Aquatic Resource Monitoring Overview

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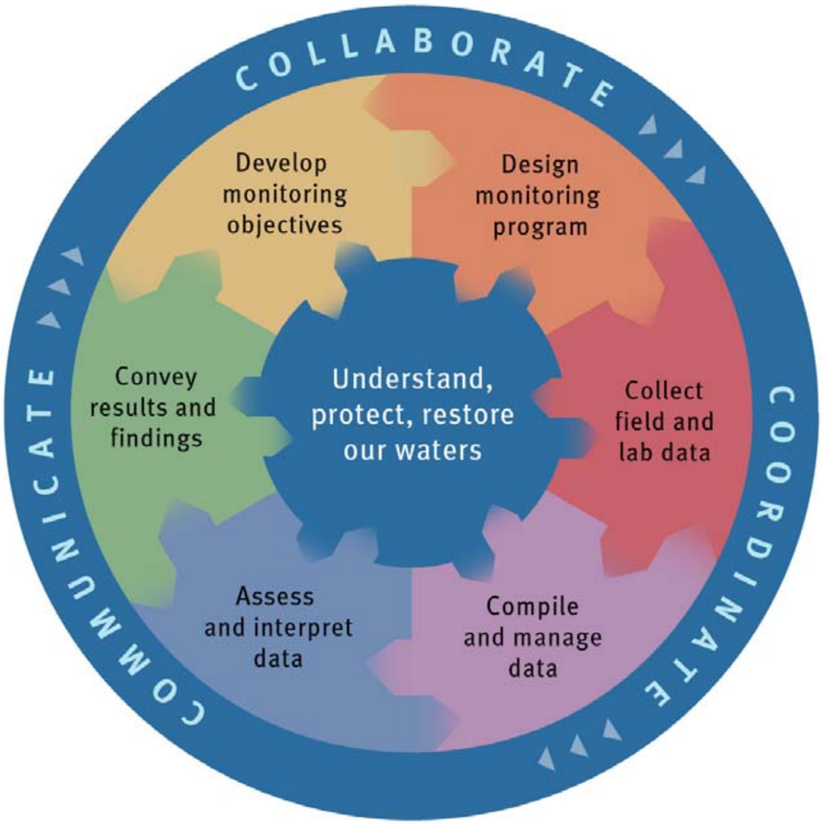
National Water Quality Monitoring Council: Monitoring Framework



- View as information system
- Monitoring pieces must be designed and implemented to fit together
- Comprehensive monitoring strategy can become central organizing approach to managing all waters in a state
- National monitoring requires consistent framework

- Reference: Water Resources IMPACT, September 2003 issue

Monitoring Program Weaknesses

- Monitoring results are not directly tied to management decision making
- Results are not timely nor communicated to key audiences
- Objectives for monitoring are not clearly, precisely stated and understood
- Monitoring measurement protocols, survey design, and statistical analysis become scientifically out-of-date

Changing Perspective in Monitoring

- Historical focus on point sources (local) and chemical pollutants
- Increased importance of non-point sources and biological/habitat condition
- Information at multiple scales: site, local, watershed, basin, state, region, national, global
- Manage at all scales
- Increased interest in tying decisions to monitoring information
- Reliance on quantitative estimates that can be used in program evaluation and cost-benefit analyses

Questions For Millennium

- What is the condition of the Nation's waters?
- Where, how, and why are water quality conditions changing over time?
- What factors are causing these problems?
- Are management programs working?
- Are water quality standards being met?

General Monitoring Questions from CALM

- What is the overall quality of waters in the State?
  - **CWA Section 305(b)**
- To what extent is water quality changing over time?
  - **CWA Section 305(b), Section 319(h)(11), Section 314(a)(1)(F) for lakes, identify emerging issues**
- What are the problem areas and areas needing protection?
  - **Section 303(d): identify impaired waters and high quality waters; identify causes and sources of impairment**
- What level of protection is needed?
  - **Establish TMDLs, NPDES permit limits, BMPs for Nonpoint sources, use attainability analyses, water quality standards**
- How effective are clean water projects and programs?
  - **Section 319 (nonpoint source control), Section 314 (Clean Lakes), Section 303(d) Total Maximum Daily Loads (TMDLs), Section 402 NPDES permits, water quality standards modifications, compliance programs (Discharge Monitoring Report information), and generally to determine the success of management measures.**

Large Scale Questions: Basin, State, Region, Nation

- Status
  - Assessment: How many stream miles, number of lakes, or estuarine hectares meet WQS or satisfy aquatic life use based on IBI scores?
  - Condition: What proportion of streams, lakes, and estuaries are in good ecological condition?
- Trends
  - How has the proportion of stream miles, number of lakes, or estuarine hectares meeting WQS or satisfy aquatic life use based on IBI scores changed over time?
  - Has the proportion of streams, lakes, and estuaries in good ecological condition changed between 2000 and 2010?

