

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:

Susan Holdsworth, Chief of the Monitoring Branch of U.S. EPA's Office of Wetlands Oceans and Watersheds and Co-Chair of the National Water Quality Monitoring Council

Ellen Tarquinio, Environmental Protection Specialist, Project Manager for NRSA, Monitoring Branch, U.S. EPA's Office of Wetlands, Oceans and Watersheds

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.

Presenter: Susan Holdsworth

- **The National Aquatic Resource Surveys – An Overview**

Presenter: Ellen Tarquinio

- **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**

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**
 - 1st 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 2nd NRSA
- **National Wetlands Condition Assessment 2010**
 - Complete data QA and conduct data analysis and peer review
 - Release 1st 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 2nd national lakes assessment
 - Conduct data analysis and peer review
 - Release 2nd 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**



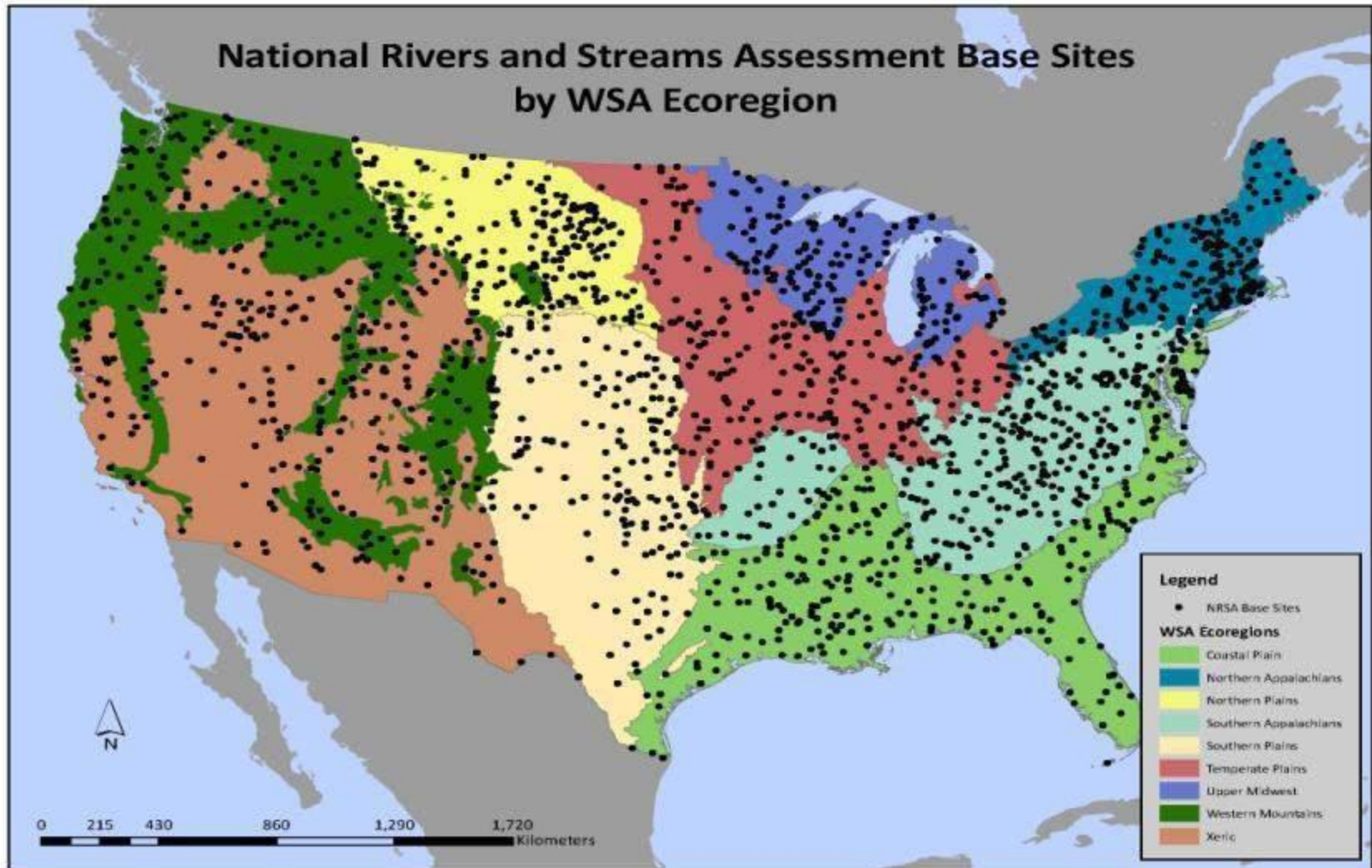
NRSA 2008/09: Design of the Survey

- **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

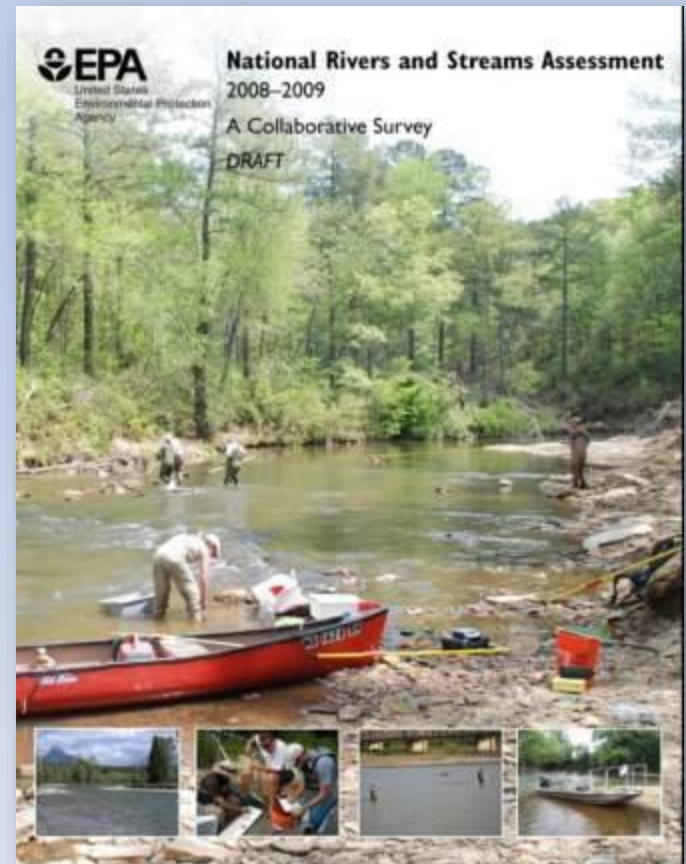


Draft NRSA Report for Public Comment includes:

- **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:

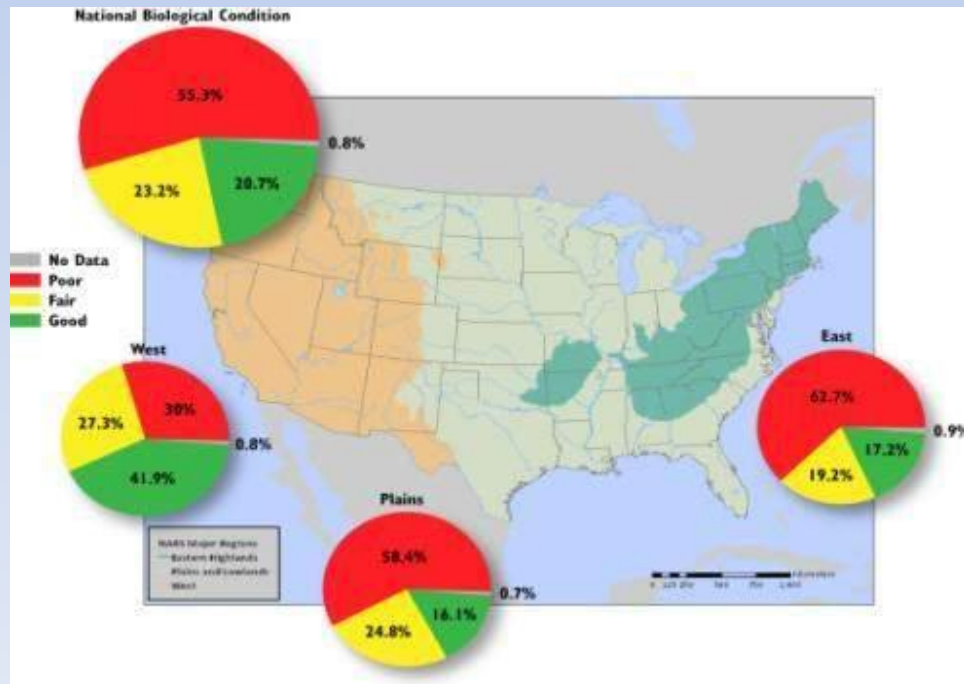
- Urban Waters for Fish Tissue PCBs and PFCs
- State Example for NRSA
- Importance of nutrients



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.

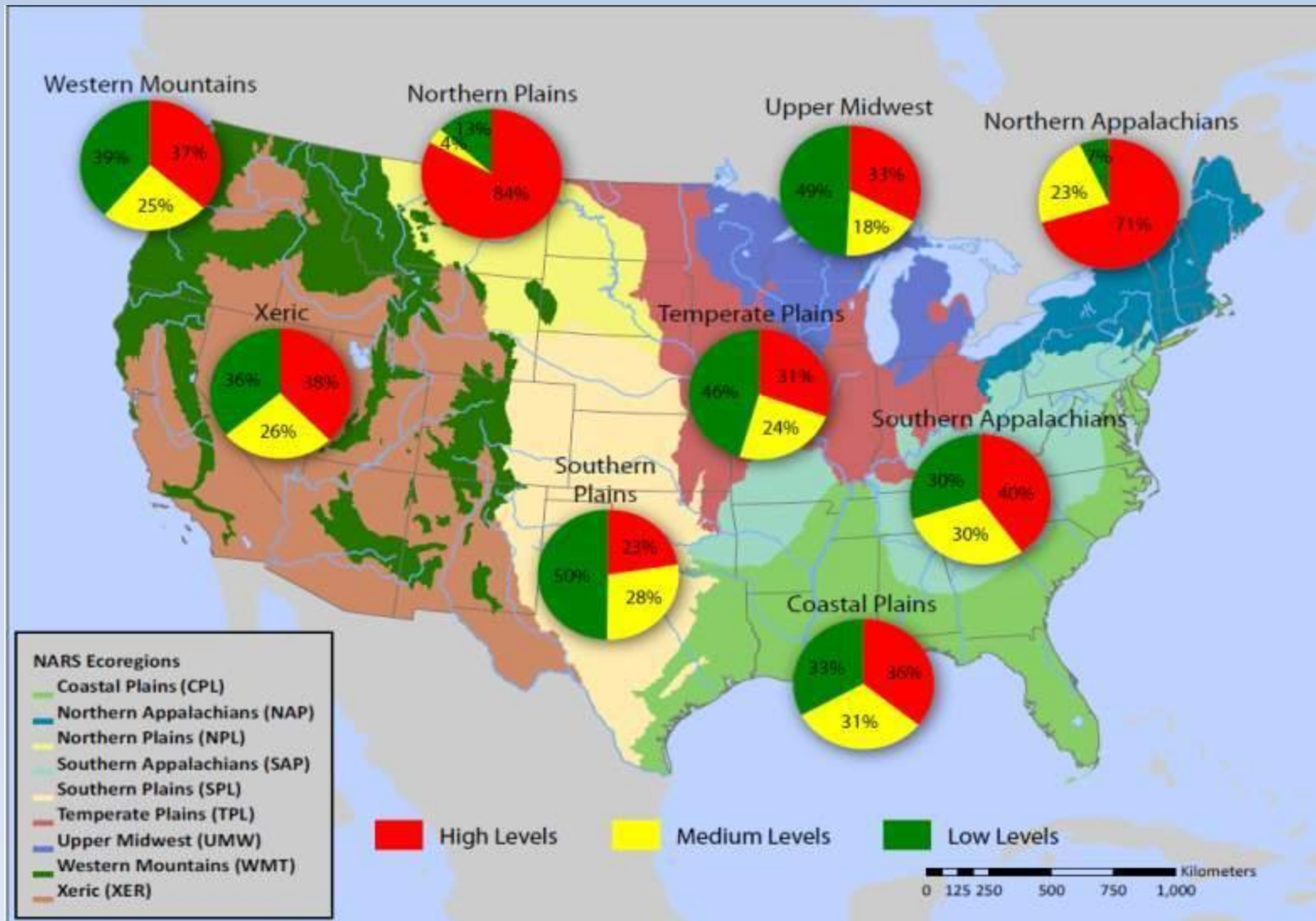


Key Findings from the NRSA – Major Stressors

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?



