

Use of Probabilistic and Targeted Sampling to Assess the Quality of Wisconsin's Wadeable Streams

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Outline:

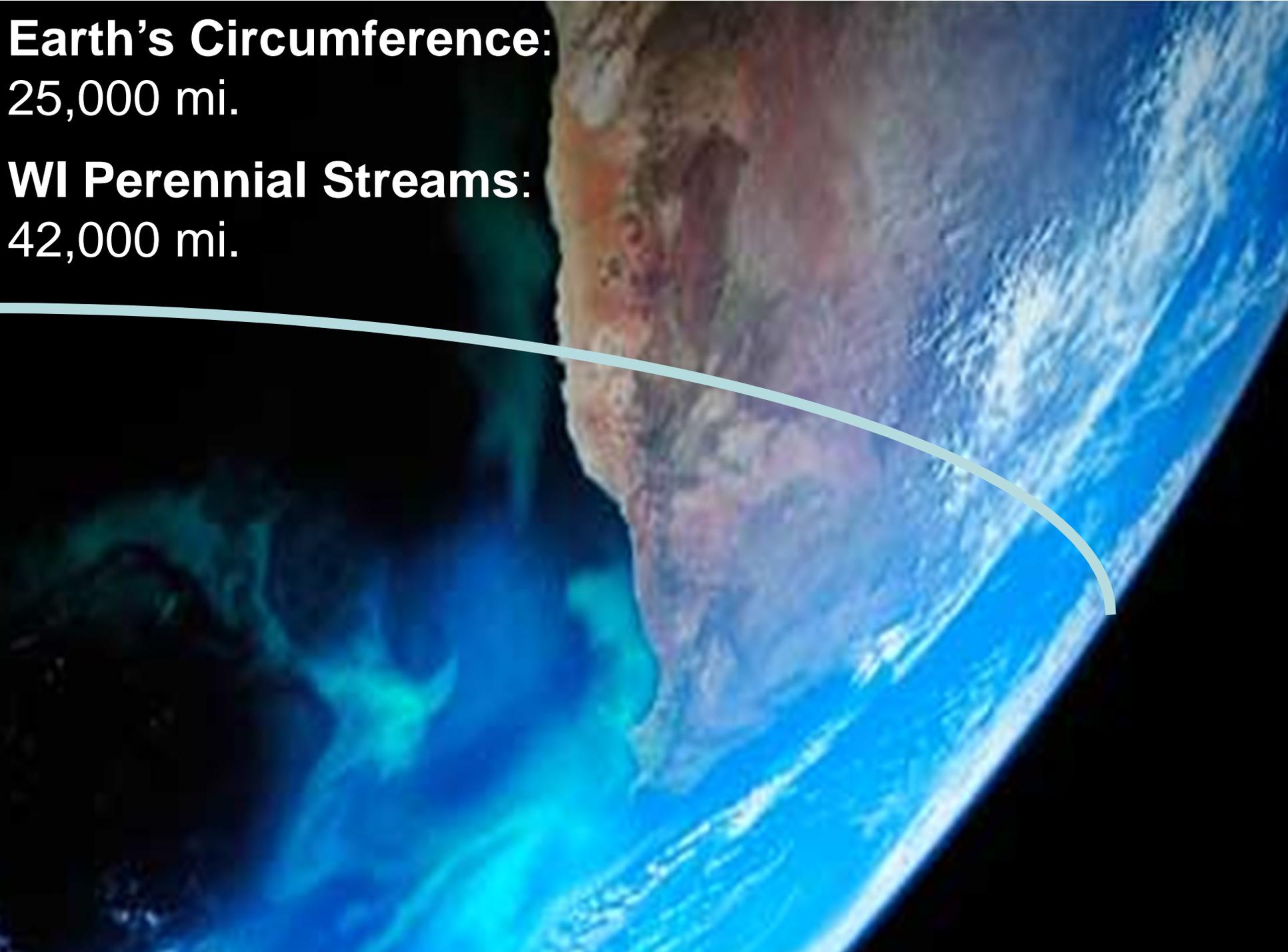
- Overview of WI Stream Resources
- Sampling Stratification and Effort
- 2011 – 2013 Sampling Results
- Future Efforts

An aerial photograph of a lush green forested landscape. A prominent, winding river or stream flows through the center of the image, its banks clearly defined. The water appears dark blue or black. The surrounding forest is a vibrant green, with some areas showing signs of clearing or different vegetation types. The text "Wisconsin is Defined by Water" is overlaid in a bold, yellow, sans-serif font, centered in the upper half of the image.

Wisconsin is Defined
by Water

Earth's Circumference:
25,000 mi.

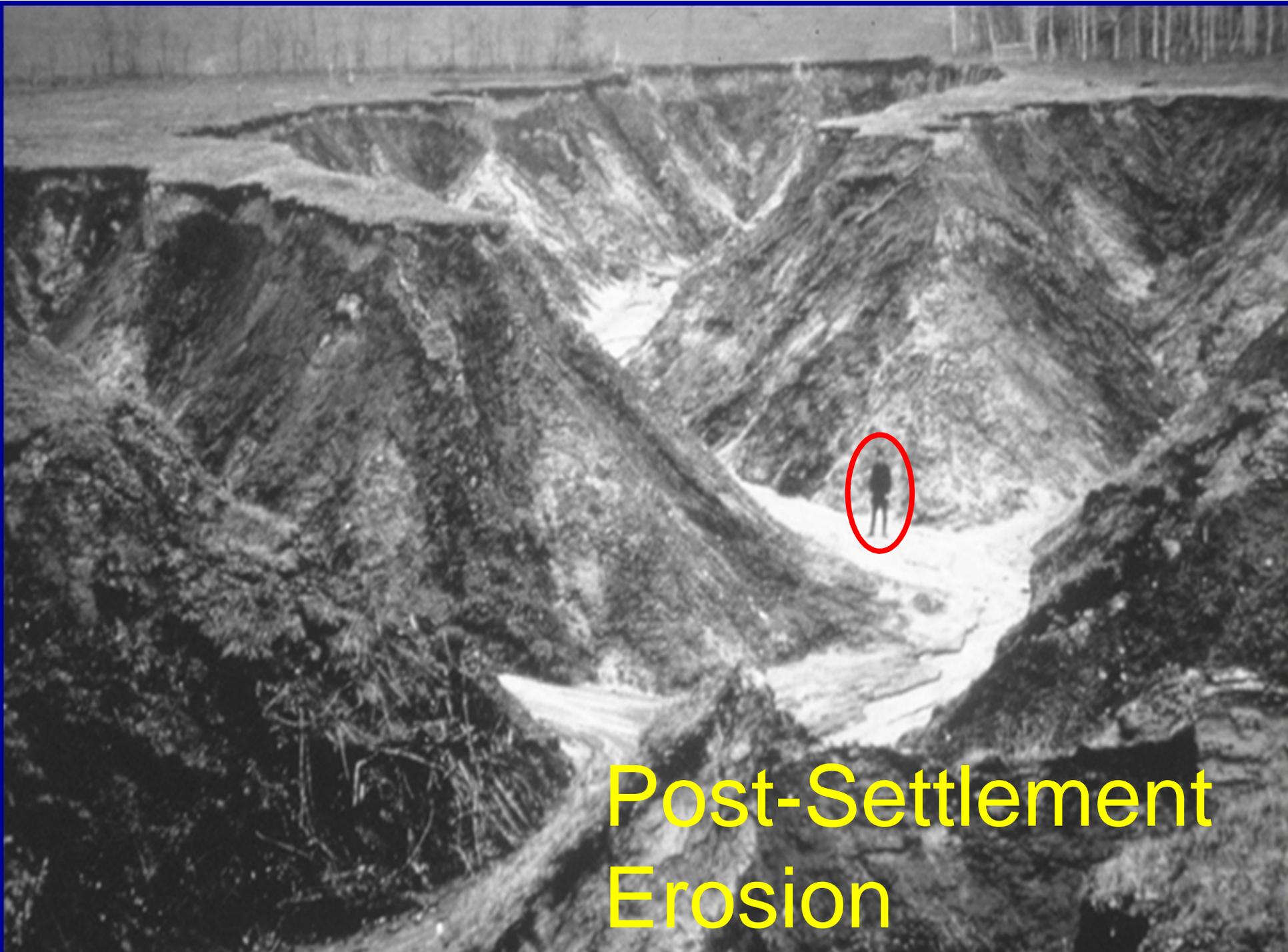
WI Perennial Streams:
42,000 mi.



