

Freshwater Bioassessment Tools for the Puget Sound Basin: Enhancing a Science-Based Performance Measure of Stream Condition

Deb Lester, Jo Wilhelm, Elene Dorfmeier

King County Department of Natural Resources

Leska Fore - Statistical Design

Bob Wisseman - Aquatic Biology Associates



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



Puget Lowland Benthic Index of Biotic Integrity (B-IBI)

- Multi-metric index measures stream health
- Developed in late 90's
- 10 individual metrics
- Individual B-IBI metrics scored on scale of 1-3-5; B-IBI score 10-50
- Widely used by PS agencies/tribes
 - Track status/trends, focus restoration, effectiveness monitoring tool, PSP Action Agenda, Vital Sign FW Indicator, etc.
- Today's session presentations highlight B-IBI uses

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

Regional Benthic Monitoring Issues

Limitations	Desired Outcomes
Differing collection methods	Standardization
Decentralized data mgmt	Centralized data mgmt
Outdated taxa attributes	Peer-reviewed or Empirically derived attributes
Insufficient B-IBI sensitivity	Re-calibrated scoring 0-100
>20 cities, counties, tribes monitoring independently	Collaboration and communication

2011-14 EPA Grant with goal to address limitations and meet desired outcomes



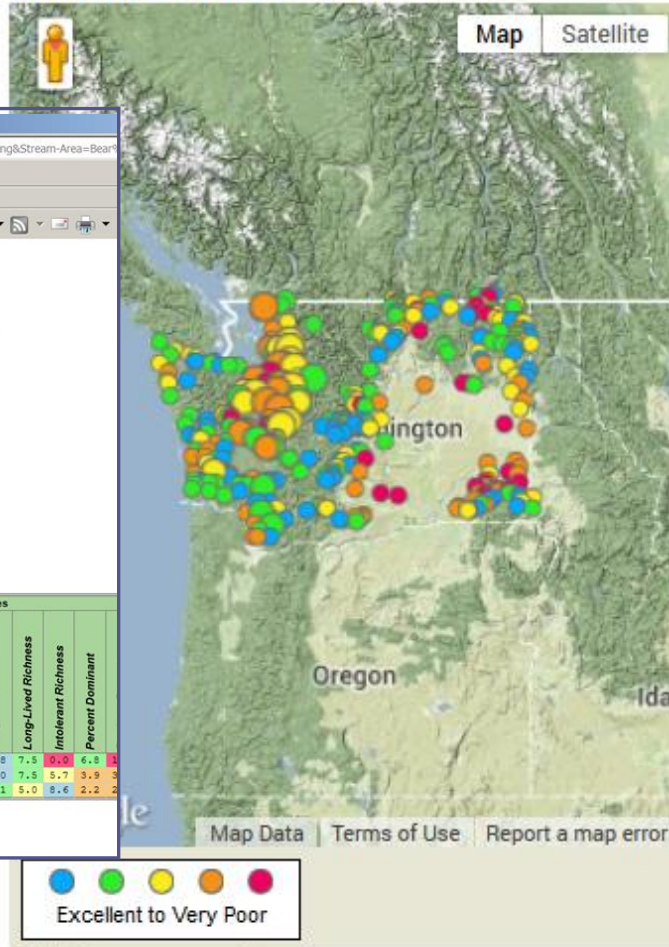
Puget Sound Stream Benthos

Home Analysis Monitoring Projects Login About Us Site Map

Analyzing Stream Health

This site analyzes benthic macroinvertebrate community structure to determine the ecological health of

Plotting Biotic Integrity



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](#)

Biotic Integrity Table - Puget Sound Stream Benthos - Windows Internet Explorer

http://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?Agency=Project=King-DNRP%3A%20Ambient%20Monitoring&Stream=Area=Bear

Biotic Integrity Table... x pugetsoundstreambenthos.org

File Edit View Favorites Tools Help

Puget Sound Stream Benthos... Suggested Sites Get more Add-ons Click for latest forecast.

