Developing Regional Networks: Monitoring to Detect Climate Change in Streams

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Integrating and Leveraging Monitoring Networks to Support the Assessment of Outcomes in the New Bay Agreement
Cambridge, MD
April12-13, 2016

Driving Questions

How will climate change impact aquatic ecosystems?

AND

What do bioassessment programs need to know to respond?

(How will they maintain their ability to assess condition and detect impairment?)

Why Monitoring?

Goal for Northeast

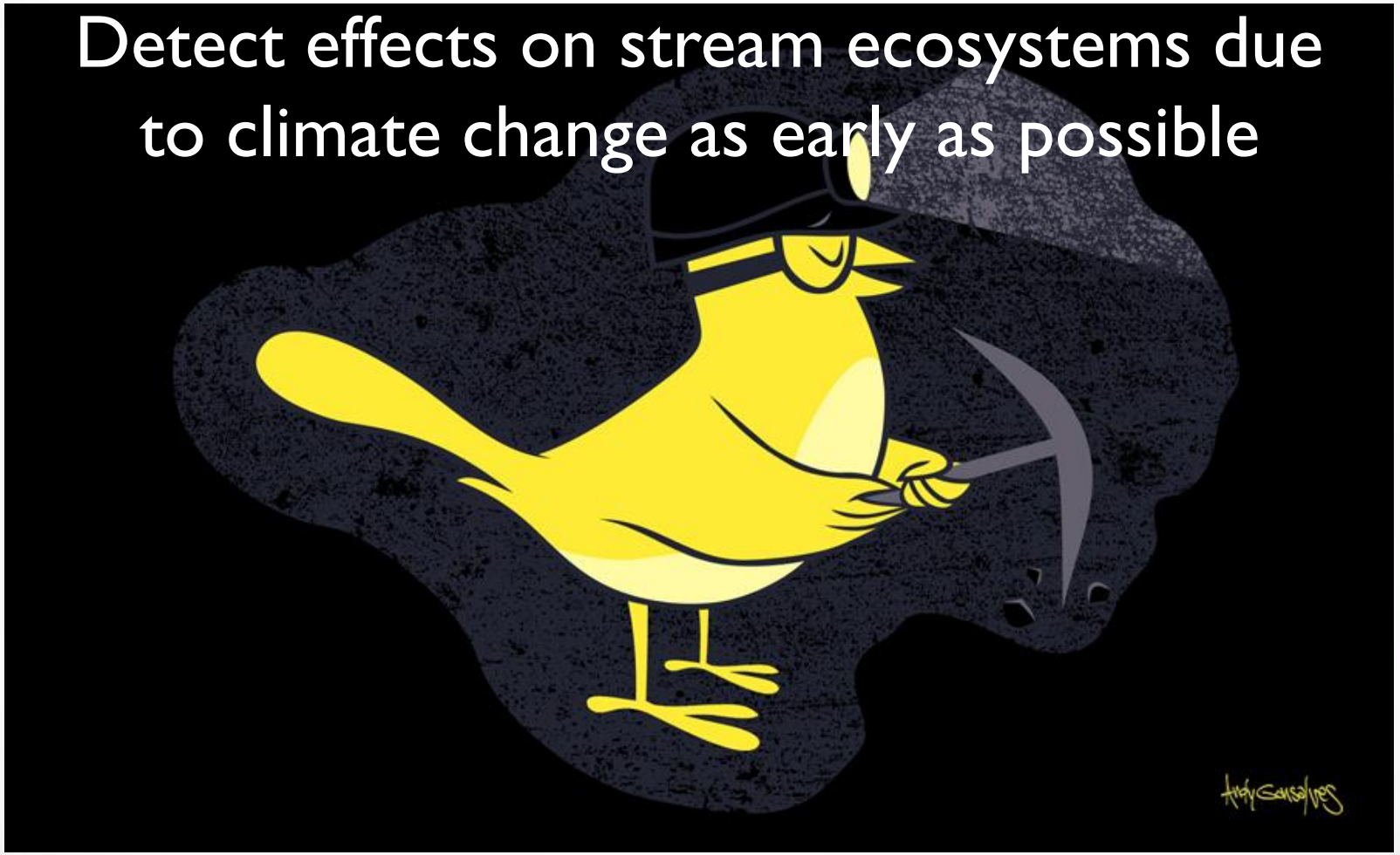


Illustration by Andy Gonsalves 2014

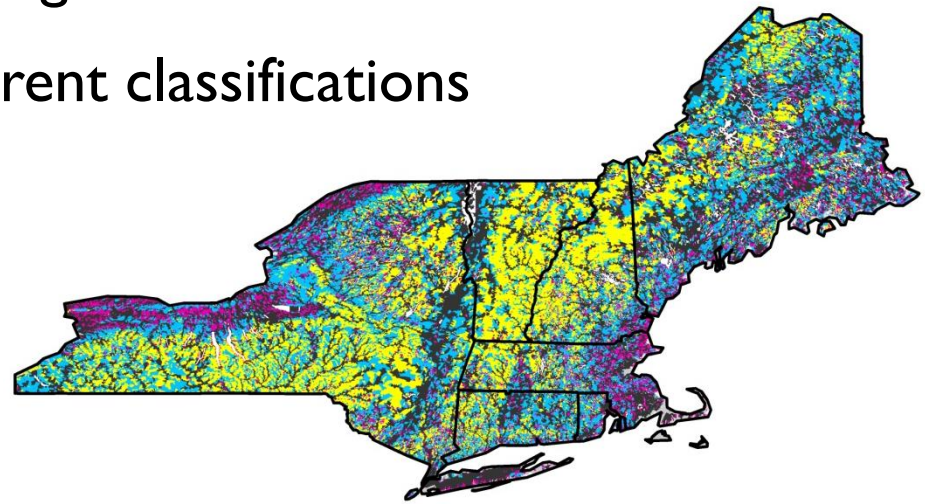
Initial Approach

Lots of barriers exist…

…no long-term funding, programs / protocols not aligned, communication across and within organizations challenging, etc.

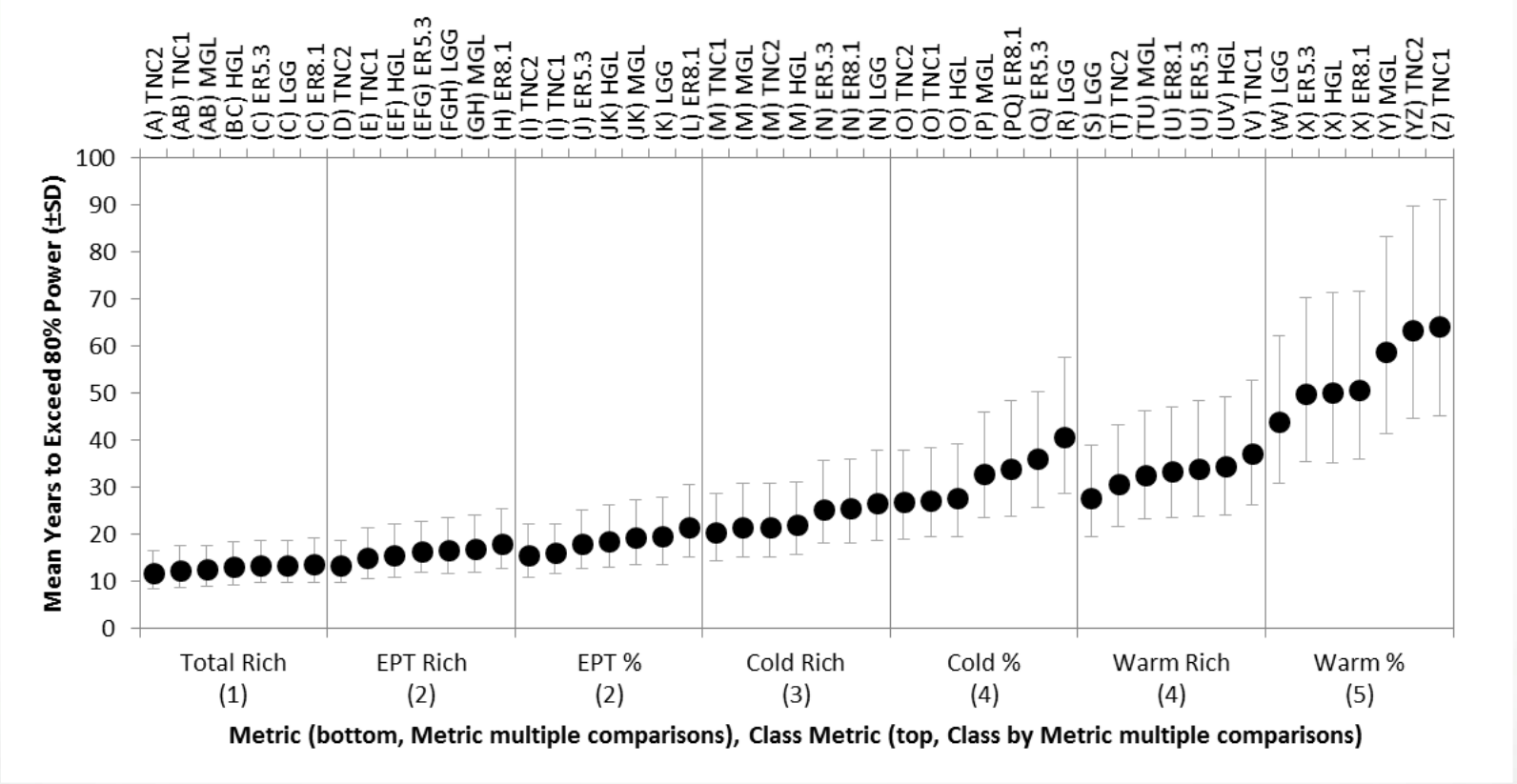
What Type of Sites?