Wisconsin clear-cut by 1910



24319 A

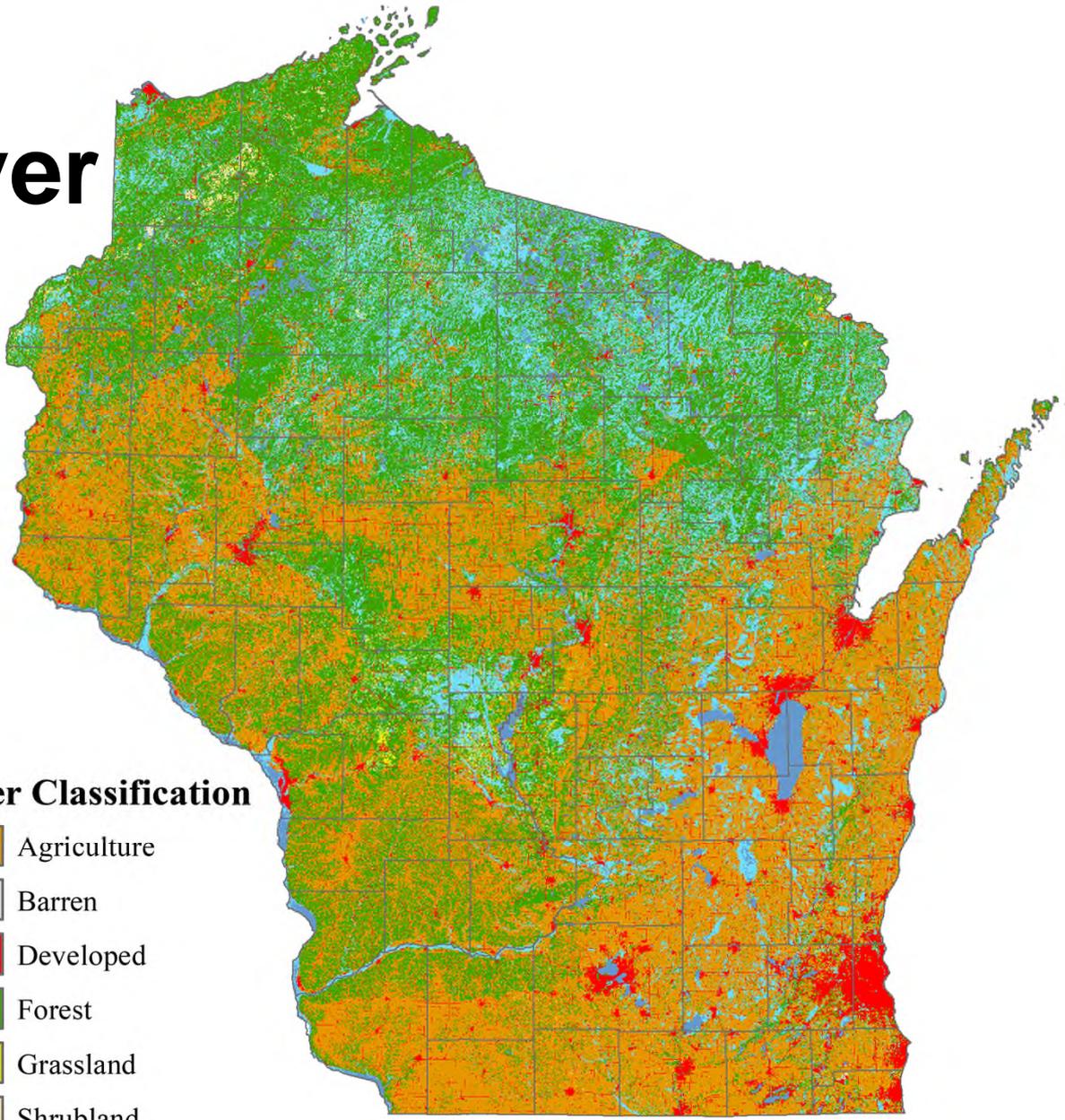


Post-Settlement
Erosion

Current Land Cover

Land Cover Classification

-  Agriculture
-  Barren
-  Developed
-  Forest
-  Grassland
-  Shrubland
-  Water
-  Wetlands



America's Dairy Land

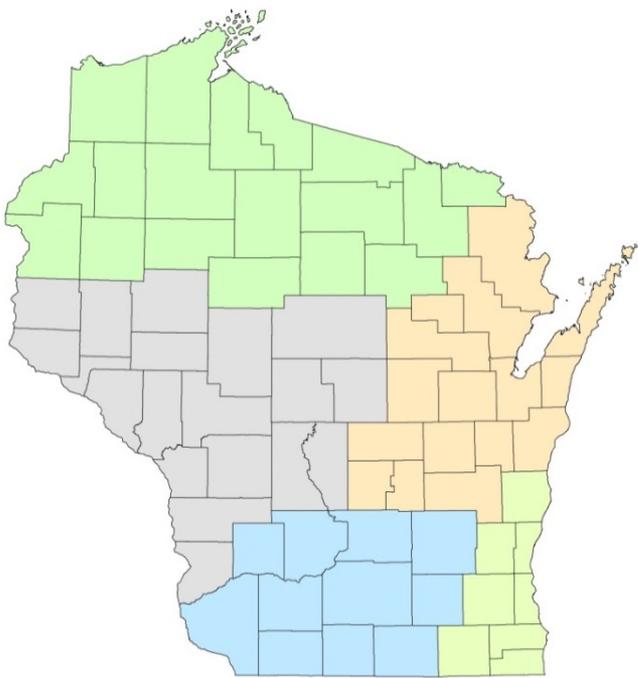


1,200,000 dairy cows x **125 lbs. manure / cow / day**
x 365 days / year = 54,750,000,000 lbs. manure / year

Statewide Random Sampling Stratified by:

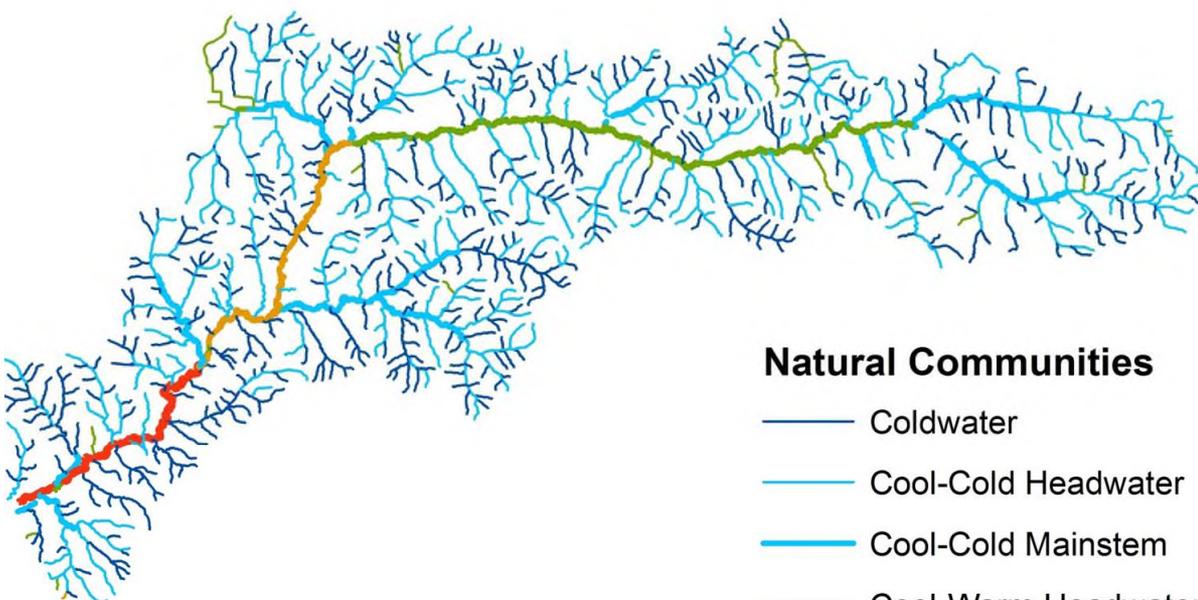
Management Area:

workload by stream resources within each DNR District



Stream Class

modeled water temp and flow volume used to predict natural fish assemblage

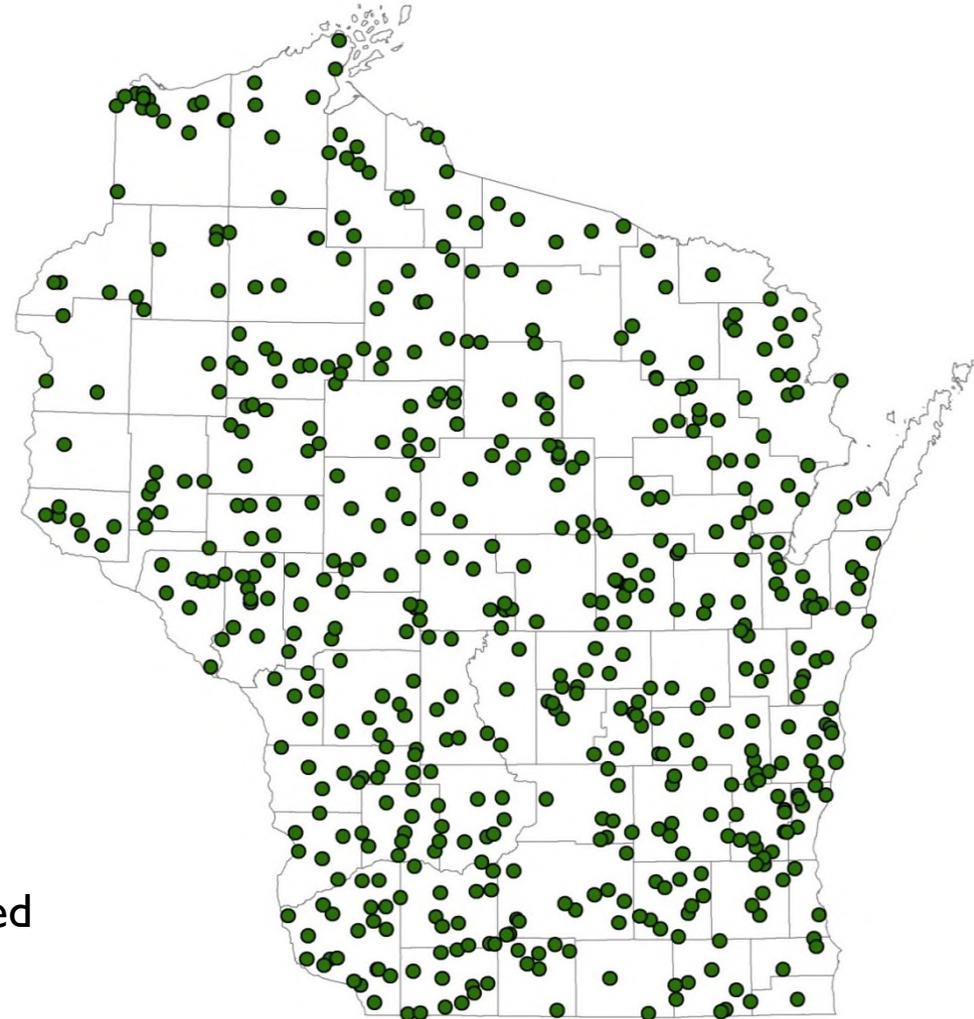


Natural Communities

- Coldwater
- Cool-Cold Headwater
- Cool-Cold Mainstem
- Cool-Warm Headwater
- Cool-Warm Mainstem
- Warm Headwater
- Warm Mainstem
- Large River

Sampling Effort 2010 – 2013

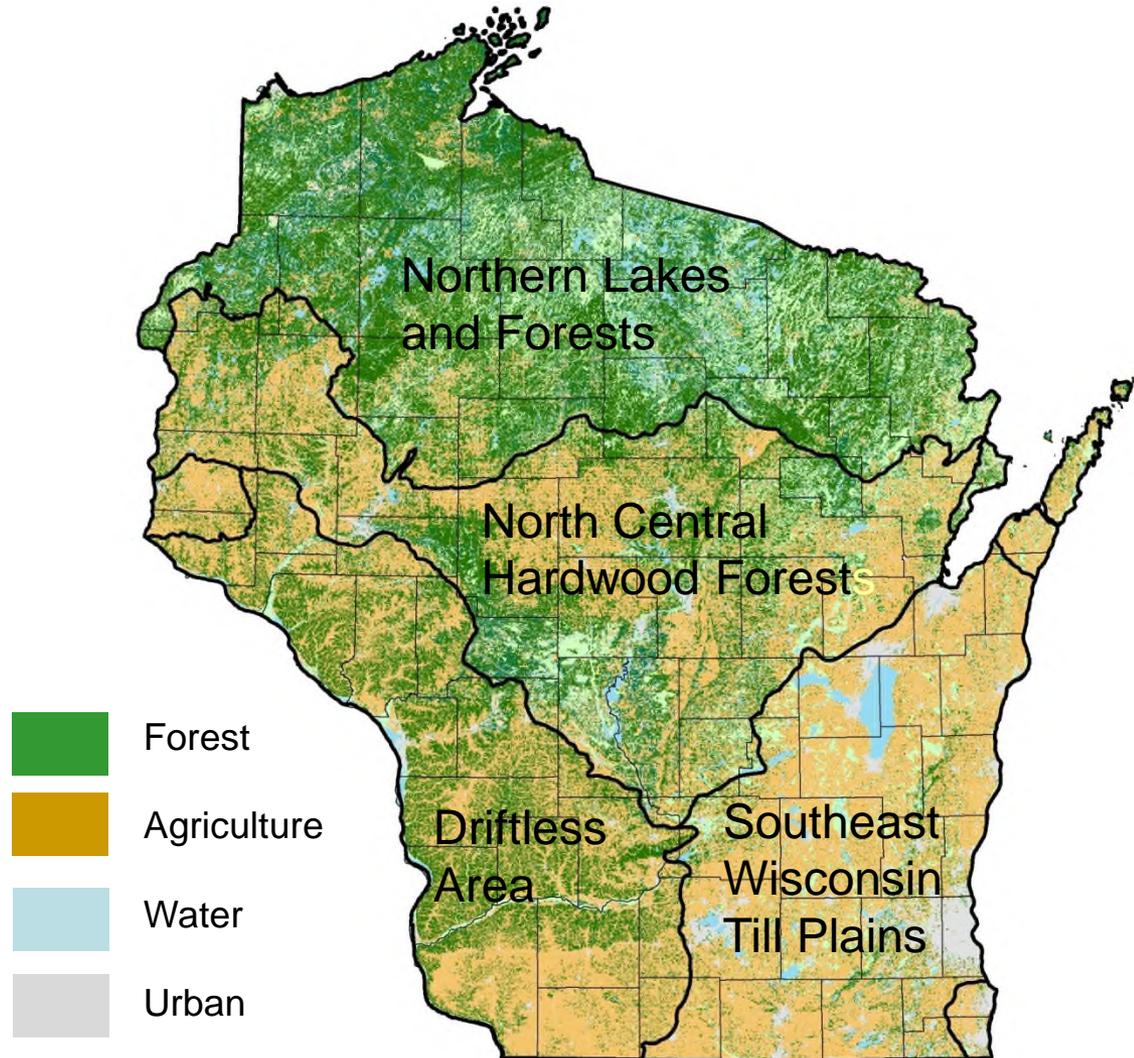
- 550 sites
- Data Collected:
 - Qualitative habitat
 - E. meter data
 - Chemistry grabs*
 - Fish & inverts



* Inconsistent parameter collection and limited number of chemistry parameters analyzed

Data analysis stratified by:

- Omernik III Ecoregions
- Aggregated Natural Community Classes



Analysis stratification cont. :

Natural Community Classes were lumped to reach minimum sample sizes per strata per ecoregion

