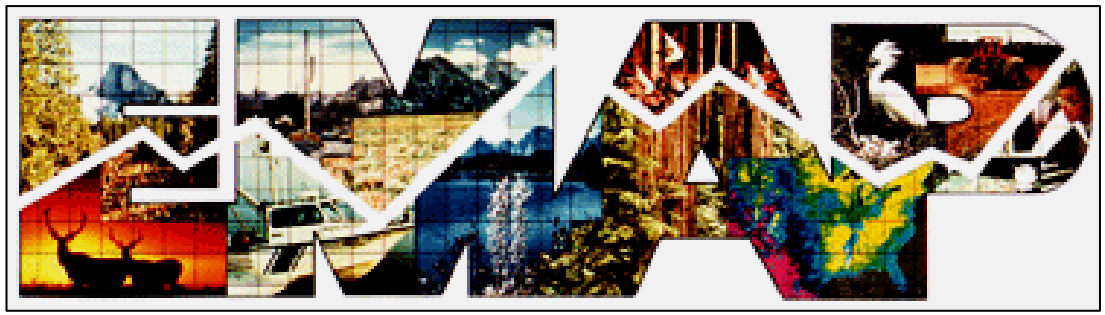
RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmen decisions

Presented at the water quality technical section of the annual meeting of the LMRCC, 9/16/06 at Vicksburg, MS



Environmental Monitoring and Assessment of Great River Ecosystems (EMAP-GRE)

Overview and Design Considerations for the Lower Mississippi River

US EPA Office of Research & Development
National Health & Environmental Effects Laboratory
Mid-Continent Ecology Division Duluth, MN
Angradi.Theodore@epa.gov

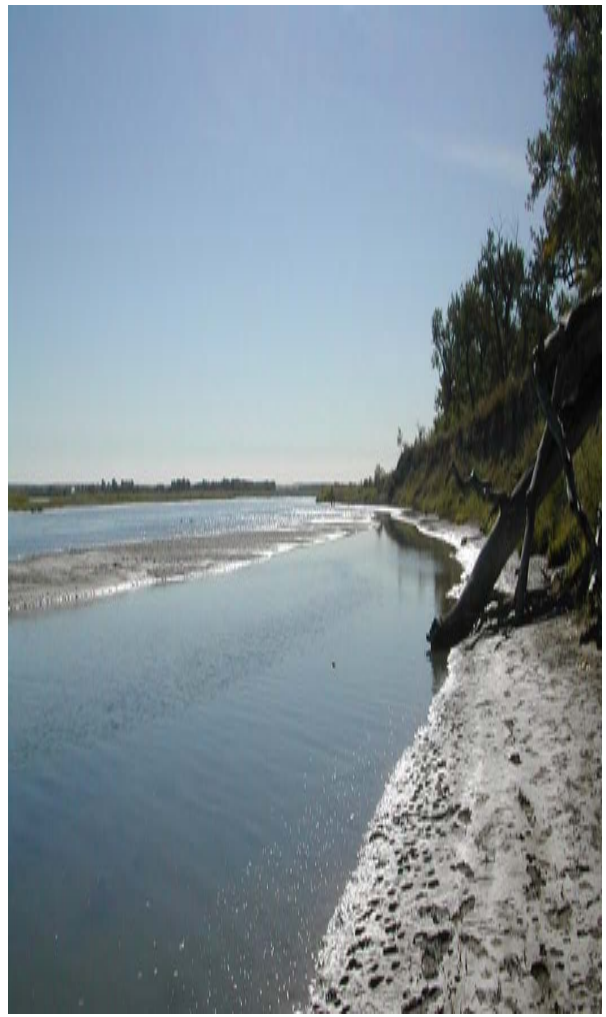
http://www.epa.gov/emap/greatriver

RESEARCH & DEVELOPMENT

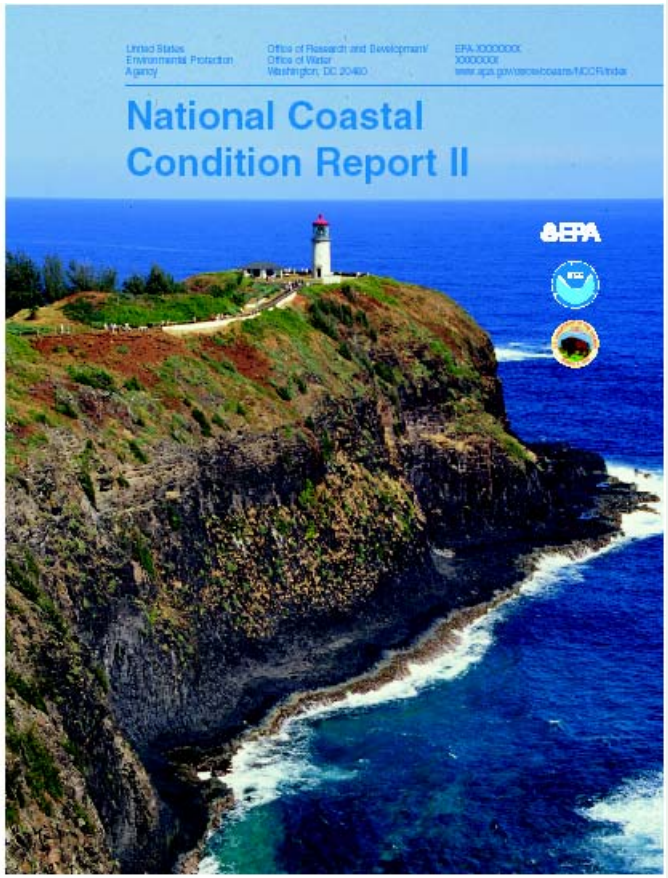
Building a scientific foundation for sound environmental decisions

