

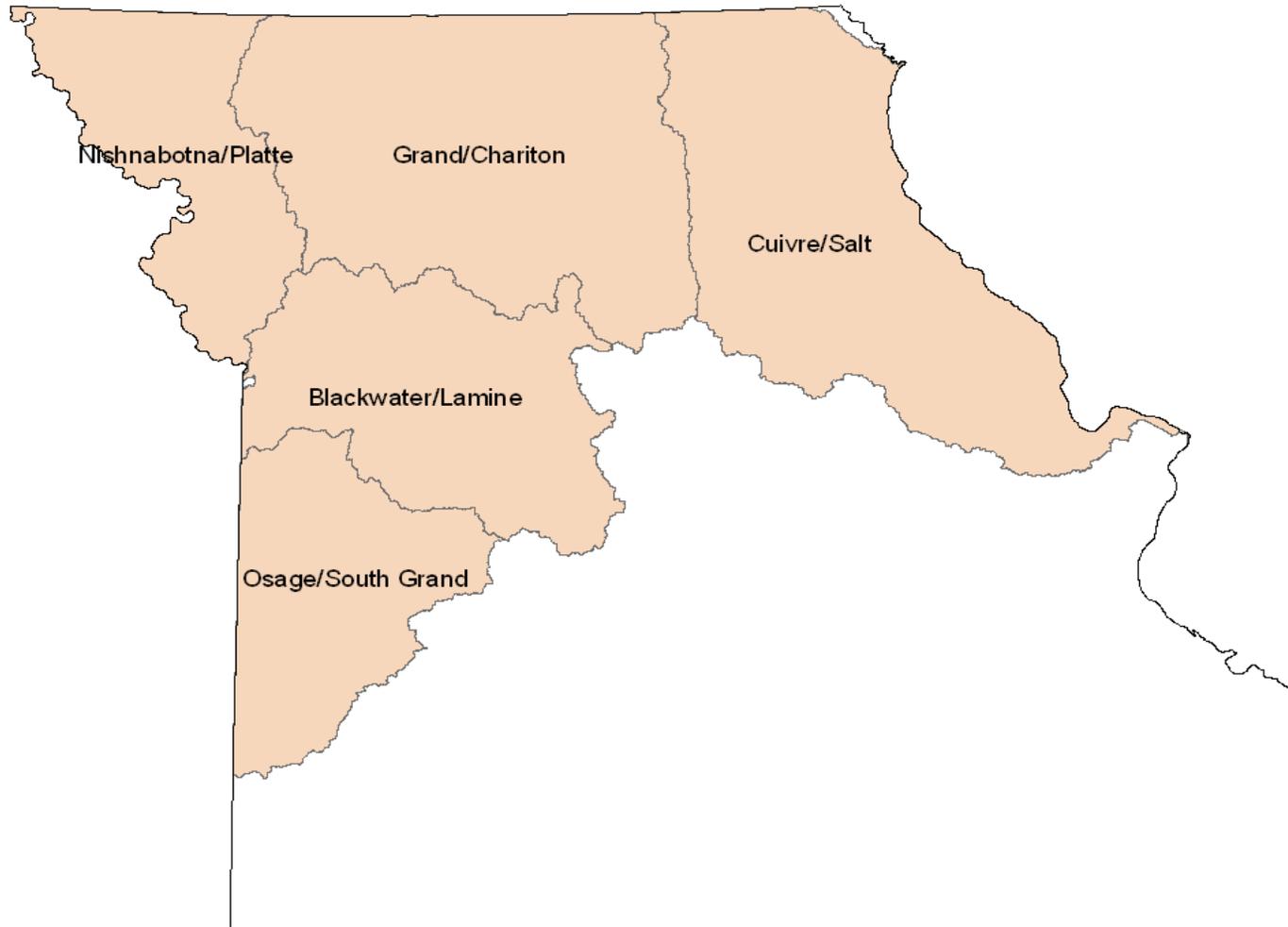
# Biological Response to Nutrients in Central Plains Regional Streams of Missouri

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# Central Plains Regional Ecological Drainage Units in Missouri



## Biological (Macro-Invertebrate) Metrics

- Taxa Richness
- Ephemeroptera/Plecoptera/Trichoptera (EPT)
- Biotic Index
- Shannon Diversity Index
- Stream Condition Index