Large Scale Questions : Basin, State, Region, Nation

- Associations
  - What factors are associated with aquatic resources that do not meet WQS?
  - How does riparian habitat quality relate to the EPT Index ?
- Regulatory
  - What should nutrient criteria be? By ecoregion?
- Management
  - What proportion of the estuarine area has NPS WQS issues?
  - How effective have NPS BMPs been in improving WQ within the state?
  - What proportion of streams are being affected by urbanization?

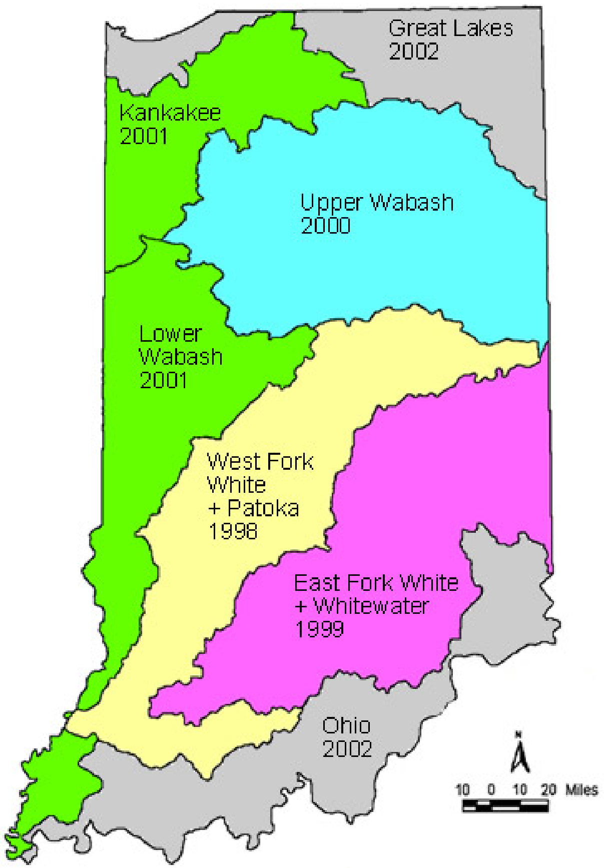
Local Scale (Site Specific) Questions

- Is the waste water treatment plant having an effect on the stream reach?
- Is stormwater off the CERCLA site clean?
- Has agricultural runoff caused the degradation in the tidal bay?

Monitoring Components Objectives-Design-Analysis-Report

- Monitoring objectives
- Institutional constraints
- Target population
- Sample frame
- Indicators and response design
- Design requirements
- Specification of survey design
- Site selection
- Site evaluation
- Conduct field and lab measurements
- Indicator results database
- Sample frame summary
- Adjust survey weights based on implementation
- Target population estimation
- Report results

Indiana Stream Example



- Objective: Within Upper Wabash basin for streams with flowing water estimate km that are impaired and non-impaired for aquatic life use
- Target population: All flowing waters during summer index period within Upper Wabash
- Sample frame: NHD perennial coded streams
- Rotating basins across state

Indiana Stream Example

- Sample size: 50 sites with equal number in 1st, 2nd, 3rd, and 4th+ Strahler order
- Survey Design: GRTS for a linear network (spatially-balanced random sample)
- Oversample: 50 sites
- Site Evaluation
  - TS: Target Sampled
  - NT: Non-target
  - LD: Landowner denied access
  - PB: Physically barrier
- Adjust weights
- Estimate perennial stream extent
- Estimate stream km impaired