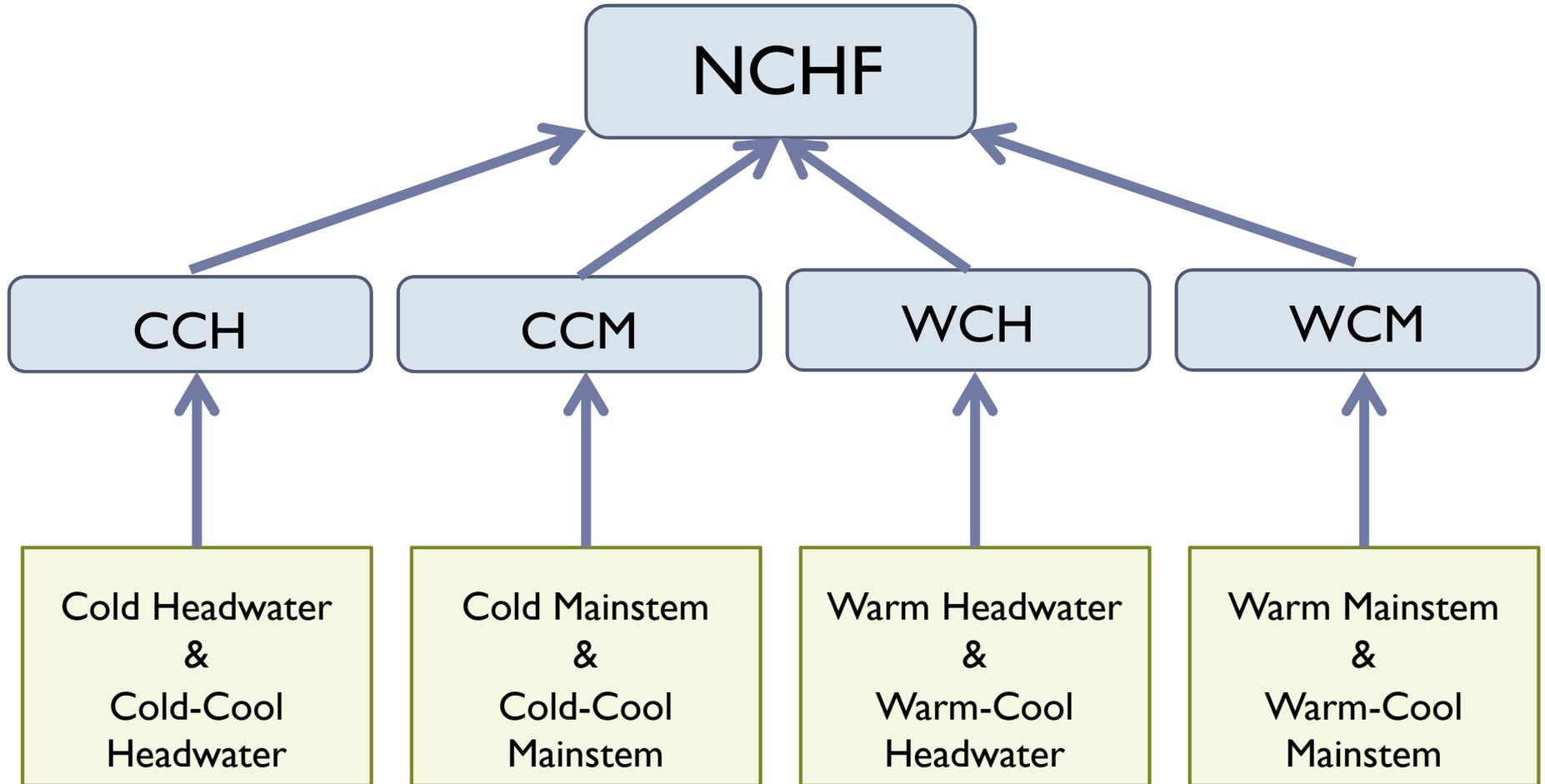
Cold Headwater
&
Cold-Cool
Headwater

Cold Mainstem
&
Cold-Cool
Mainstem

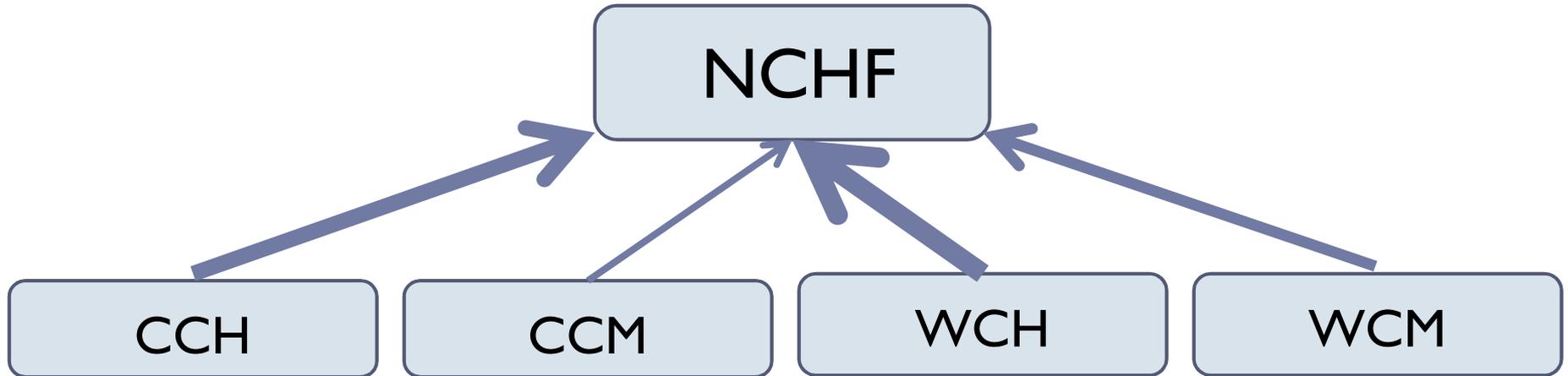
Warm Headwater
&
Warm-Cool
Headwater

Warm Mainstem
&
Warm-Cool
Mainstem

Stratification cont.



Stratification cont.



Population Size
6,050 km

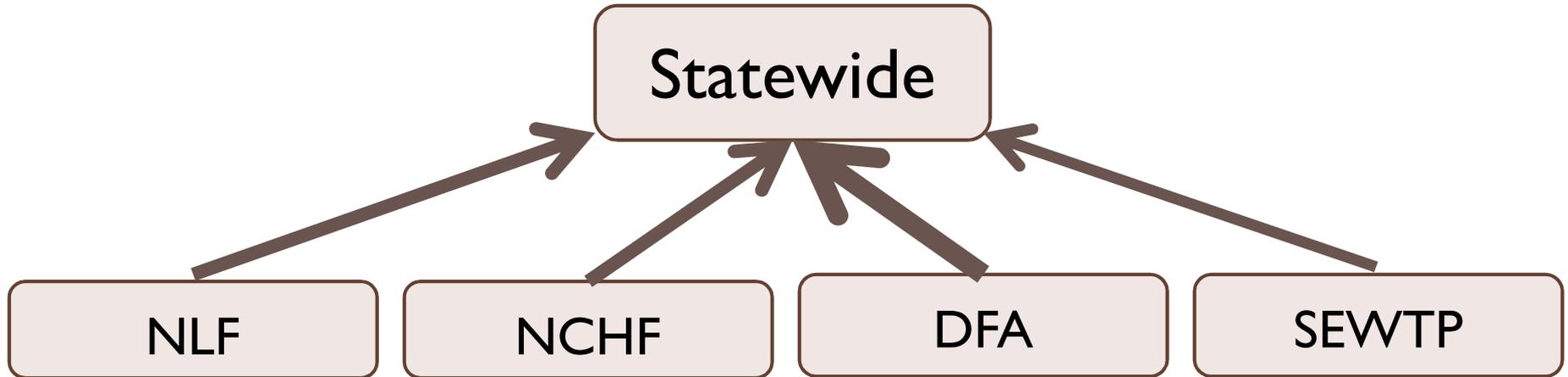
Population Size
820 km

Population Size
8,700 km

Population Size
3,300 km

Random sites data from aggregated stream classes were weighted to represent their frequency of occurrence in the respective ecoregion

Stratification cont.



Population Size
19,800 km

Population Size
18,900 km

Population Size
23,520 km

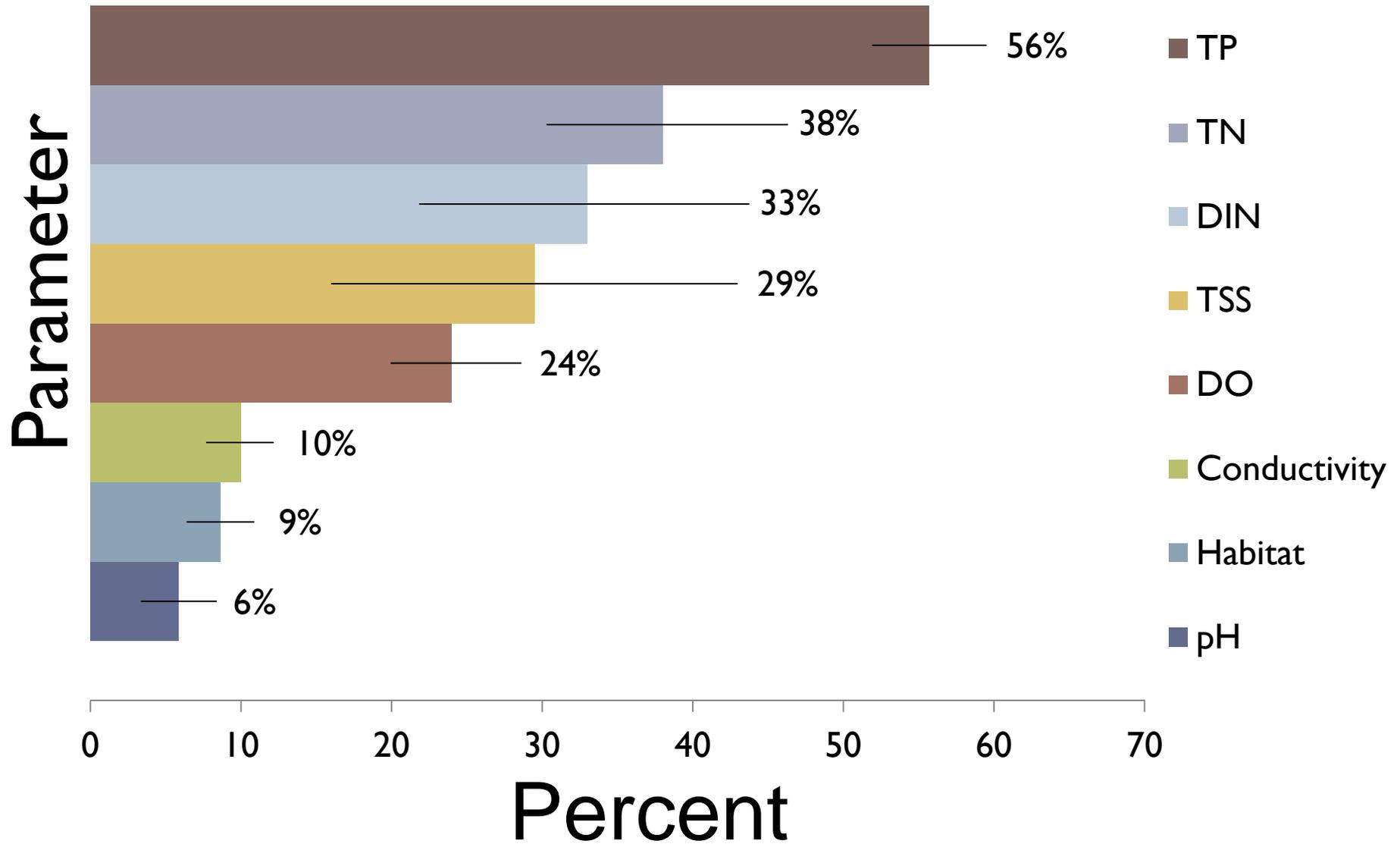
Population Size
13,700 km

Similarly random sites data from each ecoregion were weighted to represent their contribution to the statewide population

