Progress On the CBP Stream Health Outcome

Presentation to the Water Quality Goal Implementation Team

July 24, 2023

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Stream Health Outcome(s)

2009 Chesapeake Bay Executive Order 13508

Improve the **health of streams** so that **70 percent** of sampled streams throughout the Chesapeake watershed are in **fair, good or excellent** condition as measured by the **Index of Biotic Integrity** by **2025**

2014 Chesapeake Bay Agreement

Continually improve **stream health** and function throughout the watershed. Improve health and function of **ten percent of stream miles above the 2008 baseline** for the Chesapeake Bay watershed

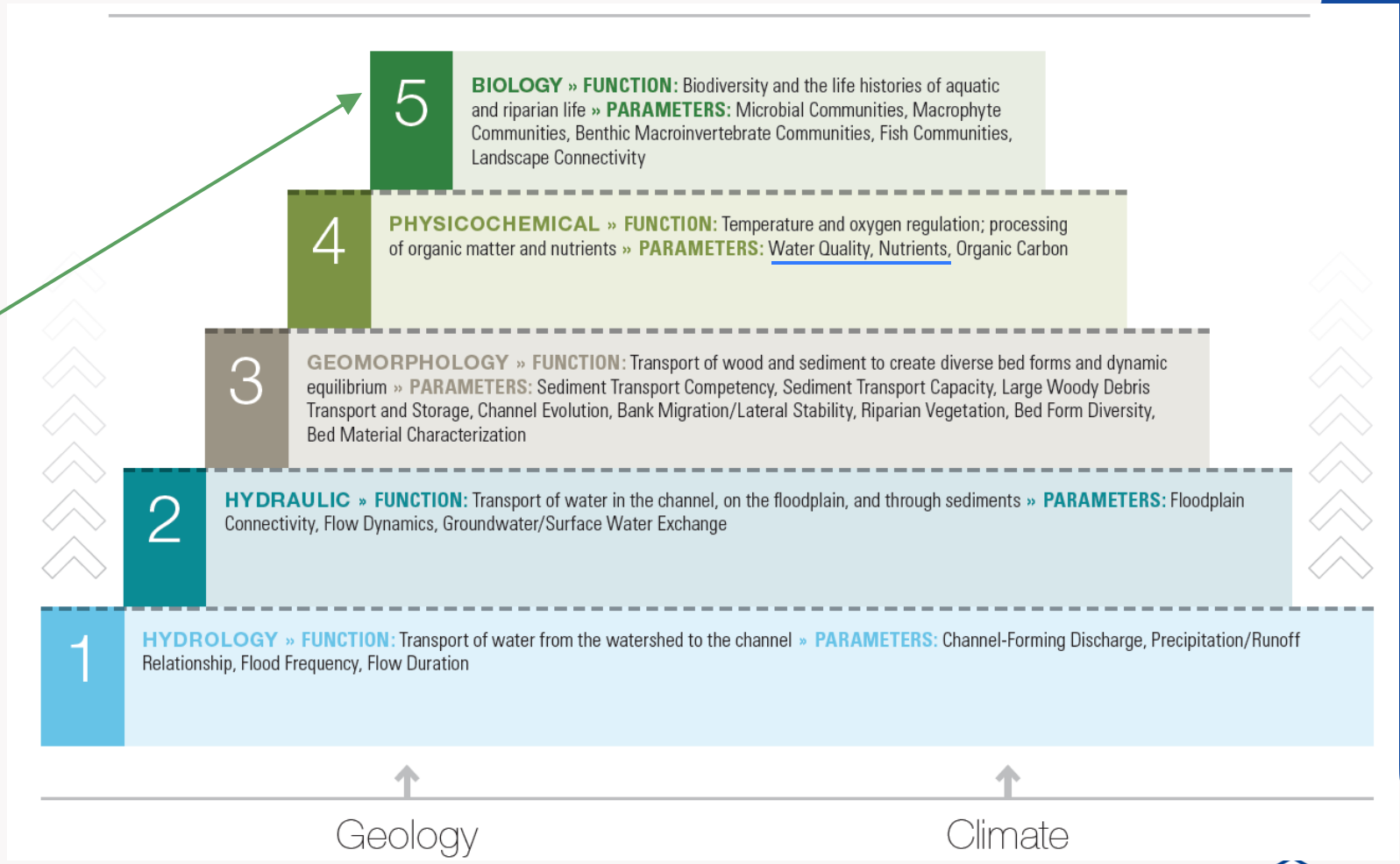
CONTENTS

How to Measure Stream Health?

- **Health** is a reflection of all the biotic and abiotic parts of an ecological system

- Chesapeake Bay jurisdictions recognize **aquatic life** as the definitive indicator of ecological health of their waters.

- When the stream health outcomes were established, **macroinvertebrates** were the only stream community measured in consistent ways across the entire Chesapeake watershed.



Stream Functions Pyramid

Harman, W., et al. 2012. A function-based framework for stream assessment and restoration projects. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.

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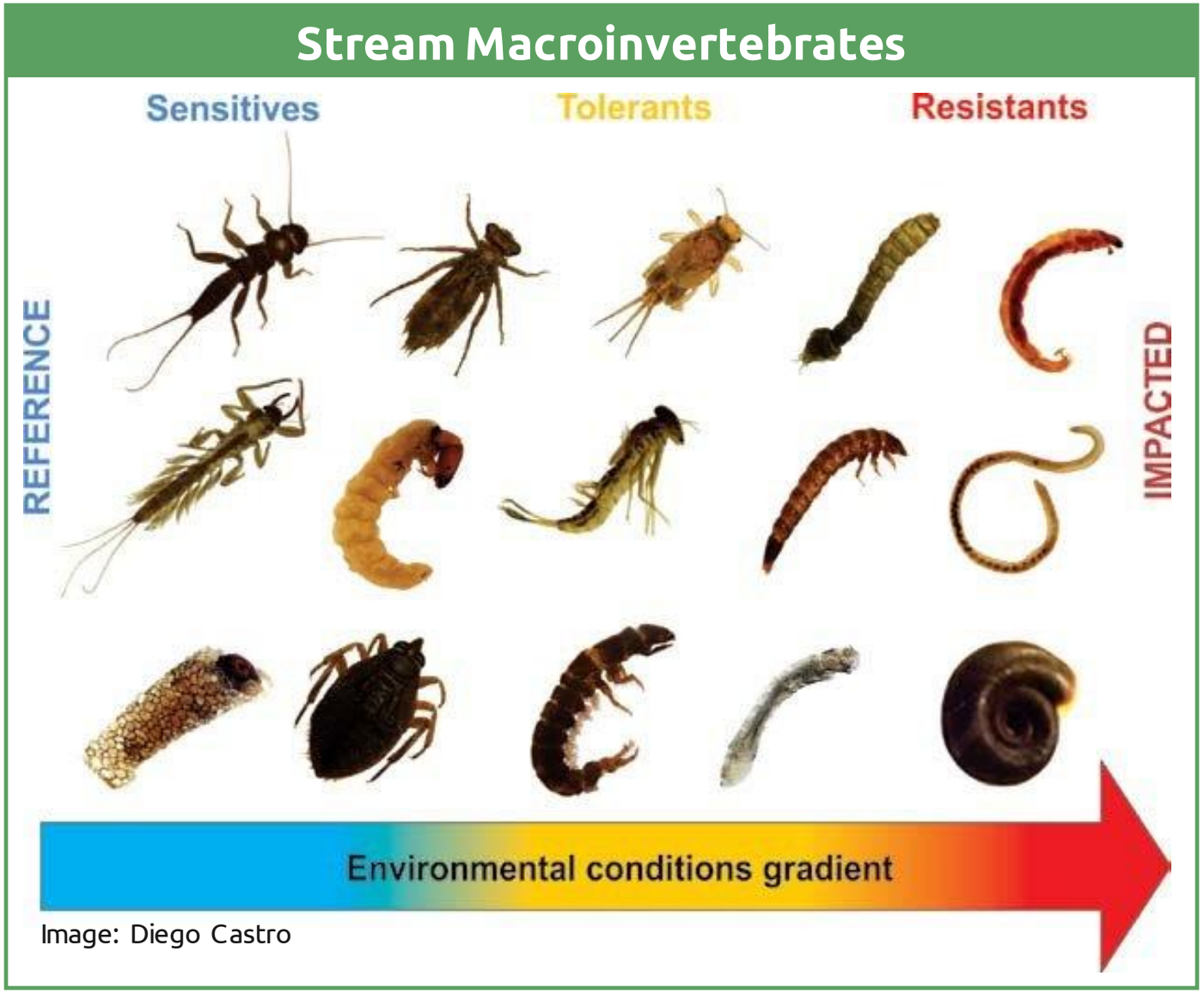
How to Measure Stream Health?