Puget Sound Stream Benthos

Home Analysis Monitoring Projects Login About Us Site Map

Analysis: **Benthic Index of Biotic Integrity** Show Criteria

Clear & Use Default Options Show Fewer Options

Area: Bear Creek (Sammamish River) Project: King-DNRP: Ambient Monitoring Location or Keyword: []

Aggregation: Don't Aggregate Score Type: 0-100 B-IBI Metric: Overall Score

Replicate Handling: Combine replicates, then calculate Taxonomic Resolution/STE: As Defined by Metadata Taxa at Visit Metrics: []

Taxa Attributes: [] Taxa Exclusions: [] Taxa at Visit Filter: []

Fore, Wiseman, 2012 (recommended for 0-100 B-IBI) See the list

Number of Organisms: Count per Sample Count per Visit Year: Latest per Site in Range All in Range

Min: [] Max: 500 Flag Omit Omit/Subsample Range from: Earliest through Latest

Open in new tab Plot on Map Tabulate Tabulate Trend Chart Trend Show Samples Download...

Row	Site Code, Location	Year, Project	Quantities										Scores											
			Taxa Richness	Ephemeroptera Richness	Plecoptera Richness	Trichoptera Richness	EPT Richness	Clinger Richness	Long-Lived Richness	Intolerant Richness	Percent Dominant	Predator Percent	Tolerant Percent	Organisms	Overall Score	Taxa Richness	Ephemeroptera Richness	Plecoptera Richness	Trichoptera Richness	Clinger Richness	Long-Lived Richness	Intolerant Richness	Percent Dominant	
1	08BEA34	2013, Ambi.	48	6	4	6	16	22	8	0	44.0%	2.8%	9.4%	500	57.1	7.2	7.1	4.3	6.3	5.3	7.5	5.0	6.8	1.4
2	08BEA36	2013, Ambi.	48	5	5	7	17	25	8	4	54.6%	7.2%	5.0%	500	65.6	7.2	5.7	5.7	7.5	10.0	7.5	5.7	3.9	3.3
3	08BEA37	2013, Ambi.	40	4	6	8	18	19	6	6	60.8%	5.8%	8.2%	500	58.4	4.5	4.3	7.1	8.8	7.1	5.0	8.6	2.2	2.2

3 scores generated from 155 sample taxa on Monday, April 28, 2014 3:17:53 PM. (0.34 seconds)

Sorted by Location, Agency, Project, Site, Date

Legend: Excellent Excellent/Good Good Good/Fair Fair Fair/Poor Poor Poor/Very Poor Very Poor

Excellent to Very Poor

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](#).

Info Presented Today

[Click here to customize chart.](#)