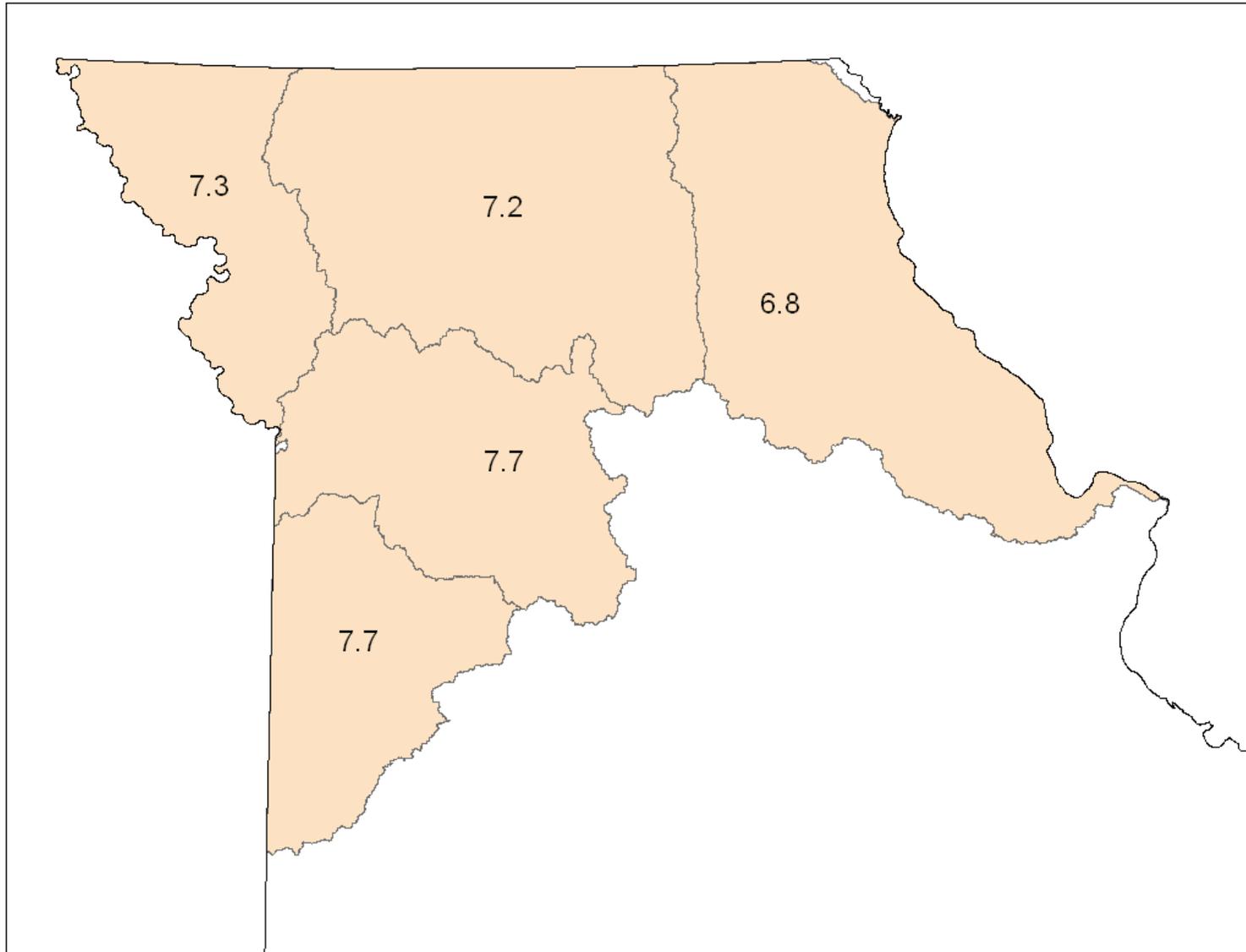
## Biological (Macro-Invertebrate) Metrics

