Some Thoughts Regarding Ecosystem Monitoring Programs

How should we design the programs?
What can we learn from the results?

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Why are we monitoring?

The evolutional hierarchy of monitoring

- To characterize water quality
- To identify sources of contamination
- To track water quality trends

- To characterize the state of the ecosystem

To Characterize Water Quality

Physical attributes

- Temperature
- Turbidity
- Color
- Dissolved oxygen

Chemical attributes

- COD (dissolved organic constituents)
- BOD (bio-available organic constituents)
- Nutrients (constituents that enable microbiological activity)
- Toxic substances (constituents that can impact biological function in plants, animals, and humans)
  - **Heavy metals**
  - **Organic substances**

To Identify Sources of Contamination

- Property or substance specific monitoring
- Spatial considerations are important
  - Must select multiple sample points – chosen specifically to locate the source
- Temporal considerations are important
  - Multiple sampling events must be chosen over a specific time period that encompasses both specific process events and unrelated variability

To Track Water Quality Trends

- Observations regarding a single property or substance
  - Spatial elements (careful selection of sample point, and ability to return to that same point – or set of points – is important)
  - Temporal elements (repeatable timing and timing with respect to variable factors is important)
- Observations regarding multiple properties or substances
  - Adds the additional need to design sampling points and timeframes around the analytical needs associated with multiple properties and/or substances and the need to accommodate temporal variables associated with each of the individual properties/substances

To Track Water Quality Trends

- Parameters/analytes
  - Define the trend for that parameter/analyate only
  - Multiply parameters/analyates may be needed for trend analysis
- Data analysis techniques employed are critical
  - An understanding of the kinetics responsible for the trend is essential for trend characterization

Characterize State of the Ecosystem

- Ecosystem outcomes are often/always the result of multiple factors
  - An integrated monitoring program must be designed to discern ecosystem status, trends, and causal factors.
  - This approach leads to looking beyond contaminant monitoring and exploring the nature of the watershed and activities in it.

Additional Parameters Needed for Ecosystem Monitoring Protocols

- Nutrient dynamics
- Community structure
- Habitat conditions
- Invasive species
- Food web structure

Interpreting Ecosystem Monitoring Results

- Understanding of specifics regarding presence and sources of contaminants
- Mapping the state of ecosystem communities
  - Species present
  - Impacts from invasives
  - Habitat related impacts
- Establishing causal relationships
  - Evaluation of land use activities
  - Defining role of each of the stressors within a given watershed

Directing our Monitoring Resources

- Screening models provide guidance for detailed substance assessments
- Contaminant monitoring programs highlight research and potential management agenda needs
- Holistic collaborative science driven review efforts reveal crosscutting and overarching Basin-wide needs
  - Example: IJC Chemicals of Emerging Concern working group recommendation:
    - Effects-based monitoring in the context of multiple stressors should be developed and implemented to supplement the current chemical monitoring regimes.