A Tool to Evaluate the Health of Streams and Rivers within the Chesapeake Bay Watershed

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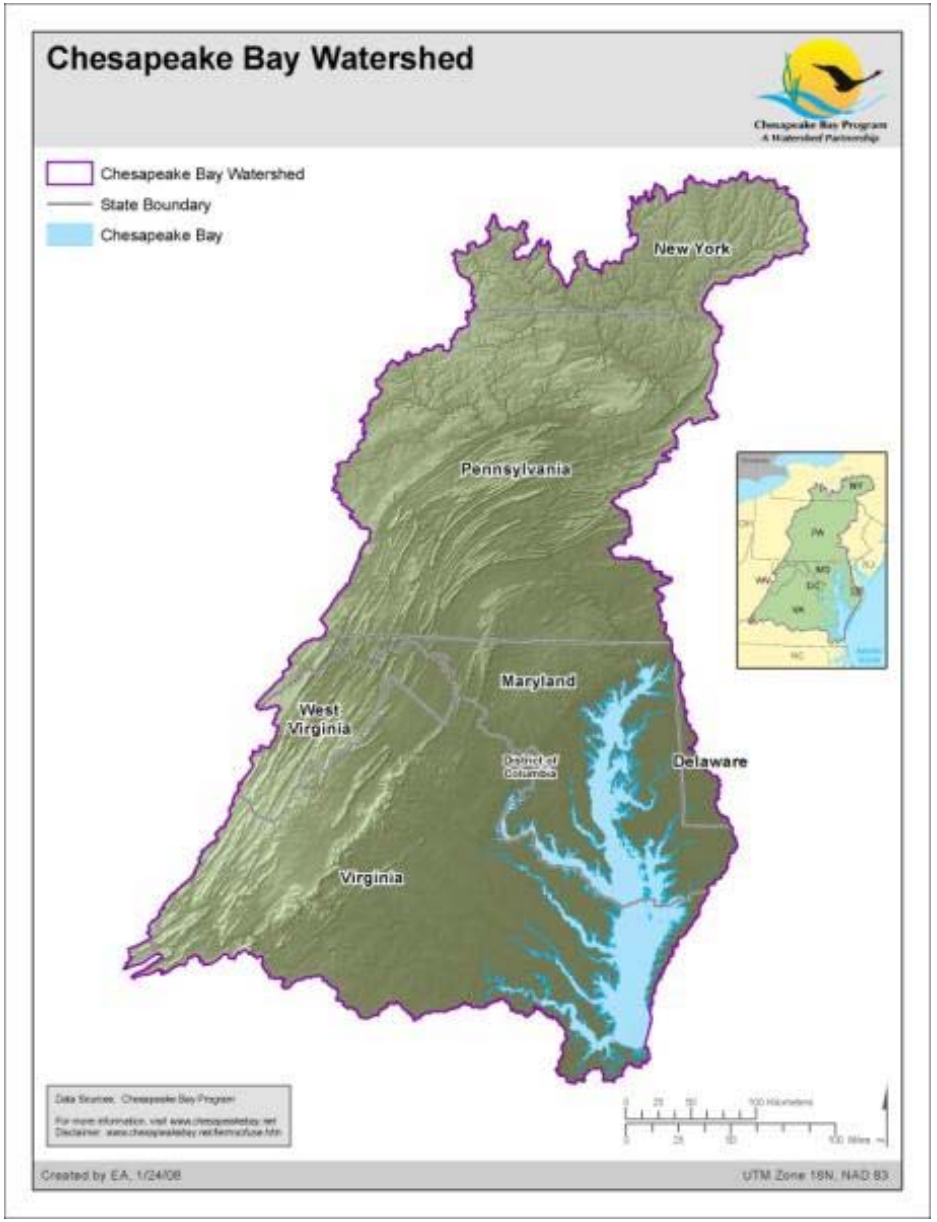
Overview