Macroinvertebrates

- Community has many diverse taxa
- Taxa respond to environmental gradients
- Several feeding groups (e.g., predator, shredder, collector)
- Several habits (e.g., climber, crawler, swimmer, burrower, clingers)
- Relatively short-lived
- Collected by all states, and some counties and federal agencies
- Mostly standard collection and counting methods (EPA Rapid Bioassessment Protocols)

How to Measure Stream Health?

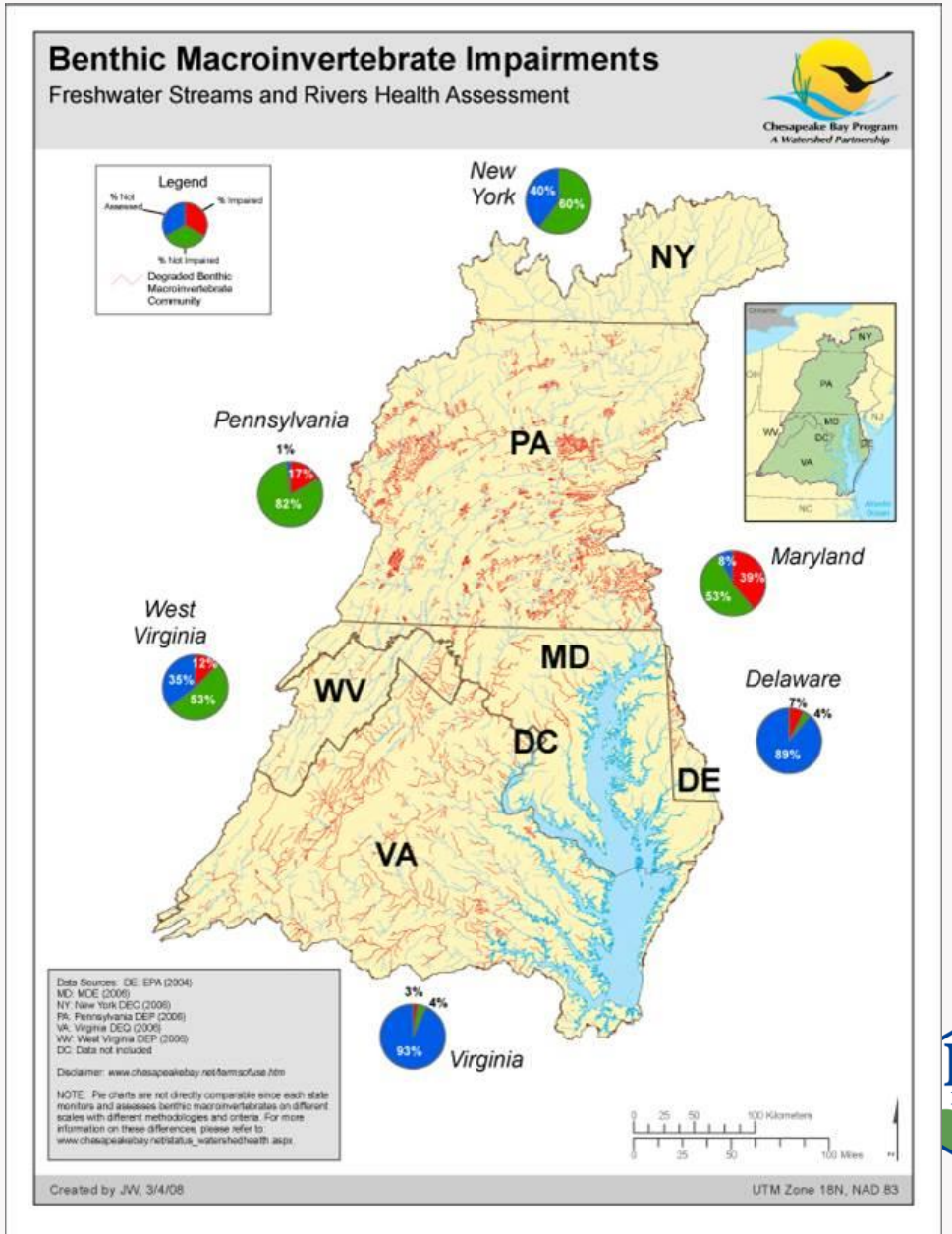
CBP cannot use State assessments

Impairment assessments are not directly comparable; cannot be used to measure progress towards meeting basin-wide goals.

