

Better Data, Better Partnerships

How can new technologies increase
the use of volunteer biomonitoring
data?

Perspectives and Discussion

The Panel

- ▶ Jim Lazorchak, Mark Bagley, Office of Research & Development, US EPA
- ▶ Dwane Young, Office of Water, US EPA
- ▶ Barb Horn, Colorado DPW
- ▶ Alene Onion, New York DEC
- ▶ Brian Hall, Ohio EPA
- ▶ Chris Kaef, Northern Kentucky Sewer District No. 1
- ▶ Laith Alfaqih, Cincinnati Metropolitan Sewer District
- ▶ Marc Hult, Kentucky Watershed Watch
- ▶ Dick Durtsche, Northern Kentucky University
- ▶ Steve Fondriest, Fondriest Environmental

TECHNOLOGY TO EMPOWER CITIZEN SCIENTISTS

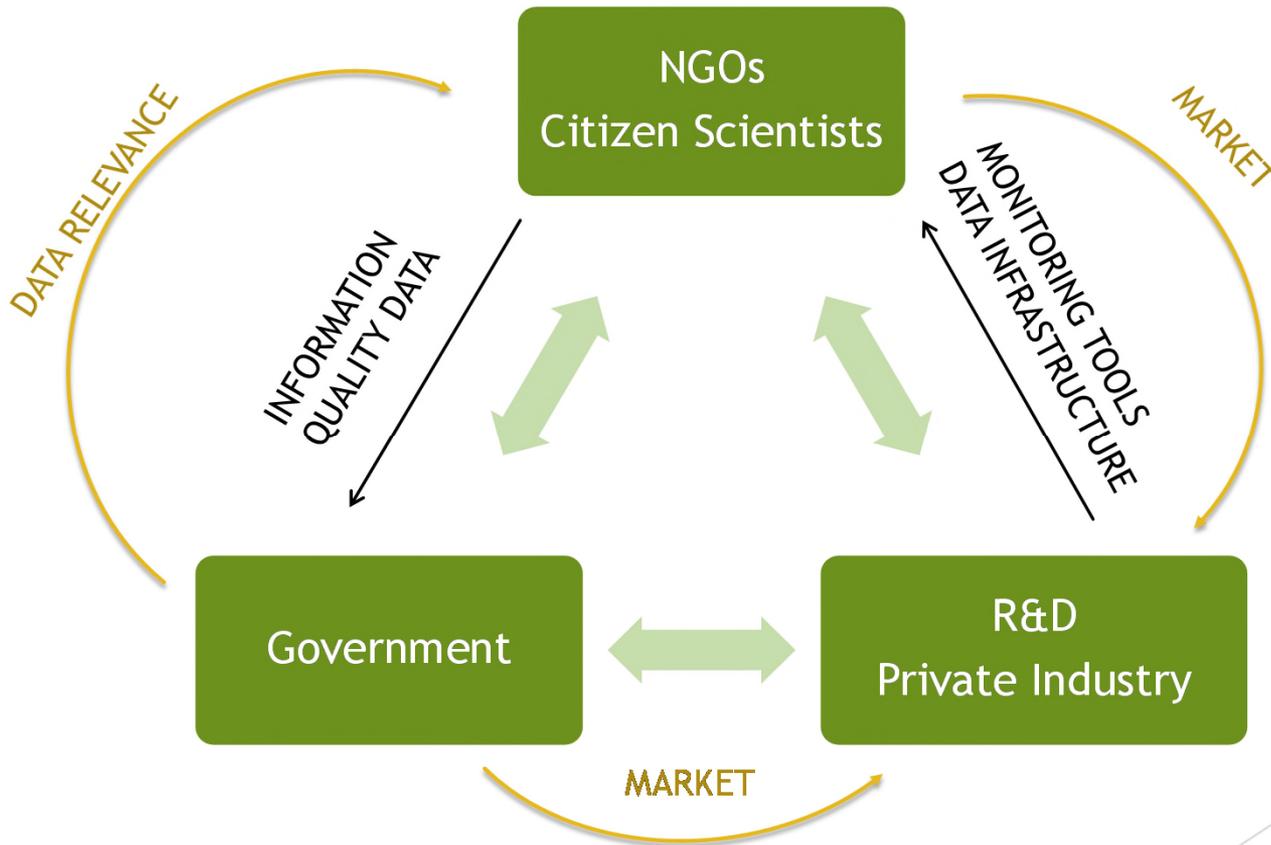
MARCH 25 - 27, 2013



A Workshop to Define Technology Development Goals That Will Expand the Power and Reach of Citizen-Based Monitoring for the Protection of Stream Biodiversity
Northern Kentucky University in Highland Heights, KY