- Use environmental variables to define stream types across northeastern region
- Compare different classifications



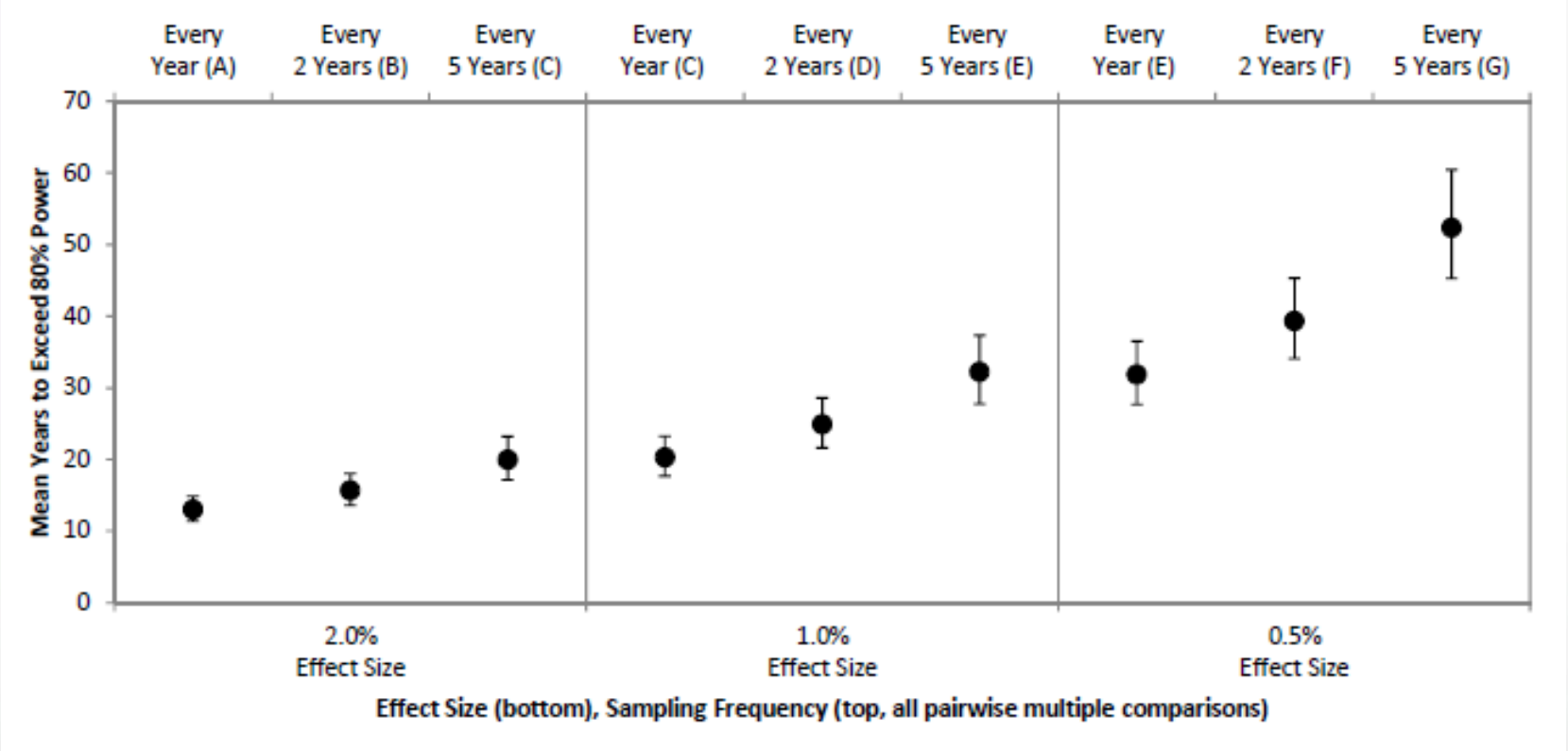
How Many & How Long?

