

# **Application of a Macroinvertebrate Nutrient Biotic Index (NBI) to New Jersey Streams and a Comparison to Diatom Indices**

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# Overview

- Describe NY study that developed a stream macroinvertebrate NBI
- Discuss reasons to apply it to NJ
- Describe two ways of applying the index
- Describe two attempts at validating the index
  - Testing scores on a different dataset
  - Comparing scores to diatom-based indices
- Discuss difficulties in applying the index, conclusions, and future work plans

# The New York NBI Study: Overview

- Smith, Bode, and Kleppel at NYSDEC
- Ecological Indicators 7 (2007) 371-386
- Paired macroinvertebrate samples with averaged nutrient data from up to 90 days prior
- Calculated TP and NO<sub>3</sub> tolerance values for 164 macroinvertebrate taxa
- Calculated a nutrient biotic index (NBI) score from tolerance values and assemblages at 129 stream sites

# The New York NBI Study: Calculations

- Split TP and NO<sub>3</sub> values into 15 bins
- Nutrient Optimum:

$$\frac{\sum W_{\text{prop}}_{\text{all bins}}}{\sum U_{\text{prop}}_{\text{all bins}}}$$

U<sub>prop</sub> = proportion of samples in a bin that yield a given taxon

W<sub>prop</sub> = U<sub>prop</sub> \* average nutrient value of samples in that bin

# The New York NBI Study: Calculations

- Nutrient optima assigned to tolerance value bins from 0 (low optima) to 10 (high optima)
- NBI score calculated for each site and nutrient:

$$\sum(a*b/c)$$

a = number of individuals of a given taxon in a sample

b = tolerance value of taxon

c = number of rated individuals in the sample

# The New York NBI Study: Results

- NBI scores showed a significant relationship to log-transformed nutrient concentrations:
  - TP:  $r^2 = 0.46$ ,  $p < 0.0001$
  - $\text{NO}_3$ :  $r^2 = 0.32$ ,  $p < 0.0001$
- Bray-Curtis similarity analysis established oligotrophic, mesotrophic, and eutrophic levels
- NYSDEC's multimetric BAP scores of same sites differed significantly between levels

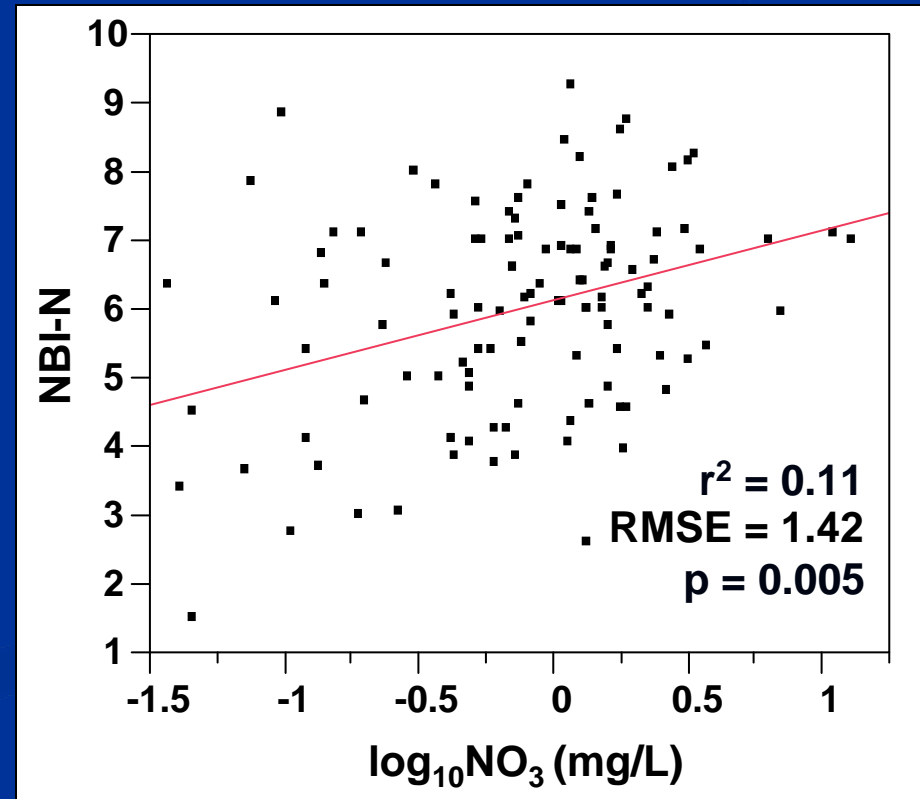
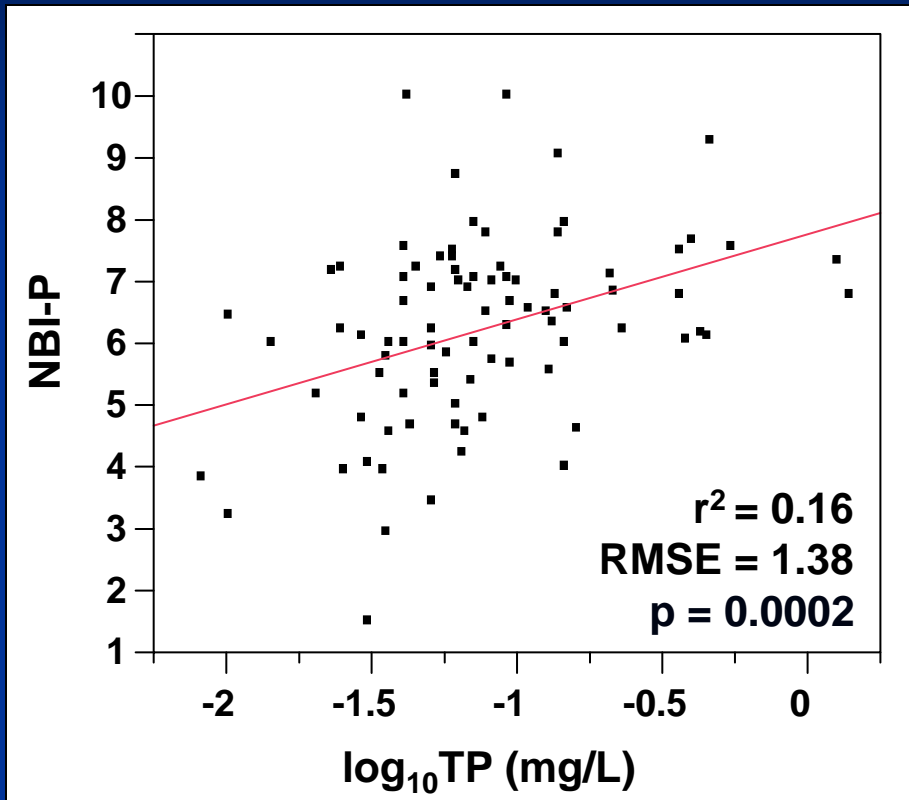
# Worth Trying in New Jersey?