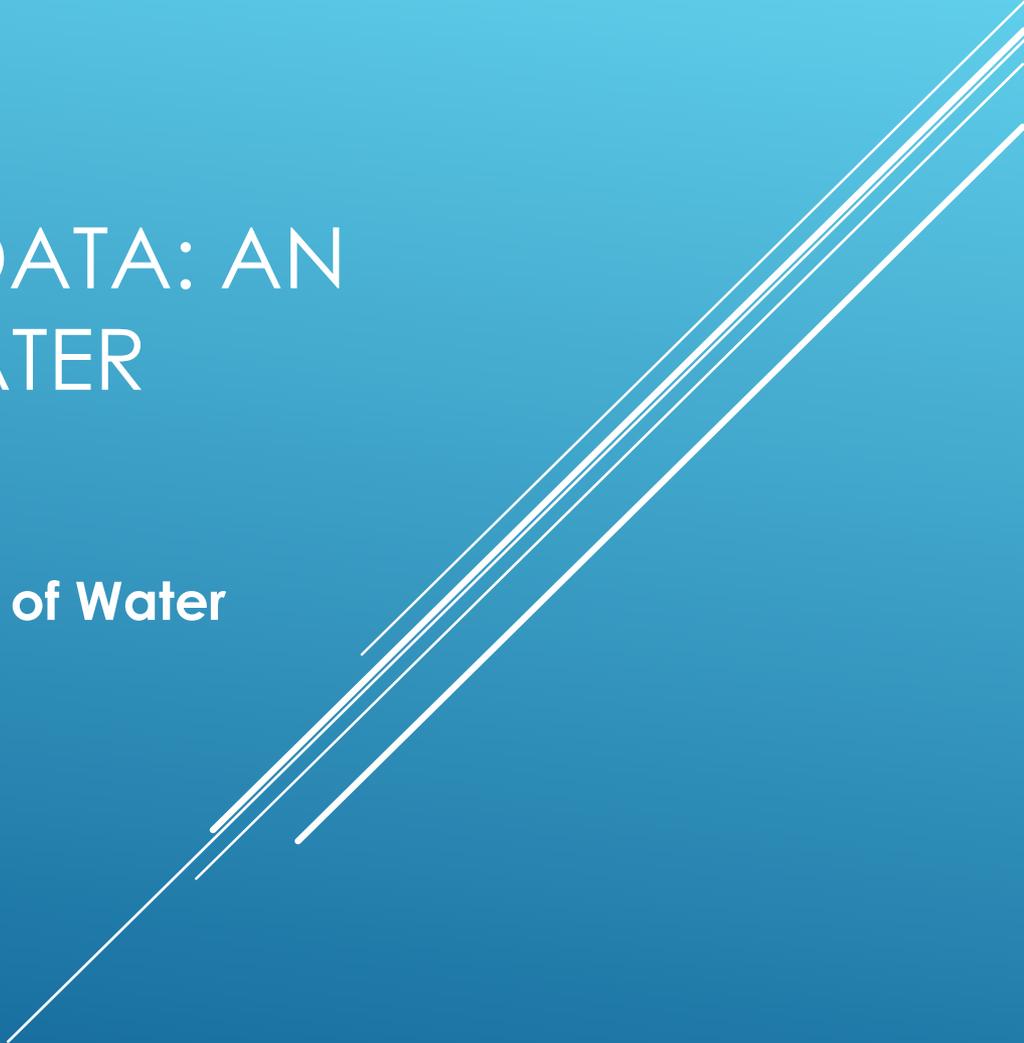
- ▶ EPA, States, Municipalities, NGOs, Academia, Industry
- ▶ Goals
 - ▶ *Understand* the motivations, skills, and limitations of citizen-based monitoring groups
 - ▶ *Understand* the data quality needs of governmental organizations
 - ▶ *Understand* the state of research in biomonitoring and its relevance to citizen scientists, regulatory agencies, and others
 - ▶ *Craft* a set of shared technology development goals that will increase the effectiveness of biomonitoring and is achievable through collaboration.

How can technology improve the virtuous cycle?



CITIZEN SCIENTIST DATA: AN EPA OFFICE OF WATER PERSPECTIVE

Dwane Young, U.S. EPA Office of Water

A decorative graphic consisting of several parallel white lines of varying thicknesses, slanted diagonally from the bottom left towards the top right, set against a blue gradient background.

USES OF CITIZEN SCIENTIST DATA

- ▶ Community Education about water quality
- ▶ Advocacy/Community organizing/Local decisions
- ▶ Establish baseline/Document existing conditions
- ▶ Document the effectiveness of restoration activities
- ▶ Identify problems
- ▶ Research