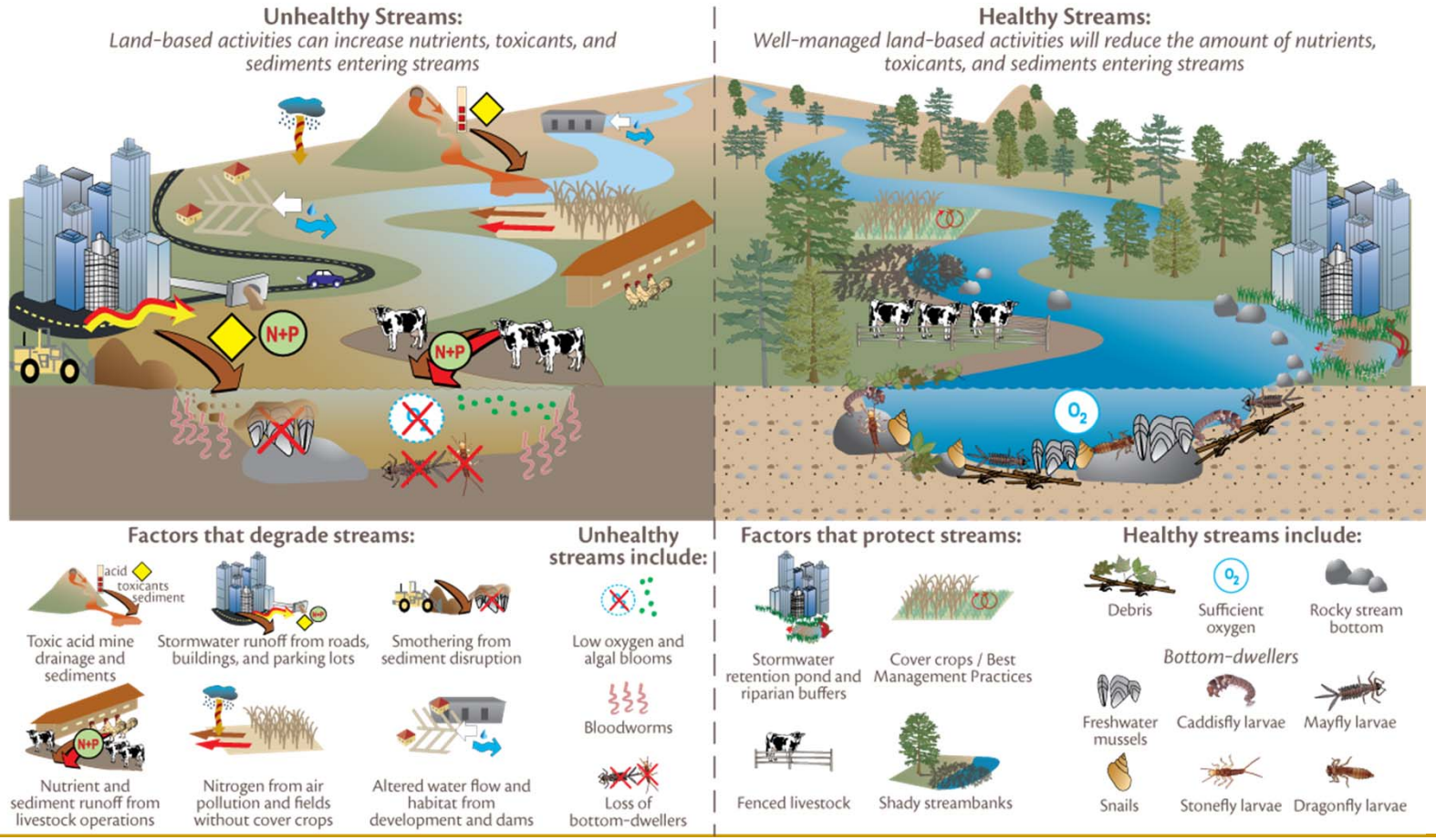
- Introduction
- Methodology for the basin-wide B-IBI
- Results
- Management applications

Need for a standardized index

- 64,000 square mile watershed
  - 6 states, District of Colombia
- Many different methodologies for monitoring and assessment
  - benthic, fish, habitat, water quality
- Need to evaluate stream health in a uniform manner and in the context of the Chesapeake Bay watershed