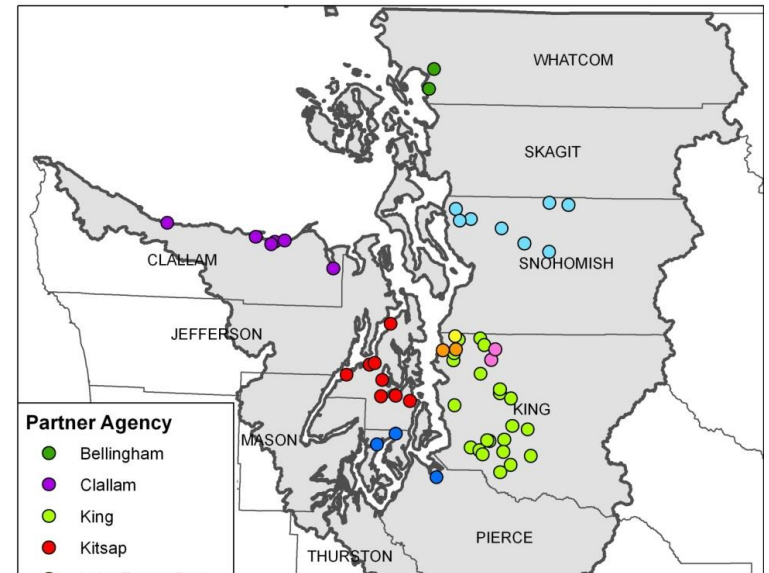
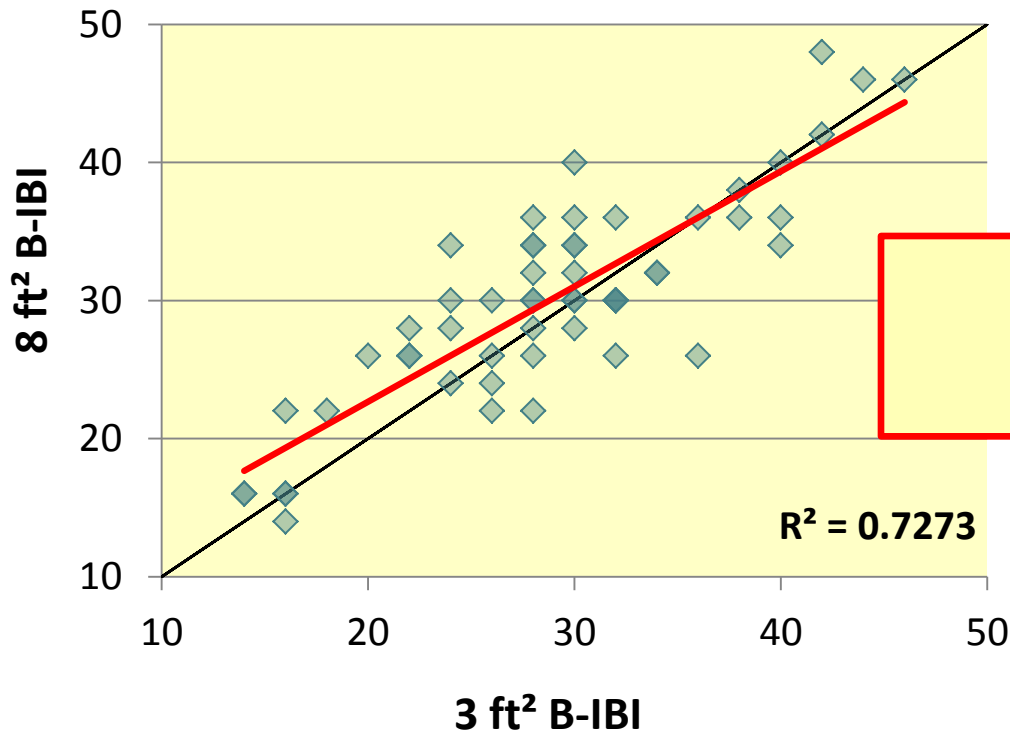
www.pugetsoundstreambenthos.org

