Measuring the Health of Puget Sound Streams: B-IBI Recalibration

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Funded by a US EPA Scientific Studies and Technical Investigation Assistance Program Grant

King County

B-IBI Advisory Board Meeting Feb 27, 2014

Overview

- Updated Metric Attributes
- Puget Lowland B-IBI Recalibration
  - Rescore B-IBI from 10-50 to 0-100
  - Adjust for taxonomic effort
  - Assess natural features and collection area
- Evaluate Index Precision

Regional Benthic Monitoring Issues

Limitations	Desired Outcomes
Differing collection methods	Standardization/NBD
Decentralized data mgmt	Centralized data mgmt
Outdated taxa attributes	Peer-reviewed or Empirically derived attributes
Insufficient B-IBI sensitivity	Re-calibrated scoring
>20 cities, counties, tribes monitoring independently	Collaboration and communication

Goal: Improved decision making to restore and protect streams

Strengthen Sensitivity of Taxa Attributes

Puget Lowland B-IBI Metrics
Total Taxa
Mayfly Taxa
Stonefly Taxa
Caddisfly Taxa
Long-lived Taxa
Intolerant Taxa
% Tolerant individuals
% Predator individuals
Clinger Taxa
% Dominance

Update Using Peer-Reviewed Literature

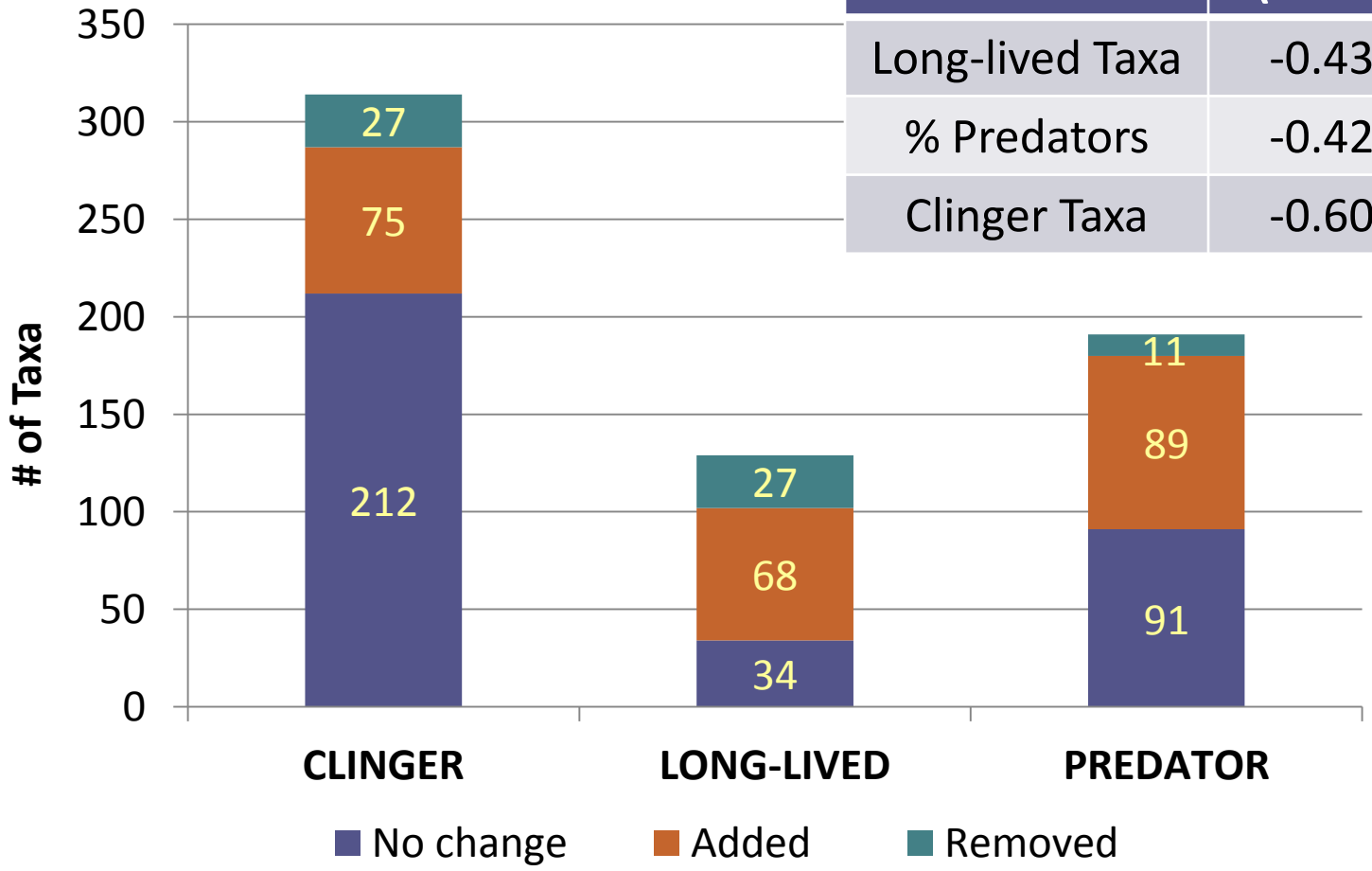
Update with Existing Data

Published Literature Updates

Attribute	Taxa Group	Primary Resources
Long-lived	stoneflies	Stewart and Stark 2002
	caddisflies	Wiggins 1996
	non-insects	Pennak 1989, Thorp and Covich 2001
	clams	Mackie 2007
	other mollusks	Dillon 2000
	other insect taxa	Huryn et al. 2008, Poff et al. 2006
Predator	insects	Merritt et al. 2008
	non-insects	Pennak 1989, Thorp and Covich 2001
Clinger	insects	Merritt et al. 2008
	non-insects	not applicable

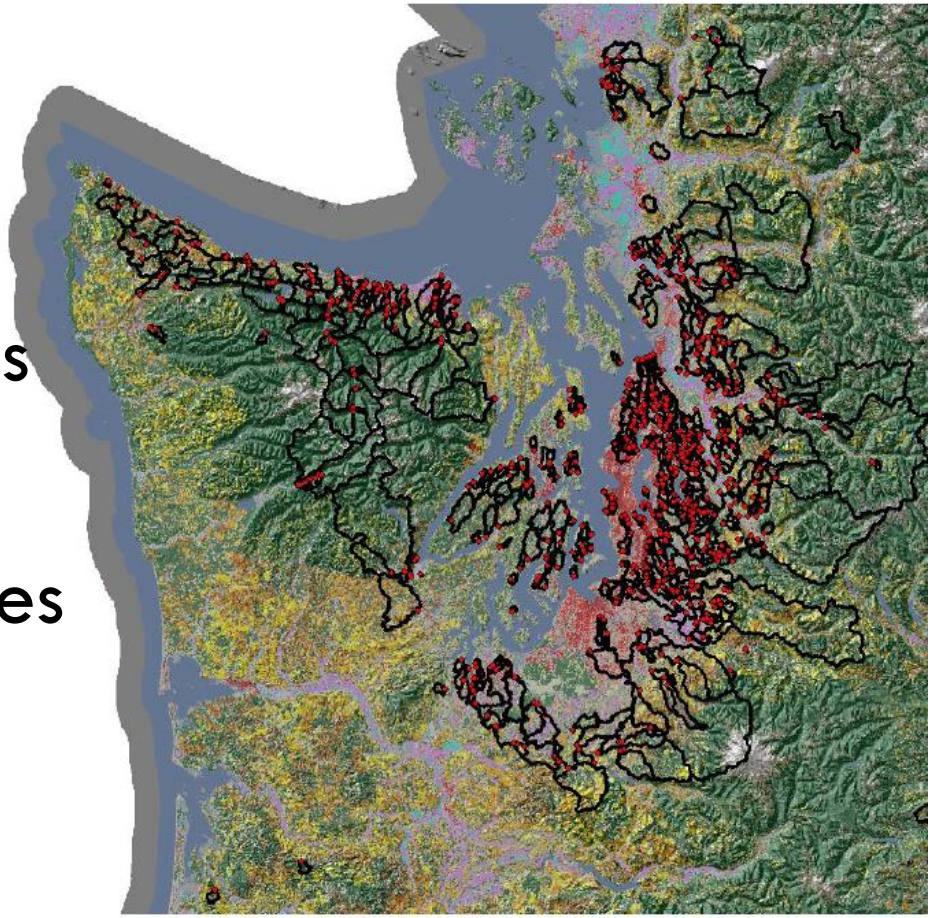
Attribute Changes: 1998 vs. 2012

Metric	Updated (2012)	Original (1998)
Long-lived Taxa	-0.43	-0.39
% Predators	-0.42	-0.43
Clinger Taxa	-0.60	-0.61



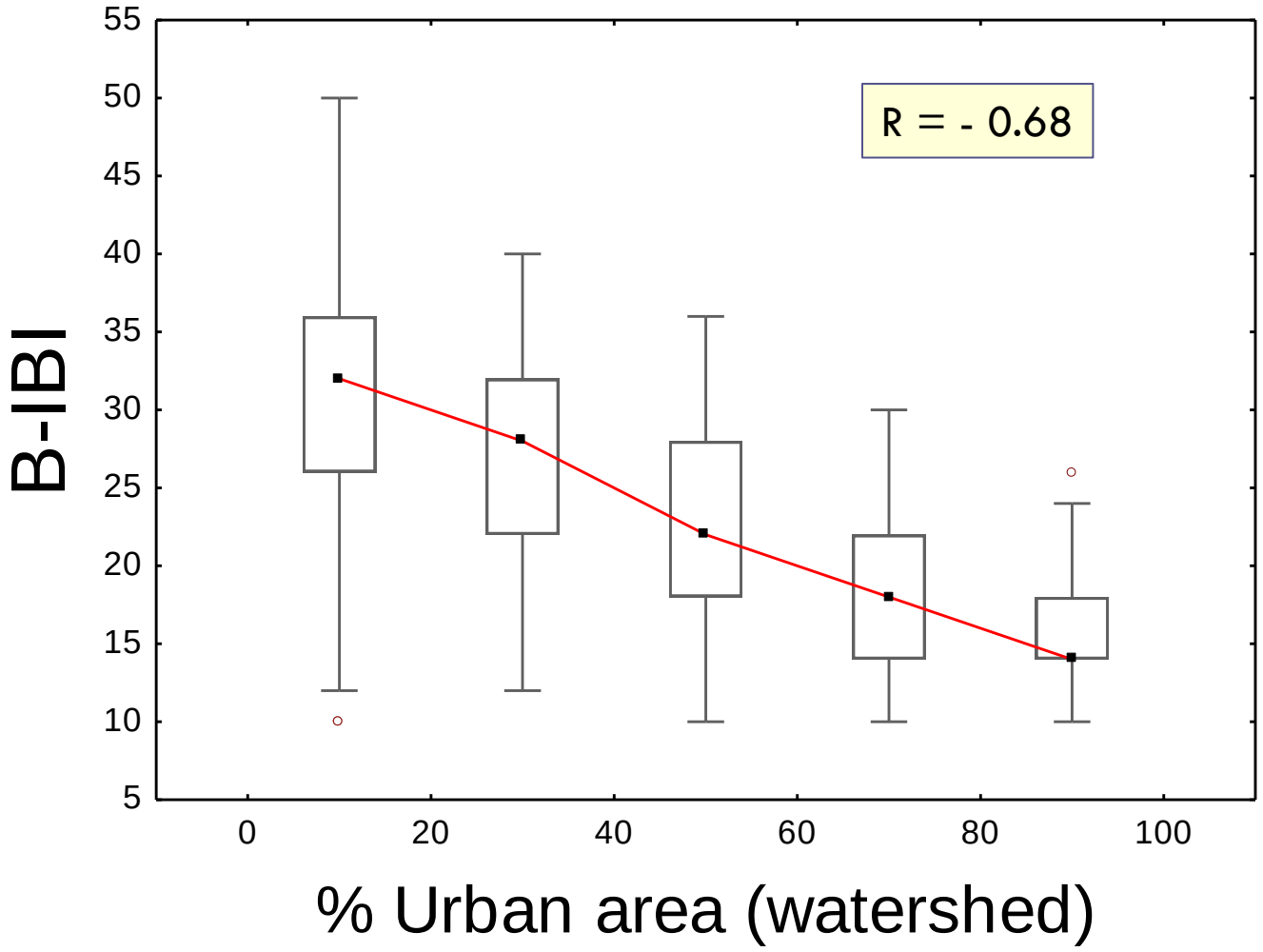
Watershed Delineation and Land Cover Calculations