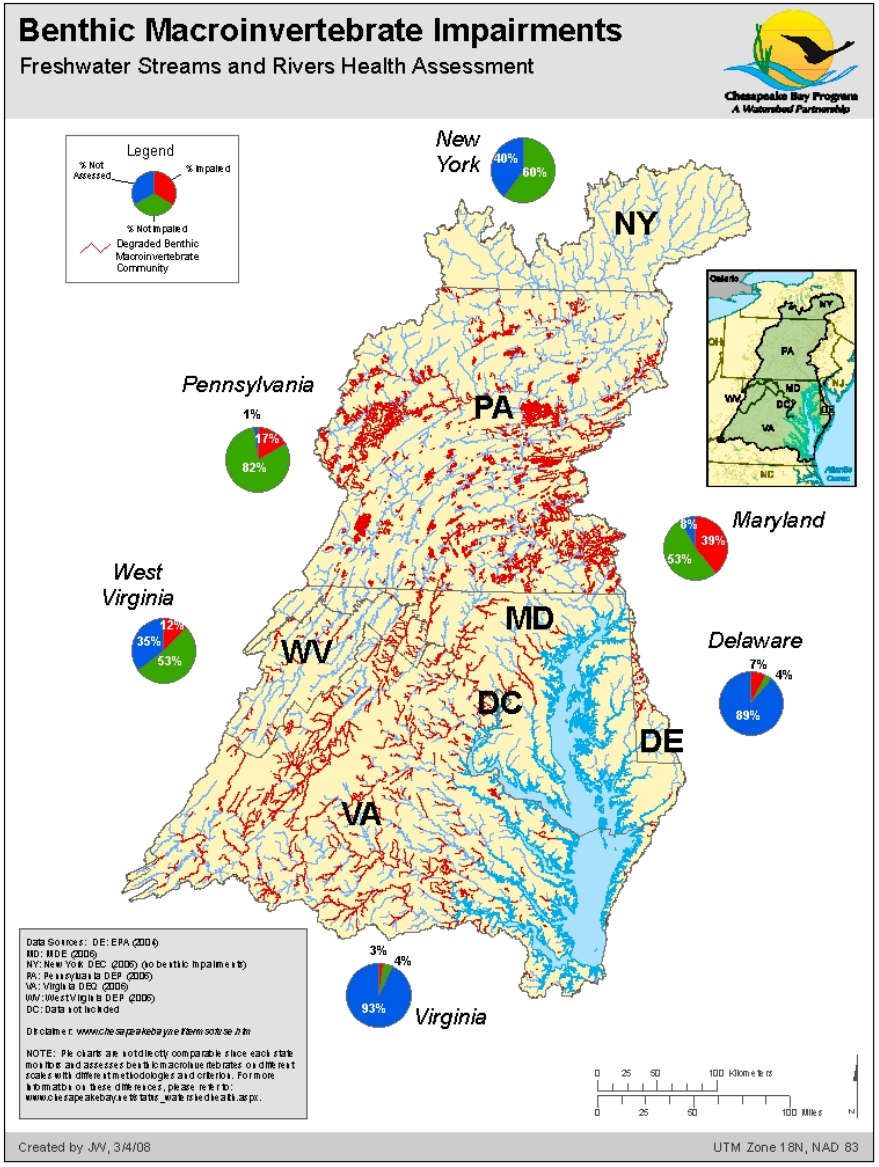


Benthic macroinvertebrate communities are good indicators of stream health



Developing indicators with 303(d)/305(b) data was insufficient

- Incomparable results
  - Different sampling methods, criteria, and scales

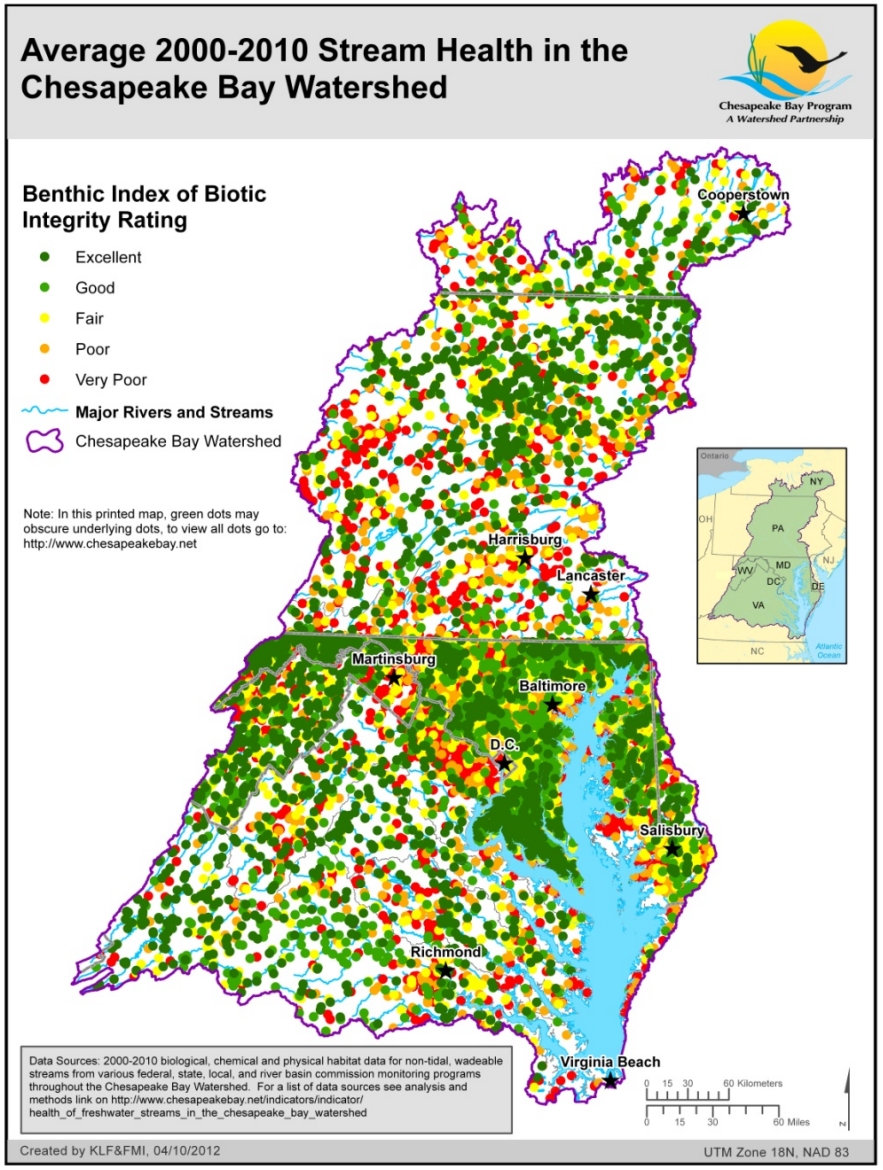


Family-Level Regional B-IBI was developed

- Developed in 2010 by Chesapeake Bay Program's Nontidal Water Quality Workgroup
- Adapted from basin-wide B-IBI for the Potomac River Basin (Astin 2006, 2007)
  - Assumption:
    - A standardized regional B-IBI can be developed from multi-jurisdictional data if family-level benthic data collection