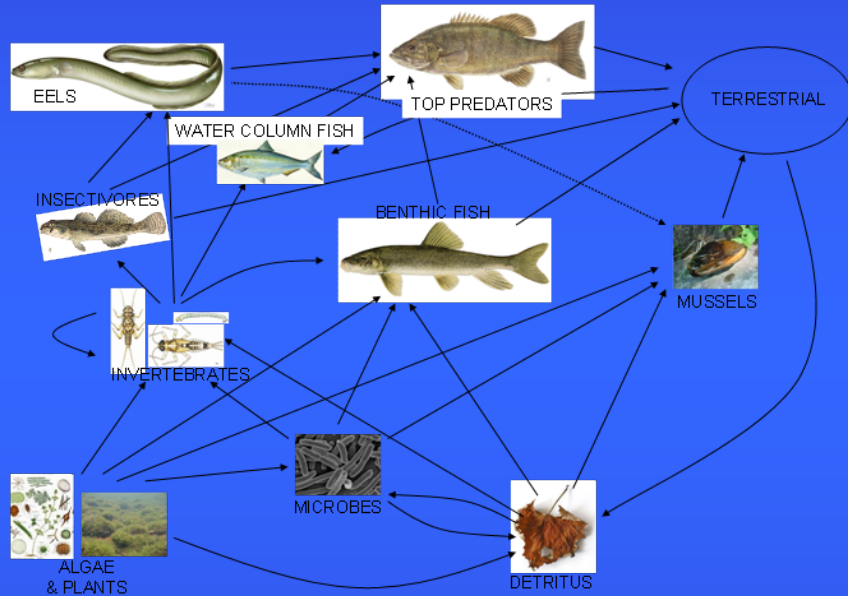


Bioassessment on the Delaware : Challenges & Approaches for a Large River

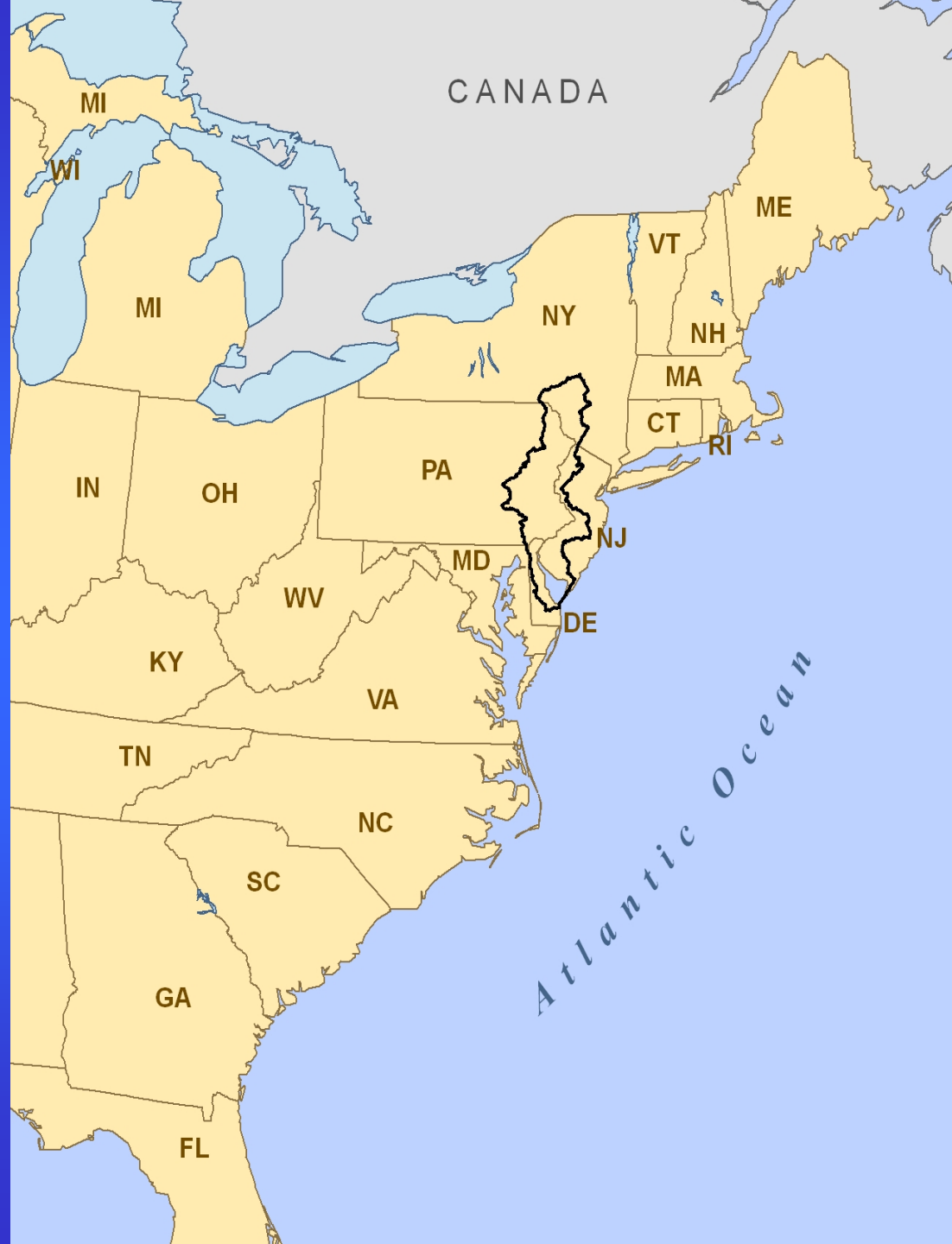


April 28, 2010
NWQMC, Denver

Bob Limbeck
& Erik Silldorff

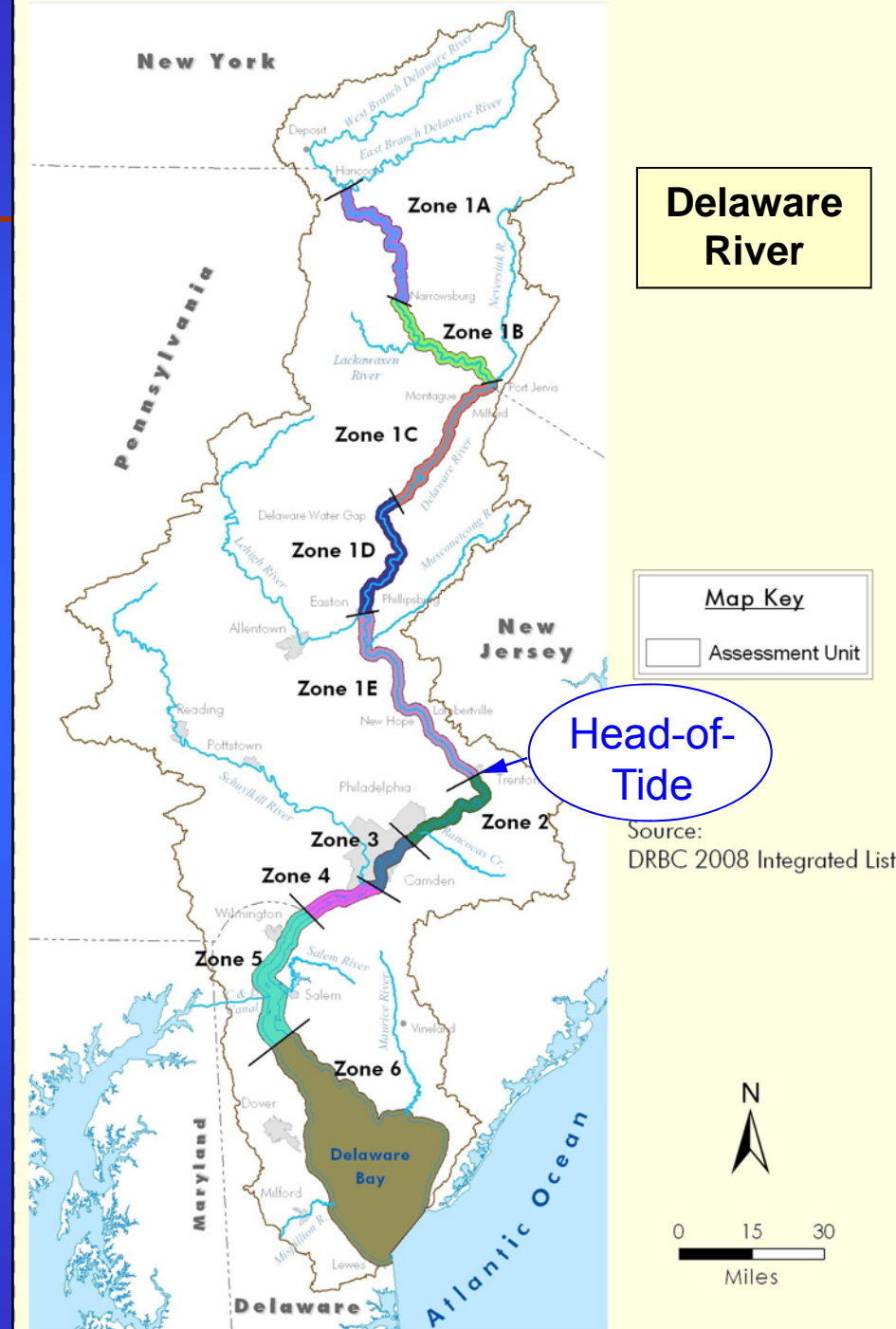
Delaware River Basin Commission

- Created in 1961
- 4 states and U.S. govt.
- 13,539 mi² (0.5% US)
- 5% of US water supply
- Water supply & Water quality
- Lead agency for interstate waters



Integrated Assessment

- Main-stem interstate waters
- 305(b) decisions
- Uses assessed:
 - Aquatic Life
