National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
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Index 201

Selection of Metrics for Index Assembly

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Multimetric Index Development

- Database consisting of reference and stressed populations (sites)
- Classify resource (reference sites,ecoregions)
- Identify and test candidate metrics
- **Select metrics for dimensionless index**
- Select thresholds for assessment (set biocriteria)

Assembling an Index

1. Identify suites of metrics that meet the following criteria:
   - Ecologically justifiable
   - Responsive
   - Precise
   - Provide unique information
   - Represent a range of metric categories (richness, composition, tolerance, trophic, habit, voltinism)

Assembling an Index

2. Set aside a portion of the data for testing / validating the index.
3. Score all potential metrics.
4. Calculate index alternatives by summing or averaging metric scores.

Assembling an Index

5. Calculate the DE and precision of each index.

6. Evaluate the alternatives.

7. Test the favored alternatives using the reserved data.

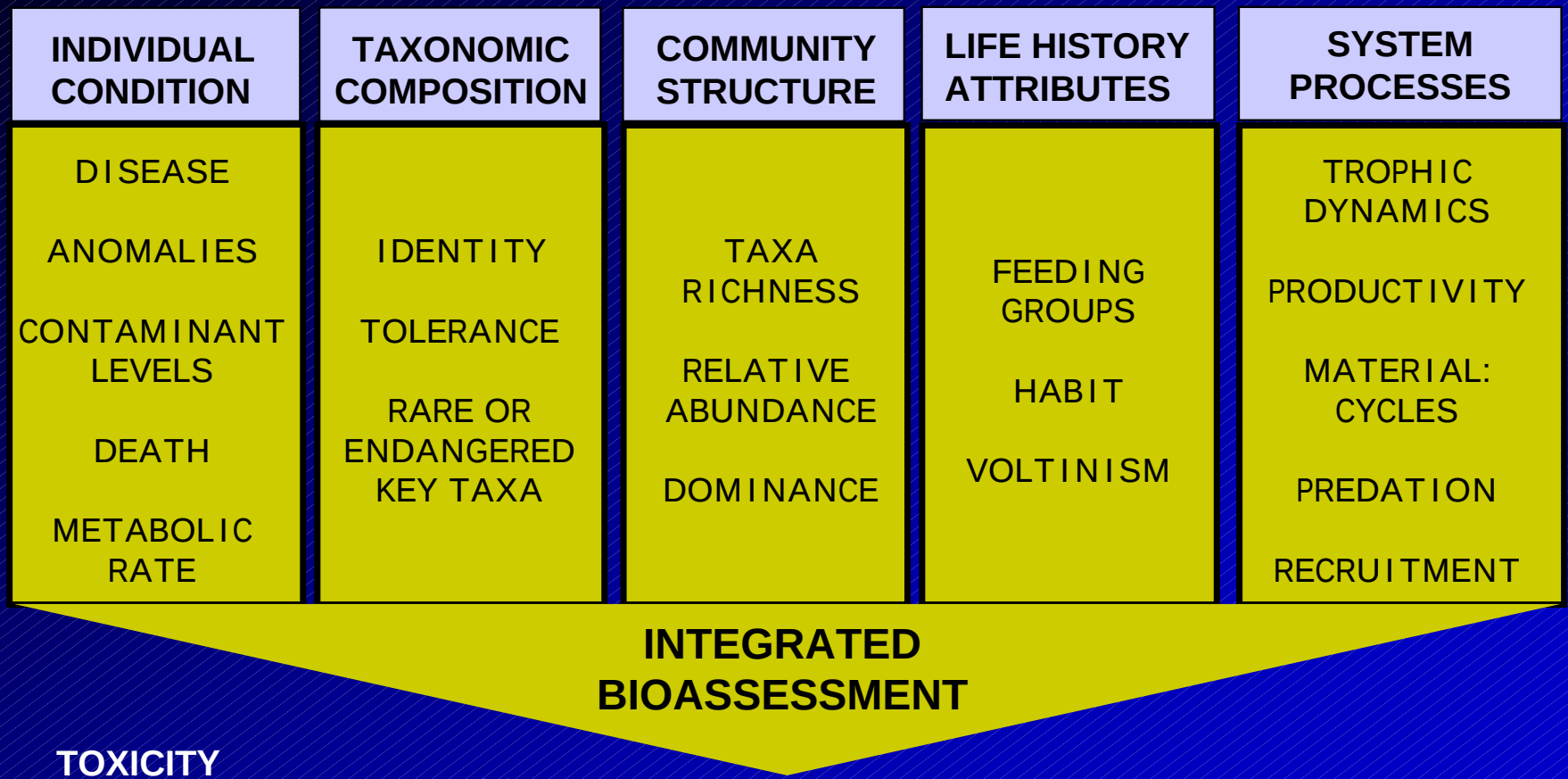
Identifying Redundancy