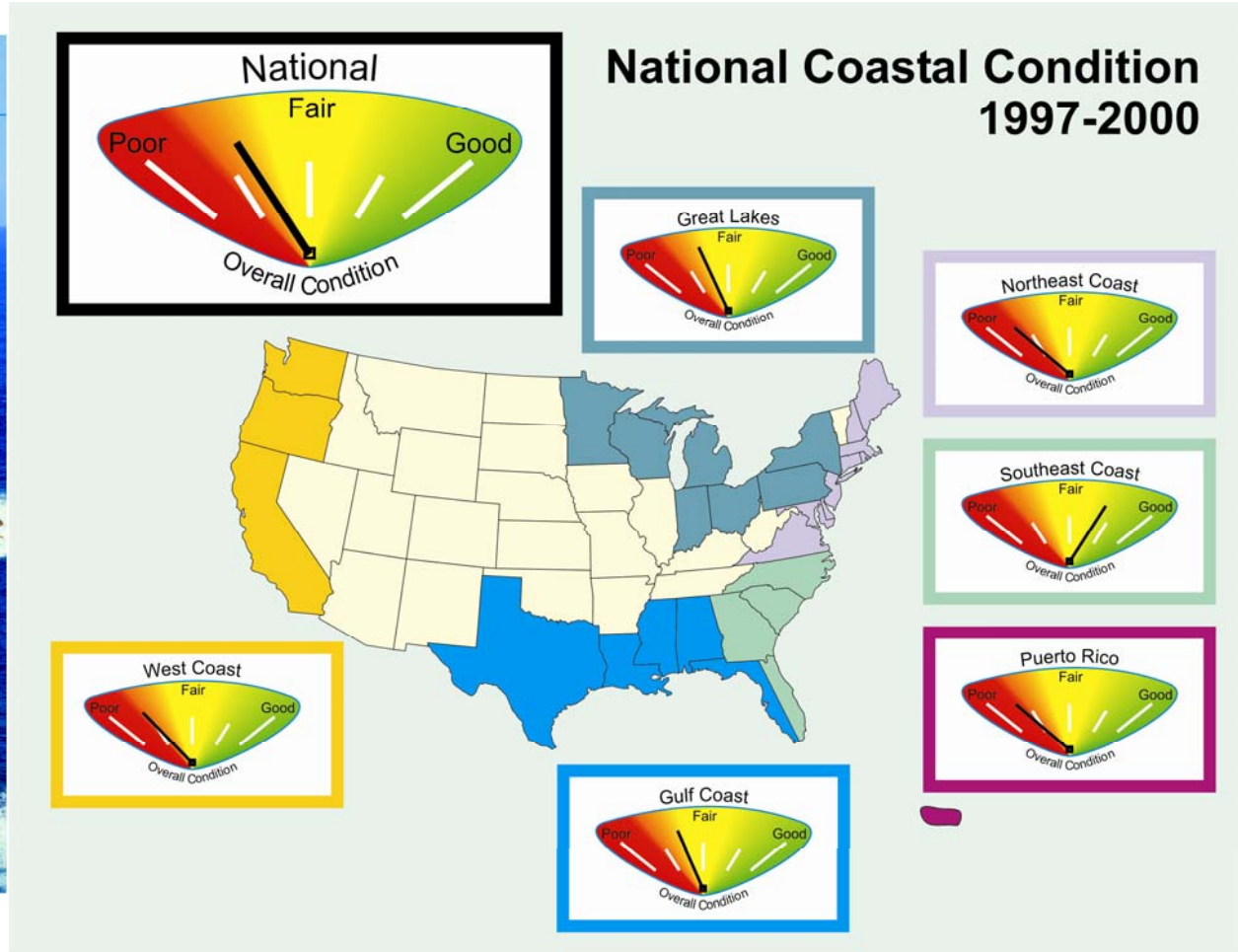
Program and Policy Questions for EMAP

- What are the current conditions of our national aquatic ecosystems?
- What stressors are associated with biological conditions?
- Where are the conditions improving or declining?
- Are management programs and policies working?