- 30 sites, panel or re-visit (see Larsen et al. 2004)
- Duration of sampling depends on metric of interest



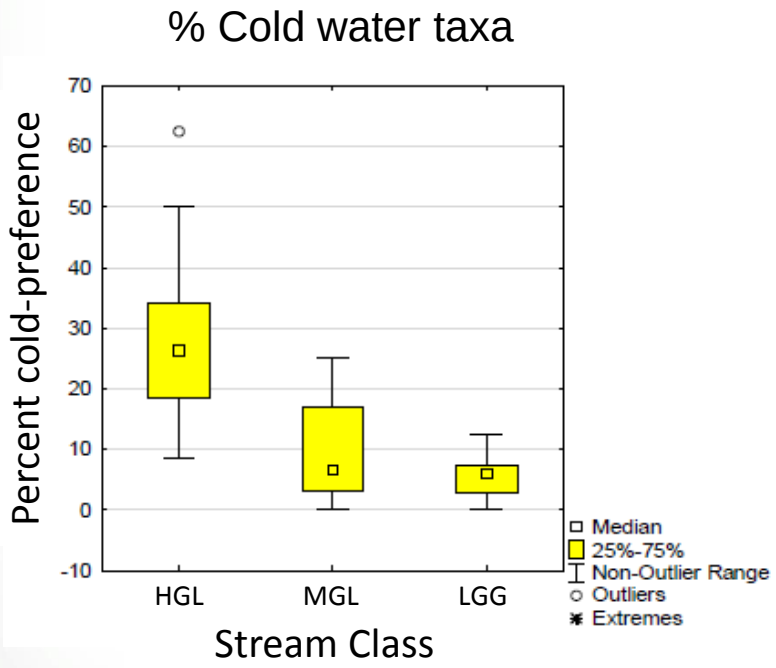
How Frequently?

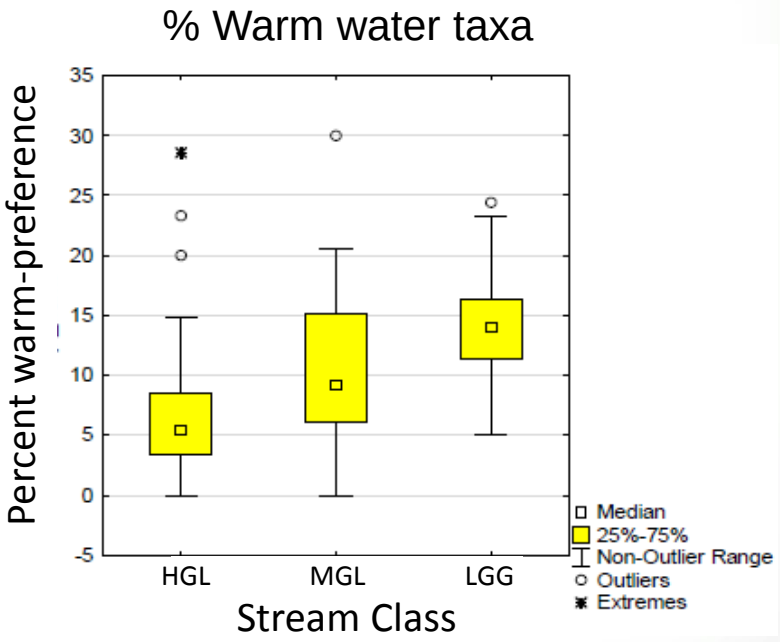
- Yearly, though every 2 years is OK
- Highly dependent on effect size



Monitoring What?

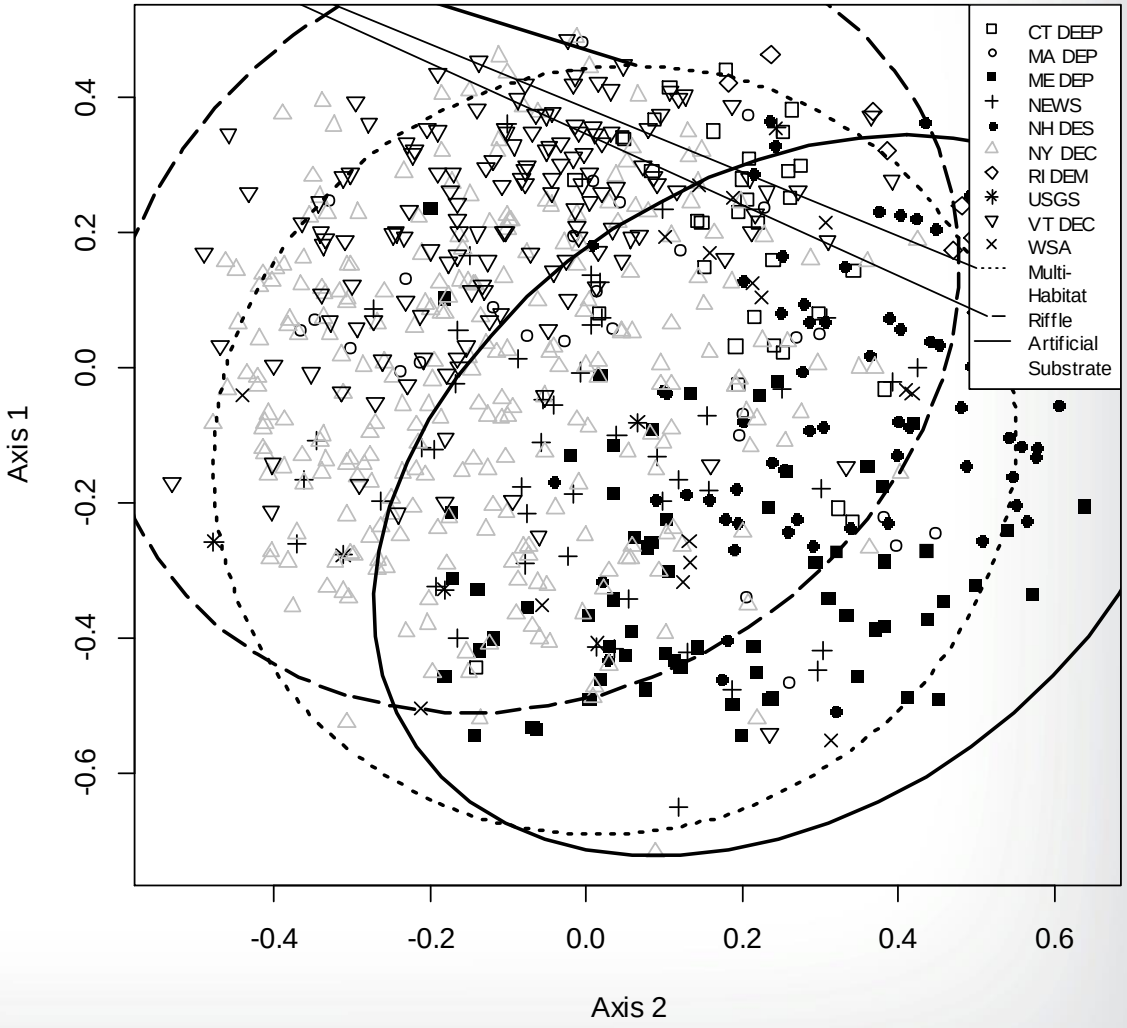
- Identify climate-sensitive traits
- Examine trait distributions among stream classes





