# WETLAND CONDITION ASSESSMENT: DEVELOPING RAPID PROCEDURES

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Advanced Wetlands Ecology, WFS 536
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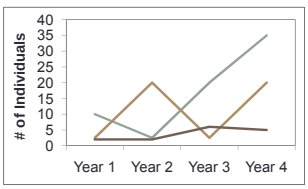
Photos: D. Osborne

## Outline

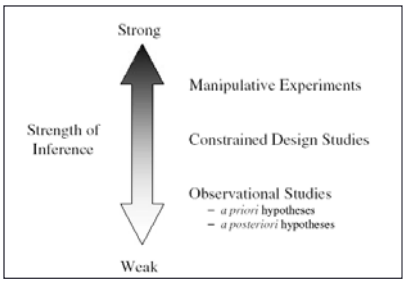
1. Understand advantages and limitations of rapid bioassessment approaches
2. Delineate and assign reference conditions based on study objectives
3. Understand how to calibrate and evaluate results from rapid assessments

## 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

so how…..

Anchor w/ reference

D. Mackenzie, pers. comm. (2011)

## 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

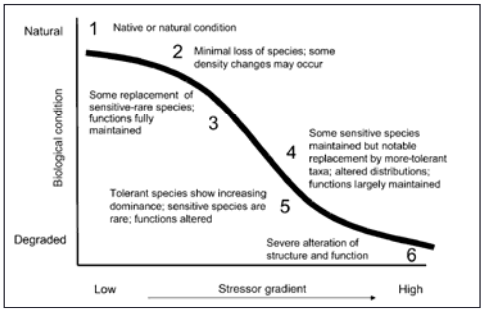

D. Osborne

E. Stein, pers. comm. (2011)

## 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

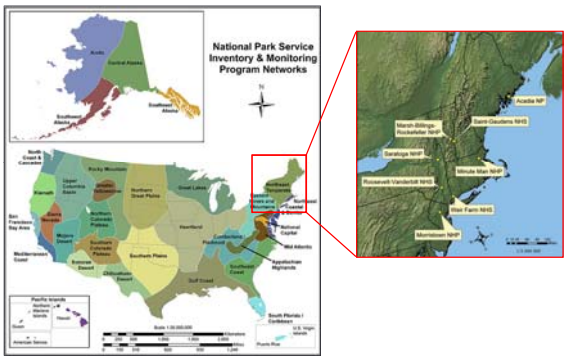
## General Stressor Gradient




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




www.NPS.gov (2011)

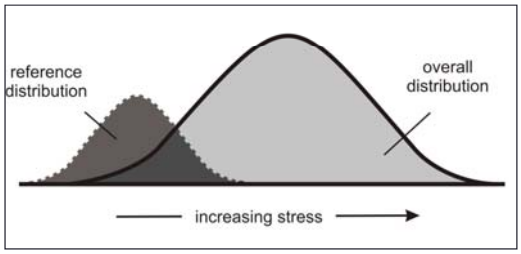
## Reference Sites

- What do they represent?
  - True pristine condition
  - Best relative condition
  - Depends highly upon objectives

E. Stein, pers. comm. (2011)

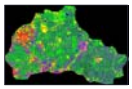
## Reference sites

- Empirical
- Modeled
- Expert judgment



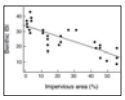

## General bioassessment approaches

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

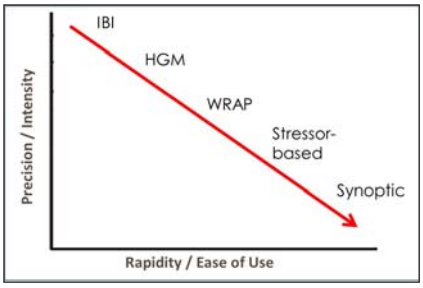


- **Level 2**: Rapid Field Methods (e.g., rapid assessments)
  - Field component
  - Calibration necessary


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

## Continuum Of Condition Assessments



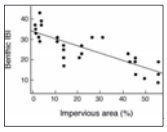

E. Stein, pers. comm. (2011)

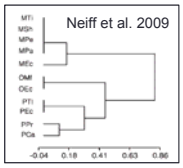
## Index of Biological Integrity

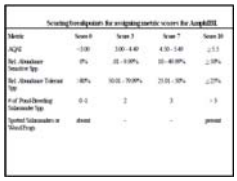
- Organismal based bio-assessment
  - Species richness
  - Various measures of species composition
- Stress is integrated within the assessment
  - but may be difficult to identify source of stress
- Detailed surveys (multiple visits) are necessary (detection)
- Multiple metrics can be combined to produce 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