EMAP - National Coastal Condition Assessment

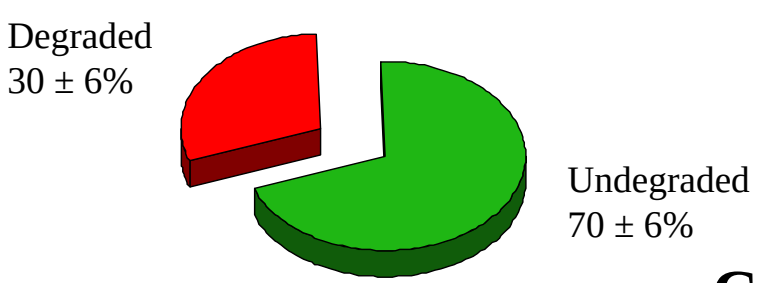


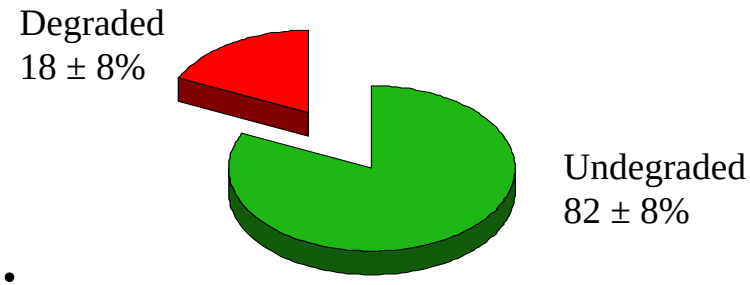


http://www.epa.gov/owow/oceans/nccr/2005/downloads.html

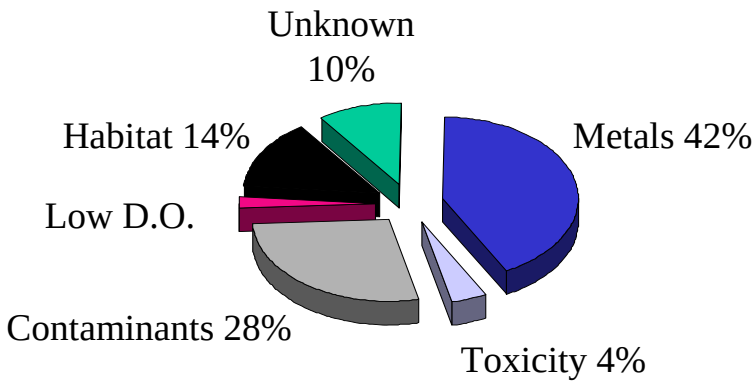
Comparison of Estuarine Conditions

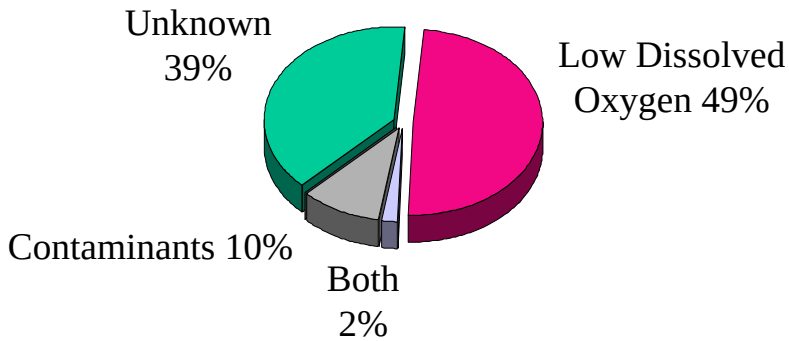
Estuarine Benthic Invertebrate IBI





Condition



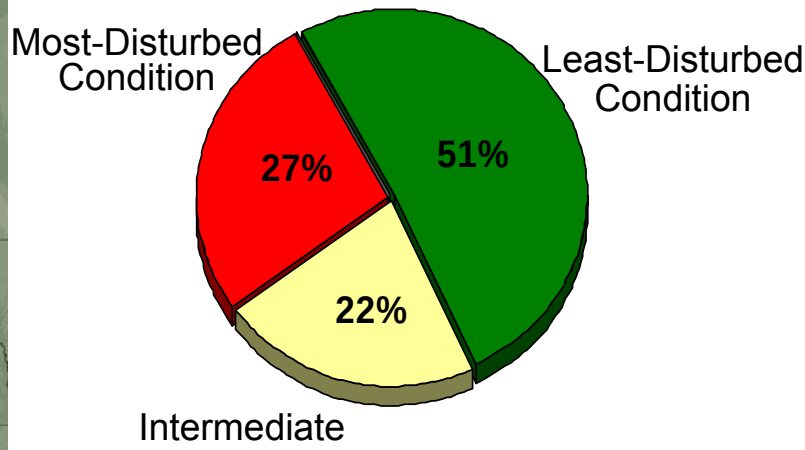


Stressors Associated with Degraded Condition

EMAP - Western Streams

Index of Biotic Integrity

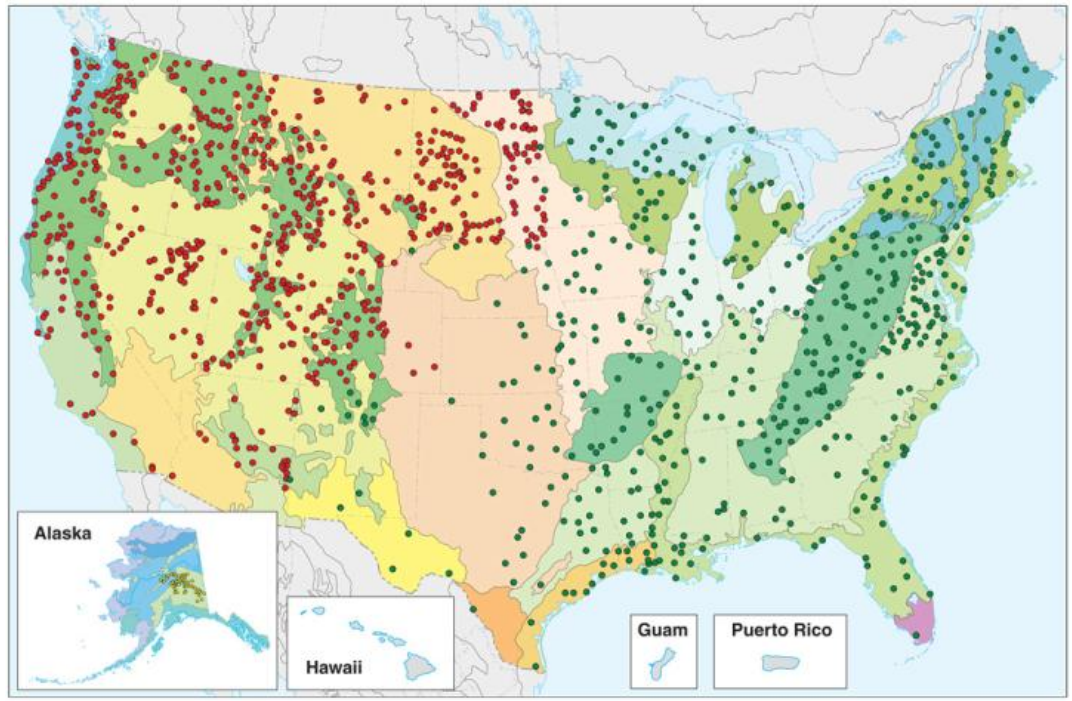
Macroinvertebrates



Proportion of Stream Length

(margin of error: +/- 4% at 95%)

Successful ORD & OW Partnership



National Report in March 2006

RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmental decisions

EMAP-Great River Ecosystems (EMAP-GRE)

Develop, demonstrate, and transfer the scientific basis for consistent, unbiased, cost-effective condition assessments for the Ohio, Missouri, and Mississippi Rivers.

Guiding Principles

Involve stakeholders.

Approach must work across boundaries.

Biology integrates environmental stresses.

Probability surveys provide statistical power.

Schedule

Assessment of Upper MS, MO, and OH Rivers: 2004-2006

Assessment of Lower MS River planned 2007-2009.