(Non-Tidal Workgroup, 2008)

Percentages from pie charts on map

As of 2008	Not Assessed	Impaired	Not Impaired
New York	40%	0%	60%
Pennsylvania	1%	17%	82%
West Virginia	35%	12%	53%
Maryland	8%	39%	53%
Delaware	89%	7%	4%
Virginia	93%	3%	4%



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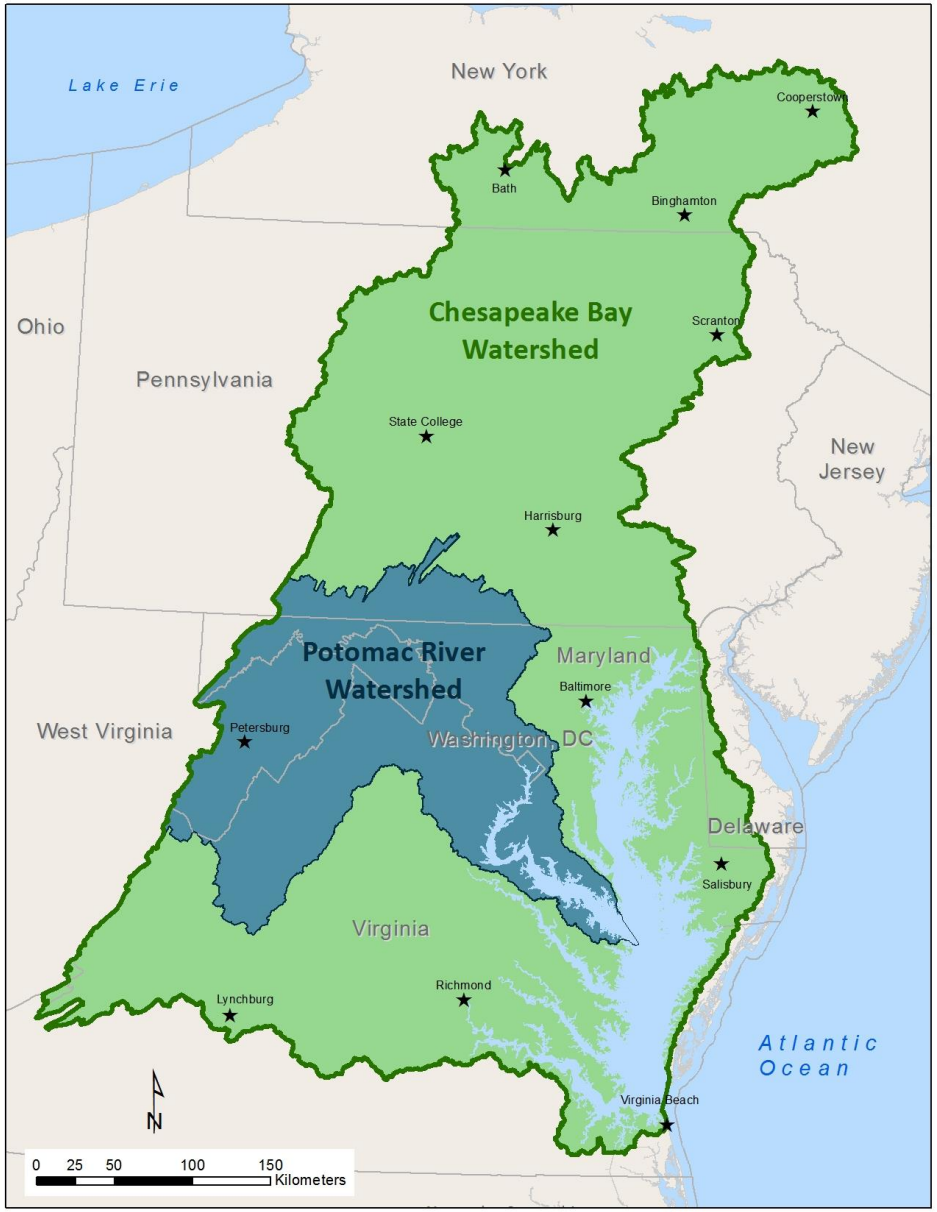
Development of a Stream Health Indicator



Early efforts to go basin-wide

- *Raw data* are relatively comparable and with standardization, can be combined

  Astin, L. E. (ICPRB) 2006, 2007
  Potomac Basin-wide Index of Biotic Integrity (BIBI)

  Others (side-by-side comparisons)

- 2008 – Proof of Concept for a Chesapeake Index

  Foreman et al. 2008

- 2011 – Prototype index for Chesapeake Bay watershed

  Buchanan et al. 2011

- 2015 – Chessie BIBI selected as indicator to track the Stream Health Outcome

  Stream Health Outcome Management Strategy, (2015 – 2025, v. 1)

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Development of a Stream Health Indicator

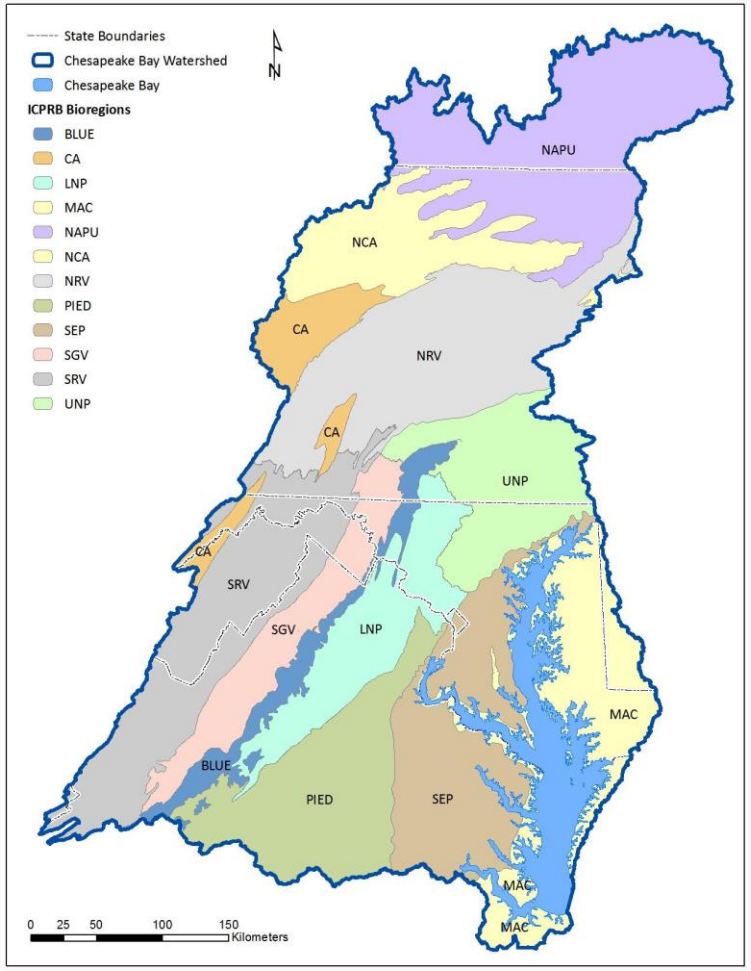
2017 – Chesapeake Basin-wide Index of Biotic Integrity (Chessie BIBI)