 - Public Water Supply
 - Recreation
 - Fish & Shellfish Consumption
- Recommend 303(d) to states



Unique Status

- 3 National Parks Service units
- “Wild & Scenic” designations
- Longest free-flowing river east of the Mississippi
- DRBC “Anti-degradation”



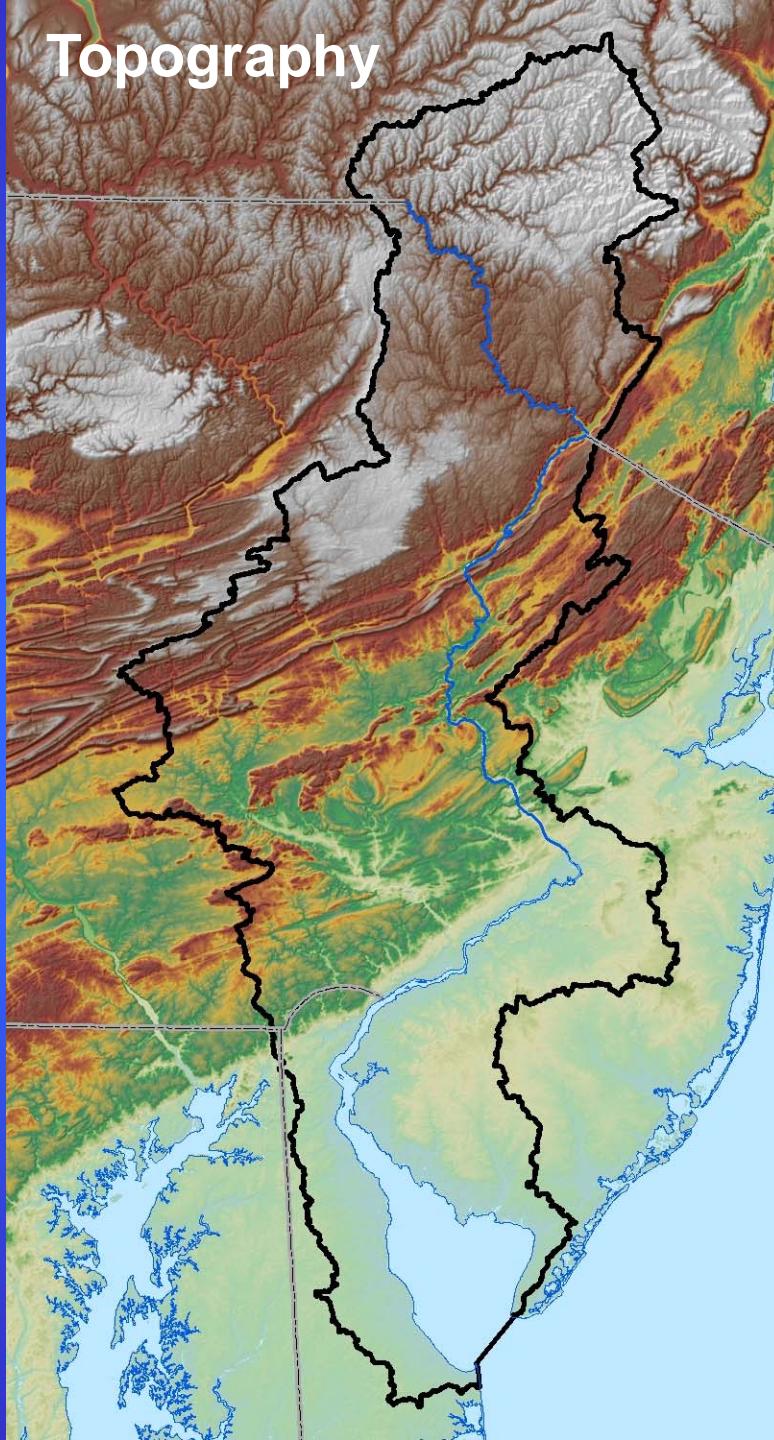
Invertebrate Biomonitoring

- Aug/Sept 2001-2008 surveys
- 25 stations
- Targeted riffle
 - 1 – 3 ft/s
 - 1 – 2 ft depth
 - 40 – 70 mm median substrate
- Composite of 3 samples 4 ft² each
- 500 individual target count
- genus-level taxonomy



