

Process for developing a Macroinvertebrate Index of Biotic Integrity for the Wadeable Streams Assessment

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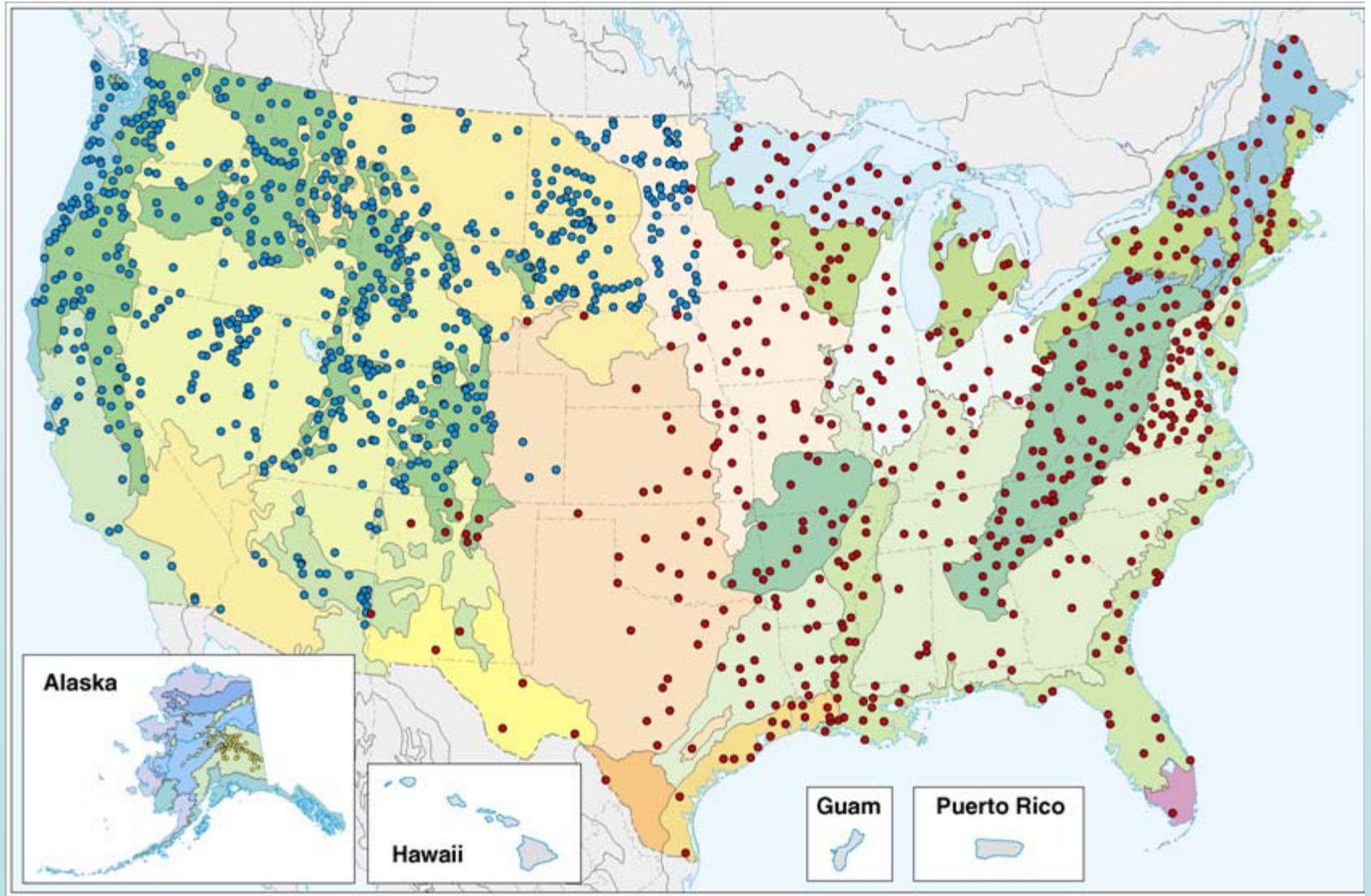
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Wadeable Streams Assessment