Smith et al. 2017

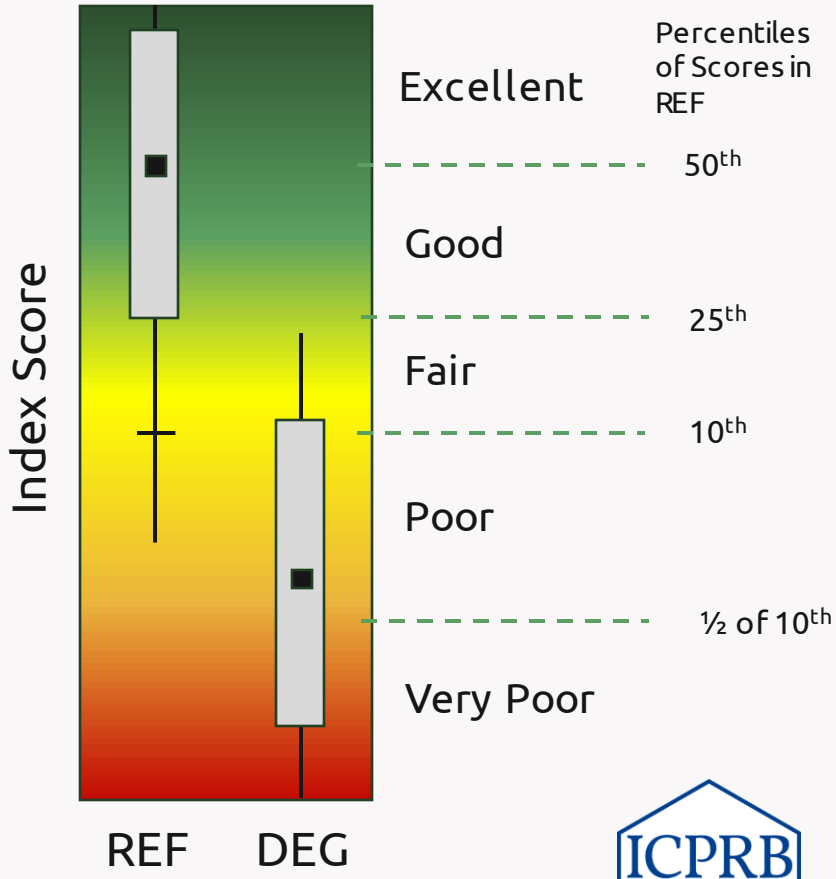
- Issued second data call
- Assembled 25,000+ samples collected & counted with similar methods
- Identified 12 bioregions (accounts for natural differences in biology)
- Standardized raw data and tested 85 macro-invertebrate metrics in each bioregion (e.g., %EPT, %clingers, %tolerant)
- Used most sensitive (discriminating) family-level metrics for each bioregion's index
- Used a common approach to score metrics and develop each bioregion index
- Applied a common rating method in each bioregion; Excellent, Good, and Fair indicates "healthy" stream community

.: Ratings are comparable across entire Chesapeake Bay watershed

Twelve Bioregions

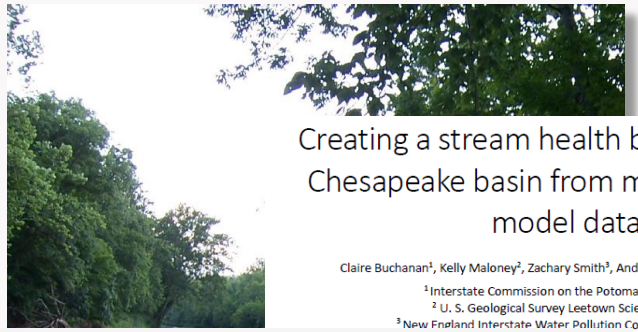


A Common Rating Method



Stream Habitat and WQ (Abiotic) Conditions

Development of a Stream Health Indicator



Creating a stream health baseline for the Chesapeake basin from monitoring and model data

Claire Buchanan[1], Kelly Maloney[2], Zachary Smith[3], Andrea Nagel[1], and John Young[2]

[1]Interstate Commission on the Potomac River Basin
[2] U. S. Geological Survey Leetown Science Center
[3]New England Interstate Water Pollution Control Commission

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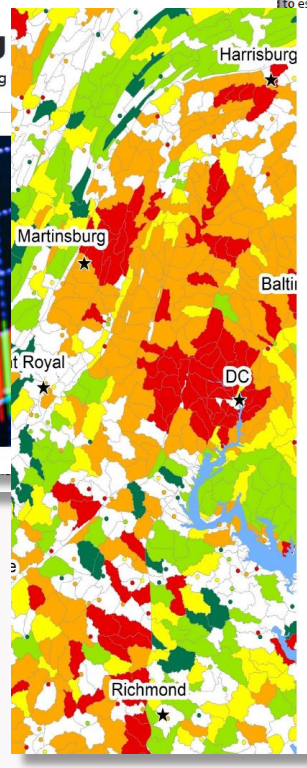
re analyzed and combined to generate
eake Bay basin for the 2006 – 2011
drainage area were evaluated with
to estimate stream health in the

Monitoring and Modeling

Our data hub offers access to a multitude of monitoring

(Mclek/Shutterstock)



Stream Biological Health in the Chesapeake Bay Watershed

February 10, 2023

Report Prepared for the Chesapeake Bay Program Stream Health Workgroup

What, Where, How, When

- 2018 – "2008 Baseline" Workshop
  ICPRB 2018
- 2019 – Preliminary Baseline Identified
  Buchanan et al. 2019
- 2021 – Data Incorporated into Chesapeake Environmental Data Repository (CEDR) (link)
- 2021 – Computer Programs to Calculate Index (link)
- 2023 – First Progress Report (2012 – 2017)
  Buchanan et al. 2023
- 2024 – Data Call
- 2025 – Second Progress Report (2018 – 2023)

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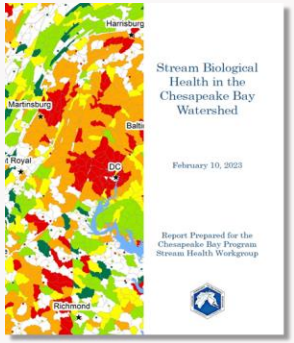
Progress Meeting the Stream Health Outcome

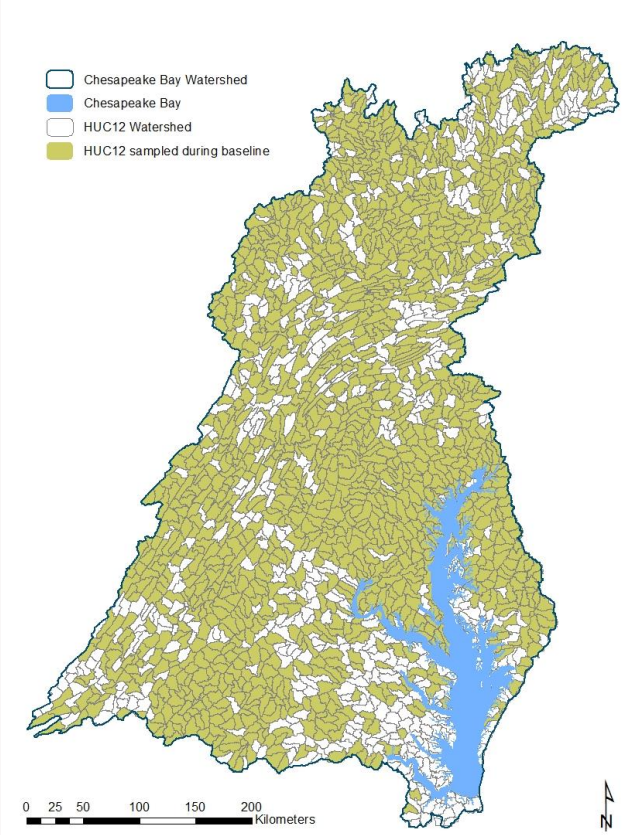
Statistical methods are used to estimate % healthy streams in the ~145,000 stream miles in the Chesapeake Bay watershed (1:24:000) …