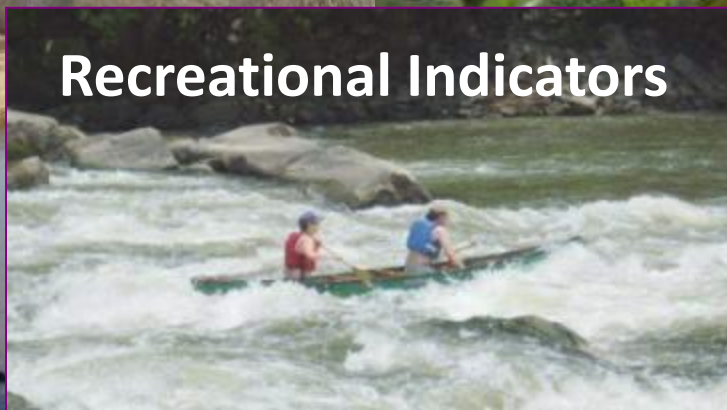
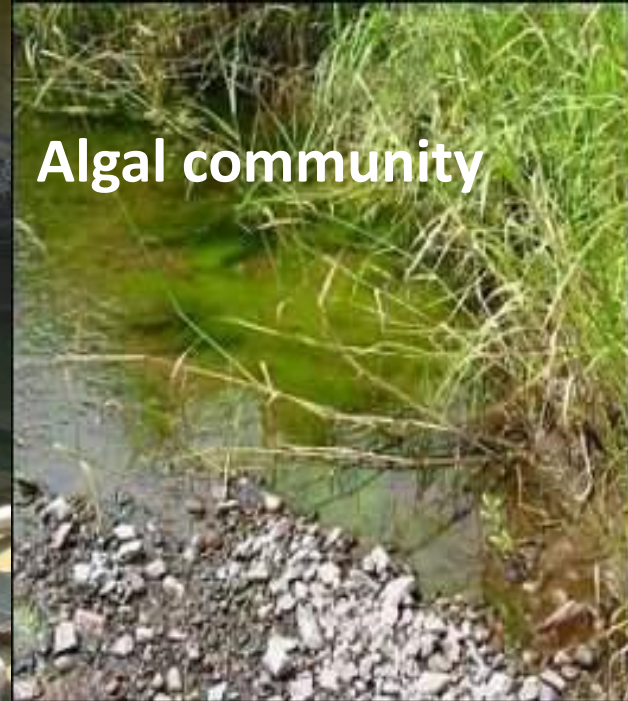
Draft National Rivers and Streams Assessment

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

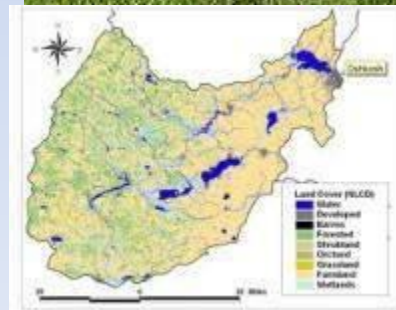




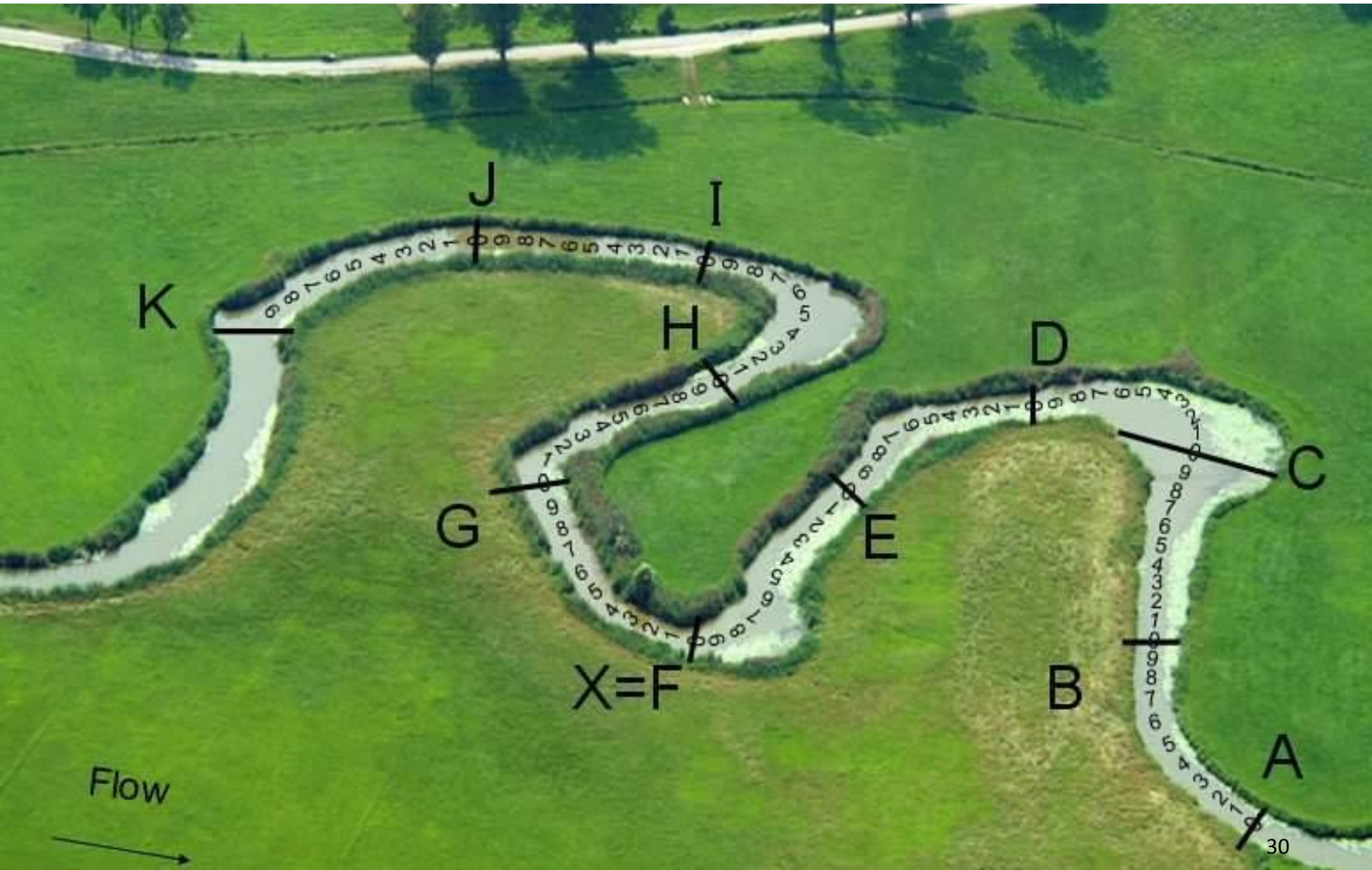
Other Variables Measured

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.

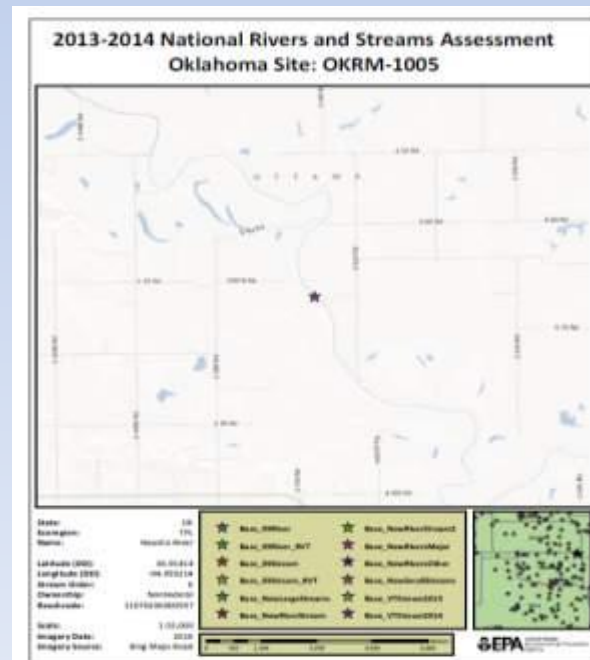


NRSA Sampling Approach



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>

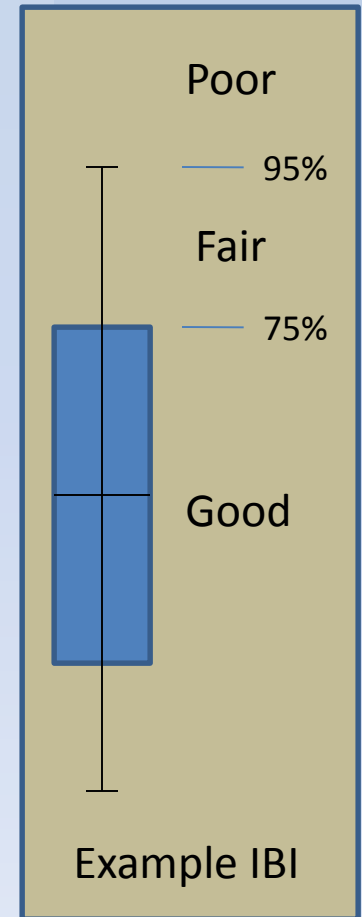


Rock Bridge Fork, KY
www.water.ky.gov

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

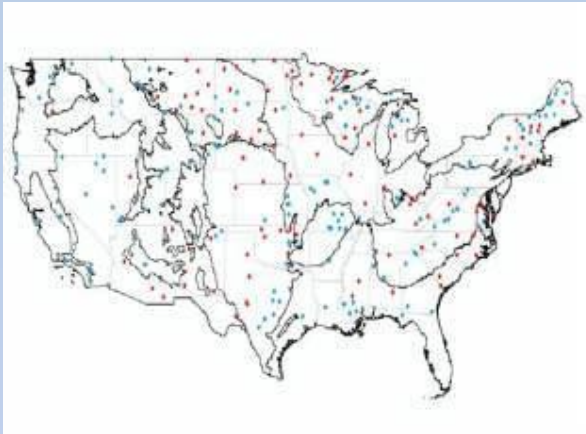
- 1) A quantitative disturbance score for the local area of influence
- 2) A quantitative disturbance score for the entire watershed
- 3) A visual assessment of disturbance at the 1:24,000 and 1:3,000 scales



