

# Draft National Rivers and Streams Assessment 2008–2009: A Collaborative Survey

Webcast sponsored by EPA's Watershed Academy



Wednesday, April 3, 2013

1:00pm – 3:00pm Eastern

## Instructors:

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# Webcast Logistics

- **To Ask a Question** – Type your question in the “Questions” tool box on the right side of your screen and click “Send.”
- **To report any technical issues** (such as audio problems) – Type your issue in the “Questions” tool box on the right side of your screen and click “Send” and we will respond by posting an answer in the “Questions” box.

# Overview of Today's Webcast

Objective: Present key findings of the first National Rivers and Streams Assessment (NRSA), provide some technical detail, and highlight policy implications.

<p><b>Presenter: Susan Holdsworth</b></p> <ul style="list-style-type: none"><li>▪ <b>The National Aquatic Resource Surveys – An Overview</b></li></ul>	<p><b>Presenter: Ellen Tarquinio</b></p> <ul style="list-style-type: none"><li>▪ <b>National Rivers and Streams Assessment Overview of Findings</b></li><li>▪ <b>Sampling Approach and Field Work</b></li><li>▪ <b>Reference Condition</b></li><li>▪ <b>Results</b></li><li>▪ <b>Relative Extent of Stressors and Attributable Risk</b></li><li>▪ <b>Assessment of Change</b></li><li>▪ <b>NRSA Draft Report for Public Comment</b></li></ul>
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# The National Aquatic Resource Surveys – An Overview



# Presentation Outline

- Background
- NARS Approach
- Accomplishments
- Upcoming Milestones





# What is NARS?



*Coastal*



*Streams and Rivers*



*Wetlands*



*Lakes*



- Series of surveys implemented by EPA and our state and tribal partners
- Assess all surface waters within the 48 contiguous states
- Cost effective, nationally consistent, regionally relevant means of tracking status and trends
- Builds from almost 20 years of research and pilots



# Purpose of the National Aquatic Resource Surveys

- Assessing biological and recreational condition using indicators of condition and stress
- Documenting associations between indicators of condition and indicators of stress
- Building/enhancing state monitoring and assessment capacity



# Why is NARS Important?

- **Fills critical water quality data gaps**
  - Statistical design provides national and regional conclusions on the health of broad population of waters, and changes over time, without sampling every water
  - Core indicators provide nationally consistent assessment relevant to Clean Water Act goals
- **Delivers data and reports that address nationally important policy questions**
  - NARS data and results support important agency priorities (e.g., nutrients in the Mississippi River Basin)
- **Complements states' and other targeted, site-specific assessments**







# NARS Approach: National Consistency

- **Statistically representative design**
  - Allows reporting on condition of each resource nationally and on a regional basis with documented confidence
- **Standard field and lab protocols**
  - All indicators evaluated for credibility, to address national and state-identified needs
- **National quality assurance and data management**
  - All partners use EPA-developed quality assurance project plan
- **Nationally consistent and regionally relevant data interpretation and peer-reviewed reports**
  - Informal and formal peer review

# Types of Survey Indicators and Measures

**Biological indicators** such as:

- Benthic macroinvertebrates
- Plants
- Fish community

**Public health indicators** such as

- Fish tissue
- Pathogens (e.g., enterococci)
- Microcystin

Occurrence and extent of key **stressors** such as:

- Nutrient enrichment
- Excess sediment
- Physical habitat characteristics (e.g. riparian cover)

May include pertinent **research indicators** such as:

- Sediment enzymes
- Contaminants of emerging concern



# Accomplishments

- **Nationally consistent and scientifically defensible reports**
- **Linking results to policy issues**
- **Advancements in monitoring methods and expanding monitoring of more waterbody types**
- **Advancing and fostering analyses**
  - **Biological indicator development**
  - **Relative risk and attributable risk analyses**



# Upcoming Milestones

- **National Rivers and Streams Assessment 2008/09**
  - 1<sup>st</sup> draft report on all flowing waters out for public review until May 9
- **National Rivers and Streams Assessment 2013/14**
  - Field season beginning in May for 2<sup>nd</sup> NRSA
- **National Wetlands Condition Assessment 2010**
  - Complete data QA and conduct data analysis and peer review
  - Release 1<sup>st</sup> National Wetland Condition Report
- **National Coastal Condition Assessment 2011**
  - Complete data QA and conduct data analysis and peer review
  - Release NCCA V report
- **National Lakes Assessment 2012**
  - Complete lab work and data QA in preparation for 2<sup>nd</sup> national lakes assessment
  - Conduct data analysis and peer review
  - Release 2<sup>nd</sup> National Lakes Assessment





Estuaries



Lakes



Wetlands

Questions?

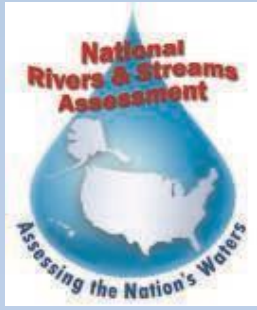


Streams



Rivers





# Draft National Rivers and Stream Assessment

## Overview and Key Findings **NRSA 2008/09**





# Presentation Outline

- National Rivers and Streams Assessment  
Overview of Findings
- Sampling Approach and Field Work
- Reference Condition
- Results
- Relative Extent of Stressors and Attributable Risk
- Assessment of Change
- NRSA Draft Report for Public Comment

# National Rivers and Streams Assessment is the latest National Aquatic Resource Survey

- **First nationally-consistent, statistically representative assessment of the nation's rivers and streams**
  - Biological and habitat condition
  - Major stressors
  - Key human health indicators
  - Change in stream condition
- **The 1,942 sites sampled – plus 234 hand-selected reference sites and 200 re-sample visits – describe the condition of perennial stream and river miles across the lower 48 states**



# NRSA 2008/09: Design of the Survey

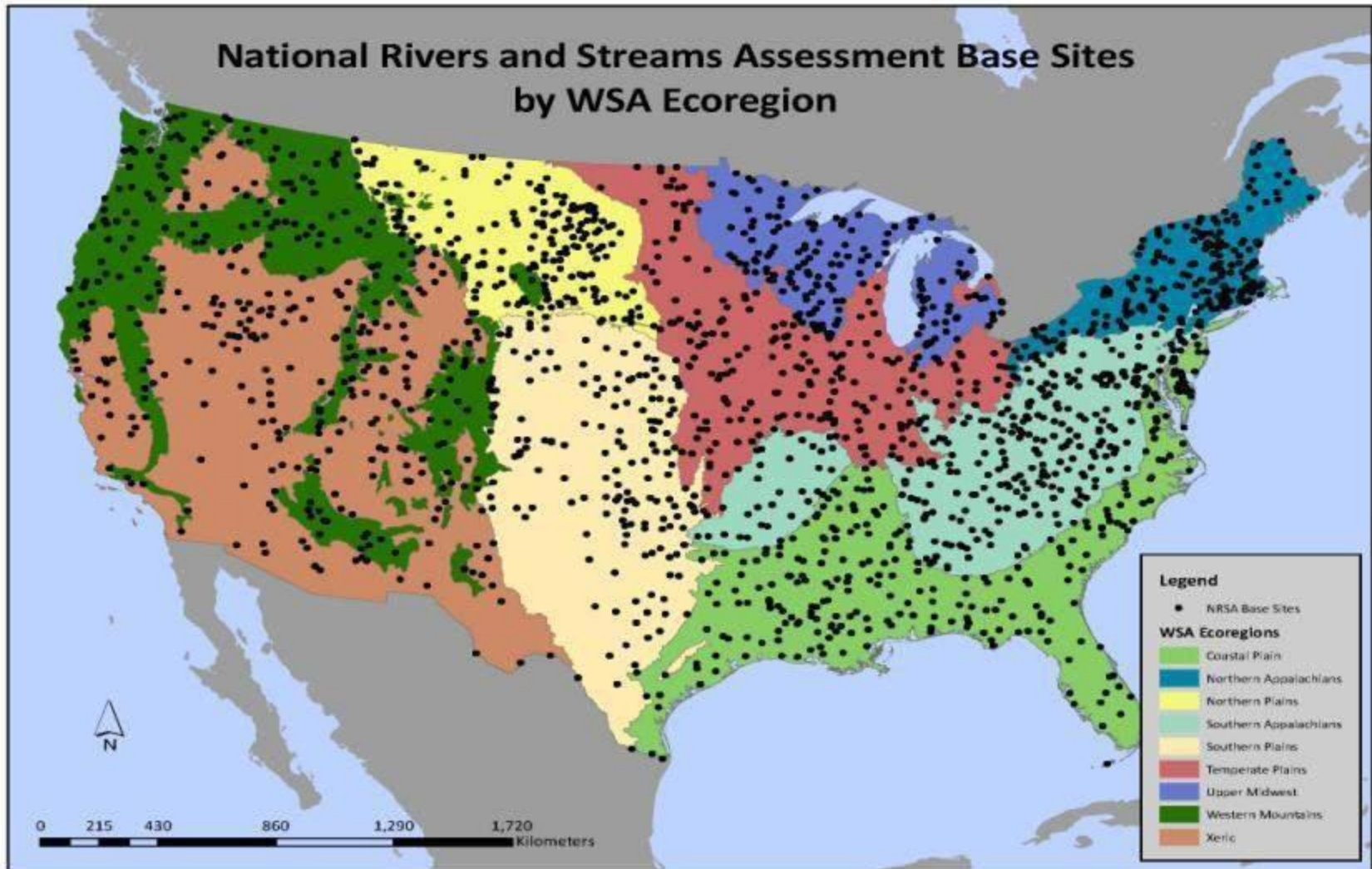
- **All streams and rivers within the 48 contiguous states that have flowing water during the study index period**
  - Includes major rivers (including Great Rivers) and small streams
  - Includes run-of-the-river ponds and pools with less than 7 day residence time
  - Must have > 50% of the reach length with standing water
- **The target population excludes:**
  - Tidal rivers and streams up to head of salt
  - Slow moving reservoirs





# Statistical Distribution of Sample Sites

- Represents 1,194,000 million miles of rivers and streams

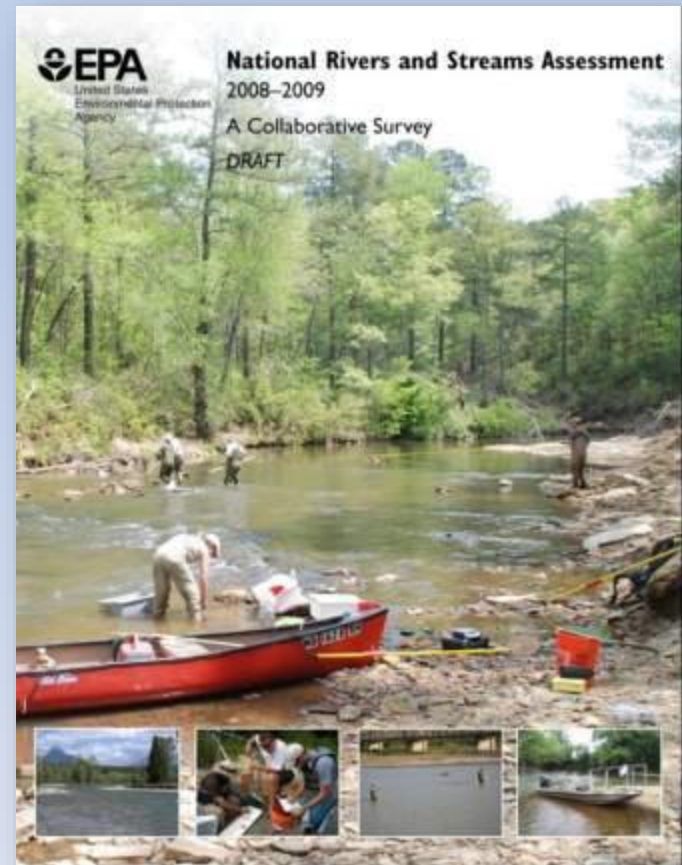


# Draft NRSA Report for Public Comment includes:

- **Biological Integrity**
  - Benthic Macroinvertebrates
  - Fish Community Assemblage
  - Periphyton Assemblage
- **Habitat Quality**
  - Excess Sedimentation
  - Riparian Disturbance
  - Human Influence
  - In-stream fish habitat
- **Chemical stressors**
  - Nutrients (Nitrogen, Phosphorous)
  - DO
  - Salinity
- **Change in stream condition**
  - Compared to 2004 streams report
- **Human Health**
  - Enterococci
  - Fish Tissue: Mercury
- **EcoRegion Summaries**