Standardize Collection Methods: Side by Side Sampling

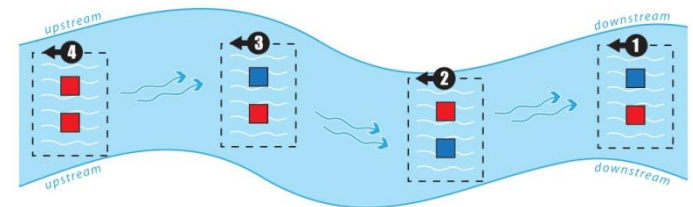
 3 vs. 8 ft² sample area

 55 sampling sites

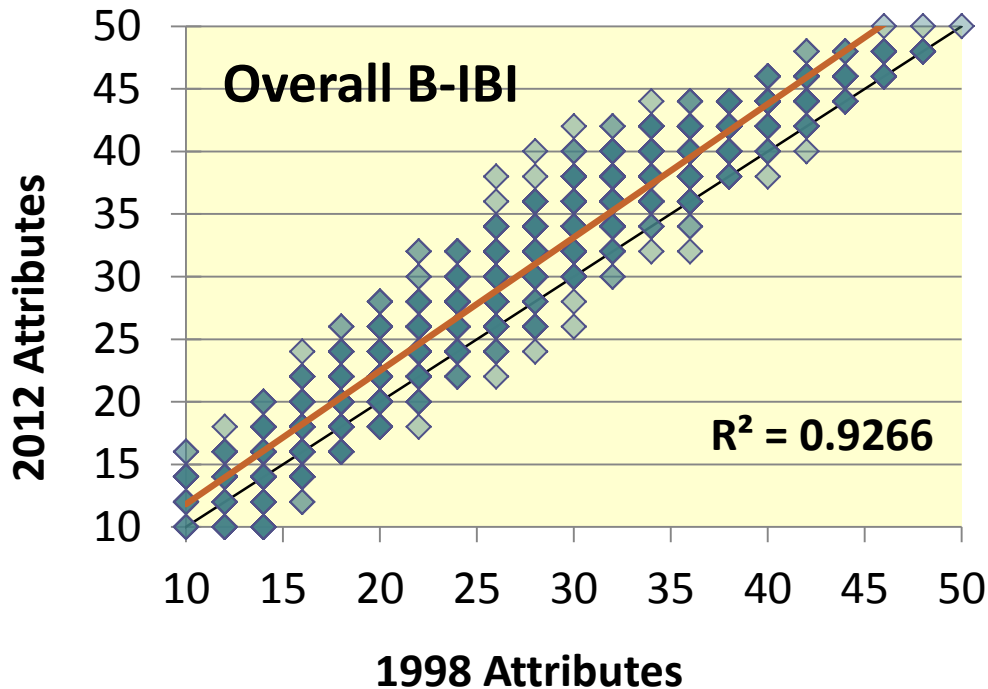
 9 regional partners



3ft² and 8ft² Data Are
Comparable



Strengthen Sensitivity of Taxa Attributes



Puget Lowland B-IBI Metrics with Attributes

Long-lived Taxa*

Clinger Taxa*

% Predator Individuals*

Intolerant Taxa**

% Tolerant individuals**

* Peer-Reviewed Literature

** Empirically with Existing Data n = 784



Biggest change for tolerant/intolerant taxa



Taxa attribute update requires B-IBI recalibration

B-IBI Recalibration: Taxa Resolution

Taxa	Fine (Ecology)	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

B-IBI Recalibration - Rescore 0-100

- Goal - better precision, sensitivity and reduced variance
- New metric scoring – convert to 0 -10 scale
 - Calculated 10th and 90th %iles for individual metrics using existing data >850 sites
- Incorporate new taxa attributes
- Initial testing resulted in need to apply taxa resolution adjustments