- Peter Leinenbach (EPA)
- 1132+ locations
- Land cover & GIS metrics
- Measure disturbance
- Test/refine taxa attributes

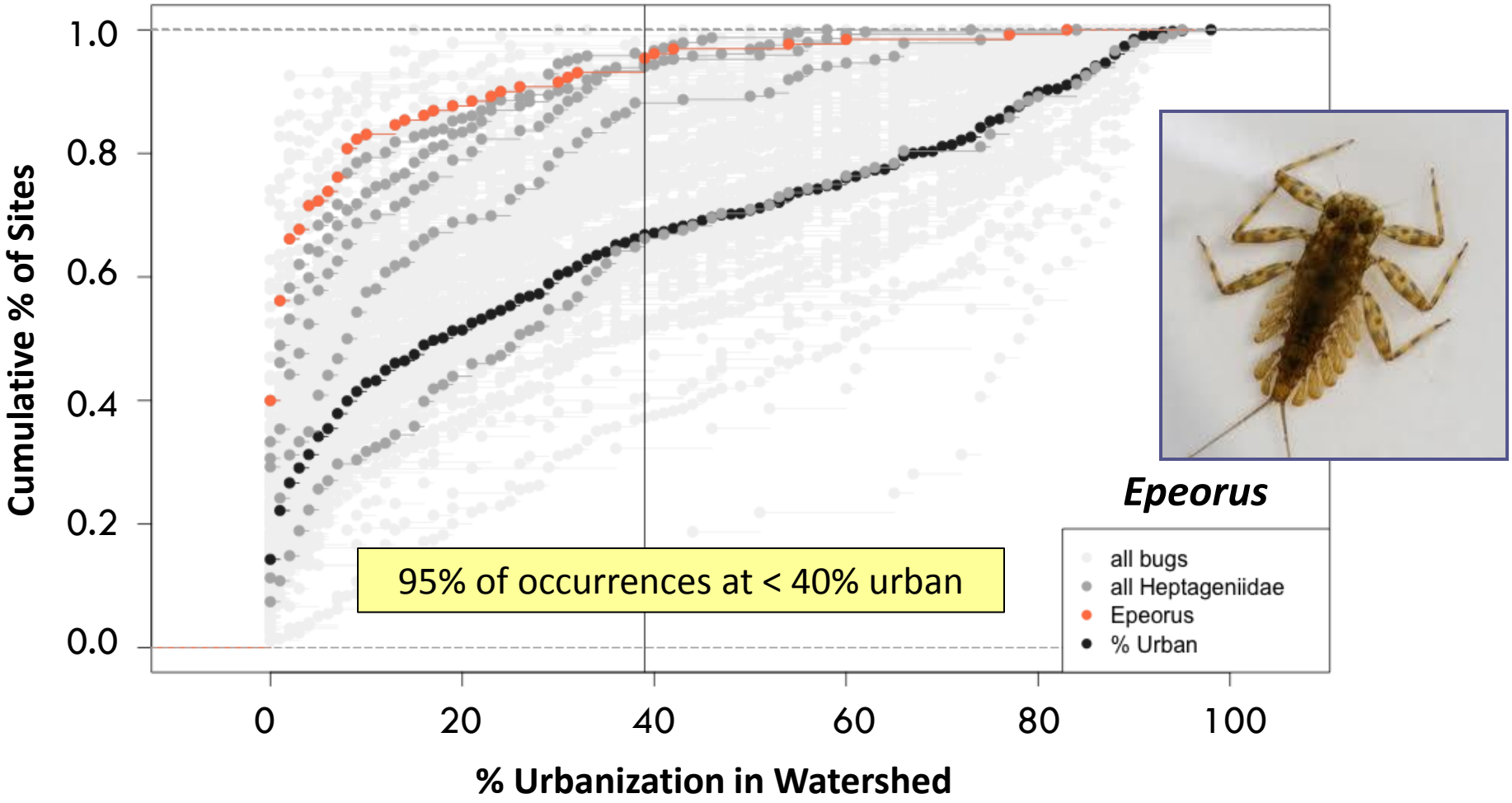


Shapefiles & metrics available on the PSSB!!!

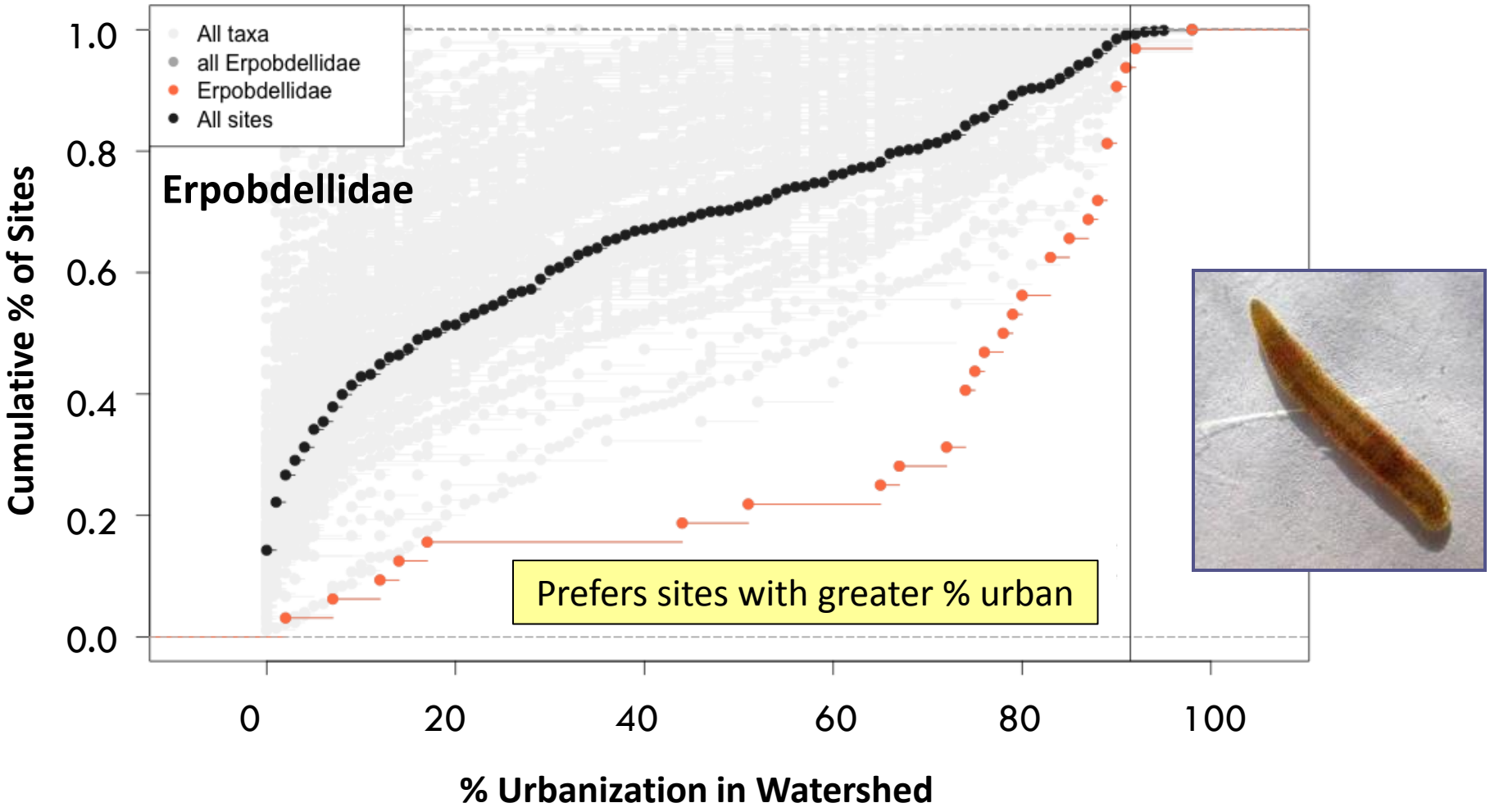
Strengthen Sensitivity of Tolerant/Intolerant Attributes