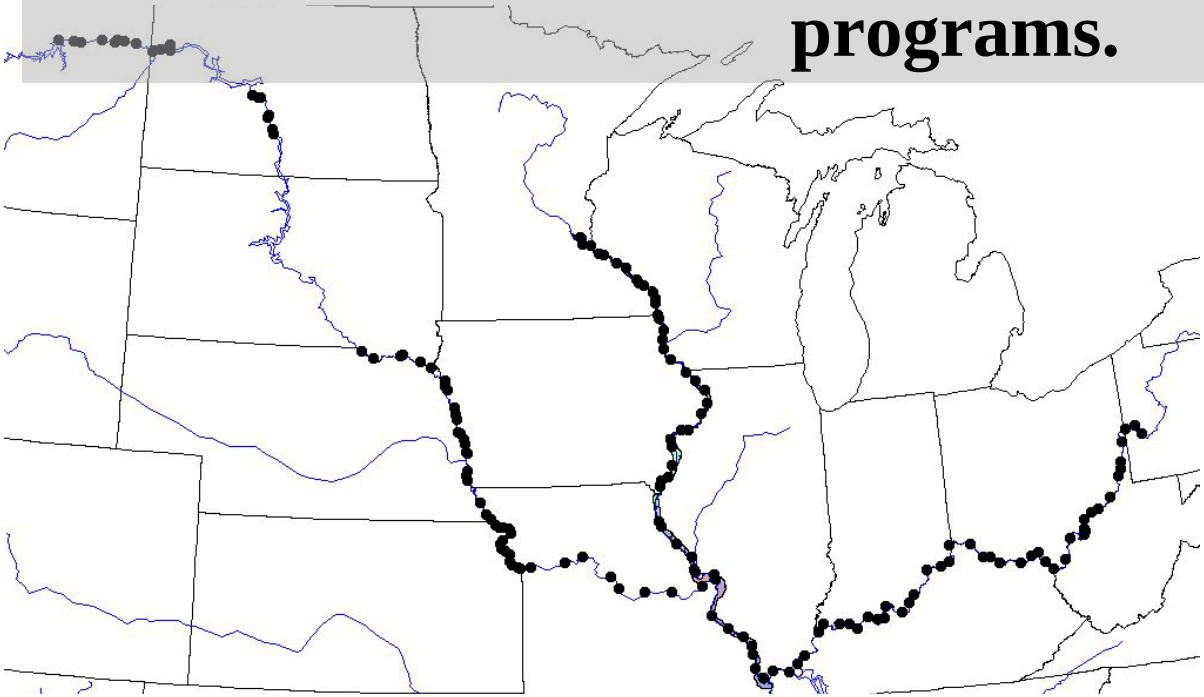
Outcomes & Products

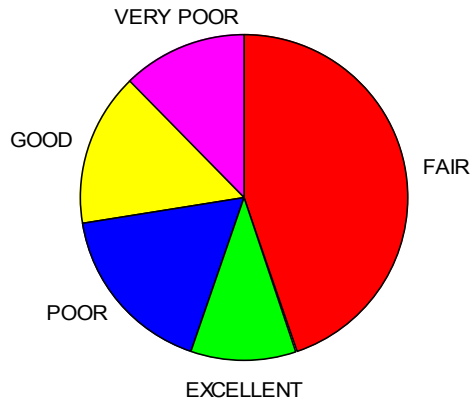
Transfer tools to states to build assessment capabilities.

Condition / Assessment Reports

Reference Condition & Indicators Reports

EMAP-GRE approach is consistent with other EMAP programs.





Designs + Indicators ➡ Assessments

Sample size
⬆
Schedule
⬆
Assessment units
⬆
Resource definition

Implementation
⬆
Training & QA
⬆
Consensus & evaluation

Bioassessment Framework
⬆
Cooperative data analysis
⬆
Standards & criteria
⬆
Partnerships

EMAP-GRE Product (extent estimate)

What % (±error) of [resource] in [unit] is in [condition] as indicated by [indicator] ?

Resource	*Unit*	*Condition*	*Indicator*
Main-channel Backwater Floodplain	State River EPA Region Ecoregion	Good Marginal Poor Threatened Impaired	Biotic integrity fish, benthic inverts, zooplankton, algae, vegetation Water Quality nutrients, DO, temperature, turbidity Stressors sedimentation, flow, land use Habitat Integrity
Challenges			
Relevancy Data limited	Sample size Funding Standardization Consensus	Reference conditions Biocriteria WQ standards	Known variability Public interest Cost-effectiveness Standardization
Example Assessment Questions			
What % (±) of the Missouri River main-channel in Kansas is impaired by [NH_3]? What % (±) of the Mississippi River main-channel in Iowa has blue-green dominated phytoplankton? What % (±) of the Mississippi River main-channel margin in Missouri has benthic invert taxa dominated by tolerant taxa?			

Great Rivers EMAP Organization (Upper MS)

EPA ORD NHEERL Director
Associate Director for Ecology
EMAP Director

ORD-MED Division Director

Advisory Committees
- Senior Advisory Committee
- Technical Advisory Committee

Technical Lead

Management Teams

Project Administration	Quality Assurance
Health & Safety	Extramural Funding

Science Teams

Sample Design	Methods/ training
Information Management	Data Analysis / Assessment

Partners

Upper Missouri River	Lower Missouri River	Upper Mississippi River	Ohio River	Analyses
USGS North Dakota & Montana District Offices; North Dakota Dept Health EPA Region 8	USGS Missouri, Iowa, Kansas, Nebraska District Offices; Missouri Dept of Conversation; Nebraska Game & Fish Commission EPA Region 7	USGS UMESC Wisconsin DNR Minnesota DNR Minnesota PCA Iowa DNR Illinois DNR Missouri Dept Conservation EPA Regions 5 & 7	EPA NERL EPA Region 3 EPA Region 4 EPA Region 5 ORSANO SoBran Inc	University of Louisville Stroud Water Center Southwest Missouri State University USGS UMESC EPA NERL EPA MED EPA MED, WED, & NERL contract staff University of Minnesota

EMAP-GRE is working.

