California Biological Condition Gradient Model

The BCG Team
Tetra Tech
SCCWRP
Our Bug and Algal Experts
Some things start with a graph...

• “What does a value of 62 for the ASCI mean?”
  • It is 15\textsuperscript{th} percentile of reference.

• “But, what does that mean ecologically?”
  • It is no longer like reference.

• “I think I’d like to know what that means – what’s been lost.”
What is the narrative of this adventure?

• Biological indices are powerful tools for assessment AND California has very sound indicators BUT numeric values do not communicate the ecological change associated with an index THEREFORE we want to use the BCG calibration effort to do that.

• BCG models convey, in ecological terms, the breadth and depth of ecological change in a way numbers often cannot.
**Desired Outcomes: A Crosswalk Between CSCI and ASCI and BCG Levels**

- Map biotic response/nutrient thresholds to BCG scores
- Translate assessment endpoints into BCG context

![Graph showing ASCI vs Average BCG Score with threshold from Piecewise Regression and 25th% reference site scores]
Desired Outcomes: Interpretation of the Ecological Change Associated with Specific Nutrient Thresholds

Key graphic is the basis for discussion between the Water Board and its Advisory Groups on decisions on assessment endpoints and default numeric targets.
What we are not doing

- We are **not** building another index
- The CSCI (and eventually the ASCI) are the tools to assess biological condition
- The BCG calibration will be a tool to help interpret those indices

**“What does a value of 62 for the H20 mean?”**

- It is where evident changes in structure due to loss of native taxa begins with shifts in relative abundance, but no loss of function.
What the BCG involves.

Levels of Biological Condition

1. Natural structural, functional, and taxonomic integrity is preserved.
2. Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.
3. Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.
4. Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.
5. Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.
6. Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.

Watershed, habitat, flow regime and water chemistry as naturally occurs.

Chemistry, habitat, and/or flow regime severely altered from natural conditions.
We needed to find the brains first.

**Experience and Knowledge**

**Invertebrates**
- Larry Brown (USGS)
- Jim Carter (USGS)
- Dave Herbst (SNARL)
- Jeanette Howard (TNC)
- Bill Isham (Amec Foster-Wheeler)
- Patina Mendez (UC-Davis)
- Allison O’Dowd (Humboldt State)
- John Olson (Cal State-Monterey)
- Andy Rehn (CFG)

**Algae**
- Don Charles (Phil. Acad. Nat. Sci./Drexel)
- Rosalina Hristova (Cal State – San Marcos)
- Rex Lowe (Bowling Green State Univ.)
- Yandong Pan (Portland State Univ.)
- Sarah Spaulding (USGS)
How does this work again?

Step 1 (Webinar 1 – Oct. 2016)
• Introduce the BCG model and process to experts
How does this work again?

Step 2 (Webinar 2 – Nov. 2016)
• Identify which taxa reflect which BCG attributes
  • Gain consensus on this
• Agreement on general taxonomic attributes is important
• Used to generate datasheets for scoring
• Experts submitted attribute assignments as homework

Attributes
I) Documented, sensitive, long-lived or endemic taxa
II) Highly sensitive or specialist taxa
III) Sensitive and common taxa
IV) Taxa of broad, intermediate tolerance
V) Tolerant taxa
VI) Non-native taxa
How does this work again?

Step 3 (Workshop 1 – Nov. 2016)
• Resolve remaining attribute consensus issues
• Practice assigning sites to BCG levels
• Separate effort for inverts and algae
• Describe assignments – what is missing or present?

Hypothetical Invertebrate Worksheet

<table>
<thead>
<tr>
<th>Taxon Abundances:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = 12</td>
</tr>
<tr>
<td>2 = 13</td>
</tr>
<tr>
<td>3 = 7</td>
</tr>
<tr>
<td>4 = 34</td>
</tr>
<tr>
<td>5 = 40</td>
</tr>
<tr>
<td>6 = 10</td>
</tr>
<tr>
<td>7 = 3</td>
</tr>
<tr>
<td>8 = 14</td>
</tr>
<tr>
<td>9 = 20</td>
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</tbody>
</table>

ExhibitID Sample001 Assigned Tier Reasoning
Collection Date 7/3/2007
Collection Method BMI JW

