
- *Can professional judgment help inform descriptions of minimally disturbed aquatic communities?*
The Biological Condition Gradient

Natural variability increases with increasing levels of stressors.

1. Natural structural, functional, and taxonomic integrity is preserved.
2. Minimal changes in structure & function.
3. Evident changes in structure and minimal changes in function.
4. Moderate changes in structure & minimal changes in function.
5. Major changes in structure & moderate changes in function.
6. Severe changes in structure & function.

Increasing Level of Stressors
The Biological Condition Gradient

Increasing Level of Stressors

1. Natural structural, functional, and taxonomic integrity is preserved

2. Minimal changes in structure & function
   Structure & function similar to natural; some additional taxa & biomass; ecosystem functions fully maintained.

3. Moderate changes in structure & minimal changes in function

4. Major changes in structure & moderate changes in function

5. Severe changes in structure & function

6. No discernible structure or function
The Biological Condition Gradient

Natural Variability

Biological Condition

Increasing Level of Stressors

1. Natural structural, functional, and taxonomic integrity is preserved

2. Evident changes
   - Loss of some highly sensitive taxa; replacement by less sensitive taxa; shifts in relative abundance; ecosystem level functions fully maintained through redundant attributes of the system.

3. Major changes in structure & moderate changes in function

4.

5. Severe changes in structure & function

6.
BCG Calibration

- Classification
- Identify stressor gradient
- Define expectations
- Identify attributes and metrics
- Develop rules for assigning sites (decision criteria)
Define Expectations:
Describe undisturbed

- Best sites (reference) are not necessarily undisturbed!
- Capture critical information for decisions
Maine best: Minimally disturbed
Connecticut, New Jersey best: Least disturbed
Wisconsin/Minnesota Driftless Area best: Least disturbed
Minnesota (wetland) best:
Minimally disturbed
Example: Minnesota Disturbance Index

- 8 metrics, score 0–81:
  - Agricultural land use
  - Urban land use
  - Animal units (feed lots)
  - Point sources
  - Watershed riparian disturbance
  - Site riparian disturbance
  - Watershed channelization
  - Site channelization

- Metric scores modified by proximity, slope, other considerations

- Site-specific factors not considered
Upper Midwest BCG development

- Panels of fish, invertebrate experts examined stream samples
- Panels assigned taxa to BCG attributes
- Identity of stream and disturbance score hidden from panel
- Panel assigned consensus BCG levels to each sample
Stream Classes (MN)

- Northern Forest Rivers
- Southern rivers
- Northern Forest Riffle–Run
- Northern Forest Glide–Pool
- Southern Riffle–Run
- Southern Hardwood Glide–Pool
- Prairie Glide–Pool
- Northern Coolwater
- Southern Coolwater (karst)

- Northern Forest Rivers
- Prairie Rivers
- Northern Wadeable Streams
- Northern Headwaters
- Southern Wadeable Streams
- Southern Headwaters
- Wetland Streams
- Northern Coolwater
- Southern Coolwater (karst)
Identify attributes and metrics

fish

Attribute 1 taxa:
Rare or endemic (river spp)

greater redhorse

American eel
Identify attributes and metrics fish

Attribute 2 taxa: most sensitive; the first to disappear

- Slimy sculpin
- Northern brook lamprey
- Wild brook trout
Identify attributes and metrics
fish

Attribute 3 taxa: Intermediate sensitive

burbot

Hornyhead chub

Northern redbelly dace
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BCG Level 1 site

St. Croix River

- 26 species
- Dominated by sensitive spp
- Rare spp present
Problematic species

nonnative trout

really cool bugs
Panel BCG decisions and the Disturbance Gradient

Minneapolis Fish - All Streams

Human Disturbance Score

Consensus BCG level
Northern Wadeable Streams

Fish

Consensus BCG level vs. Human Disturbance Score

- Median
- 25%-75%
- Non-Outlier Range
- Outliers
- Extremes
Wetland Dominated Streams

Fish

Consensus BCG level

Human Disturbance Score

- Median
- 25%-75%
- Non-Outlier Range
- Outliers
- Extremes
Lessons – assemblages

- Fish:
  - historical observations
  - museum collections, archeology
  - historic distributions of spp. generally known

- Invertebrates:
  - museum collections
  - historical distributions not generally known.
  - Mussels: middens, if documented
Lessons Learned – reference

- Professional experience informs expectations
- Reference sites provide ground truth
- Professional experience bolsters expectations for (nonexistent) minimally disturbed
  - Based on ecological considerations, not a particular data set
  - Not dependent on statistical comparison to specific reference set
- Classification is critical!