Pro:

- Representative sampling of current conditions.
- Numerous water chemistry, habitat, and biological variables.
- Methods are consistent.
- Results contribute to reference condition characterization and indicator development.

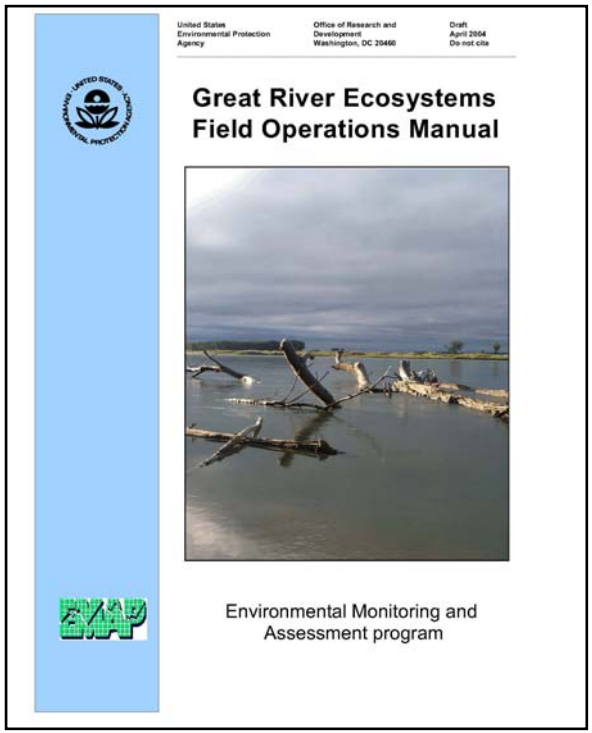
Con:

- Bioassessment frameworks are undeveloped on great rivers.
- Current approach may be sub-optimal for Lower MS River.
- Limited ability to make site-specific, before-after, or control-impact inferences.

EMAP-GRE is a research program, not an ambient monitoring program.

EMAP-GRE Program Components

Field Operations Manual



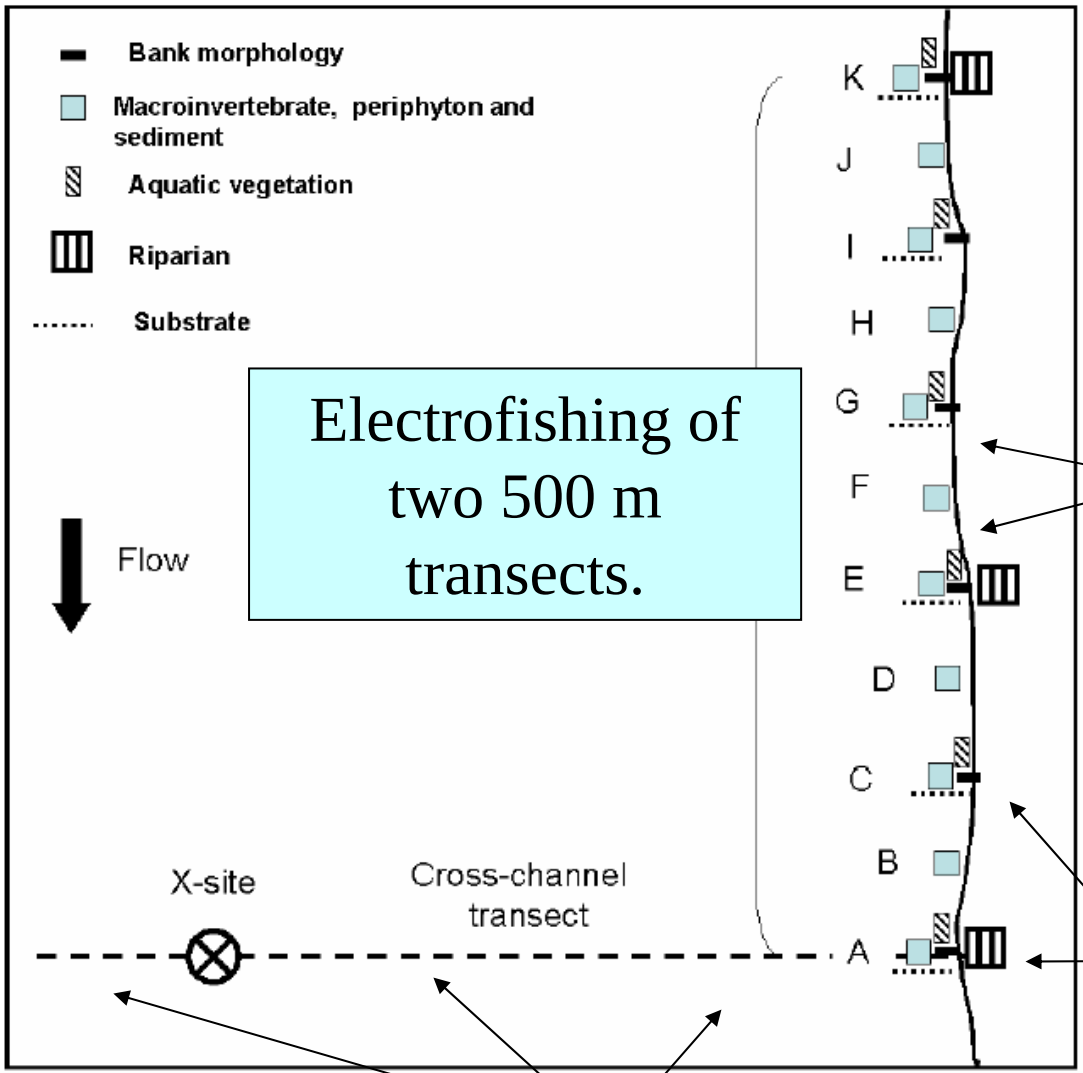
Crew Training

Sample Analysis
Data Analysis
Design Support
Information Management

Current metrics and indicators

- **Water Quality**
  - Dissolved oxygen
  - Dissolved N (NO_x, ammonia)
  - Conductivity
  - pH
  - Metals (As, Pb, Se, CU, Fe, Ni)
  - Temperature
  - Anions & Cations
  - Turbidity, suspended matter
  - Alkalinity
  - Total & Dissolved P, N, & C
  - Elemental particle analysis
  - Particulate stable isotopes
  - Chlorophyll
- **Sediment**
  - Enzyme activity
  - Toxicity
  - Total and volatile matter
  - Chemistry
- **Biotic Assemblages**
  - Fish
    - Tissue contaminants
    - DNA
  - Invertebrates
    - Littoral benthos
    - Snags
  - Zooplankton
  - Phytoplankton
  - Periphyton
  - Submersed aquatic vegetation
- **Habitat**
  - Littoral
    - Vegetation cover
    - Substrate
    - Woody debris
  - Riparian
    - Vegetation cover
    - Invasive/exotic species

