Using Ambient Data to Establish Antidegradation Standards: The Utility of Non-Parametric Confidence Limits

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Delaware River Basin Commission

Anti-Degradation

- Established via EPA Regulations (40 CFR § 131.6, § 131.12)
- 3rd Component of Water Quality Standards
- Three Primary Goals
  - (i) Tier 1: Prevent losses of designated uses
  - (ii) Tier 2: Maintain water quality above Criteria when shown to be higher
  - (iii) Tier 3: Preserve water quality for Outstanding National Resources Waters
- Implementation Typically via 2 Approaches
  - (i) Designation for a waterbody
  - (ii) Parameter designations

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DRBC Antidegradation

NPS & DRBC Recognition of Threat in 1980s

- Designated Uses included “Industrial”
- Extremely high water quality
- “Scenic & Recreational” and NPS units

Data Collection Resulted in “Tier 2” Antidegradation in 1992

- Defined “Existing Water Quality” for 13 parameters
- Room for growth via “Measurable Change”

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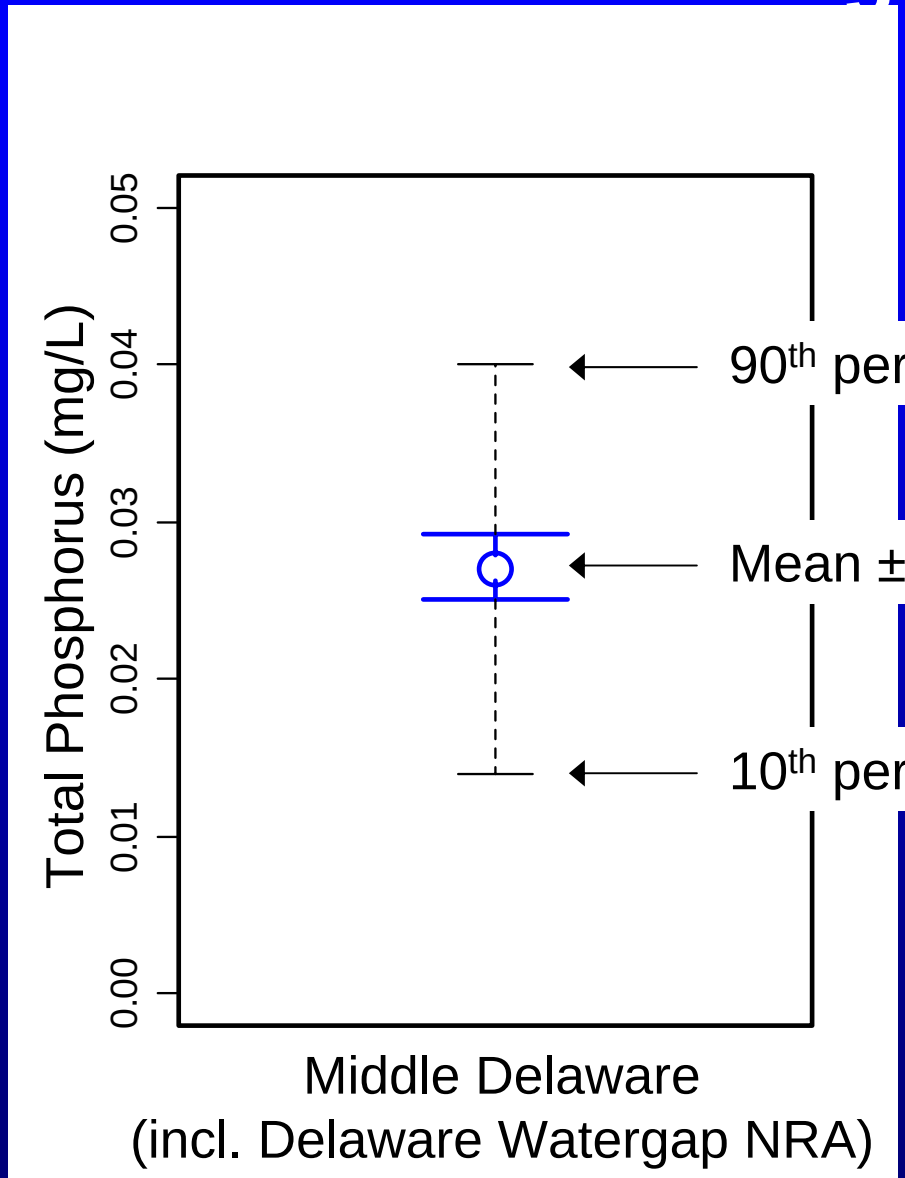
DRBC Antidegradation: "Measurable Change"



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Lower Delaware R.