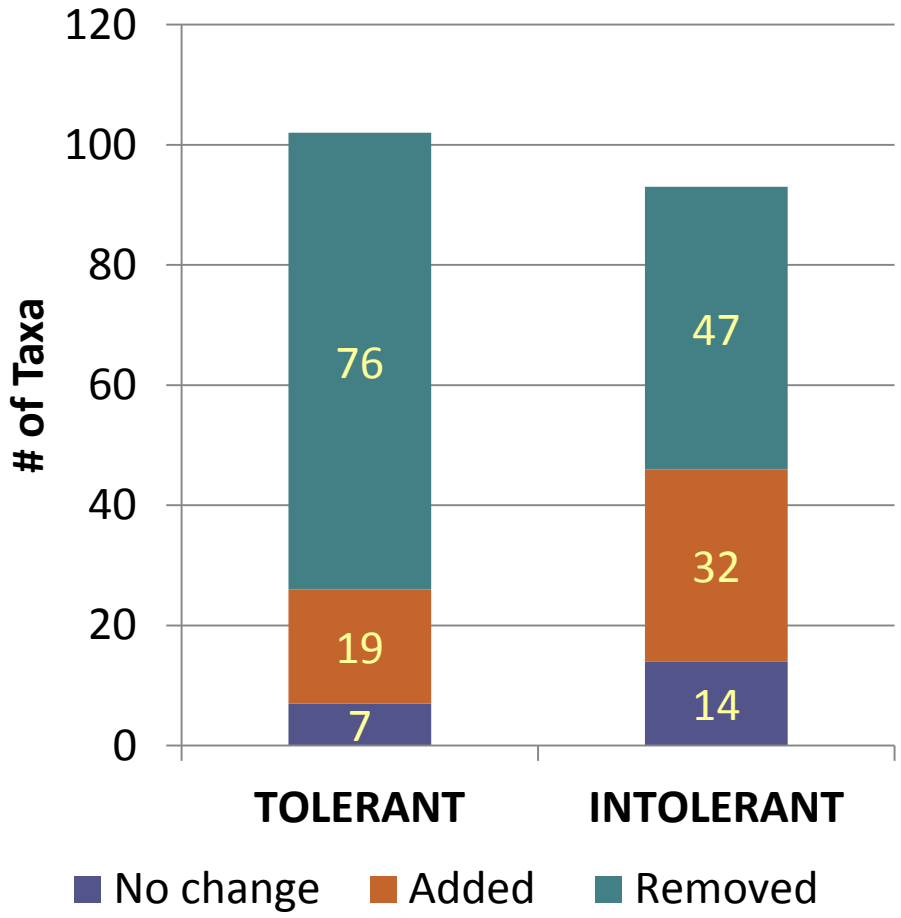
Example of an Intolerant Taxon



Example of a Tolerant Taxon

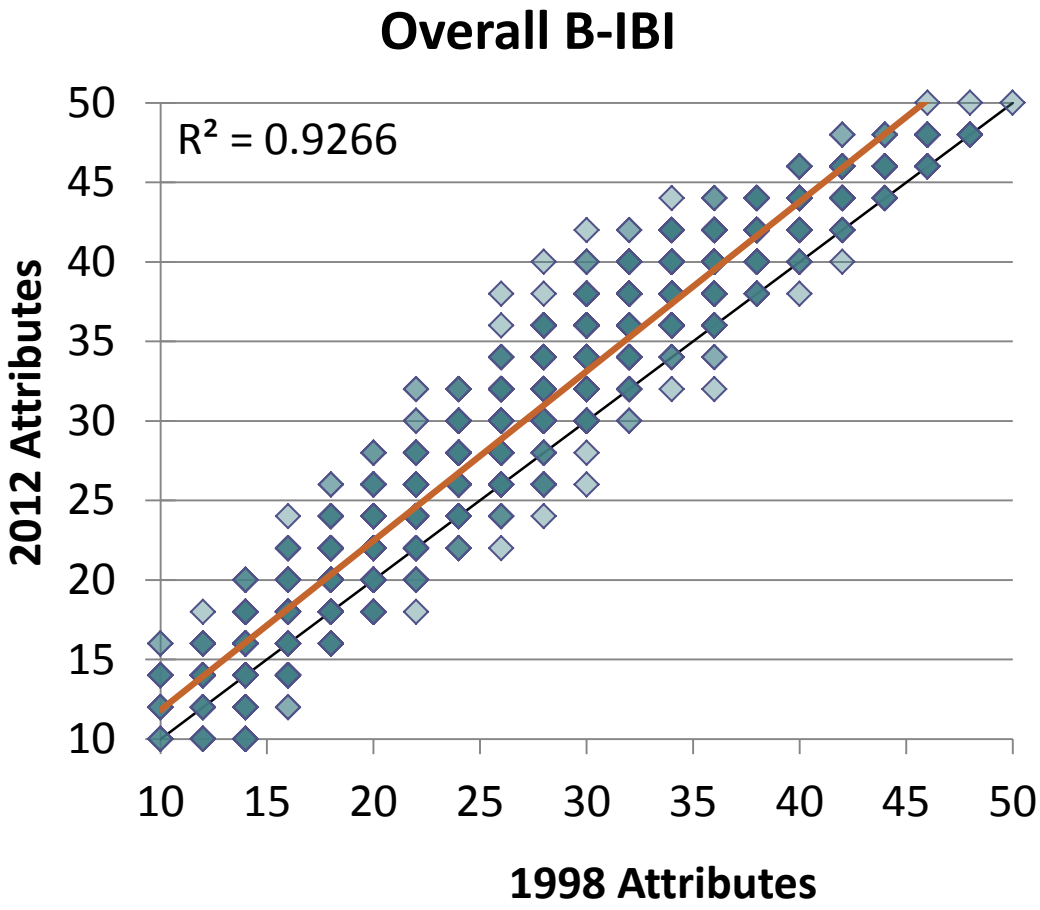


Attribute Changes: 1998 vs. 2012



Metric	Updated (2012)	Original (1998)
Tolerant	0.62	0.47
Intolerant	-0.75	-0.52

B-IBI Scores: Attributes Compared



Metric	R^2	Mean Residual*
Long-lived Taxa	0.41	3.2
Intolerant Taxa	0.49	1.35
Clinger Taxa	0.95	1.21
% Tolerant	0.07	-1.96%
% Predator	0.96	0.46%
Overall B-IBI	0.93	2.98

* All mean residuals significantly different than 0 ($p<0.05$)

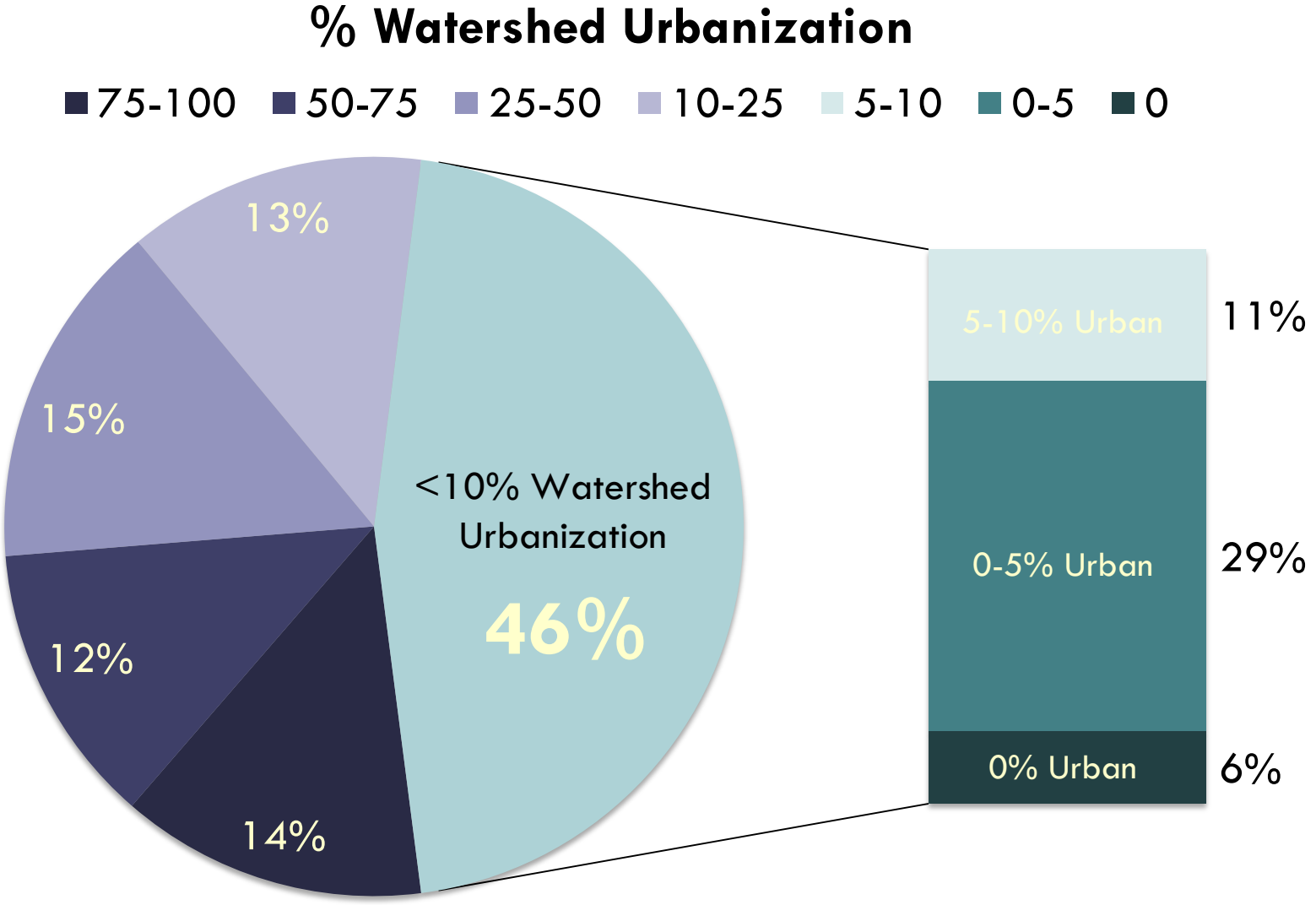
Taxa Attribute Conclusions

- No change to structure of B-IBI, all metrics highly correlated with % urbanization
- Many rare taxa dropped from tolerant and intolerant lists
- Taxa attribute updates require B-IBI recalibration

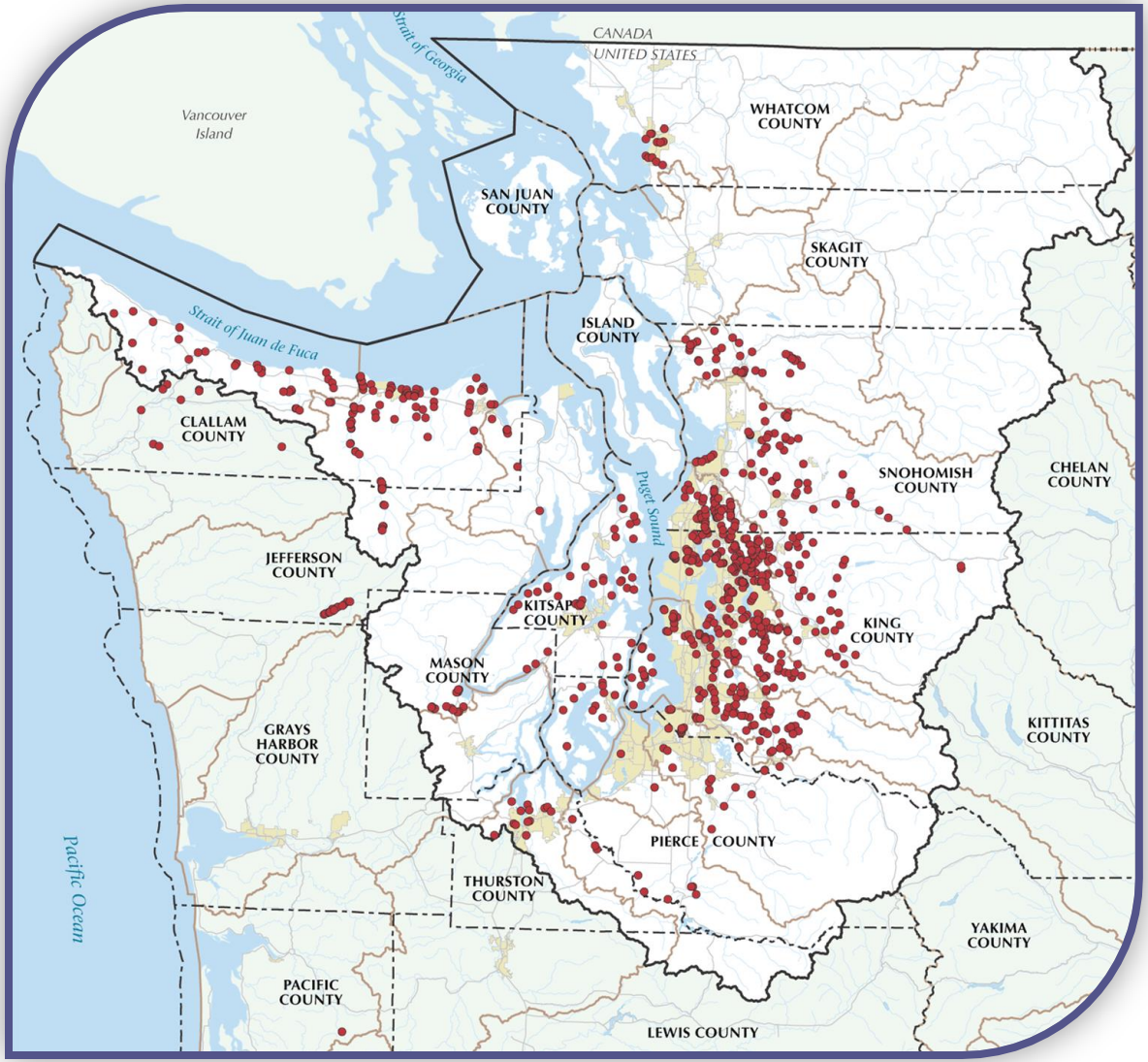
B-IBI Recalibration

- Incorporate new attributes
- Utilize existing data: 856 sites
- New scoring scheme
- Apply any adjustments?