- New Jersey shares 3 contiguous ecoregions with New York
  - Ridge and Valley
  - Northeast Highlands
  - Northern Piedmont
- NJDEP maintains a substantial macroinvertebrate monitoring program
  - ~900 stream monitoring stations
  - water quality data

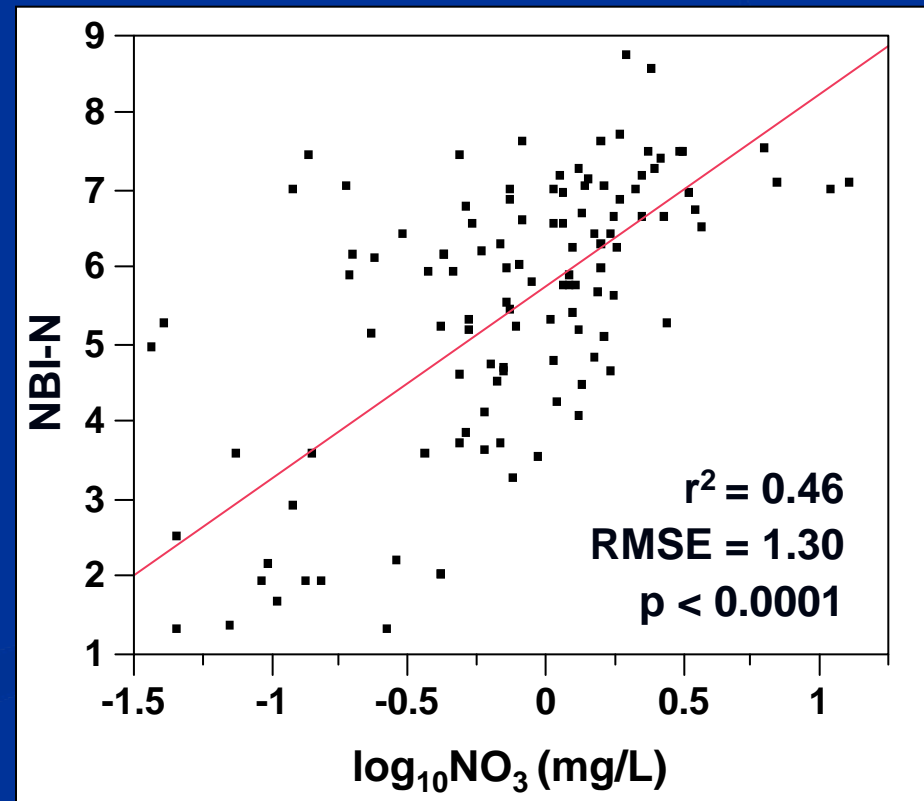
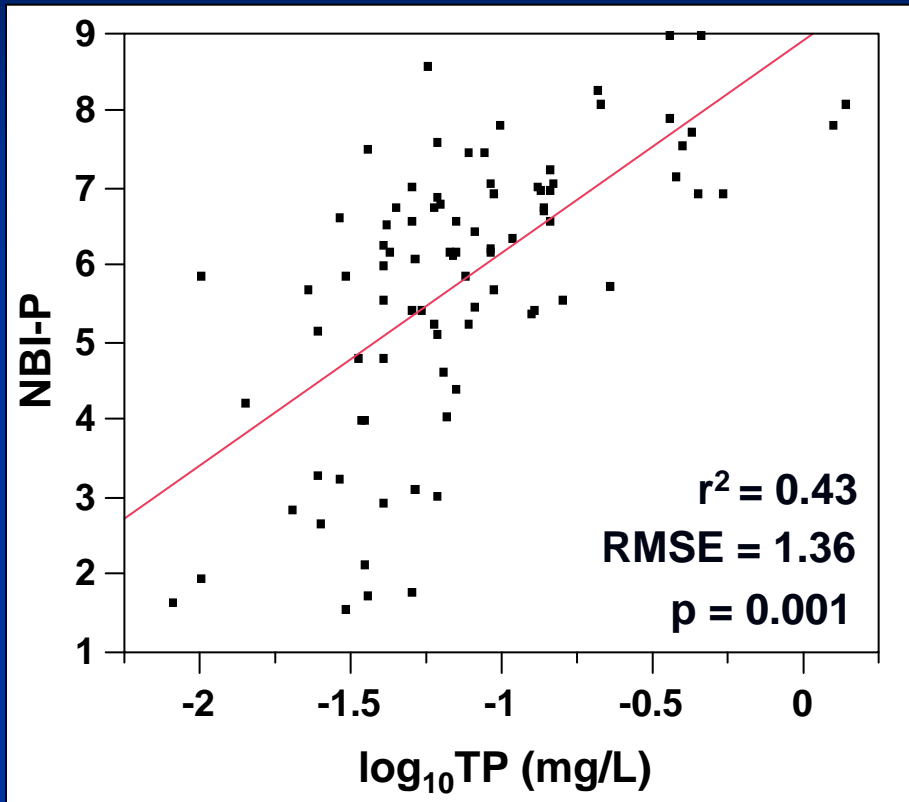
# The New Jersey Dataset

- 98 eligible sites
- Used sites in Northern NJ only due to lack of Southern NJ data and differences in nutrient responses and invertebrate assemblages
- Nutrient and invertebrate samples collected in the same season within 5 years of each other
- 254 taxa found at above sites after excluding rare taxa, 70 of which rated by NY study