EMAP-GRE field methods on the Upper MS system.



Electrofishing of two 500 m transects.

Composite benthos, sediment, and periphytin samples, and habitat data collected at 50 m intervals.

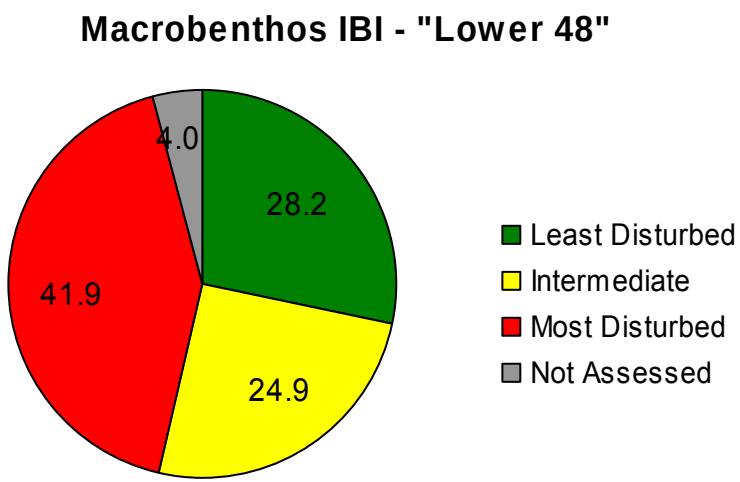
Aquatic and riparian vegetation, and bank morphology data collected at 100 m intervals.

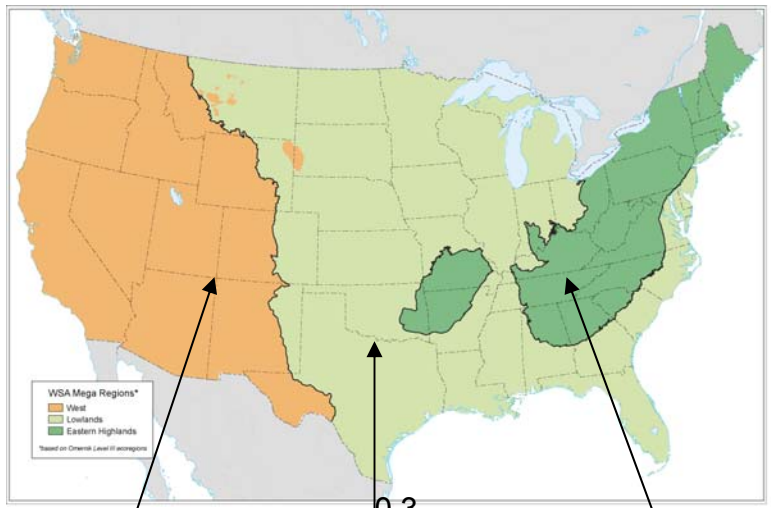
3-9 point composite water chemistry, phytoplankton, zooplankton, DO, turbidy samples