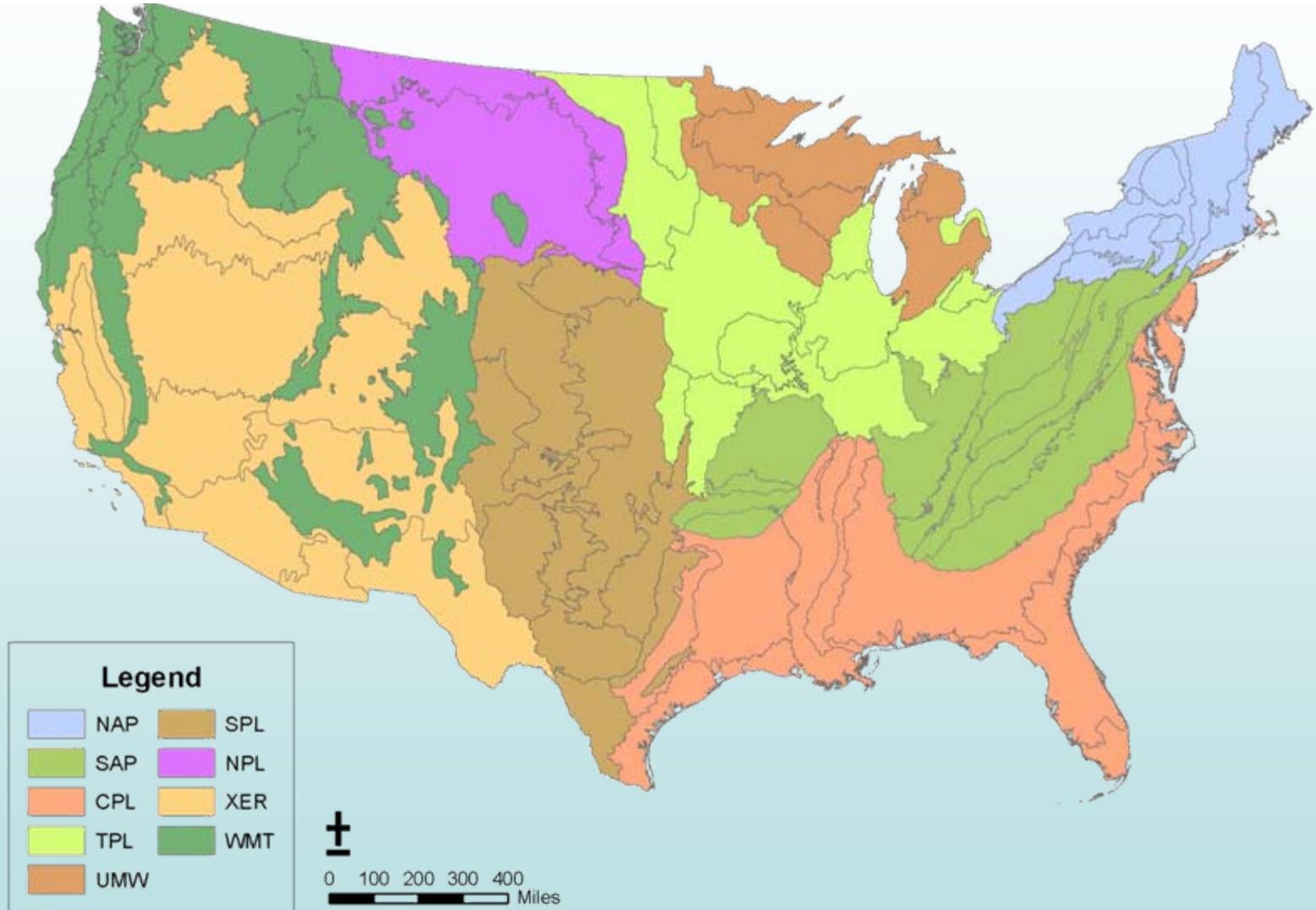


Indices of Biotic Integrity

a method of quantifying characteristics of assemblages that typify biological integrity:

- **Richness:** the number of different kinds of taxa.
- **Diversity:** evenness of the distribution of individuals across taxa.
- **Composition:** the relative abundance of different kinds of taxa.
- * **Functional feeding groups:** primary method for acquiring food.
- * **Habit:** habitat preference or dominant behavior, e.g., do taxa cling to substrates, or burrow into substrates?
- * **Tolerance:** often expressed as a general tolerance to chemical stressors.
- * Require autecological information (genus-level assignments of tolerance, feeding group, habit)

Ecological Regions



Metric Selection Process for WSA

For Each of 9 Ecological Regions:

Find the “best” metric in each metric class, according to these characteristics:

- Good range
- Repeatability
- Relationship to Natural Gradients
- Responsiveness
- Uniqueness (not redundant)

Score metrics separately for each Ecological Region

Sum metrics and scale total to 100 to create Index of Biotic Integrity

Metric Selection - Range Test

Fail metrics that have one or both of these characteristics:

All values are within small range (e.g., 0-2)

- Especially relevant for Richness metrics
- More important for fish metrics than macroinvertebrate metrics
- None of the WSA bug metrics failed
- Example of failed metric from EMAP-W: Megaloptera Richness (0-2)

1. Majority of sites have identical metric scores

- Usually occurs when a metric deals only with “rare” taxa
- Example: Amphipod Richness – 75% of sites have values of zero

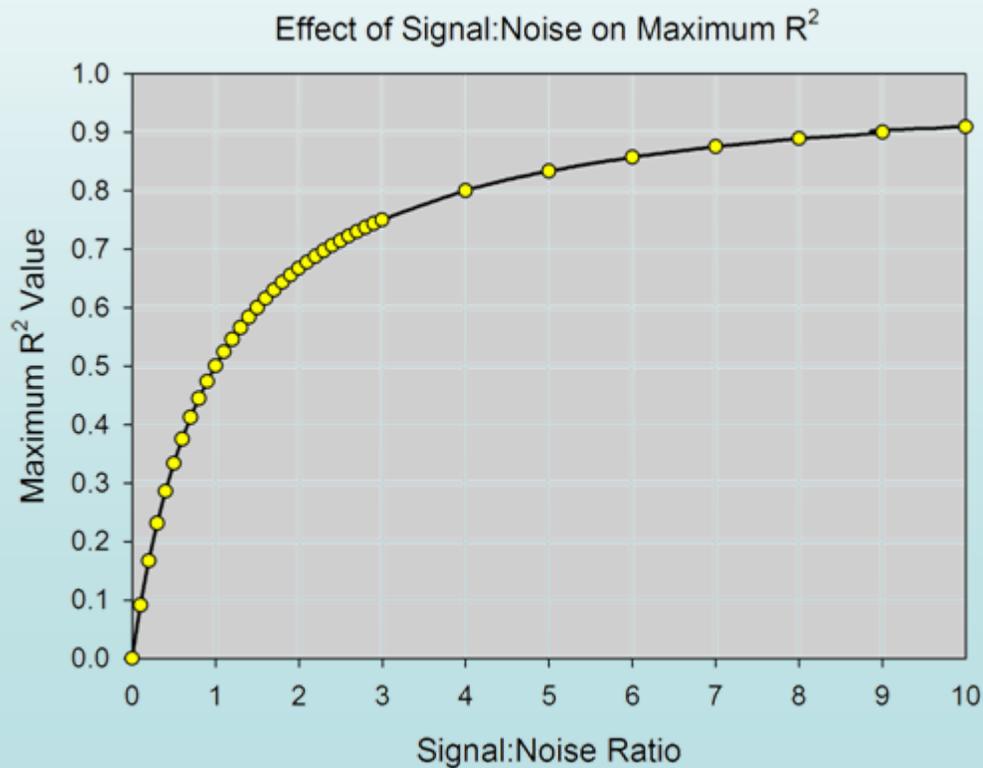
With a dataset as large (geographically, sample size), range test is of limited utility

Metric Selection - Repeatability

We use signal:noise ratio to quantify repeatability:

Calculated from repeat visits (within index period) to subset of sites

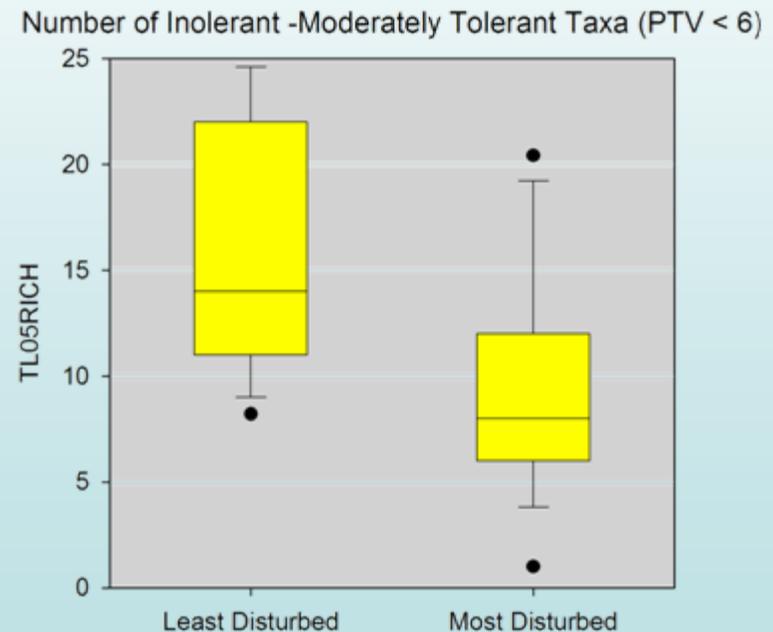
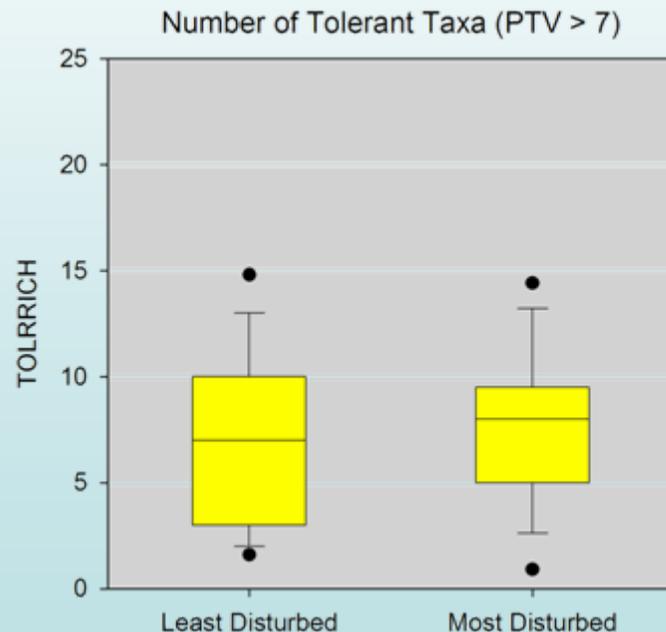
$$S:N = (\text{Variance across all sites}) / (\text{Variance at single site})$$



Metric Selection - Responsiveness

Many ways to test responsiveness:

1. Individual scatter plots (for critical stressors) or correlation statistics
2. Quick and Dirty F test of scores in best and worst sites:



All metrics (by Region and by Class) ranked by their ability to differentiate reference from trashed sites

Metric Selection - Redundancy

Create correlation matrix of all responsive metrics, using only reference site data

(metrics that are highly correlated only because they respond similarly to stressors are not considered redundant)

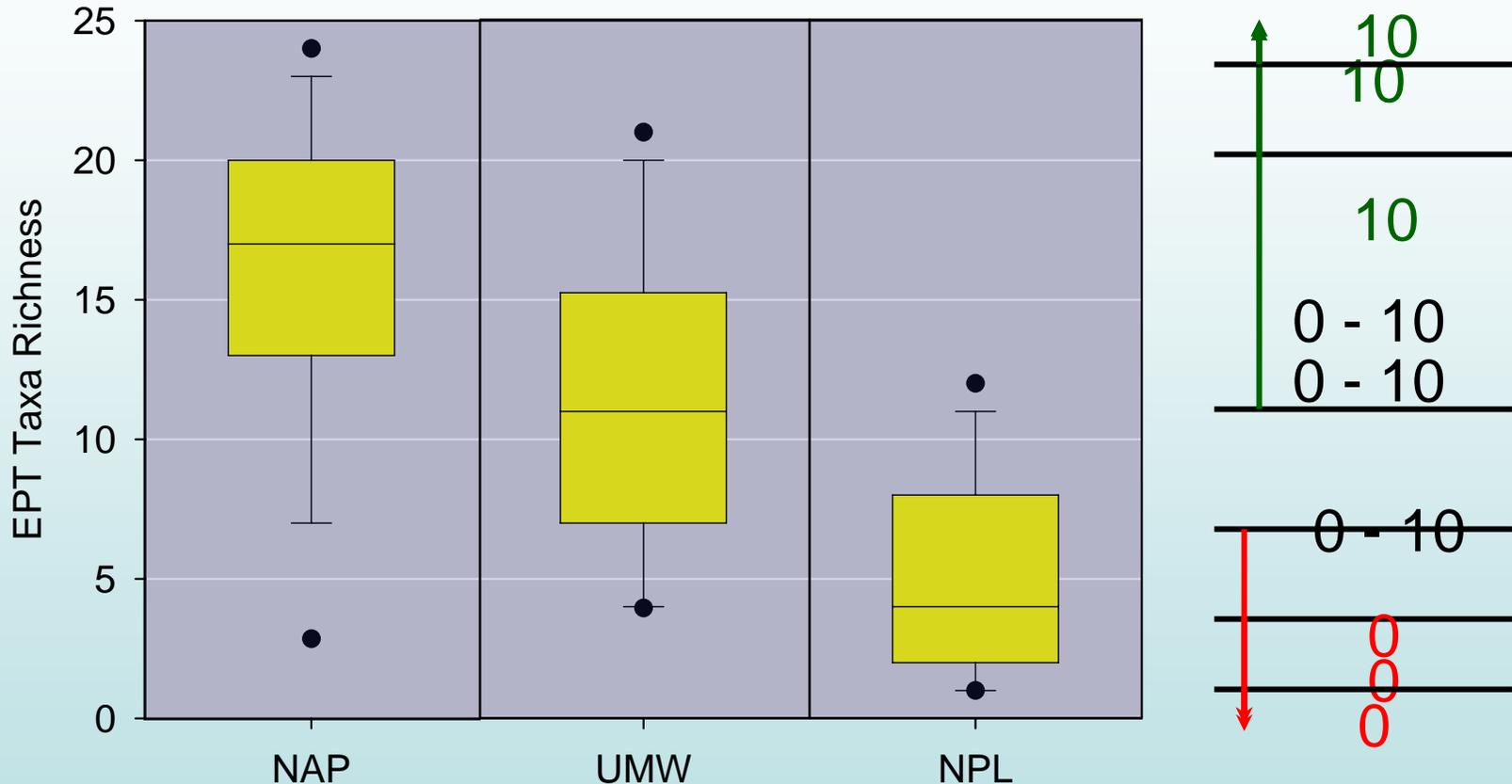
Redundancy information used iteratively in metric selection process:

1. Most responsive metric (highest F score) goes into IBI first, regardless of class
2. Next most responsive metric from a different metric class, and not redundant with first chosen metric, chosen next
3. Repeat process until all metric classes are represented, and none of the metrics is redundant

WSA Metrics

	NAP	SAP	CPL	UMW	TPL	NPL	SPL	WMT	XER	ALL
% EPT Taxa	X					X		X		X
% EPT Individuals					X		X			
% Non-Insect Taxa									X	
% Non-Insect Individuals			X							
% Ephemeroptera Taxa		X								
% Chironomid Taxa				X						
Shannon Diversity		X	X	X	X		X			X
% Individuals in top 5 taxa	X							X	X	
% Individuals in top 3 taxa						X				
Scraper Richness	X	X			X	X	X	X	X	X
Shredder Richness			X	X						
% Burrower Taxa		X		X		X	X			X
% Clinger Taxa	X		X					X	X	
Clinger Taxa Richness					X					
Ephemeroptera Taxa Richness	X	X	X	X			X	X	X	X
EPT Taxa Richness					X					
Total Taxa Richness						X				
Intolerant Richness						X	X			X
% Tolerant Individuals		X	X					X	X	

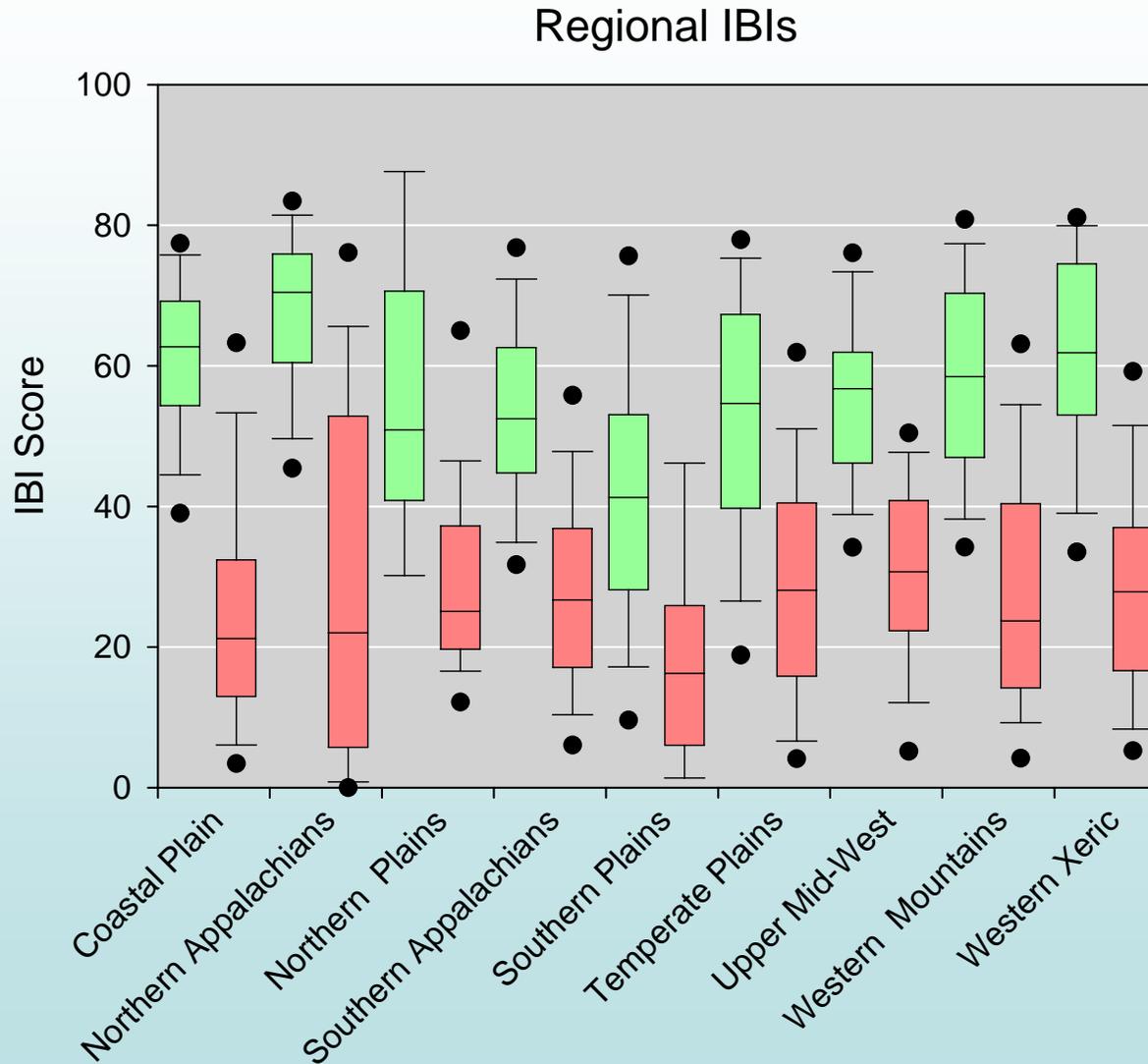
Metric Scoring



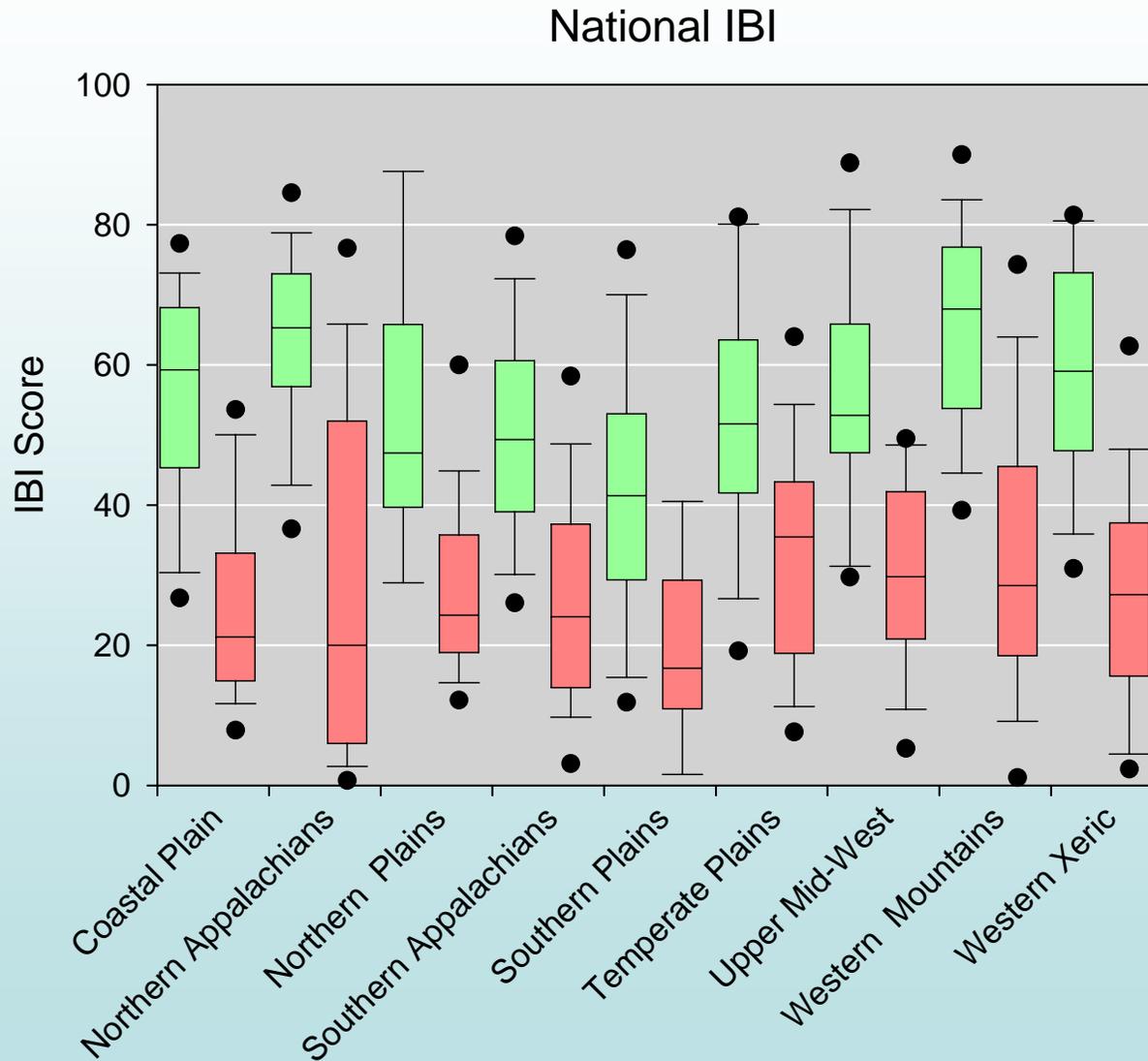
5th and 95th percentiles of metric distribution (within region)
used to score metrics from 0 to 10.