## Highlights include:

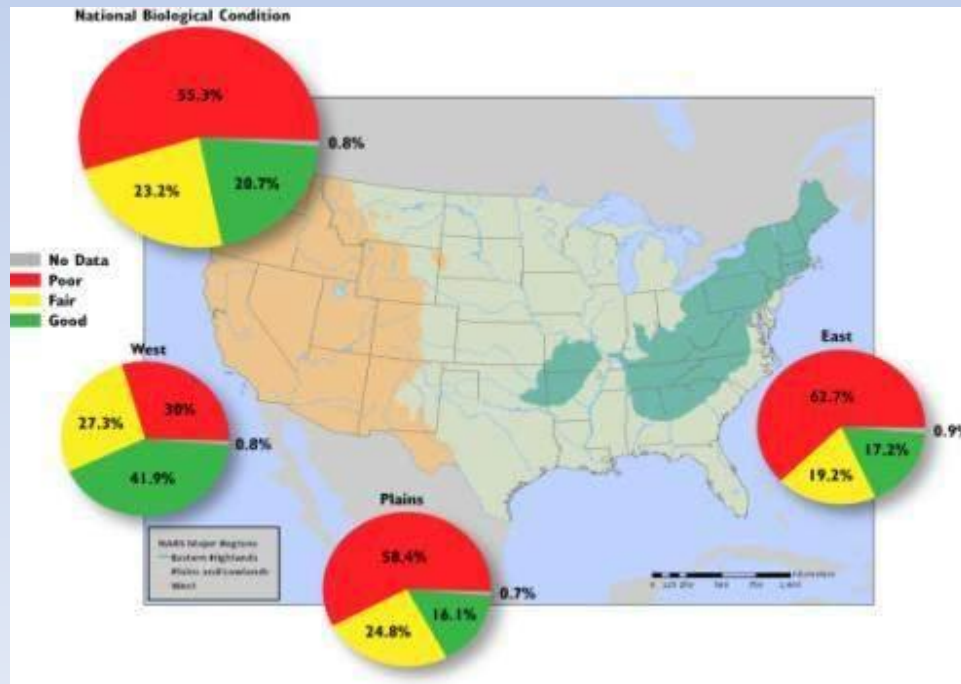
- Urban Waters for Fish Tissue PCBs and PFCs
- State Example for NRSA
- Importance of nutrients



# Key Findings – Biological Condition

55% of our nation's river and stream miles are in poor biological condition, 23% are in fair condition, and 21% are in good condition. Rivers and streams that are in fair or poor biological condition can lead to loss of fishing and recreational opportunities.

Compared to a 2004 stream assessment, *7% fewer stream miles* are in good biological condition.



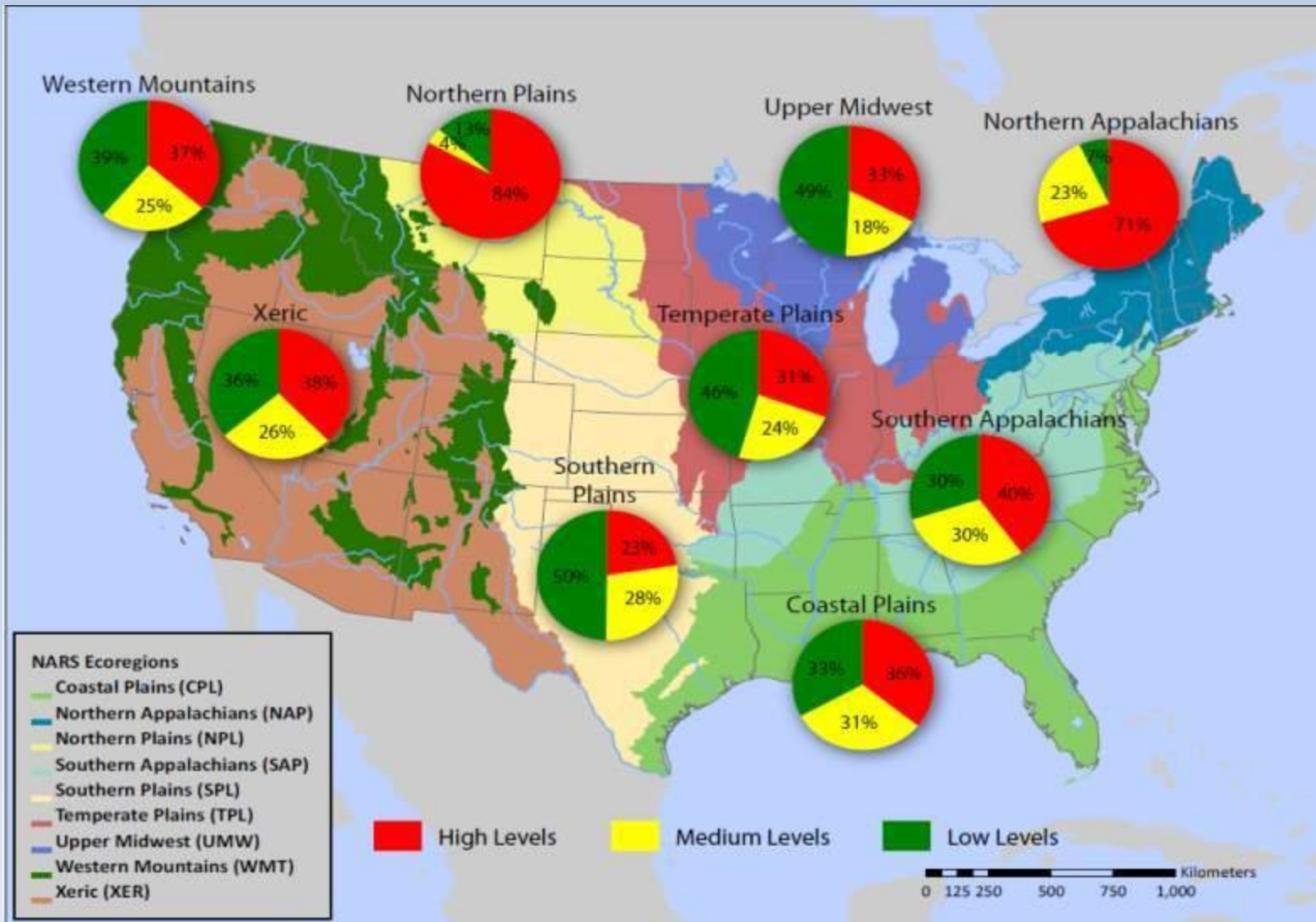
# *Key Findings from the NRSA – Major Stressors*

## **Nutrients and poor habitat continue to be widespread problems**

- **Nutrients:**
  - 40% of the nation's river and stream miles have excessive levels of **phosphorus**
  - 27% have high levels of **nitrogen**
- **Habitat:**
  - **Poor quality vegetative cover** is widespread in 24% of rivers/streams
  - High levels of **human disturbance** near river and streambanks occur at 20% of the nation's river and stream miles



# Conditions vary regionally: Total phosphorus



# *Key Findings from the NRSA – Change in Streams*

**Compared to a 2004 streams study, detectable changes occurred in streams. The direction of change varied for different stressors. Determining why and identifying trends will take more years of data.**

- **Biology and phosphorus: Fewer stream miles in good condition**
  - 7% fewer stream miles in good biological condition
  - 19% fewer stream miles in good condition for phosphorus.
- **Nitrogen and habitat: More stream miles in good condition**
  - 9% more stream miles in good condition for nitrogen
  - 17% more stream miles in good condition for in-stream fish habitat
  - 12% more stream miles in good condition for human disturbance

## ***Key Findings in the NRSA – Human Health***

**Two indicators that show potential risk to human health -- enterococci bacteria and mercury in fish tissue -- are widespread in rivers and streams.**

- **In 9% of river and stream miles, enterococci exceed thresholds protective of human health.**
- **Over 13,000 miles of rivers are found to have mercury in fish tissue at levels that exceed thresholds protective of human health.**



# Questions?



# Draft National Rivers and Streams Assessment

Detailed Findings  
and Process

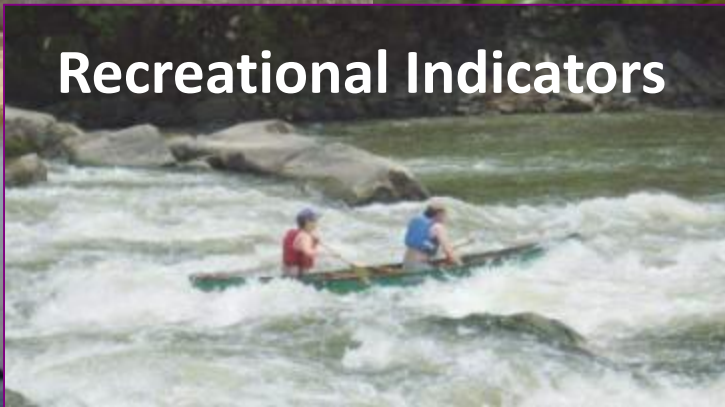


# NRSA Project Scope

- 10,000,000 data points from field and lab
- Over 25,000 samples collected and shipped to labs
- Extensive QA/QC throughout field and lab
- 17 sample types collected and tracked through labs for each site
  - 2 additional samples from urban sites





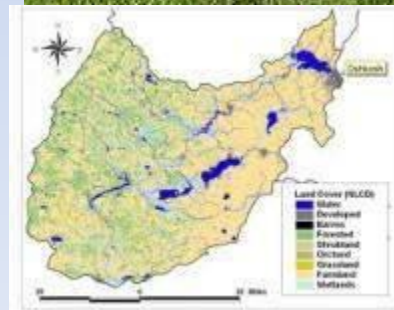




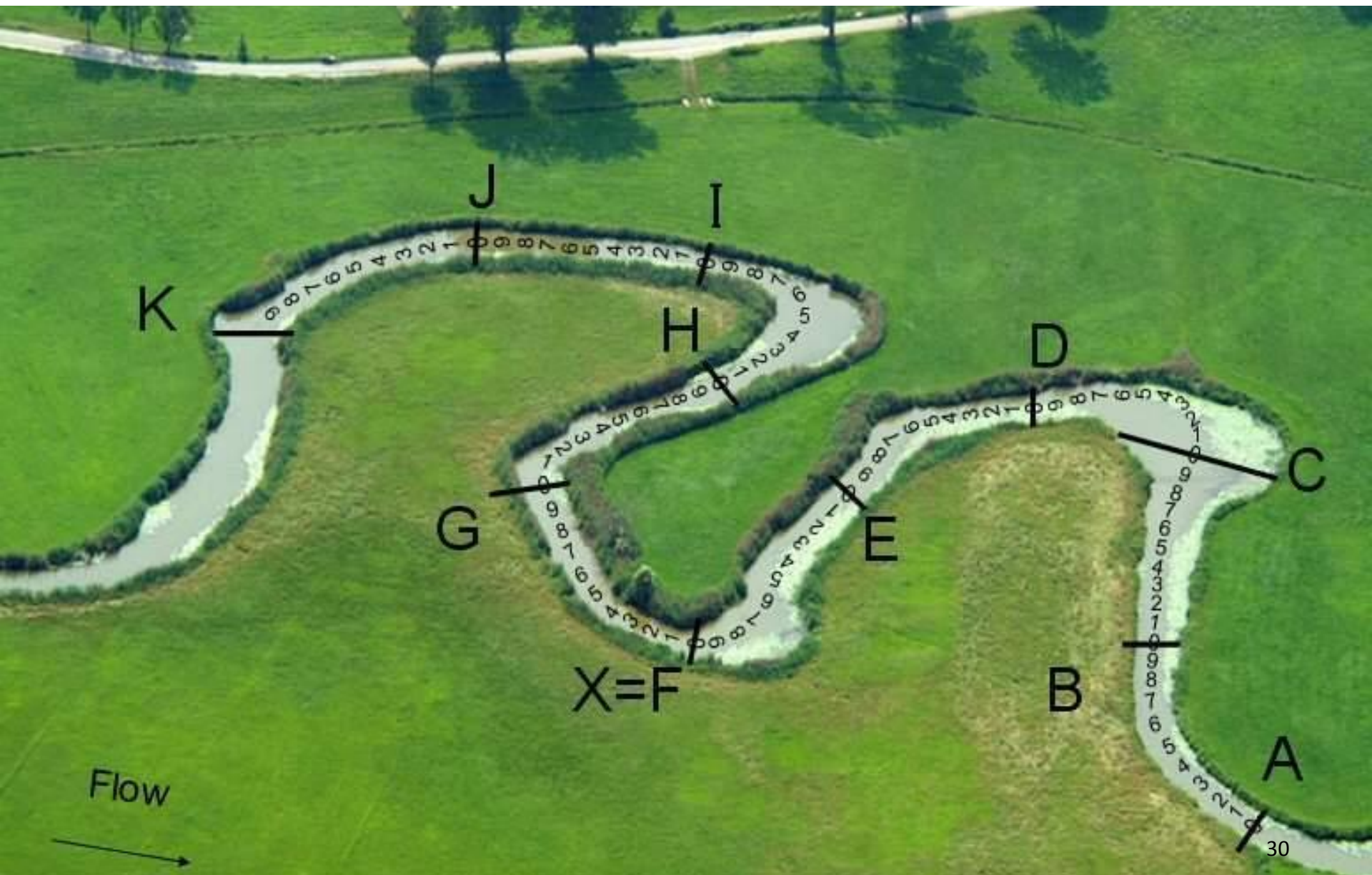
# Other Variables Measured

## Other Indicators: Watershed

- Field crews made observations of watershed activities and disturbances
- Site characteristics
  - *Pristine vs Disturbed*
  - *Appealing vs Unappealing*
- General assessment
- In the office:
  - Evaluation of dams, land use, precipitation.