and RBP protocols are employed by each organization; differences in sampling size, gear used, etc. are not significant at the family level of assessment.

Large dataset leads to rigor in B-IBI

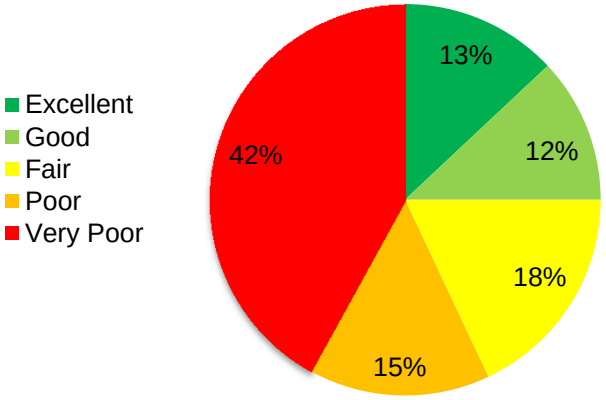
- 18 data sources
- 20,833 stations

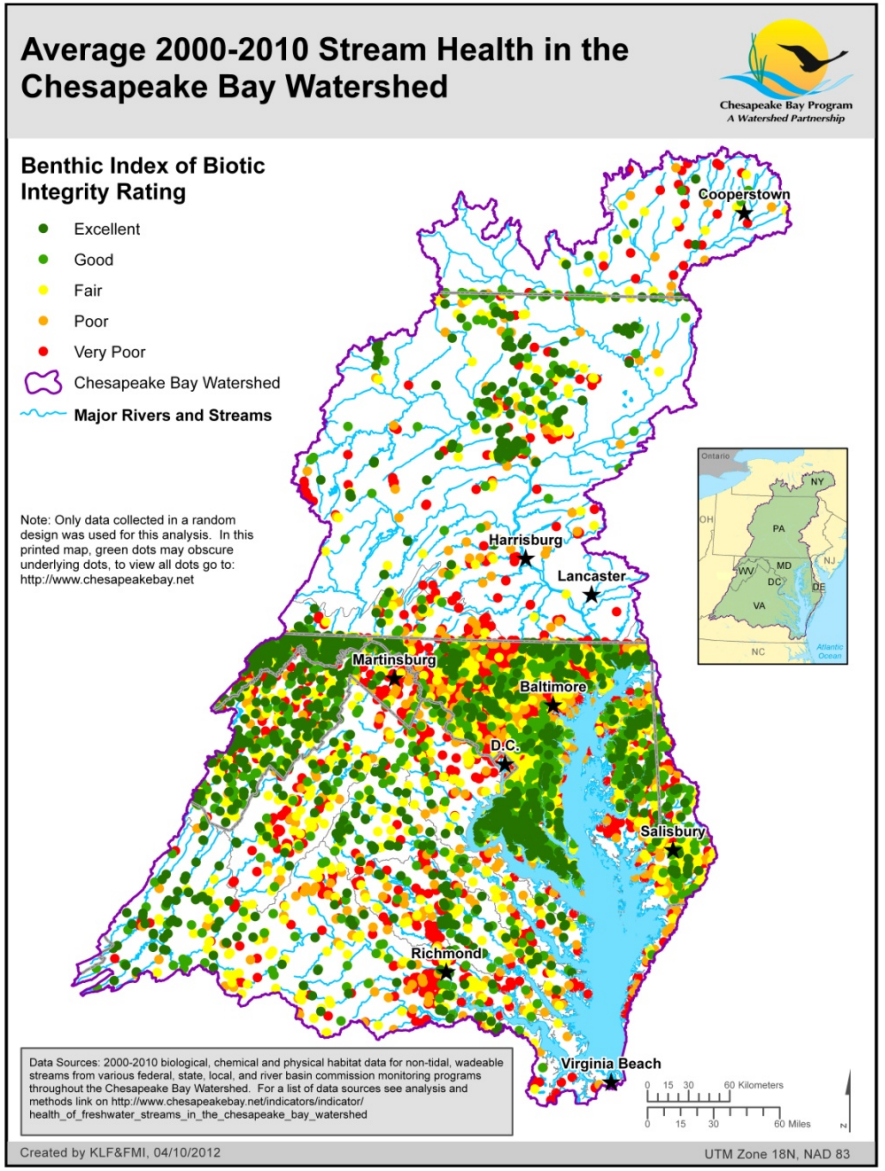


Eight steps to develop the B-IBI

1. Compiling data
2. Identifying candidate metrics
3. Classifying by bioregion (non-coastal plain)
4. Identifying reference and degraded sites
5. Testing metrics
6. Selecting the best performing metrics
7. Testing and choosing the best scoring approach
8. Jackknife validation of results