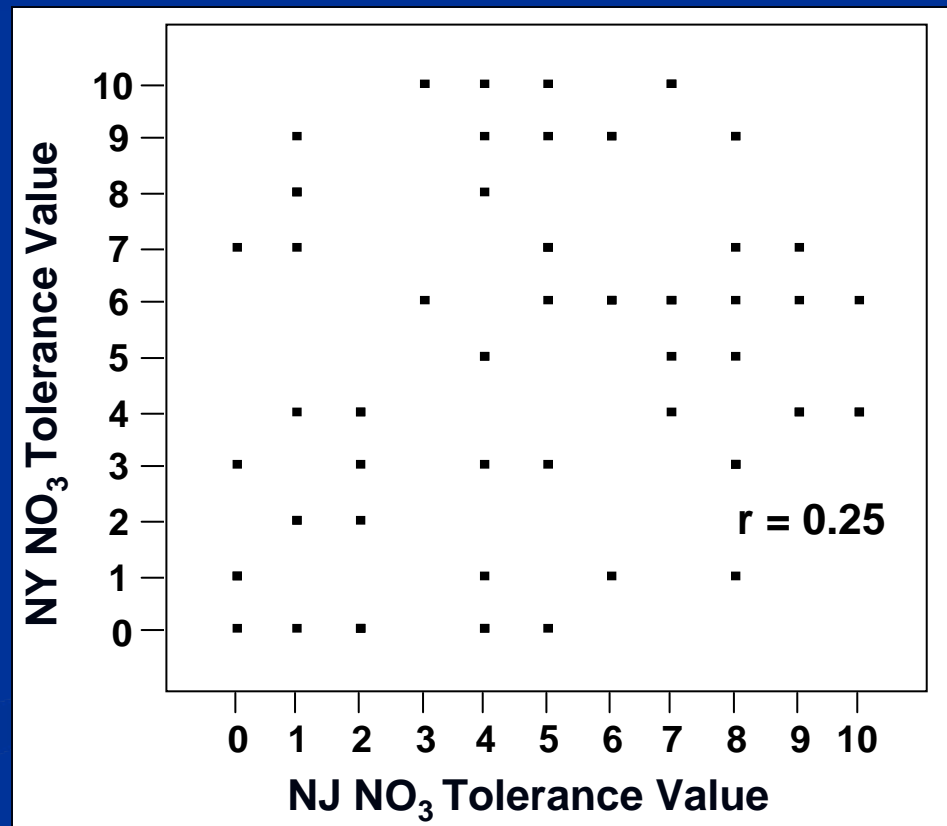
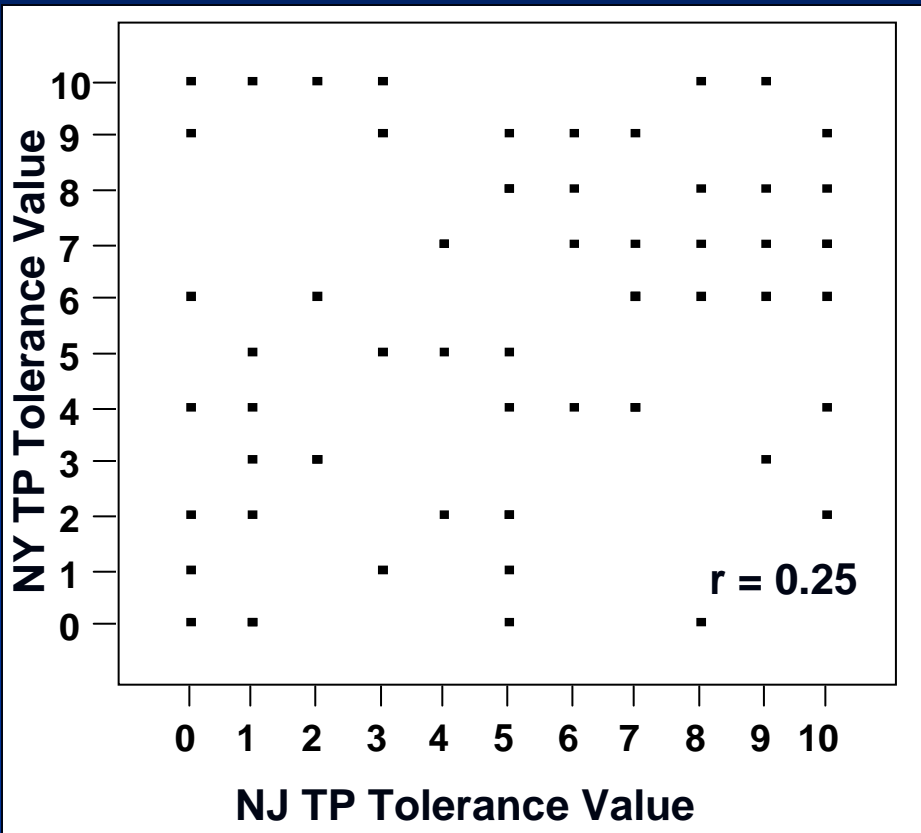
# Application 1: Use NY's Tolerance Values