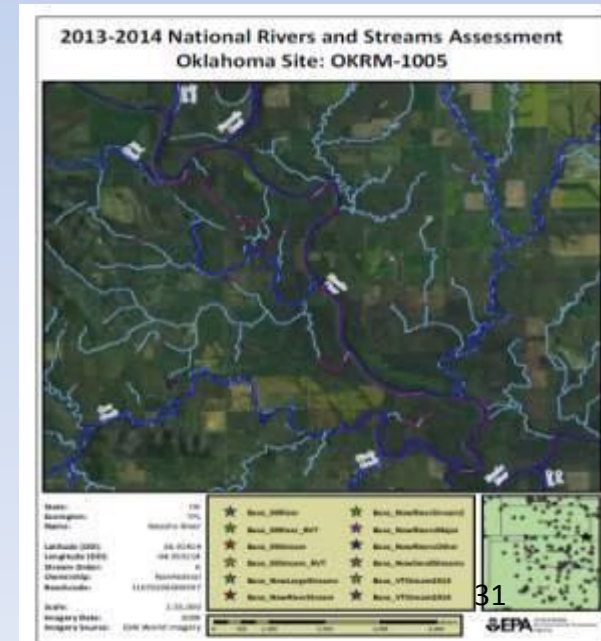
# NRSA Sampling Approach





# Site Evaluation Resources

- Sites evaluated in the office and in the field
- Site evaluation ensures sites target population of perennial streams are sampled
- Desktop review, permits, landowner permission part of evaluation process



**In the Field: 2008-2009**



**Index Period: Late May to end of September**



**Field Crews: States, Tribes, EPA, Contractors, USGS, NPS**



**Standard methods and indicators**



# Determining Thresholds: Setting the Bar

- Reference Condition: Least disturbed condition
  - Represents ‘best of what’s left’ in an altered landscape
- Baseline for evaluation of survey data
  - Set good/fair/poor condition categories for most indicators



Telegraph Creek, FL  
<http://water.dep.state.fl.us>



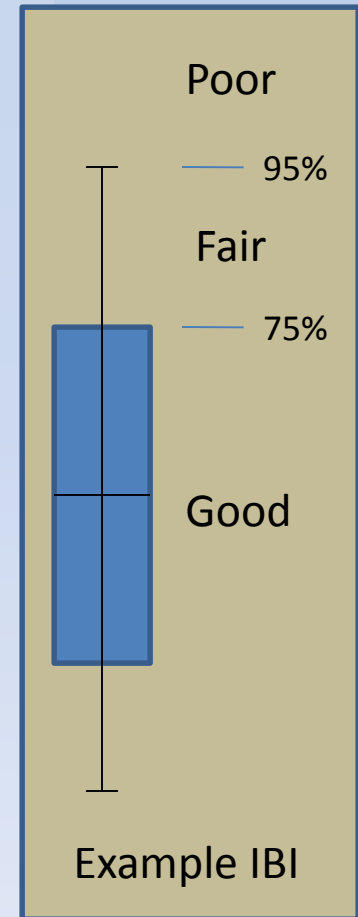
Rock Bridge Fork, KY  
[www.water.ky.gov](http://www.water.ky.gov)



# Determining Thresholds: Setting the Bar

*For the NRSA, two types of thresholds were used to determine condition:*

- **Regionally reference-based thresholds**
  - Fixed percentile defines good/fair and fair/poor
  - Applied to bioindicators, habitat indicators and major stressors
- **National consistent thresholds**
  - Screening thresholds developed by EPA that are protective of human health
  - Applied to human health indicators



# The Screening Procedure: 3 components

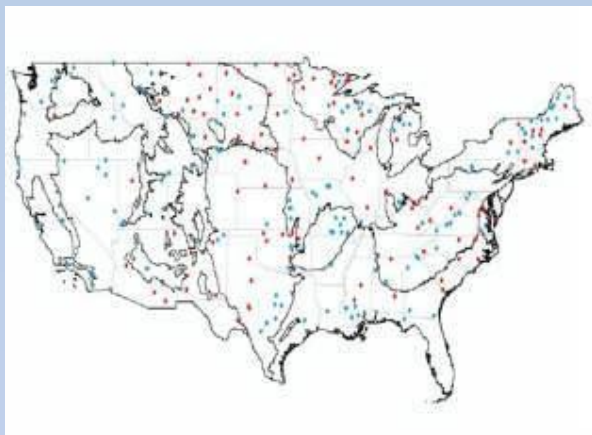
- 1) A quantitative disturbance score for the local area of influence
- 2) A quantitative disturbance score for the entire watershed
- 3) A visual assessment of disturbance at the 1:24,000 and 1:3,000 scales



*NHDPlus catchments within a watershed*

# Setting the Bar: Screening Process

Step 1



Sample all sites (both probabilistic and selected reference sites)



Screen all sites sampled with regional reference screening thresholds

Step 2

- TP
- TN
- CL
- SO4
- Turb
- ANC (given DOC)
- Riparian Dist.
- % fine substrate

Filter criterion	NAP	SAP	CPL	UMW	TPL	SPL
Total P (µg/L)	>20	>20	>75	>50	>100	>150
Total N (µg/L)	>750	>750	>2500	>1000	>3000	>4500
Cl <sup>-</sup> (µeq/L)	>250 <sup>a</sup>	>200	–	>300	>2000	>1000
SO <sub>4</sub> <sup>2-</sup> (µeq/L)	>250	>400	>600	>400	–	–
ANC (µeq/L) + DOC (mg/L) <sup>b</sup>	<50 + <5	<50 + <5	<50 + <5	<50 + <5	<50 + <5	<50 + <5
Turbidity (NTU)	>5	>5	>10	>5	>50	>50
Riparian Disturbance Index <sup>c</sup>	>2	>2	>2	>2	>2	>2
% fine substrate	>25	>25	>50	>40	>80	>90

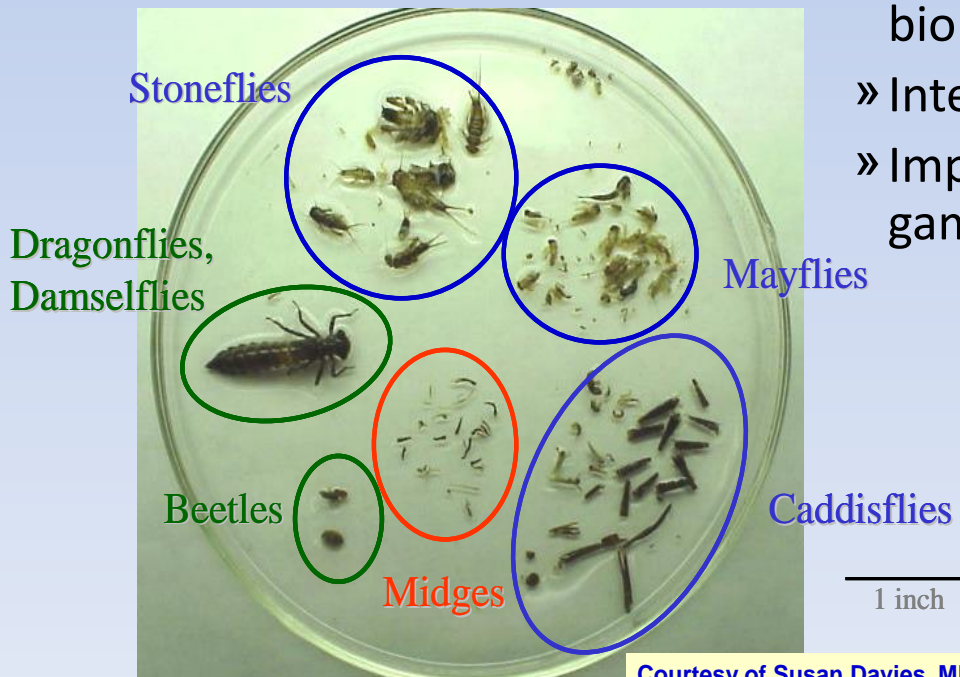
Must pass all = ref



# Indicators of Biological Condition

- **Benthic Macroinvertebrates:** Index of biotic integrity (IBI) incorporating 6 metrics of benthic community health
- Why benthic macroinvertebrates?

- » Used by most states as indicator of biological condition
- » Integrate the effects of stressors over time
- » Important food source for game and non-game fish

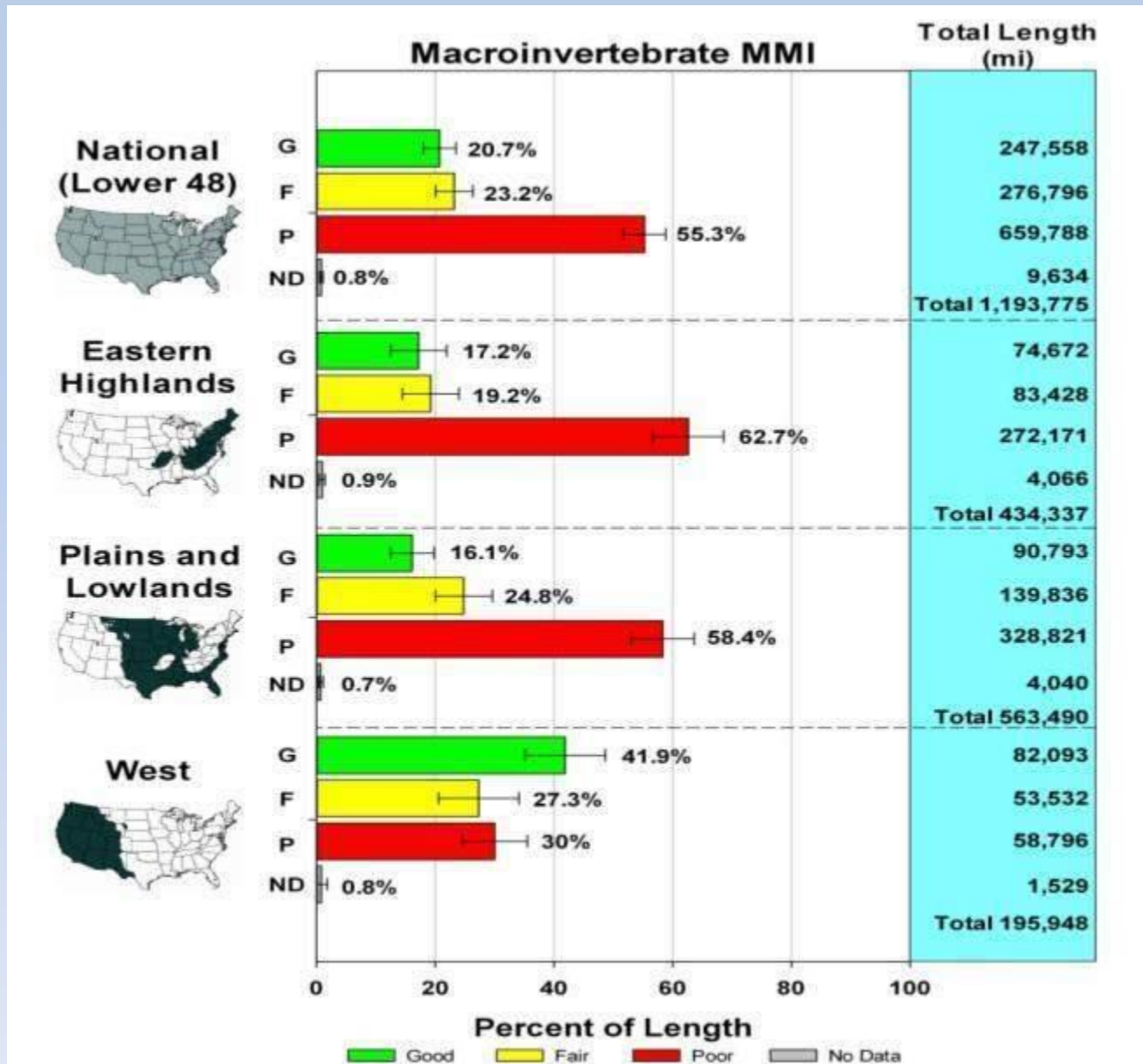


Courtesy of Susan Davies, ME DEP

# Biological Condition of the Nation's Rivers and Streams: Benthic Macroinvertebrates

- Multi Metric Index (MMI) combines measures of community integrity.
  - Process:
    - Reference sites are identified within ecoregions
    - A variety of metrics describing the functional and structural attributes of the community are tested
    - Researchers identify those metrics that identify changes from the ecoregional reference sites that are ecologically relevant
    - MMI is adjusted for natural attributes that affect the community (e.g., depth, lat/long, elevation, pH)
- MMI is scaled to a score of 0-100