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

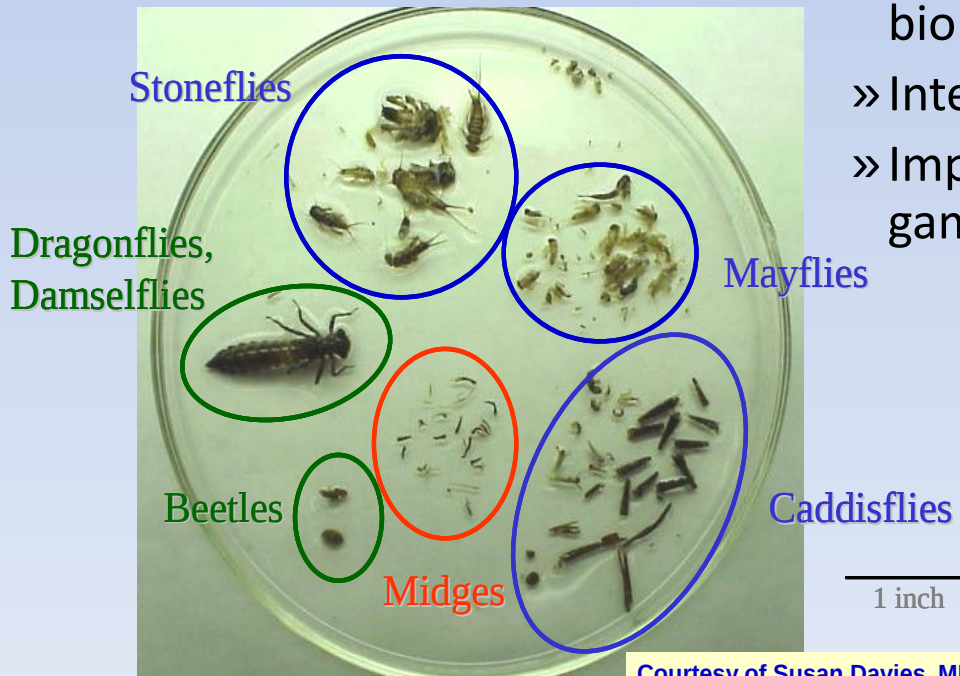
Filter criterion	NAP	SAP	CPL	UMW	TPL	SPL
Total P (µg/L)	>20	>20	>75	>50	>100	>150
Total N (µg/L)	>750	>750	>2500	>1000	>3000	>4500
Cl ⁻ (µeq/L)	>250 ^a	>200	—	>300	>2000	>1000
SO ₄ ²⁻ (µeq/L)	>250	>400	>600	>400	—	—
ANC (µeq/L) + DOC (mg/L) ^b	<50 + <5	<50 + <5	<50 + <5	<50 + <5	<50 + <5	<50 + <5
Turbidity (NTU)	>5	>5	>10	>5	>50	>50
Riparian Disturbance Index ^c	>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

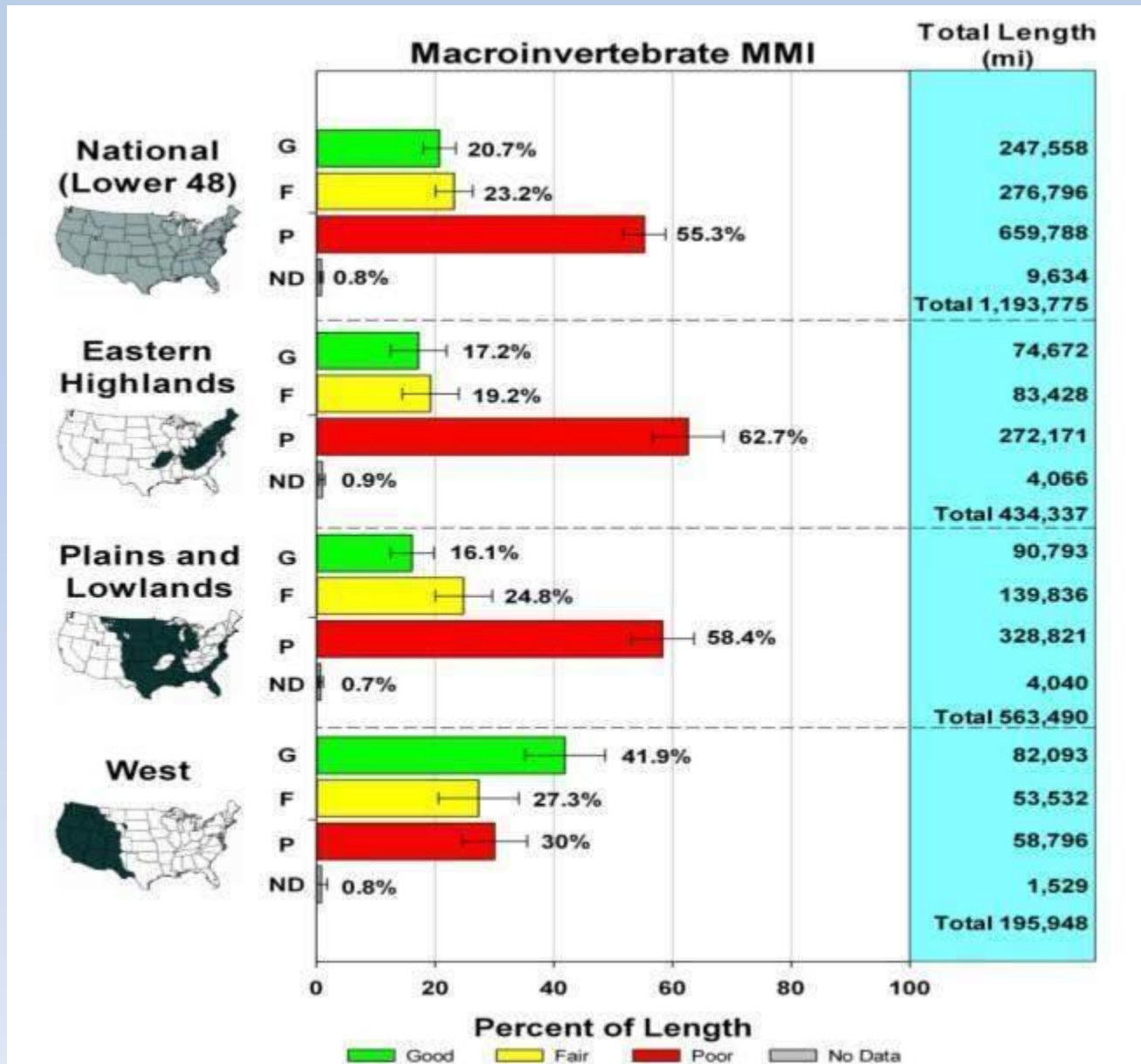


Courtesy of Susan Davies, ME DEP

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

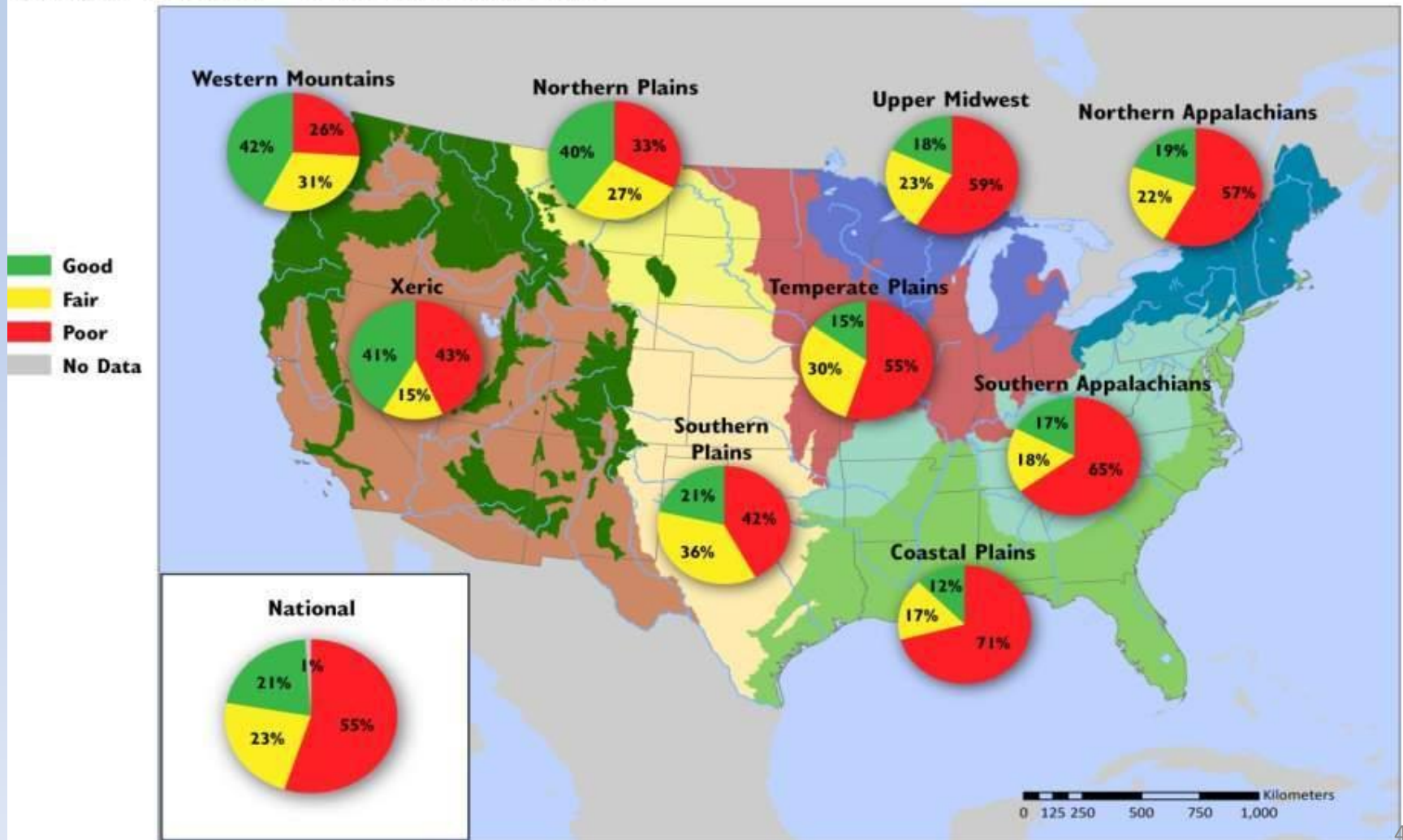
- Multi Metric Index (MMI) combines measures of community integrity.
 - Process:
 - Reference sites are identified within ecoregions
 - A variety of metrics describing the functional and structural attributes of the community are tested
 - Researchers identify those metrics that identify changes from 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

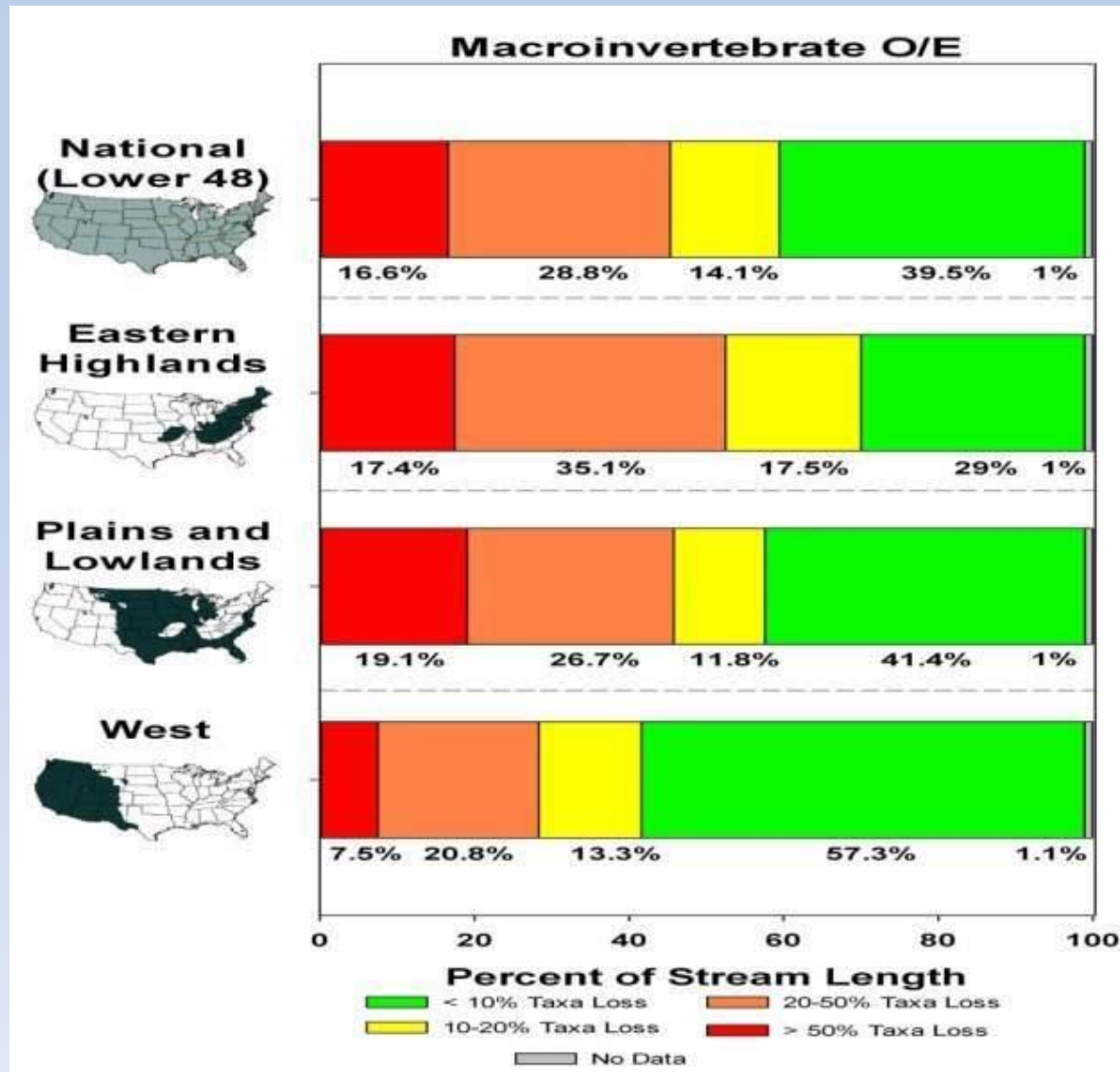
Biological Condition — Macroinvertebrate MMI