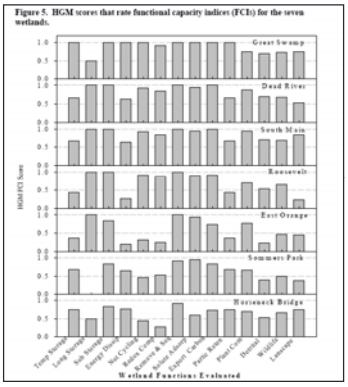



Photos: D. Osborne, W. Sutton, E. Stein

## Hydrogeomorphic Approach

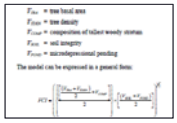
- Functional-based assessment
  - Functions are derived via multiple indicators
- Distinct Classification
- Functions difficult to formulate
  - HGM manuals per region
- Scores easily determined once function relationships are identified.



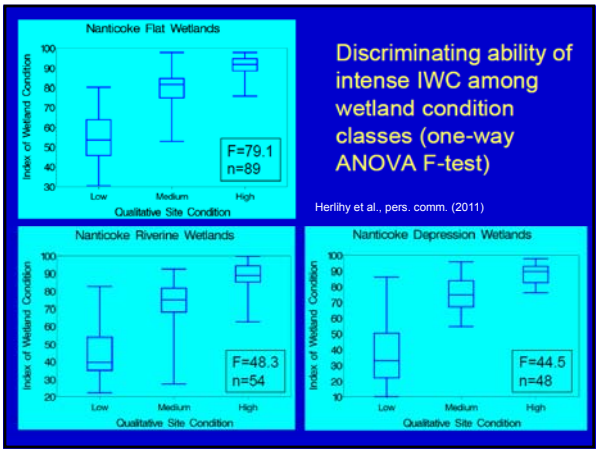

Function-based
- Multiple Indicators

Calculated Singularly

Can be summed
- IWC



E. Stein, pers. comm. (2011)



## What are Rapid Approaches?

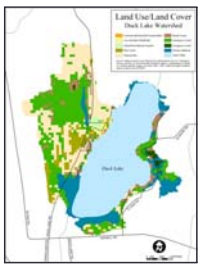
- Abbreviated condition assessments
  - Generally < 0.5 day survey time
  - Semi-quantitative; categorical data
- Overall score obtained by summing individual categories
- Ecosystem functions are contained within each assessment category

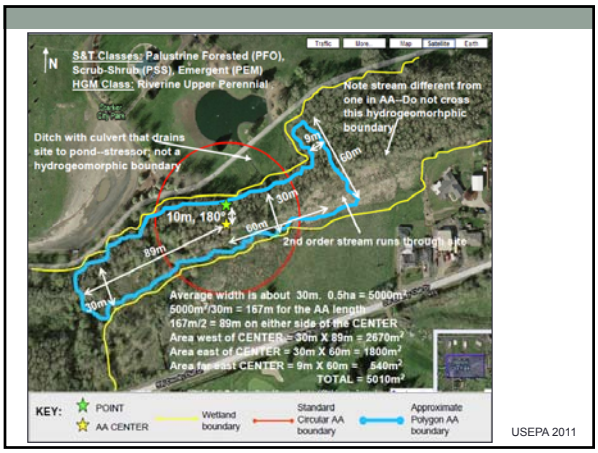
## Rapid Approaches

- 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






USEPA 2011

**Table 3. Metrics in quantitative rating and the partitioning of the score**

| Metric | Title | submetric | submetric maximum | metric maximum | % total score each metric |
|---|---|---|---|---|---|
| 1 | Wetland Size | None | 6 | 6 | 6% |
| 2 | Upland buffers and surrounding land use | 2a Average buffer width | 7 | 14 | 14% |
| | | 2b Surrounding Land Use | 7 | | |
| 3 | Hydrology | 3a Sources of Water | 11 | 30 | 30% |
| | | 3b Connectivity | 3 | | |
| | | 3c Maximum water depth | 3 | | |
| | | 3d Duration inundation or saturation | 4 | | |
| | | 3e Modifications to natural hydrologic regime | 12 | | |
| 4 | Habitat alteration and development | 4a Substrate Disturbance | 4 | 20 | 20% |
| | | 4b Habitat development | 7 | | |
| | | 4c Habitat alteration | 9 | | |
| 5 | Special Wetland Communities | None | 10+/10- | 10 | 10% |
| 6 | Vegetation, Interspersion, Microtopography | 6a Wetland vegetation communities | 18 | 20 | 20% |
| | | 6b Horizontal community interspersion | 5 | | |
| | | 6c Presence of Table 1 Invasives | -5 | | |
| | | 6d Microtopography | 12 | | |