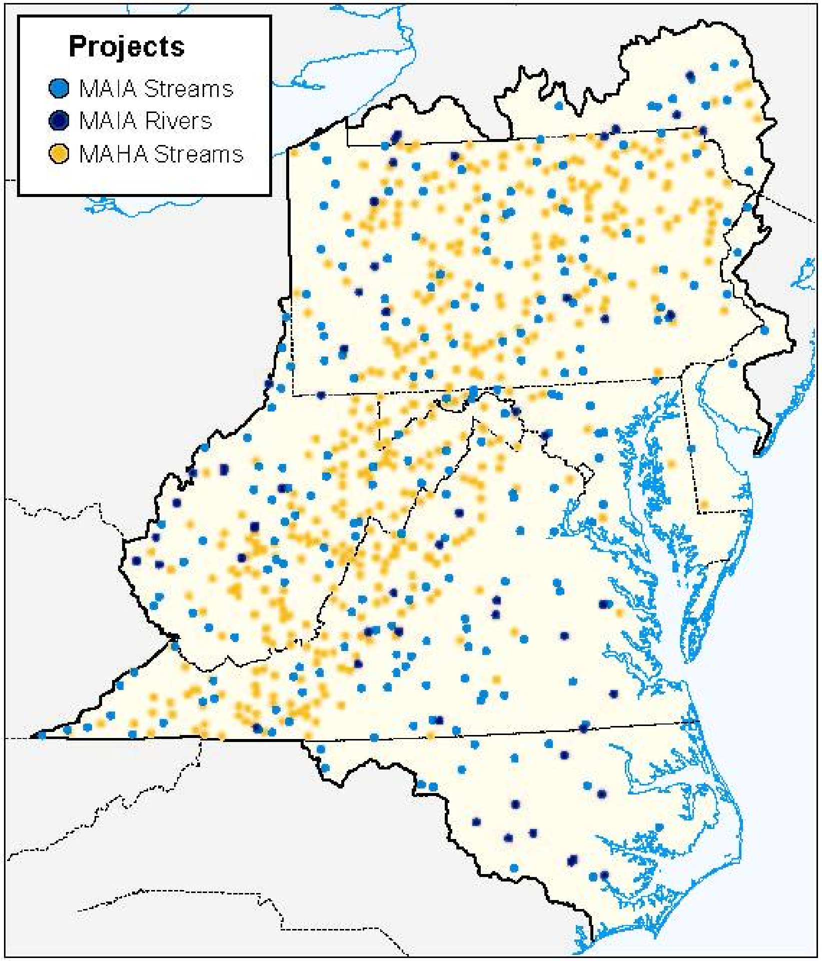
Indiana Upper Wabash Basin: Perennial Stream Length (km)

Stream Length Category	Length (km)	Percent Total
NHD GIS coverage	7358	100
Estimated perennial	5707 ± 724	77.6 ± 9.8
Estimated sampled	3414 ± 729	46.4 ± 9.9

Indiana Upper Wabash Basin: Biological and Habitat Assessment

Indicator	Status	Length (km)	Percent Total
IBI	Not Impaired	4128 ± 1134	72.3 ± 13.0
	Impaired	1579 ± 810	27.7 ± 13.0
	Total	5707	100
QHEI	Not Impaired	3373 ± 990	59.1 ± 16.3
	Impaired	2334 ± 1168	40.9 ± 16.3
	Total	5707	100