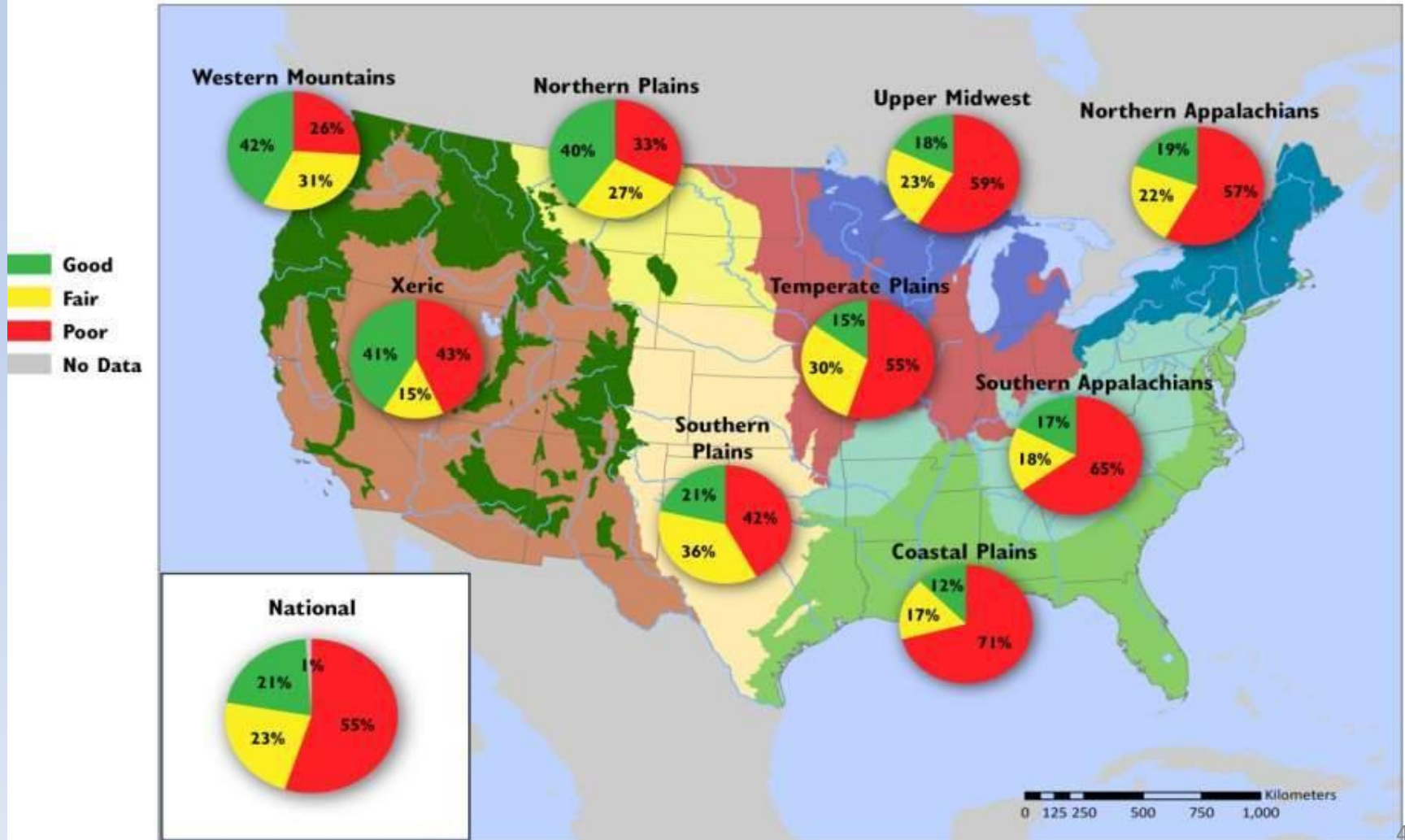
# Benthic Macroinvertebrate MMI





# Biological Condition Varies Across the Country

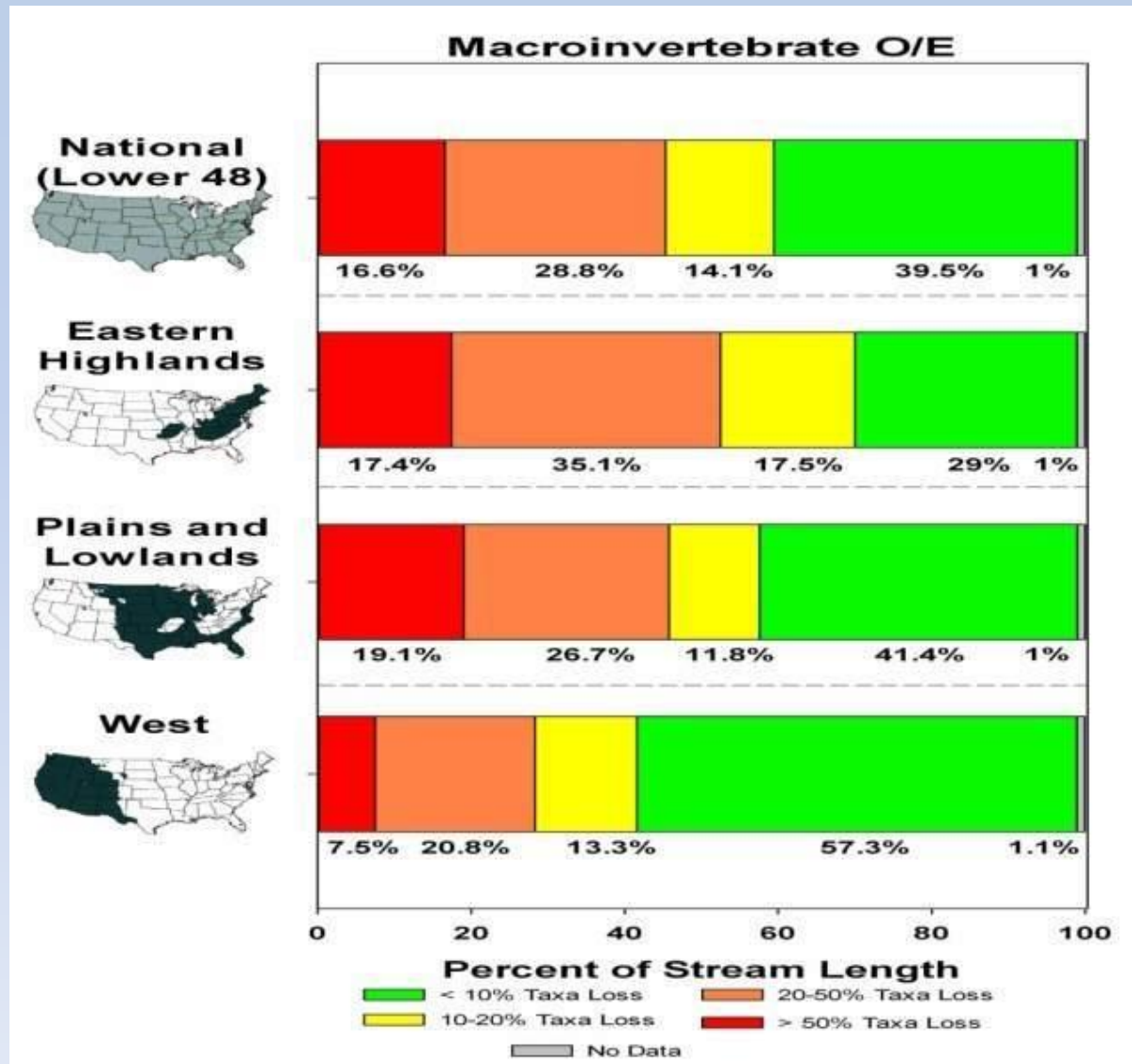
Biological Condition — Macroinvertebrate MMI



# Biological Condition of the Nation's Rivers and Streams: Taxa Loss Using an "O/E" Model

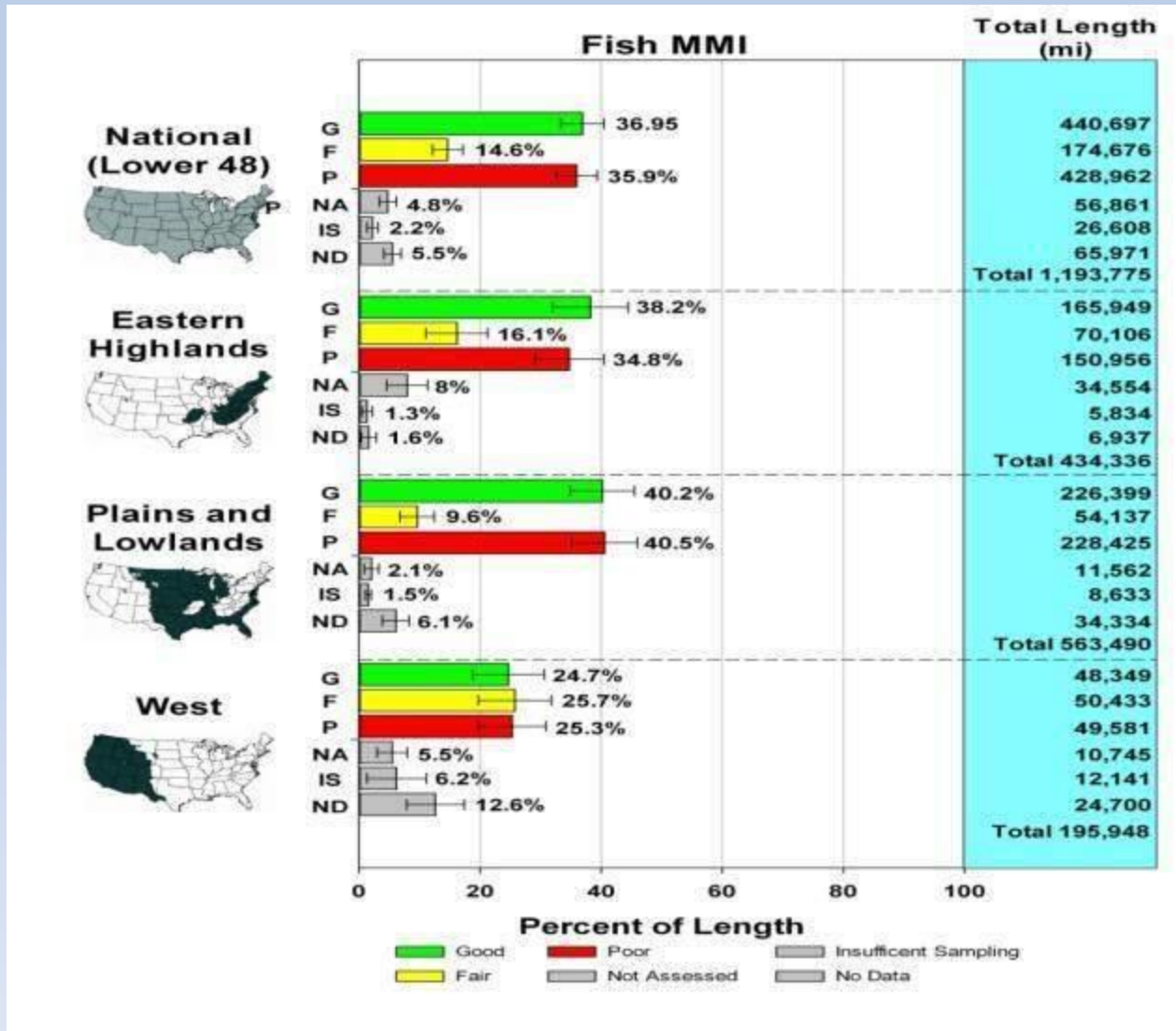
- Taxa loss models estimate the taxa Observed at sites relative to the taxa that are Expected at sites of a similar type.
  - Process:
    - Reference sites within regions are classified using physical attributes
    - All sites are compared to reference classes
    - Expected taxa are determined from the reference sites, by class
    - Observed taxa are related to expectation
- O/E ranges from near 0 (complete loss) to >1.0