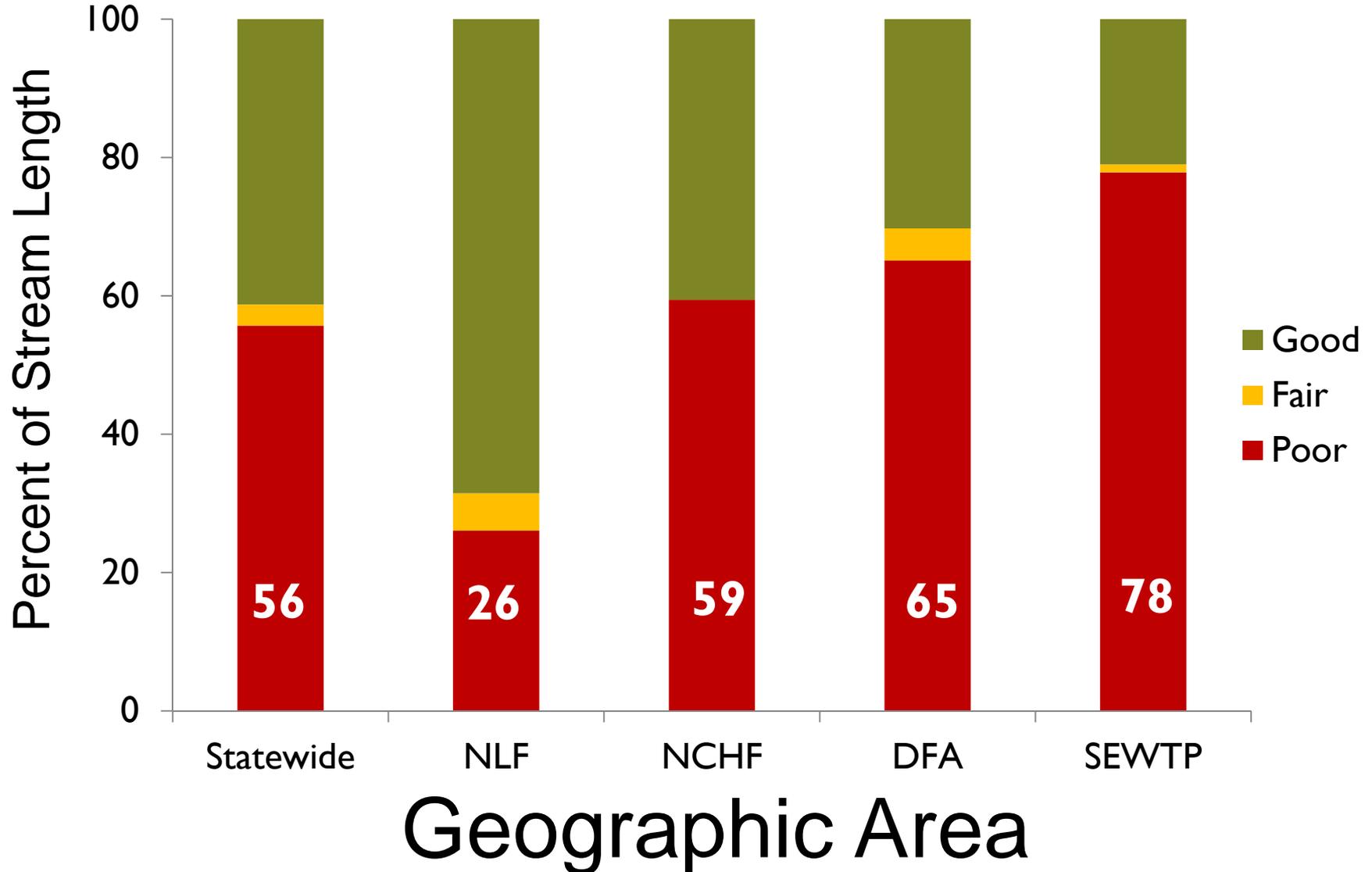
Criteria and Sample Sizes Used to Estimate Statewide Percentages of Stream length in “Poor” Condition

Parameter	Threshold Source	Number Samples
Total Phosphorus	WI WQS	348
Conductivity, Dissolved Oxygen	Reference Site 90 th Percentile	308
pH	WI WQS	308
Nitrogen & TSS	Reference Site 90 th Percentile	31
Qualitative Habitat	Categorical Rating	419
Macroinvertebrate IBI	Categorical Rating	392
Fish IBI	Categorical Rating	440

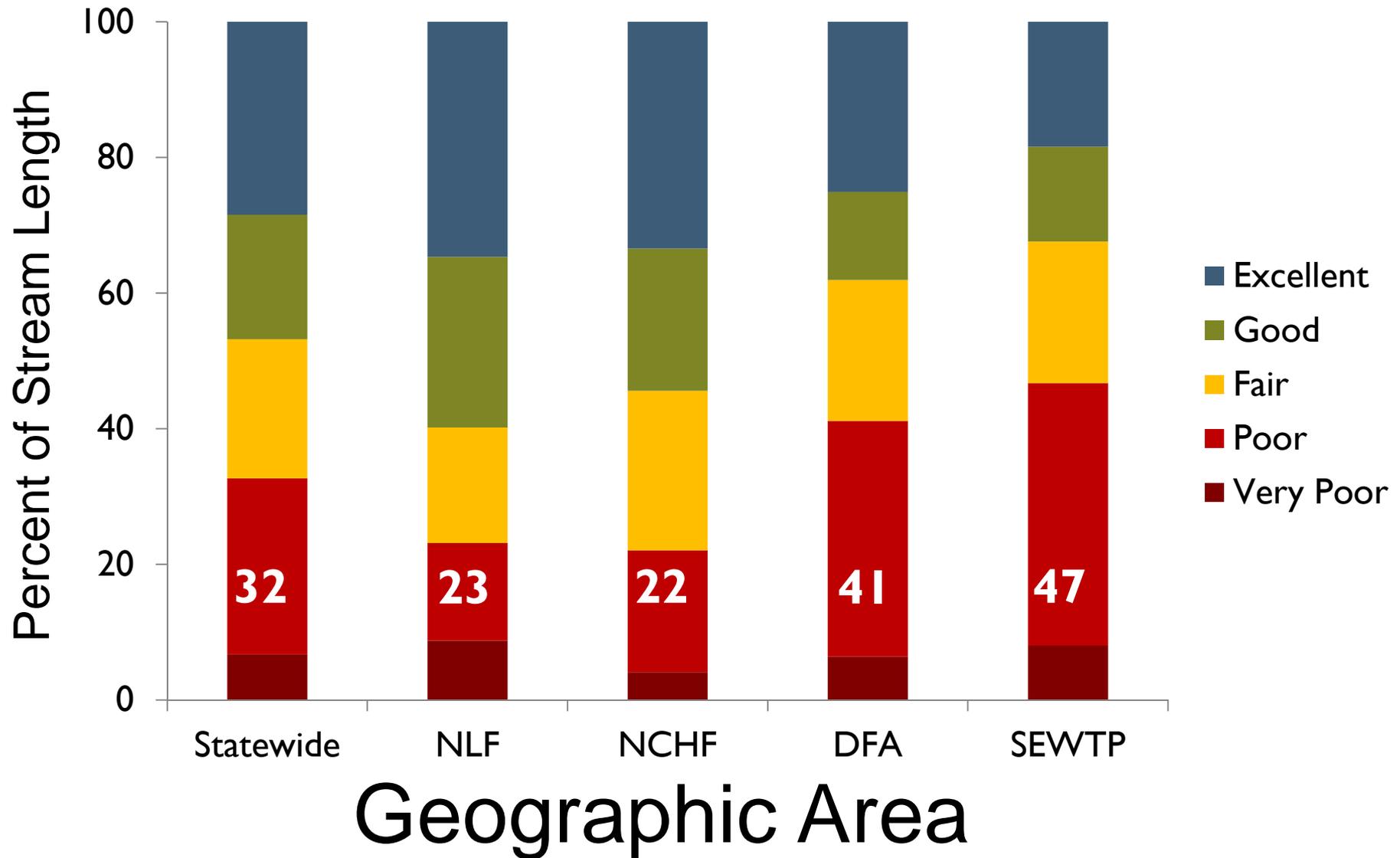
Statewide Relative Extent – Percent Stream Lengths in “Poor” Condition