Using What Methods?

- Collection methods vary by agency
- More uniform methods decrease this source of variability in data



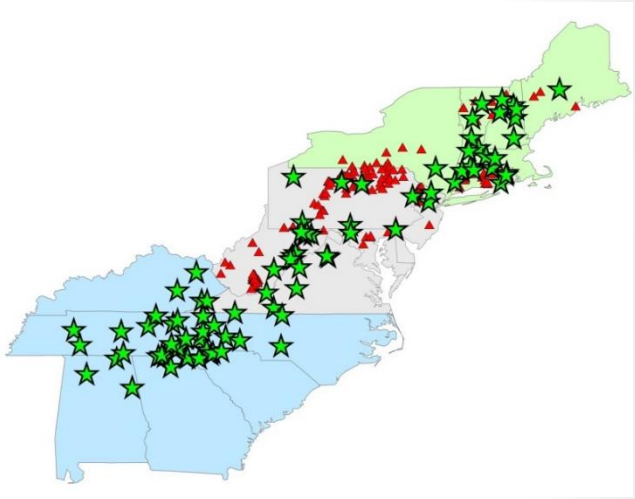
With growing interest, how have other states and Regions joined?

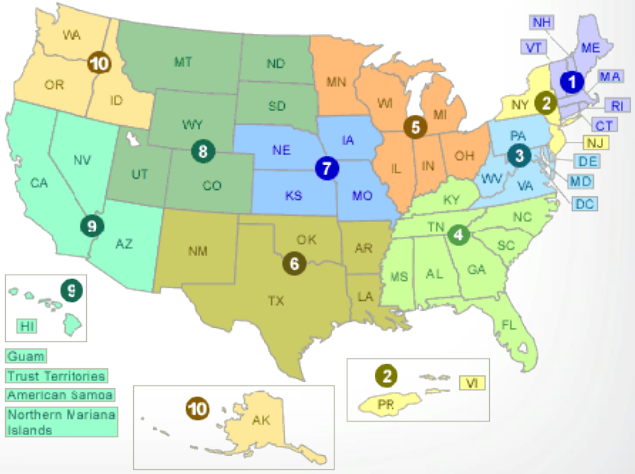
Resources to Develop RMNs

- Coordination of regional workgroups with EPA Regions, states, tribes, other organizations
- Generic QAPP to encourage consistent quality and methods
- Report on best practices for continuous temperature and flow monitoring
- Documentation of approach for RMN development
- Workshops on sensor deployment and data management using R

Report on Developing Regional Monitoring Networks

- Describes development of Regional Monitoring Networks in Northeast, Mid-Atlantic, and Southeast
- Illustrates site selection for riffle-dominated, freshwater, wadeable streams
- Describes data collection and quality assurance procedures, rationale for collecting these data, and analysis plan
- Discusses potential implementation in other regions (R5, R7, more?)