Education/
Awareness



Problem ID,
Assess Impairment,
Local Decisions

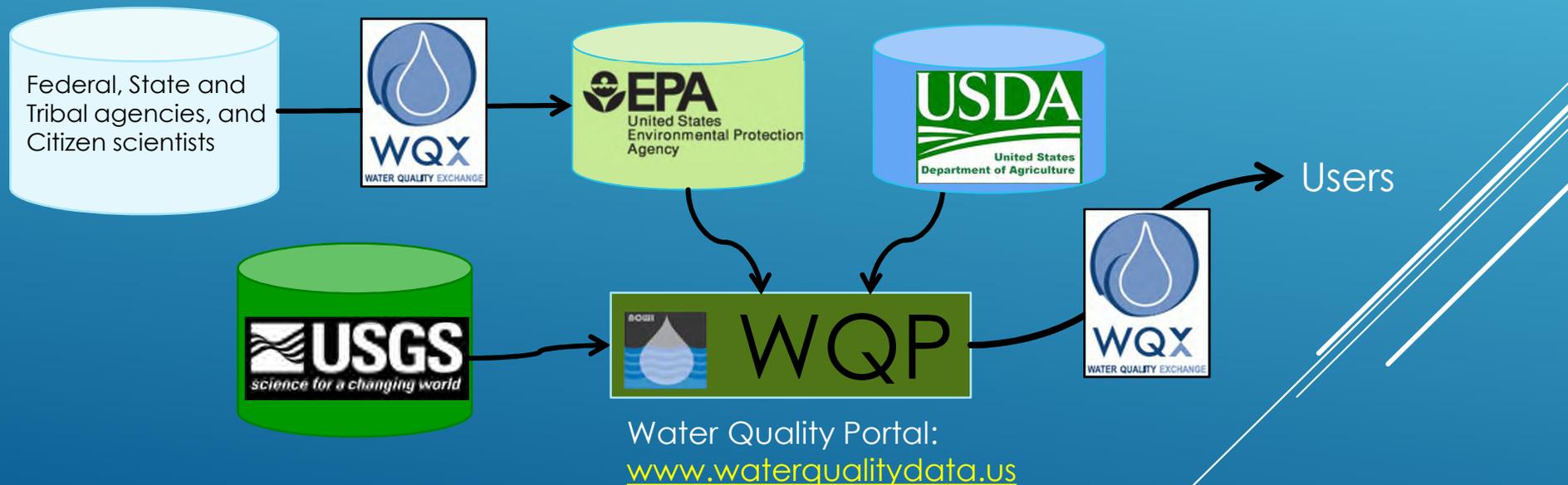


Legal & Regulatory

Increasing Time - Rigor - QA - Expense \$\$

DATA ARE VALUABLE, PLAN FOR RE-USE

- ▶ Electronic data are more valuable than data in file cabinets
- ▶ The more data are re-used, the more valuable they become
- ▶ Shared data are of even higher value
- ▶ The Water Quality Exchange (WQX) is an easy way of **publishing** data to the water quality portal so that the data can be reused



Citizen Monitoring Data uses for State and Federal Regulatory Agencies

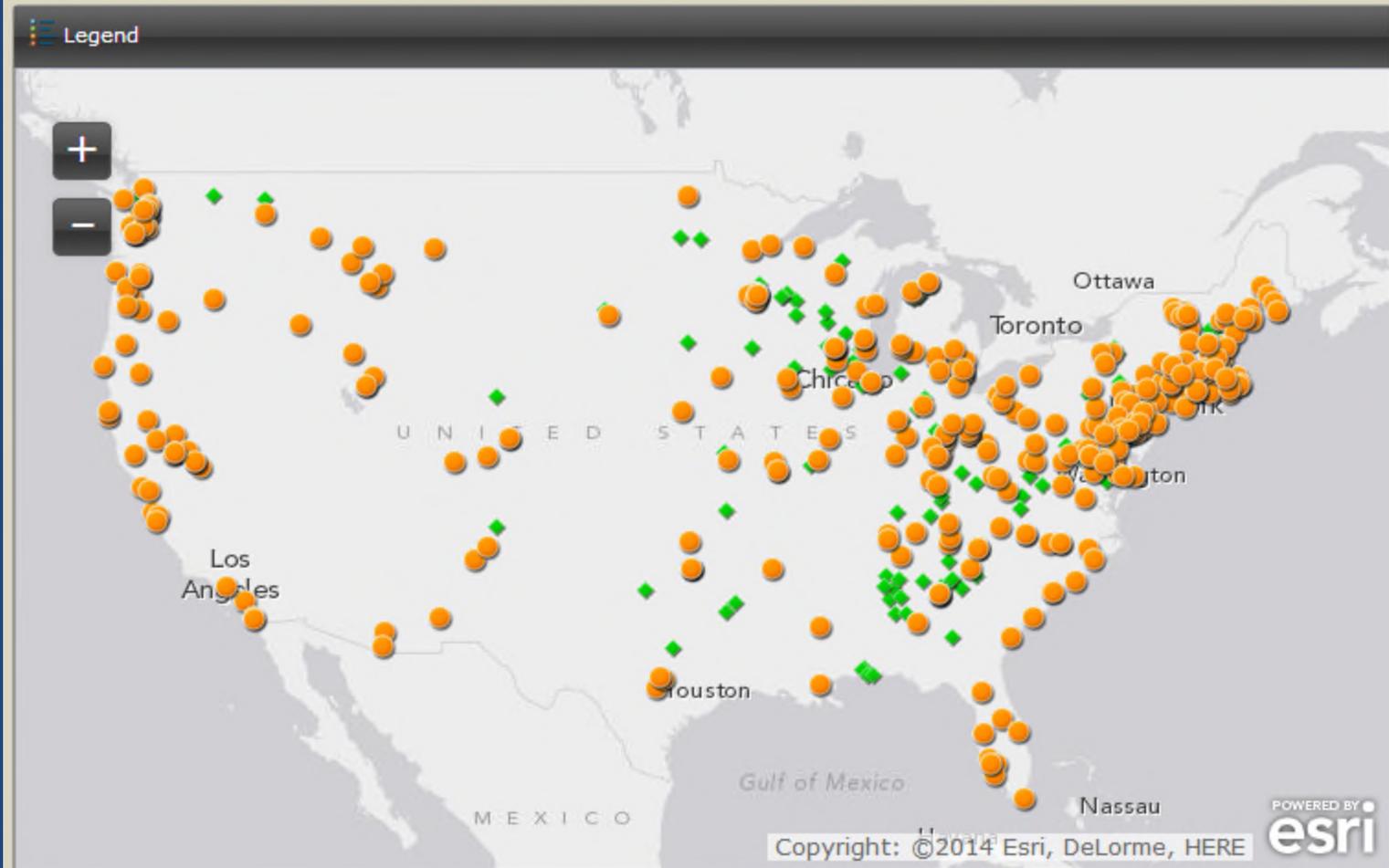


Alene Onion

**New York State Department of
Environmental Conservation**

National Distribution of Citizen Monitoring Programs

The **MAP LEGEND** is in the top, left corner of the map. There you will find the **ORANGE** circles represent monitoring programs and the **GREEN** diamonds represent monitoring subprograms.



