




## Use of IBI Models to Assess Ecological Function

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## Outline

- **Introduction**
  - IBI history
  - How IBI's are used
- **Current Knowledge**
  - IBI development
- **Future Directions**
  - Terrestrial ecosystems
  - Potential taxa

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## Introduction

### Bioassessments

- Use plant or animal communities to measure ecological function
- Cumulative effect of multiple stressors
  - **Physical , Chemical and Biological**
    - Water quality
    - Riparian condition
    - Vegetative structure
    - Lower trophic levels
- Incorporate changes over time
- More efficient

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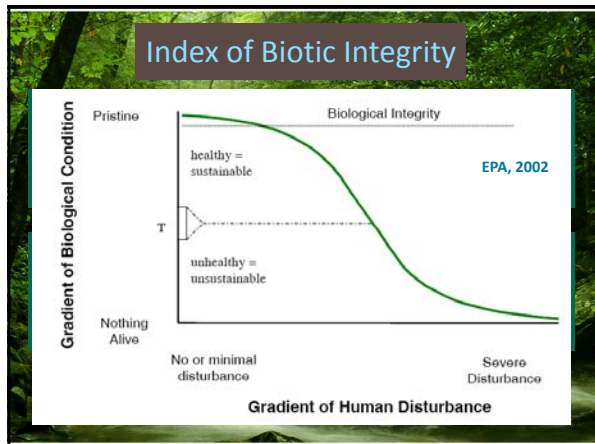
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- ### Uses of IBIs
- Assessing impacts of human activities
  - Monitoring restorations
  - Identifying areas in need of restoration
  - Can be applied to a variety of systems
    - Streams (traditional)
    - Wetlands
    - Lakes / Ponds
    - Coral Reefs
    - Terrestrial systems

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- ### IBI Application
- Sites are given a score for each metric
    - Score based on comparison with the range of observed values, including reference sites
  - Add scores for multiple biological metrics
    - Result: summary score
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### Reference Sites

- Important to know reference condition
  - Biota resulting from **relative absence of modern human activity**
  - Same habitat type as assessments
- Establish reference standard
  - **Range of values** measured for each metric at sites with the least amount of human activity

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### History- Original IBIs

Karr, 1981

- 1<sup>st</sup> developed for warm water streams
  - Fish species richness and composition
  - Abundance of indicator species
    - Darters
    - Suckers
    - Sunfish
  - Reproduction
  - Condition of individuals
- Spatial component

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### Spread of IBI Use

- As popularity increases, other versions developed for other regions and ecosystems
- Currently, all states use some form
- Most common communities
  - Fish
  - Benthic macroinvertebrates
  - Algae
- Others include
  - Birds
  - Terrestrial insects

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## Model development

- 1) Data Collection
- 2) Select metrics

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## Selection of Metrics

- Consistent response to disturbance (predefined)
- Large range of response
- Reproducible

The box plot shows five yellow boxes representing the distribution of metric values at increasing levels of disturbance. The y-axis is labeled 'Metric Value or Index Scores' and the x-axis is labeled 'Increasing Disturbance'. As disturbance increases from left to right, the median metric value decreases, and the spread of the data (interquartile range and whiskers) also decreases.

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## Types of Metrics

- 1) Species Richness and Composition
- 2) Tolerance to human disturbance
- 3) Trophic composition
- 4) Population characteristics
  - individual condition
    - Occurrence of malformations
    - Body Size

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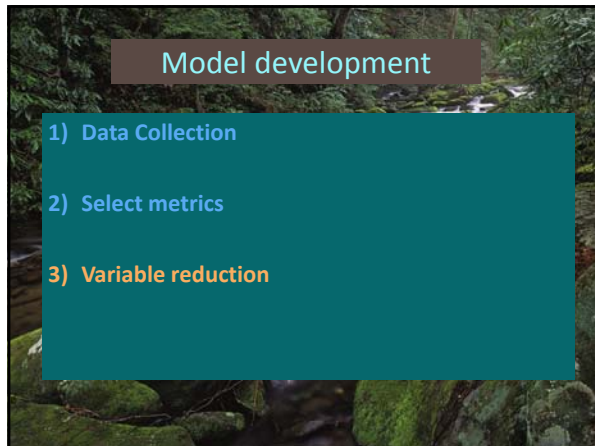
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**Model development**

- 1) Data Collection
- 2) Select metrics
- 3) Variable reduction

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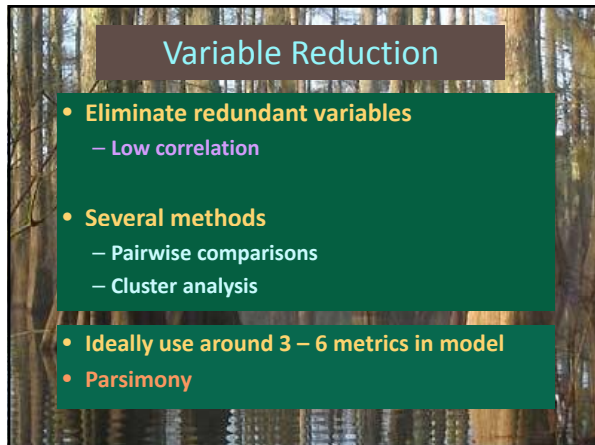
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**Variable Reduction**