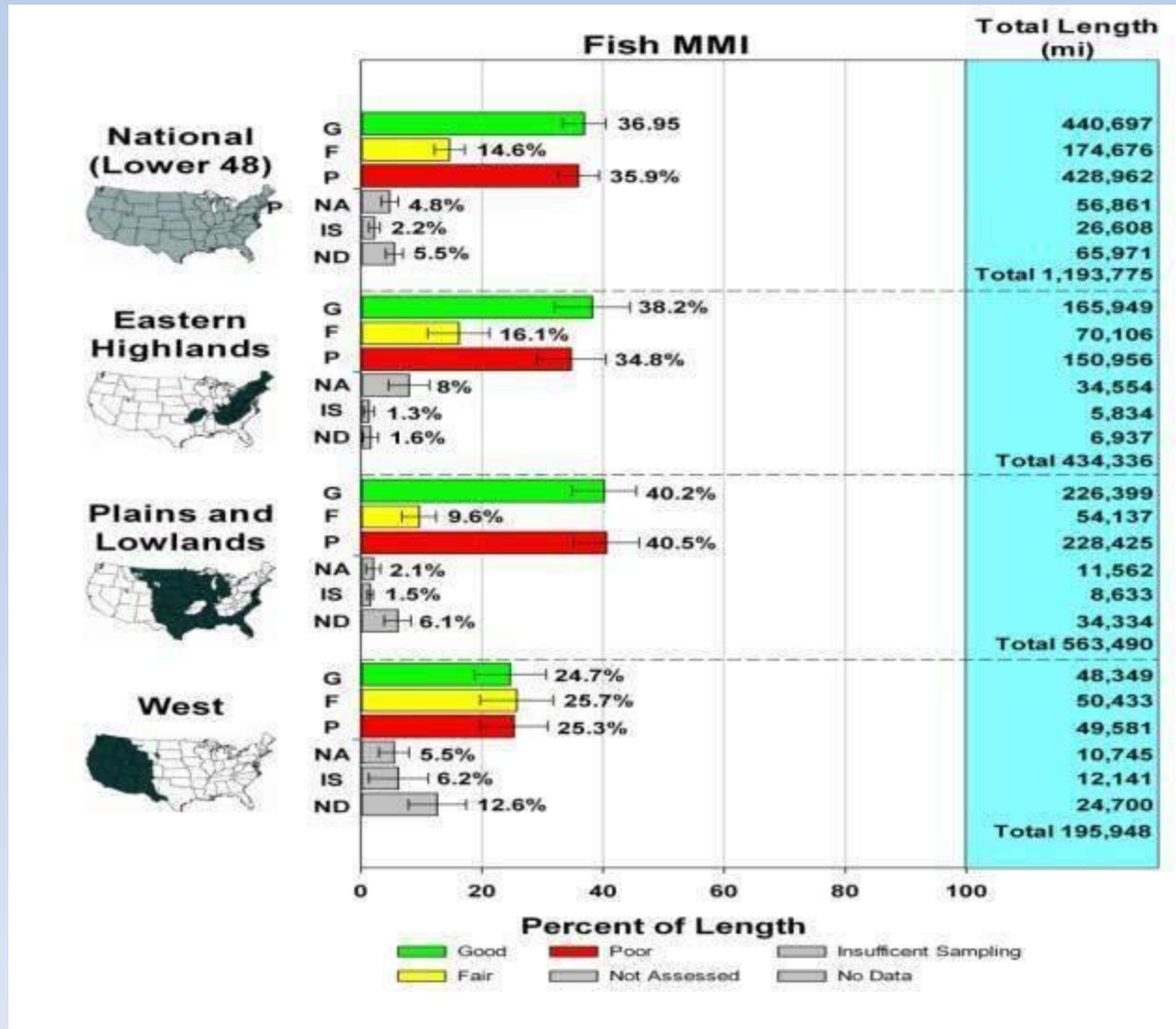
Biological Condition of the Nation's Rivers and Streams: Taxa Loss Using an “O/E” Model

- 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

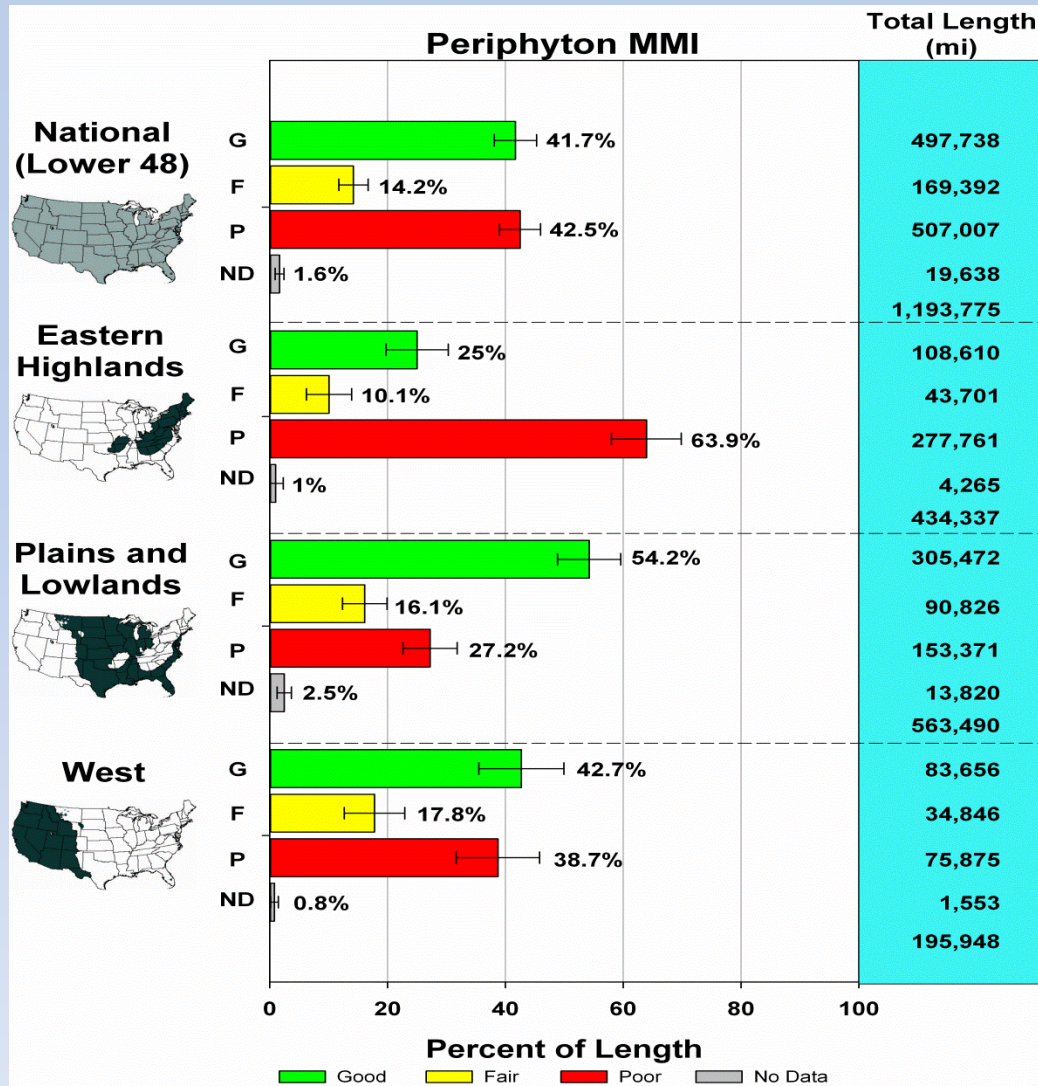
Benthic Macroinvertebrate Taxa Loss Model