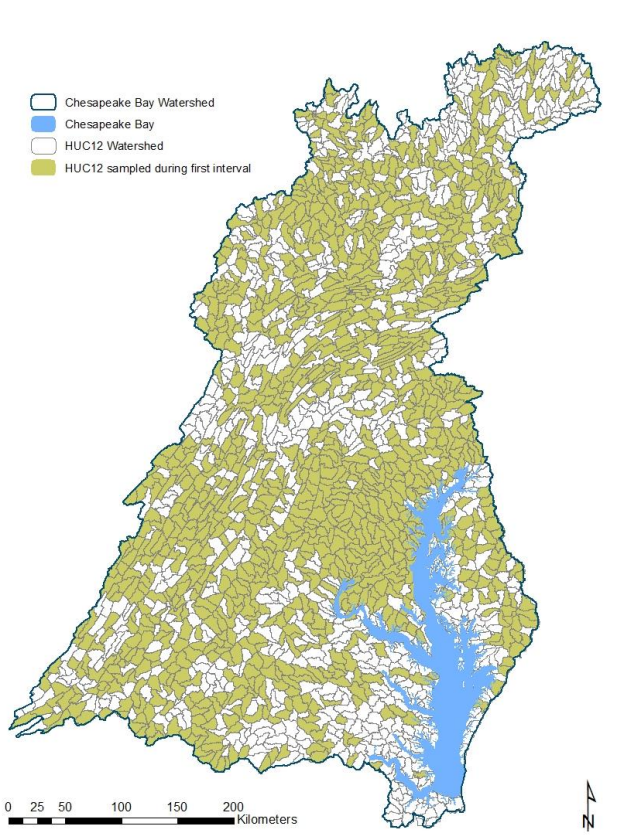
See report for details

HUC12 Subwatersheds

2006 – 2011 "Baseline"



2012 – 2017 "First Interval"



Statistical methods are possible because:

- Sites are located randomly in most HUC12 subwatersheds
- HUC12 subwatersheds are roughly the same size and are evenly dispersed (nearest neighbor method)

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Progress Meeting the Stream Health Outcome

"Improve health and function of ten percent of stream miles above the 2008 baseline."

(2014 Chesapeake Watershed Agreement)

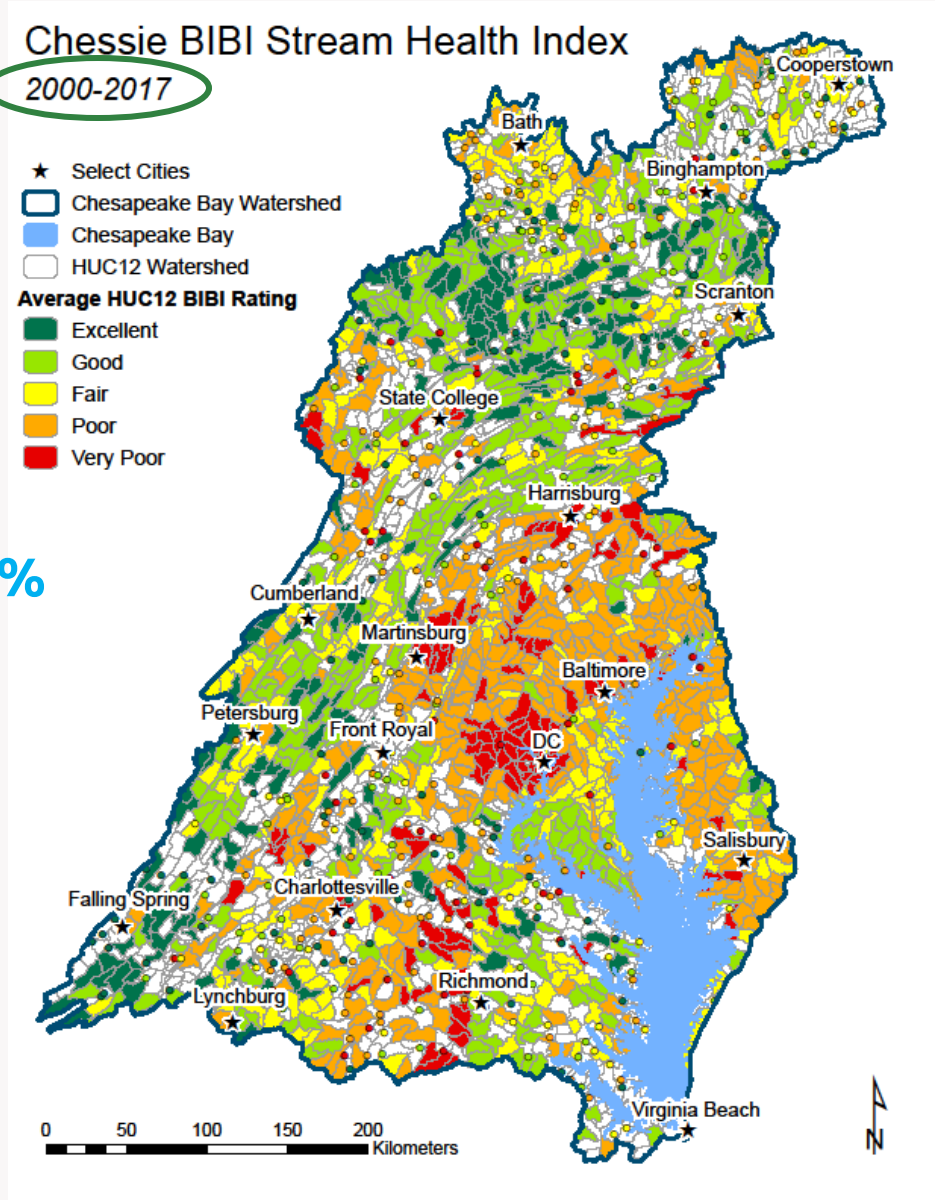
Period	Years	% Stream Miles
Pre-Baseline	(2000 – 2005)	57.1%
2008 Baseline	(2006 – 2011)	61.7%
First Interval	(2012 – 2017)	67.8%

+6.1%

Nearly 70%

"Improve the health of streams so that 70 percent of sampled streams …are in fair, good or excellent condition as measured by the Index of Biotic Integrity by 2025."