# Benthic Macroinvertebrate Taxa Loss Model

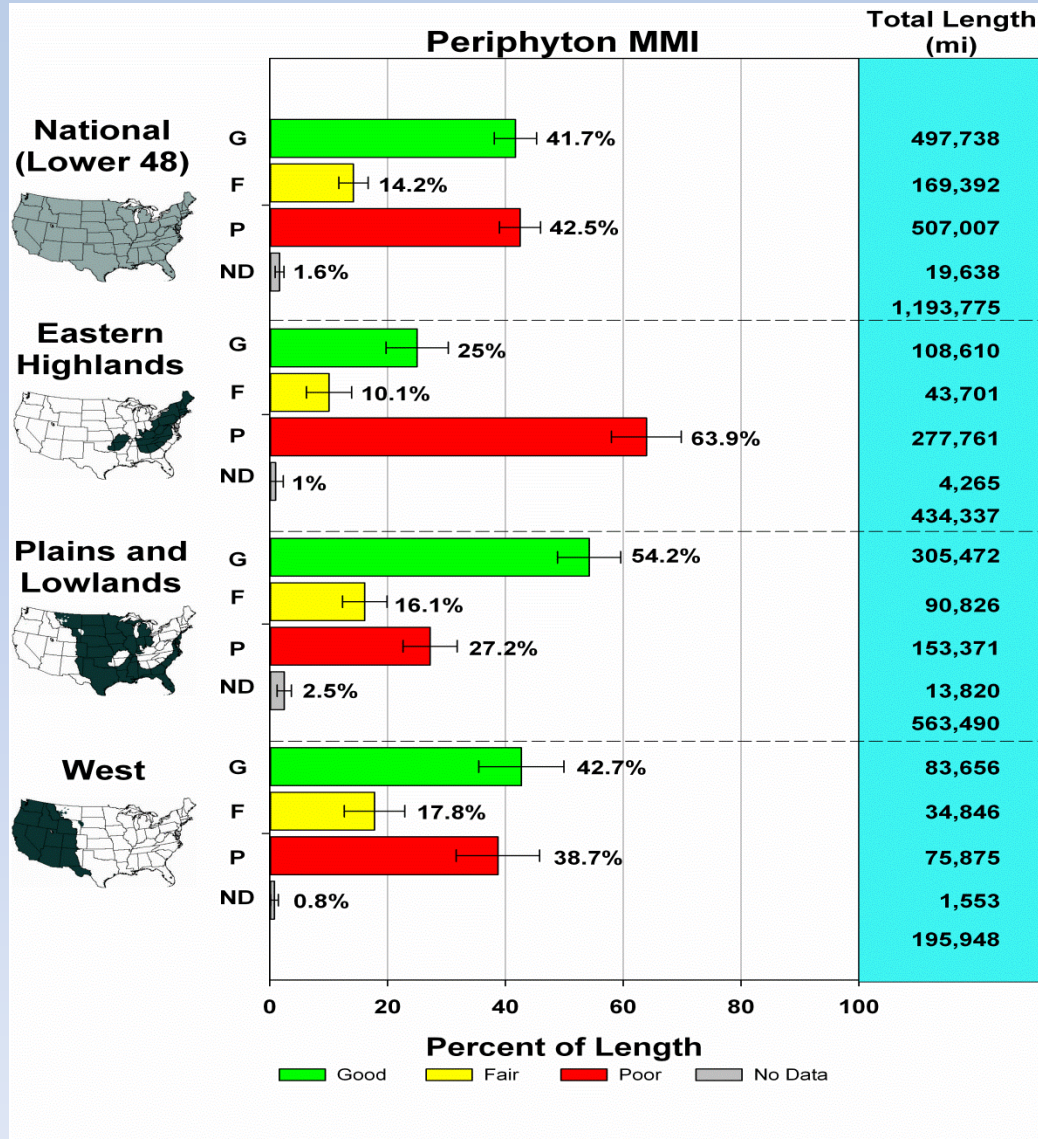




# Fish Assemblage MMI



# Periphyton MMI



# Questions?

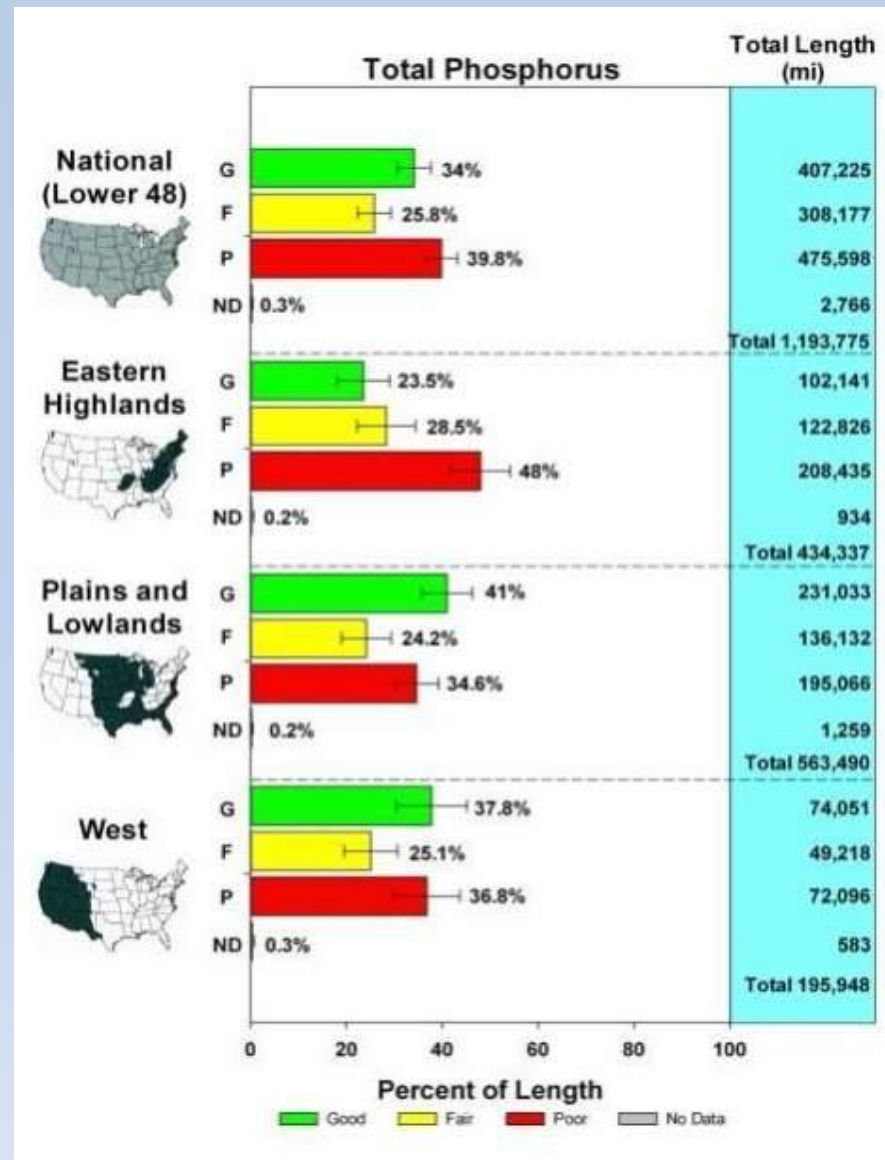
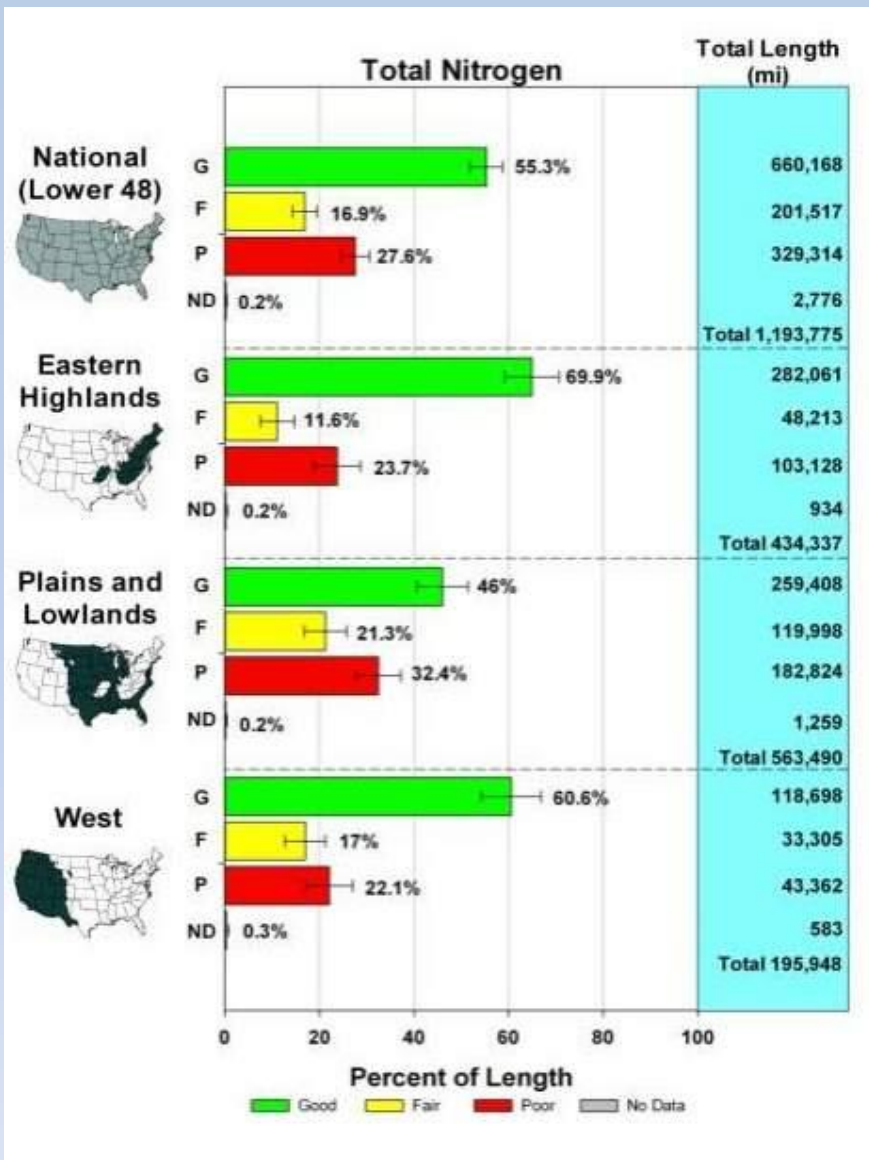




# Water Chemical Stressors

- Grab sample center of the reach
- Compared to ecoregional reference thresholds
- Parameters reported:
  - Total Nitrogen
  - Total Phosphorus
  - Salinity
  - Acidification

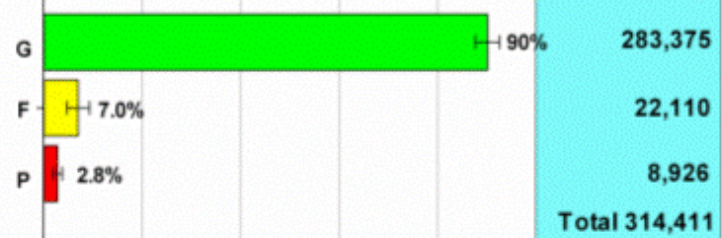
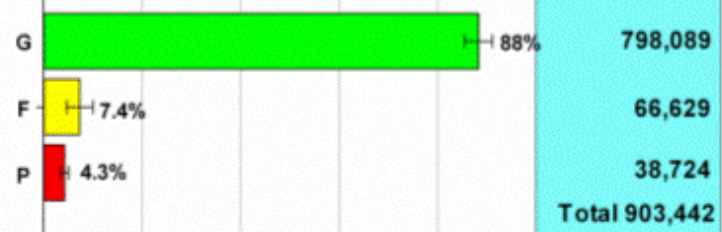
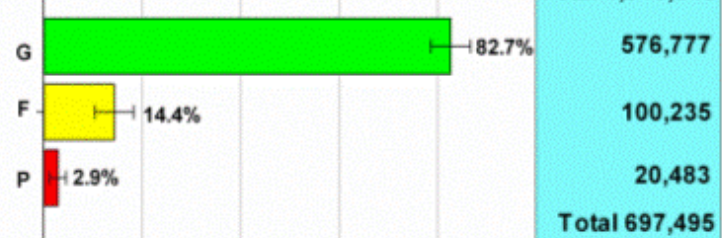
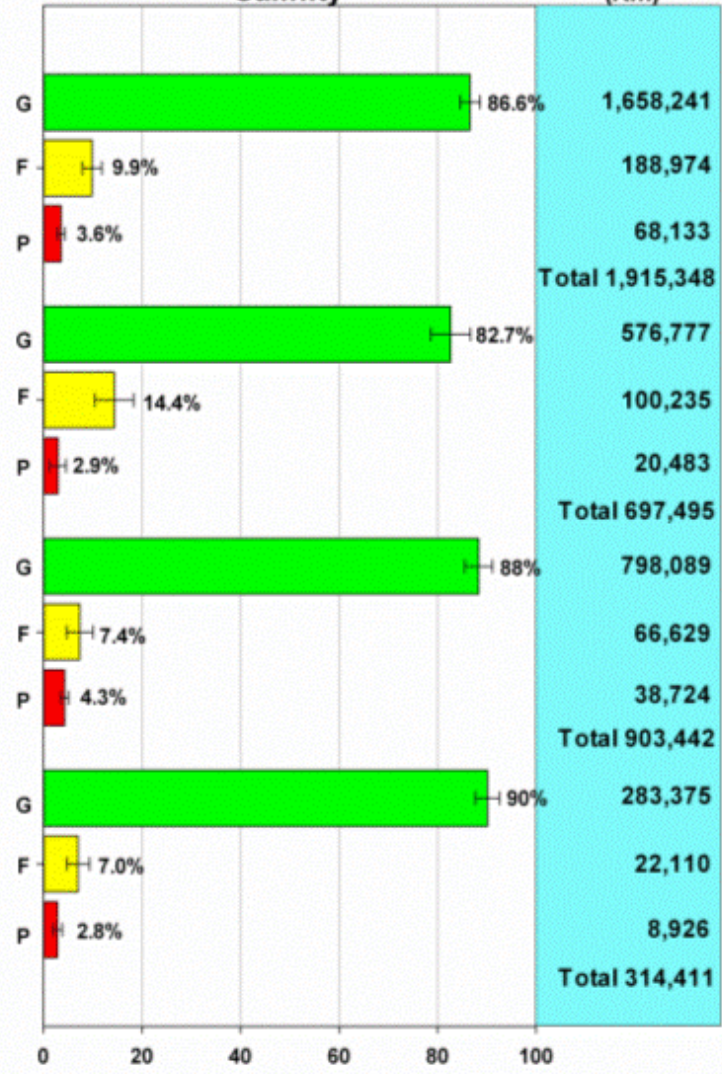