- "Scenic & Recreational" in 2000
- Petition for Remaining Non-Tidal
- Collection of Data from 2000-2004

- 2005 Interim Designation

  → continued "Measurable Change"

  → postponed parameter limits

Wild & Scenic Designations

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Data Analysis: “Measurable Change”

Common Challenges to Environmental Data

- Skewed data distributions: long right tail
- Censored data: “non-detects” and “too-numerous”
- Data rounding into discrete bands

Three Approaches Considered

- Simplistic normal-theory estimation
- Advanced interval estimation methods
- Non-parametric interval estimation

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Data Analysis: "Measurable Change"

Approach	Advantages	Disadvantages
Simplistic Normal	1. Narrow intervals 2. Acceptance 3. Precedent	1. Inaccurate coverage 2. Special data handling
Advanced Estimation	1. True coverage	1. Intervals variable 2. Unconventional 3. Labor intensive
Non-Parametric	1. True coverage 2. Simplicity 3. Robust to data issues	1. Broad intervals (= Loss of Power)

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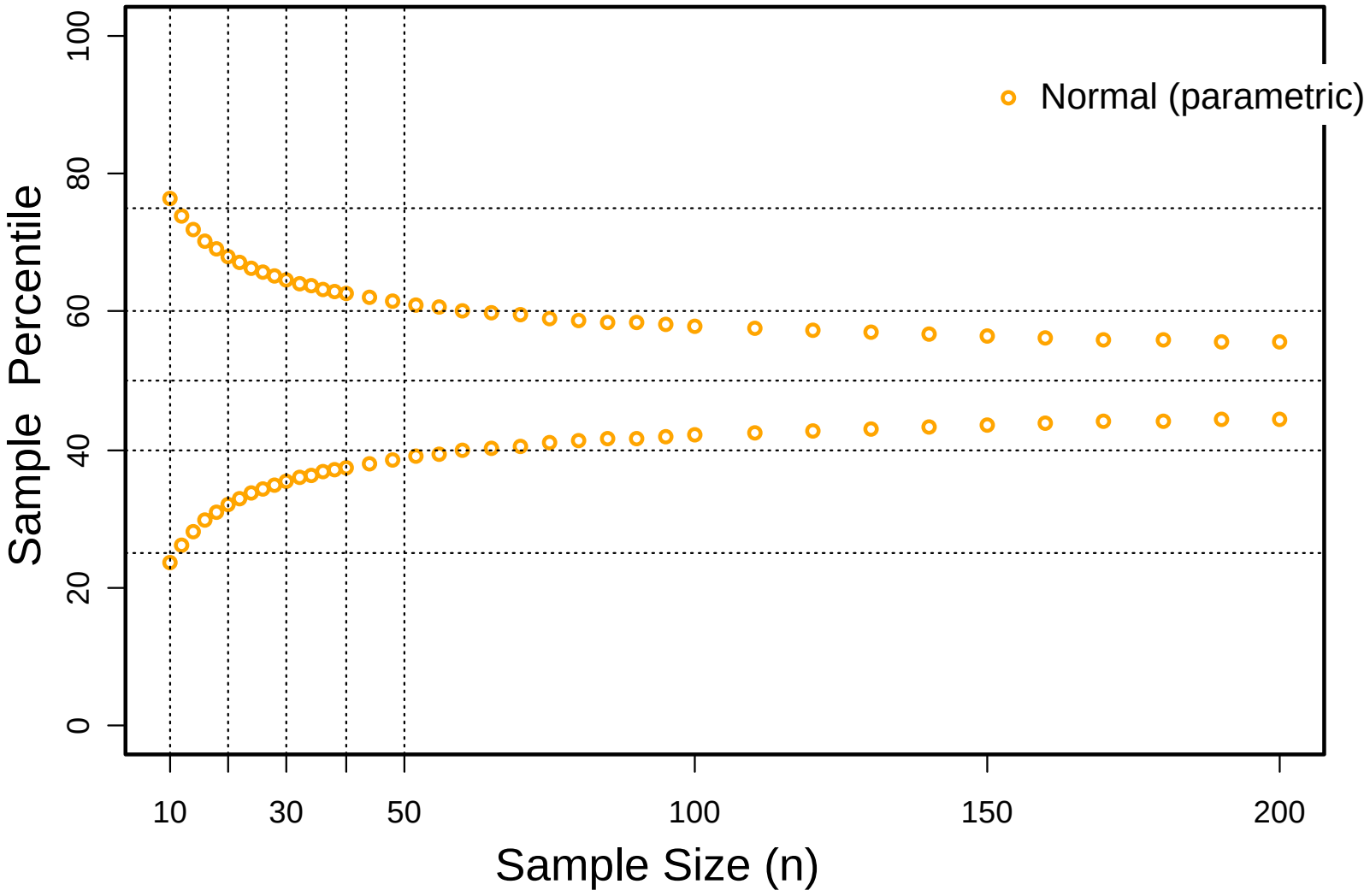
Width of Confidence Intervals vs Sample Size