(2009 Executive Order 13508)



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Progress Meeting the Stream Health Outcome

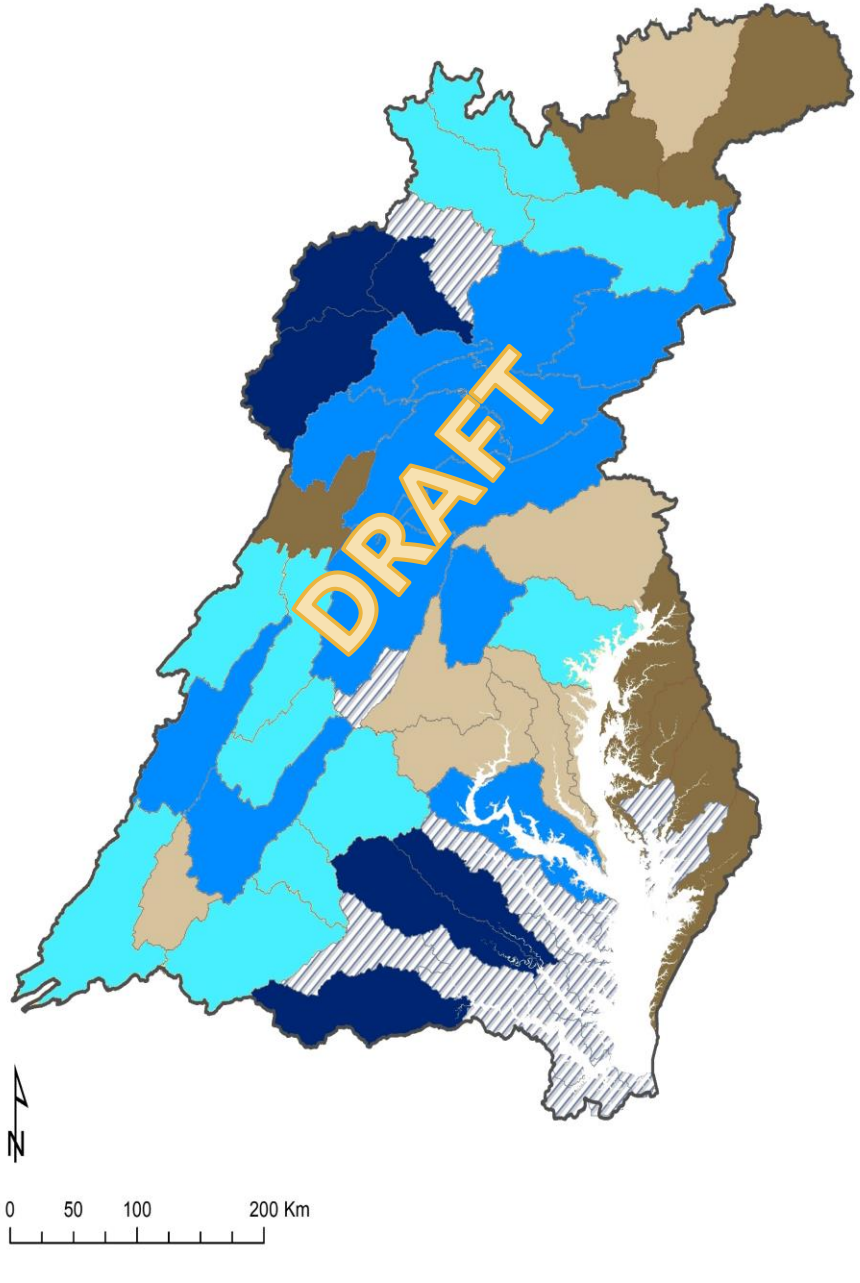
Change in Avg. BIBI Score, by HUC8

Pre-baseline (2000-2005) to First Interval (2012-2017)