- Correlation analysis of potential metrics
- Identify pairs as redundant if the correlation coefficient, r, is > 0.9
- For r > 0.8, examine scatterplots
- Avoid suites of metrics containing both metrics in a redundant pair

Example Correlations

	Total taxa	EPT taxa	Ephemerop. taxa	Plecoptera taxa	Trichoptera taxa	% EPT	% Plecoptera	% Trichoptera	HBI	Intolerant taxa (0-1)
EPT taxa	**0.92**									
Ephemerop. taxa	**0.8**	**0.87**								
Plecoptera taxa	0.77	**0.86**	0.63							
Trichoptera taxa	**0.82**	**0.86**	0.6	0.63						
% EPT	0.26	0.43	0.4	0.4	0.31					
% Plecoptera	0.26	0.38	0.23	0.53	0.24	0.45				
% Trichoptera	0.2	0.23	0.09	0.13	0.37	0.31	0.01			
HBI	-0.38	-0.56	-0.48	-0.54	-0.44	-0.77	-0.53	-0.37		
Intolerant (0-1)	**0.84**	**0.94**	**0.81**	**0.83**	**0.82**	0.41	0.37	0.2	-0.59	
Intolerant (0-3)	**0.89**	**0.97**	**0.82**	**0.88**	**0.83**	0.41	0.4	0.2	-0.59	**0.97**

Attribute groups



Select Metric Suites-Examples

Metric	A	B	C	D
Total taxa	X			
EPT taxa		X		
Ephemeroptera taxa			X	X
Plecoptera taxa			X	X
Trichoptera taxa			X	X
% EPT		X	X	
% Plecoptera	X			X
% Trichoptera	X			X
HBI	X	X	X	X
% 3 Dominant			X	
% 5 Dominant	X	X		
Shannon-Weiner				X
Scraper taxa	X	X	X	X
% Scrapers	X	X	X	X
Clinger taxa			X	