Fish Assemblage MMI



Periphyton MMI



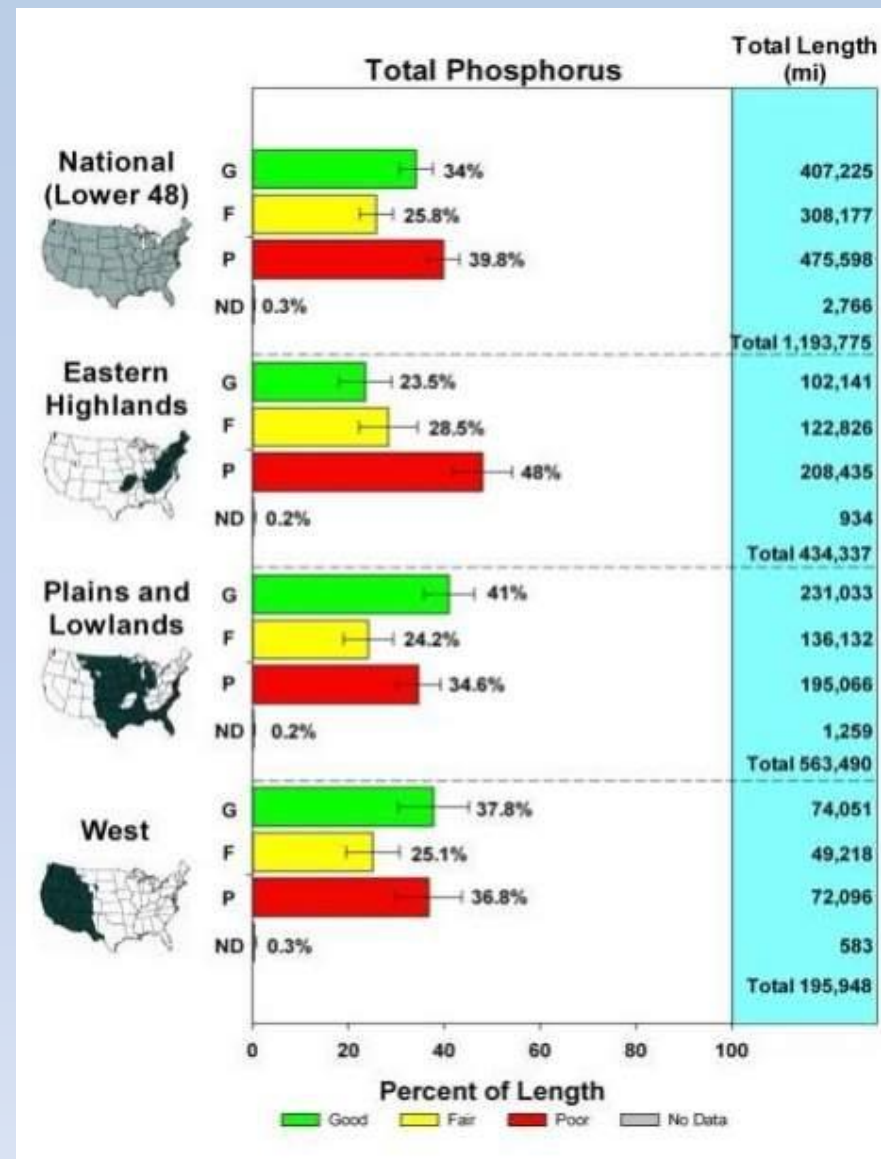
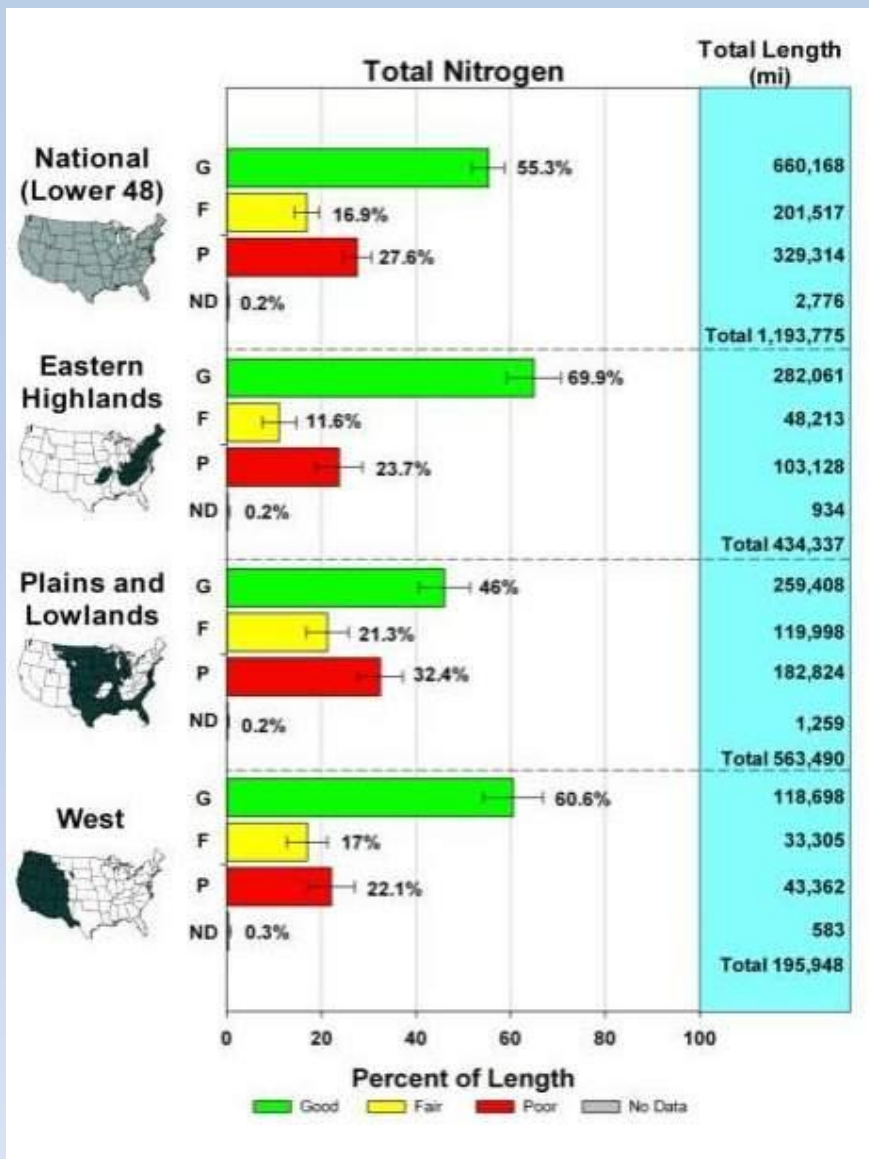
Questions?

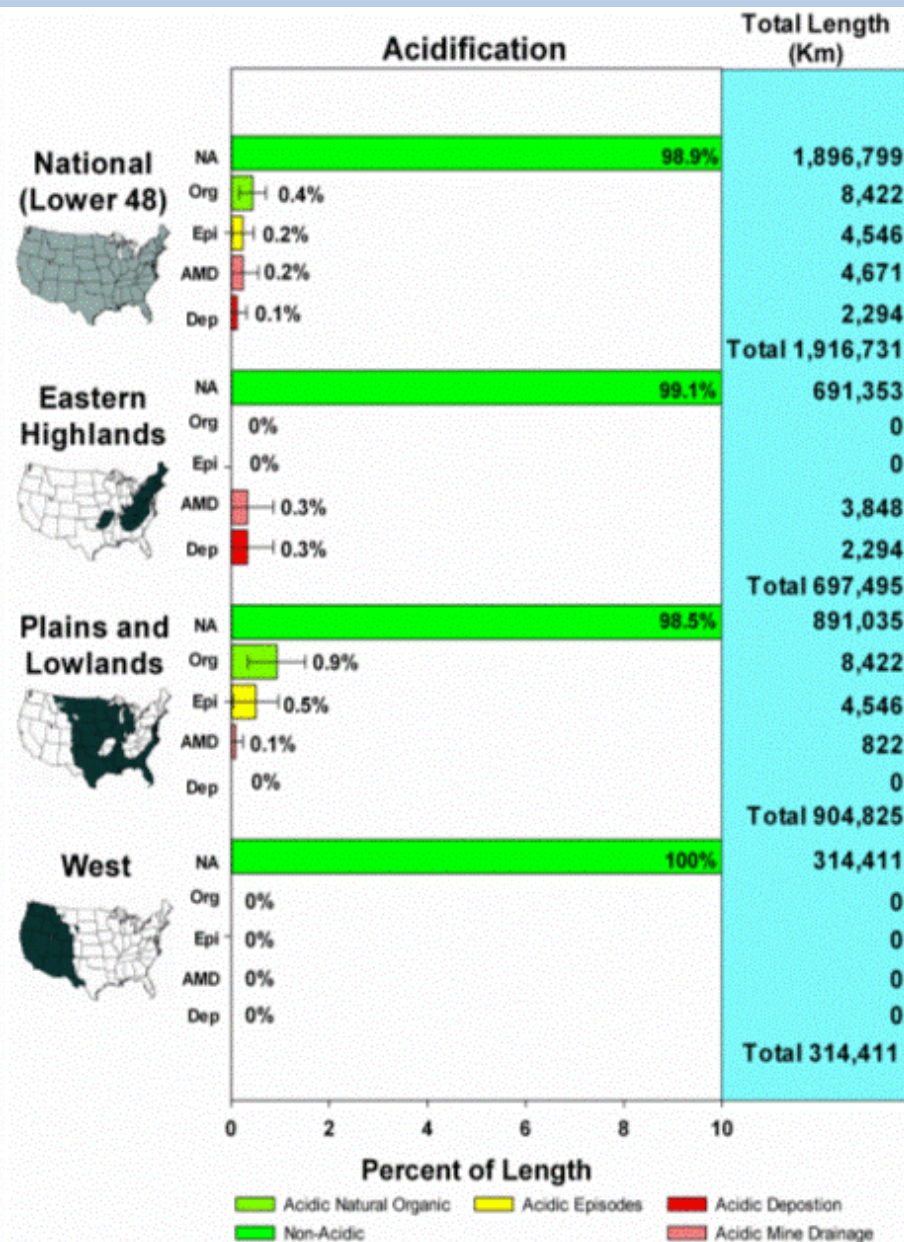
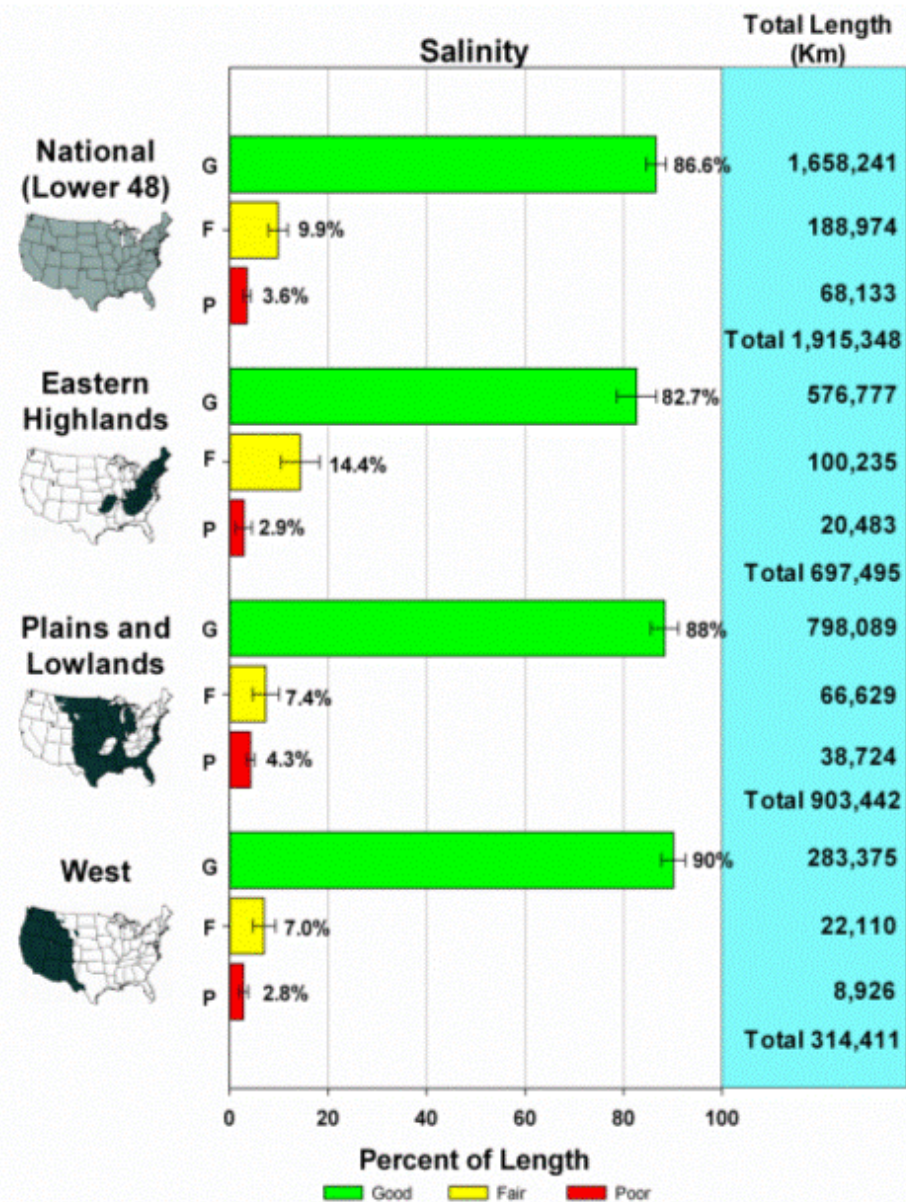