<http://acwi.gov/monitoring/vm/index.html>

Total Contributions

| Water Body Type | Number of Sites | Number of Volunteers |
|-----------------|-----------------|----------------------|
| River/stream | 14,619 | 46,225 |
| Lake/pond | 4690 | 7386 |
| Wells | 312 | 336 |
| Beach | 659 | 9383 |
| Wetlands | 295 | 708 |
| Estuary/Marine | 433 | 1684 |
| other | 111 | 8527 |
| TOTALS | 21,118 | 74,249 |

“Characterizing Volunteer Monitoring Programs: Results from 2011-12 Volunteer Water Monitoring Needs Assessment” - Linda Green, Kristine Stepenuck, Elizabeth Herron, Frank Finley, Bill Deutsch, Adam Sigler

Education / Awareness

Non Regulatory Data Needs

- Modeling
- Restoration Efforts
- Rare, Threatened, Endangered Species
- Invasive Species

Regulatory Data Needs

- Screening Tool Trend Monitoring
- Non-Point Source Assessments
- BMP monitoring
- 305b / 303d listing
- Permitting
- TMDL development
- Enforcement Actions

Local Data Needs

- Conservation / Preservation Efforts
- County / Municipal / Watershed monitoring programs

Difficulties with using citizen monitoring data for government purposes

- Credibility of Volunteer Collected Data
 - Identification of Macroinvertebrates
 - Credible Site Location Data
 - Credibility of Index Calculations
 - Credibility of Habitat Assessments
 - Credibility of Sensor Data
- Access to Training
- Access + Cost of Equipment
- Data Storage, Access and Upload



Potential
Solutions from
Modern
Technology

- Funding
- Volunteer Retention
- Administrative Infrastructure to Integrate Data
- State Level Citizen Monitoring Coordinator
- Citizen Monitoring “Champion” at EPA
- Distribution of Volunteers Across Areas with Sampling Needs
- State Collection Permit Restrictions
- Access to Streams / Trespassing

Better Data, Better Partnerships: Increase the Use of Volunteer Data

9th National Monitoring Conference

April 30, 2014

Brian Hall, Assistant Chief

Ohio EPA Division of Surface Water

Ohio EPA's Water Quality Program

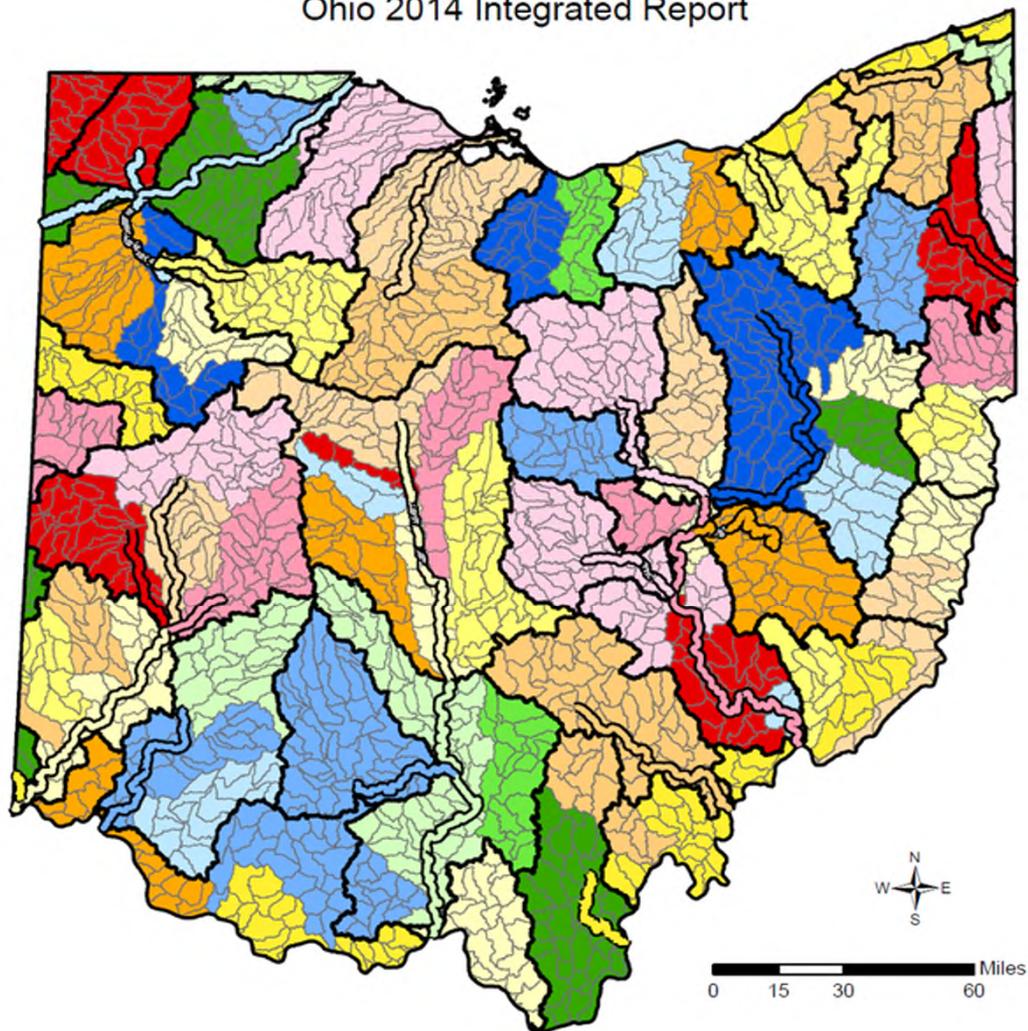
- Establishing codified water quality standards
- Monitoring and assessing the condition of Ohio's surface waters
- Developing watershed restoration plans for waters not meeting standards (Total Maximum Daily Loads)
- Field response and investigation of pollution spills