### Salinity

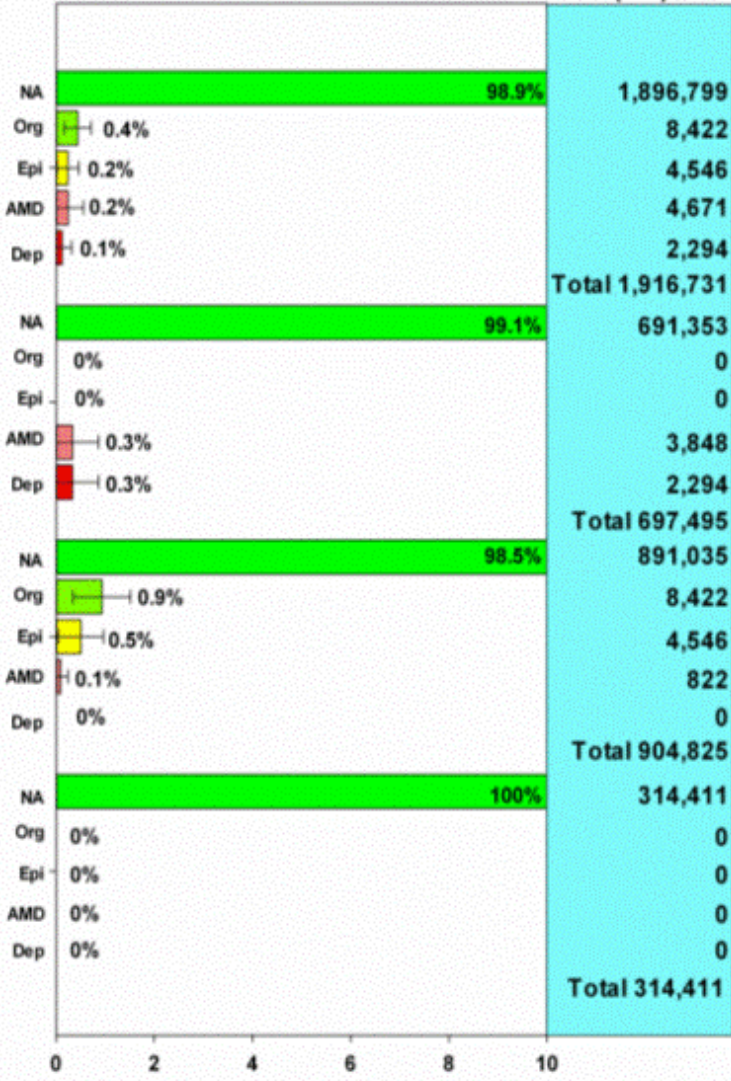
Total Length (Km)



Percent of Length  
■ Good ■ Fair ■ Poor

### Acidification

Total Length (Km)



Percent of Length  
■ Acidic Natural Organic ■ Acidic Episodes ■ Acidic Deposition  
■ Non-Acidic ■ Acidic Mine Drainage



# Physical Habitat:

Crews measure hundreds of aspects of the stream and river physical habitat to assess its condition.

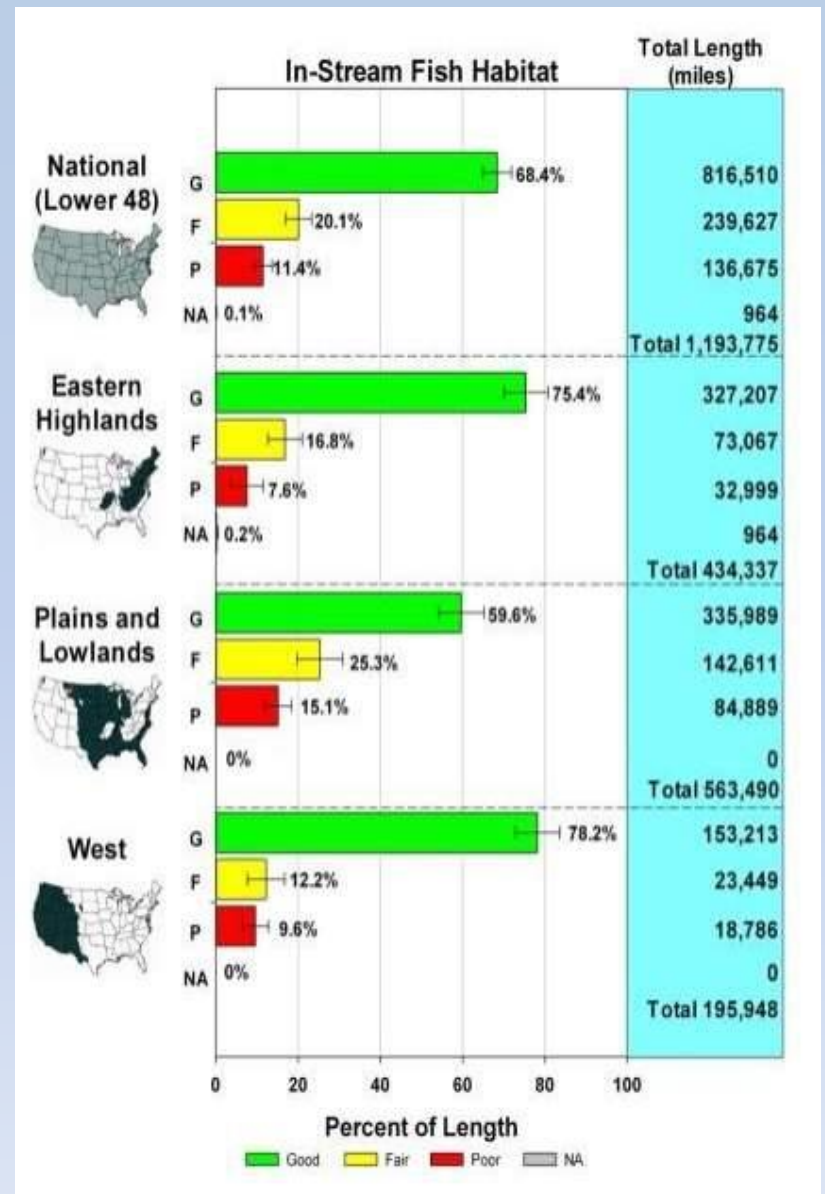
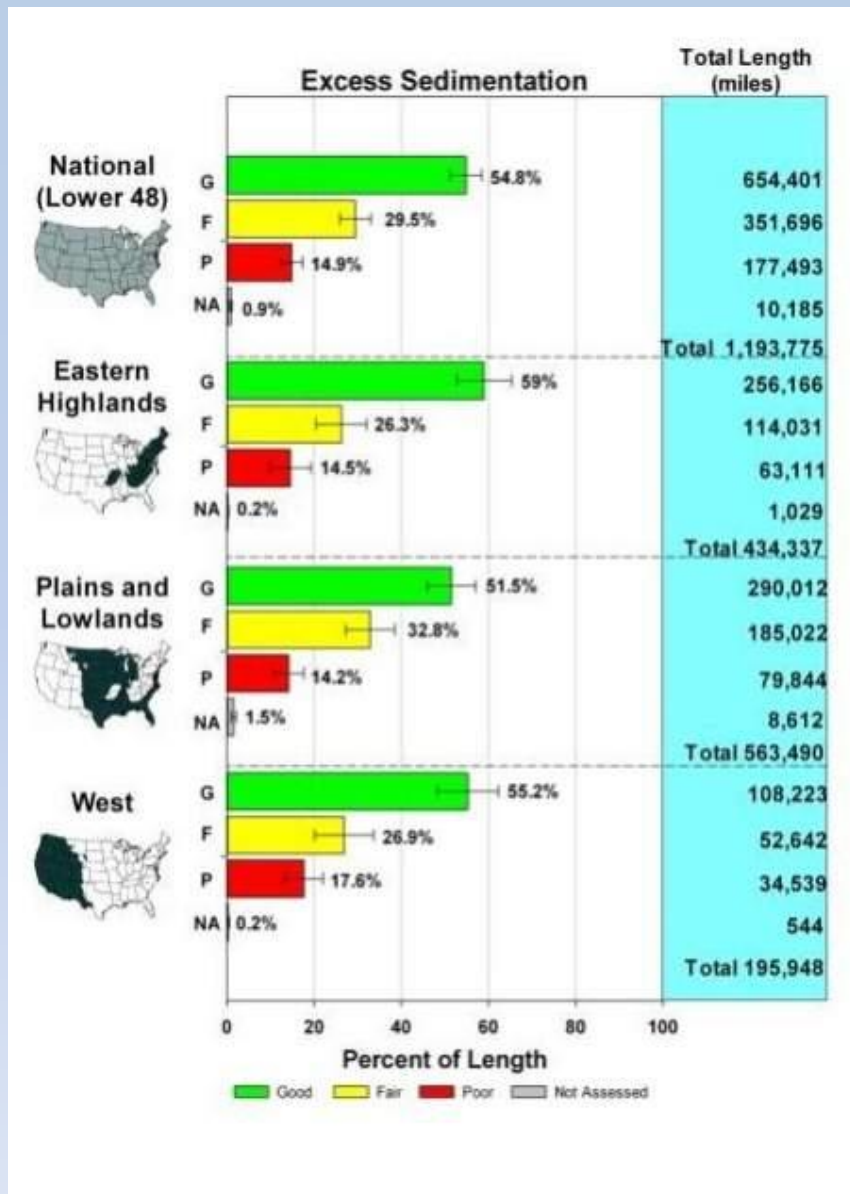
Quantitative measure of stream habitat condition.



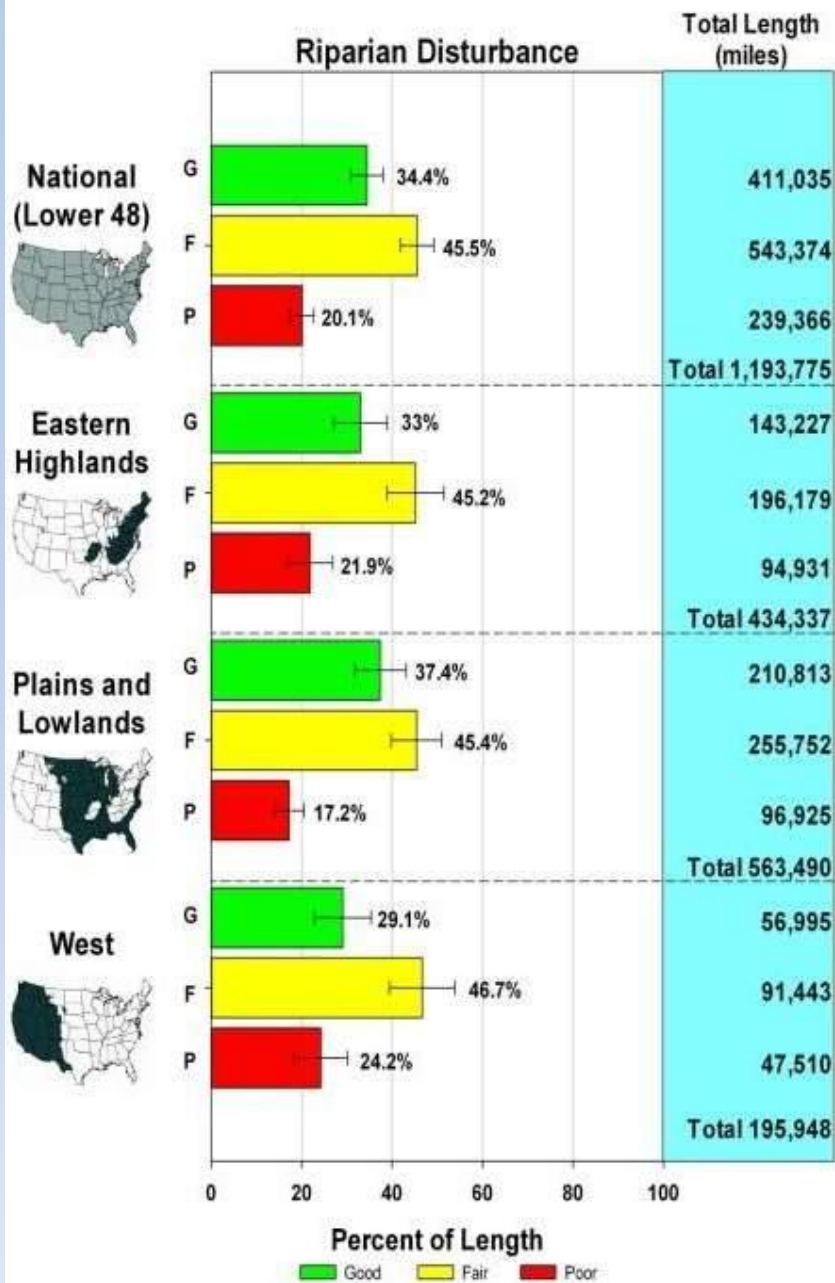
SUBSTRATE CROSS-SECTIONAL INFORMATION			
Code	Dist	Flow	W/O
1.00	10	10	10
1.10	10	10	10
1.20	10	10	10
1.30	10	10	10
1.40	10	10	10
1.50	10	10	10
1.60	10	10	10
1.70	10	10	10
1.80	10	10	10
1.90	10	10	10
2.00	10	10	10