- Biotic Index

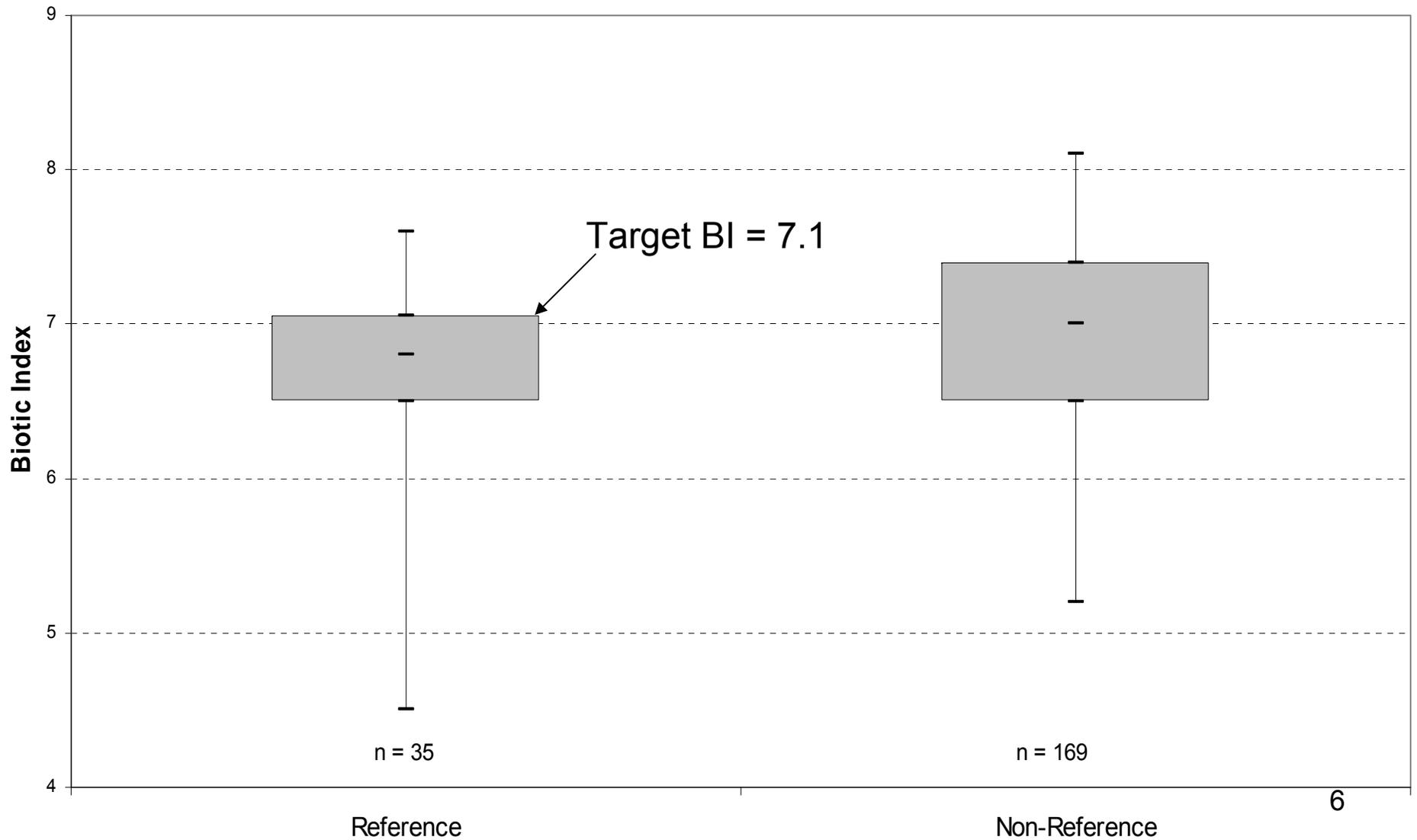
$$BI = \sum_{i=1}^n \frac{X_i T_i}{n}$$

- $X_i$  = number of individuals within each species
- $T_i$  = tolerance value of that species
- $n$  = total number of organisms in the sample

# Autumn Biotic Index Criteria for Glide/Pool Habitat Streams in Plains EDUs



# Distribution of autumn BI values for Glide/Pool Habitat in Plains



# Selection of Data Points

- Minimum of three TN readings within two years and within two miles of biological sample
- No point sources between TN and biological sample locations
- Biotic data restricted to samples taken during autumn