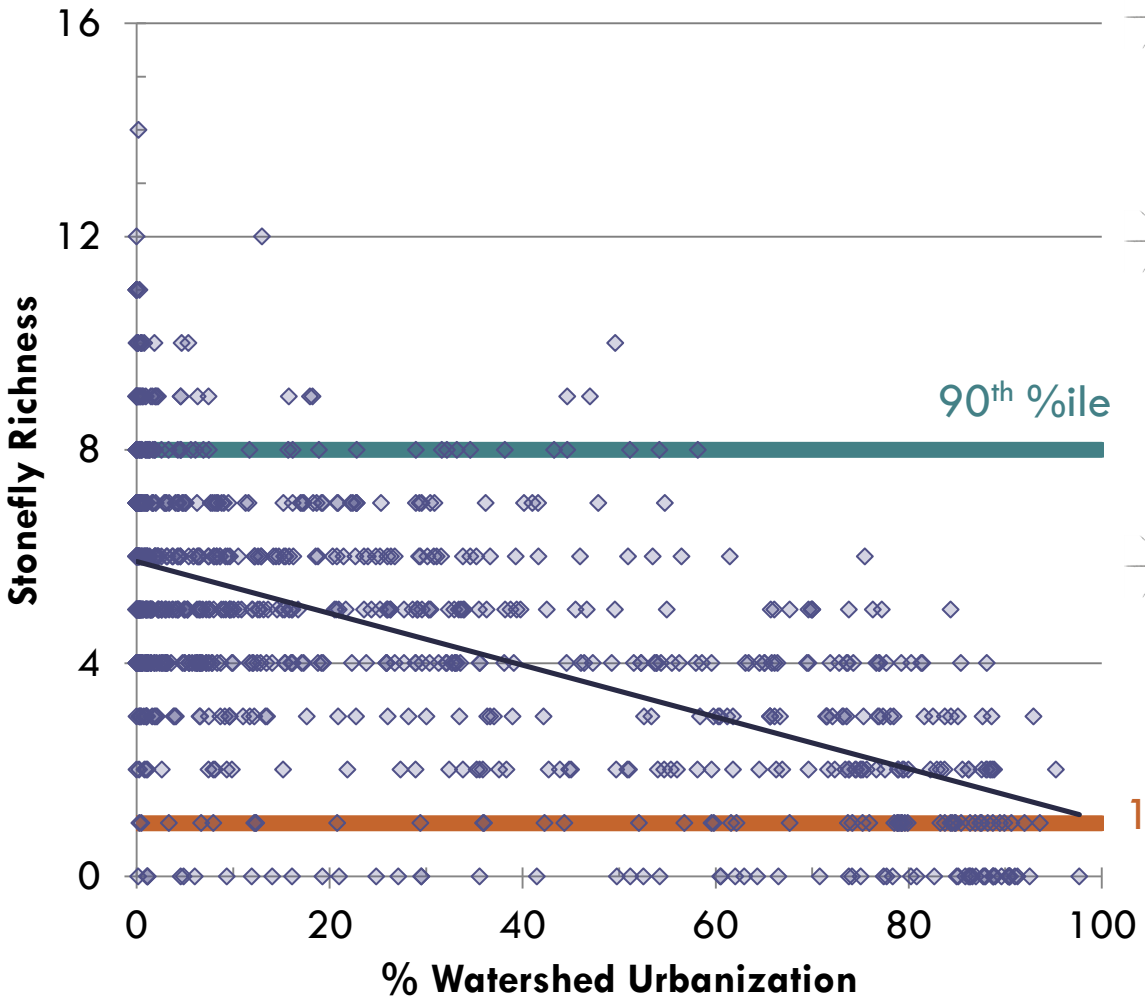
Landcover: Watershed Urbanization



Puget Sound Stream Monitoring



B-IBI Recalibration: Scoring



- Metrics well behaved
- Percentiles set upper & lower bounds
- Continuous scoring

B-IBI Recalibration: Scoring

$$= \frac{10 * (\text{Observed Value} - 10^{th}\ \%ile)}{(90th\ \%ile - 10th\ \%ile)}$$

- Metrics that *decrease* with disturbance
  - Values < 10th %ile score 0
  - Values > 90th %ile score 10

B-IBI Recalibration: Scoring

$$= 10 - \left[\frac{10 * (\text{Observed Value} - 10^{th}\ \%ile)}{(90th\ \%ile - 10th\ \%ile)} \right]$$

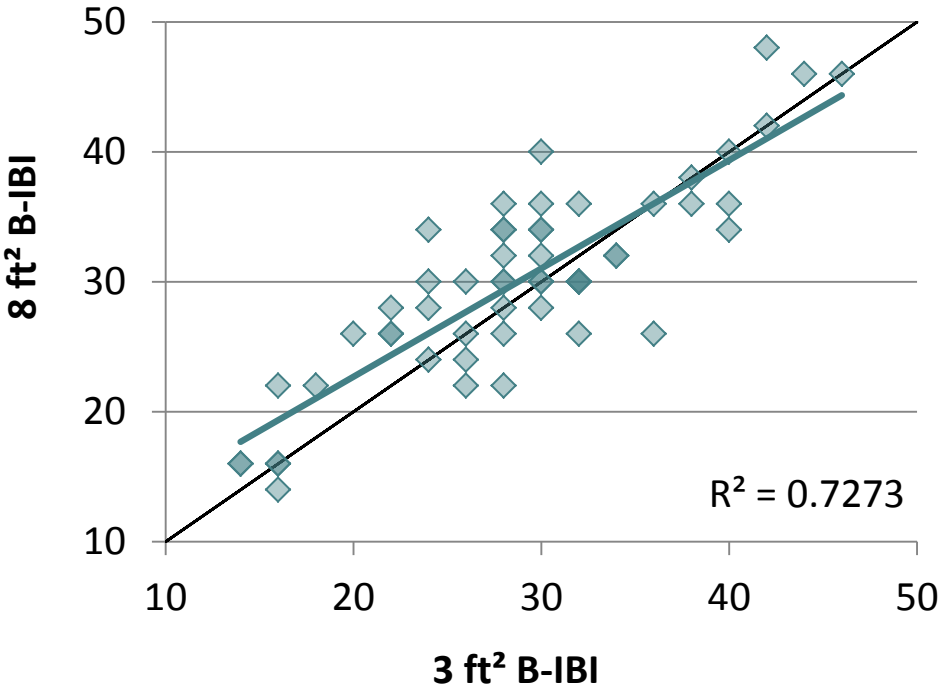
- Metrics that ~~*decrease*~~ *increase* with disturbance
  - Values < 10th %ile score ~~0~~ 10
  - Values > 90th %ile score ~~10~~ 0

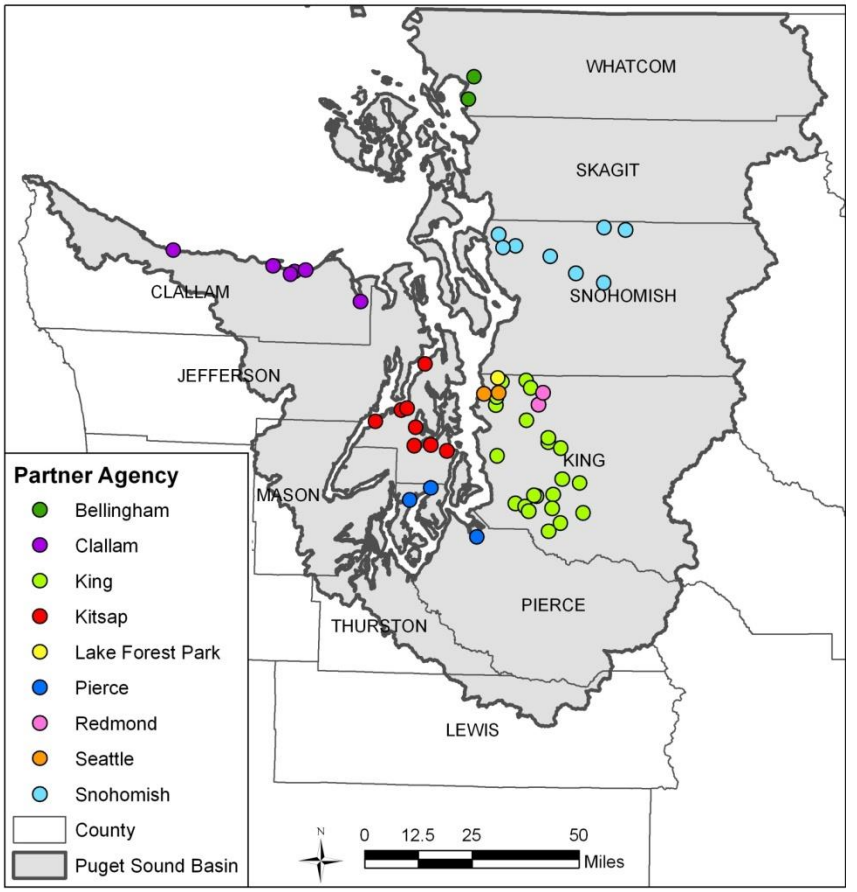
B-IBI Recalibration: Testing

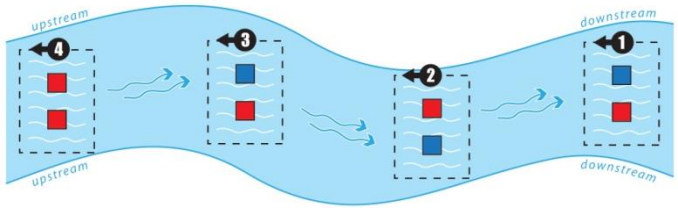
- Natural Factors (Elene's Talk)
- Collection Area (3 vs. 8 ft^2)
- Taxonomic Effort

Side by Side Sampling (2011)