Index Assembly Hands-on Exercise – Selecting metrics

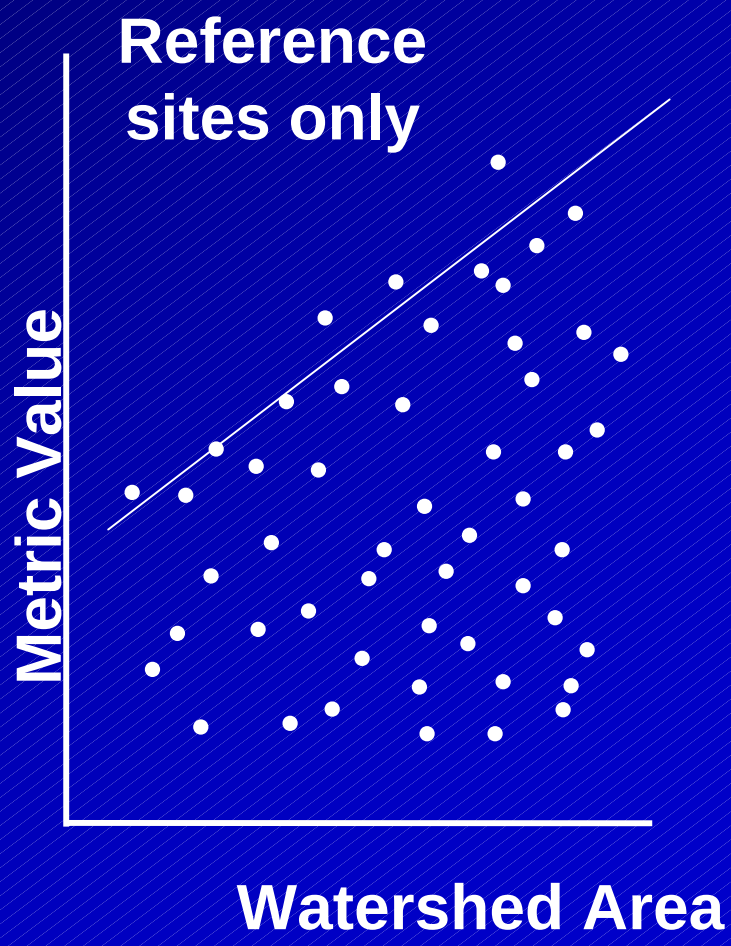
- Discrimination efficiencies (DE) and metric correlations for Idaho data
- **Goal:** Use metric evaluation information to select suites of candidate metrics and test as index alternatives

Scoring Metrics

- Creates dimensionless values that can be summed or averaged into a single index value.
- Standardizes metric values with respect to some expectation.
- Can be continuous or discrete.
- Can use expectations based on reference distributions or the entire distribution of values in a region.

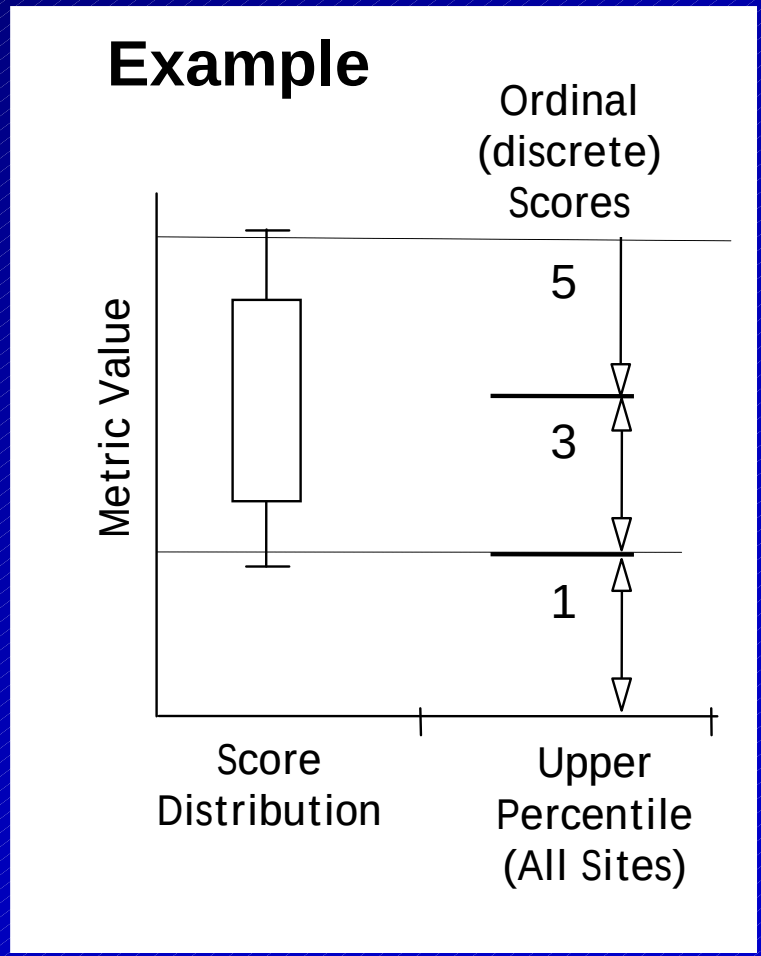
Scoring metrics – adjustment for natural variation

- Some metrics vary naturally with physical features, such as watershed area, elevation, gradient, and stream order.
- Adjustment for natural factors is necessary to set appropriate expectations for scoring these metrics.
- This type of adjustment can be done by eye or using quantile regression techniques.