Mid-Atlantic Integrated Assessment (MAIA) Streams and Rivers

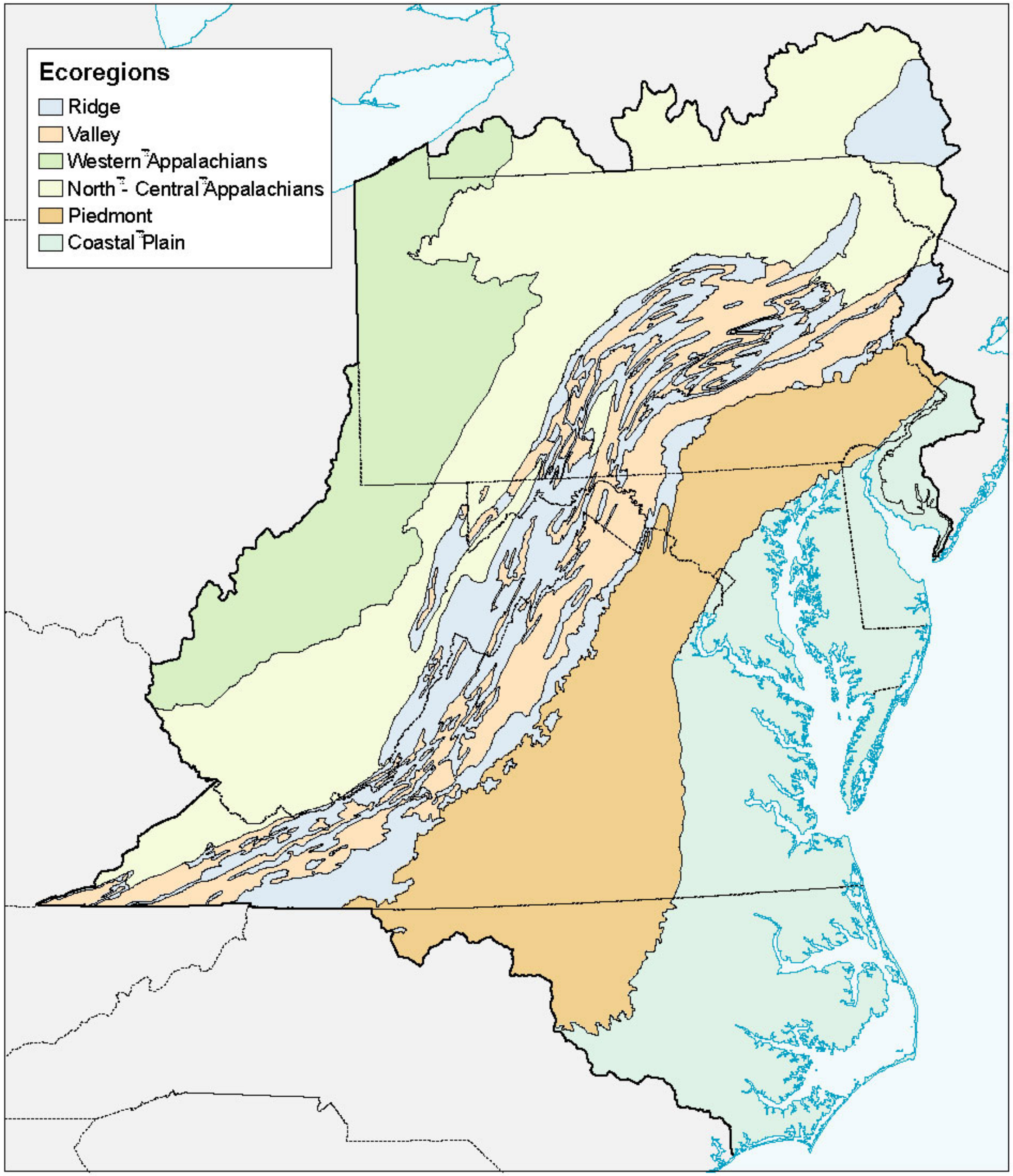


Mid-Atlantic Integrated Assessment Streams and Rivers

Biological Assemblage:	***Proportion of Stream Resource in Poor Condition***	***Primary Stressors****
Fish	31%	Non-native fish Lack of large wood
Macroinvertebrates	41%	Excess fine sediments Acidity
Algae	33%	Nutrients Excess fine sediments

