Outline

1. Understand advantages and limitations of rapid bioassessment approaches

2. Delineate and assign reference conditions based on study objectives

3. Understand how to calibrate and evaluate results from rapid assessments

Biological Monitoring

- What is the basis of biological monitoring
  - Detect positive and negative trends

- Can be difficult to know the nature of some trends

- Long-term data-sets are often required
About data quality

Manipulative Data
Best!

BUT
Not Always the Best Option
1. Feasibility
2. Past Disturbance
3. so how.....
4. Anchor w/ reference

Biological or Condition Assessment Techniques

- A general class of monitoring techniques that can be used to evaluate the ecological condition of a particular site.

- Intensive and non-intensive approaches (Index of Biological Integrity, Rapid Approaches, Basic Checklists)

- Generally a final assessment approach will involve multiple assessment methods

Bioassessment Planning

1. Clearly establish monitoring objectives and identify appropriate indicators
2. Establish gradient
3. Define overall scale
4. Designate reference conditions (wetland types)
5. Determine appropriate level of data resolution
6. Develop and calibrate rapid assessments tools
Wetland Condition Indicators
- Habitat structure, diversity, complexity
- Species complexity
- Hydrology or geomorphology
- Biogeochemistry or water quality
- Landscape context
  - Connectivity
  - Buffers

Condition Gradient
- Gradient can represent disturbance, forest age, etc.
  - GIS, used to determine disturbance
- Varies greatly on objectives
- Should encompass all stages of gradient
- Increase strength of overall condition assessment

General Stressor Gradient

E. Stein, pers. comm. (2011)

Davies and Jackson 2006
Assessment Scale

- Determined by assessment objectives
  - Single wetland type; multiple types
  - Probabilistic sampling design
  - Incorporate regional and other stratifications

- Greatly impacts study design
  - (Watershed, state, geographic province, national)

- As scale increases, study design gets extremely complex

Reference Sites

- What do they represent?
  - True pristine condition
  - Best relative condition
  - Depends highly upon objectives
Reference sites
- Empirical
- Modeled
- Expert judgment

General bioassessment approaches

- **Level 1**: Landscape Assessments (e.g., remotely-sensed data)
  - No field component
  - Calibration necessary

- **Level 2**: Rapid Field Methods (e.g., rapid assessments)
  - Field component
  - Calibration necessary

- **Level 3**: Intensive Field Methods (e.g., IBI and HGM approach)
  - Field Component
  - Used to Calibrate Levels 1 and 2

Continuum Of Condition Assessments
# Index of Biological Integrity

- Organismal based bio-assessment
  - Species richness
  - Various measures of species composition

- Stress is integrated within the assessment
  - but may be difficult to identify source of stress

- Detailed surveys (multiple visits) are necessary (detection)

- Multiple metrics can be combined to produce final IBI

## IBI calculation

- Wetlands are classified into category classes (BPJ)
  - Cluster analysis

- Cutoff values are assigned (i.e., 1 – 3)
  - lower values indicate lower condition

- Scores are summed to create overall site score

Neff et al. 2009

Photos: D. Osborne, W. Sutton, E. Stein
Hydrogeomorphic Approach

- Functional-based assessment
  - Functions are derived via multiple indicators

- Distinct Classification

- Functions difficult to formulate
  - HGM manuals per region

- Scores easily determined once function relationships are identified.

Herlihy et al., pers. comm. (2011)
What are Rapid Approaches?

• Abbreviated condition assessments
  - Generally < 0.5 day survey time
  - Semi-quantitative; categorical data

• Overall score obtained by summing individual categories

• Ecosystem functions are contained within each assessment category

Rapid Approaches

• Level 2 rapid approaches (semi-quantitative)
  - Ohio Rapid Assessment Method
  - California Rapid Assessment Method

• Series of rapid questions drive the assessment (vary from presence/absence to estimation covariates)

• Simplified Rapid Assessment Technique (i.e., DERAP)
  - Stressors are noted during survey
  - Plots lose points as stressors increase

• Stressors can be weighted depending on objectives

Remotely-Sensed Rapid Approaches

• Generally known as synoptic approaches

• No field component required

• Landuse data
  - Buffer hits

• Must also be calibrated using more detailed approach
Table 3. Metrics to quantitative rating and the partitioning of the score

| Metric | Title | Metrics | Automatic | Semi-Automatic | Manual | % of Site Scored | % of Site Total | % of Site Raster
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Habitat Zona</td>
<td></td>
<td>6</td>
<td>6</td>
<td>6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Upland soils and topographic land use</td>
<td></td>
<td>7</td>
<td>14</td>
<td>14%</td>
<td></td>
<td></td>
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<td>3</td>
<td>Hydrology</td>
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<td>30</td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Vegetation</td>
<td>0</td>
<td>5</td>
<td>5%</td>
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<tr>
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<td>Vegetation</td>
<td>0</td>
<td>5</td>
<td>5%</td>
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</tr>
</tbody>
</table>

- Ohio Rapid Assessment Method
- Mack (2001)
Weights can be assigned to each stressor - Based on variable importance - Statistical methods optimal

Model Calibration (Examples)

Model Calibration (Continued)

- Run multiple regression iterations (stressor combinations)
- Model selection techniques (Akaike’s Information Criterion)
  - \[ \text{AIC} = - 2 \ln L(\theta) + 2K \]
  - Evaluate fit of each model (Akaike’s weights \( \omega \))
  - Model averaging for highest supported models
    \[ \bar{\theta} = \sum \omega_i \theta_i ; \quad \omega_i = \text{weight for particular model} \]
    \[ \theta_i = \text{Regression coefficient for parameter} \]
- Use model regression coefficients as weights to adjust rapid model parameters
Model Evaluation and Calibration

- Necessary and essential steps
  - Multiple version of rapid assessments

- Rapid assessment methods are not stand-alone
  - Must be paired with a detailed level 3 approach

- Wetland ecosystems are dynamic environments
  - As the ecosystems change, so should your models

Evaluation: California Rapid Assessment Method

<table>
<thead>
<tr>
<th>Wetland Condition</th>
<th>Landscape Context</th>
<th>Hydrology</th>
<th>Physical Structure</th>
<th>Biotic Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>57%</td>
<td>30%</td>
<td>47%</td>
<td>25%</td>
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</tbody>
</table>

Interspersion and Zonation
- A = 12 or 100%
- C = 6 or 50%
- B = 9 or 75%

Plant Comm. Composition
- A = 12 or 100%
- C = 6 or 50%
- B = 9 or 75%

Vertical Biotic Structure

25/36 = 75% of Possible

E. Stein, pers. comm. (2011)
Model Validation

- Overall model accuracy...
  - Signal to noise ratio?
  - Does evaluation assign appropriate scores?
- Can method cover the range of disturbance?
- How redundant are the components?
- How reproducible are the results?
  - Can different evaluators arrive at the same result?
  - Variation associated with observers...

Points for Consideration

- Multiple methods are often necessary for developing a rapid assessment approach
- Significant effort should be allocated during the planning process
  - Well-established and distinguishable gradient
  - Scale
  - Reference Conditions
  - Stratifications (region, wetland type)

Points for Consideration

- A working feedback loop should be established for model evaluation and validation
  - Model re-assessment should occur regularly
  - Rapid assessments useful, but need constant evaluation
- Clear understanding of monitoring objectives

- Questions drive assessments!

  “An approximate answer to the right question is worth a great deal more than a precise answer to the wrong question.”
  - John Tukey