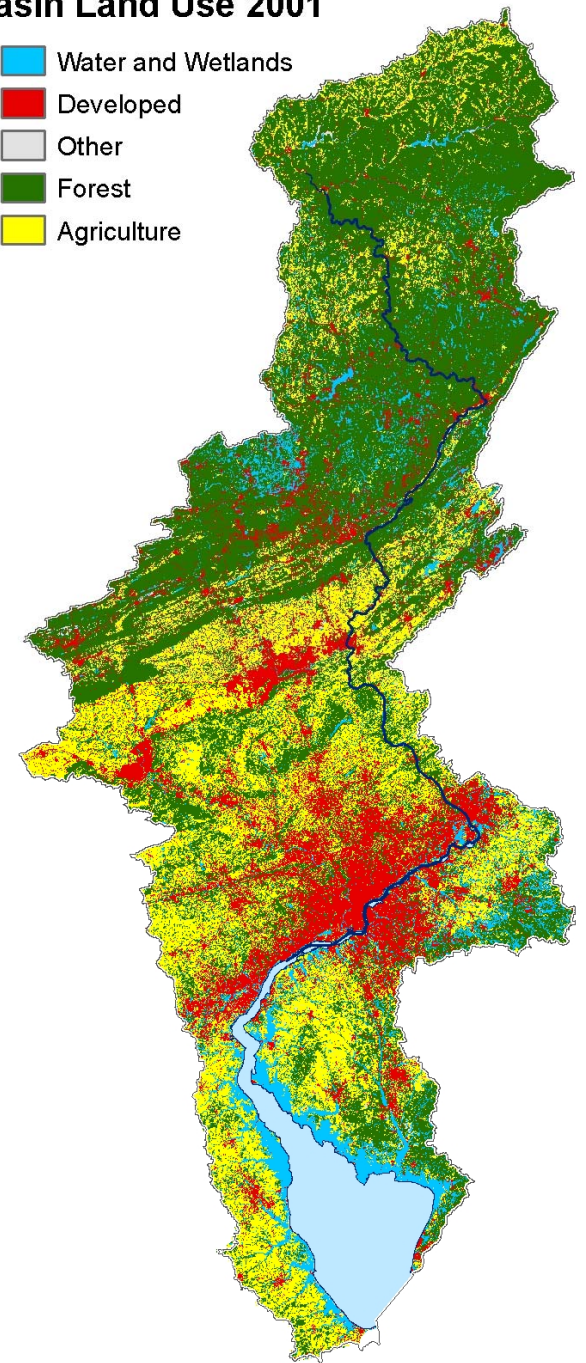
Basin Tour: Natural vs. Human Influences