SUBSTRATE CROSS-SECTIONAL INFORMATION			
Code	Dist	Flow	W/O
1.00	10	10	10
1.10	10	10	10
1.20	10	10	10
1.30	10	10	10
1.40	10	10	10
1.50	10	10	10
1.60	10	10	10
1.70	10	10	10
1.80	10	10	10
1.90	10	10	10
2.00	10	10	10

Riparian Disturbance  
Excess Sedimentation  
In-stream Fish Habitat  
Riparian Vegetative  
Cover







### National (Lower 48)



### Eastern Highlands



### Plains and Lowlands



### West





# Human Health Indicators

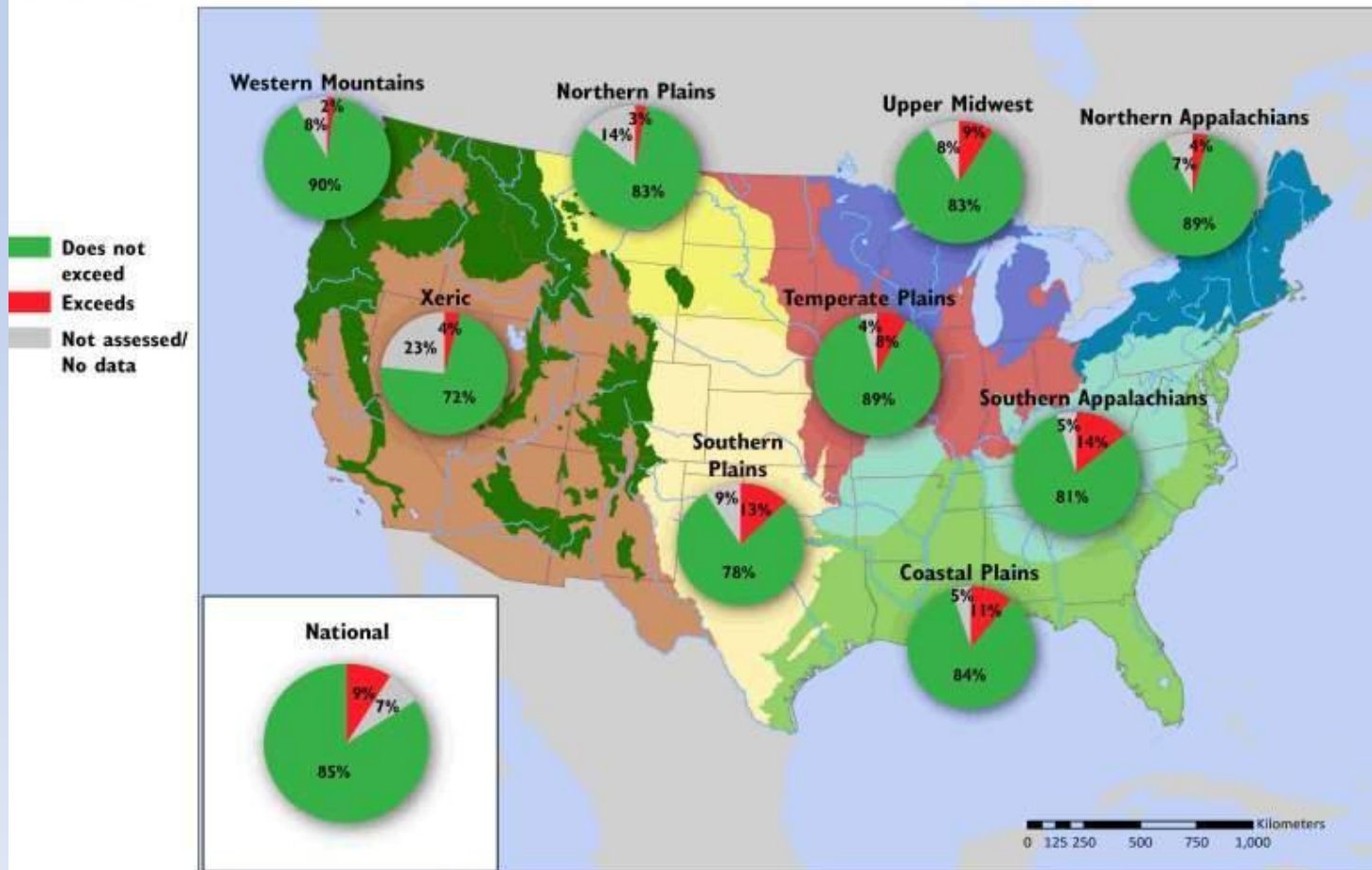
- Fish Tissue
  - Report focuses on mercury
  - Human health thresholds applied
  - Samples collected from 5<sup>th</sup> order and larger sites
  - Additional parameters reported on when available



# Human Health - Enterococci (qPCR)

- Fecal Indicator collected at all sites
- Quantitative Polymerase Chain Reaction analysis

## Enterococci



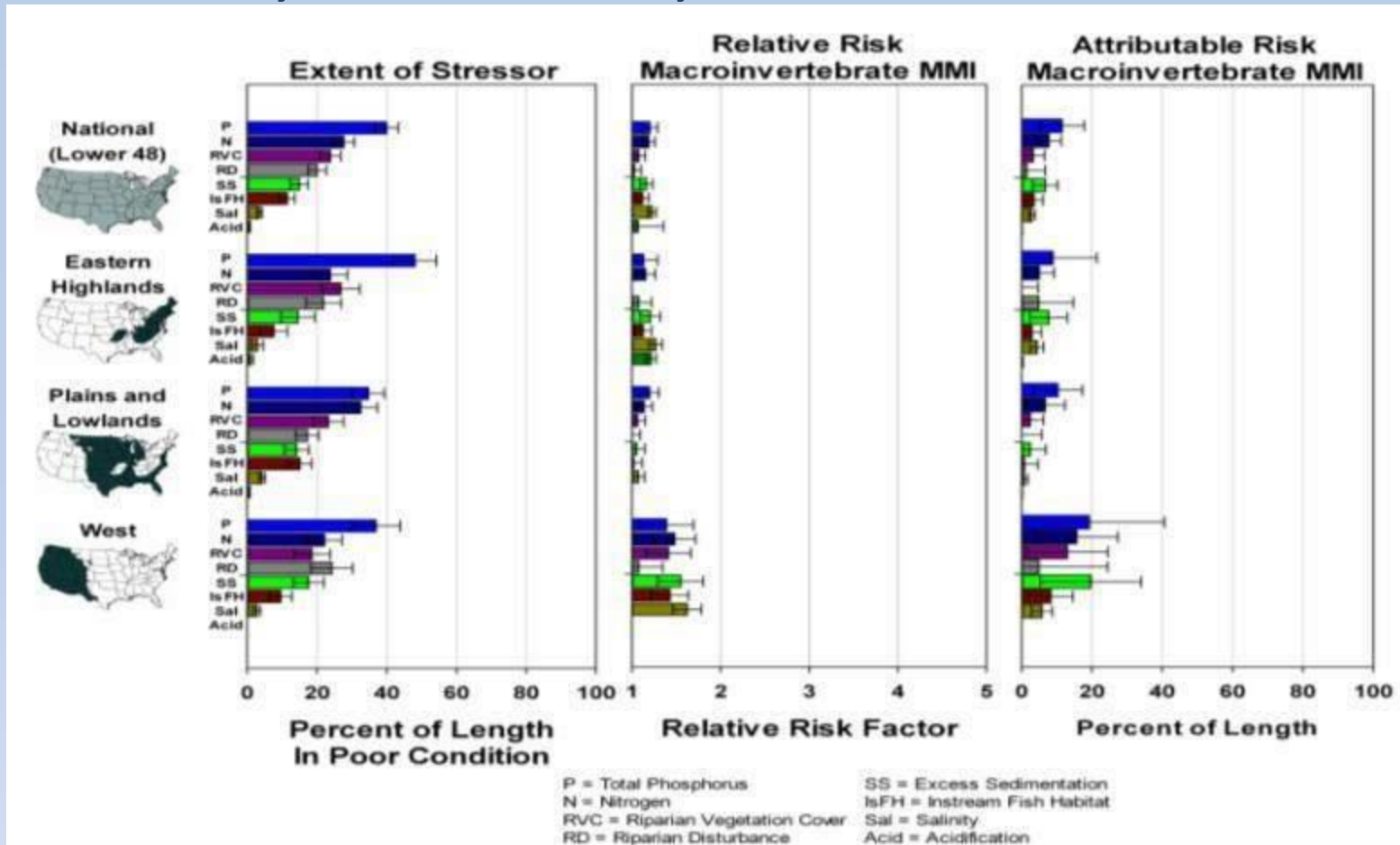
Compared to  
EPA thresholds

# Stressor Extent and Resulting Risk: Relating Stressors to Biological Condition

- NRSA evaluated stressors against biological condition, to assess which are most important.
- Examination of the relationship between three indicators provides:
  - Relative Extent – What is the proportion of stressors in poor condition?
  - Relative Risk – When stressors indicate poor condition, what is the increased proportion of river and stream miles with poor biological condition?
  - Attributable Risk – What percent of river and streams miles that are in poor biological condition should move to good/fair if this stressor is eliminated?



# Stressors of the NRSA: Extent, Relative Risk, and Attributable Risk



- RE- Total Phosphorous: Most widespread stressor across the U.S.
- RR- Poor biology is 50% more likely when high levels of phosphorus present.
- AR –IF phosphorous levels were reduced to “low,” 10% of river and stream miles would move into the good condition class for biologic condition.