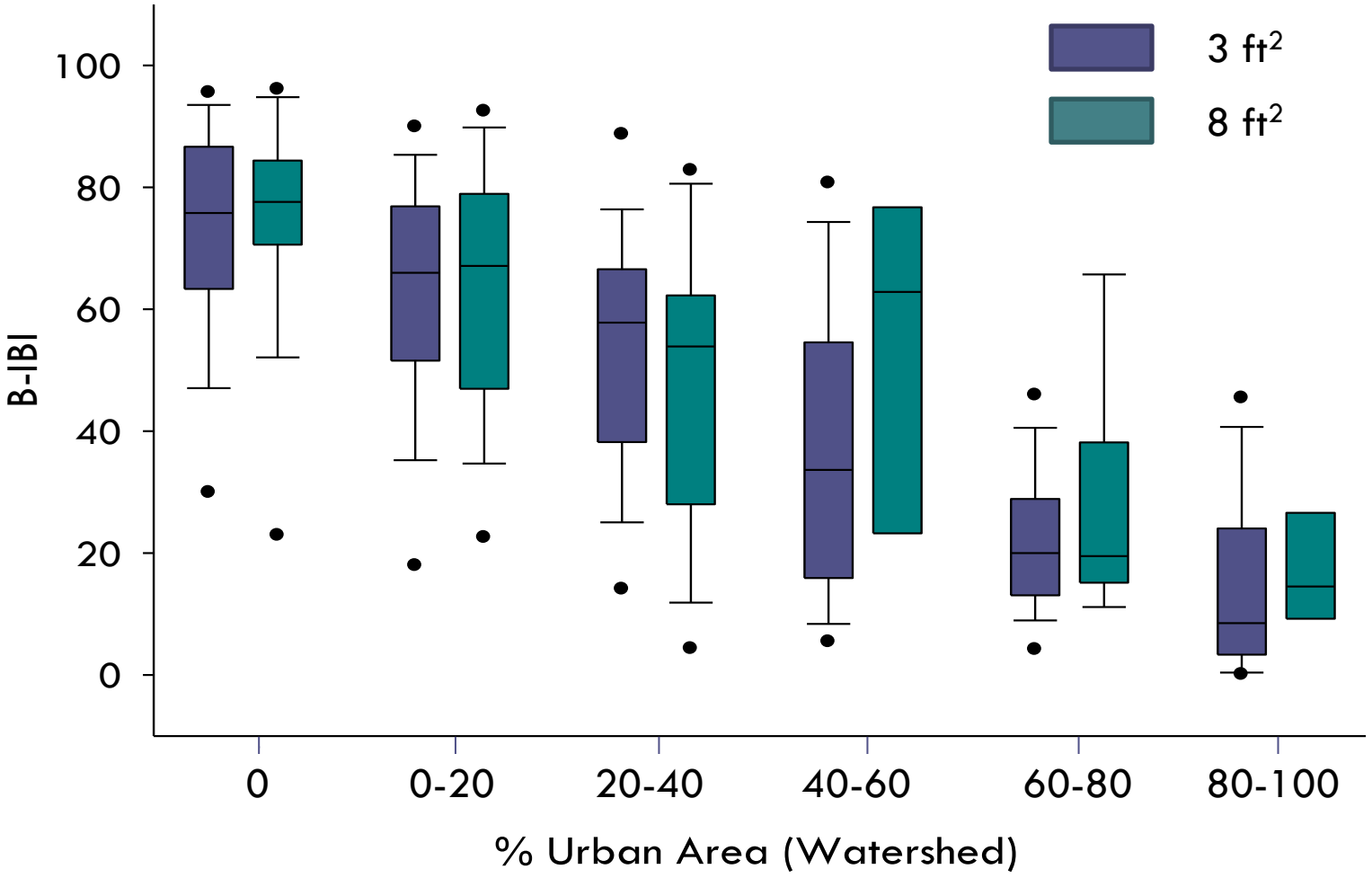
- 3, 8, 9 sq ft
- 55 sites
- 9 partners







Collection Area

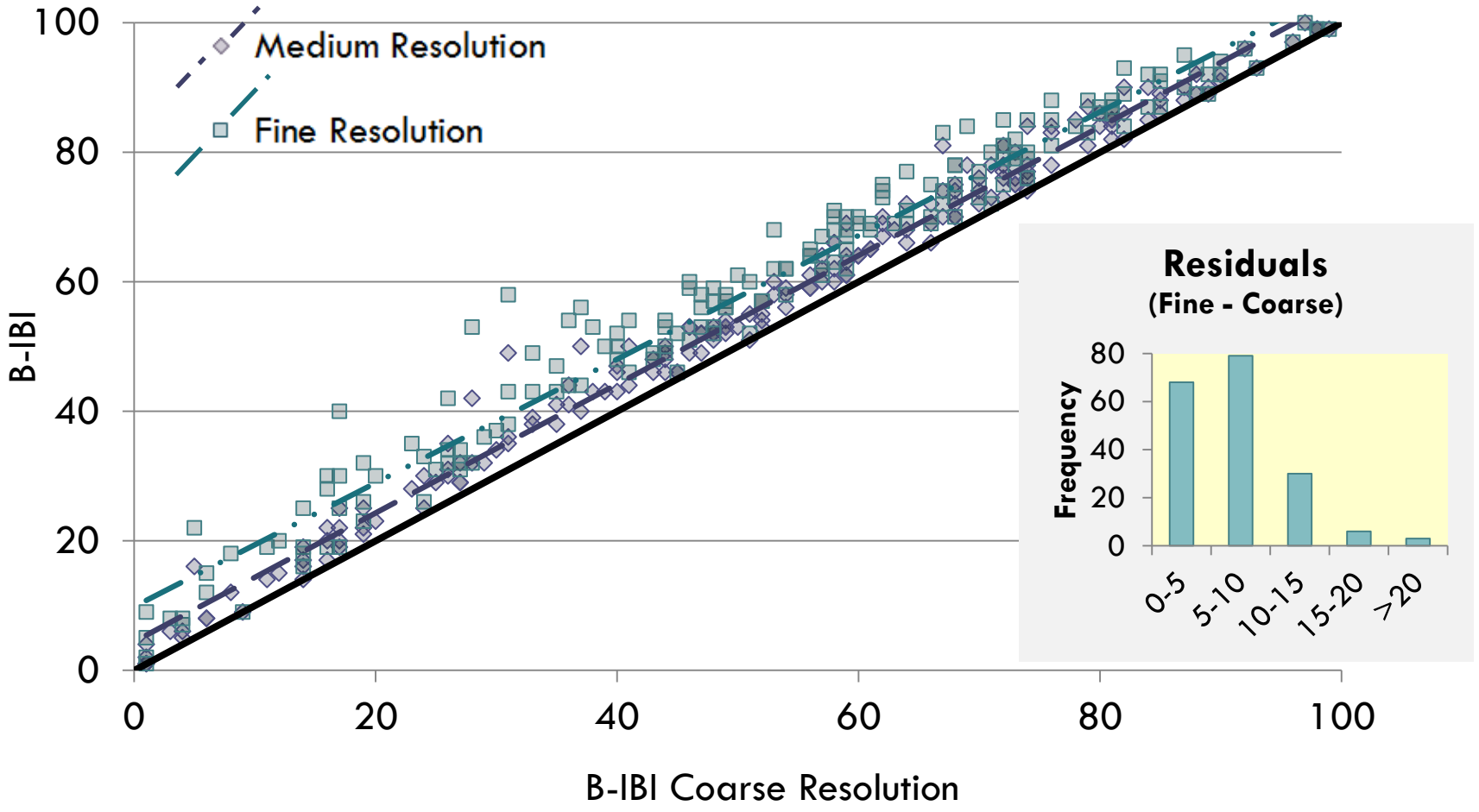


Taxa Effort: 3 Levels of Resolution

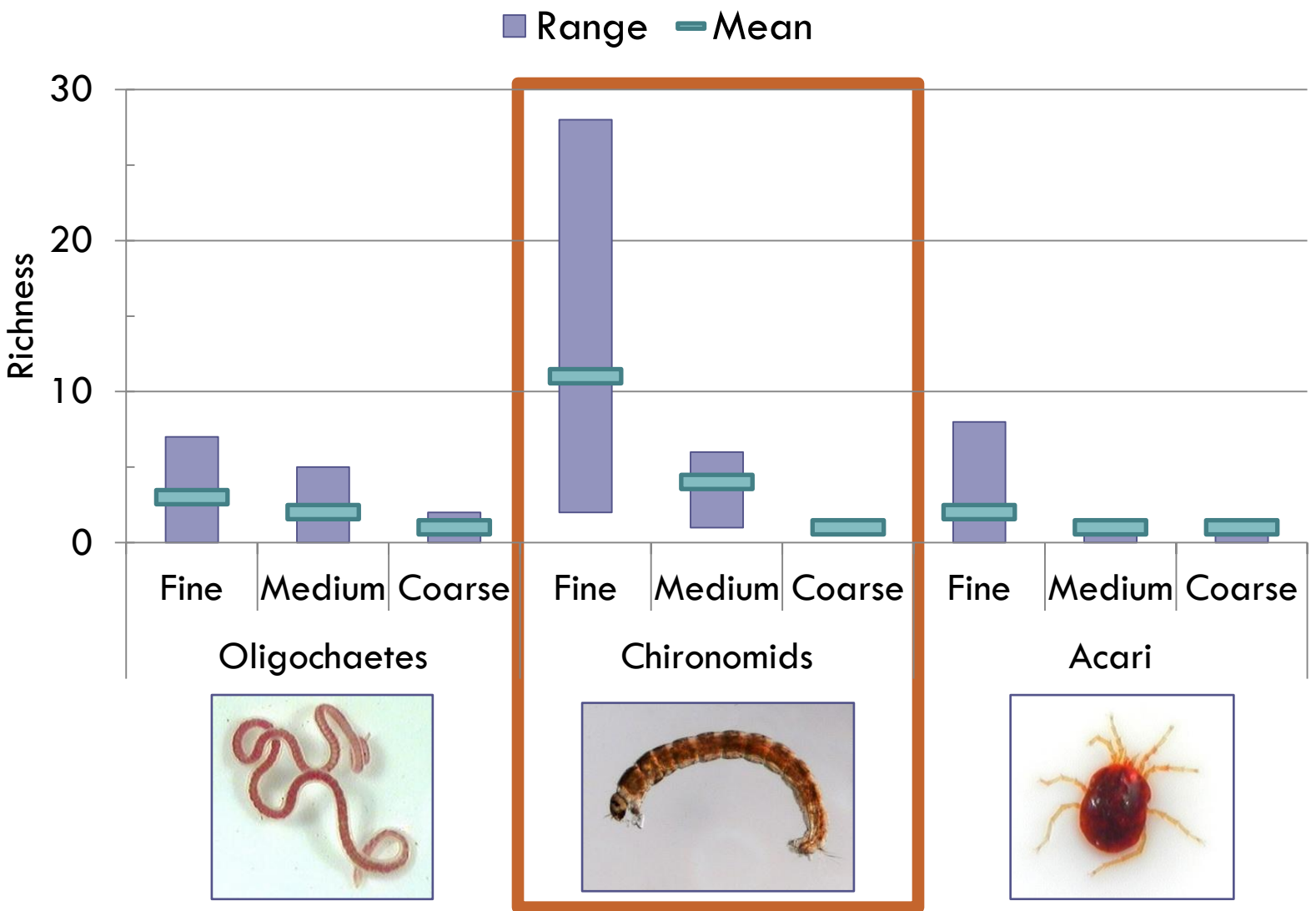
Taxa	Fine	Medium	Coarse
Oligochaetes	Subfamily/Genus	Family	Subclass
Acari	Genus	Subclass	Subclass
Gastropods	Genus	Genus	Family
Dytiscids	Genus	Genus (adults) Family (larvae)	Family
Simulids	Genus	Genus (larvae) Family (pupae)	Family
Chironomids	Genus/Sp/Sp grp	Subfamily/tribe	Family
Trichoptera (Pupae only)	Genus/Sp/Sp grp	Family	Order

Other groups = Lowest practical level (Genus/sp)