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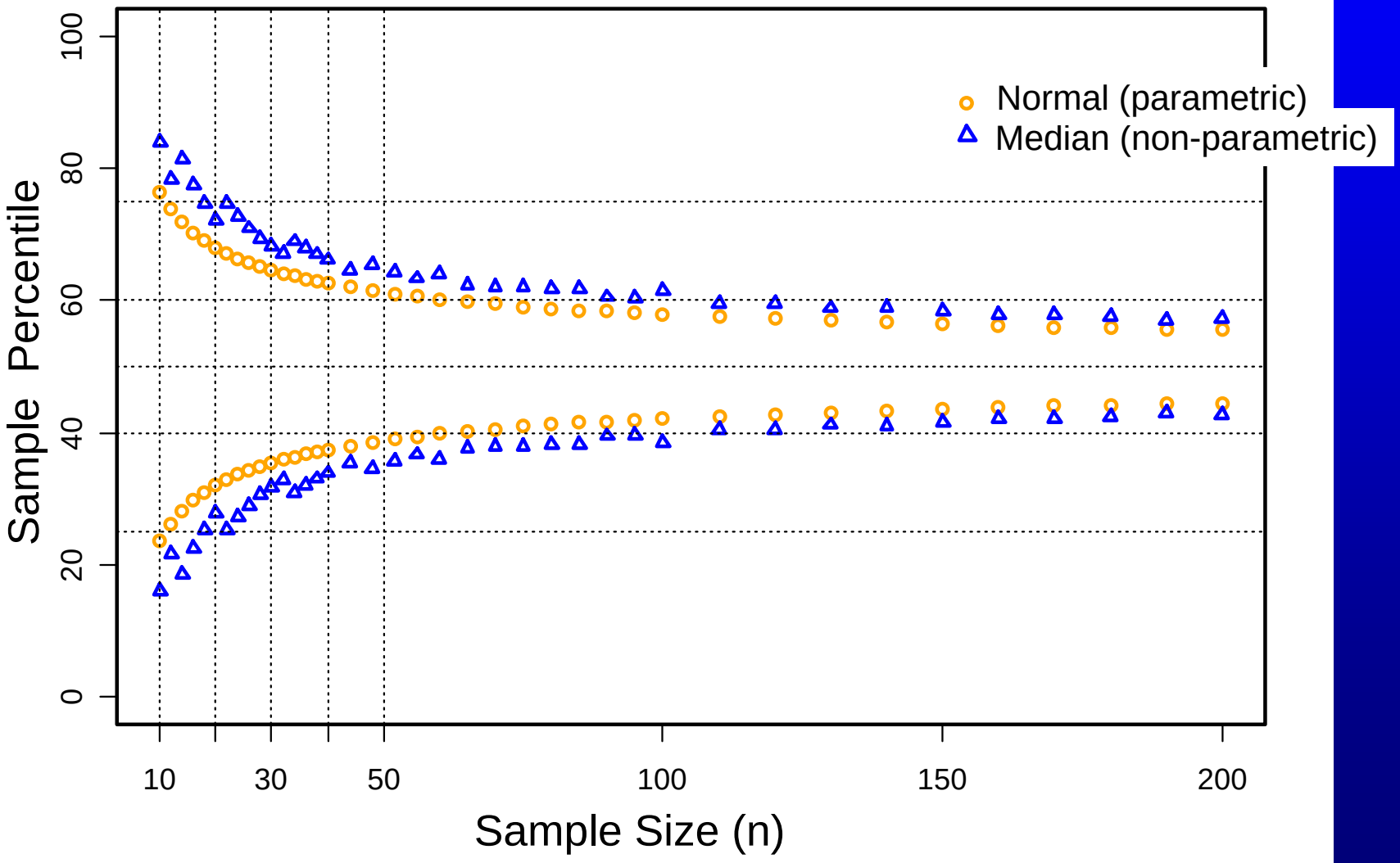