Water Chemical Stressors

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







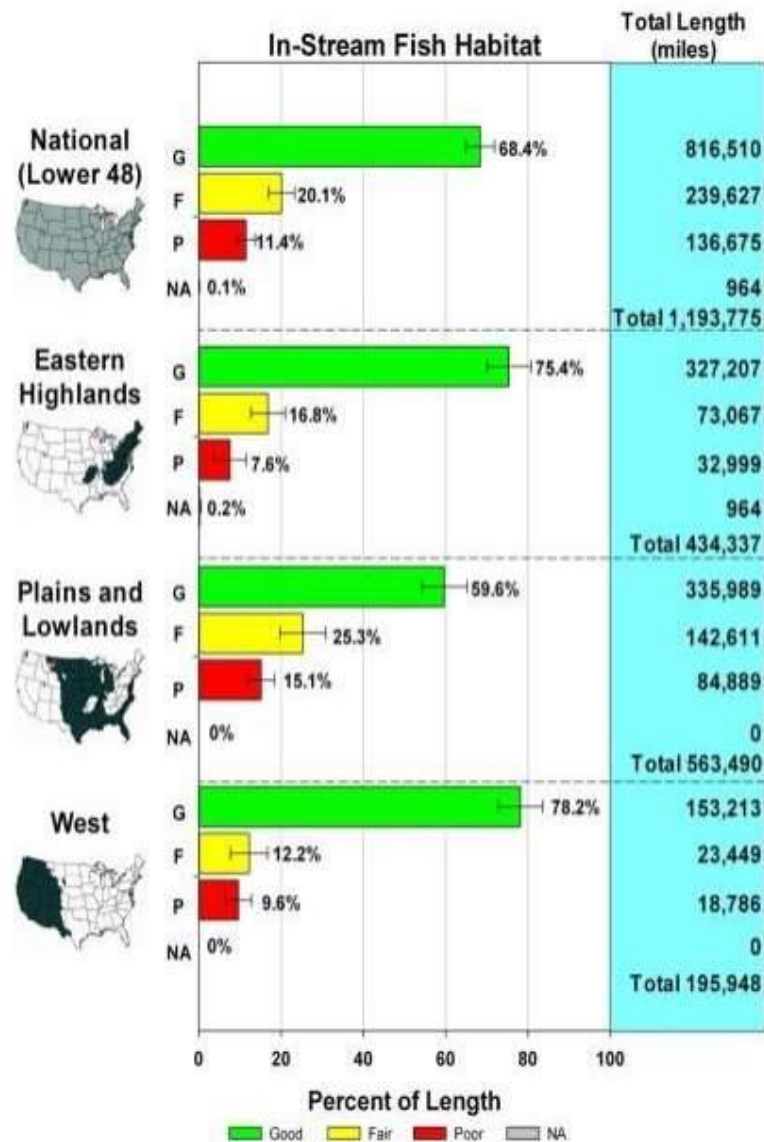
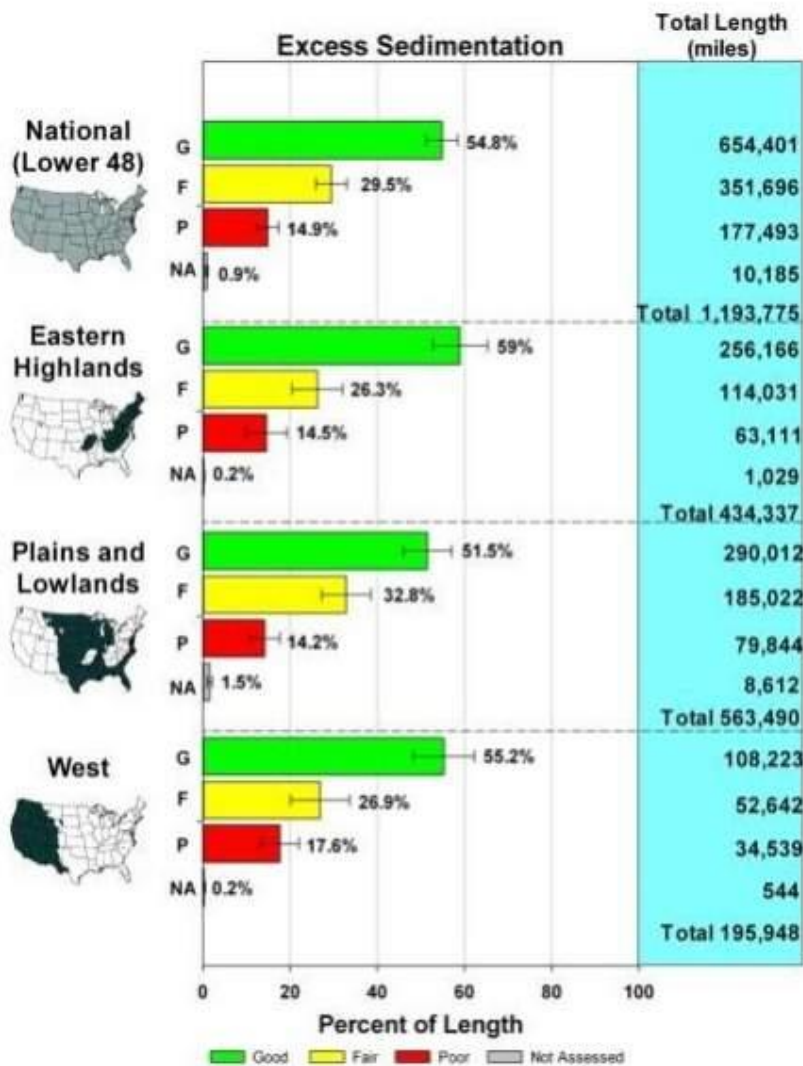
Physical Habitat:

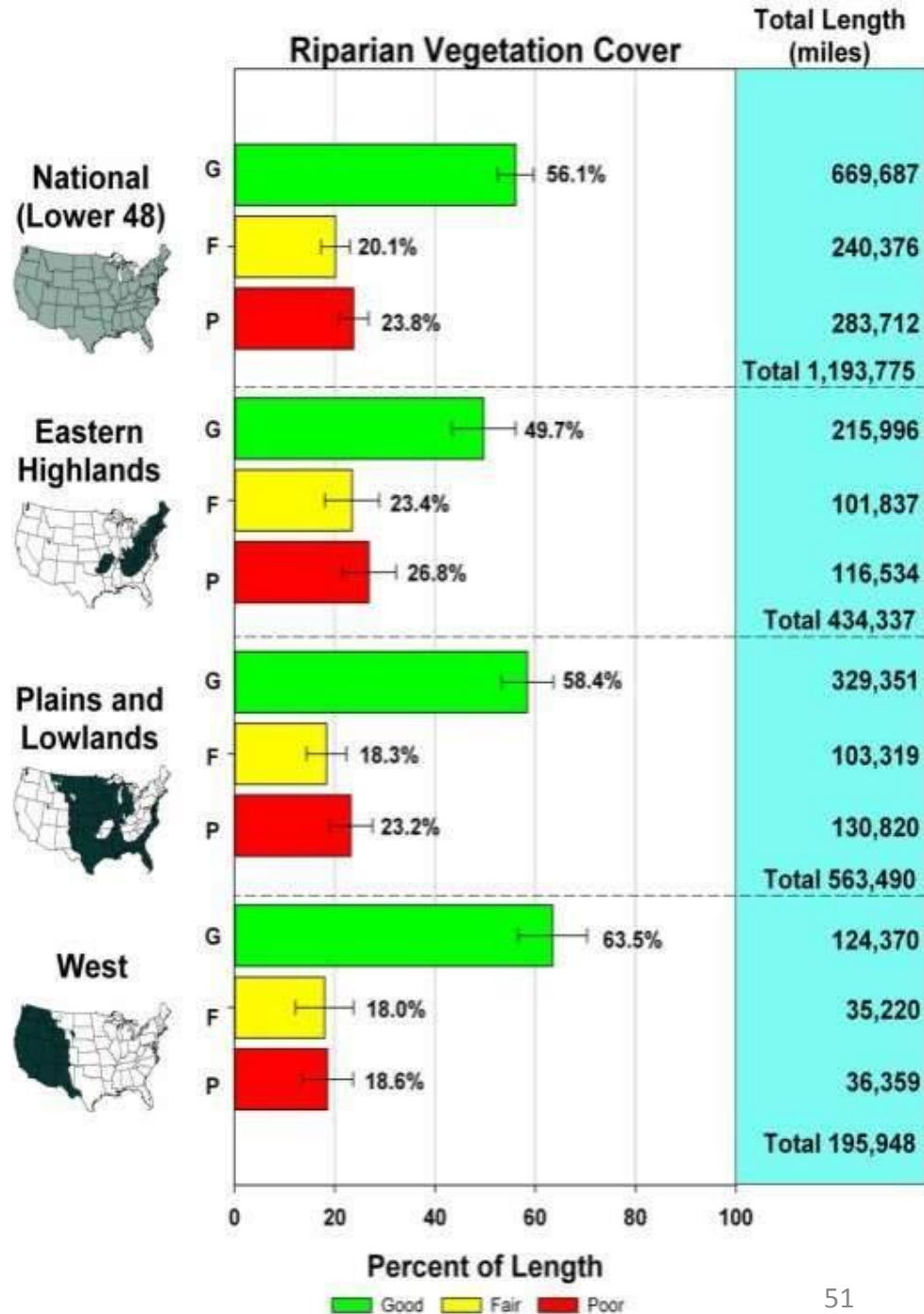
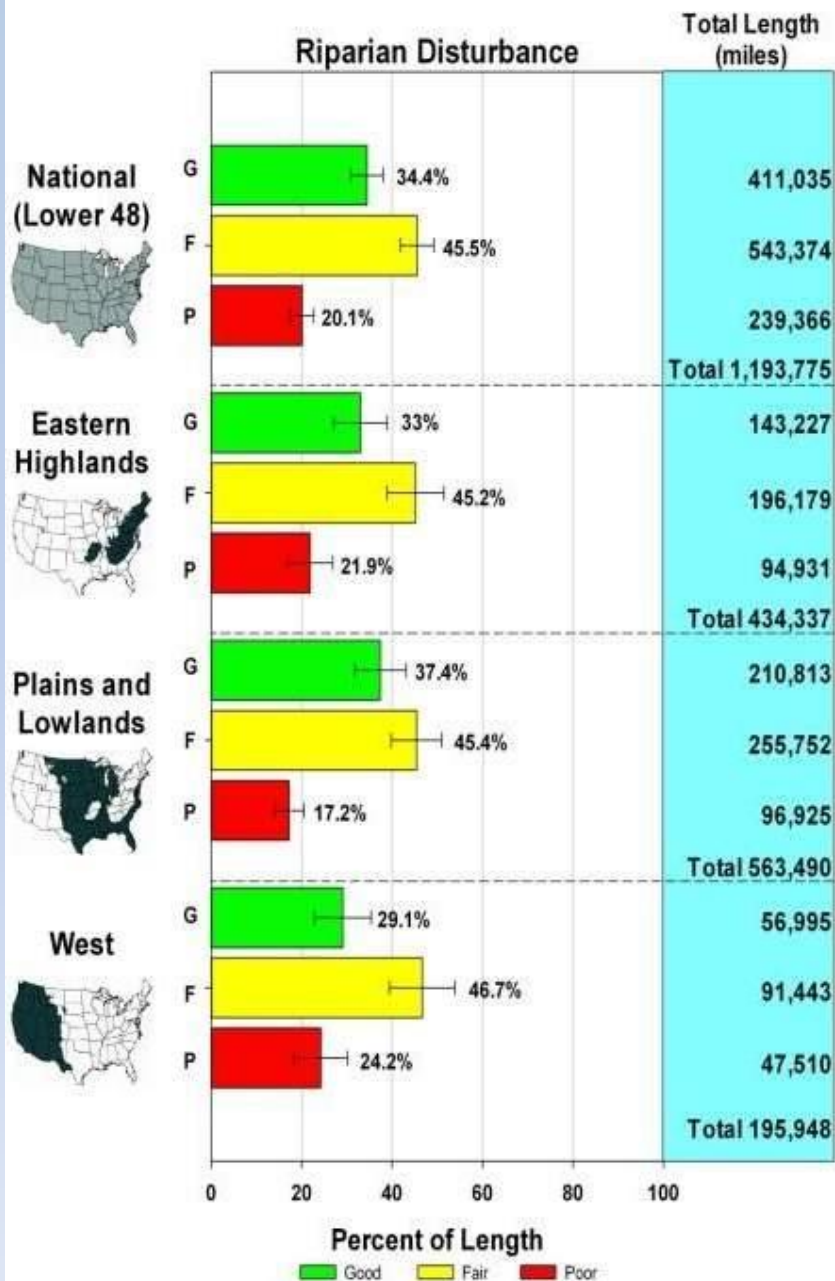
Crews measure hundreds of aspects of the stream and river physical habitat to assess its condition.

Quantitative measure of stream habitat condition.

A detailed form titled "RIPARIAN CROSS-SECTION FORM - WADEABLE". It contains various sections for data collection, including "SUBSTRATE CROSS-SECTIONAL INFORMATION", "VEGETATION", "WATER QUALITY", and "HABITAT". The form is filled out with handwritten data, including measurements of stream width, depth, and substrate composition.A detailed form titled "RIPARIAN CROSS-SECTION FORM - WADEABLE". It contains various sections for data collection, including "SUBSTRATE CROSS-SECTIONAL INFORMATION", "VEGETATION", "WATER QUALITY", and "HABITAT". The form is filled out with handwritten data, including measurements of stream width, depth, and substrate composition.