Core Biological and Water Quality Monitoring Program

- 5-6 watersheds are monitored each year
- 400-450 sites total
- Results reported in CWA Section 305(b) water quality reports and Section 303(d) lists
- Data used for TMDLs if impairment detected.
- Biology, habitat, chemistry, and bacteria are all assessed.
- Work shared by Central & 5 District Offices

Long-Term Monitoring Schedule

Ohio 2014 Integrated Report

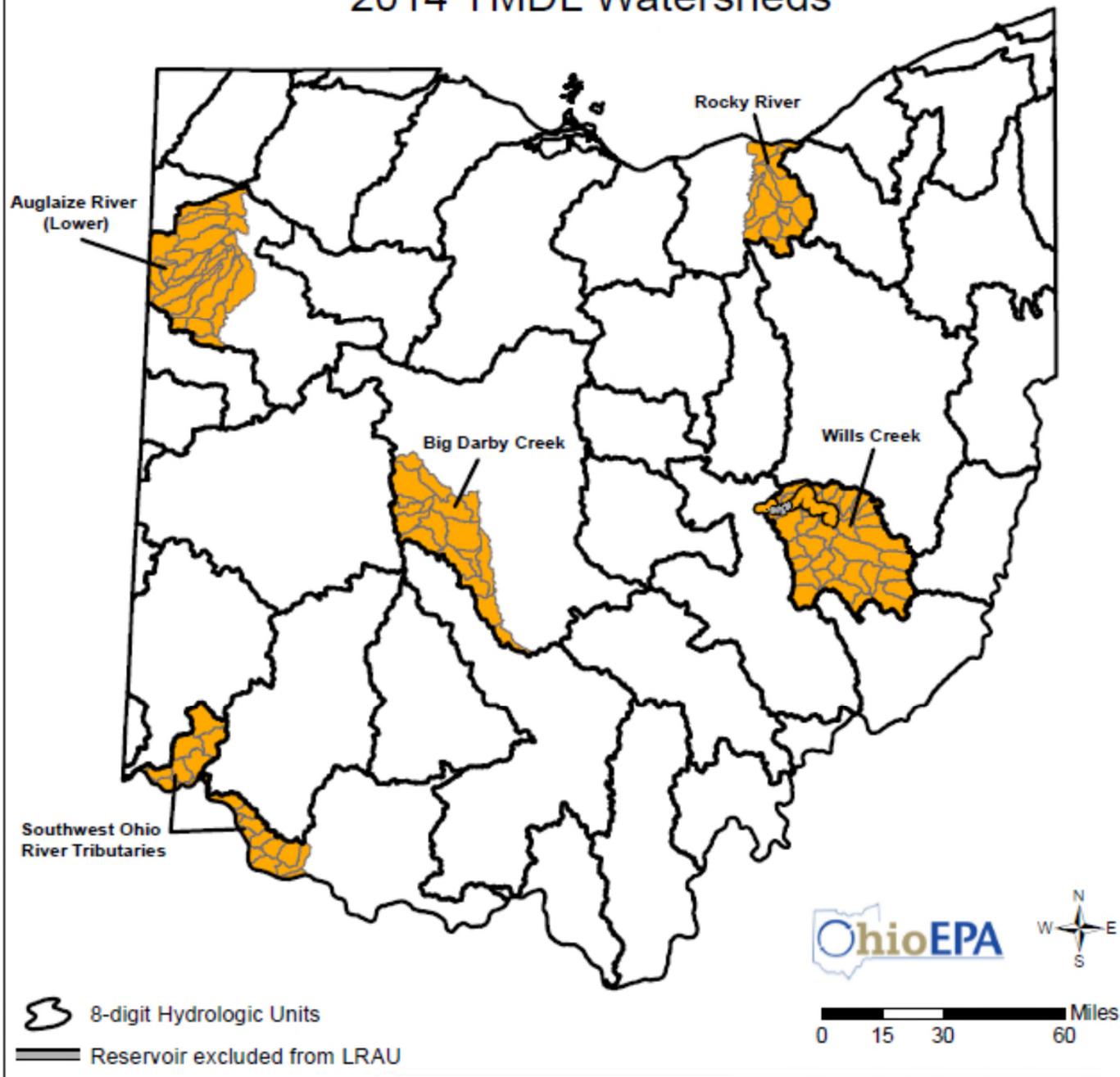


- | | | | | | | | |
|---|------|---|------|---|------|---|--------------------------------|
|  | 2013 |  | 2018 |  | 2023 |  | 8-digit Hydrologic Units |
|  | 2014 |  | 2019 |  | 2024 |  | Reservoirs excluded from LRAUs |
|  | 2015 |  | 2020 |  | 2025 | | |
|  | 2016 |  | 2021 |  | 2026 | | |
|  | 2017 |  | 2022 |  | 2027 | | |