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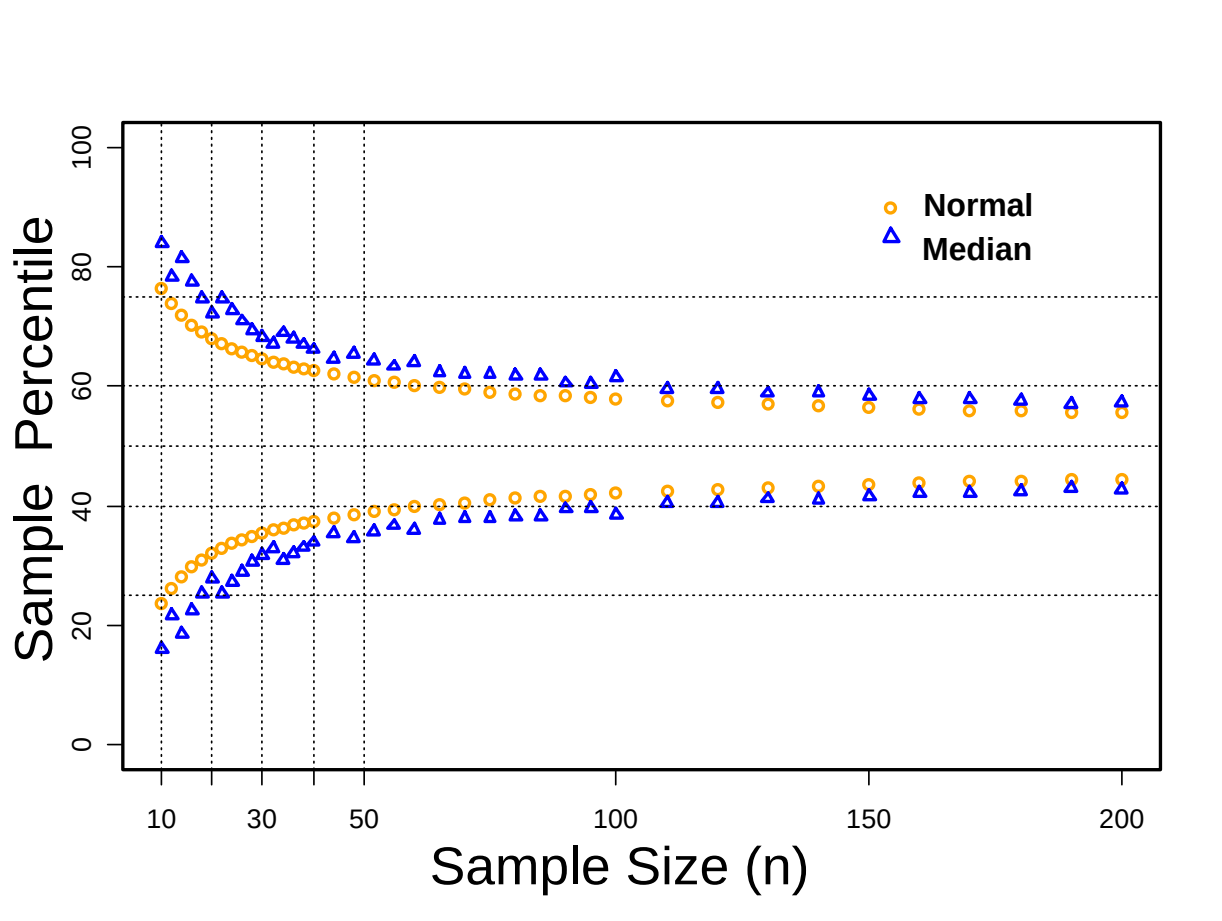
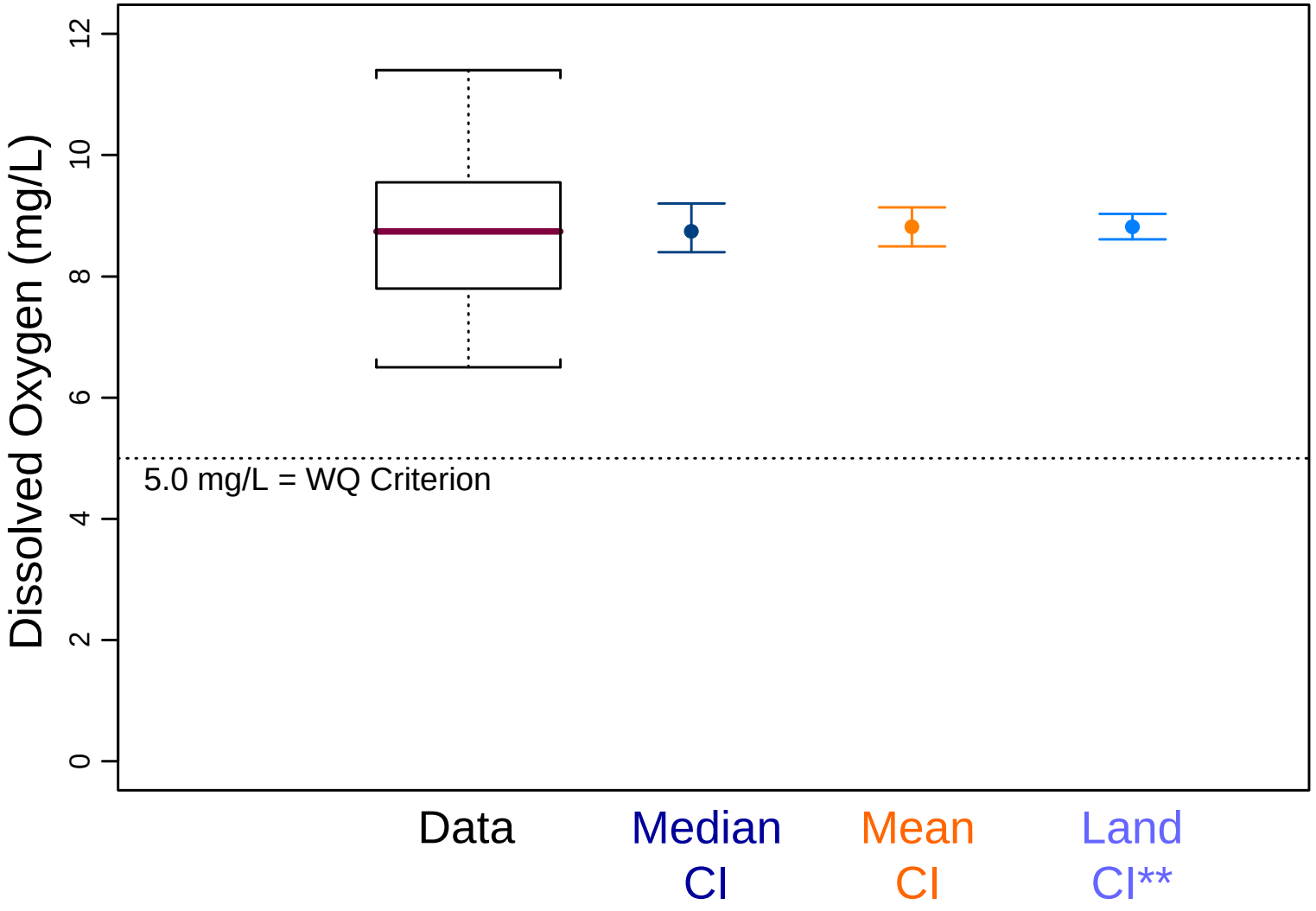