Improving

No Change

Degrading



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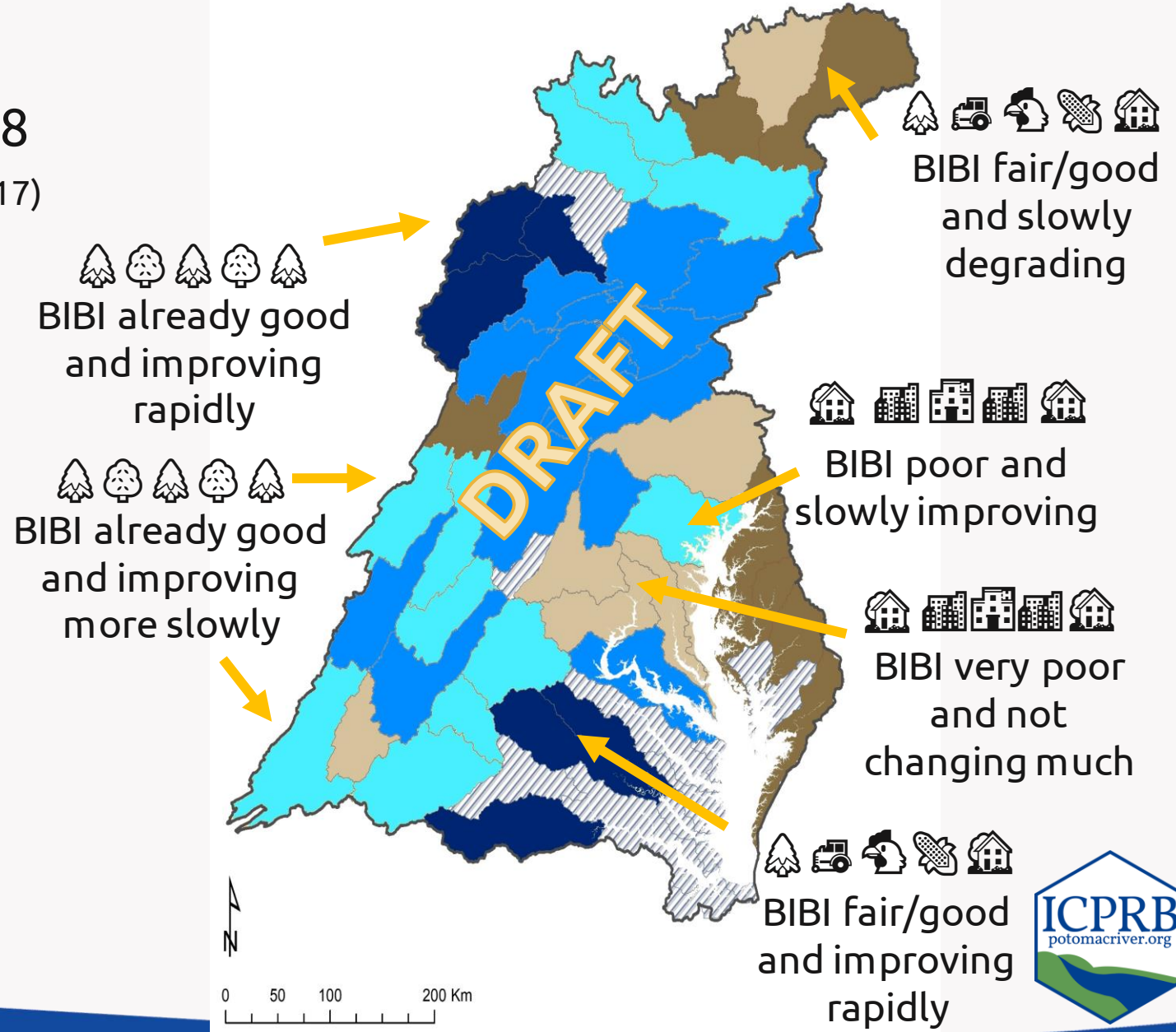
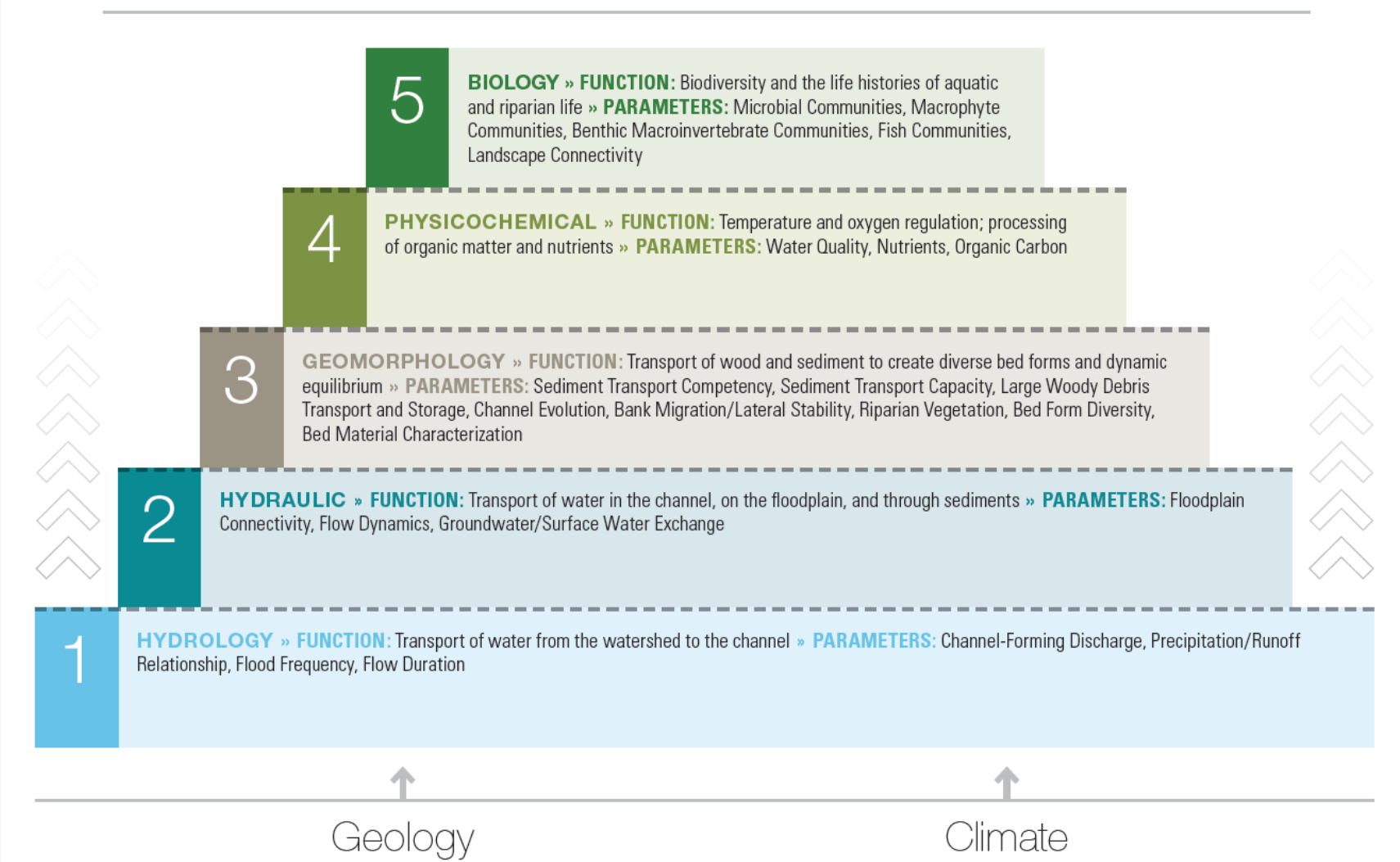


Progress Meeting the Stream Health Outcome

We don't know exactly why aquatic life is improving overall…

…but the results suggest the **collective impact of environmental stressors on streams is slowly lessening**, at least in parts of the Chesapeake watershed.

We also don't know **if** the improving trend will continue in the next 6-year interval (2018 – 2023).



Stream Functions Pyramid

Index Responsiveness to Stressors

Chessie BIBI
(empirical & modeled)