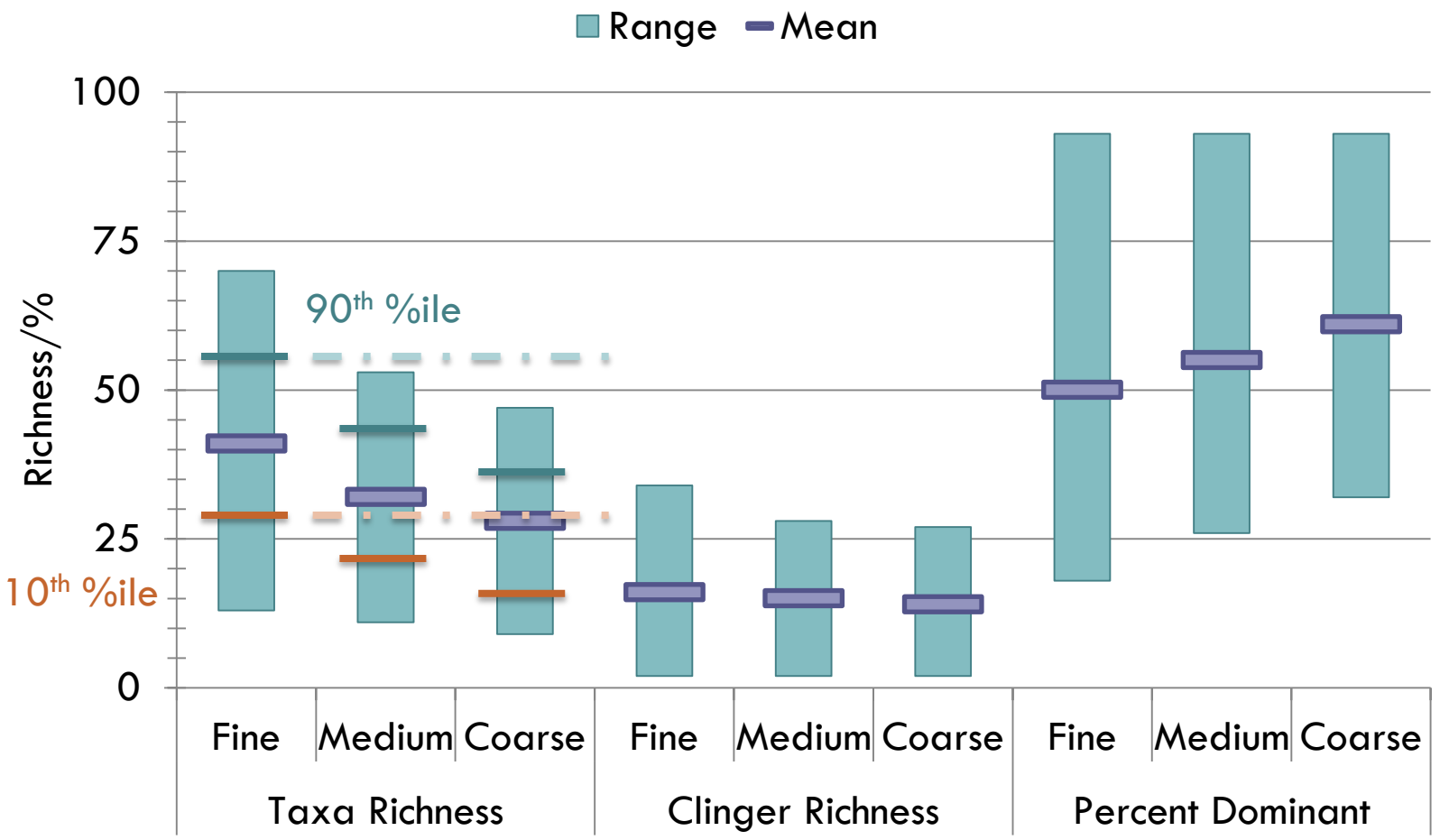
B-IBI: No Taxa Adjustments



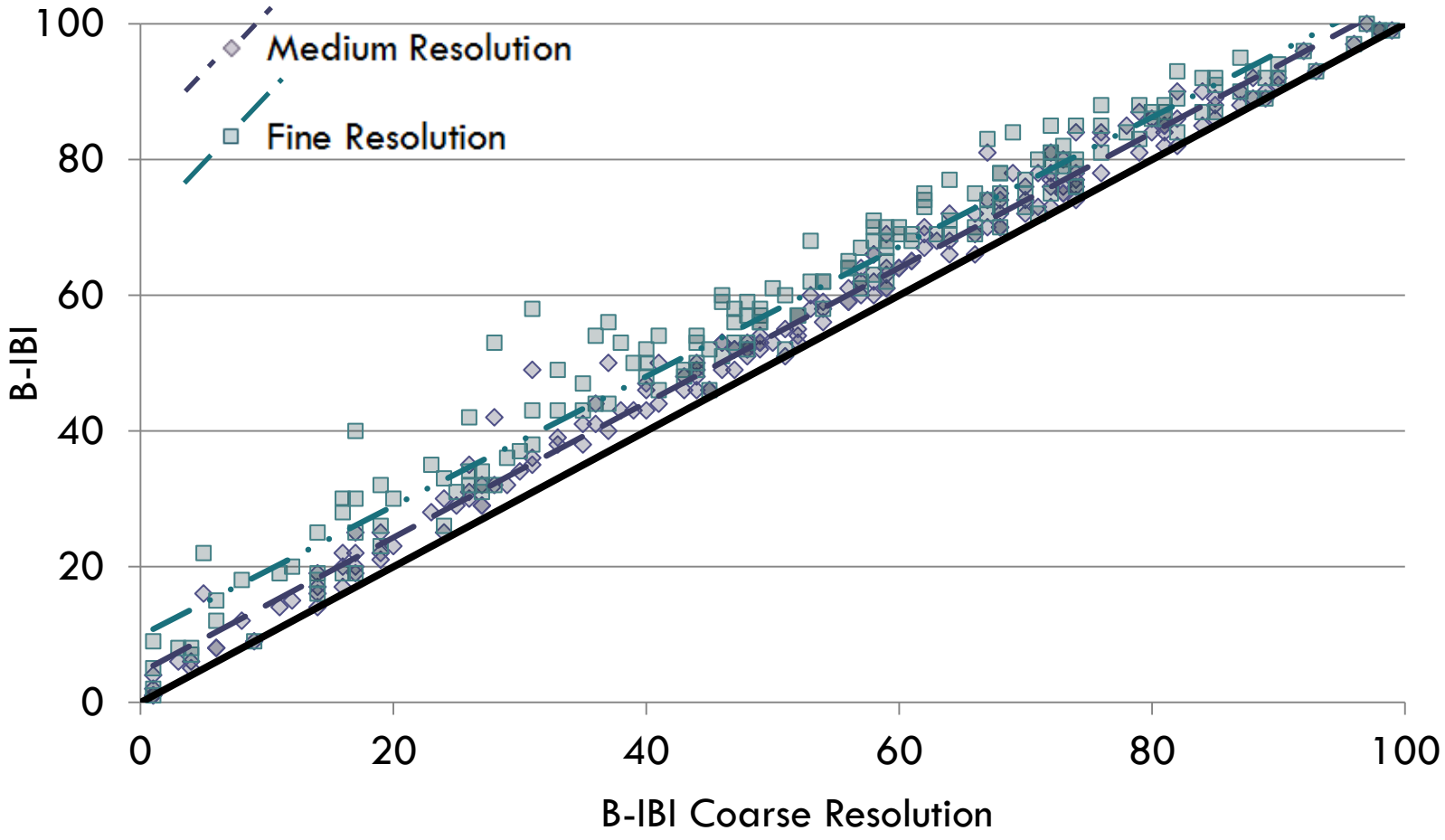
Taxa Effort: Chironomids Matter



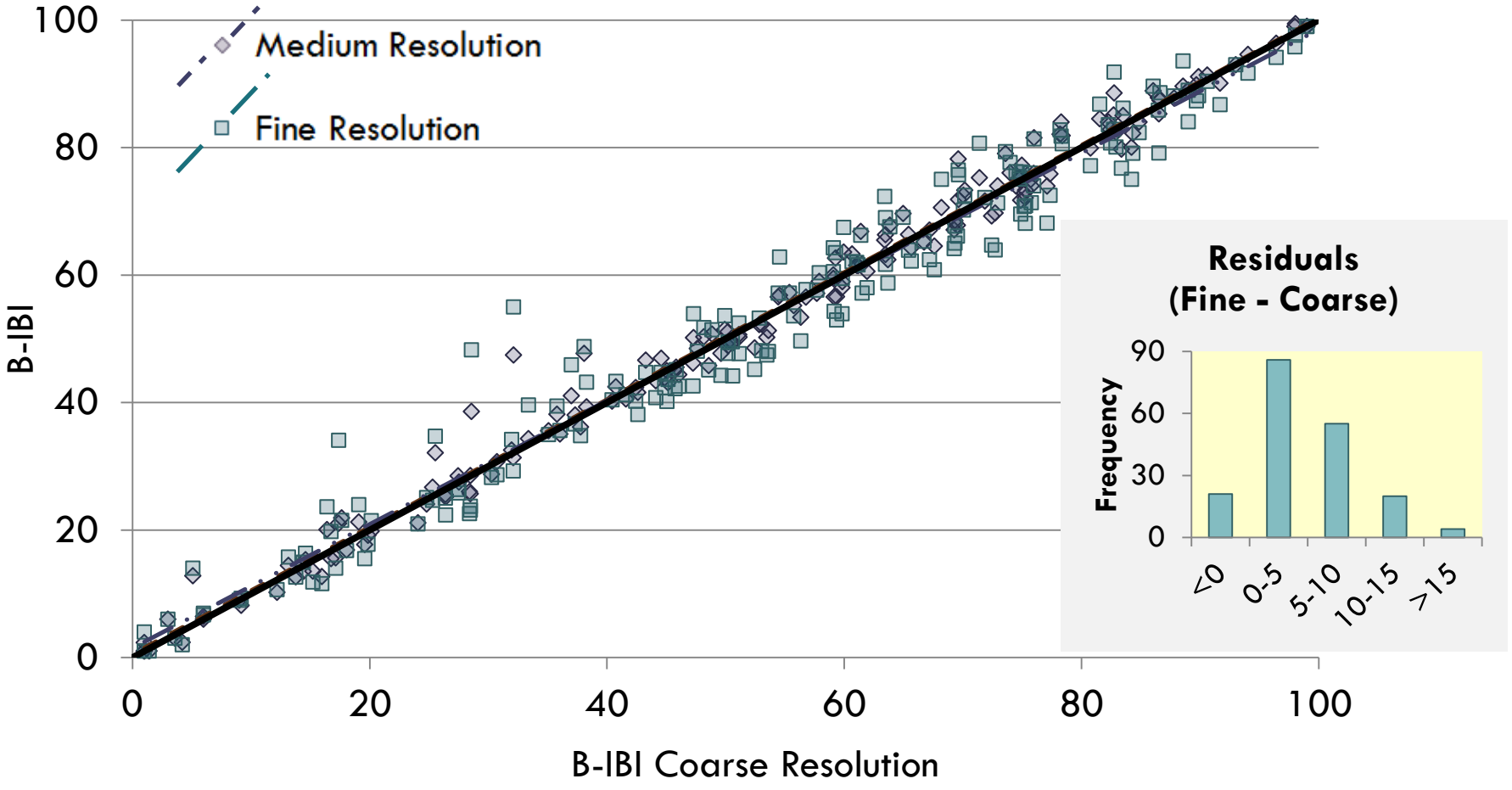
Taxa Effort: 3 Metrics Influenced



B-IBI: No Taxa Adjustments



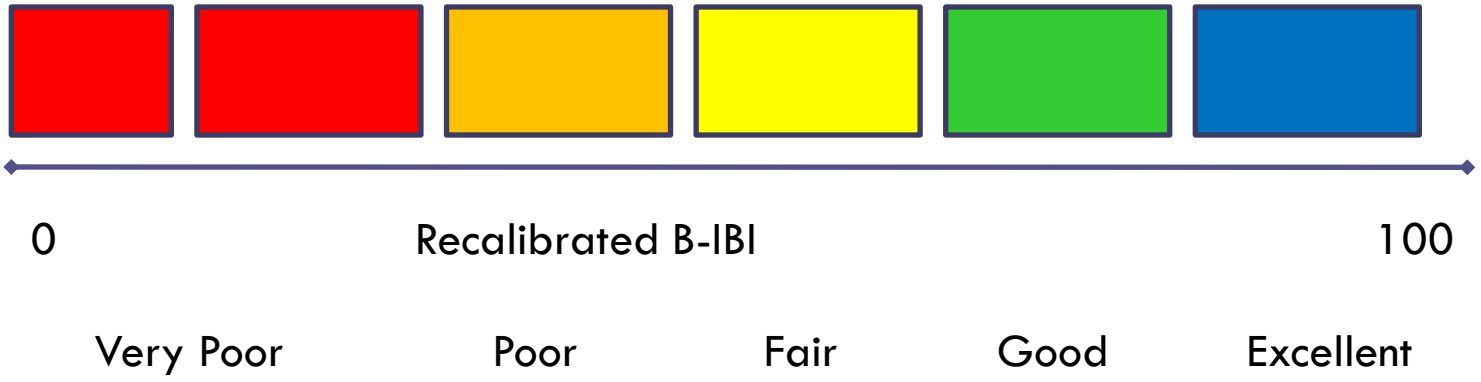
B-IBI: Adjusted for Taxa Effort



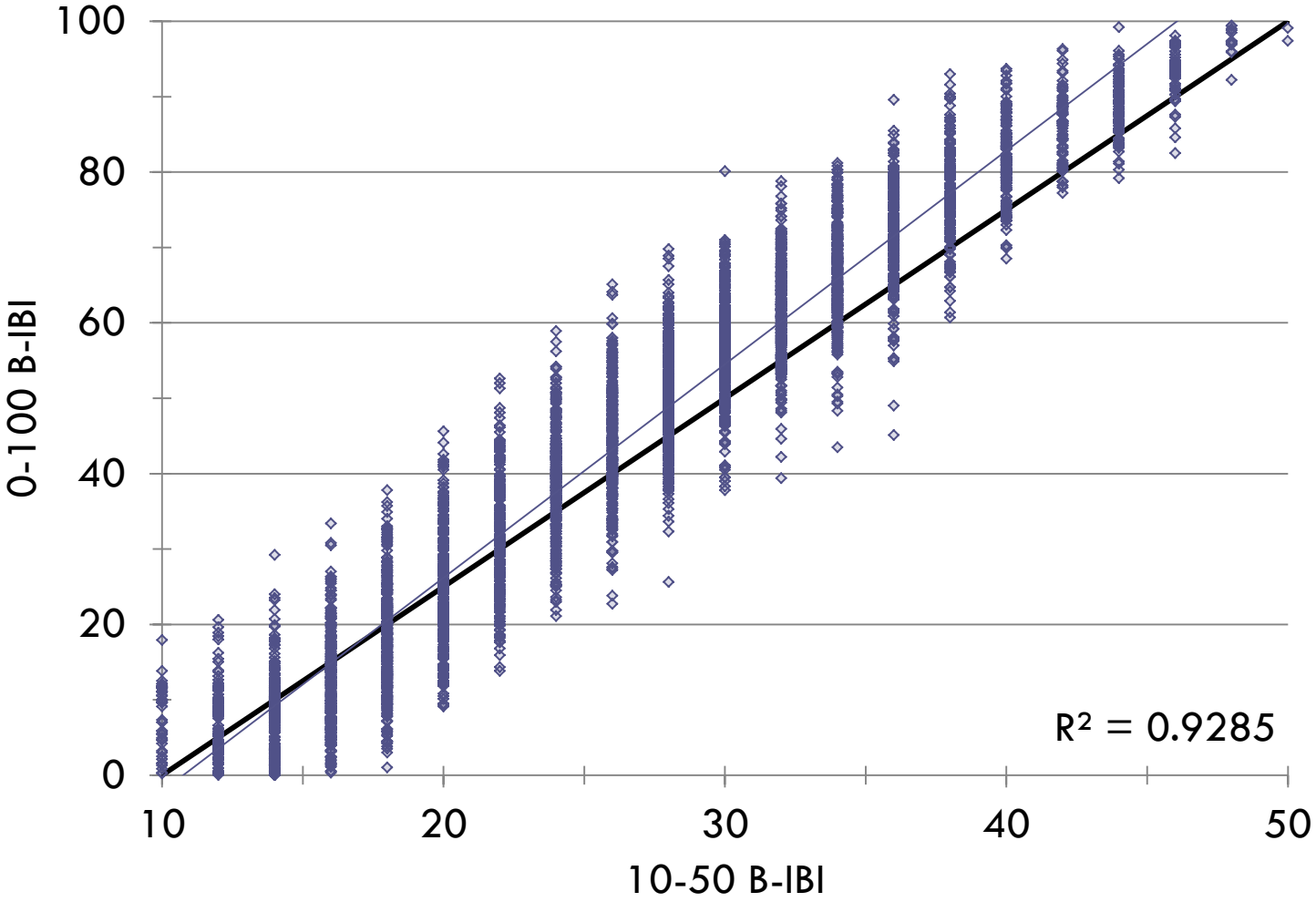
Precision of B-IBI: Comparison

~ 4.3 categories of biological condition

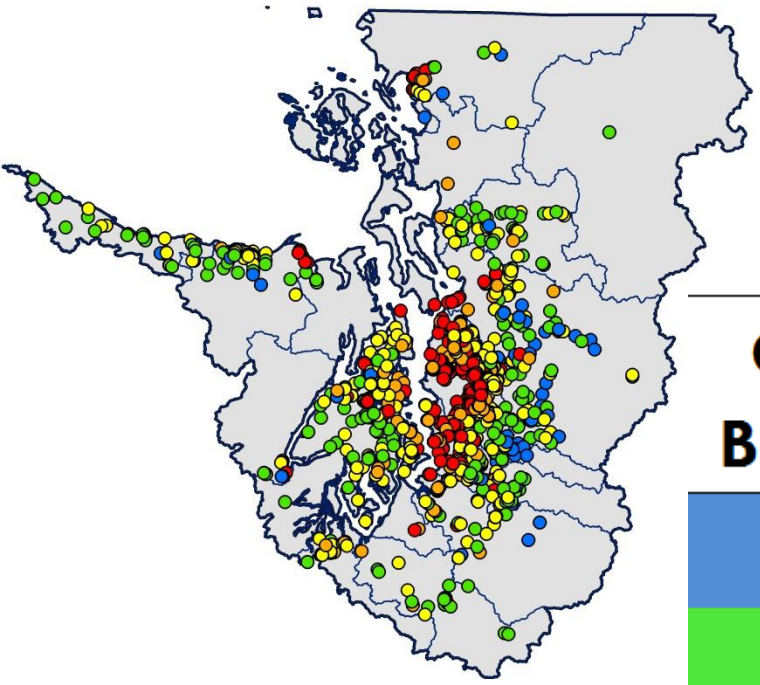
~ 5.6 categories of biological condition



B-IBI Recalibration: Comparison



B-IBI Condition Categories



Condition of Biotic Integrity	$B\text{-}IBI_{10\text{-}50}$ Score	$B\text{-}IBI_{0\text{-}100}$ Score
Excellent	46-50	80-100
Good	38-44	60-80
Fair	28-36	40-60
Poor	18-26	20-40
Very Poor	10-16	0-20

Puget Sound Stream Benthos

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- B-IBI Results Map
- B-IBI Results Table
- About the B-IBI Scoring System
- B-IBI Scoring Types
- The Scoring Process Step-By-Step
- Benthic Taxa Attributes
- Standard Taxonomic Effort