- Eliminate redundant variables
  - Low correlation
- Several methods
  - Pairwise comparisons
  - Cluster analysis
- Ideally use around 3 – 6 metrics in model
- Parsimony

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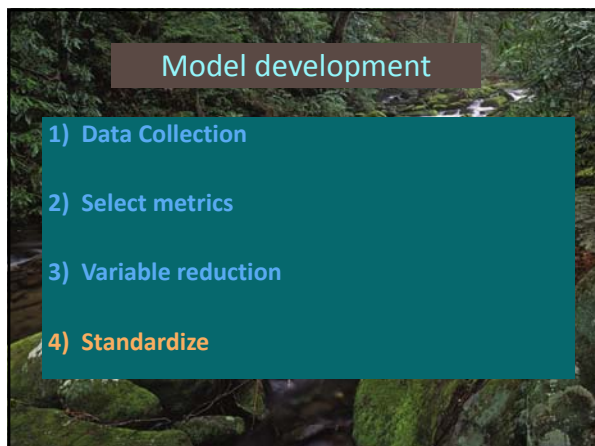
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**Model development**

- 1) Data Collection
- 2) Select metrics
- 3) Variable reduction
- 4) Standardize

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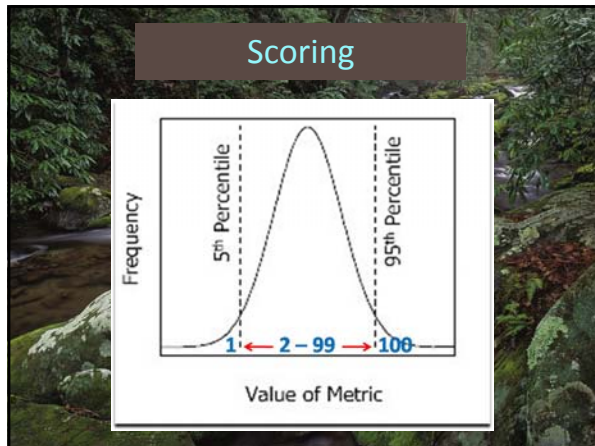
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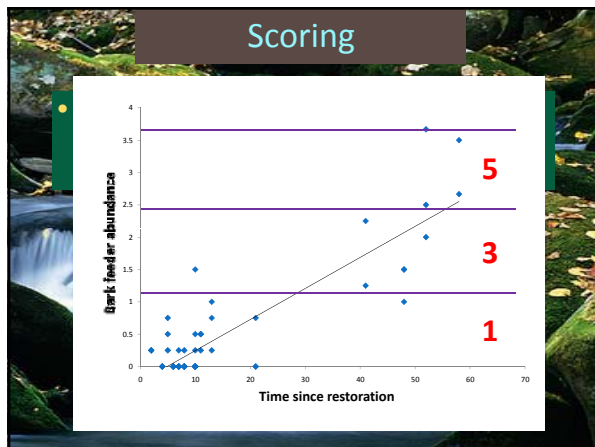
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### Example: 6 metrics

- Score of 1, 3 or 5  
Maximum Score of 6 (variables) \* 5 (highest score) = 30  
Minimum score of 6 (variables) \* 1 (lowest score) = 6
- Scores range from 6 – 30 depending on disturbance

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### Limitations

- Sampling requires **expertise and time**
- Metrics of biological communities can vary
  - Interact with each other
  - Change over time or space

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### Future Directions

- Seldom applied to terrestrial systems
  - O'Connell et al. 1998:
    - Bird community index for Mid-Atlantic highlands
  - Kimberling et al. 2001:
    - Insects: shrub-steppe on nuclear site, Washington

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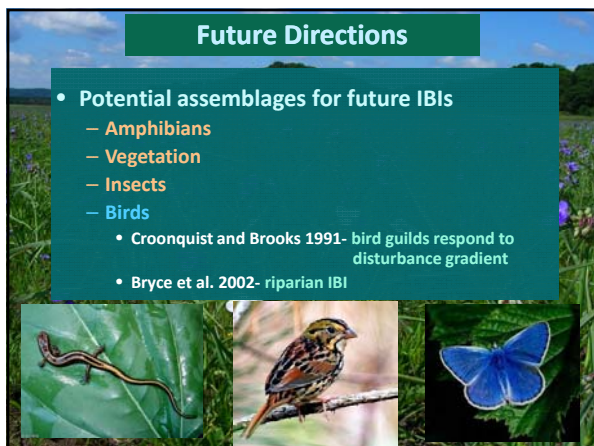
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### Future Directions

- Potential assemblages for future IBIs
  - Amphibians
  - Vegetation
  - Insects
  - Birds
    - Croonquist and Brooks 1991- bird guilds respond to disturbance gradient
    - Bryce et al. 2002- riparian IBI

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### Resources

- See handout
  - Example IBI datasheet
  - References
- EPA website
  - <http://www.epa.gov/biolweb1/index.html>
- Ohio State University: Index of Biotic Integrity (IBI) Scoring
  - <http://www.dnr.state.md.us/Bay/monitoring/tidalfish/ibi.html>
- Aquatic
  - Karr, J. R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6:21-27.
- Terrestrial
  - Coppedge, B. R., D. M. Engle, R. E. Masters and M. S. Gregory. 2006. Development of a grassland integrity index based on breeding bird assemblages. Environmental Monitoring and Assessment 118:125-145.

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### Questions?



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