Scored metrics summed, and resulting IBI scaled from 0 to 100.

Regional IBI Results



National IBI Results



Comparison of Performance: National and Regional IBIs

F Scores, distinguishing Reference from Trashed

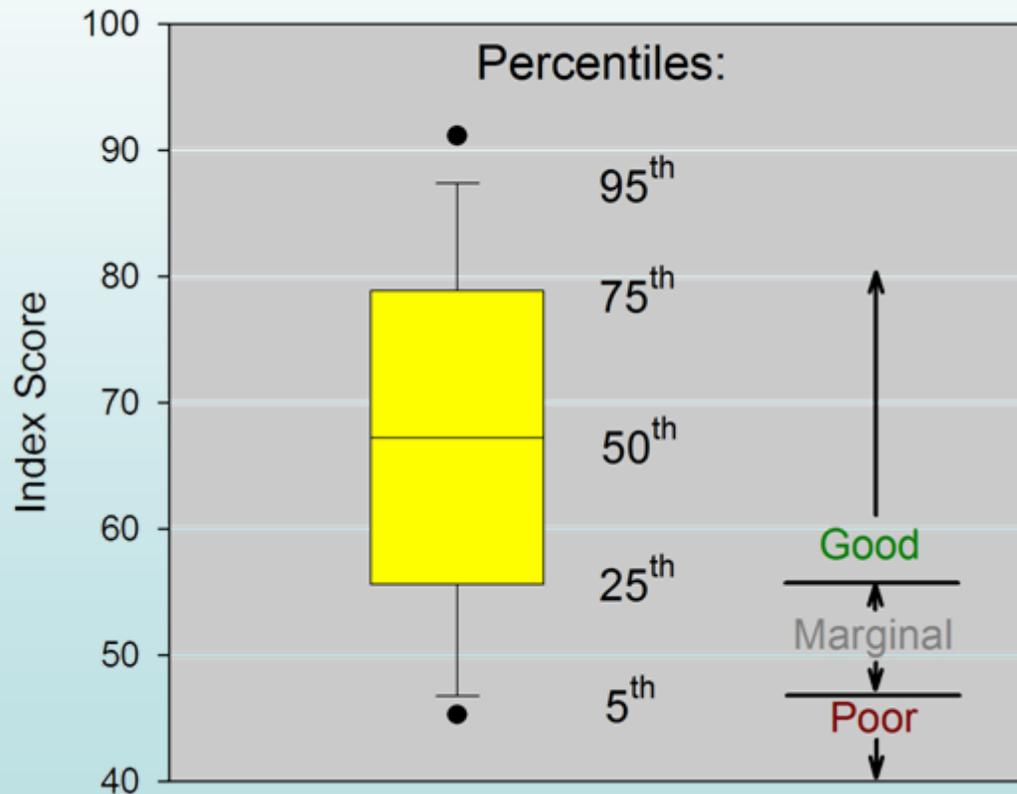
	Regional IBI	National IBI
No. Appalachians	158	110
So. Appalachians	217	157
Coastal Plain	143	93
Upper Midwest	102	50
Temperate Plains	95	67
Northern Plains	43	43
Southern Plains	33	34
Western Mountains	246	133
Xeric	217	144