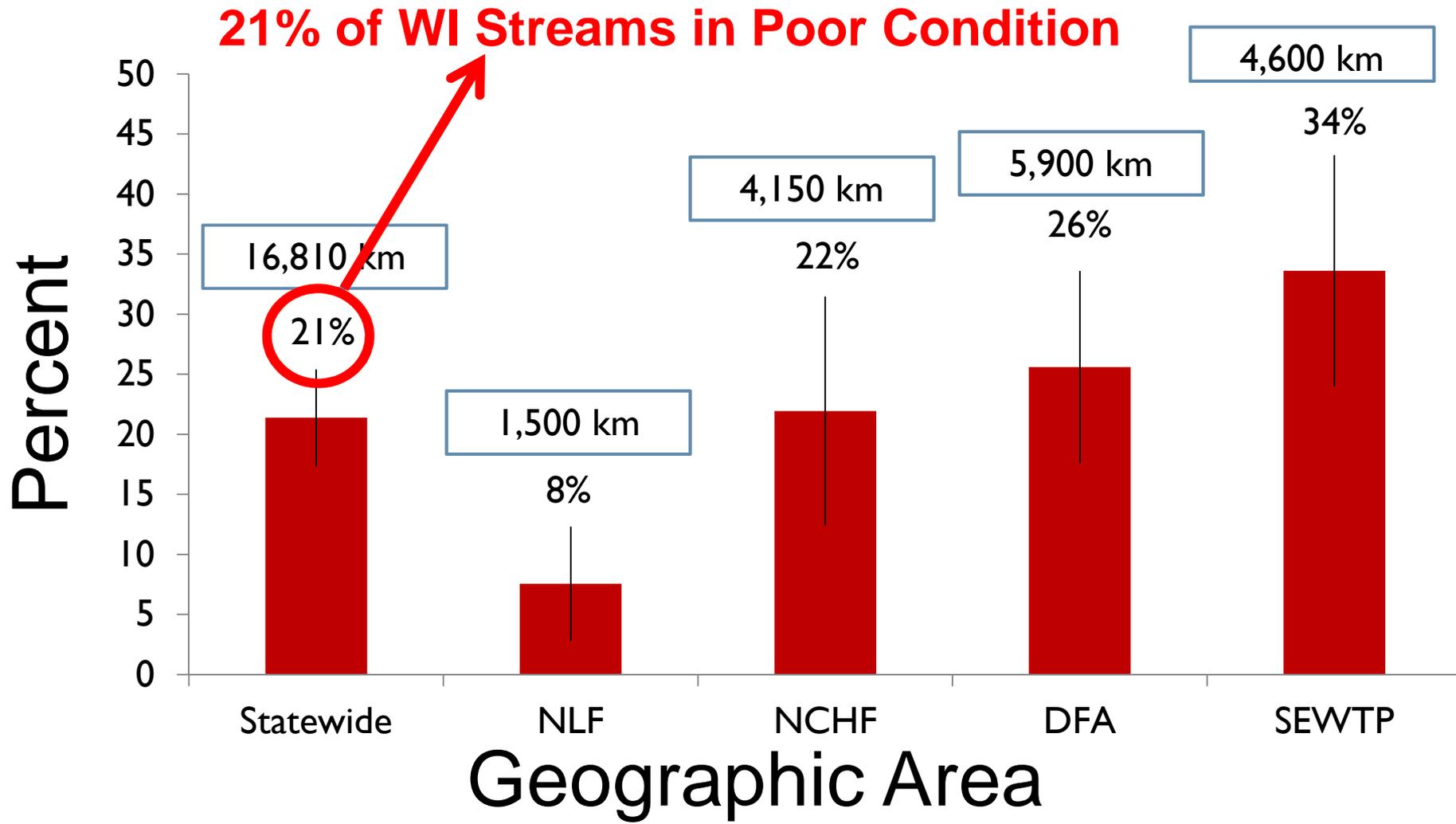
Stream Length Conditions - Total Phosphorus



Stream Lengths Condition - Fish IBI



Percent Stream Lengths in Poor Condition ([TP] > 0.075 mg/L and 1 "Poor" Biotic Assemblage)



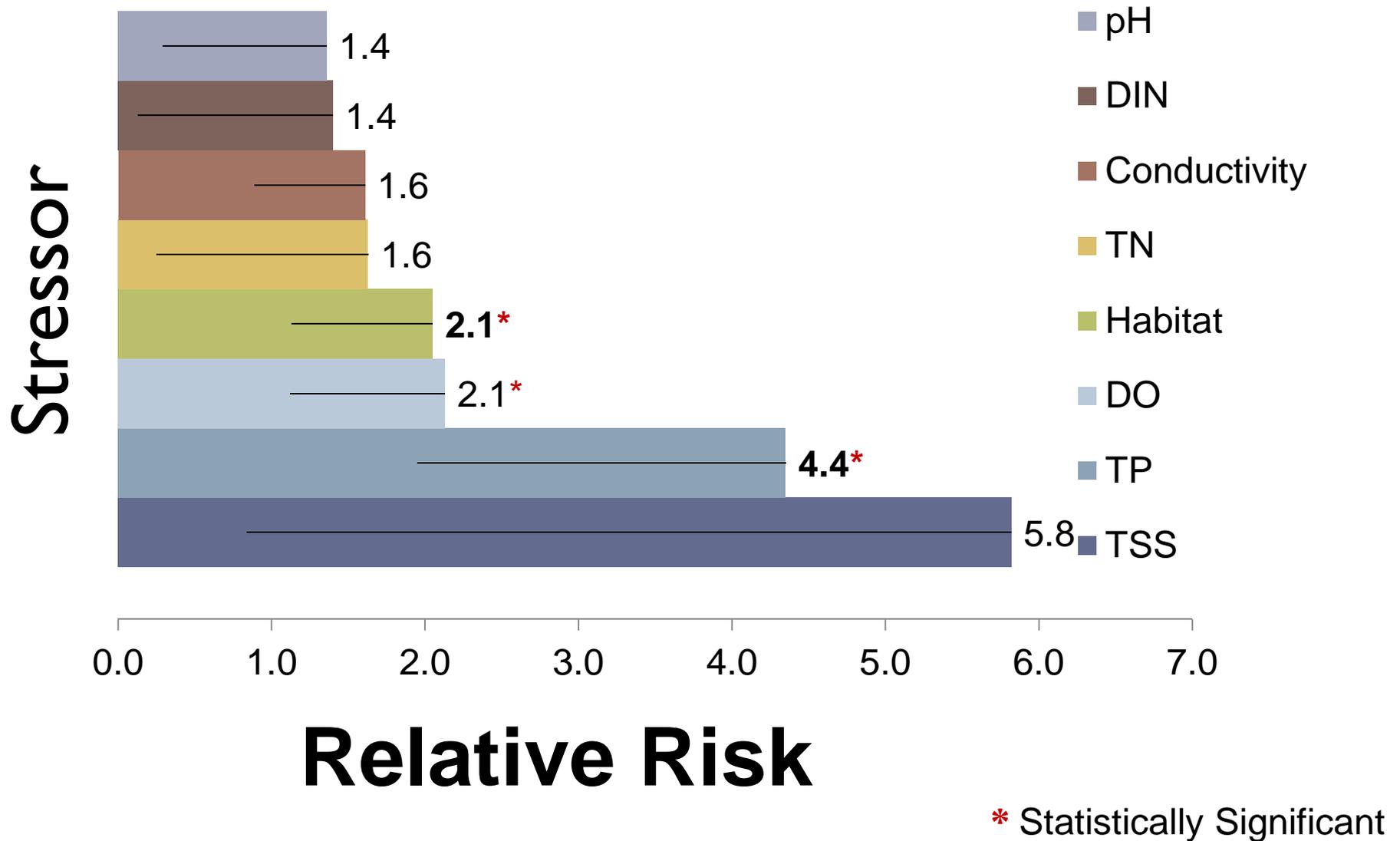
Relative Risk Analyses

(after Van Sickle and Paulsen)

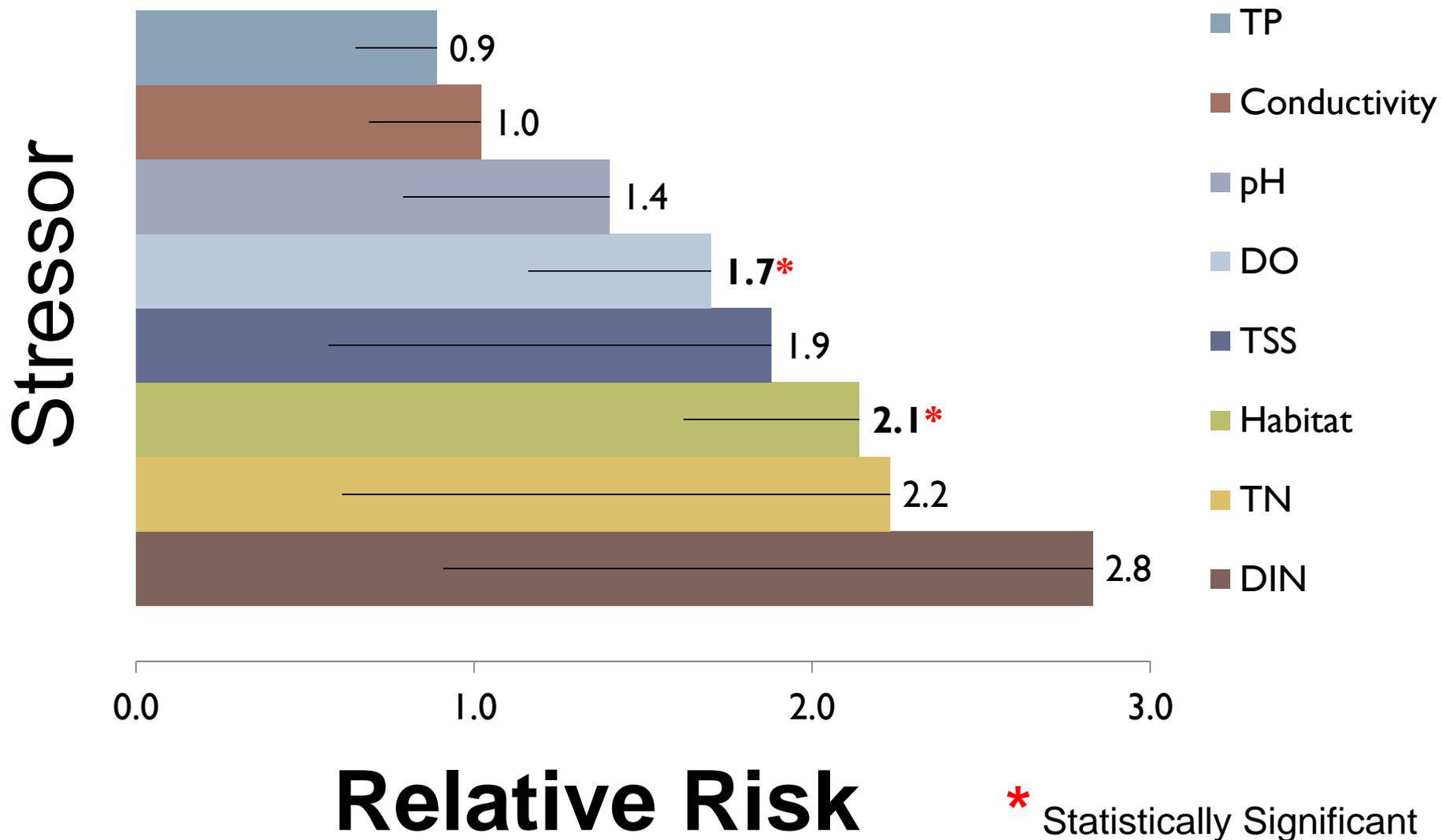
		Stressor		
		Good	Poor	
Response	Good	0.55	0.05	Risk Poor Response Poor Stressor $0.35/0.4 = 0.875$
	Poor	0.05	0.35	Risk Poor Response Good Stressor $0.05/0.6 = 0.083$
	Total	0.6	0.4	