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

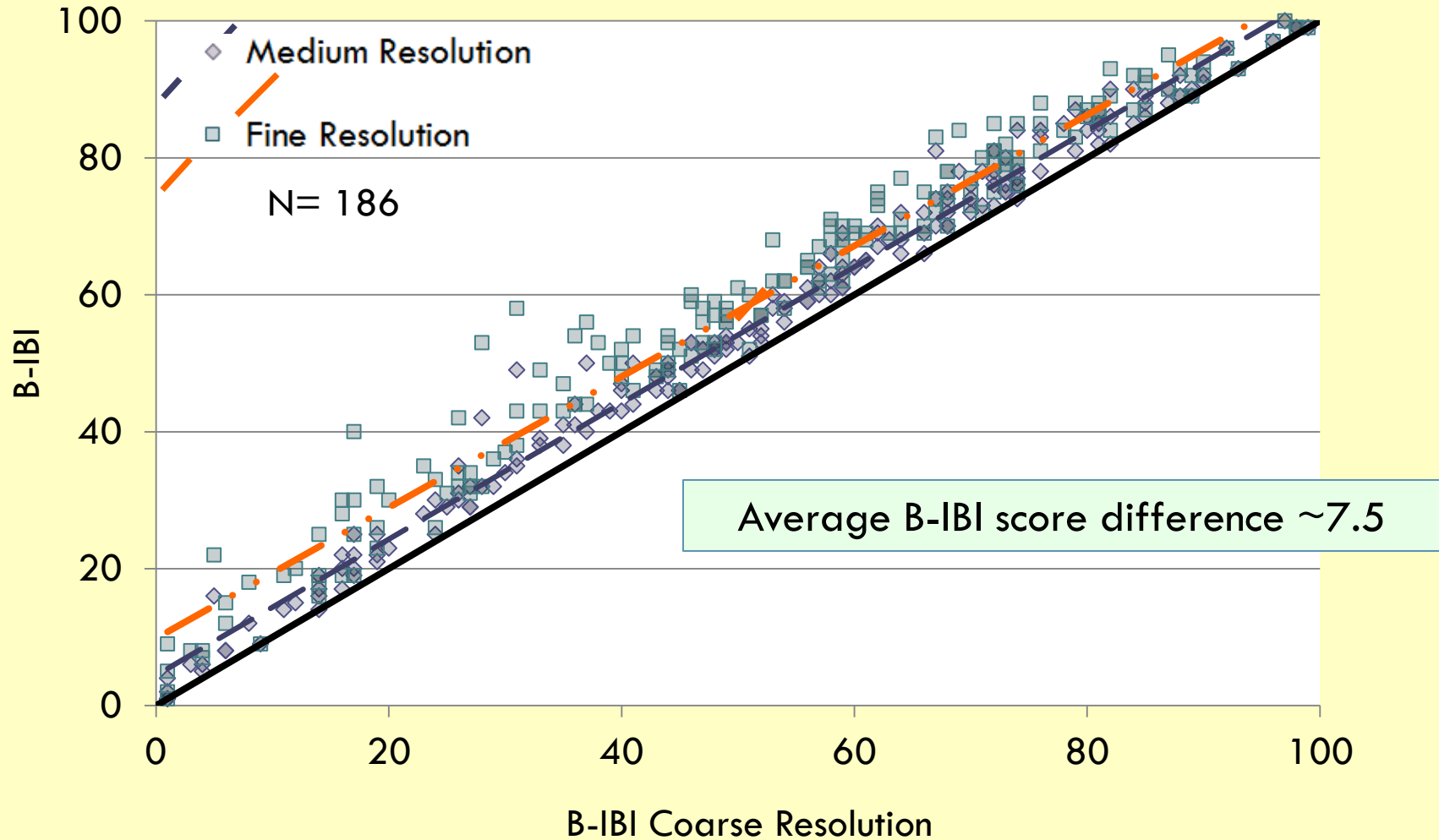
Metrics that increase with disturbance