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





Human Health Indicators

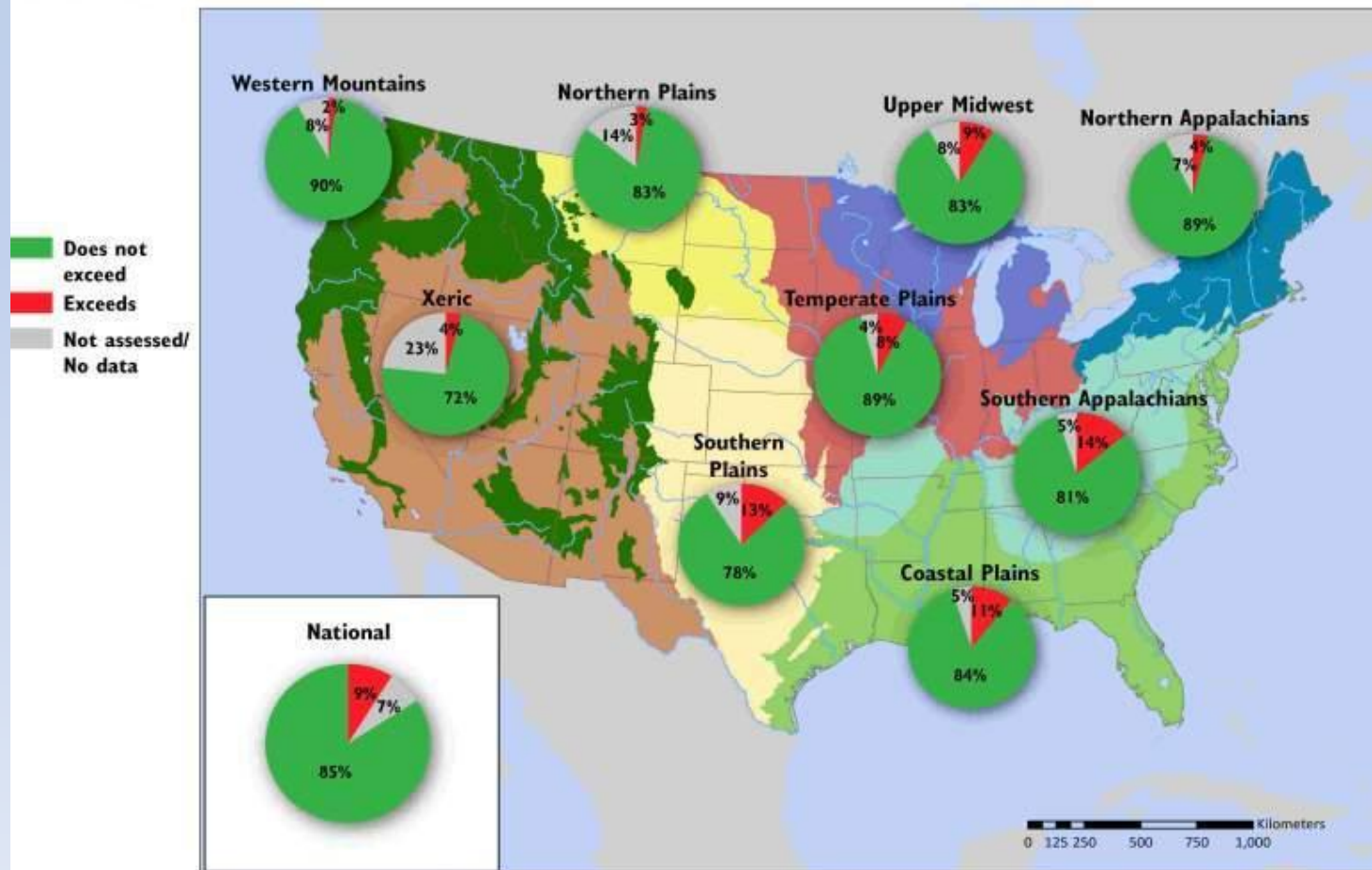
- Fish Tissue
 - Report focuses on mercury
 - Human health thresholds applied
 - Samples collected from 5th order and larger sites
 - Additional parameters reported on when available



Human Health - Enterococci (qPCR)

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

Enterococci



Compared to
EPA thresholds

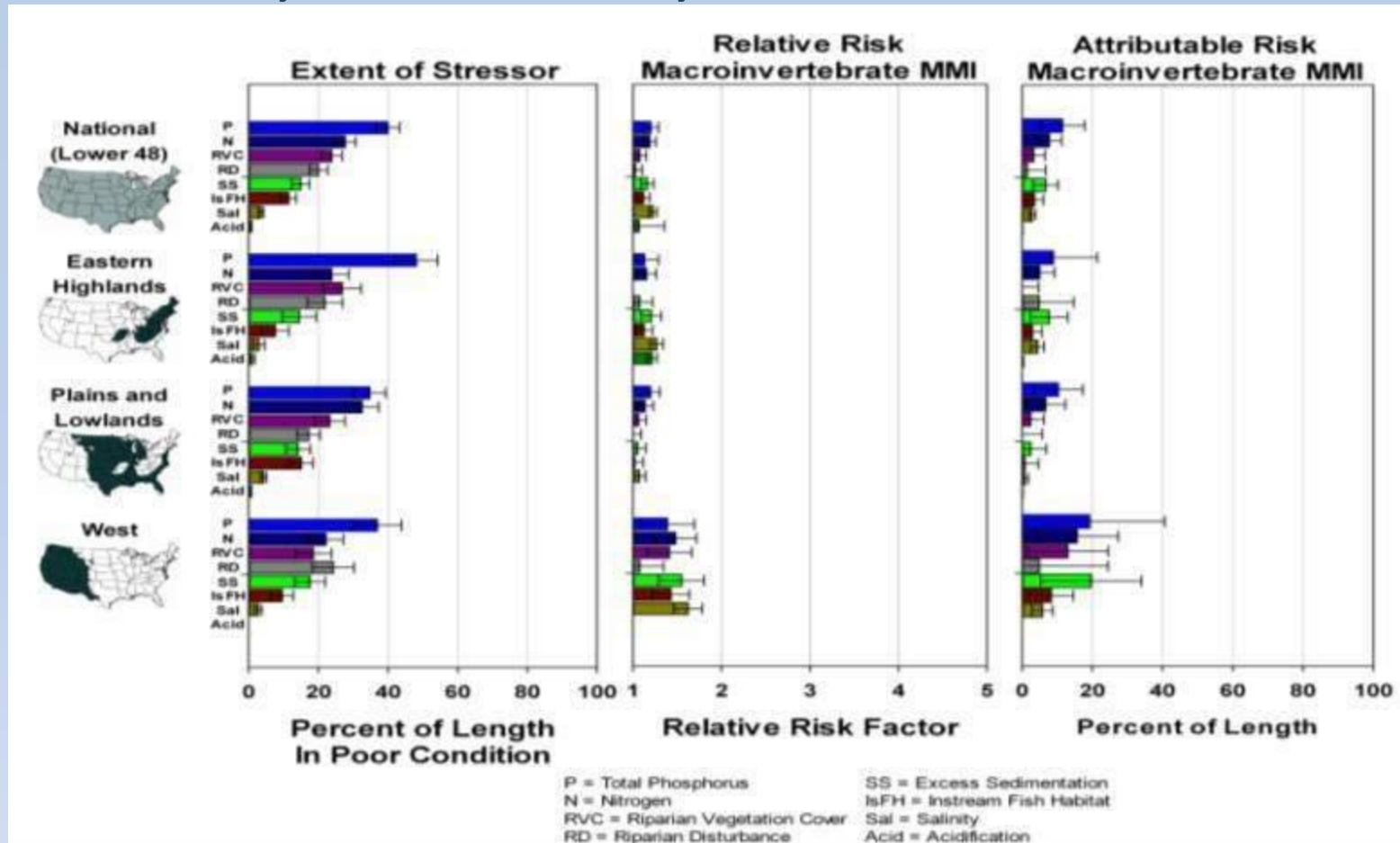
Stressor Extent and Resulting Risk:

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

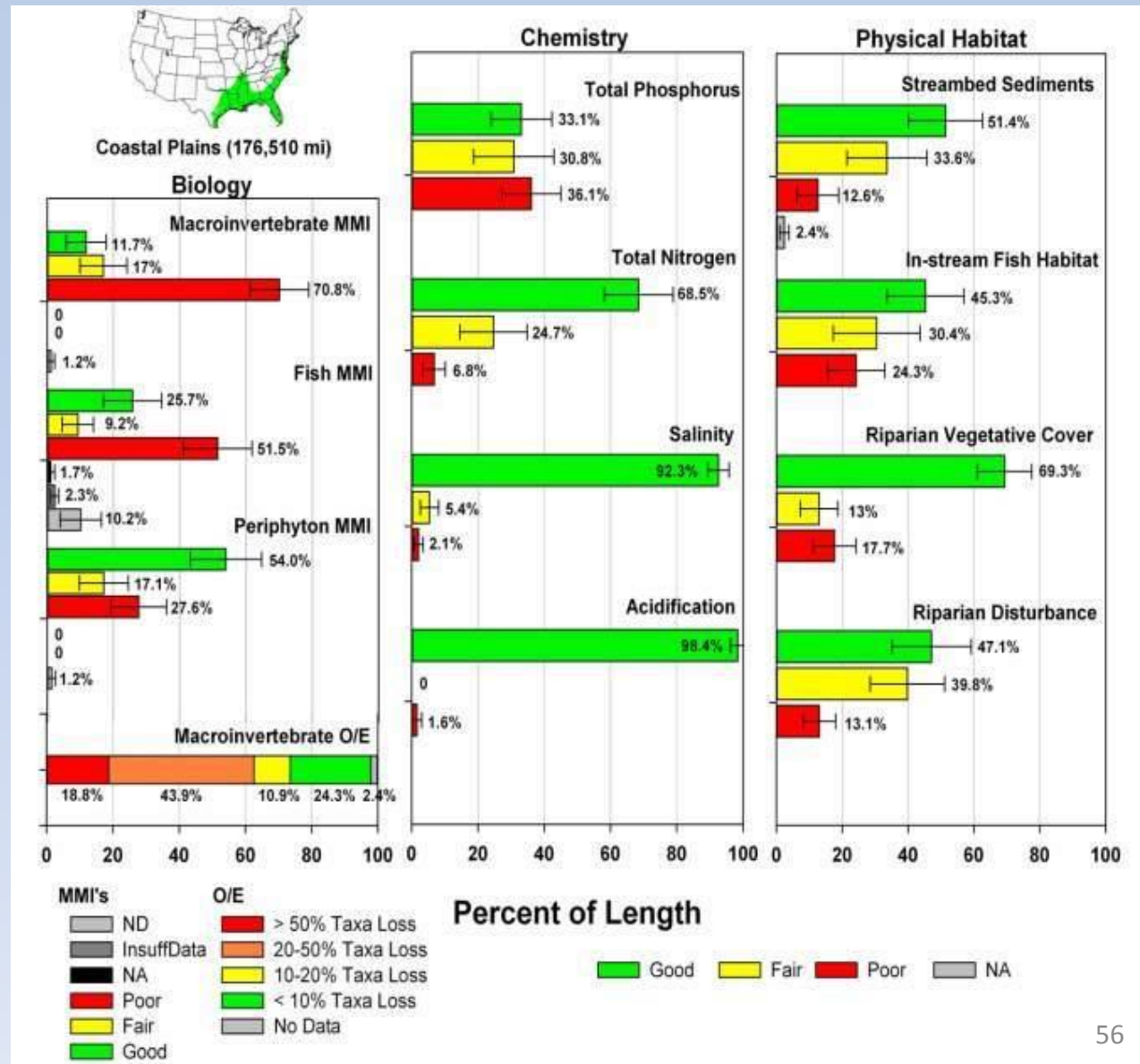
Temperate Plains

Southern Plains

Northern Plains

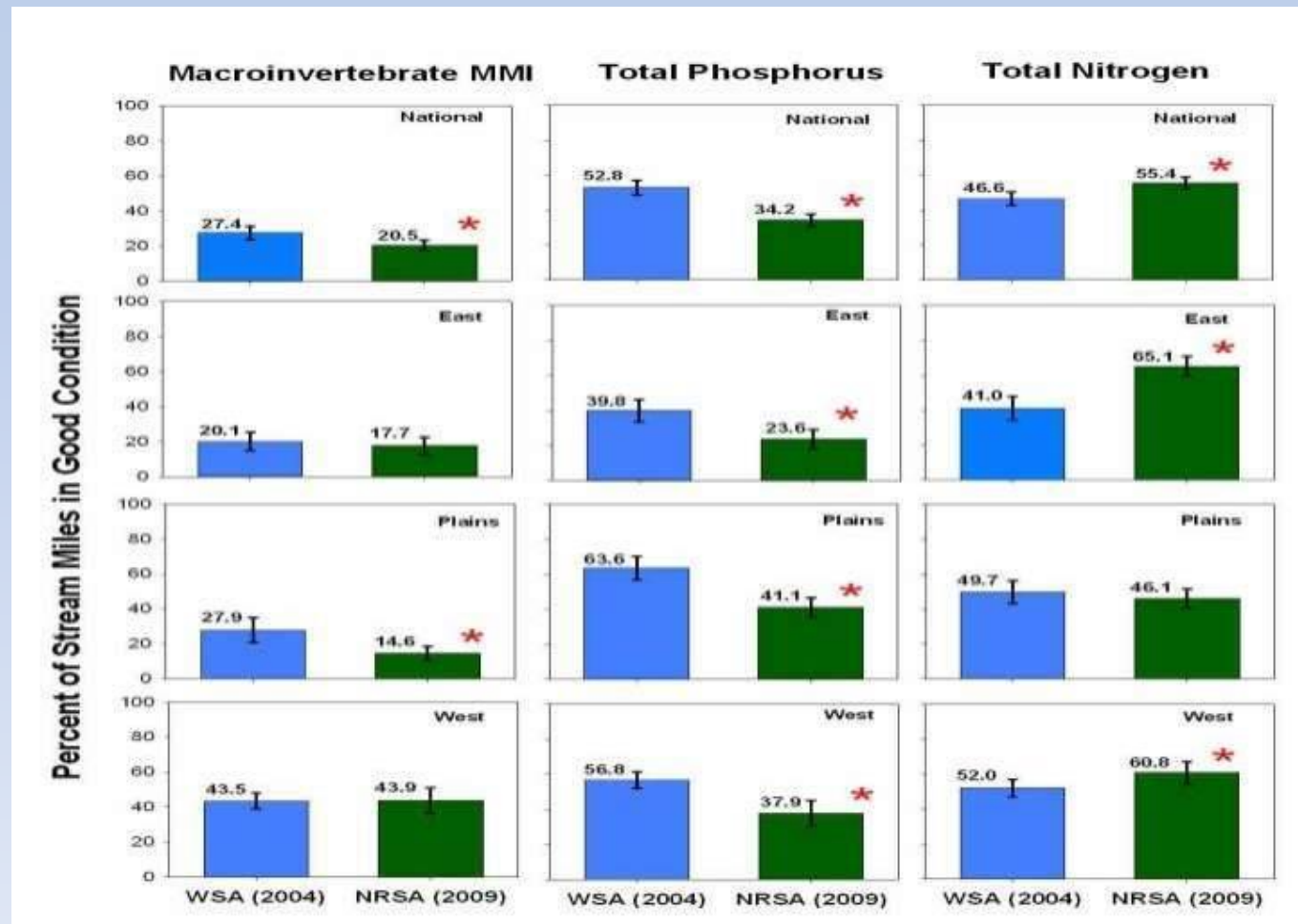
Western Mountains

Xeric West

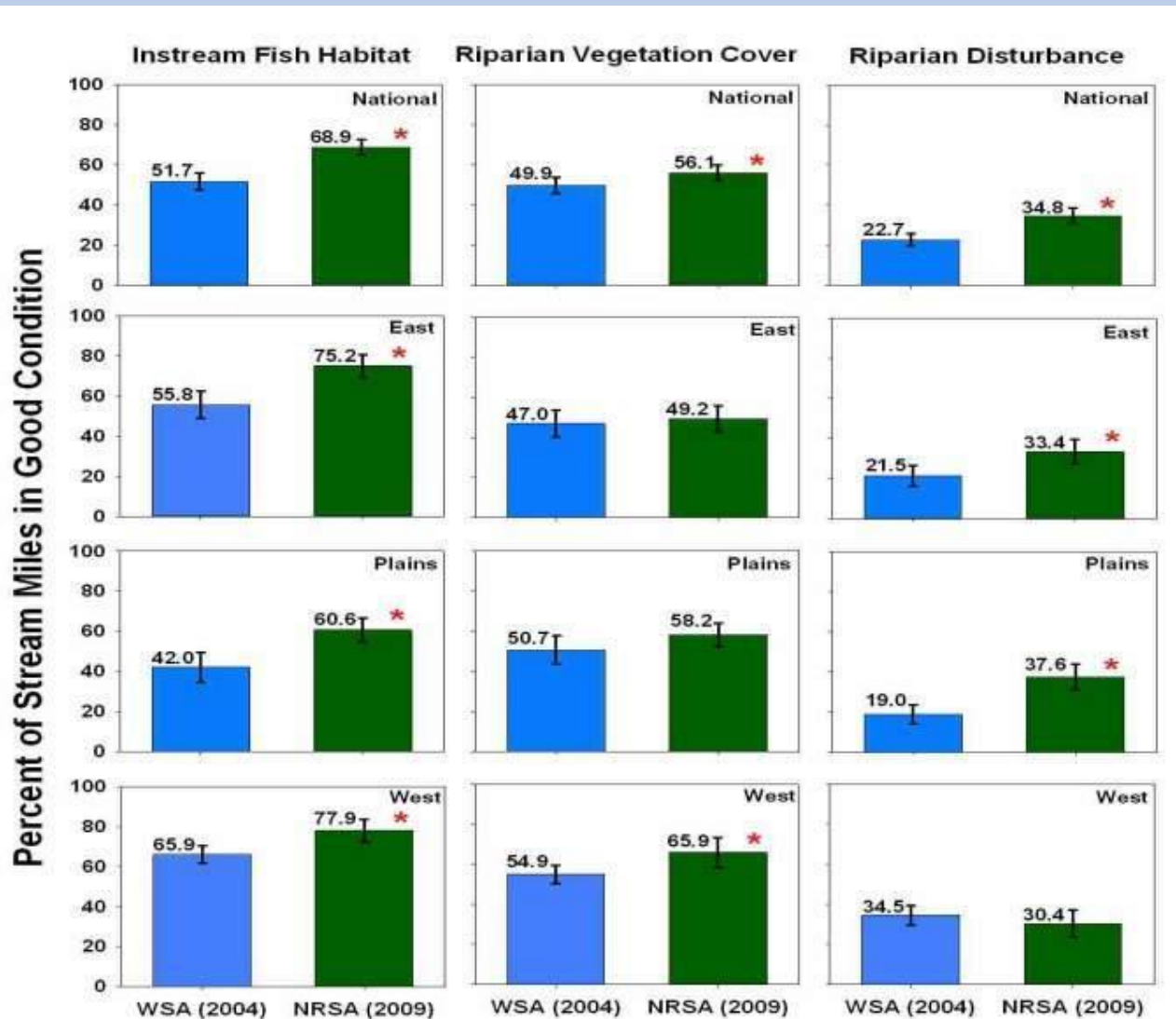


Change in Streams: 2004-2008/09

- Change is measured across the population of wadeable streams



Change in Streams: 2004-2008/09



Next Steps for the NRSA

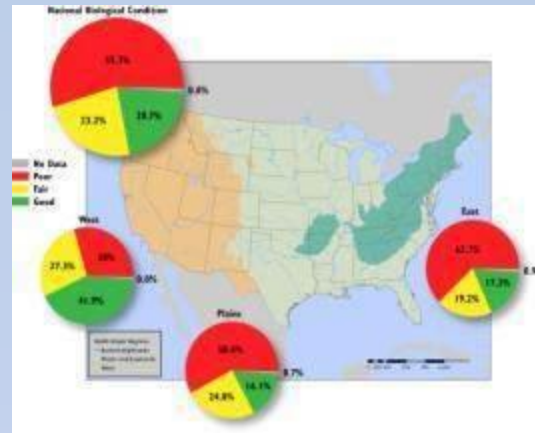
- Complete analysis and publications on supplemental indicators and new approaches
 - Additional fish tissue data
 - Random Forest Model for the Macroinvertebrate MMI
- Invite others to download the data sets for exploration and analysis
- Work with States and other Clean Water Act programs to analyze 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

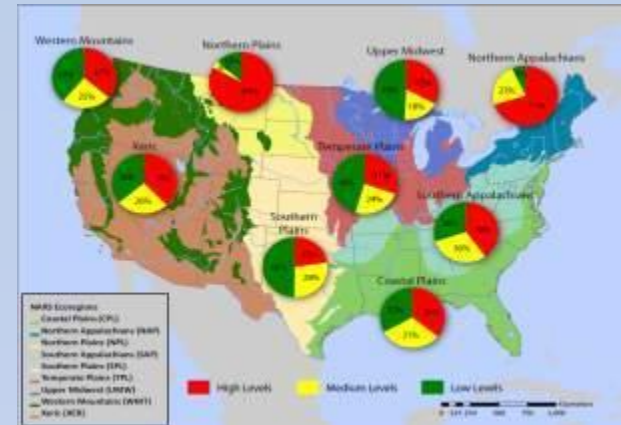
Intro and Design



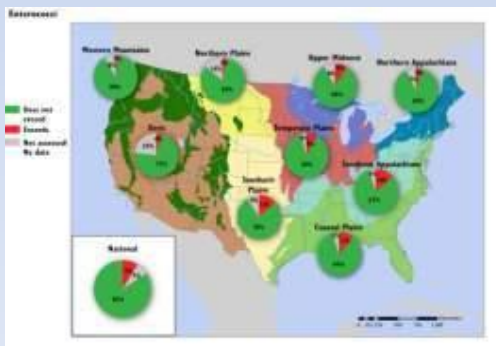
National Findings



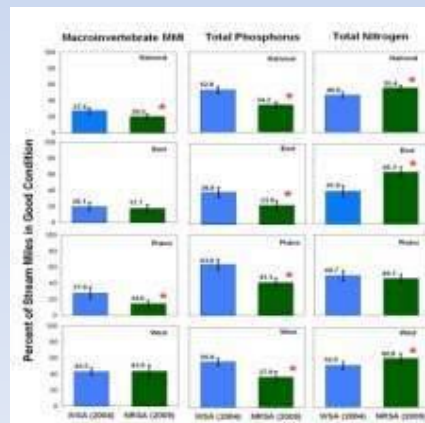
Ecoregional Findings



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 [nrса-hq@epa.gov](mailto:nrsa-hq@epa.gov).
- Main National Aquatic Resource Surveys website: www.epa.gov/aquaticsurveys

Speaker Contact Information

Susan Holdsworth



Chief, Monitoring Branch

U.S. EPA's Office of Wetlands, Oceans, and Watersheds

Co-Chair, National Water Quality Monitoring Council

[**Holdsworth.Susan@epa.gov**](mailto:Holdsworth.Susan@epa.gov)

Ellen Tarquinio



Environmental Protection Specialist

Monitoring Branch

U.S. EPA's Office Wetlands, Oceans,
and Watersheds

[**Tarquinio.Ellen@epa.gov**](mailto:Tarquinio.Ellen@epa.gov)



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

Participation Certificate

If you would like to obtain participation certificates **type the link below into your web browser:**

[http://water.epa.gov/learn/training/wacademy/
upload/2013-04-03-certificate.pdf](http://water.epa.gov/learn/training/wacademy/upload/2013-04-03-certificate.pdf)

You can type each of the attendees names into the PDF and print the certificates.