Updated 1/21/2014



2014 TMDL Watersheds



Ohio's Credible Data Program

- Legislation created in 2003 (HB43)
- Rules effective March 2006 (OAC 3745-4-01 through 06)
- Intent
 - to **encourage the collection of monitoring data by “volunteers”** AND
 - to **ensure the data is valid for its intended purpose** (*i.e.*, “credible”)
- Process
 - Qualified Data Collector Certification
 - Project Study Plans/QAPs
 - Review/audit data submission

Credible Data Levels

- Level 1
 - Public Awareness and Educational Activities, (science education and volunteer monitoring)
- Level 2
 - Evaluate effectiveness of pollution controls and/or long term WQ **trends**, Frontline/Screening for problems
- Level 3
 - Regulatory Purposes, Equivalent to Ohio EPA methodology and data quality

Use of Credible Data

- All State and Federal data collected, and all NPDES data reported is considered credible
- Only Level 3 can be used to
 - Develop WQS use designations
 - Determine designated uses
 - Identify, list, and delist impaired waters -303(d)
 - Establishing a total maximum daily load

Overview of Local Government Perspectives on Citizen Monitoring



Laith Alfaqih, PhD, PE

METROPOLITAN
SEWER DISTRICT
of greater
CINCINNATI

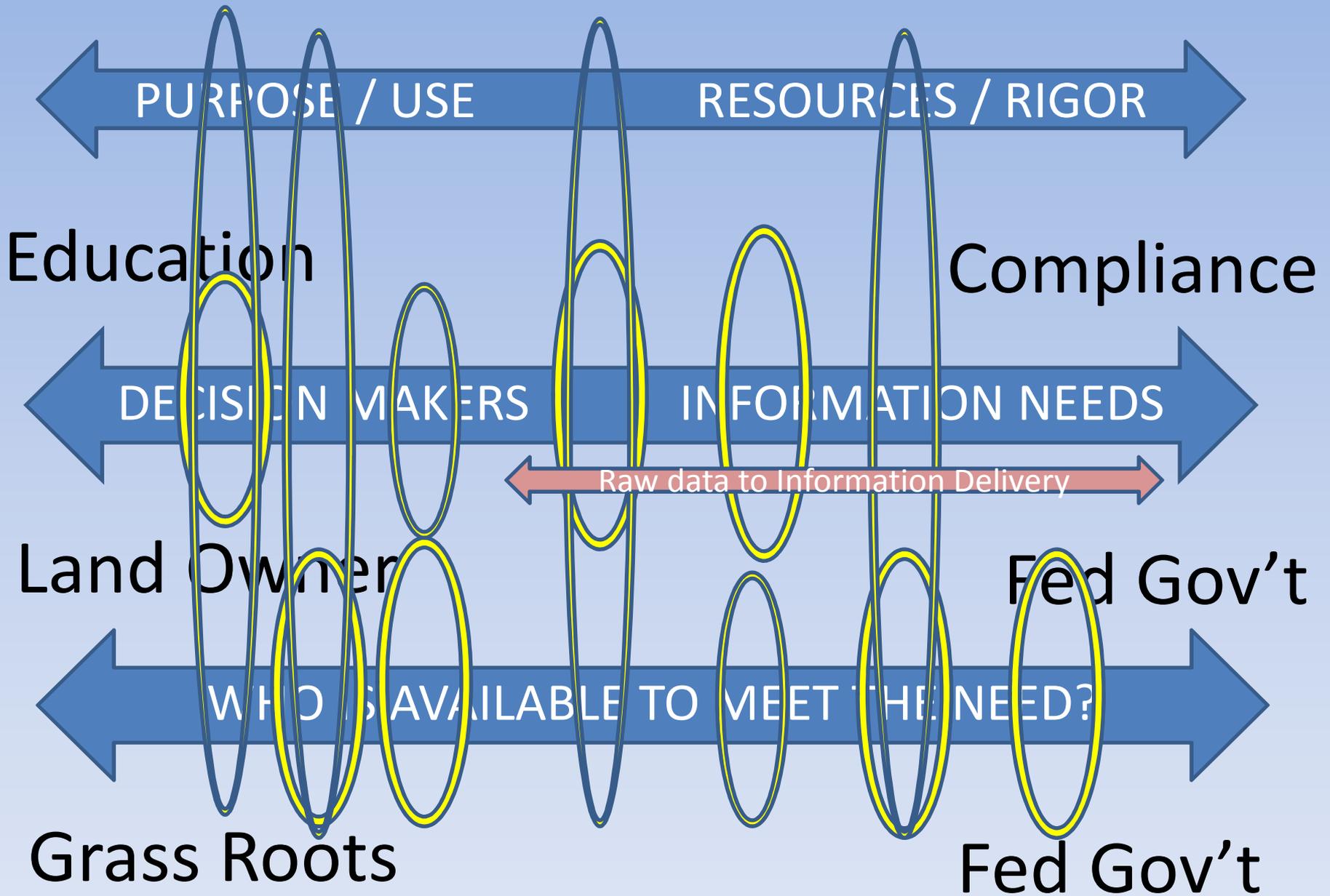


Discussion Points

- Objective(s) of monitoring
 - Education
 - Condition Assessment
- Parameters collected
- Quality of collected data
- Quality of analyzed data
- QA/QC
- Infrastructure to report and host the data
- Data usage to inform projects and initiatives