$$= 10 - (\text{same equation presented above})$$

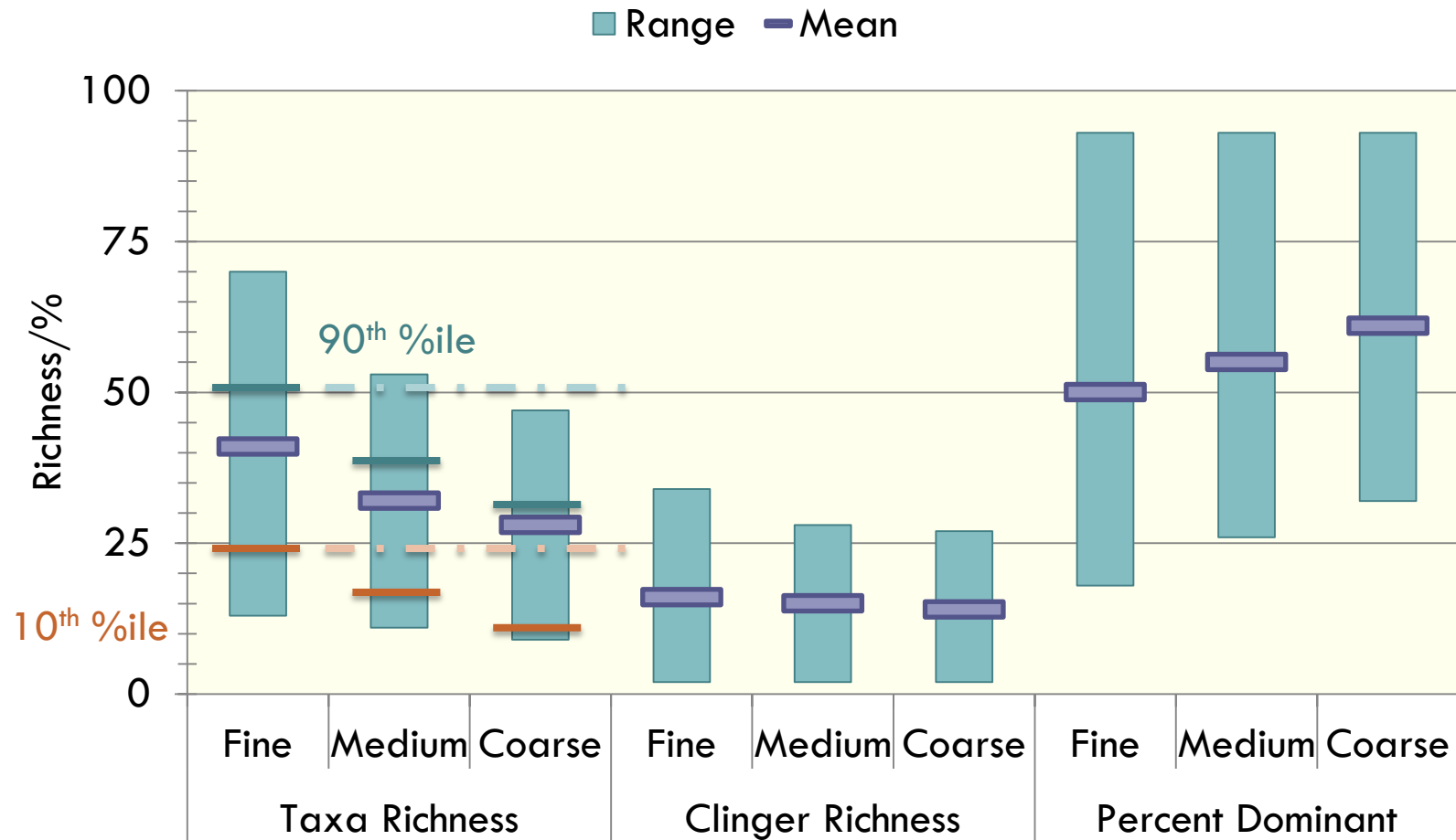