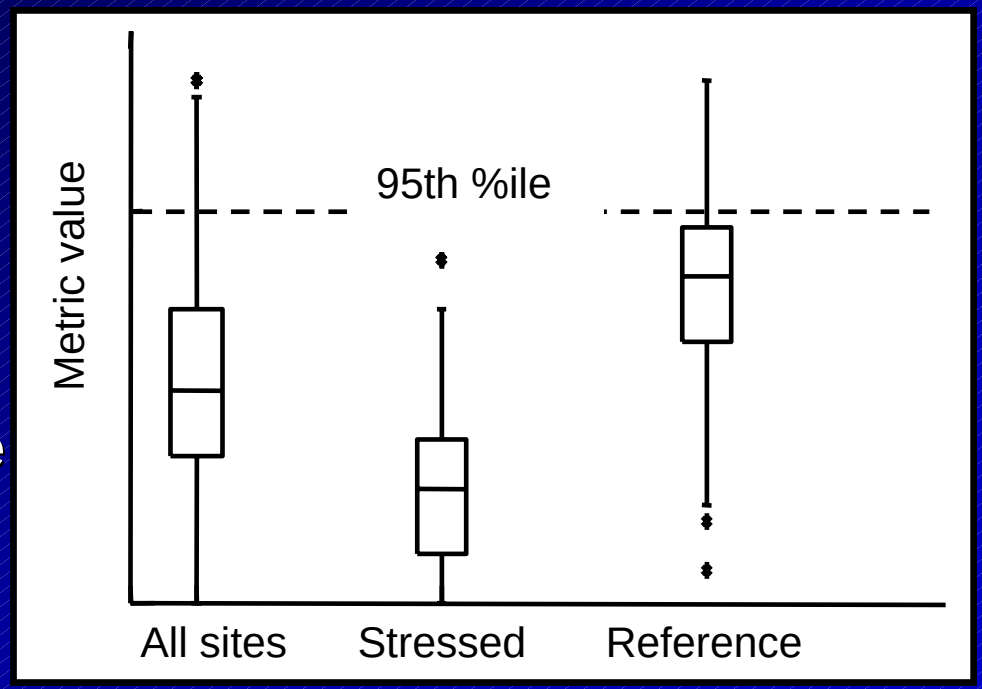
Scoring Metrics – Discrete

- Metric values receive a discrete score (e.g., 1, 3, or 5) based on comparison to some expectation.
- “Reverse” metrics are scaled so that higher values receive lower scores.
- Metric scores are summed, sometimes rescaled to a sum of 100.



Scoring Metrics – Continuous

- Scores are scaled to the 95th percentile of all values within each region.
- Scoring is on a continuous scale from 100 to 0.
- “Reverse” metrics are scaled to the 5th percentile.
- Metric scores are averaged (or summed) to obtain index value.