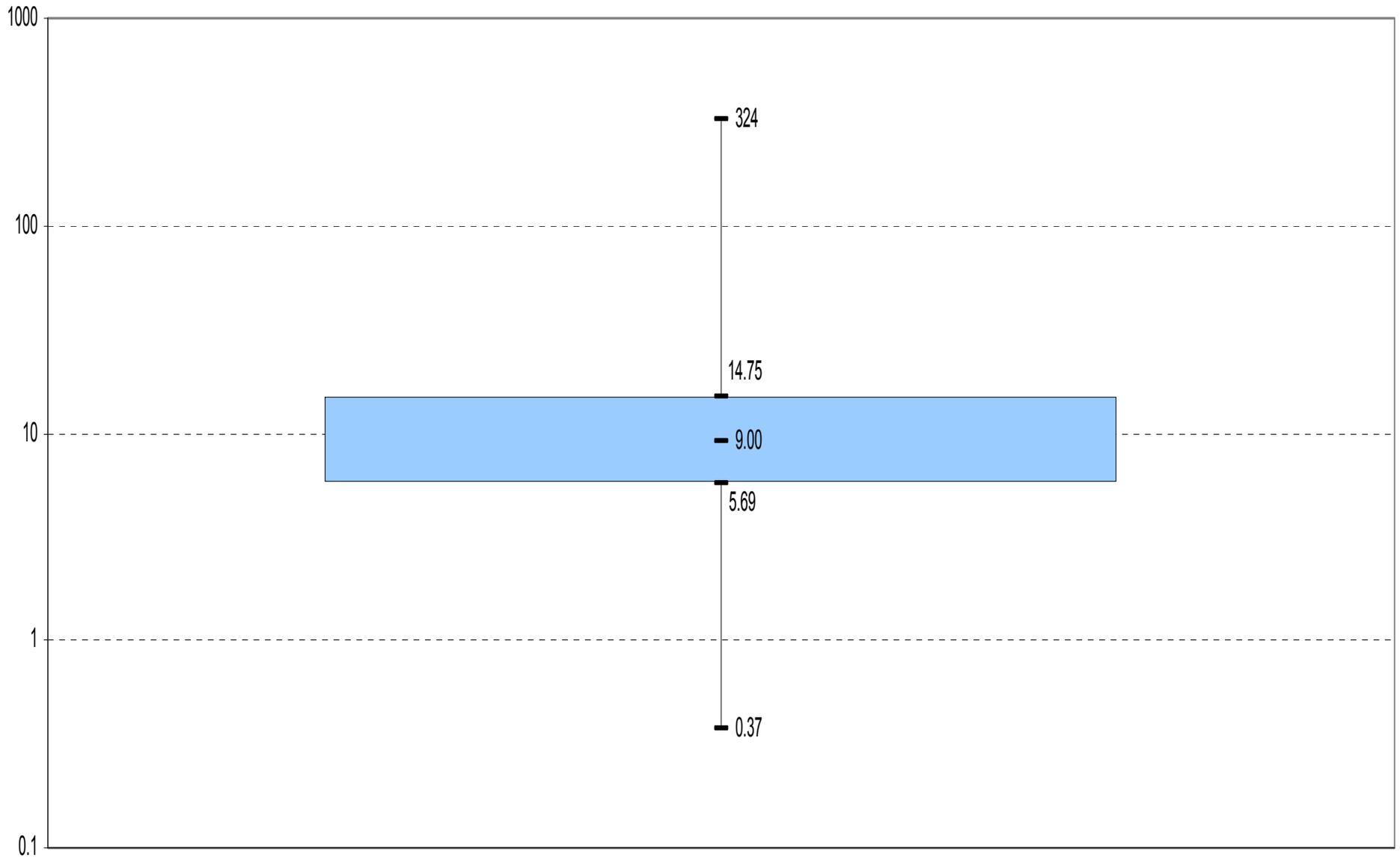
# Parameters Considered

- Total Nitrogen ( $\mu\text{g/L}$ )
- Total Phosphorus ( $\mu\text{g/L}$ )
- Flow ( $\text{ft}^3/\text{sec}$ )
- Watershed area ( $\text{km}^2$ )
- Area in row crops ( $\text{km}^2$ )
- Point source flow ( $\text{gal/d}$ )
- Stormwater Permits (#)

# Stepwise Regression

- Forward and Backward:  $\alpha$  to enter and remove = 0.05
- 4<sup>th</sup> step:  $BI = 4.825 + 0.43 \cdot \ln(TN) - 0.049 \cdot \sqrt{(\text{watershed area})} + 0.065(\text{sw permits}) - 0.000005$  (animal units)  
 $R^2 = 68.7\%$   
 $p = 0.000$