BARB HORN

STATEWIDE WATER QUALITY SPECIALIST
COLORADO PARKS & WILDLIFE





- Make D
- Believe
capacit
- Owner
- See a n



Citizen Scientist ↔ Governmental Relations

Marc F Hult, Watershed Watch in Kentucky

Chris Kaeff, Sanitation District # 1, Regulatory Reporting
& Wet Weather Coordinator

Citizen Scientist organizations come in all sizes and shapes:

- State-wide, State-Run
- Citizen led, limited geography (Eg: watershed, basin)
- State-wide and citizen owned and operated (Watershed Watch in Kentucky)



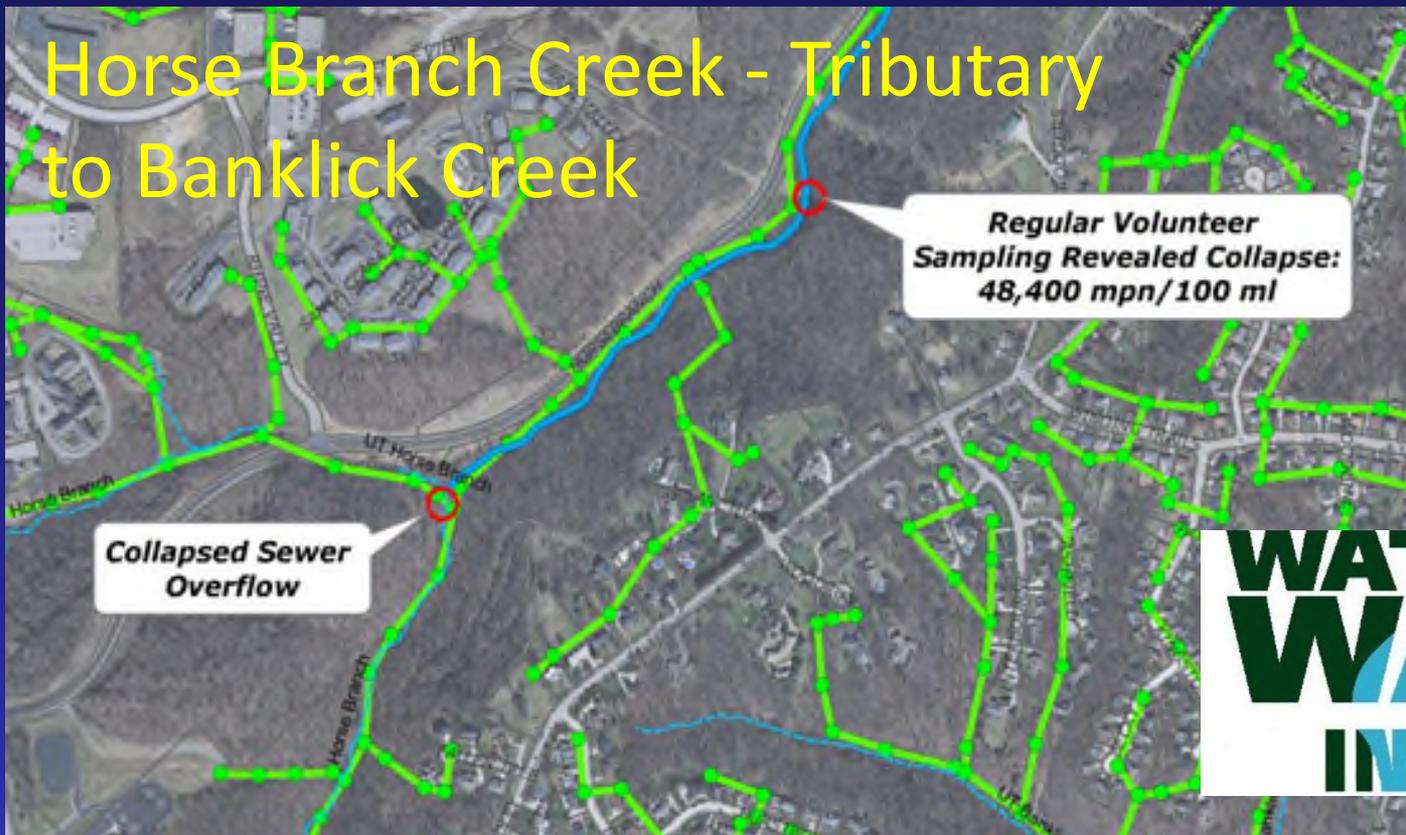
- Watershed Watch in Kentucky is State-wide and citizen owned and operated:
 - Eight independent 501(c)3 basins across entire State
 - Coordinated by umbrella 501(c)3 that includes Kentucky Division of Water, Sierra Club, and Kentucky Waterways Alliance

Two examples of effective actions using data collected and :

- Horse Branch Creek
- Burning Fork



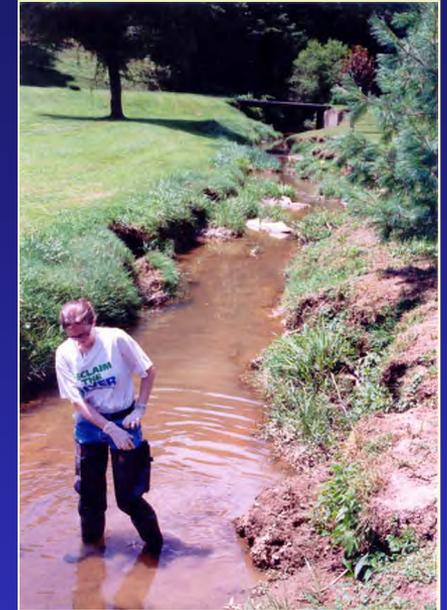
Horse Branch Creek - Tributary to Banklick Creek