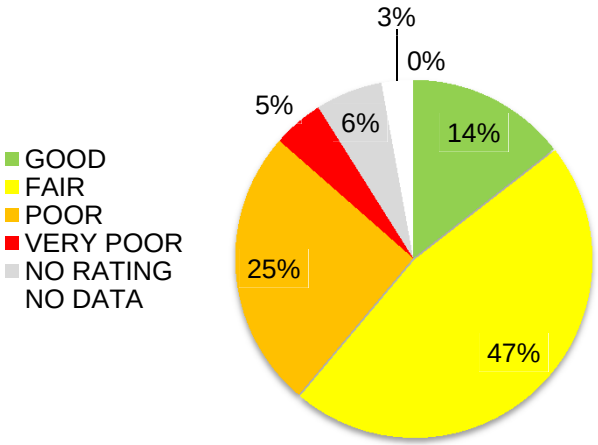
Stream health is mostly very poor or poor

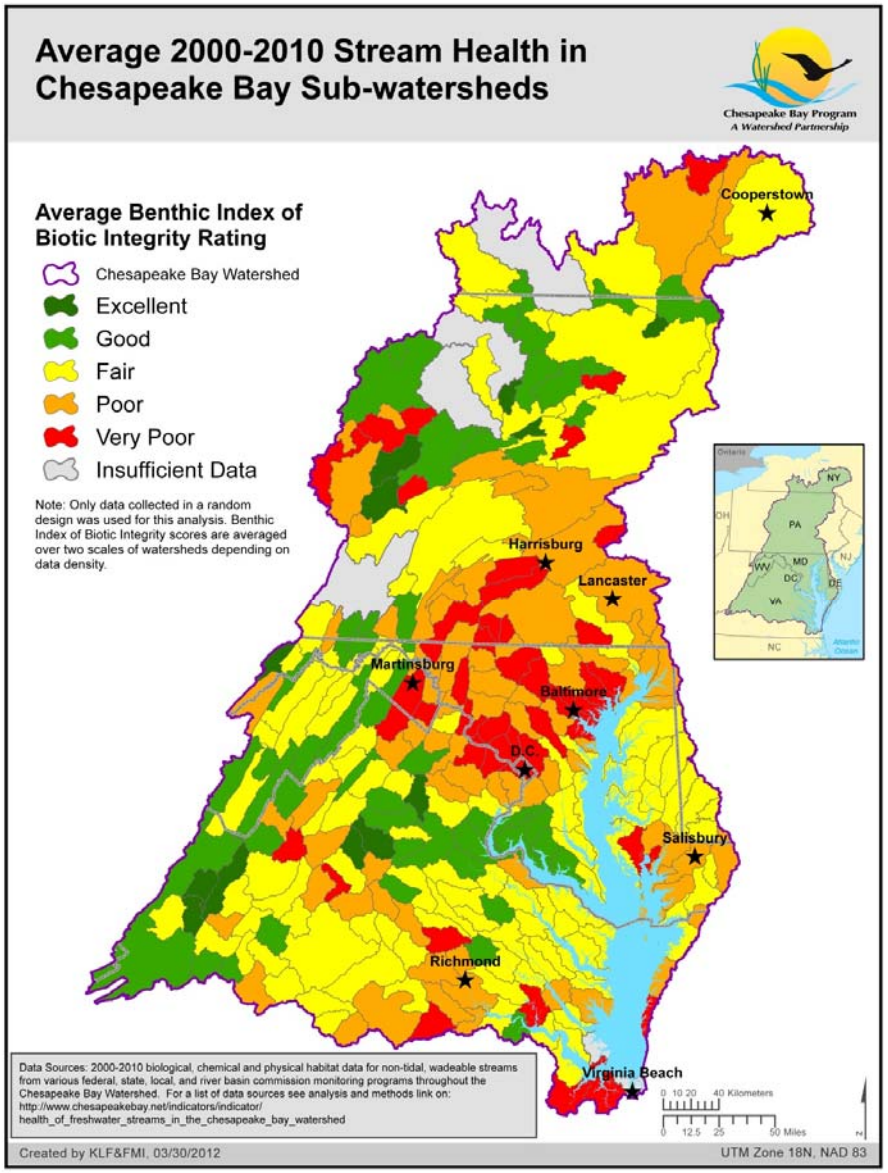




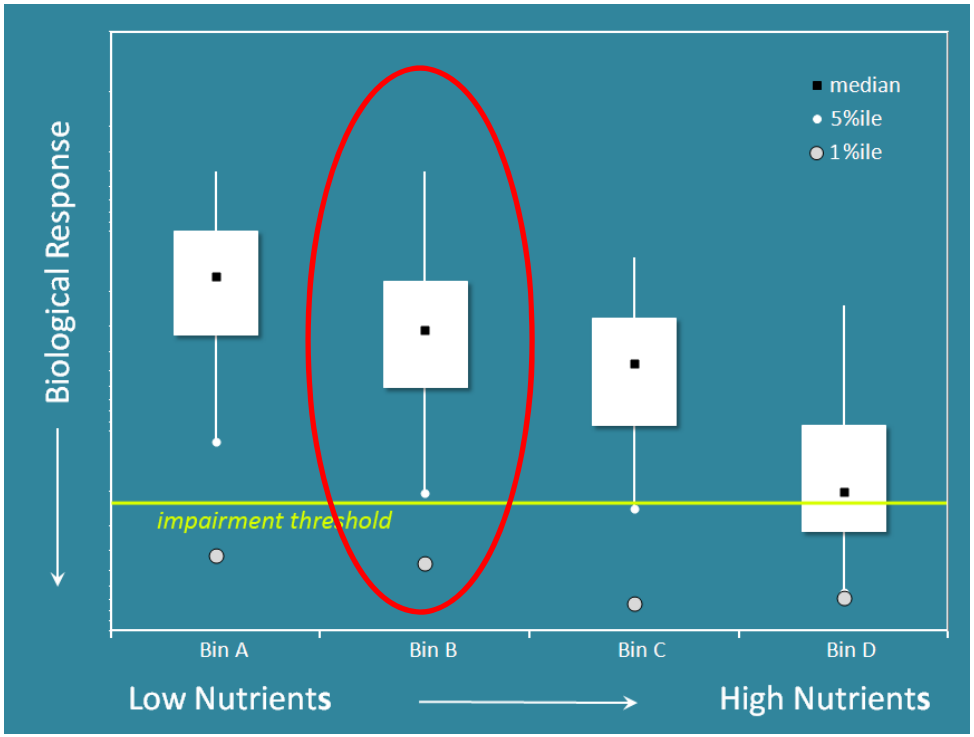
Stream health linked to land use