<table>
<thead>
<tr>
<th>Taxa SUMMARY</th>
<th>Number of Taxa</th>
<th>Count</th>
<th>Pri Taxa</th>
<th>Pri Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>7</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>57</td>
<td>28%</td>
<td>19%</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>121</td>
<td>33%</td>
<td>4%</td>
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<tr>
<td>7</td>
<td>6</td>
<td>115</td>
<td>33%</td>
<td>38%</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>9</td>
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<td>0%</td>
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<tr>
<td>Total</td>
<td>18</td>
<td>300</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Mystery Creek
Elevation = 300m
0 = 11
E = 16.5
Geology = Y
Ecoregion = X
Taxonomic Richness = 11 (17)
Stream order = 2
Shredder Taxa Richness = 4 (7)
Wetted width = 3m
Percent Clinger Taxa = 34% (45%)
Percent EPT Taxa = 25% (40%)
Percent Coleoptera Taxa = 18% (25%)
Percent Intolerant Individuals = 35% (55%)
How does this work again?

Step 3 (Homework - Dec. 2016)

- Experts assigned 200 sites to BCG levels individually and recorded reasoning...then wanted 50 more!!
What if they don’t agree?

Step 3 (Workshop 2 – Jan. 2017)

- Review samples with high variability in assigned BCG levels
- Re-vote, based on reasoning (modified Delphi)
- Final BCG assignments and indices may/may not agree – that is fine
- Also, this is done separately for inverts and algae – scores may disagree – also fine

<table>
<thead>
<tr>
<th></th>
<th>CSCI</th>
<th>ASCI</th>
<th>Expert 1</th>
<th>Expert 2</th>
<th>Expert 3</th>
<th>Expert 4</th>
</tr>
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<tbody>
<tr>
<td>Site X</td>
<td>0.3</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Site Y</td>
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<td>0.7</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Site Z</td>
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<td>0.3</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Site A</td>
<td>0.5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

“This sample is a BCG level 3 because it has plenty of sensitive taxa and a good balance of functional groups.”

“It is a 2 because most of the CSCI metrics meet expectations”

“It is not a 2 because it is missing some taxa that should be in an undisturbed site”
What we will have at the end

- Sites with CSCI scores
- Sites with ASCI scores
- Expert consensus BCG level assignment for those same sites
- Expert interpretation of why those assignments were made

<table>
<thead>
<tr>
<th>Site X</th>
<th>CSCI</th>
<th>Expert 1</th>
<th>Expert 2</th>
<th>Expert 3</th>
<th>Expert 4</th>
<th>Consensus</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Vote</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
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<tr>
<td>Revote</td>
<td>0.3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

“The sample is a BCG level 5 because it is lacking sensitive taxa (no attribute 2 and few 3s), is dominated by tolerant taxa (55% attribute 5s), and shows an imbalance of functional groups. It is not a level 6 because there is at least 1 attribute 3 and richness shows some diversity (>15 taxa). This agrees with a CSCI score of 0.30.”
Where are we now?

- BCG attributes for all CA algal and bug taxa

- We’ve scored 250 sites across CA based on both algae and bug

- Reconciled large disagreements

- Compiled full ecological narratives for each level

- Compiling data and preparing for crosswalk analysis
Next steps: crosswalk

• What is the distribution of CSCI scores by BCG category?

• How is the CSCI translated into degrees of biological impact?
Next steps: crosswalk

• E.g., Alabama BCG

Figure 51. Alabama macroinvertebrate MMI distributions in site classes and BCG levels.
Next steps: ecological interpretation

• A CSCI of 0.7 is where we see a threshold in stressor response.

• “That CSCI score is associated with a loss of many sensitive taxa and is just above where tolerant taxa may begin replacing these taxa. Functional alteration often begins below this as well.”
Next steps: interpreting existing patterns

- What are the best conditions of channels in developed landscapes?
- What ecological characteristics can the best of those maintain?
- How does that inform goals for modified channels?
Next steps: communicating

- Technical Reports
- Peer Reviewed Manuscripts
  - Both groups interested
- Modified Delphi Process
- Results and Patterns
- Comparisons
Questions?