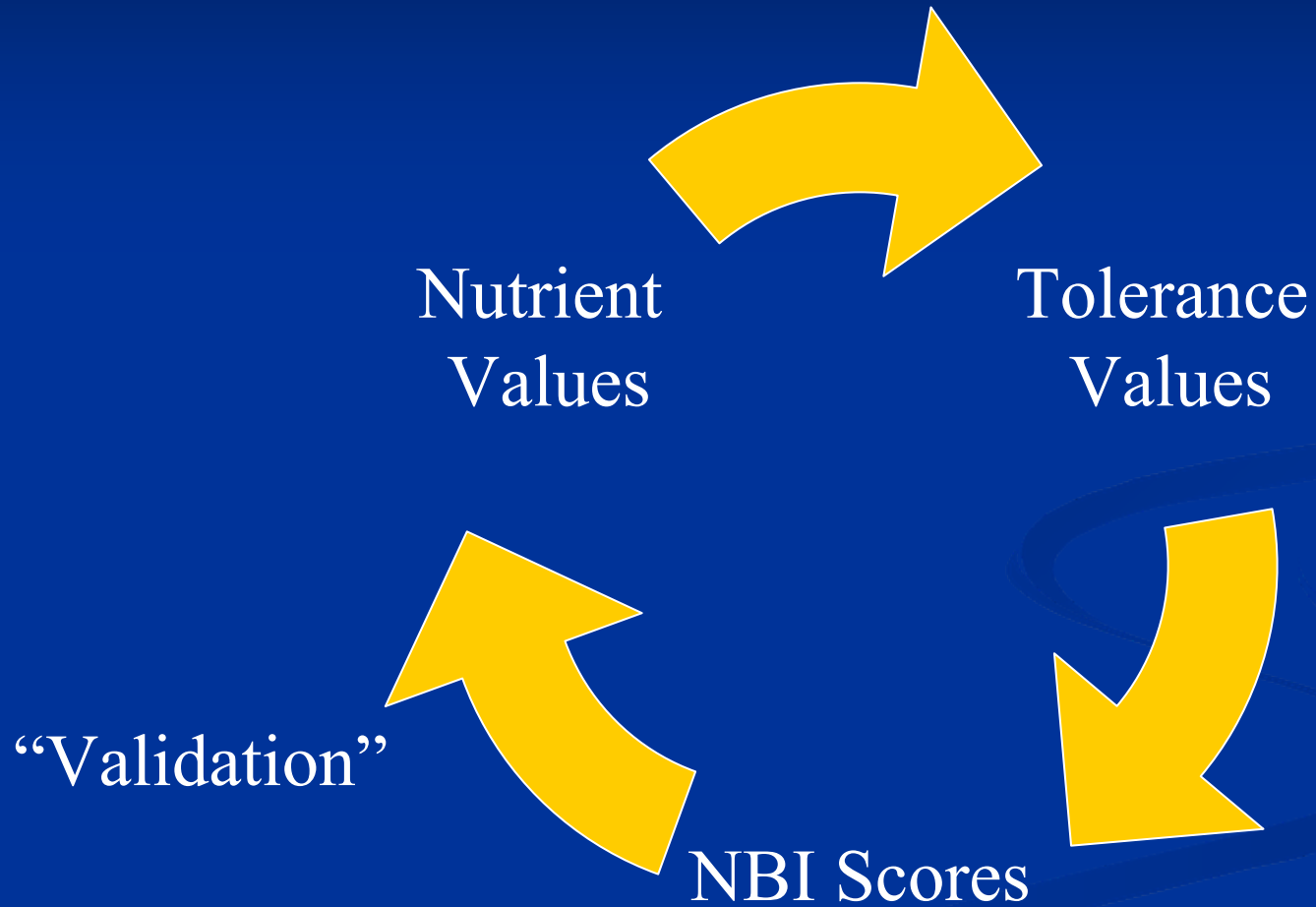
## Application 2: Develop NJ Tolerance Values