Metrics that decrease with disturbance



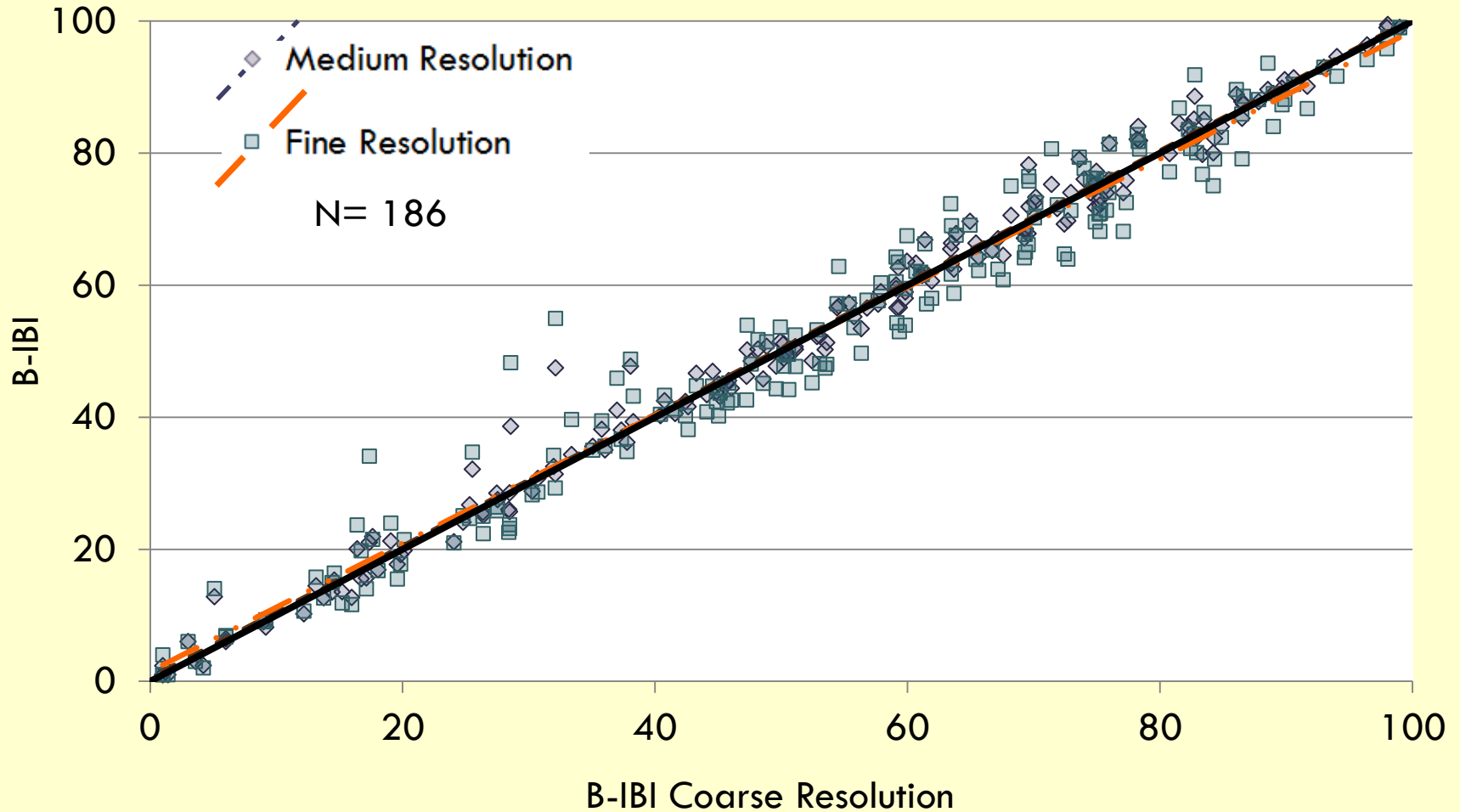
B-IBI₀₋₁₀₀: No Taxa Resolution Adjustment