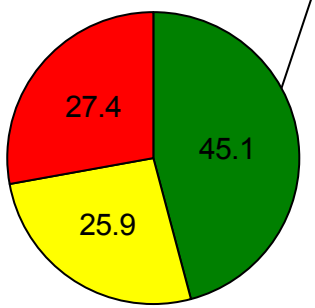
EMAP Assessment Products

Biotic Condition

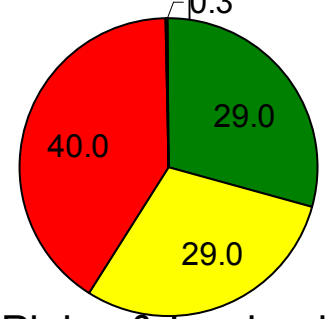
Regionally- applicable
Reference-based



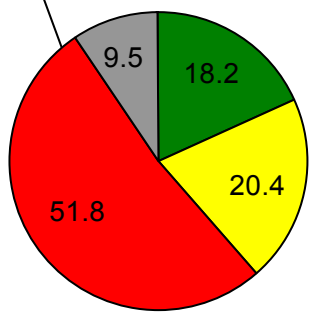




West
245,678 km



Plains & Lowlands
390,409 km

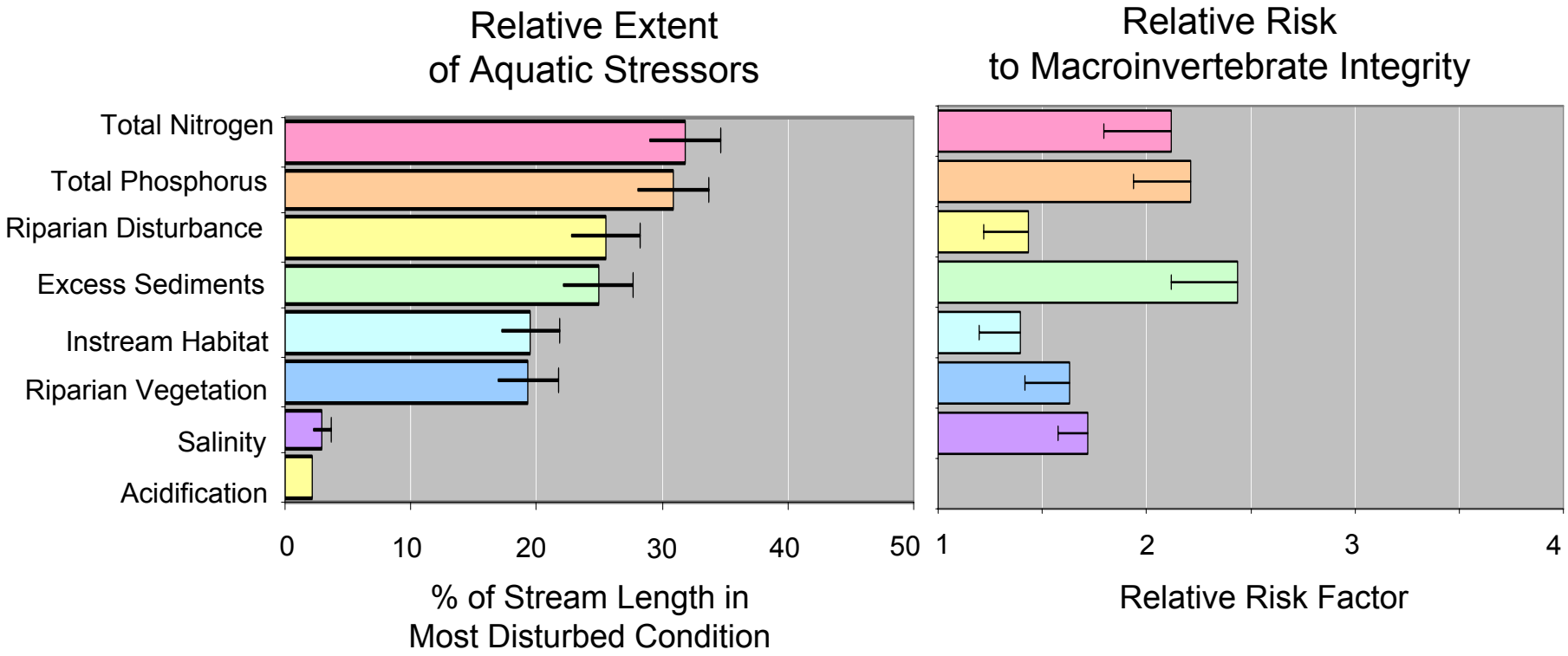


Eastern Highlands
444,668 km

National Stream Assessment data

EMAP Assessment Products

Extent estimates of stressors and relative risk of biotic condition to stressors



National Stream Assessment data

EMAP-GRE data example: Occurrence of pesticides, polychlorinated biphenyls (PCBs), and polybrominated diphenyl Ethers (PBDEs; flame retardants) in fish

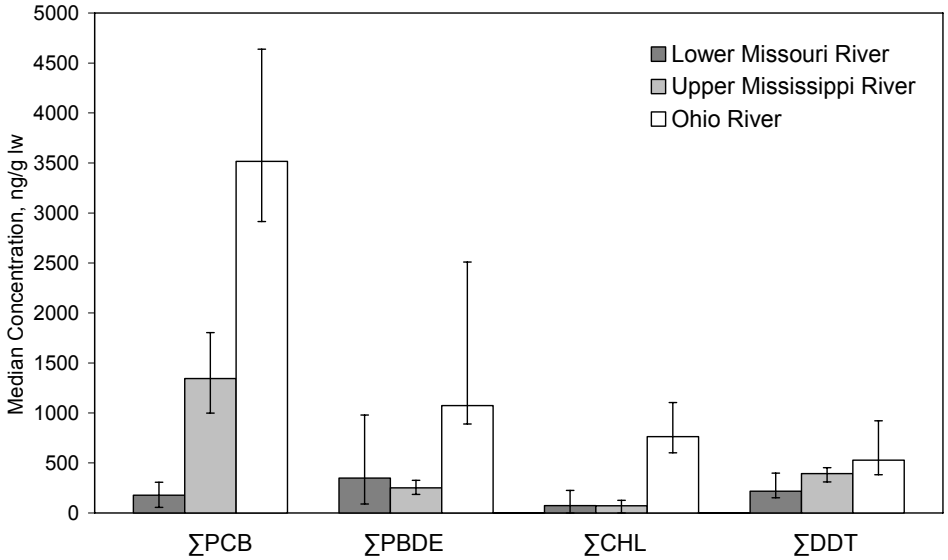


Figure 1. Total PCB congeners (∑PCB), total PBDE congeners (∑PBDE), total chlordanes (∑CHL), and total DDTs (∑DDT) median concentrations for large fish samples from the Ohio, Upper Mississippi and Lower Missouri Rivers.

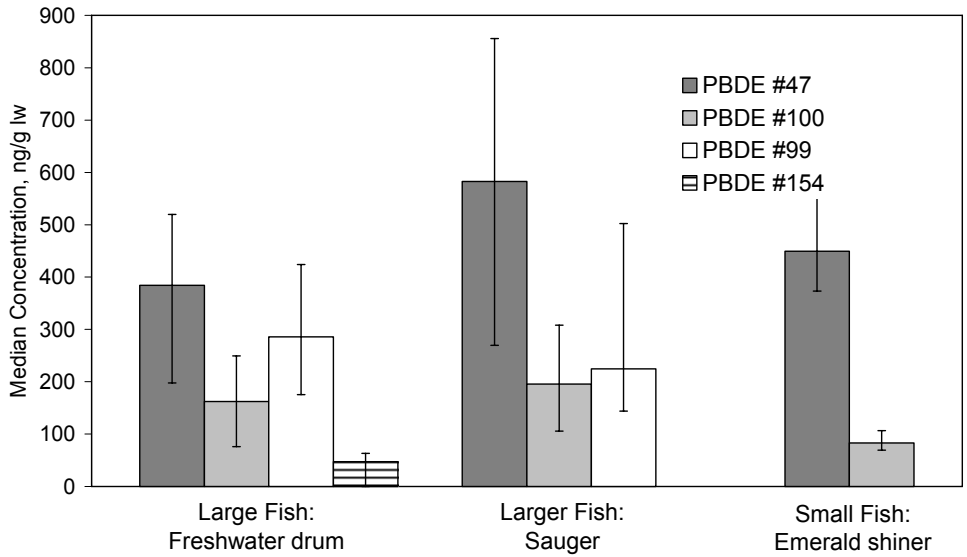


Figure 2. Median conger-specific PBDE concentrations and the 95% confidence intervals for two large fish and one small fish species (with n>9) collected from the Ohio River.