Sample Size	UCL – Normal	UCL – Median
10	76%	84%
20	68%	72%
30	65%	68%
40	63%	66%
52	61%	64%
100	58%	61%

Results Comparison: D.O. at Trenton



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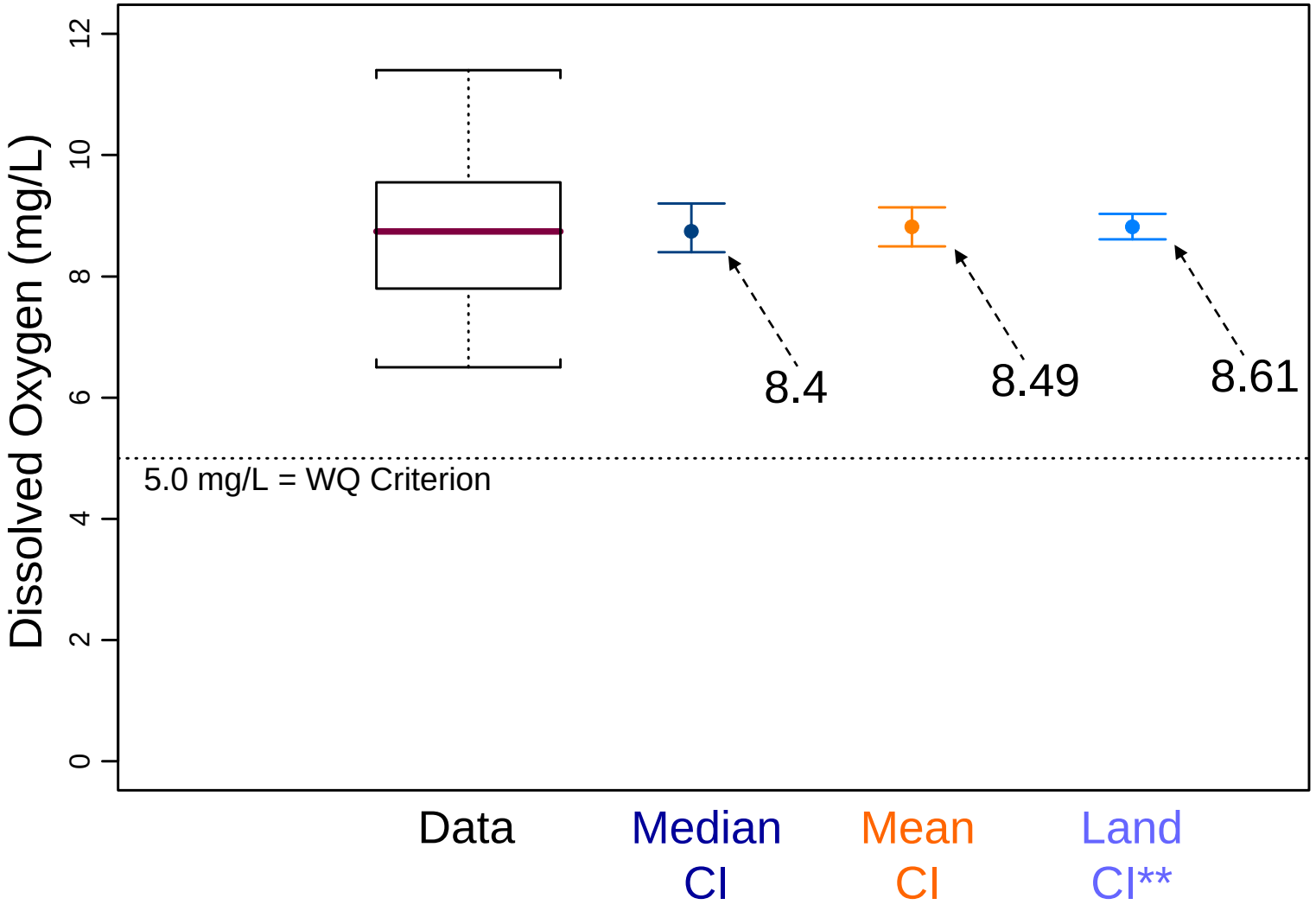
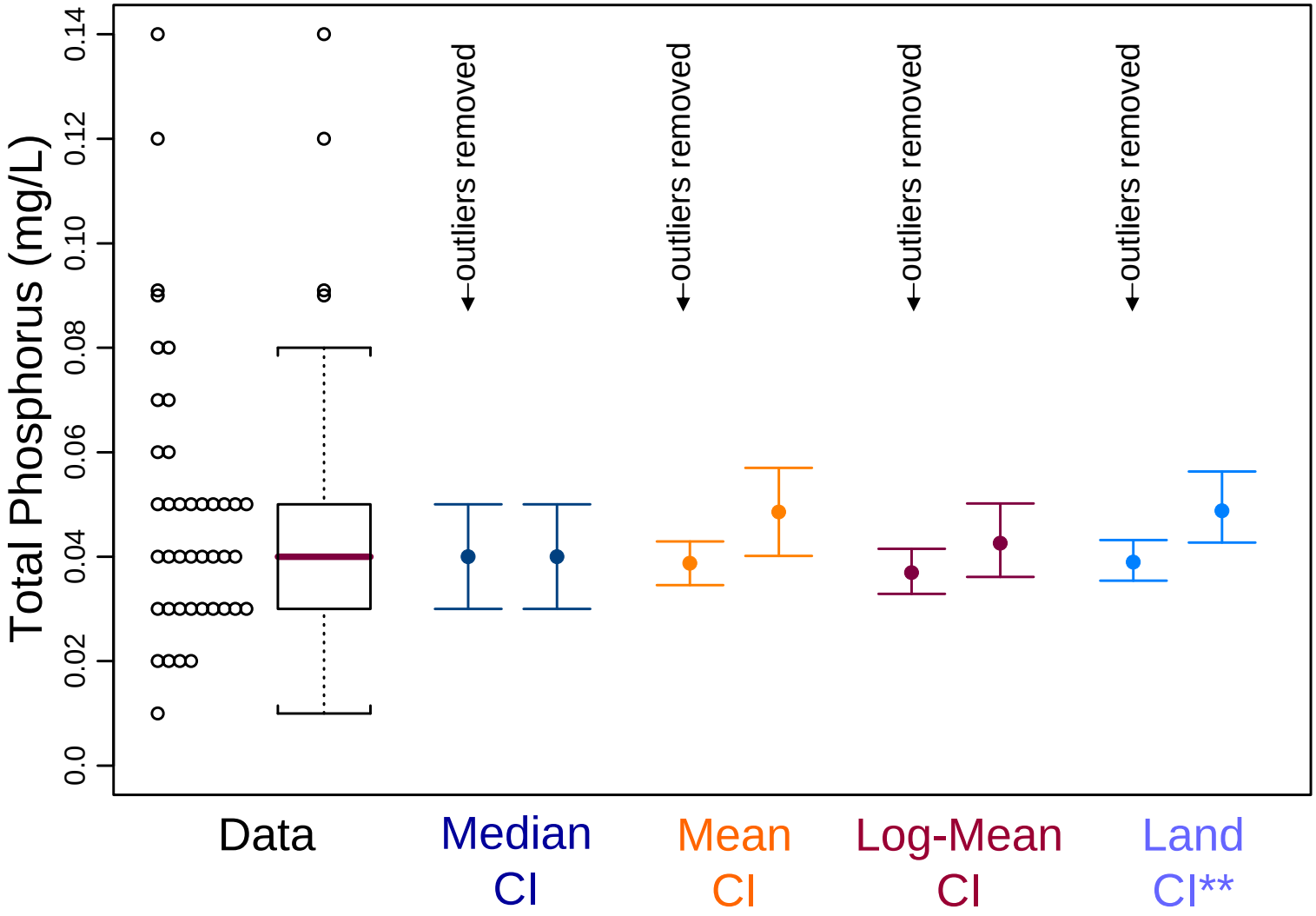