Ohio Rapid Assessment Method Mack (2001)


National Wetland Condition Assessment USEPA (2011)

Appendix C: Stressor Weights

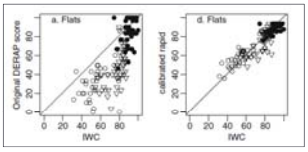
updated May 15, 2006

| Description | Weights Flats | River | Dep |
|---|---|---|---|
| **Habitat Category** | | | |
| Mowing in AA | | | |
| Farming activity in AA | | | 53.1 |
| Grazing in AA | | | |
| No forestry activity within 50 years | | | |
| Forestry activity 30-50 years | | | |
| Forestry activing 15-30 years | 7.3 | 5.3 | |
| Forestry w/in 15 | | | |
| Forest activity <10% of site | | | |
| Clear cut w/in 2 | 22.0 | 10.1 | |
| Cleared land not recovering | | | 53.1 |
| Excessive Herbivory:Pinebark Beetle/Gypsy | | | |
| Invasive spp dominating site | | 23.4 | |
| Invasives not dominating | | | |
| Chemical Defoliation | | | 57.2 |
| Managed or Converted to Pine | 5.9 | | |
| Burned | | | |
| Trails | | | |
| Garbage/Isolated Dumping | | | 49.9 |
| Nutrients direct application/runoff | | | |
| Nutrients derive algal mats | | | |
| Logging road in AA | | | |
| Dirt or gravel road in AA | | | |
| Paved road in AA | | | |

Weights can be assigned to each stressor
- Based on variable importance
- Statistical methods optimal

Delaware Rapid Assessment Method
Jacobs (2006)

## Model Calibration (Examples)




DERAP Method:

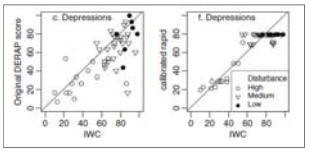
Stressor-based method

Correlated with IWC

Calibration:

$IWC = A + B_1X_1 + B_2X_2 \ldots + B_nX_n$

$A$ = Intercept
$B_i$ = Regression coefficient
$X_i$ = Stressor




Herlihy et al. 2010

## Model Calibration (Continued)

- Run multiple regression iterations (stressor combinations)
- Model selection techniques (Akaike's Information Criterion)
  - **AIC = - 2 ln $L(\theta)$ * 2K**
  - Evaluate fit of each model (Akaike's weights [$\omega_i$])
  - Model averaging for highest supported models

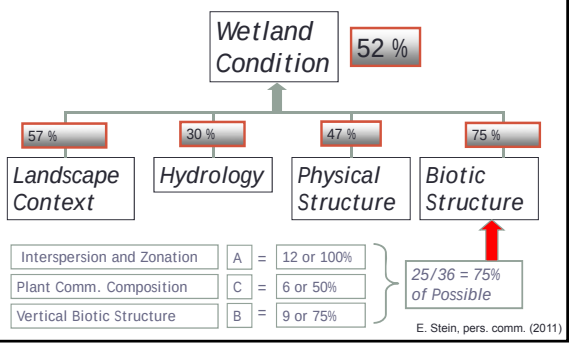
    $\boldsymbol{\theta = \Sigma\, \omega_i\theta_i}$ ; $\omega_i$ = weight for particular model

    $\theta_i$ = Regression coefficient for parameter
- Use model regression coefficients as weights to adjust rapid model parameters

## Model Evaluation and Calibration

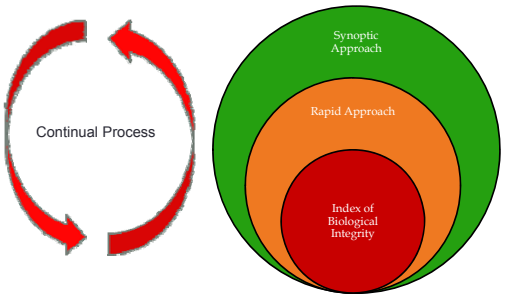
- Necessary and essential steps
  - Multiple version of rapid assessments
- Rapid assessment methods are not stand-alone
  - Must be paired with a detailed level 3 approach
- Wetland ecosystems are dynamic environments
  - As the ecosystems change, so should your models

## Evaluation: California Rapid Assessment Method




E. Stein, pers. comm. (2011)

## Model Evaluation and Calibration



## 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**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