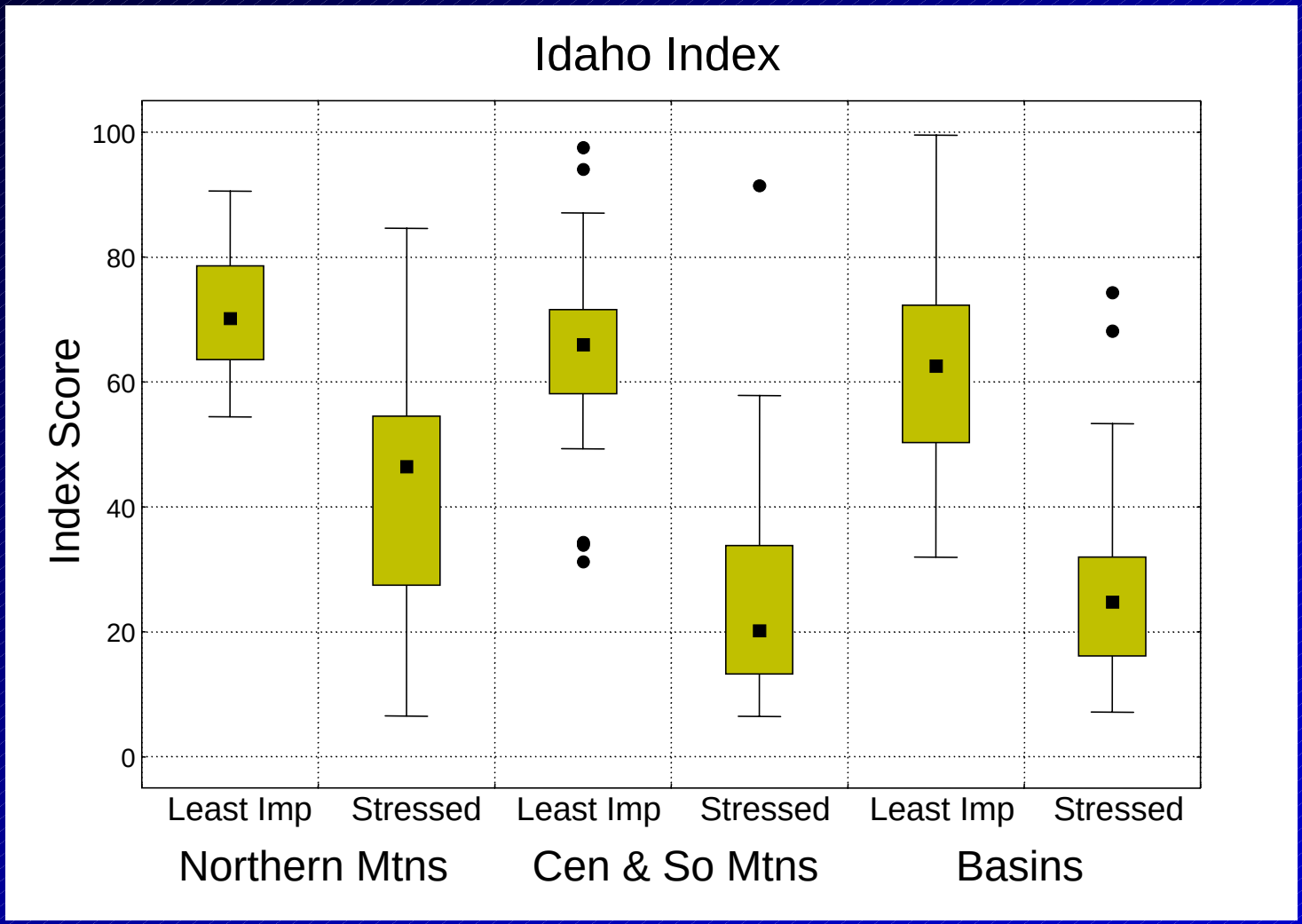
Formulas:

- Score = 100 * (Max - Value) / (Max - 5th%) (“reverse” metrics)
- Score = 100 * Value / 95th%