Topography

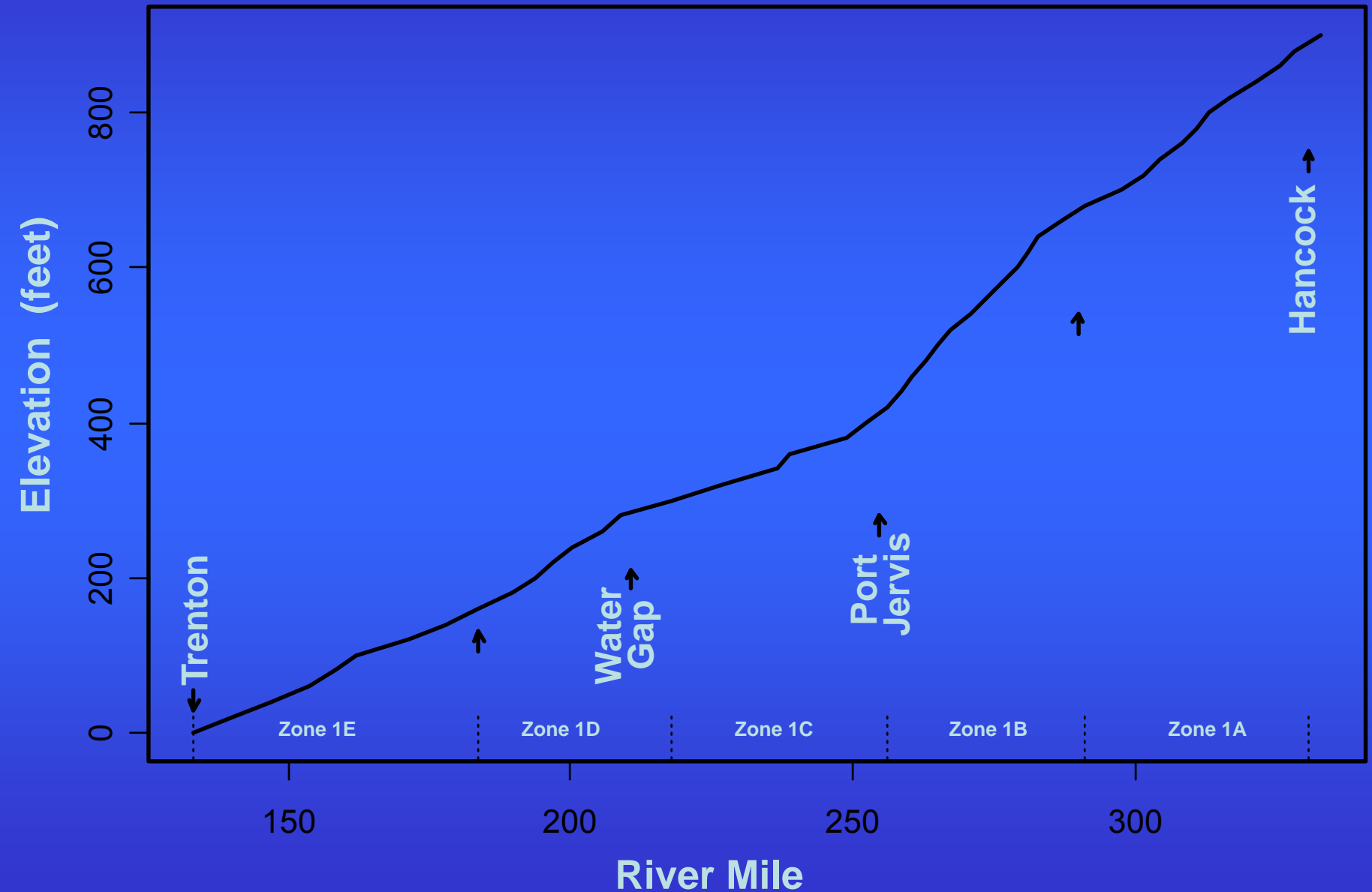


Basin Land Use 2001

- Water and Wetlands
- Developed
- Other
- Forest
- Agriculture



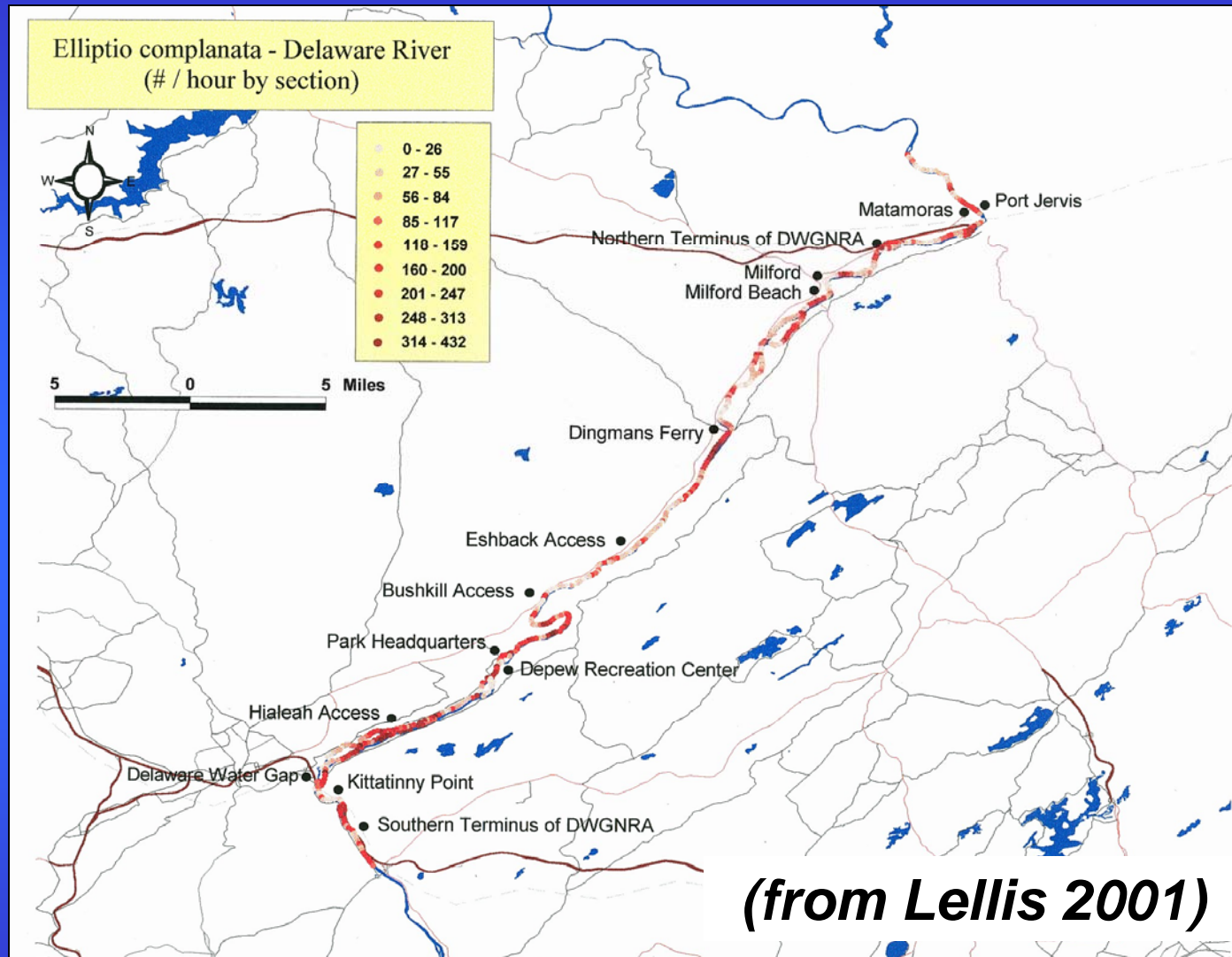
Natural Influence: Stream Gradient (~5 ft/mi median)