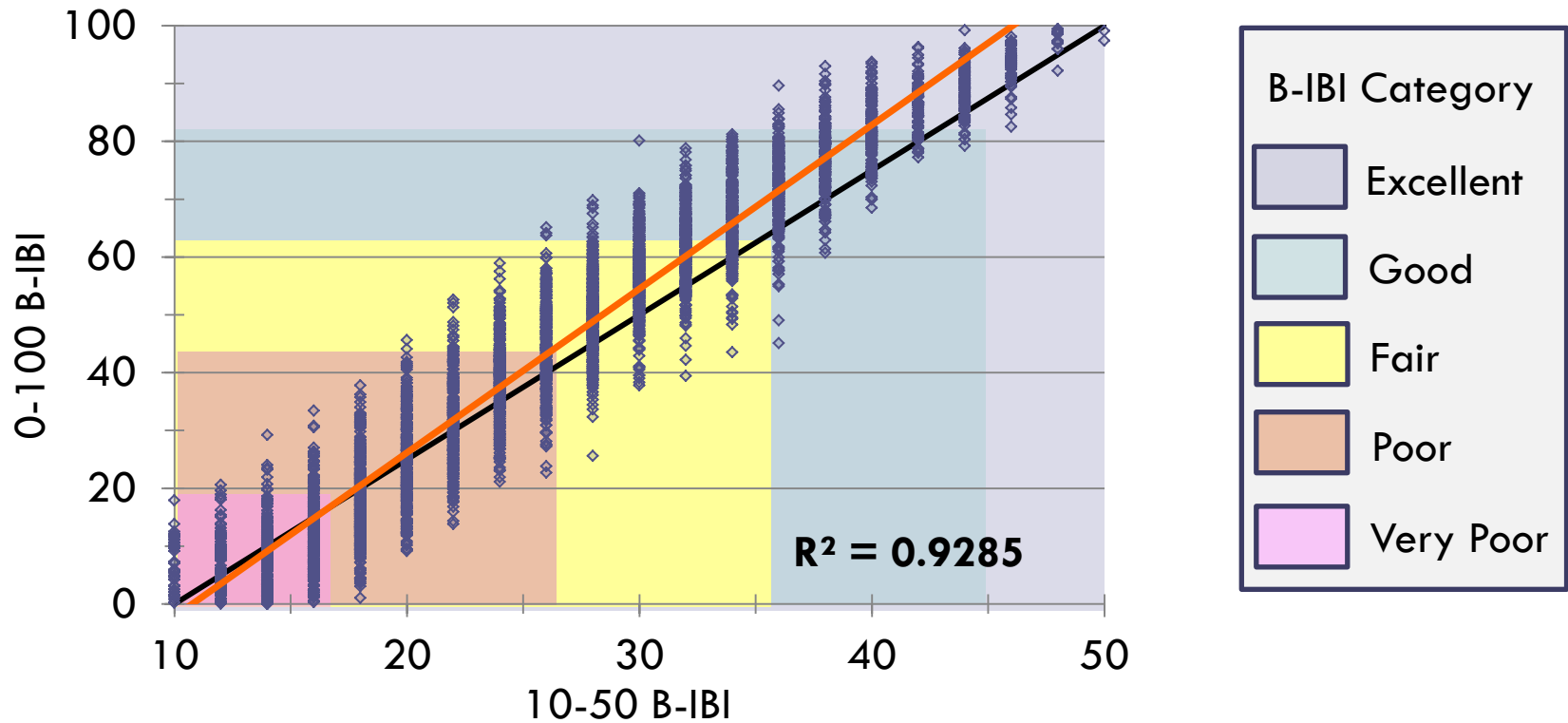
Taxa Effort: 3 Metrics Influenced



B-IBI₀₋₁₀₀: Adjusted for Taxa Resolution



B-IBI Recalibration: Old₁₀₋₅₀ vs. New₀₋₁₀₀



🐛 0-100 scale in line with National indices

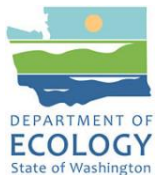
🐛 Increased precision

Acknowledgements

- ✂️ Gretchen Hayslip - US EPA Region 10
- ✂️ Peter Leinenbach - US EPA Region 10
- ✂️ Wease Bollman - Rhithron Associates, Inc.
- ✂️ Sean Sullivan - Rhithron Associates, Inc.
- ✂️ Karen Adams - formerly of WA Dept. of Ecology
- ✂️ James Develle - King County
- ✂️ Doug Henderson - King County
- ✂️ Staff from numerous Puget Sound Basin agencies/tribes



King County



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

Standardize Collection Methods