- Taxa Excluded from Scoring

Analy

This site
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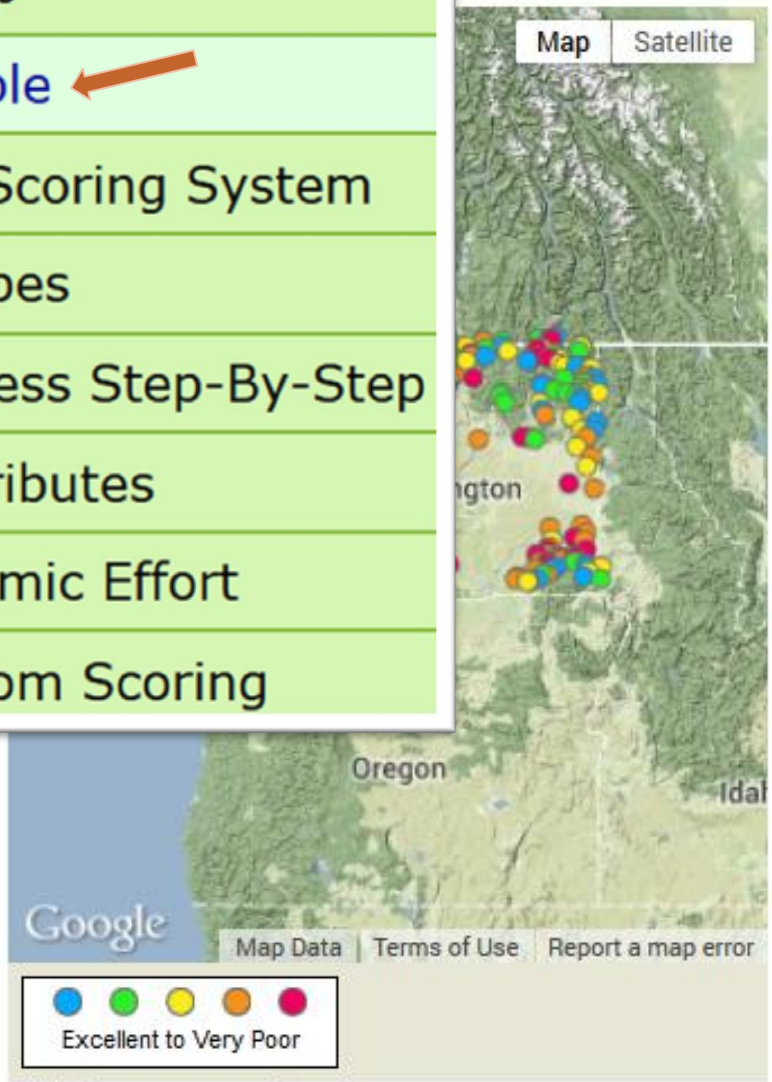
Benthic
because they are good indicators of the biological health of stream systems and play a crucial role in the stream ecosystem.



Click here to customize chart.

The B-IBI Scoring System

We use the Benthic Index of Biotic Integrity (B-IBI) scoring system to determine stream health. Since the B-IBI is a standardized scoring system, it can be used to compare and rank the health of different streams.

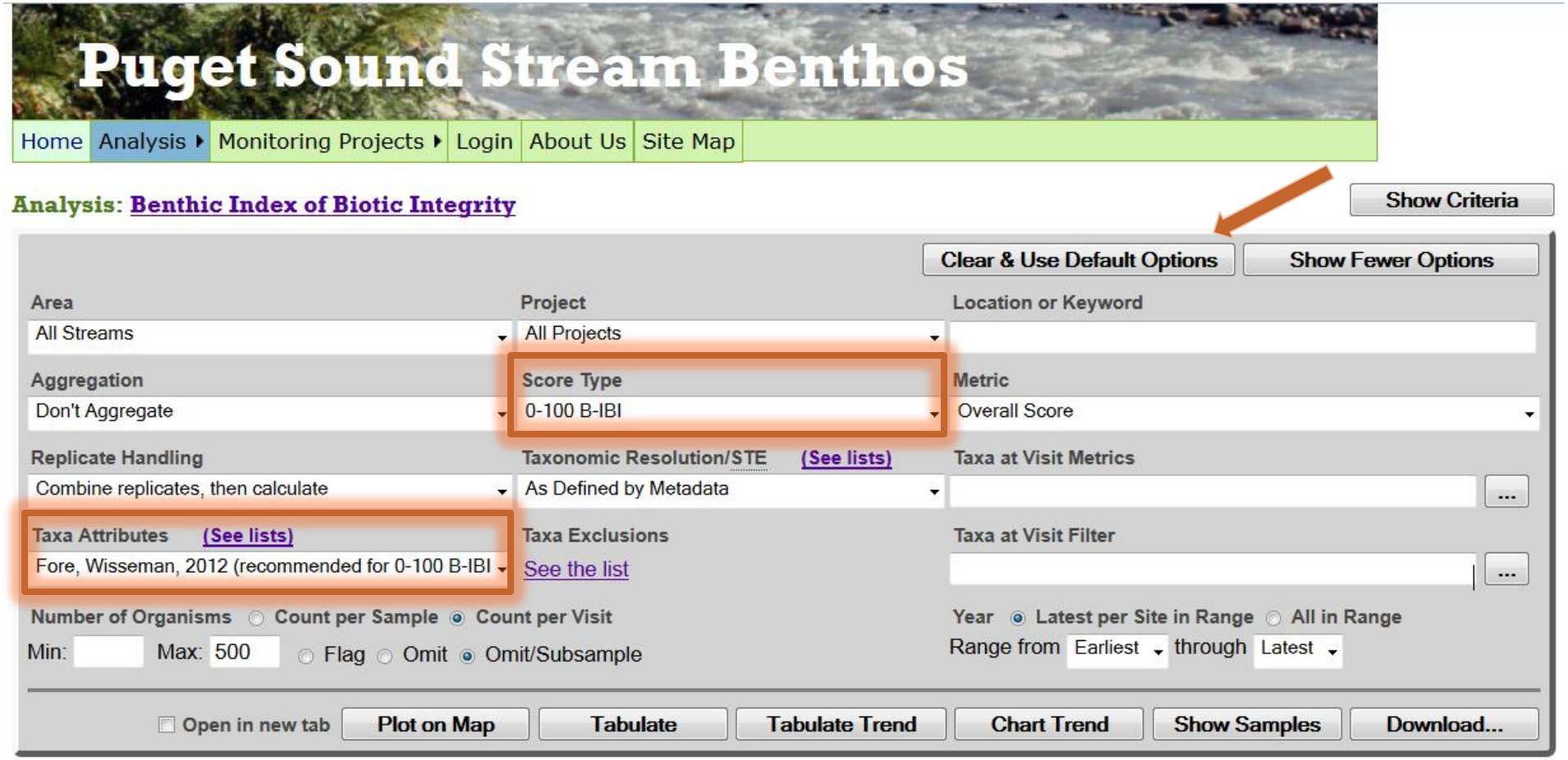
B-IBI has several variants, and we will support many of them over time. Currently, we are using Puget Sound Lowlands B-IBI. This site allows you to filter the scores by a variety of parameters and then

- Plot the scores on maps
- Show the scores in tables

B-IBI Recalibration

We are currently working to enhance benthic macroinvertebrate monitoring tools for the Puget Sound region. For more information and to view documents and other products please go to the B-IBI Recalibration page.