** based on combination of high relative extent and high relative risk to assemblage*

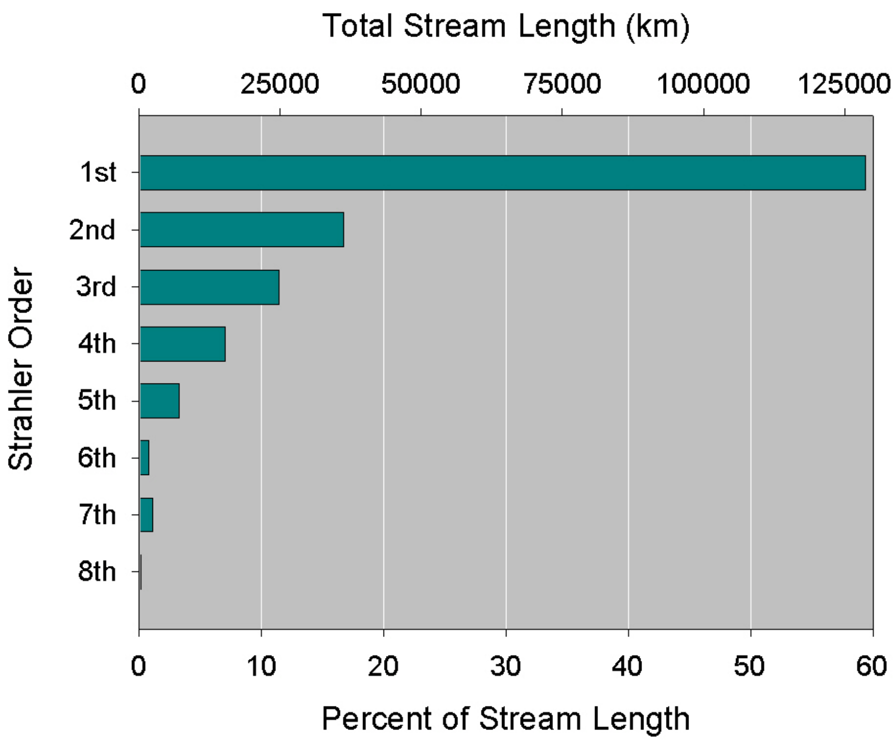
MAIA Ecoregions: Omernik Level III



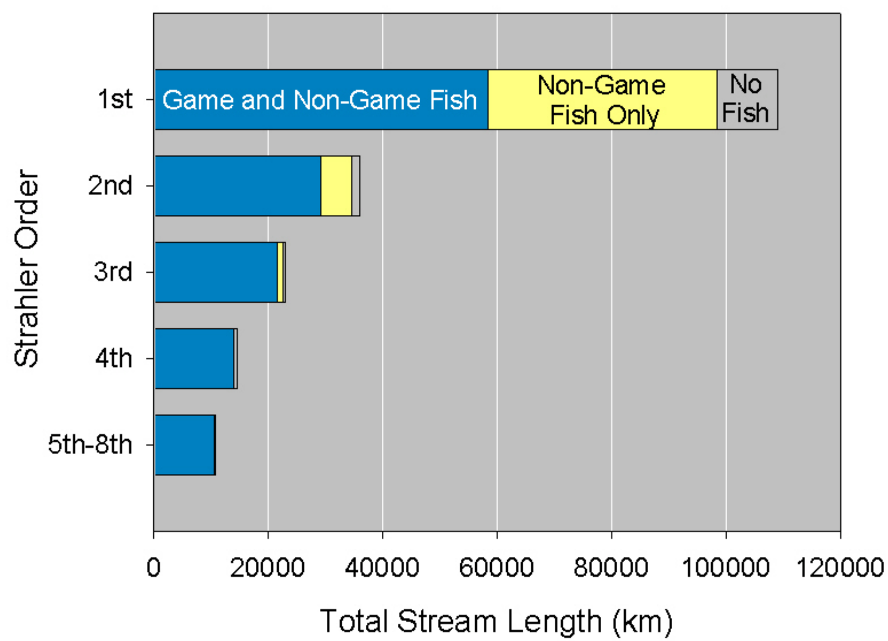
Mid-Atlantic Integrated Assessment: Assessment by Ecoregion

Ecological Region:	***Summary of Condition***	***Biological Assemblage Most at Risk*** *(% of stream length in poor condition)*	***Primary Stressors****
Coastal Plain	Relatively Poor	Macroinvertebrates *(88%)*	Excess sediments Non-native fish
Piedmont	Intermediate	Macroinvertebrates *(42%)*	Non-native fish Nutrients
Valleys	Intermediate	Macroinvertebrates *(45%)*	Non-native fish Nutrients
Ridges	Relatively Good	Fish *(26%)*	Non-native fish Lack of large wood
North and Central Appalachians	Relatively Good	Fish *(40%)*	Non-native fish Lack of large wood
Western Appalachians	Relatively Poor	Algae *(51%)*	Excess sediment Lack of large wood