# NY vs NJ Tolerance Values



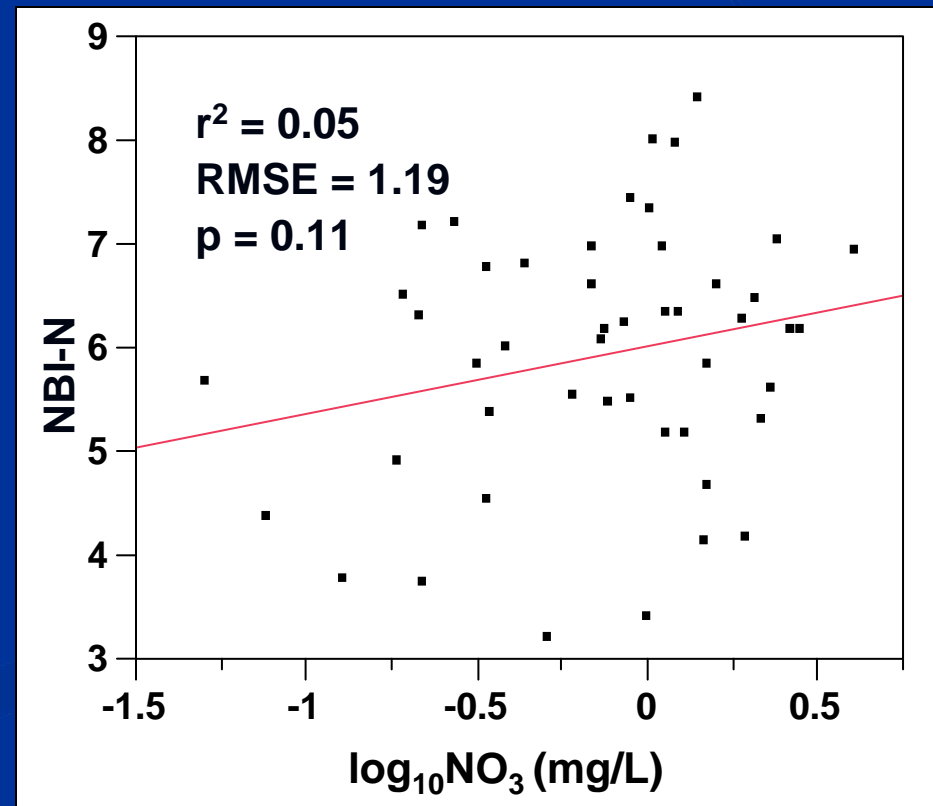
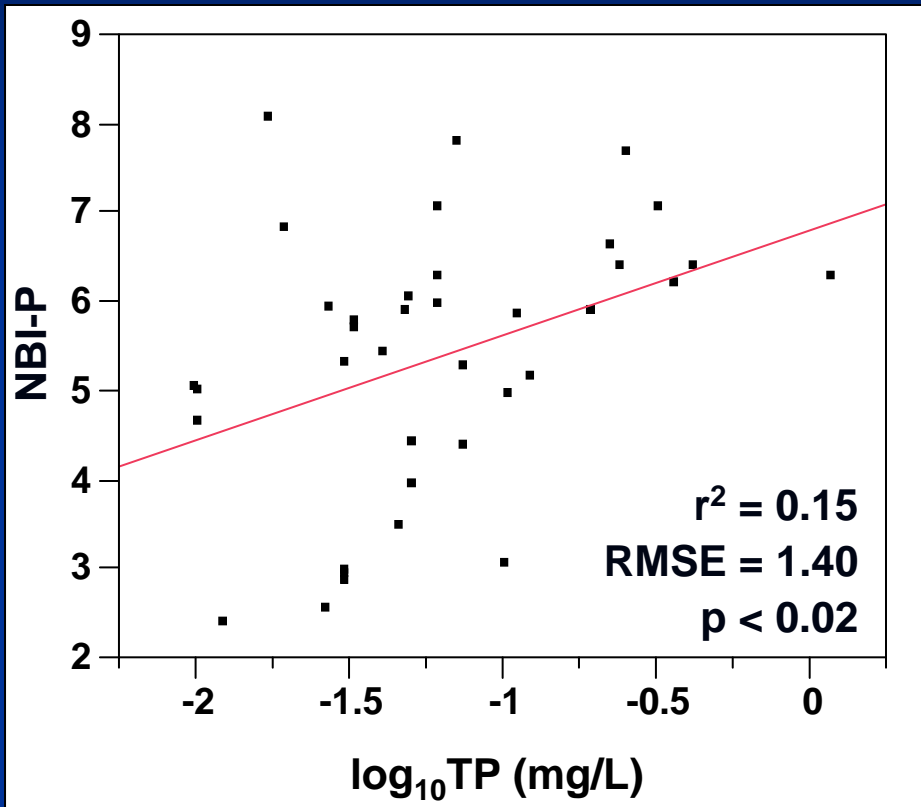
# Circularity Issues



# Validation 1: Additional Dataset

- Used tolerance values calculated with the entire initial NJ dataset (98 samples)
- Calculated NBI scores for 50 new samples
- Tested NBI scores using nutrient data from the 50 new samples