B-IBI Recalibration: Now Available!



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Taxa Attributes (See lists)

Fore, Wisseman, 2012 (recommended for 0-100 B-IBI)

- Fore, Wisseman, 2012 (recommended for 0-100 B-IBI)
- Wisseman, 1998 (recommended for 10-50 B-IBI)

Specify the compilation of attributes or characteristics of the taxa included in the analysis. These attributes include whether or not the invertebrate is a predator, long-lived, and tolerant or intolerant of pollution, and whether or not the animal is a clinger.

Score Type

0-100 B-IBI

- 0-100 B-IBI
- 10-50 B-IBI
- Ecology MMI
- Metric Quantities without Scores

Select the score type. B-IBI is scored based on the designated taxonomic resolution.

B-IBI 0-100: Use the updated Puget Lowland B-IBI (2013). Individual metric scores range from 0-10, and the overall score (index) ranges from 0-100.

B-IBI 10-50: Use the historic Puget Lowland B-IBI (Species-Family and Species-Genus; developed in the 1990s). Individual metrics are scored 1, 3, or 5, and the overall score (index)

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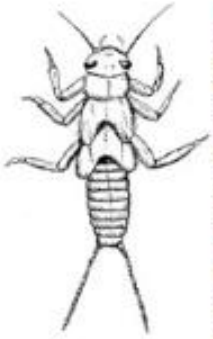
Analyzing Stream Health

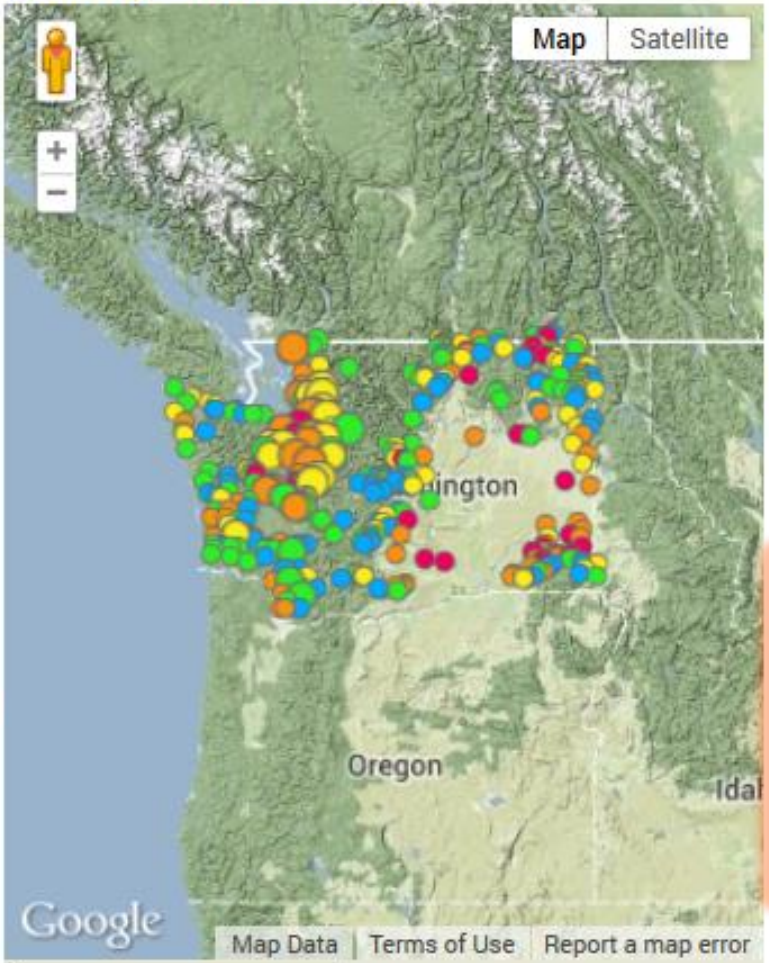
This site analyzes benthic macro-invertebrate community structure to determine the ecological health of streams. Participating agencies use this site to manage, analyze and share data from their ongoing stream monitoring programs.



Benthic macro-invertebrates, also known as stream bugs, are animals that can be seen with the naked eye, do not have backbones and live in the **stream benthos**—in or near the streambed. They include insects, crustaceans, worms, snails, clams, etc.

Benthic macroinvertebrates are monitored because they are good indicators of the biological health of stream systems and play a crucial role in the stream ecosystem.

Plotting Biotic Integrity



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Go to B-IBI Recalibration Documents and Materials

B-IBI Recalibration

Enhancement and Standardization of Benthic Macroinvertebrate Monitoring and Analysis Tools for the Puget Sound Region

Background

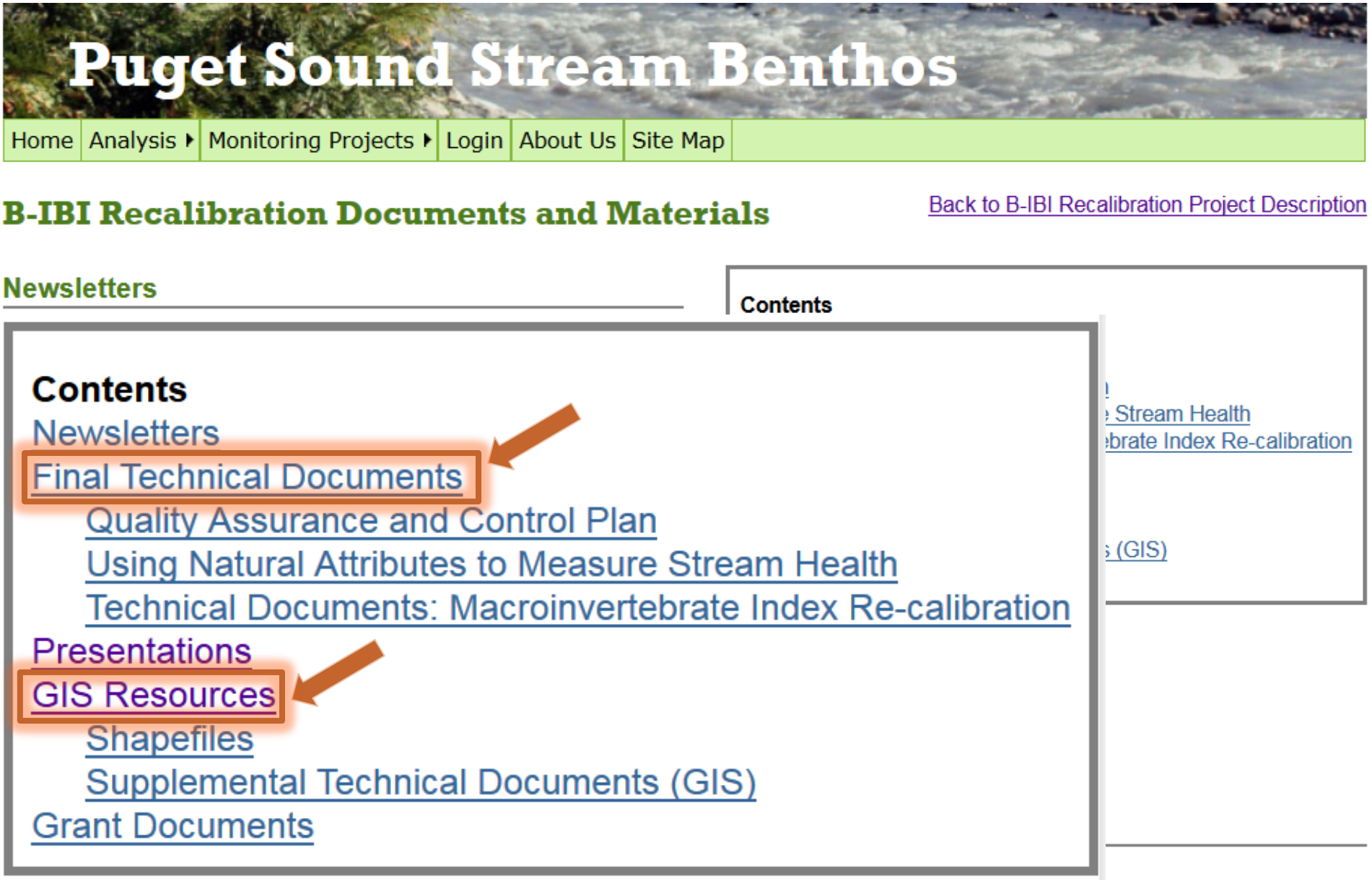
In 2010 King County was awarded a grant from the EPA to begin working towards a more standardized approach for benthic macroinvertebrate monitoring and data analysis in the Puget Sound region. Standardization begins with collaboration; this project brings together regional partners and experts to define standards for macroinvertebrate-based stream assessment.

Stream bioassessment protocols, including the multi-metric Puget Lowland benthic index of biotic integrity (PL-B-IBI), were initially developed in the early 1990's and are widely used to report stream health by over 20 cities, counties, tribes and state agencies in the Puget Sound basin. However, despite widespread collection and use of macroinvertebrate data, a variety of factors made it difficult to compare and evaluate these data on a regional scale.

Many entities used different sampling and analysis methods making data comparison challenging. The taxa attributes used to calculate individual B-IBI metrics were out of date and not empirically derived. The original PL-B-IBI was derived from a spatially limited data set raising concern regarding its regional applicability. Taxonomic resolution used by different entities is variable throughout the region. The Puget Sound Stream Benthos (PSSB) data system was established in 2008 as a regional tool for macroinvertebrate data management; however, there was a need to enhance the functionality of the system and increase regional participation. These issues, in addition to an overarching need for regional collaboration to encourage a more standardized and regional approach to monitoring and data analysis and a desire to strengthen and enhance the B-IBI as a regional freshwater indicator led to the development of this project.

Primary Project Goals

- Strengthen the B-IBI sensitivity by updating the taxa attributes used to calculate the % predator individuals, clinger taxa richness, long-lived taxa richness, % tolerant individuals and intolerant taxa richness metrics
- Evaluate differences in sampling methods to allow for regional comparison of data
- Recalibrate the Puget Lowland B-IBI using the wealth of existing data in the PSSB to enhance metric sensitivity
- Enhance the functionality and analytical capability of the PSSB
- Enhance and strengthen the sensitivity of the B-IBI for use as a regional freshwater indicator
- Enhance regional collaboration among jurisdictions and agencies that collect and use macroinvertebrate data



http://pugetsoundstreambenthos.org/Projects/BIBI-Recalibration-Documentation.aspx

Come Learn More PSSB Tips!

- **Wednesday, March 19th**
- 7th floor computer lab, this building
- AM & PM sessions

Contact me with questions and suggestions for training content: Jo.Wilhelm@kingcounty.gov

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Take Home Messages: B-IBI$_{0\text{-}100}$

- Attributes keyed to literature & empirical data
- 0-100 scale in line with National indices
- Increased precision

Acknowledgements

- Karen Adams – formerly of WA Dept of Ecology
- Gretchen Hayslip - US EPA Region 10
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- Sean Sullivan - Rhithron Associates, Inc
- Elene Dorfmeier - King County
- James Develle - King County
- Doug Henderson - King County

Thank You 2011 Sampling Partners!

- Bellingham: Sara Brooke Benjamin
- Clallam Co.: Ed Chadd & Volunteers
- Kitsap Co.: Mauro Heine & Volunteers
- Lake Forest Park: Mark Phillips & Volunteers
- Pierce Co.: Isabel Ragland & Christopher Towe
- Redmond: Tanya MacFarlane & Scott McQuary
- Seattle: Katherine Lynch
- Snohomish Co.: Jennifer Oden

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All Grant Materials Can be Found at:
www.pugetsoundstreambenthos.org