Natural Influences: Substrate, Depth, Velocity

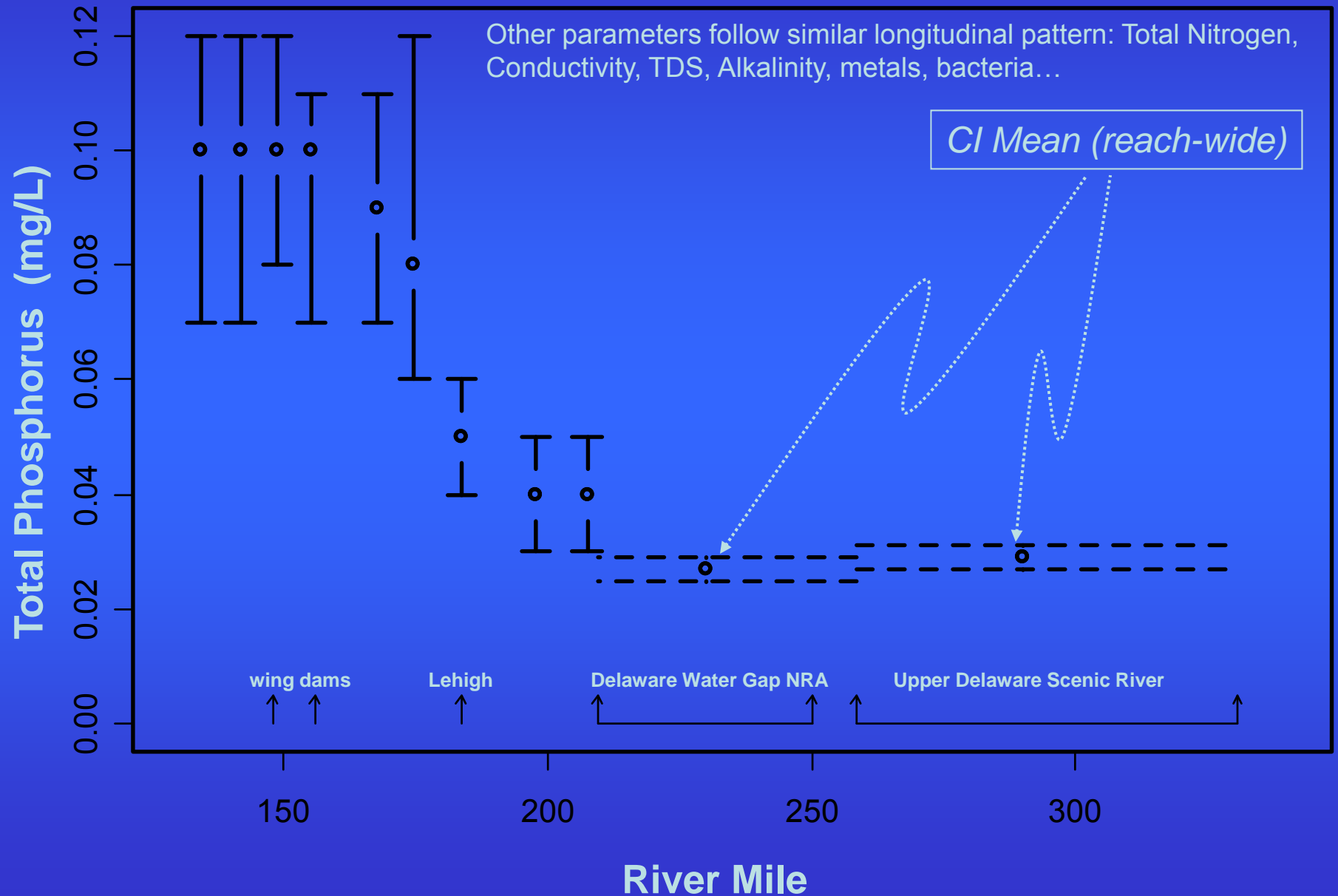


Freshwater Mussels: 8 species, density $\sim 10 / \text{m}^2$

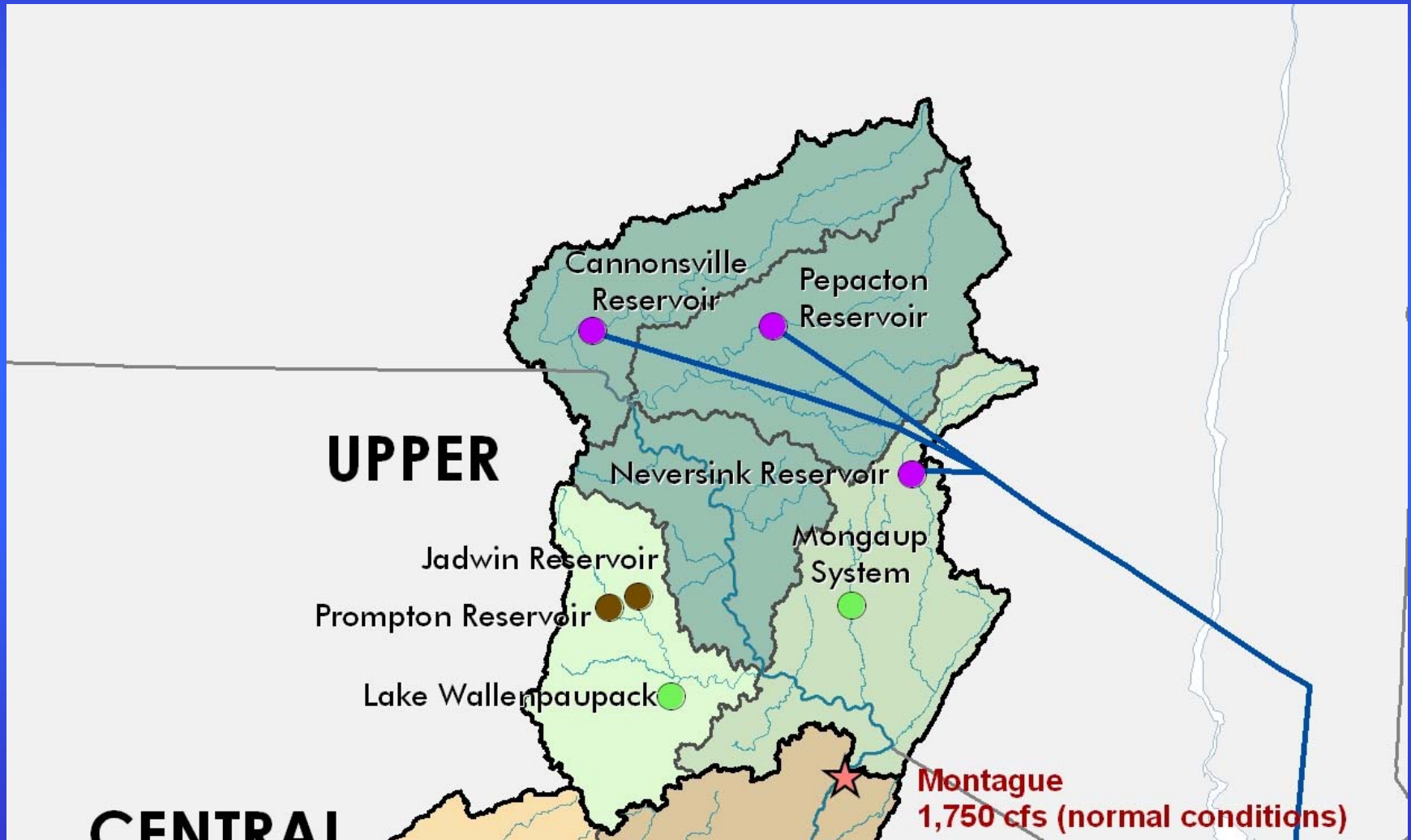


An example of high biological productivity in a free-flowing river with the Delaware's physical characteristics...

Natural + Anthropogenic Influences: Total Phosphorus



Reservoir Influence: Hydrology, Temperature



Use Above Information to Define “Reference Conditions”

Kinds of Reference

- Historical conditions
- Regional reference
- System-defined reference



Considerations for Reference Selection

Reference Qualities

1. Excellent & consistent benthic habitat
2. Excellent water quality for upper 150 miles (above Lehigh)
3. Relatively consistent gradient

Human Influences

1. Temperature alteration in upper 30 miles (above Callicoon)
2. Altered water quality in lower 50 miles (below Lehigh)
3. Hydrology moderately altered throughout

Uncertainty

1. Natural vs Human contribution to Nitrogen, Phosphorus, Conductivity, TDS in transition zone
-

Reference Decision:

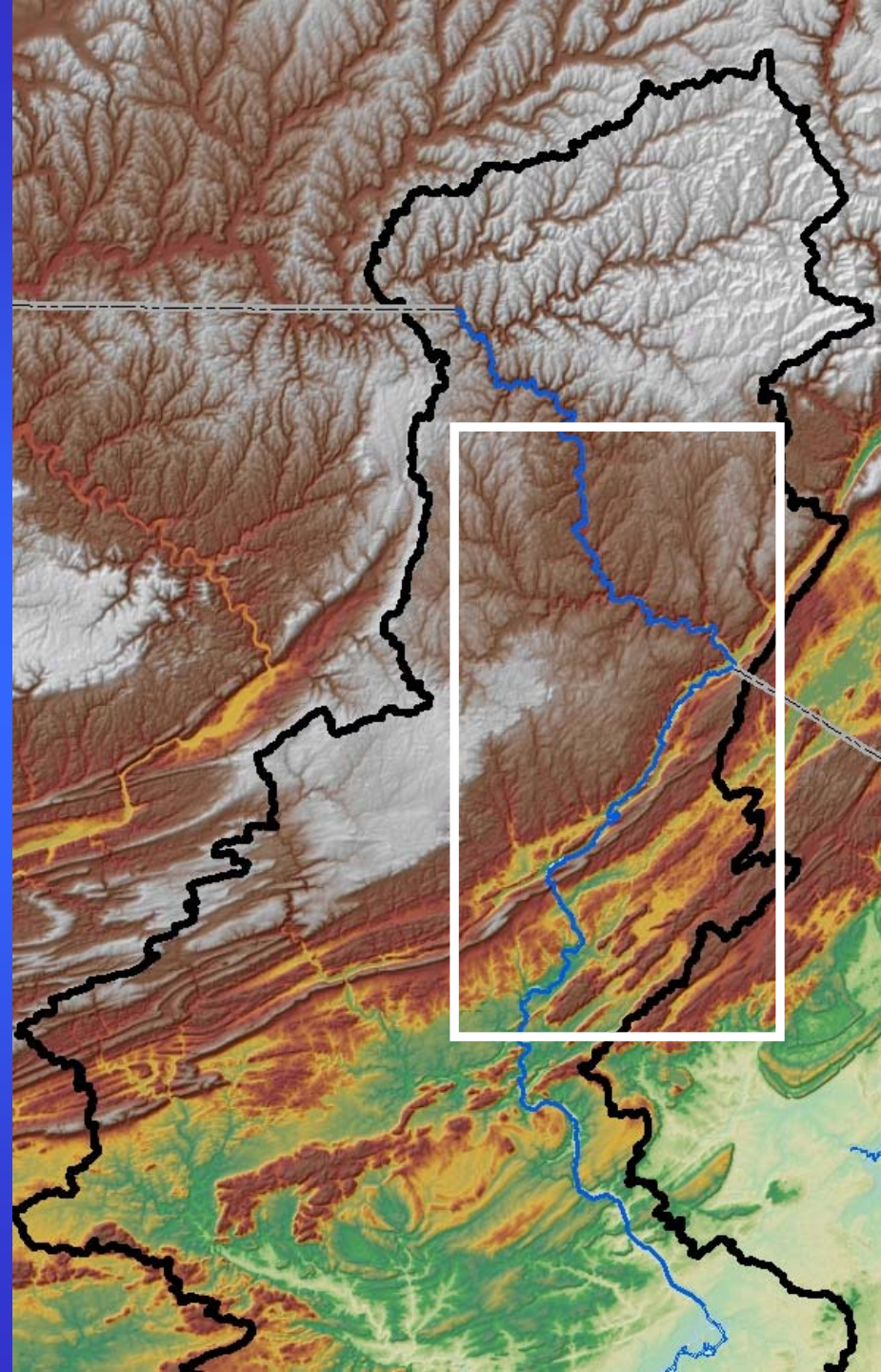
Callicoon (RM 305)

to

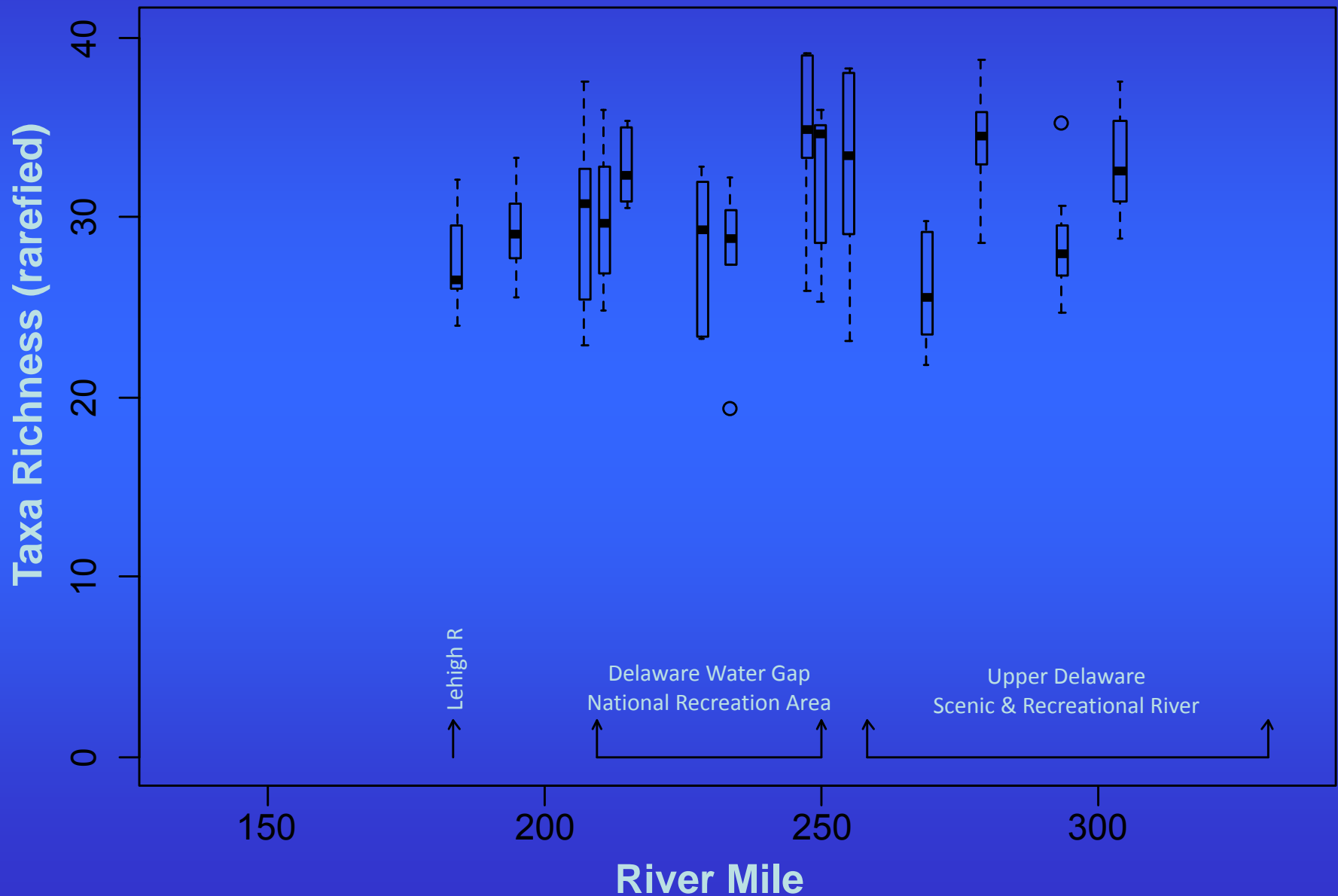
Lehigh R. (RM 184)

Use 120 least-impacted contiguous miles to assess 200 total miles...