- Urban and agricultural footprint most apparent





B-IBI used to determine nutrient response thresholds



no impairment ⟶ **most impaired**

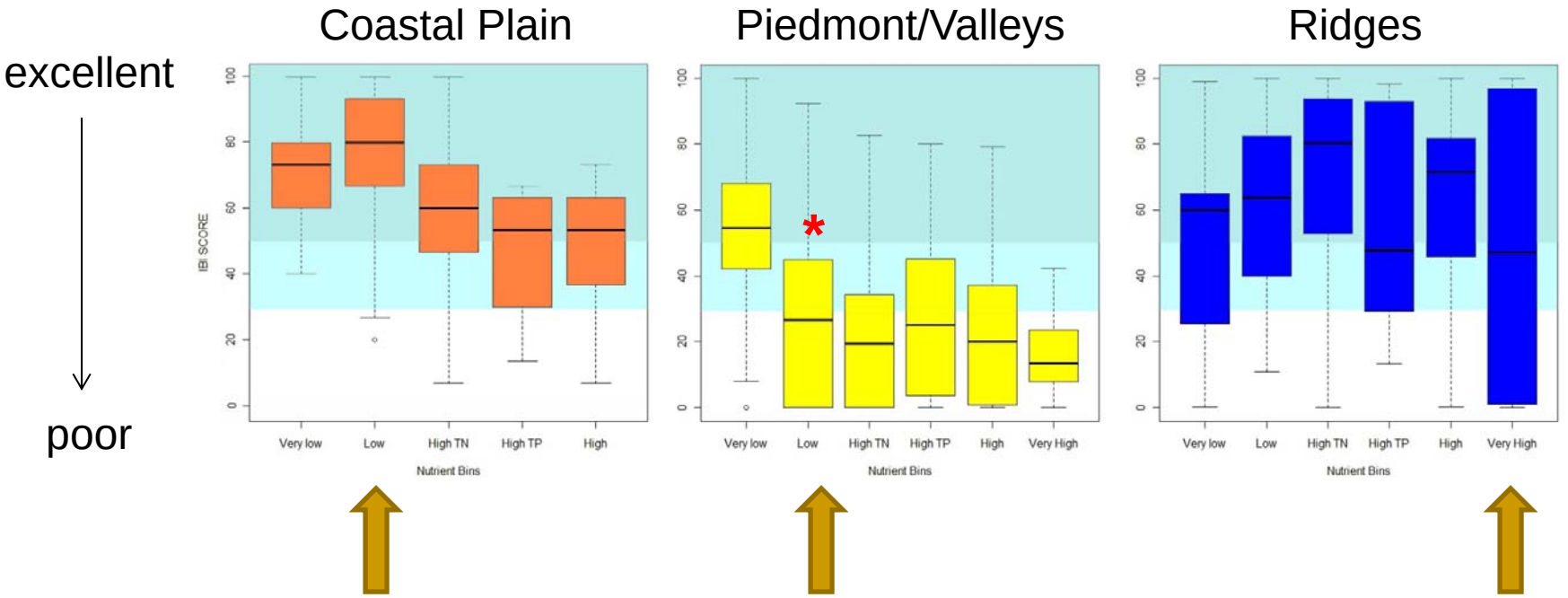
"Desirable biological communities will occur most of the time when…