$$RR = \frac{\Pr(Poor|Poor)}{\Pr(Poor|Good)} = \frac{0.875}{0.083} = 10.5$$

Relative Risk of Various Stressors to Macroinvertebrate IBI Condition



Relative Risk of Various Stressors to Fish IBI Condition



Key Findings:

- Phosphorus and Nitrogen concentrations statewide commonly exceed WQ criterion or reference condition thresholds.
- Phosphorus is a greater risk to macroinvertebrates than fish
- Nitrogen and TSS results indicate a risk to biota, although sample sizes were low
- Stream habitat conditions (measured qualitatively) impact macroinvertebrate and fish integrity scores

Future Effort:

- Reduce state and ecoregional probability monitoring
- Compile targeted most and least disturbed site data to ID thresholds and set expectations (“bookend” random sites)
- Move forward on Biocriteria
- Evaluate ~ HUC 10 sampling efforts

Questions?

-
- ▶ Stratified Random vs Fixed Station
 - ▶ Wadeable Rotation Monitoring
 - ▶ HUC10 Pour Points 2006-2011



% Poor	TP	TN	n
NCSR	56%	33%	~350
Wadeable Rotation	55%	26%	~4,000



Stratified Random vs Fixed Station

▶ Fixed Station

- ▶ Target locations based on needs
- ▶ Identify "hot spots"
- ▶ Multiple visits to sample variability
- ▶ Detecting trends

▶ Stratified Random

- ▶ Better representation of all stream types
- ▶ Statistically valid estimation of whole resource
- ▶ Less samples need to cover large geographic area



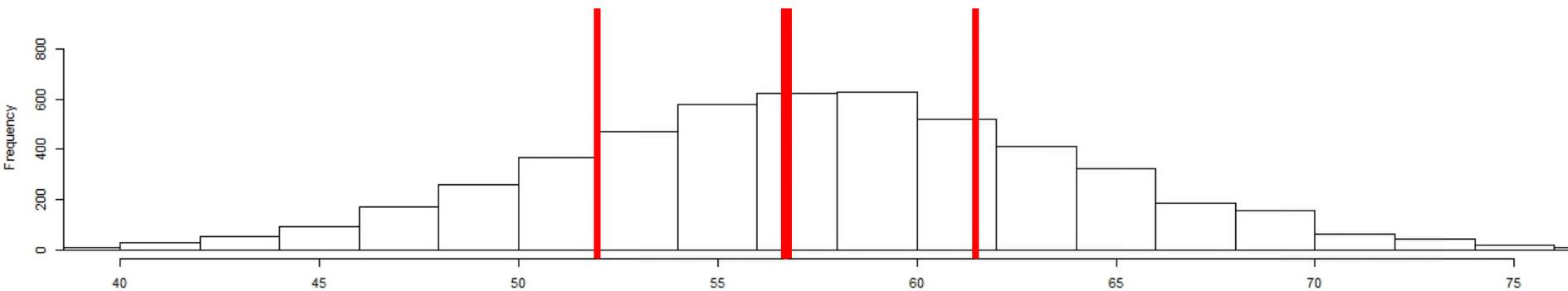
How Many Sites Do We Really Need?

- ▶ Randomly subset sites and rerun analysis with smaller sample sizes
- ▶ Do we get the same answer using 50, 100, 150 sites instead of ~550?