# Regional Assessments

Northern Appalachians

Southern Appalachians

Upper Midwest

Coastal Plains

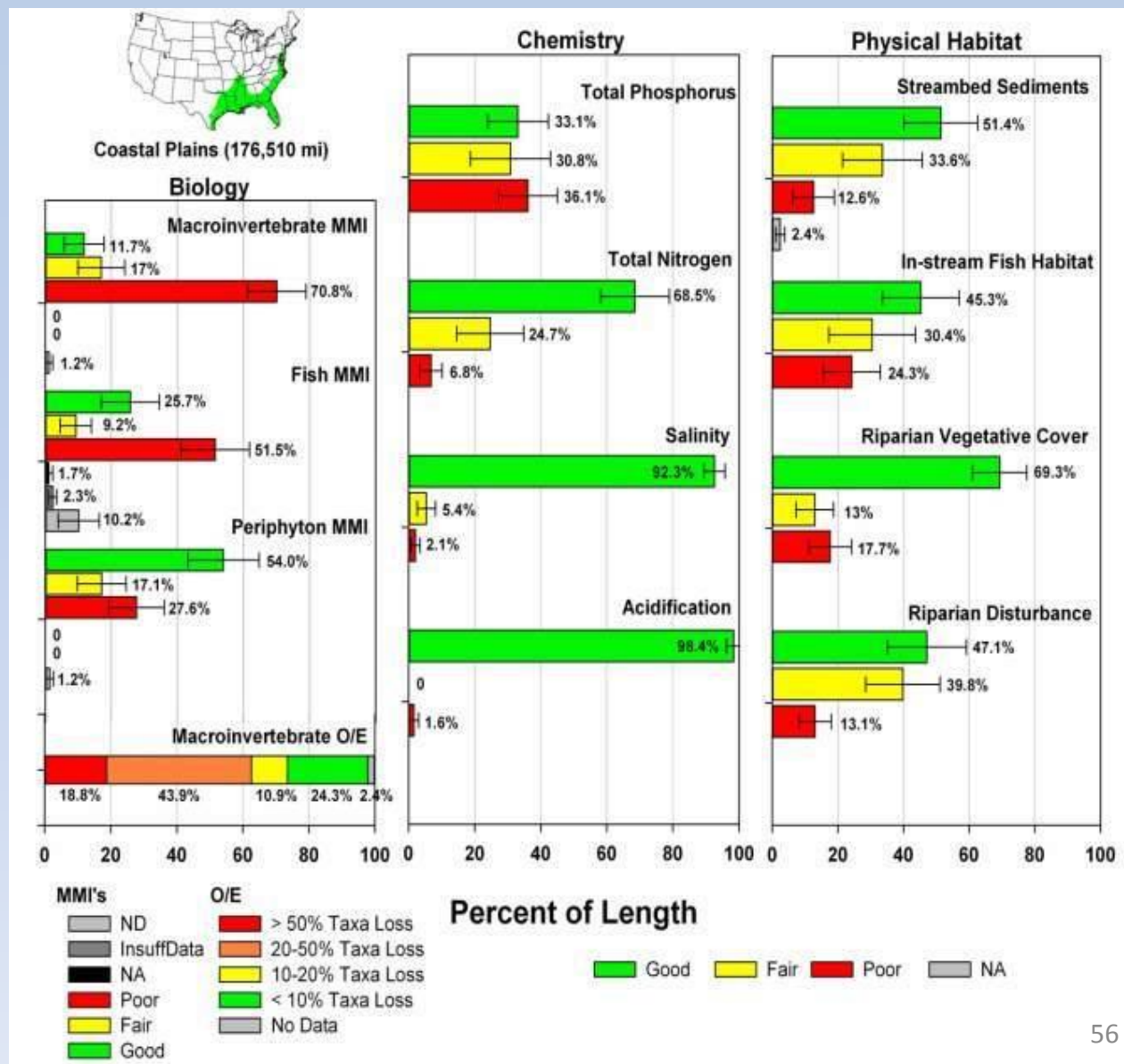
Temperate Plains

Southern Plains

Northern Plains

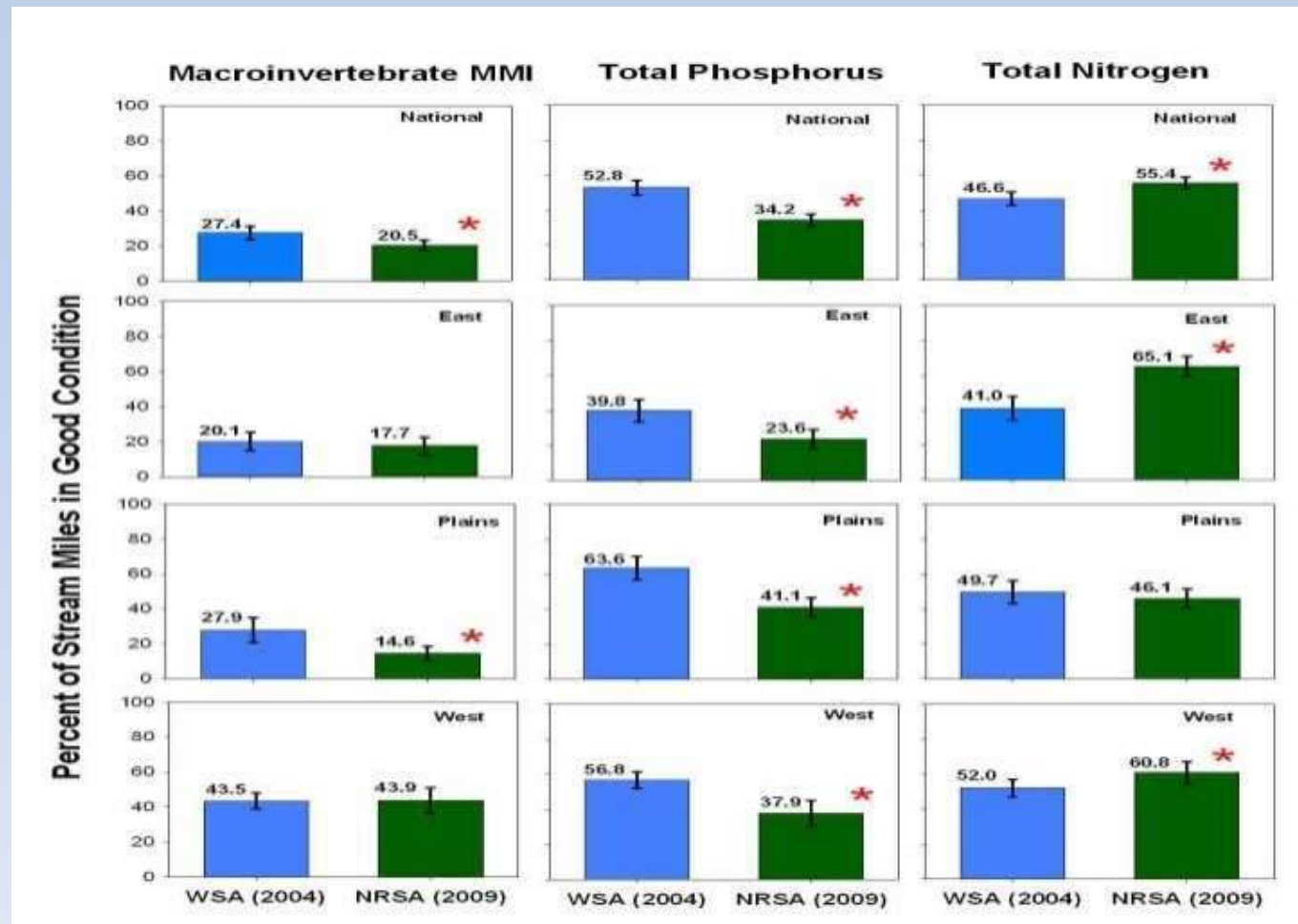
Western Mountains

Xeric West



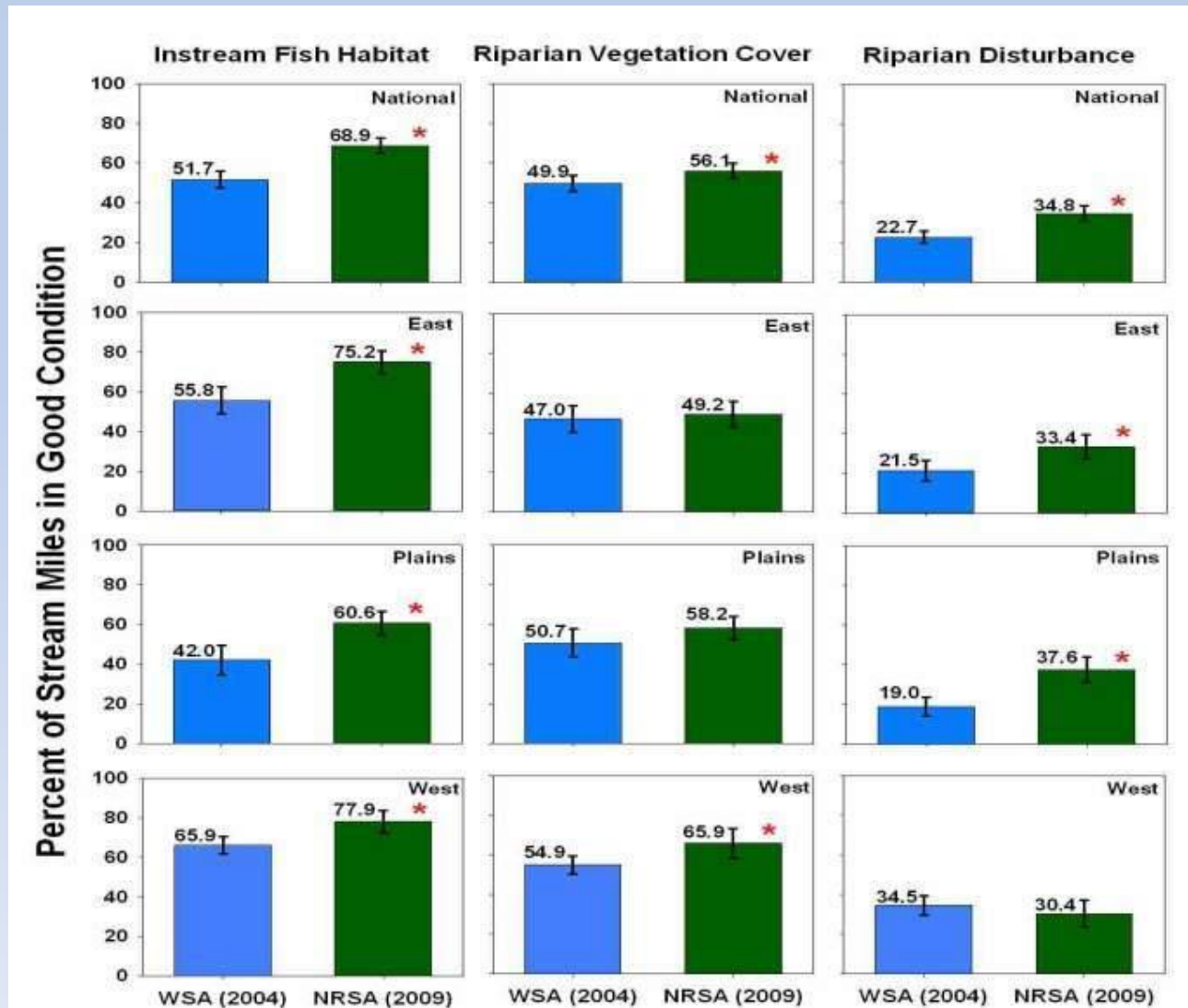
# Change in Streams: 2004-2008/09

- Change is measured across the population of wadeable streams





# Change in Streams: 2004-2008/09



# Next Steps for the NRSA

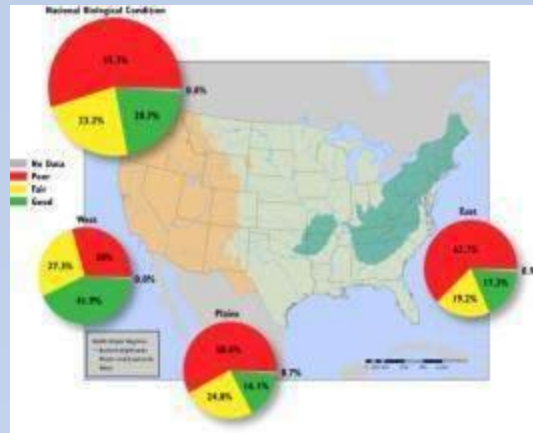
- Complete analysis and publications on supplemental indicators and new approaches
  - Additional fish tissue data
  - Random Forest Model for the Macroinvertebrate MMI
- Invite others to download the data sets for exploration and analysis
- Work with States and other Clean Water Act programs to analyze data in their programmatic context
- Present results at several upcoming meetings with Regions, States, and academics
- Initiate next round of sampling for the 2013/2014 National Rivers and Streams Assessment

# National Rivers and Streams Assessment Report

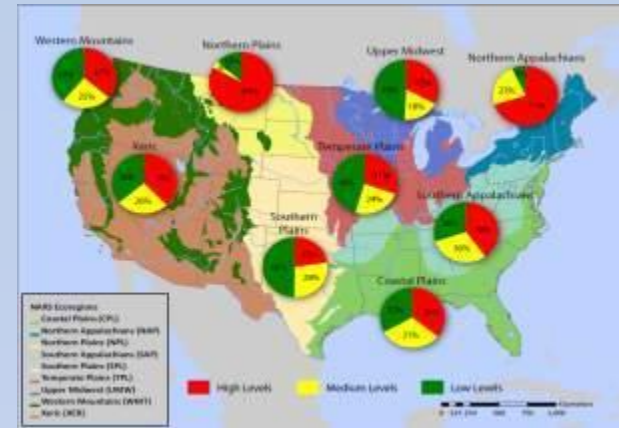
## Intro and Design



## National Findings



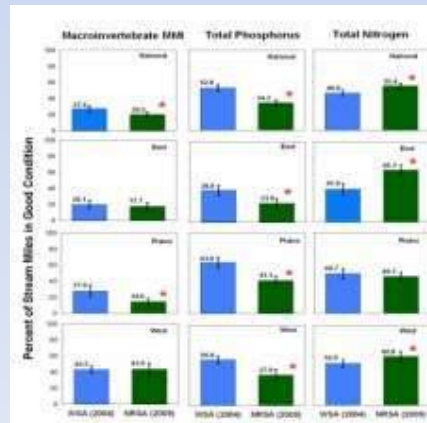
## Ecoregional Findings



## Human Health Indicators



## Change over Time



## Future Actions – NRSA in 2013/14





# Draft National Rivers and Streams Assessment Report

- EPA has published a Federal Register notice calling for a 45-day comment period
- NRSA Report available for public comment at <http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm>. Comments, due May 9, should be submitted to [nrsa-hq@epa.gov](mailto:nrsa-hq@epa.gov).
- Main National Aquatic Resource Surveys website: [www.epa.gov/aquaticsurveys](http://www.epa.gov/aquaticsurveys)

# Speaker Contact Information

## **Susan Holdsworth**



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# Next Watershed Academy Webcast



## *Using Social Indicators in Watershed Projects*

May 1, 2013 1:00 – 3:00 p.m. EST

Information will be posted at  
[www.epa.gov/watershedwebcasts](http://www.epa.gov/watershedwebcasts)



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