# Total Nitrogen/Total Phosphorus



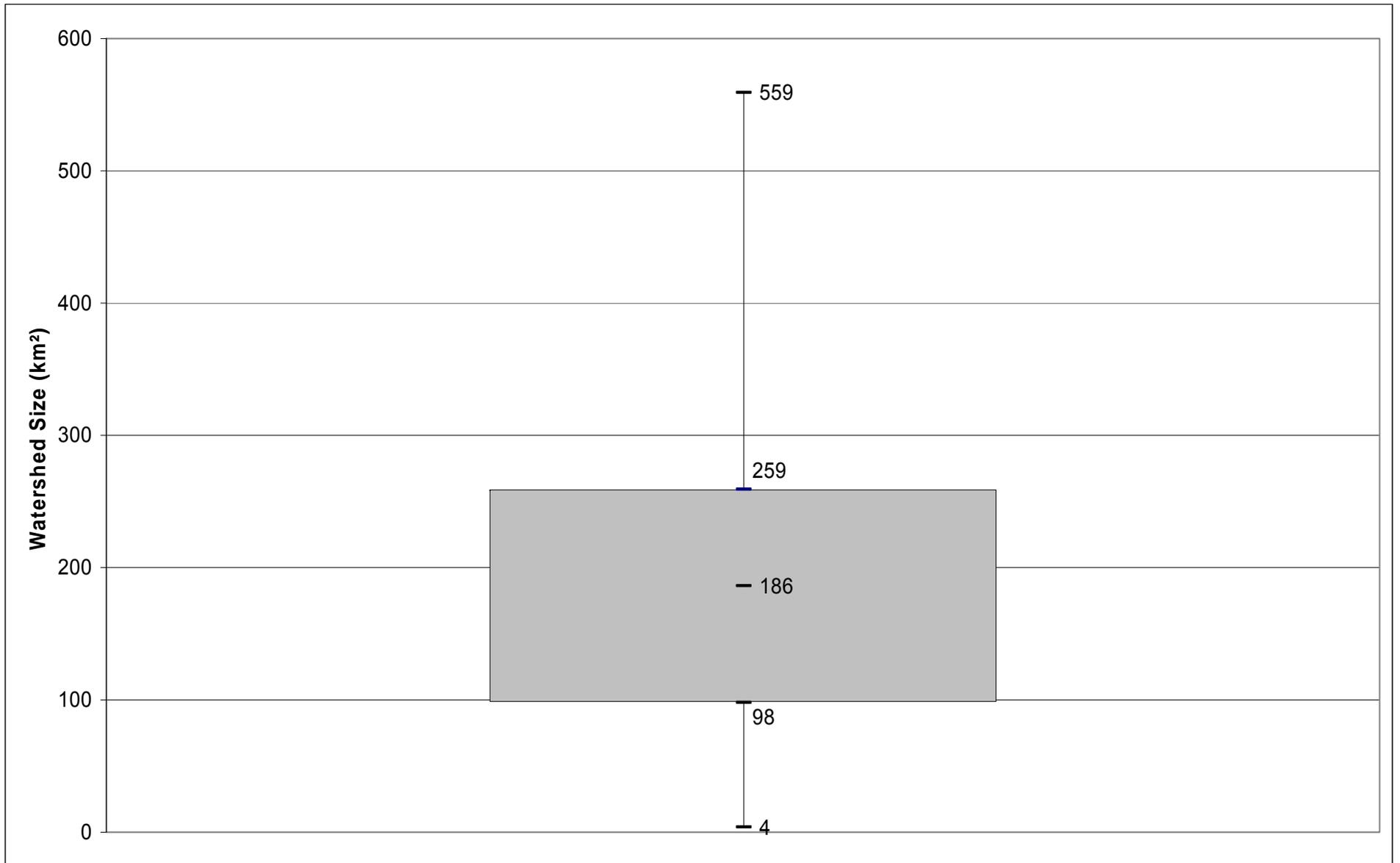
# Simplified Regression

- $BI = 3.21 + 0.644 \cdot \ln(TN) - 0.0352 \cdot \sqrt{\text{watershed area}}$
- $R^2 = 41.9\%$
- $p = 0.000$