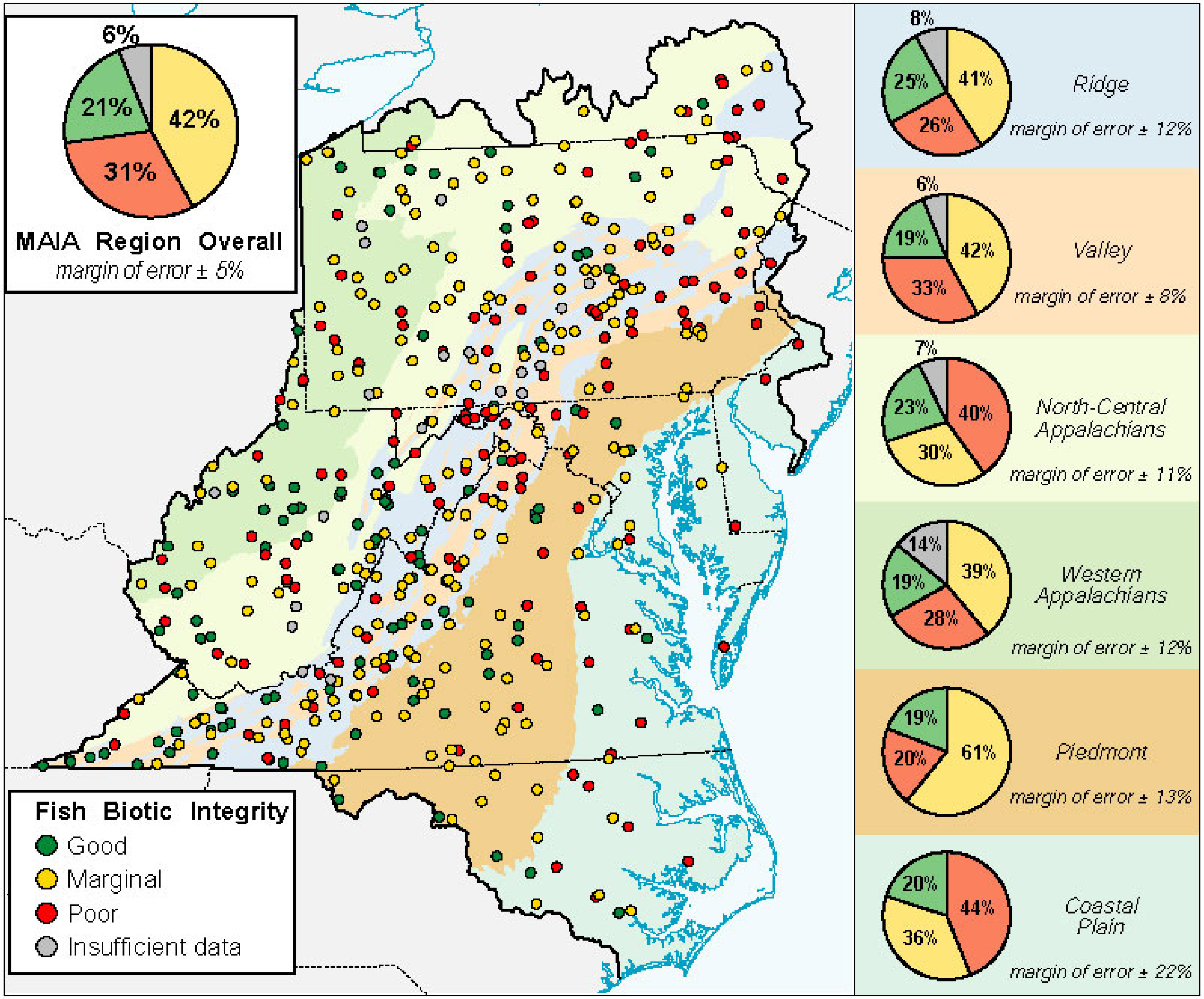
MAIA: Description of Extent



Presence Game, Non-Game, No Fish



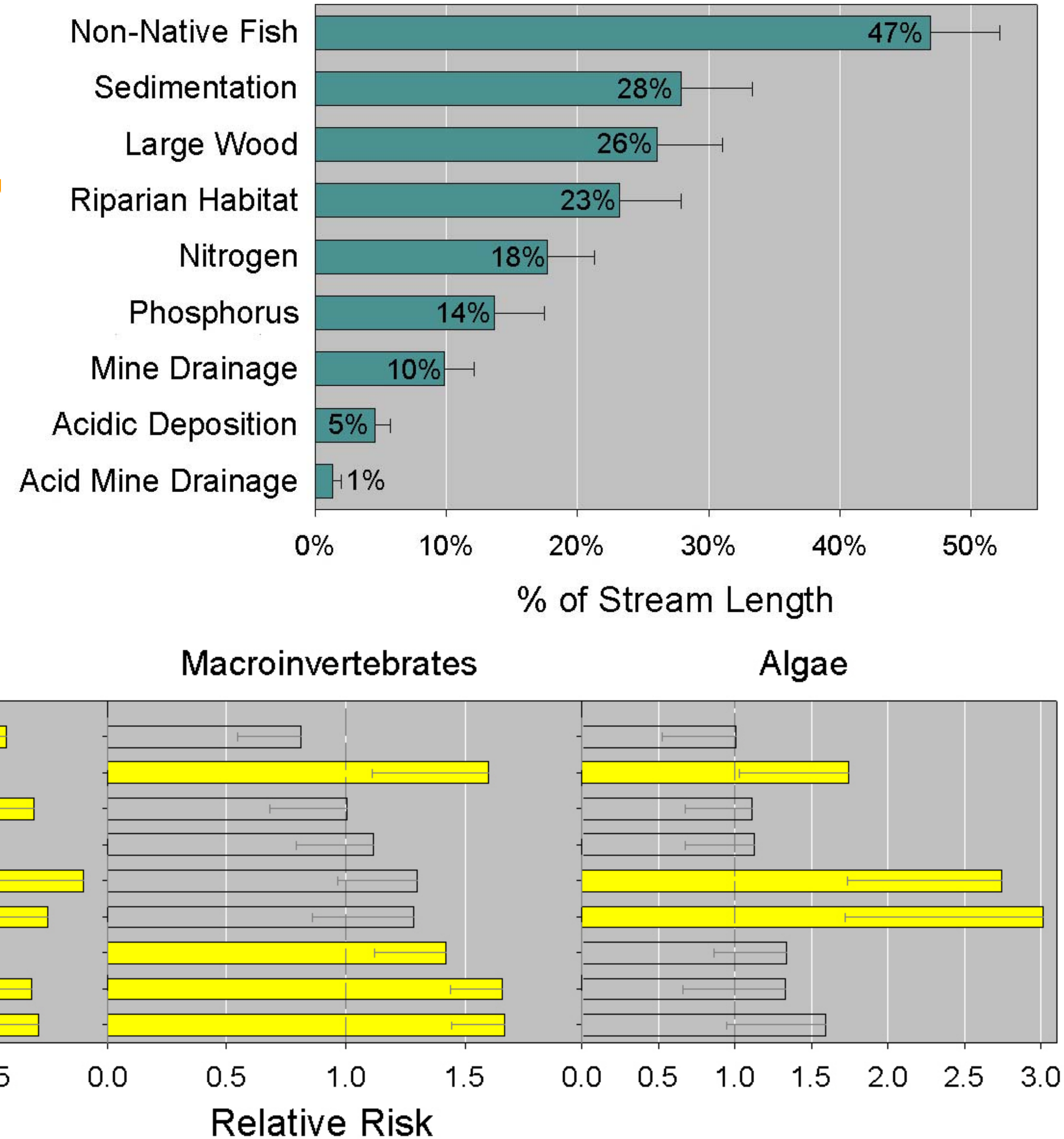
MAIA: Fish Assemblage Condition

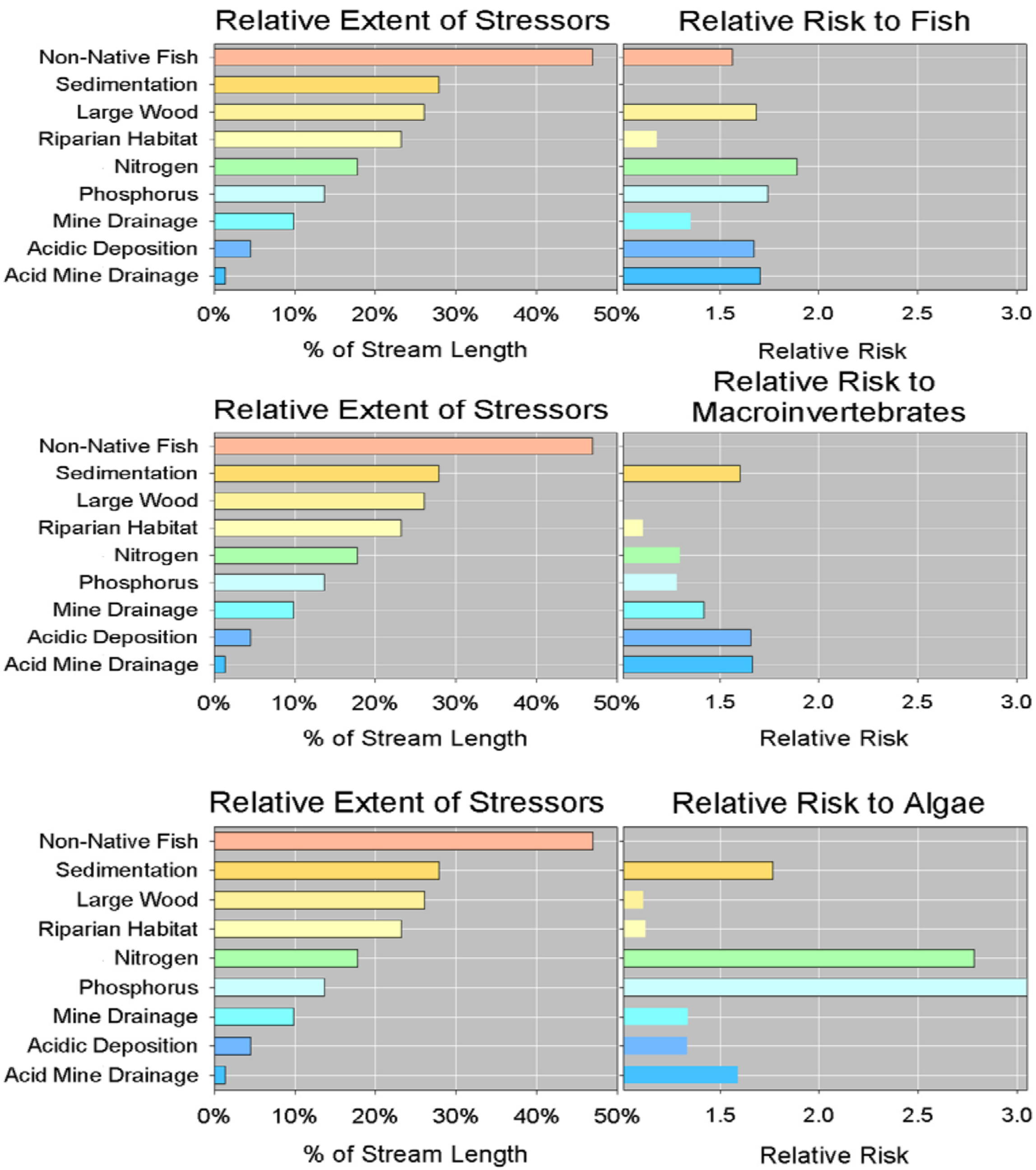


MAIA: Fish, Macro-invertebrate and Algal IBI results

Region	% in Good Condition			% in Poor Condition		
	Fish	Macro-invertebrates	Algae	Fish	Macro-invertebrates	Algae
Mid-Atlantic Region	21	26	31	31	41	33
Coastal Plain	20	0	35	43	88	41
Piedmont	20	20	27	20	42	37
Valleys	19	26	25	33	45	34
Ridges	26	49	42	26	20	21
North and Central Appalachians	23	40	45	40	28	19
Western Appalachians	19	13	8	28	46	51

MAIA: Extent of Stressor Presence & Relative Risks





MAIA: Relative Risk Assessment

$$RR = \frac{\text{Pr(Poor BMI, given Poor SED)}}{\text{Pr(Poor BMI, given OK SED)}}$$

"The risk of Poor BMI is 1.6 times greater in streams with Poor SED than in streams with OK SED."

CALM: Elements of a State Monitoring Program

- Monitoring program strategy
- Monitoring objectives
- Monitoring design
- Core and supplemental water quality indicators
- Quality assurance
- Data management
- Data analysis and assessment
- Reporting
- Programmatic evaluation
- General support and infrastructure planning