median [TP] ≤ threshold
and
median [TN] ≤ threshold
and
confounding habitat and water quality factors are removed/accounted for."

**** Nutrient response thresholds can be: median TP and median TN of Bin B**

Courtesy of ICPRB 2012

B-IBI used to develop ecologically-based WQ criteria



	Coastal Plain	Piedmont/Valleys	Ridges
TP (mg/liter)	**<0.029**	**<0.012**	**<0.013**
	and	***and***	***and***
TN (mg/liter)	**<0.58**	**<1.13**	**<0.85**

Thresholds Indicated in Analysis of Multiple Nutrient-Sensitive Family-Level Metrics

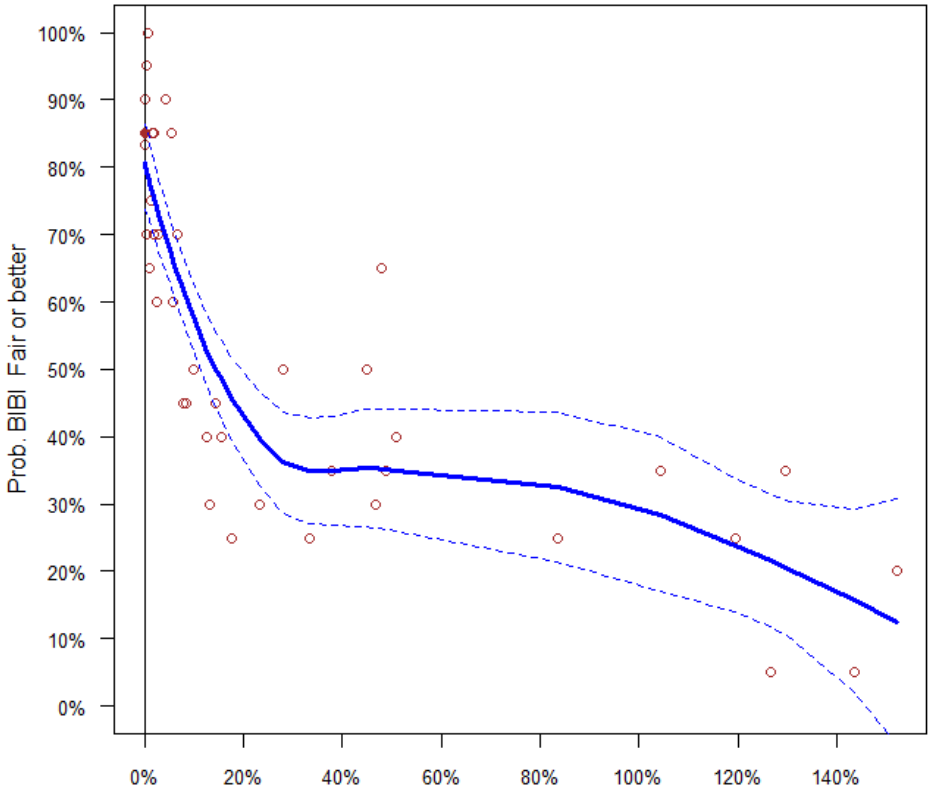
* Chessie BIBI is apparently more nutrient sensitive than its component metrics