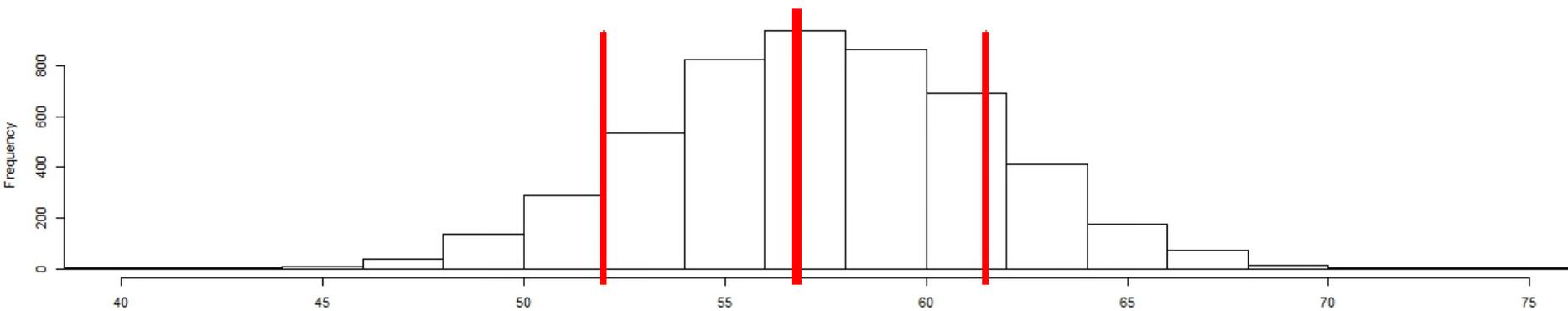


Total Phosphorus

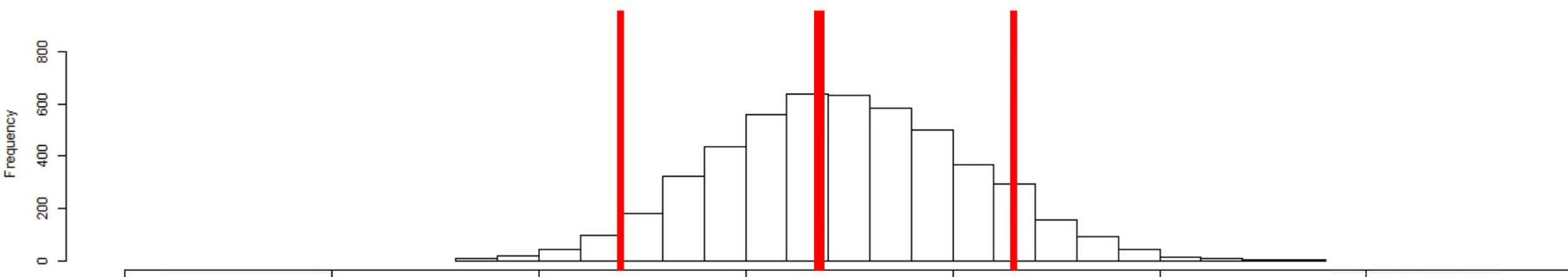
n=50



n=100



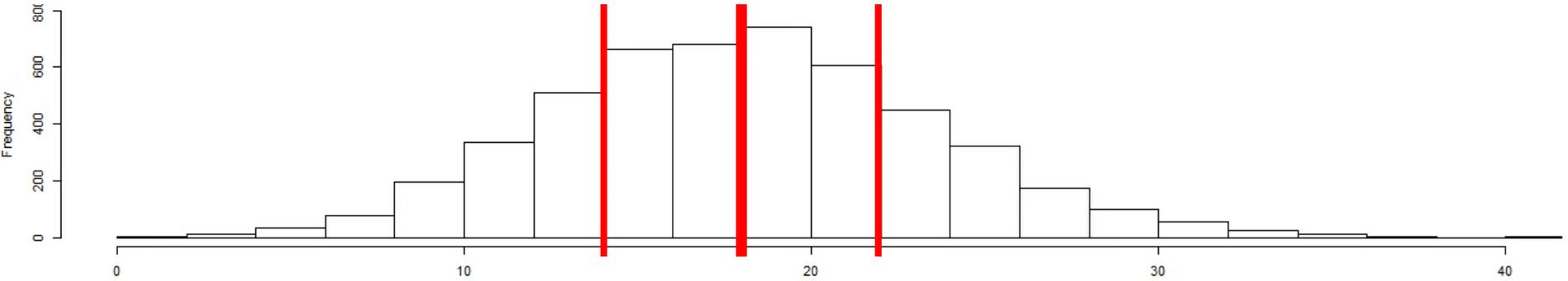
n=150



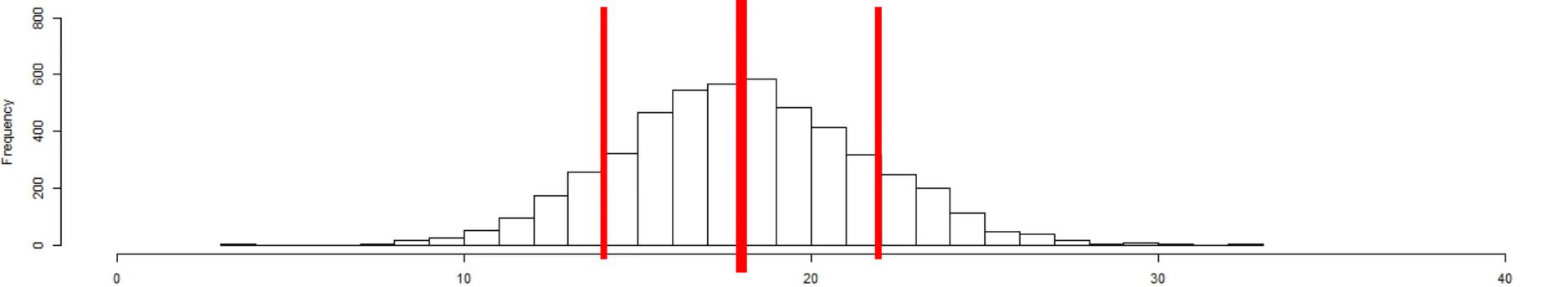
Percent Stream Length TP > 75 ug/l with Random Resampling

Macroinvertebrate IBI

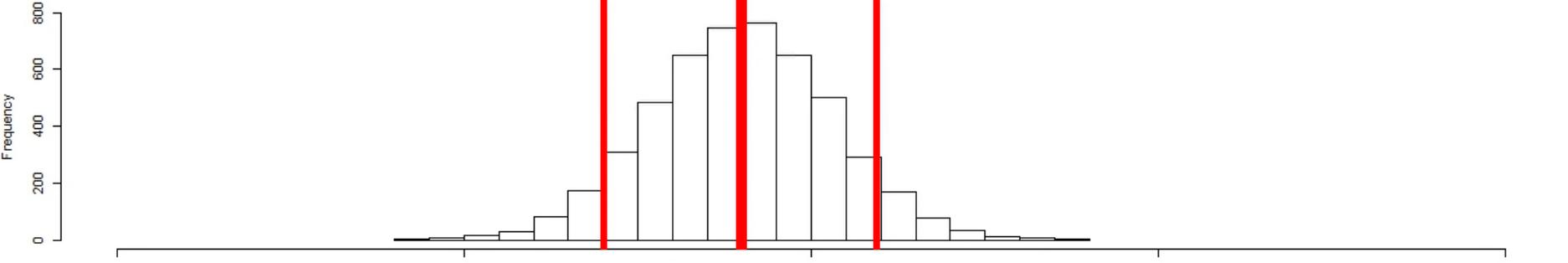
n=50



n=100



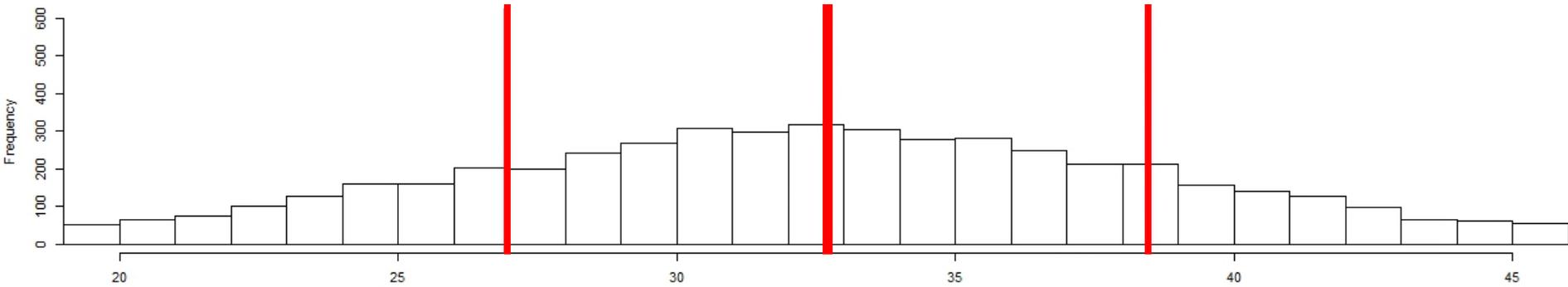
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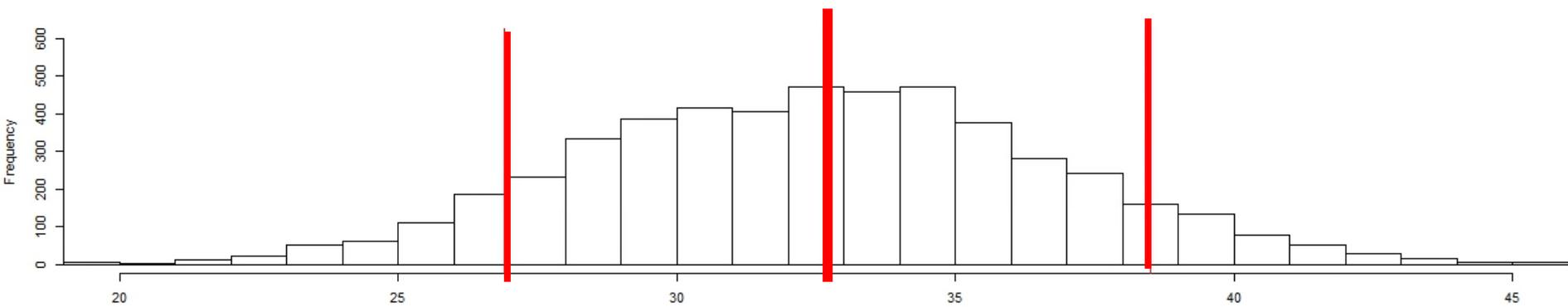
Percent Stream Length mIBI = "Poor" with Random Resampling

Fish IBI

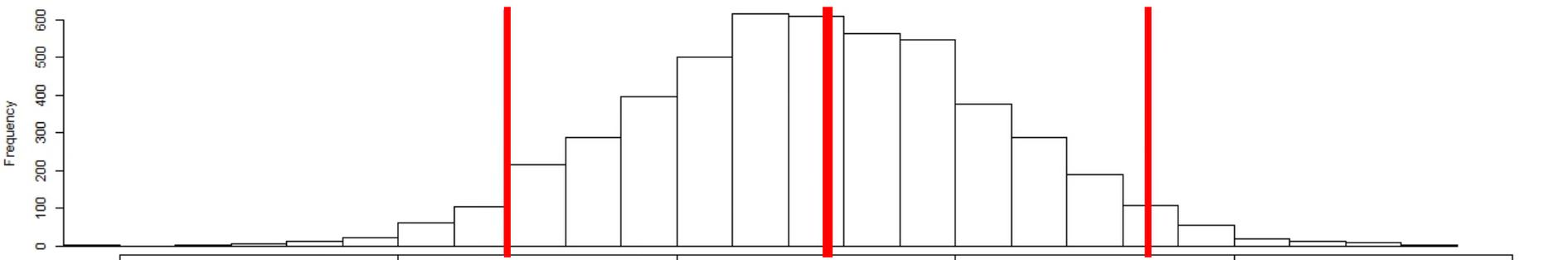
n=50



n=100



n=150



Percent Stream Length fIBI = "Poor" with Random Resampling

Future of NCSR monitoring program

- ▶ Reduce number of sites per year to 50
 - ▶ Starting in field season 2014
- ▶ NCSR “cycle” is every 2 years
 - ▶ Total of 100 sites for analysis
- ▶ Include Nitrogen series and TSS at all sites
- ▶ Analyze for status and trends every 2 years
 - ▶ Consistent with 305b reporting



2014 Baseline Streams and Rivers Monitoring program

- ▶ **Follow Up Monitoring**

- ▶ 78 sites
- ▶ Identify Suspected Impaired Sites
- ▶ Fulfill WisCALM Minimum Data Requirements

- ▶ **Targeted Watershed Assessments**

- ▶ 15 HUC 12 Watersheds
- ▶ 5-8 Monitoring Locations per Watershed
- ▶ Evaluation, Effectiveness, Protection and Planning