## Further Simplified Regression

- $BI = 3.6 + 0.512 \cdot \ln(TN)$
- $R^2 = 23.3\%$
- $p = 0.004$

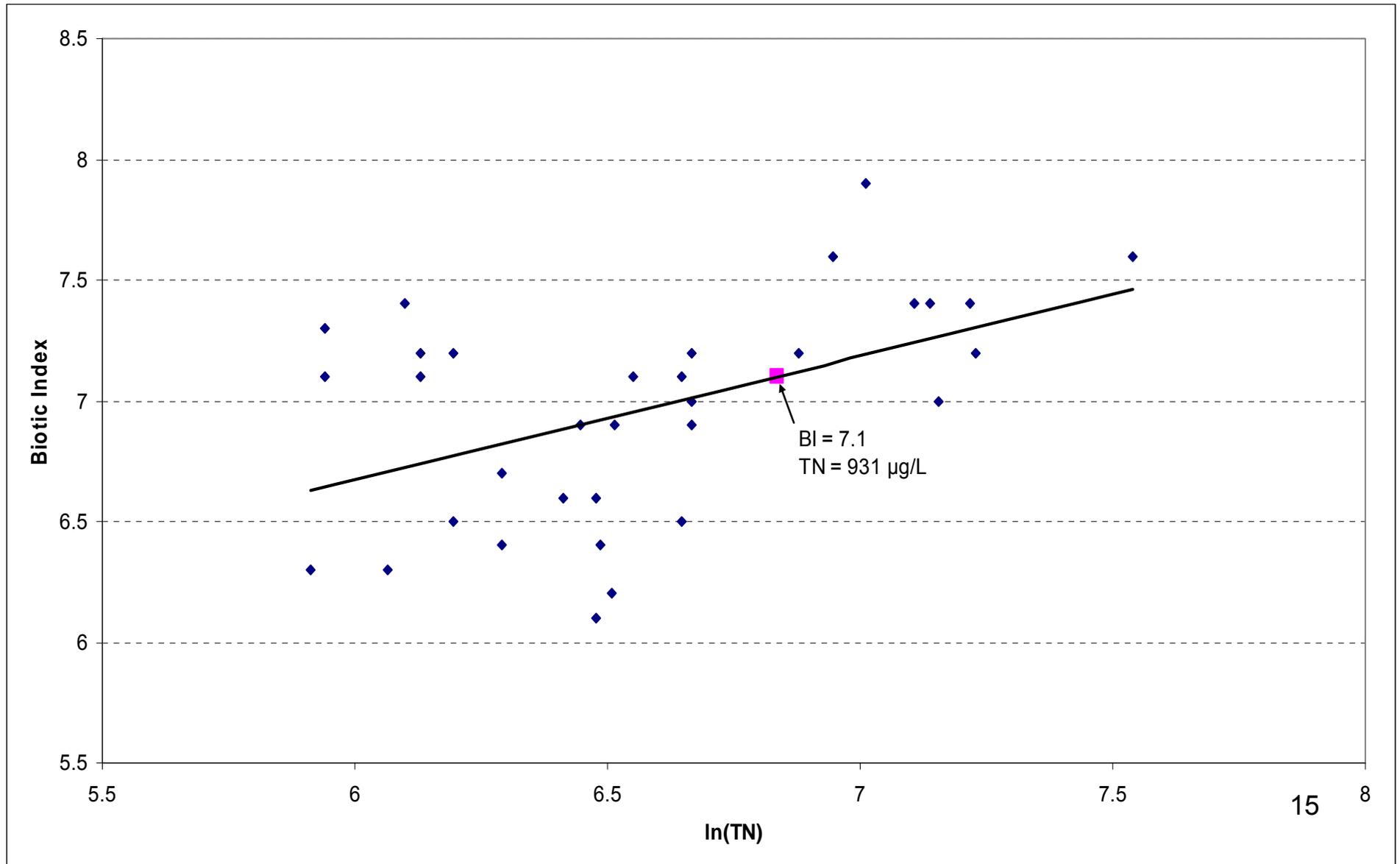
# Distribution of Watershed Areas



## Summary of Regression Equations and Resulting Target TN levels

Regression	R <sup>2</sup>	Watershed Area (km <sup>2</sup> )	TN (µg/L) (BI = 7.1)
$BI = 4.83 + 0.427 \cdot \ln(TN) - 0.049 \cdot \sqrt{wa} - 0.000005(\text{animal units}) + 0.0652(\text{stormwater permits})$	68.7%	98	634
		186	974
		259	1291
$BI = 3.21 + 0.644 \cdot \ln(TN) - 0.0352 \cdot \sqrt{wa}$	41.9%	98	722
		186	885
		259	1012
$BI = 3.6 + 0.512 \cdot \ln(TN)$	23.3%		931

$$BI = 3.6 + 0.512 \cdot \ln(TN)$$



## Uncertainties and Other Disclaimers

- Linear regression provides a partial, but not complete interpretation of biological response to nutrient concentrations.
- Other explanatory factors, such as watershed size, generally enhance the regressions.
- Maximum watershed size in this analysis is <600 km<sup>2</sup>. May not be applicable to larger watersheds.
- Linkage between TN concentration and biological response is not conclusively proven by this analysis. It can be treated as a line of evidence.