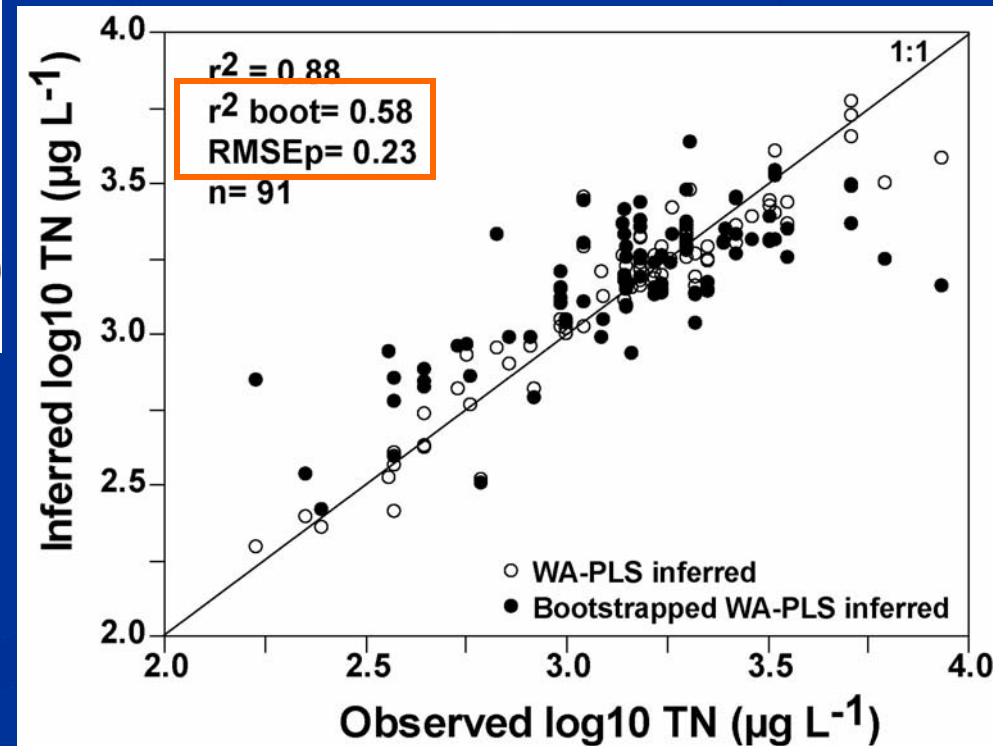
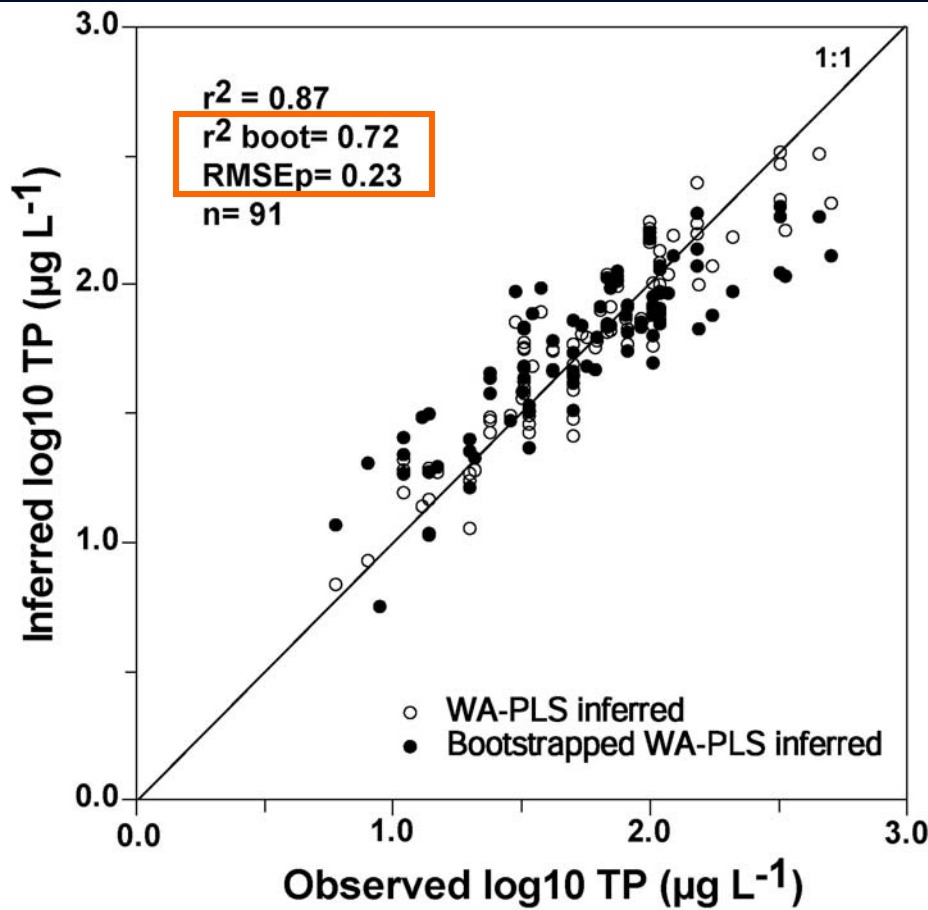
# Validation 1: Additional Dataset