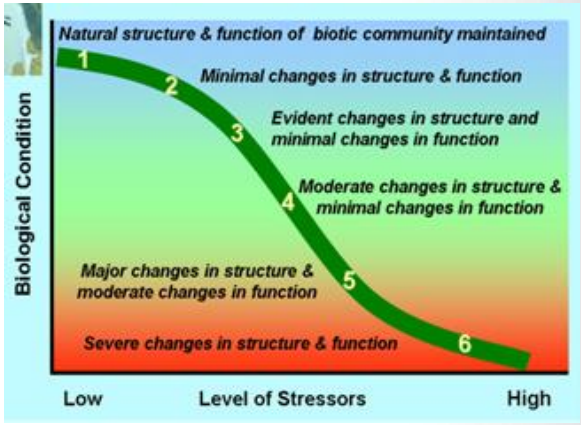


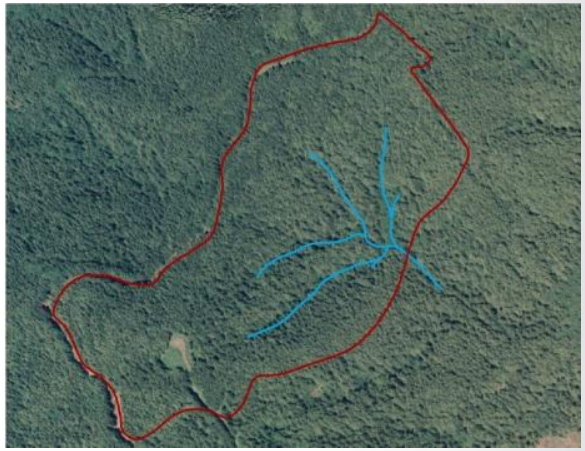
Process

- Form regional working group
- Select goal
  - Determine target stream type
  - Conduct stream classification
  - Conduct vulnerability assessment
- Discuss site selection criteria, data collection methods, and logistics
  - Utilize and build on current data collection by partners
- Identify logistical, training and equipment needs
- Develop plan for sharing and analyzing the data
- Begin implementation and data collection

Site Selection

- Apply consistent criteria
- Long-term (10+ year) sampling efforts concentrated at 'primary' sites
- Up to 15 primary sites per state (workload sometimes shared across entities)
- Well-designed networks of 30 to 50 sites monitored consistently can detect underlying changes of 1–2% per year in a variety of metrics within 10–20 years





Data Collection

- Biological indicators
  - Benthic macroinvertebrates, optional fish and periphyton if resources permit
- Temperature
  - Continuous water and air temperature
- Hydrology
  - Continuous water level data, converted to discharge if resources permit
- Habitat (rapid visual habitat methods like USEPA RBP or state equivalent)
  - Quantitative Habitat (optional, e.g. NRSA methods)
- Water chemistry (optional, state or RBC methods)

Adaptable Framework

Level of rigor	Usability for RMNs
1 (lowest)	**Data are usable under certain or limited circumstances**. Data are not collected and processed in accordance with methods agreed upon by the regional working group, which severely limits their usefulness.
2	**Data are usable under some, but not all circumstances**. Only certain aspects of sample collection and processing are done using the protocols that are agreed upon by the regional working group, which limits their usefulness.
3 (target) 	**Data meet the desired level of rigor**. They are collected in accordance with the methods that are agreed upon by the regional working group. Where methodological differences exist, steps have been taken to minimize biases, and data are sufficiently similar to generate comparable indicators and meet RMN objectives.
4 (optional) 	**Data exceed expectations**. Data include optional high quality data and meet or exceed the desired level of rigor agreed upon by the regional working group.

Macroinvertebrate Sampling

Level of rigor	Fixed Count Subsample
1 (lowest)	Presence/absence or field estimated categorical abundance (e.g., rare, common, abundant, dominant)
2	Fixed count with a target of 100 or 200 organisms
3 (target) ★	Fixed count with a target of 300 organisms
4 (optional) ★★	Fixed count with a target of more than 300 organisms