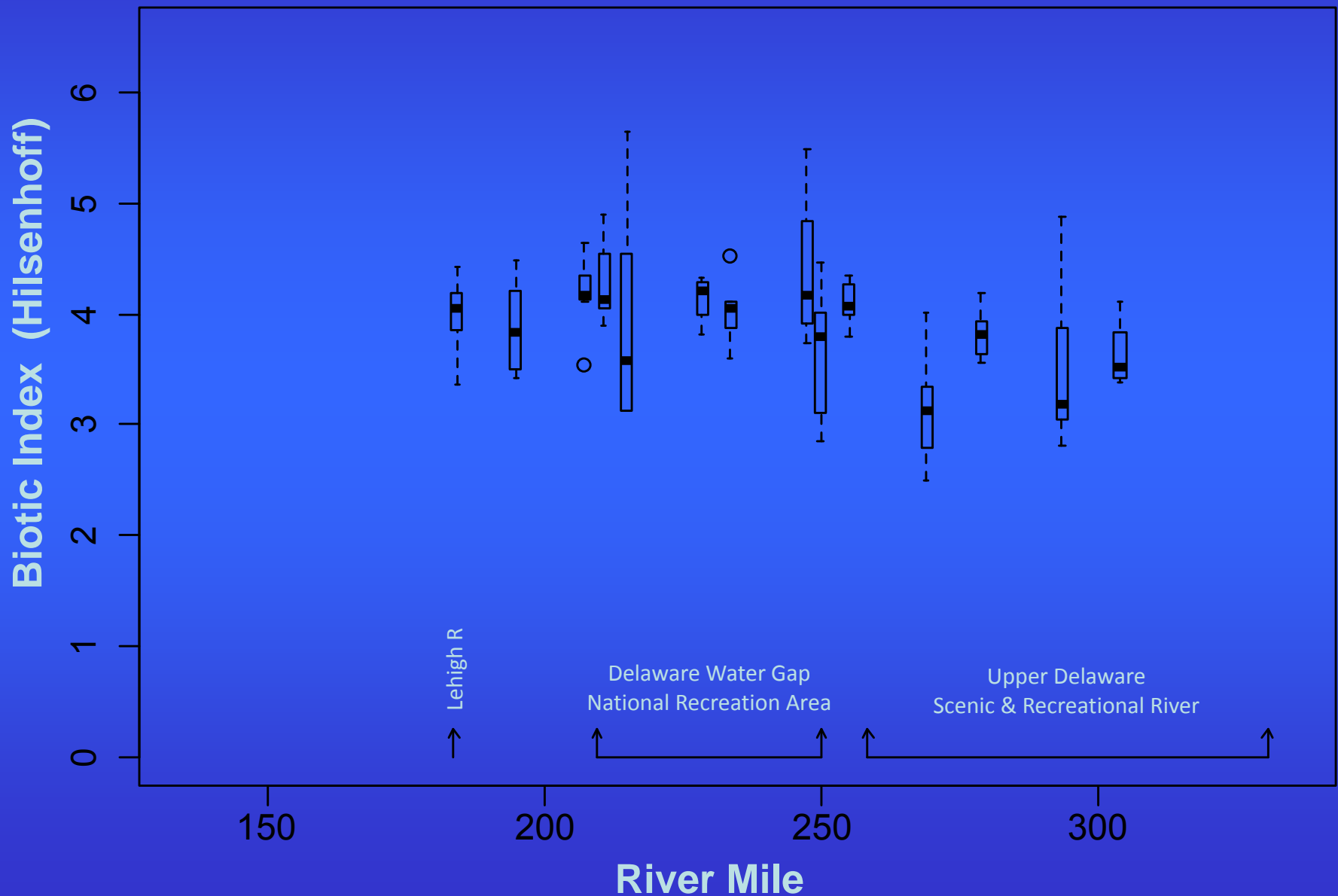
This is a system-defined reference condition, where we chose a least-impacted reach away from the temperature/hydrologic impacts of reservoir releases; and away from the impacts of the most influential tributary and population center – the Lehigh River.



Reference Reach Macroinvertebrate Results: Taxa Richness



Reference Reach Macroinvertebrate Results: Hilsenhoff Biotic Index



How To Measure Ecological Impacts?

- **Use proven metrics in the region**
 - ⇒ “Signal” established by the states
 - **But select among them based on Delaware performance**
 - ⇒ “Noise” quantified for Delaware data
 - **Result: 6-metric IBI**
 - Richness (rarefied to 200 count)
 - EPT Richness (rarefied to 200 count)
 - Shannon-Wiener Diversity
 - Biotic Index (Hilsenhoff)
 - % Intolerant Richness (0,1,2)
 - Scraper Richness
-

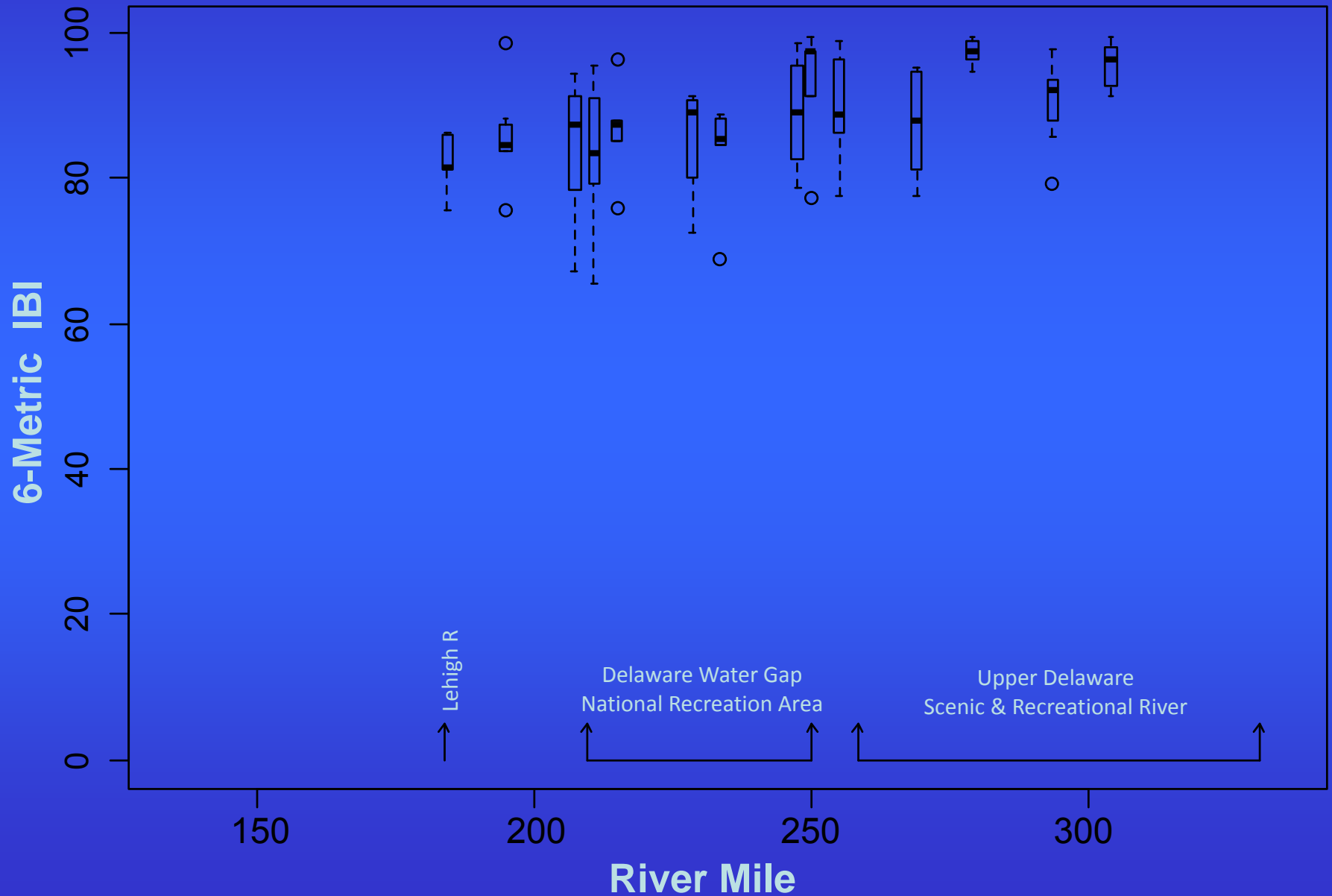
Do we need different “reference” standards for different parts of the river?