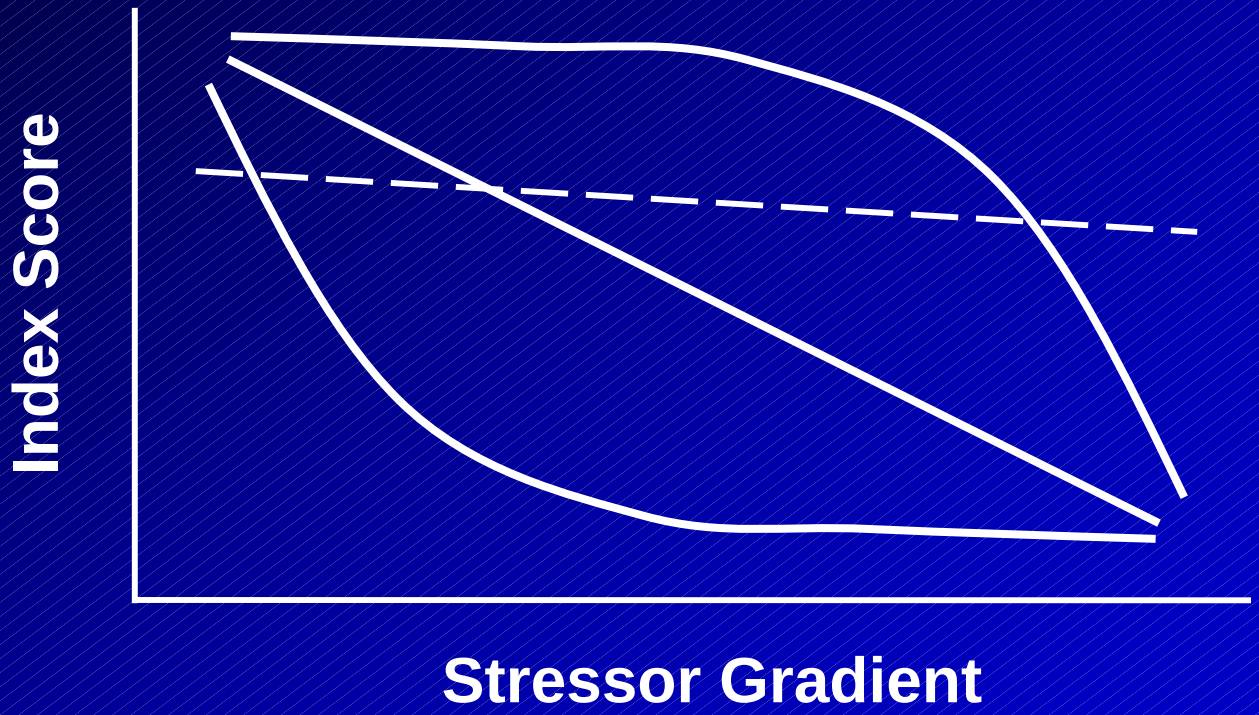
Evaluating Index Alternatives

Metric	Model 1	Model 2	Model 3
Total taxa	X	X	X
Ephemeroptera taxa	X	X	X
Plecoptera taxa	X	X	X
Trichoptera taxa	X	X	X
% EPT		X	
% Plecoptera	X		X
% Clingers	X	X	
Clinger taxa			X
Scraper taxa			X
HBI			X
% 5 Dominant taxa			X
Basins DE (25th)	93.1 (47.6)	96.6 (57.1)	96.6 (50.5)
N. Mtns DE (25th)	83.8 (58.1)	89.2 (67.9)	89.2 (65.2)
C&S Mtns DE (25th)	85.7 (55.0)	90.5 (57.3)	90.5 (57.7)
DE (Wtd avg)	88.8	93.1	93.1