Courtesy of ICPRB 2012

B-IBI used to determine the ecological effects of flow alterations

Conditional Probability of Chessie BIBI Score = "Fair" or Better

Chessie BIBI



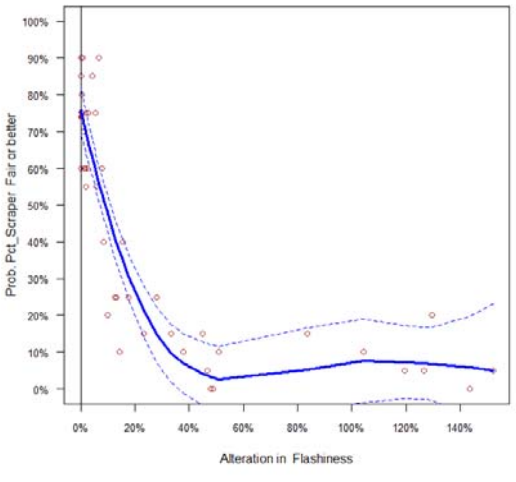
% Alteration in Flashiness

* Piedmont, Ridges, and Valleys bioregions of the Potomac River Basin

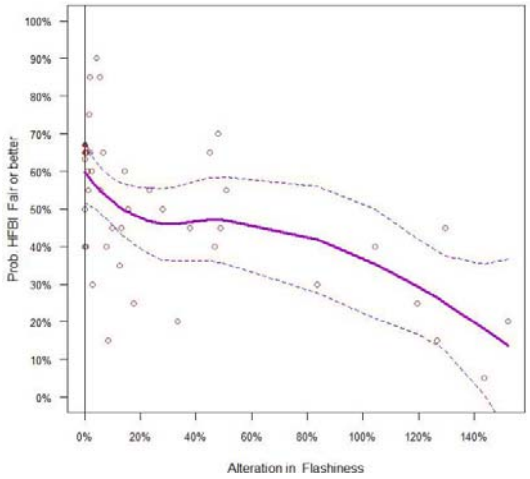
Courtesy of ICPRB 2012

Conditional Probability
Probability of Macroinvertebrate Metric Receiving a "Fair" or Better Score →

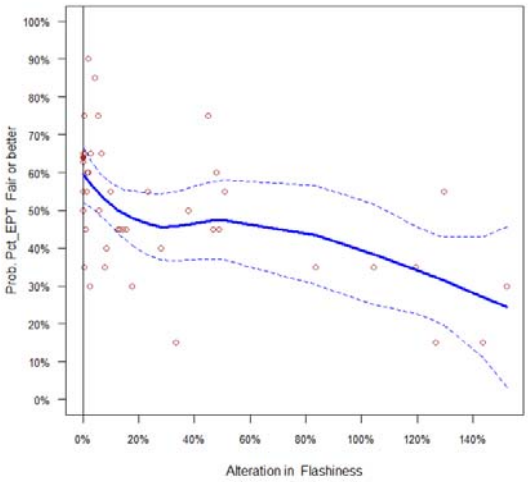
% Scrapers



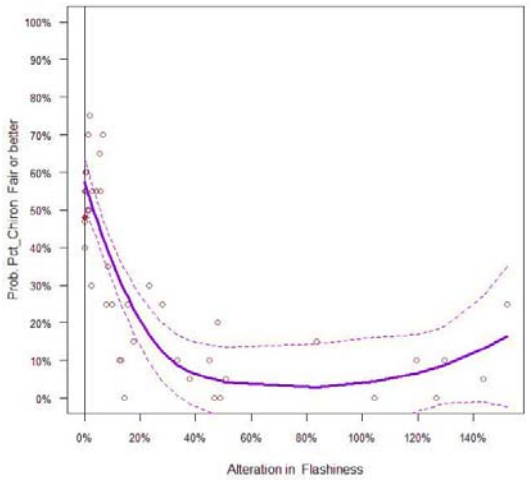
Hilsenhoff FBI



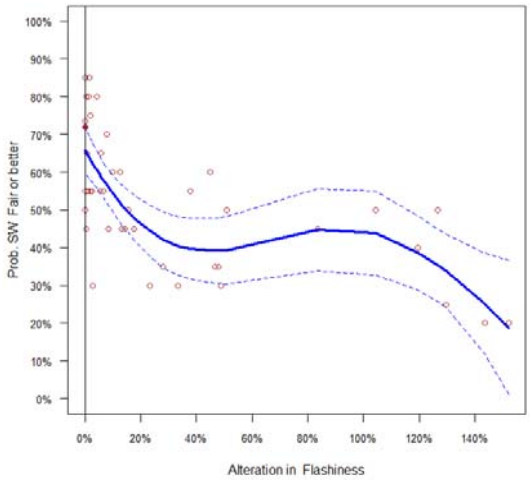
% EPT



% Chironomidae



Shannon-Wiener Diversity



% Alteration in Flashiness

* Piedmont, Ridges, and Valleys bioregions in the Potomac River Basin

Courtesy of ICPRB 2012

B-IBI is an effective tool for stream health assessments

- Standardizes and utilizes multi-jurisdictional data for regional water quality assessments
- Provides a tool for managers to:
  - Determine relative health of local and regional waterways
  - Investigate the impacts of BMPs and watershed protection measures
  - Identify areas in need of restoration or protection
  - Evaluate the impacts of different management decisions on the biological community including water quality standards and flow management

Acknowledgements

References

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- Foreman, K., Buchanan C., Nagel, A. 2008. *Development of ecosystem health indexes for nontidal wadeable streams and rivers in the Chesapeake Bay basin.* Report to the Chesapeake Bay Program Non-Tidal Water Quality Workgroup. 12/5/08.