Evidence Says No, But Maybe, But Probably Not...

- Metrics: statistically stable through reference reach
- Species: dominants stable; some turnover among less common
- Multivariate Analyses: weak structure, no obvious clusters among or between sites in the reference reach

Decision: **Use a single reference designation**
(interim) **for 200 miles of non-tidal river**

Delaware River IBI Performance at Reference Sites



How To Define “Too Much” Ecological Change?

Options as “Next Steps”

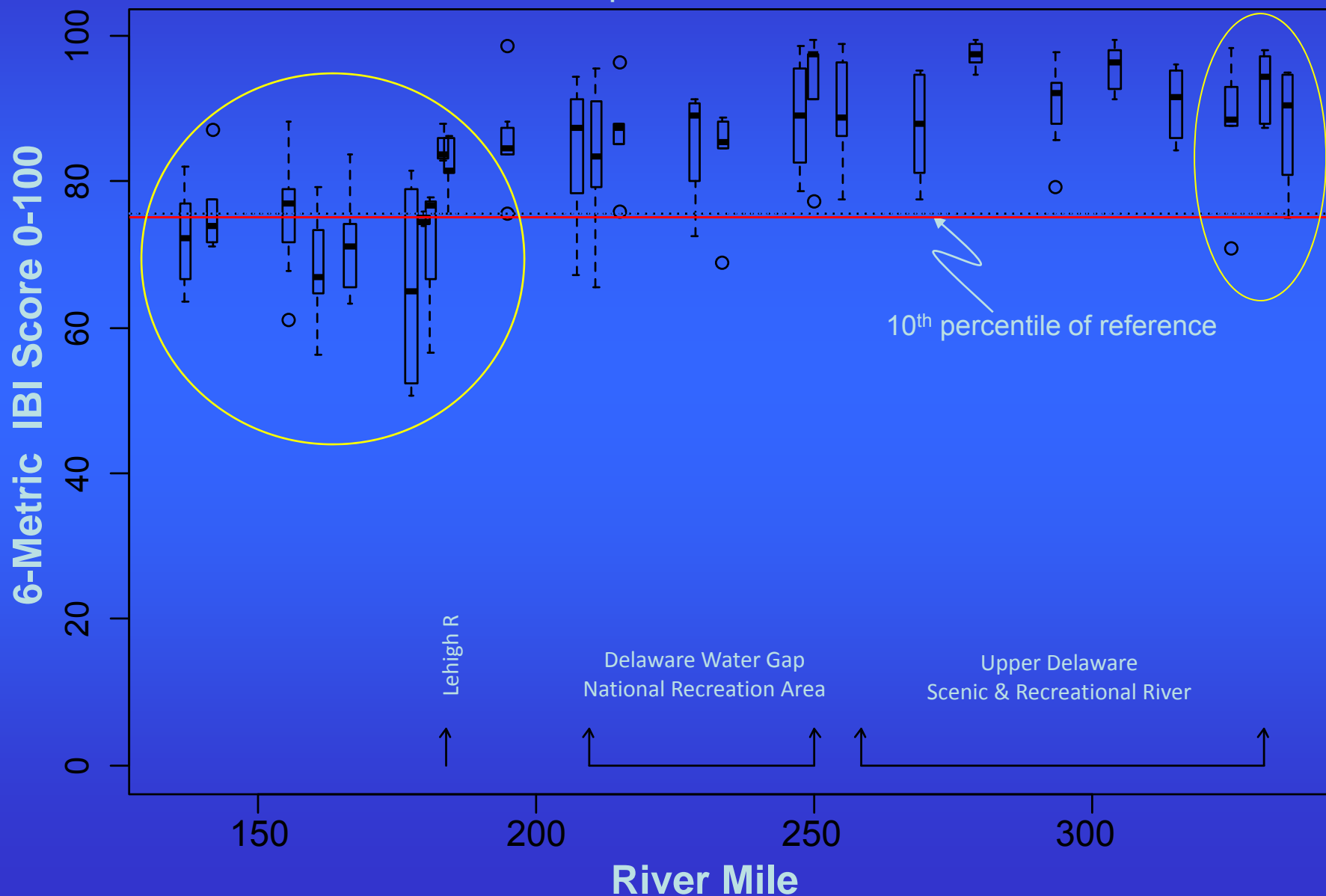
- Draw from state or national thresholds
- Derive from an understanding of ecological system
- Expert workshop (e.g., TALU)
- Empirical based on data variability



2010 Bioassessment Results

Threshold: 10th percentile of reference samples for 2001-2006 data

Decision Rule: 30% of samples from 2007-2009 below Threshold



Conclusions

Reference Designation

- Use the Delaware as a “reference” for itself
- Apply a single standard for 200 miles of non-tidal river


Ecological Change

- Draw from States’ experience, but tailored to the Delaware

Impairment Threshold

- Listing requires 3-fold increase in the frequency of “poor” samples below the 10th percentile of reference
-

Podostemum sp.
(Good Stuff!)



Acknowledgements

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