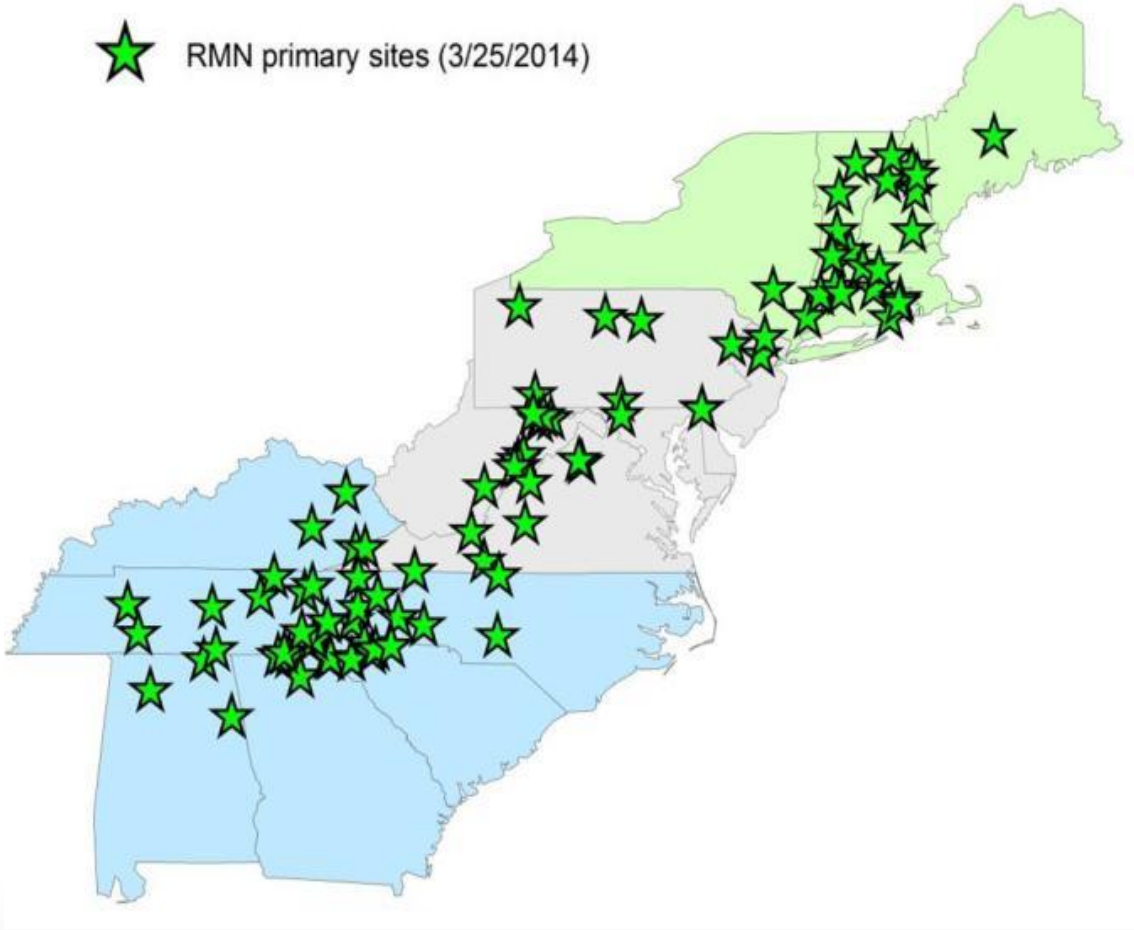
Best Practices for Continuous Monitoring Report Objectives & Contents

- Facilitate deployment of continuous temperature and water-level sensors at ungaged sites in wadeable streams
- Address challenges posed by year-round deployment
- Report describes
  - Equipment needs, options, costs
  - Equipment calibration & configuration
  - Installation
  - Maintenance
  - Data retrieval
  - Data processing
  - Lessons learned

Underwater epoxy method

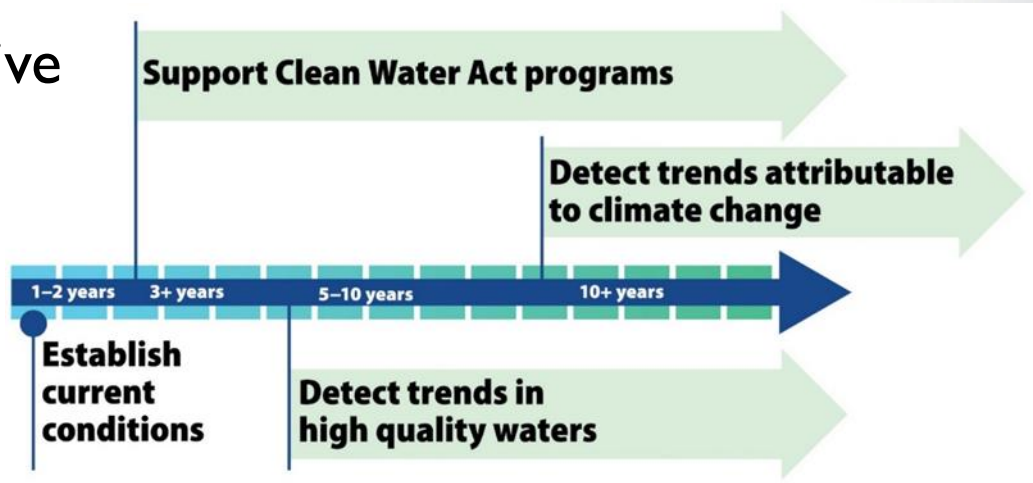
Vented vs. non-vented transducers

Current Status in East



How Can Data Be Used?