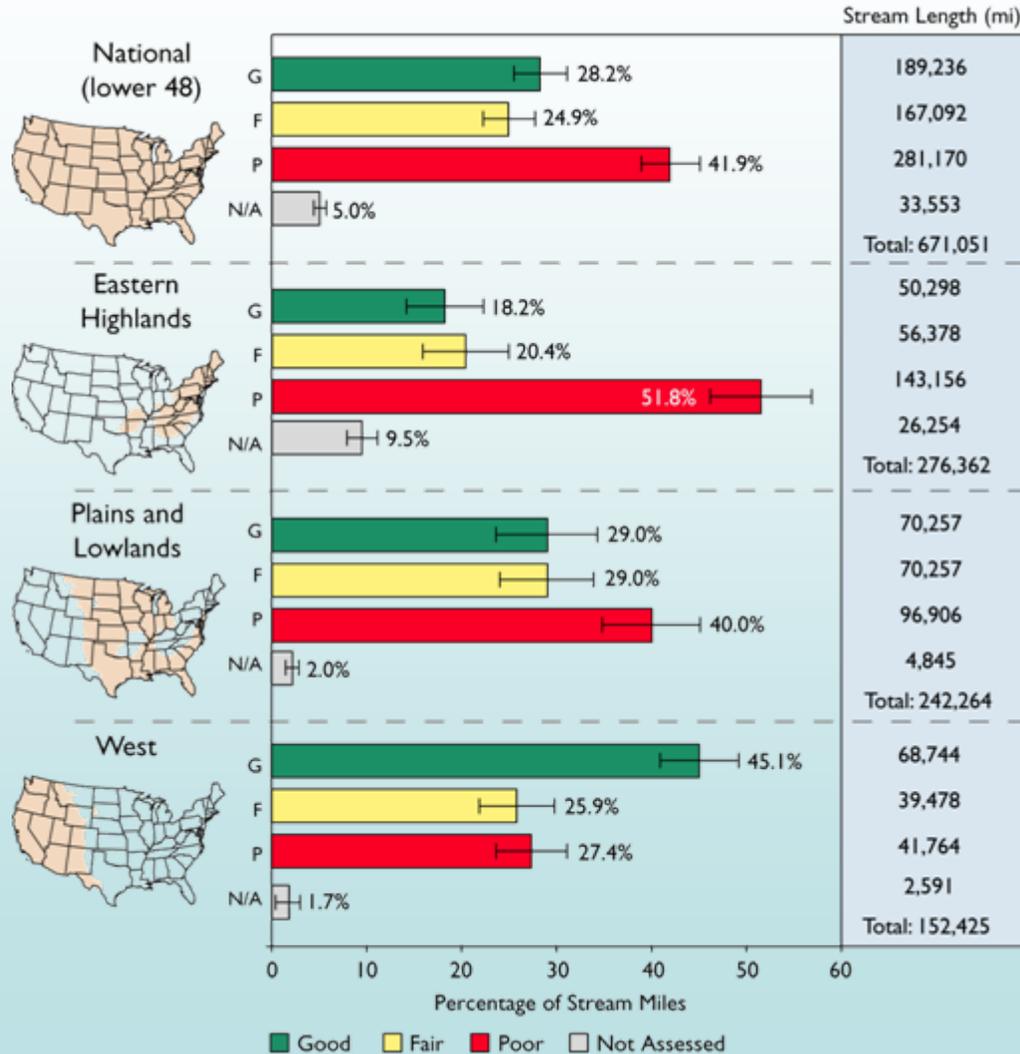
Regional IBI Scoring

For Each Ecoregion, Distribution of IBI Scores at Least-Disturbed Sites Used to Set Thresholds

Reference Distribution



Wadeable Streams Assessment Macroinvertebrate IBI Results



United States
Environmental
Protection Agency

Office of Research and Development
Office of Water
Washington, DC 20460

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www.epa.gov/owow/surveys/streams



Wadeable Streams Assessment

A Collaborative Survey of the Nation's Streams