Index Discrimination



Index Responsiveness to Stressor Gradient



Index Precision

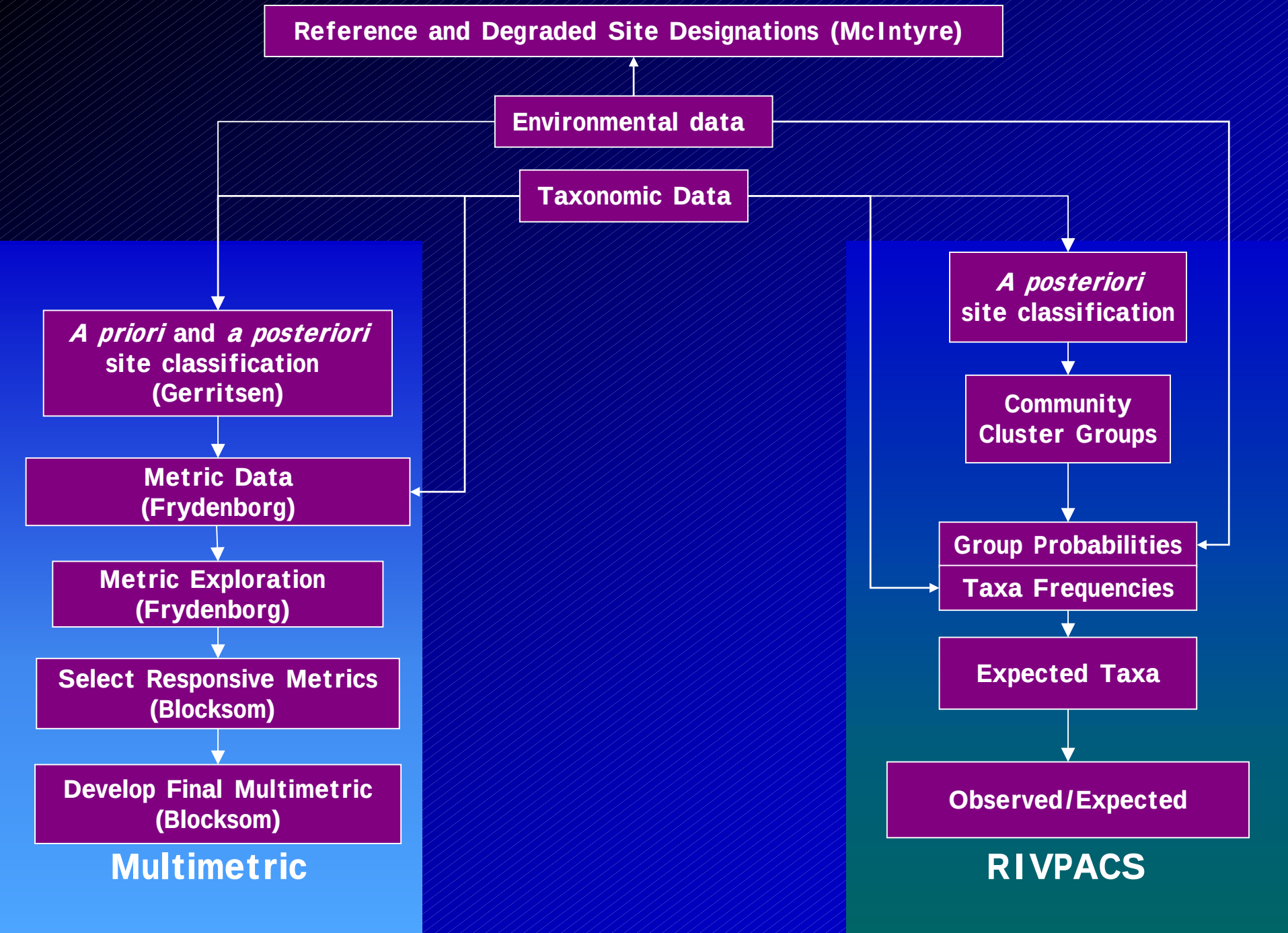
1. Find replicated samples.
2. Run ANOVA with Station as the grouping variable.
3. Use the MSE term as an estimate of variance.
4. Take the root of the MSE as an estimate of standard deviation.
5. Calculate CV or CI

Testing / Evaluating the Index

- Calculate the selected index using the reserved (validation) data.
- Check the "validation" samples against the "calibration" reference 25th percentile.
  - Are approximately 75% of validation reference samples above the threshold?
  - Is the percentage of validation stressed samples below the threshold comparable?

Summary

- Select suites of metrics that meet criteria.
- Score metrics and average or sum scores into index value.
- Calculate DE and precision of alternatives.
- Select appropriate index.
- Test the DE of index with validation data.


Reference and Degraded Site Designations (McIntyre)
Environmental data
Taxonomic Data
A priori and a posteriori site classification (Gerritsen)
Metric Data (Frydenborg)
Metric Exploration (Frydenborg)
Select Responsive Metrics (Blocksom)
Develop Final Multimetric (Blocksom)
Multimetric
A posteriori site classification
Community Cluster Groups
Group Probabilities
Taxa Frequencies
Expected Taxa
Observed/Expected
RIVPACS