- Detect temporal trends
- Investigate relationships between biological, thermal, and hydrologic data
- Explore ecosystem responses and recovery from extreme weather events
- Test hypotheses and predictive models related to climate change
- Quantify natural variability
- Identify potential sites for restoration and adaptation



Additional Considerations Beyond the Current Eastern RMN Sites

Challenges & Opportunities Engaging Additional Partners

- Different goals (not all streams resemble Eastern Woodlands)
- Selection of lower condition sites requires additional analyses
  - Vulnerability assessment gains new relevance
- Distribution of effort allows inclusion of additional sampling strata within overall network
- Fulfill multiple purposes
  - Reference condition monitoring
- Leverage expertise and resources among partners
  - Data infrastructure
  - Data sharing and analysis

Data Management Issues

Problem: No single existing system currently can accommodate all of the types of data being collecting at RMN sites.

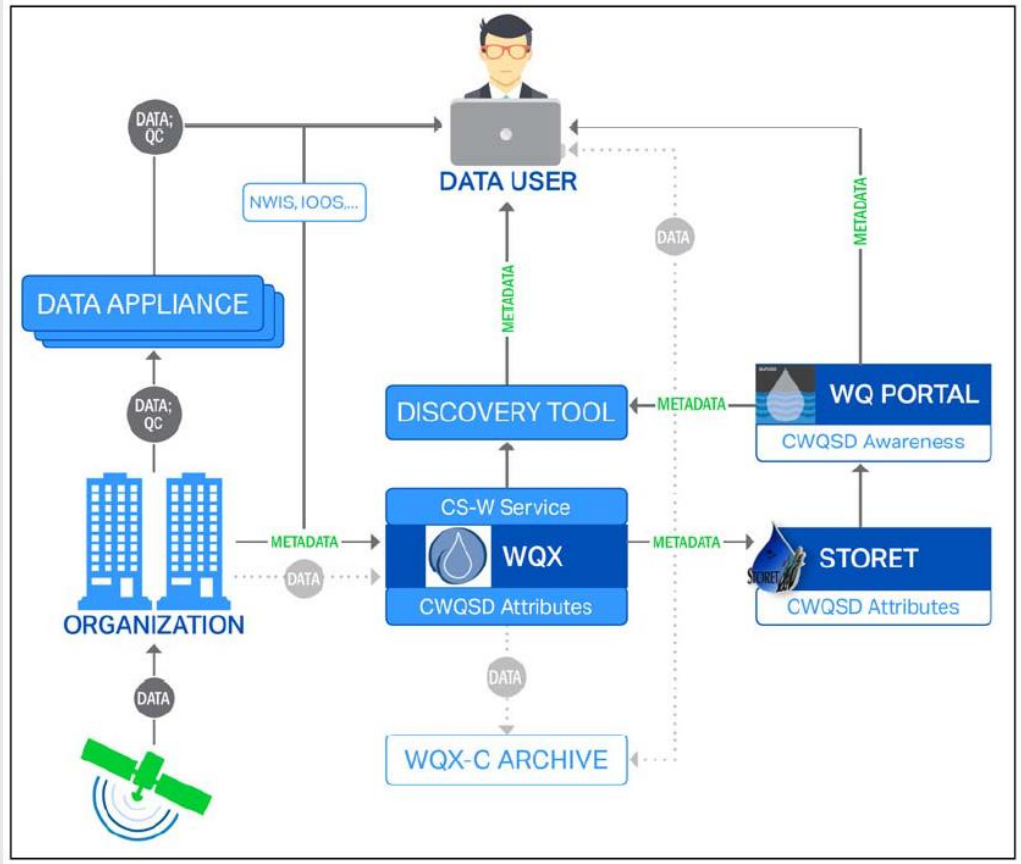
- **Biological**
- **Habitat**
- **Water chemistry**

Water Quality Exchange (WQX)

Continuous data:

- **Thermal**
- **Hydrologic**

Data Management Vision



- Continuous data accumulates quickly
- Data management software can be costly
- A multi-agency effort is underway to develop a data management system for continuous data (Contact: Dwane Young, EPA)
- Full implementation is several years off

Data Management Pilot

- Understand continuous data collection and management needs from states and tribes
- Use R to overcome barriers to QA/QC, data formatting, and data analysis
- Hold workshops and webinars to train partners

Two Workshops: Procedures and R Scripts for Continuous Temperature and Hydrologic Data

National Water Quality Monitoring Conference

May 5, 2016 in Tampa, FL

On-going Work

- Region 5 states and tribes
  - Developing tribal climate change monitoring strategy
  - Selecting sites for streams RMN
  - Discussing strategy for lakes RMN
- Region 1 discussing strategy for lakes RMN
- Region 7-10 considering RMN options beyond least-disturbed mountainous headwater streams
  - Opportunities for sites that are not 'reference'
  - Focus on drought
  - Co-development with Biological Condition Gradient

Thank you to Regional Steering Committee members and many others who have provided data and input

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