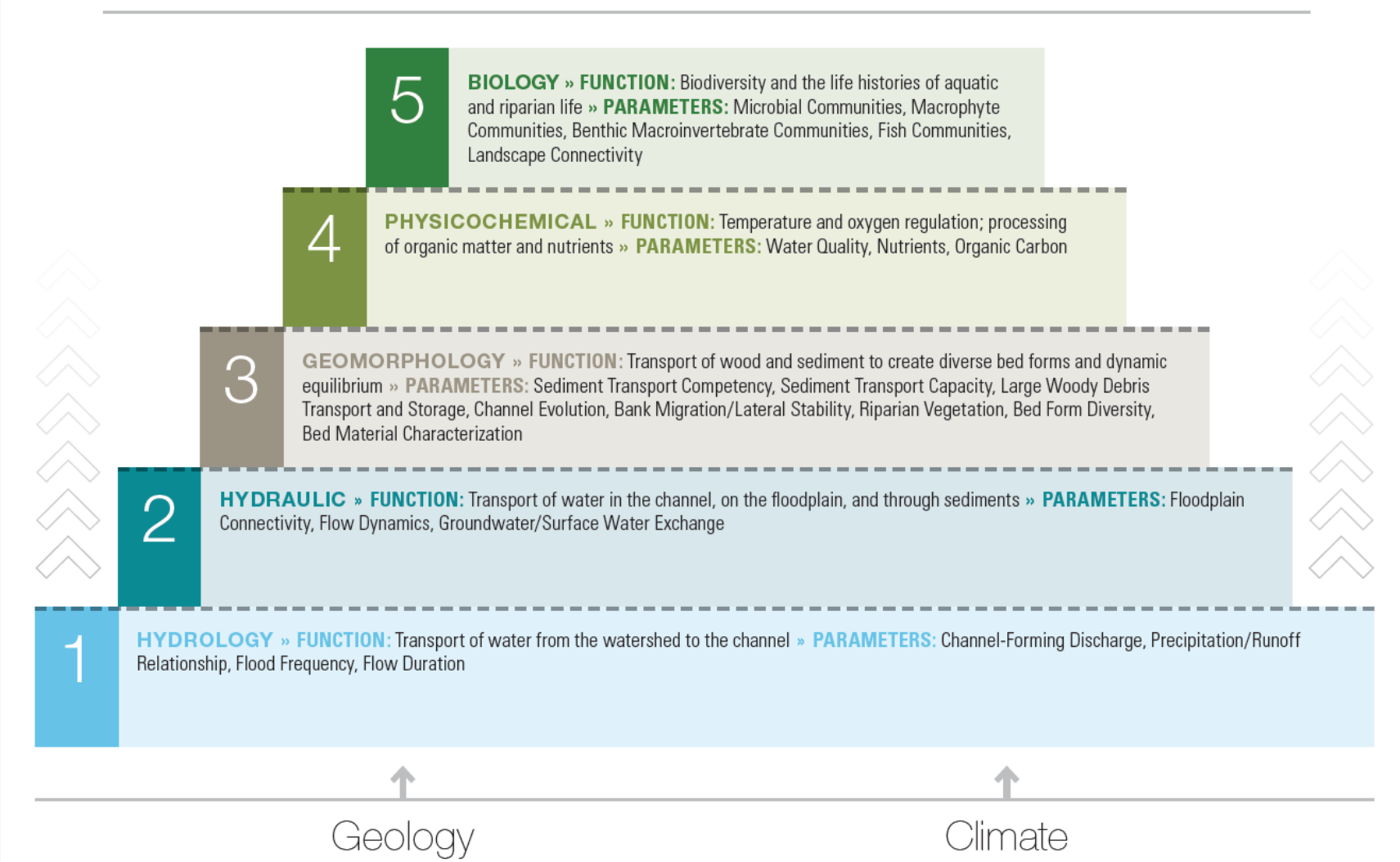
Nutrients, DO, Conductivity, pH

Instream Habitat

Flow Alteration

Forest Landcover & Imperviousness

Bioregion & Climate



Stream Functions Pyramid

Index Responsiveness to Stressors

Possible reasons for the overall improvement in stream health

- Reduced acid rain and atmospheric deposition?
- Sewage treatment plant upgrades?
- Stormwater control practices?
- Instream habitat and riparian buffer protection/restoration?
- Continued regrowth in many remaining headwater forests?

Healthier stream ecosystems retain more nutrients and sediments …

The progress report and more information about the Chessie BIBI can be found at:

Website:
bit.ly/chessiepage

Interactive map:
bit.ly/chessiemap

Questions?

www.potomacriver.org

EXTRA SLIDES

How to Calculate Statistical Estimates of % Healthy Streams

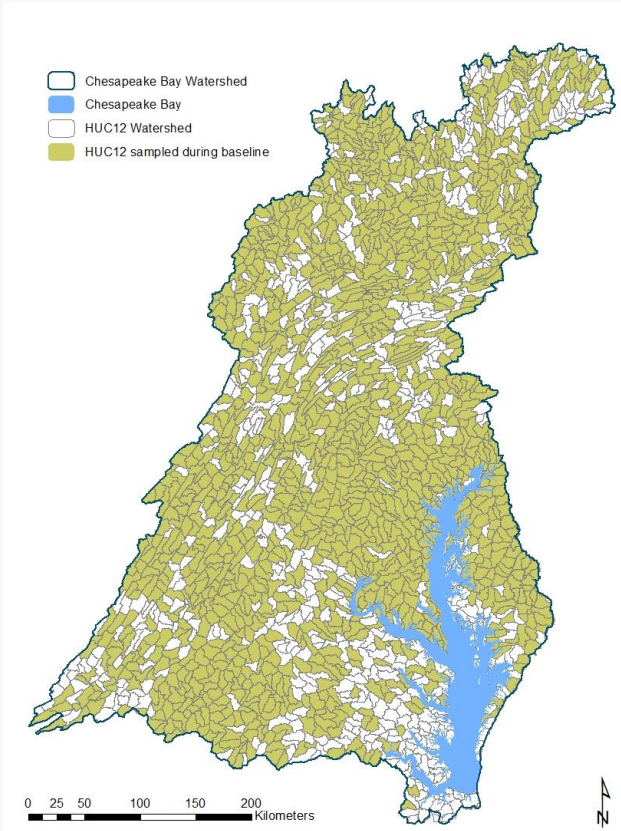
Assumption #1: sampling sites within a HUC12 subwatershed are randomly distributed

Assumption #2: the HUC12 subwatersheds are randomly or evenly distributed

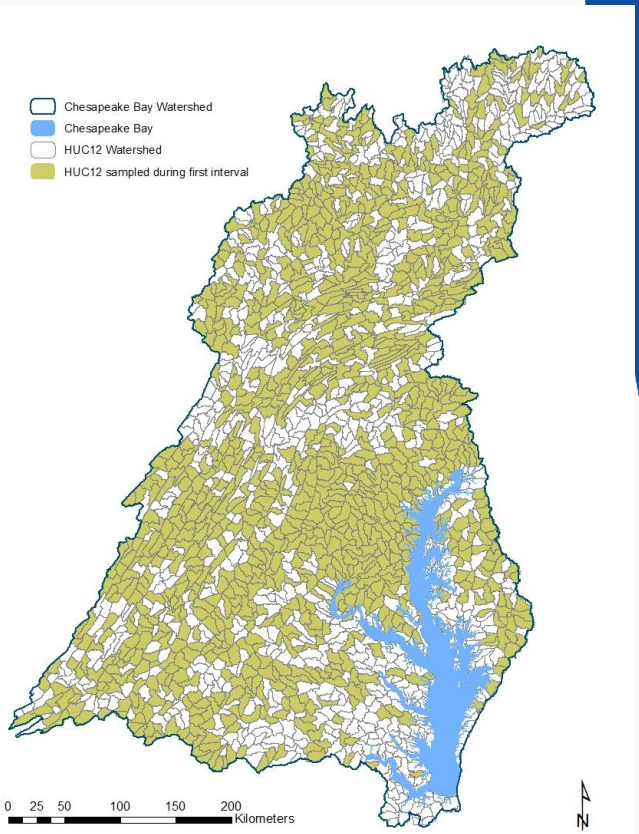
Obtain a statistical estimate of the percent of healthy streams in each period:

- Group Chessie BIBI ratings for sampling sites by HUC12 subwatershed
- Weight each site's rating in a HUC12 by an equal portion of the total stream miles in the HUC12 (1:24,000)
- Sum up all the portions for each rating across all sampled HUC12 subwatersheds
- Extrapolate to entire Chesapeake watershed (accounts for HUC12's with no data)

2006 – 2011 "Baseline"



2012 – 2017 "First Interval"



Nearest neighbor analysis shows HUC12 subwatersheds are evenly distributed.

See Report for details: Buchanan et al. 2023