## Validation 2: Comparison to Diatom-Based Indices

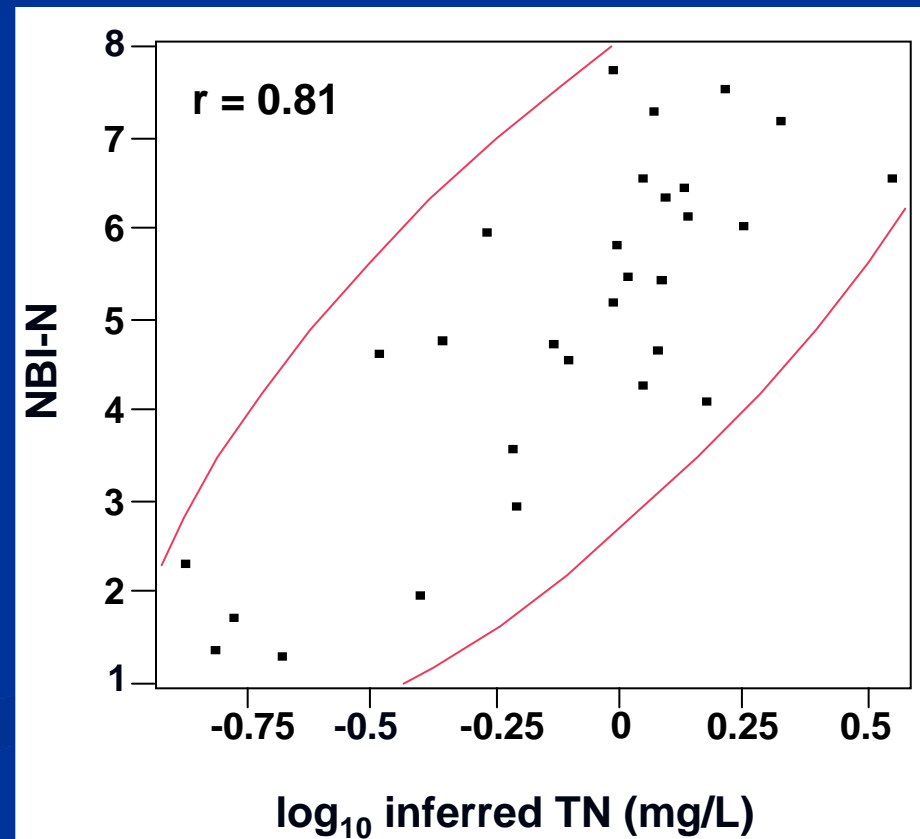
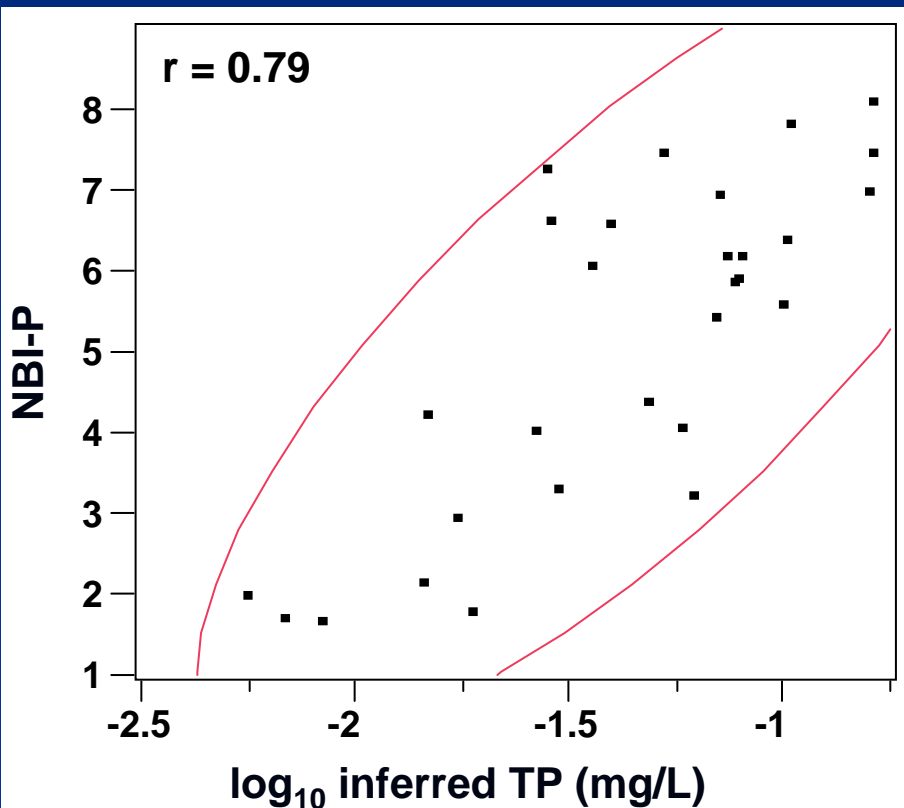
- Ponader, Charles, and Belton at PCER and NJDEP
- Ecological Indicators 7 (2007) 79-93
- Collected diatom and nutrient samples at 45 stream and river sites in Northern NJ
- Developed a WA-PLS inference model of TN and TP concentrations using diatom assemblage data, tested with bootstrapping

# Predictive power of diatom-based inference models



Ponader et al (2007) Ecological Indicators 7:79-93

## Validation 2: Comparison to Diatom Indices



# Complications encountered

- Tolerance values depend on the distribution of the nutrient concentrations
  - Many taxa may be relatively indifferent to nutrient levels
- TP and NO<sub>3</sub> concentrations, tolerance values, and NBI scores correlated
  - Observed response may be to general nutrient profile or pollution

# Conclusions

- NBI appears to work about as well in NJ as in NY,
- but didn't validate well using additional NJ data, though relationships to diatom-based indices are strong
- Index *as is* may not be precise enough in NJ as a stand-alone assessment tool, but may be useful in conjunction with other data

# Future Work

- Identify good indicator taxa, weigh those more heavily
- Use principal components analysis or similar technique to identify levels of enrichment
- Compare NBI scores to AMNET classifications
- Apply the NBI to Southern NJ
- Collect nutrient and invertebrate samples simultaneously to strengthen, expand, and validate dataset
- More detailed data analyses

# Acknowledgements

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