Whole fish were analyzed for found higher concentrations of PCBs, PBDEs, chlordanes, and DDT for Ohio River fish than Missouri River or Mississippi River fishes.

The distribution of PBDE congeners (lower) in fish differs from commercial formulations suggesting difference uptake and/or absorption properties of some congeners by fish.

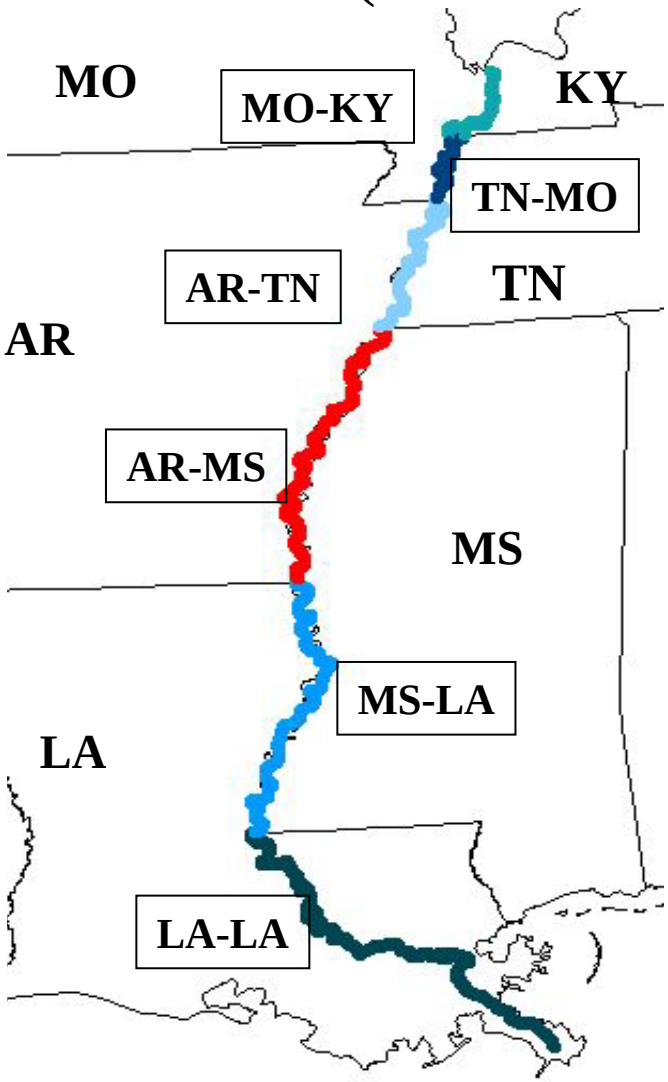
Tettenhorst, D.R. et al. (UES Inc contractor to the EPA), 2006. American Chemical Society Symposium

Design considerations for the Lower Mississippi River Consensus building with LMRCC

- **Objectives**
  - Must produce an EMAP Assessment of river.
  - Must support water quality and biological assessment needs of states.
- **Assessment units**
  - Must be definable within explicit spatial domains
  - Reasonable to complete assessment under EMAP-GRE approach.
- **Sample sizes**
  - Must be rationale & practical & statistically sufficient.
  - Must incorporate characterization of reference conditions, intra/inter annual variability, and QA requirements.
- **Methods & Indicators**
  - Must be relevant, practical, safe, cost-effective, and efficient for the river.
  - Must consider compatibility with current EMAP-GRE approach.
  - Should not need much exploratory research to implement.
- **Analytical Frameworks**
  - Must be developed within partnerships.
  - Must develop legacy for river bioassessments.

Proposed Design for Lower MS River Assessment

The number of sites in each inter-state section and in each state after 3 years. Data from inter-state sections are used by both states for assessments (i.e. sites are double-counted). Does not include QA re-visits.



State	Shares river with	Section length (km)	# Sites in each section	# Sites in each state
LA				
	LA	485	32	162
	MS	324	22	132
AR				96
	MS	334	22	
	TN	181	12	57
MO				51
	KY	100	10	30
	TN	100	7	
TOTAL		1,524	105	

Funding EMAP-GRE work on the Lower Mississippi River (2007-2010)

- State funding through Cooperative Agreements
  - Anticipated total over 4 years: $ 2.2M (beginning FY07)
  - No required match or cost-sharing.
  - Only state CWA agencies were eligible to apply.
  - Non-competitive, but peer-reviewed, selection process.
  - Proposals received from TN and MS. LA will submit one soon.
  - Work done as collaborations between state agencies and USGS.
- Federal funding through Inter-agency agreements with USGS
  - An existing agreement with MO Water Science Center will be amended.
  - A new agreement is being developed with AR WSC.
  - EPA is encouraging the USGS to involve state partners in states without a cooperative agreement (i.e. AR, KY, and MO).

Overview of cooperative work in EMAP-GRE

- EPA will:
  - Fund sample collection and lab analyses.
  - Track samples.
  - Manage data.
  - Coordinate consensus building of design and methods
  - Provide design (with sites and dossiers).
  - Provide field forms & labels.
  - Conduct training.
  - Conduct audits.
  - Coordinate data analyses.
  - Lead workshops
- States/USGS will:
  - Manage agreements.
  - Assemble & coordinate crews.
  - Provide, maintain, and use appropriate gear.
  - Participate in methods development.
  - Attend training.
  - Provide field forms and labels.
  - Collect samples.
  - Deliver samples & data.
  - Review and verify data.
  - Promote EMAP for river assessments.