Results Comparison: Phosphorus at Portland



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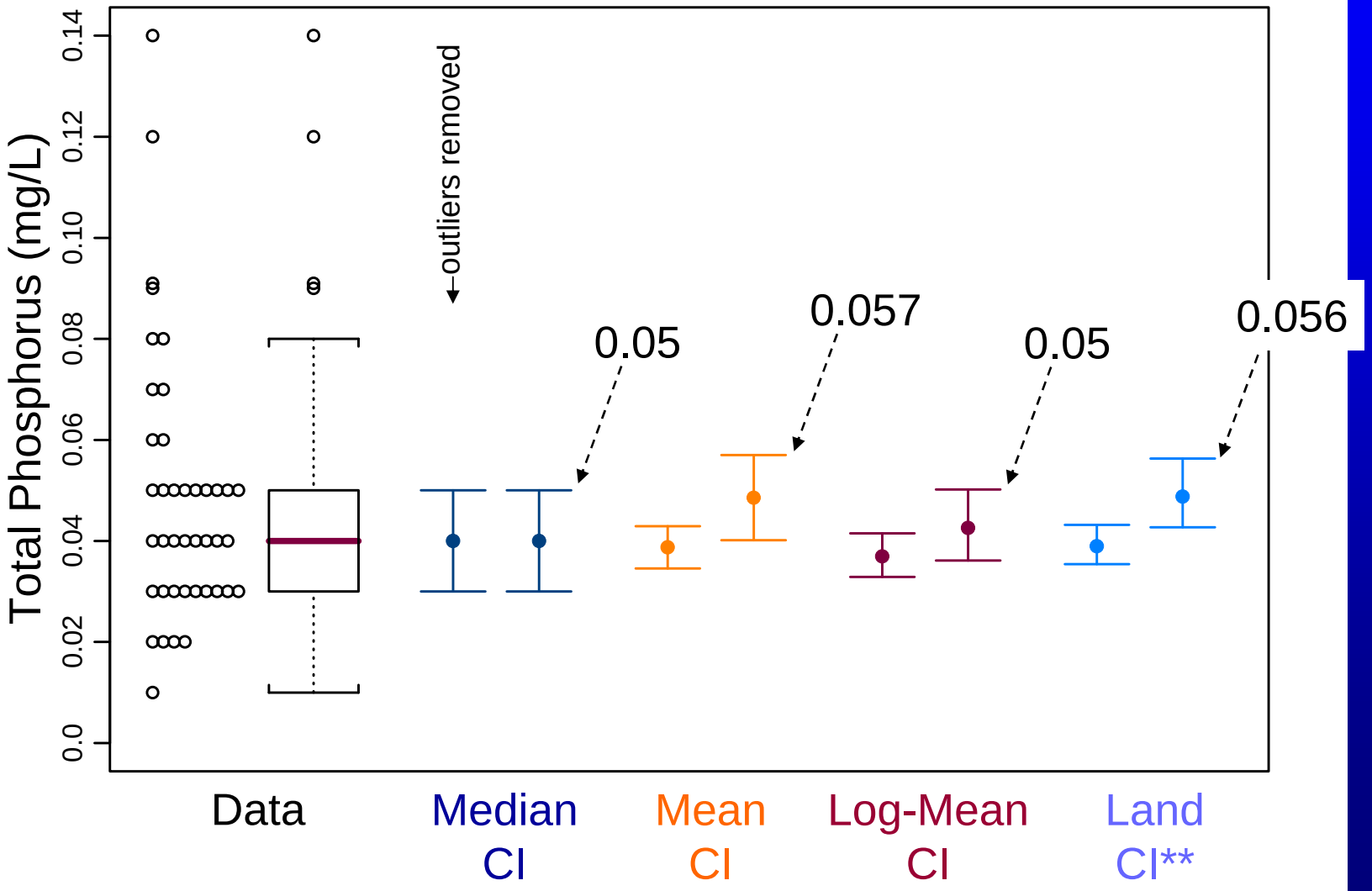
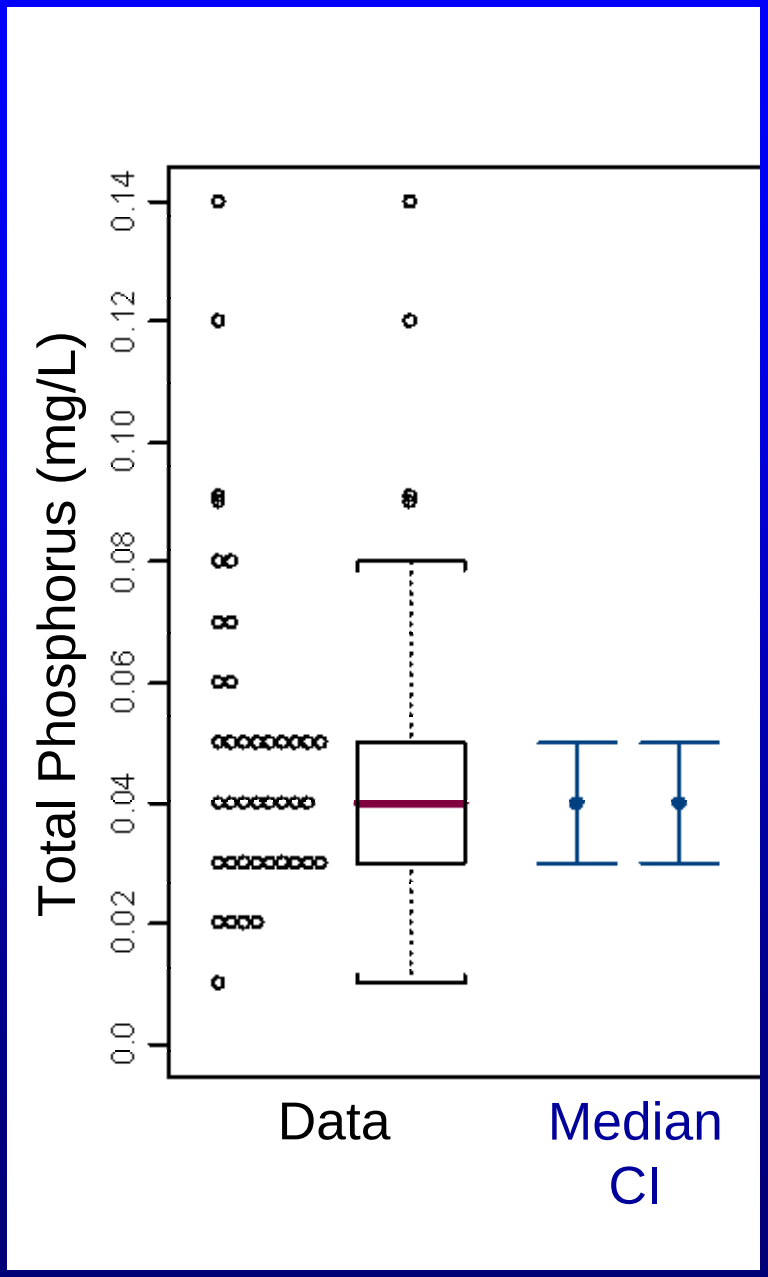
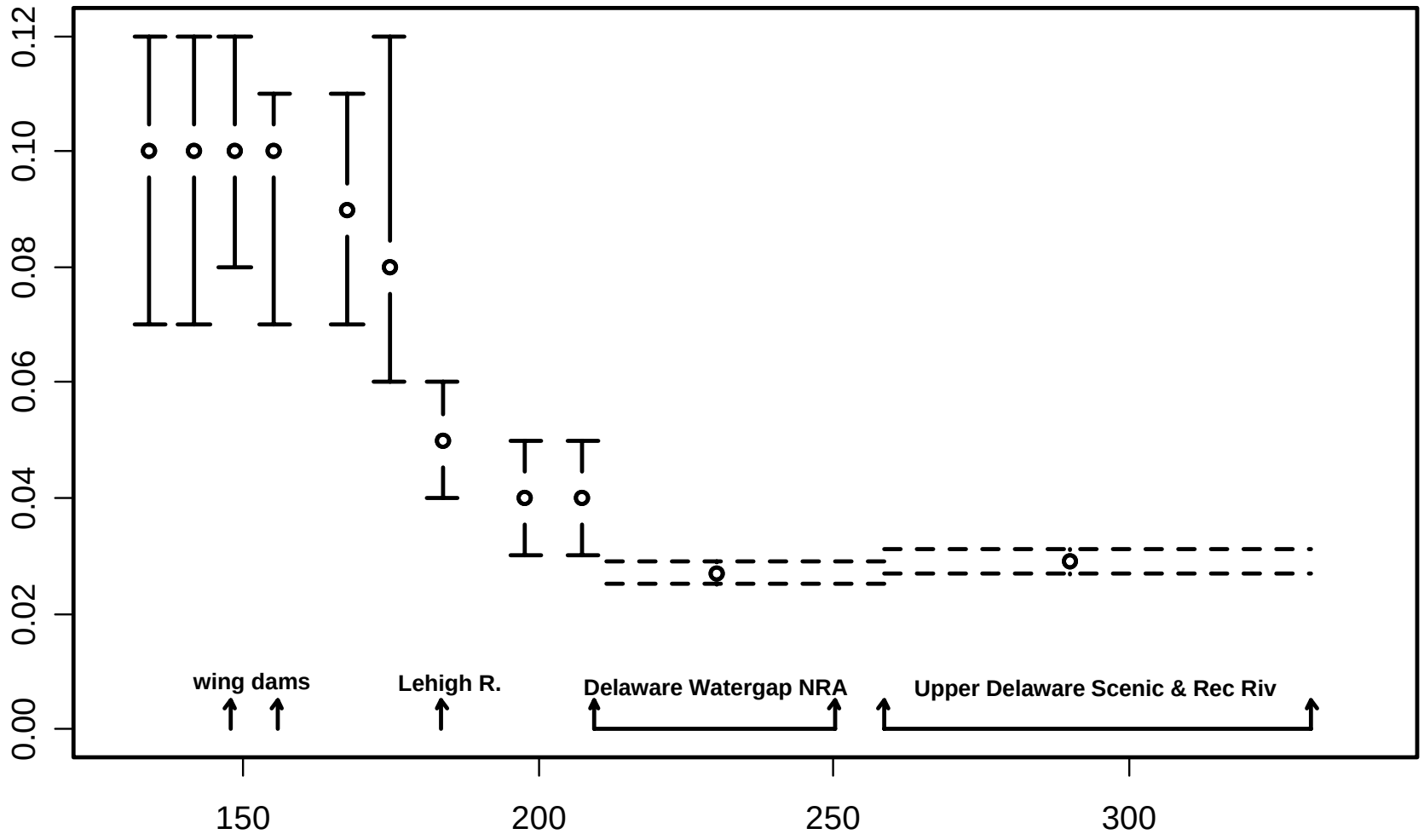


Conclusion: Median Confidence Limits



- Minimal loss in statistical power
- Provide more protective limits (skewed data)
- Robust to outlier considerations
- Robust to “non-detects” and “too-numerous”
- Attain true coverage

Questions?

Overview: EWQ for Total Phosphorus