**WATERSHED
WATCH
IN KENTUCKY**

- Utilities need actionable intelligence (“eyes and ears”)
- Data that can lead to results, sometimes immediate
- Coordination between with appropriate contacts is key
- Identifying infrastructure rehab needs from volunteer water quality data validates the need for citizen science

Brushy Fork: A Pathogen-impaired Appalachian Headwater Stream



1. 40,000 “straight pipes” in Kentucky

- No mention of “straight pipes” in 305(b) report
- Brushy Fork – bristling with SP’s but identified in 303(d) list as “unknown” source of pathogen impairment
- Licking River Watershed Watch volunteer conducts ‘focus study’ collecting samples of up to 40,000 cfu/100ml
- Licking River Watershed Watch comments on 303(d), 305(b)
- 319(h) grant obtained
- But ultimately causing City of Salyersville to extend sewer line.

- Symmetry: We all get to use the data
(Being Citizen Scientist does not exclude being a Citizen Activist)
 - Extreme values allow immediate action/conclusion
(with obvious extension to biodiversity monitoring)
-
- Technology advances that promote Citizen Science are typically those that reduce the distinction between methodologies available to professionals and citizens



NKU's Water Quality Pro

*"The equalizer for citizen scientists and
water quality professionals alike"*

Richard D. Durtsche, Ph. D.

Department of Biological Sciences and the

Ecological Stewardship Institute

Northern Kentucky University

To develop of technologies that bridge the gap between citizen scientists and agencies by:

- Improving credibility of data collected
- Increasing public literacy and interest in science
- Improving mechanisms for recording stream quality data
- Provide a conduit for data flow - open access database
- Increase communications
- Continuing research to find new solutions for bioassessment

Role of Academia to enhance use of citizen data by government agencies

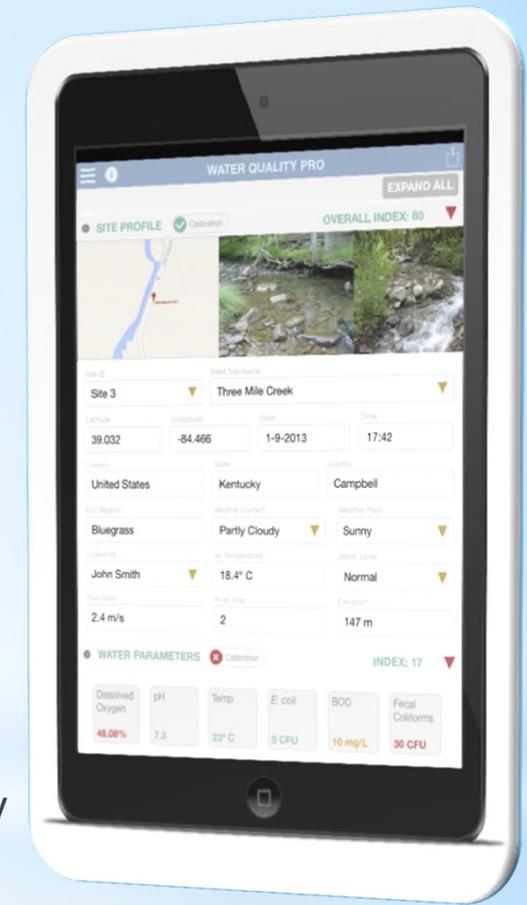


- * University-based training in mobile technologies and stream assessment
- * Video descriptions of technology procedures and functions with stream sampling from website
- * Summer and weekend field camps
- * Workshops dedicated to a specific technology or method of stream assessment
- * Webinars



Workshops, Training, and Field Camps

Water Quality Pro (WQP) app



- Bioassessment of streams
- Recording: water quality and site location data
- Five modules: water parameters, macroinvertebrates, fish, algae, & habitat
- Photo documentation of site and organisms
- Passive and active credibility filters
- Modifications and user defined functions possible

Website and Database

- Website houses open access database for WQP
- Database with credibility filters and can provide summary outputs
- Available in Spanish and English
- Technical workshops, events, camps
- Resource links and social media

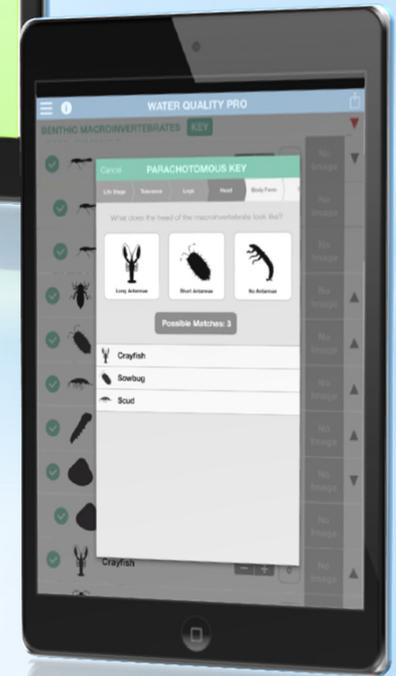
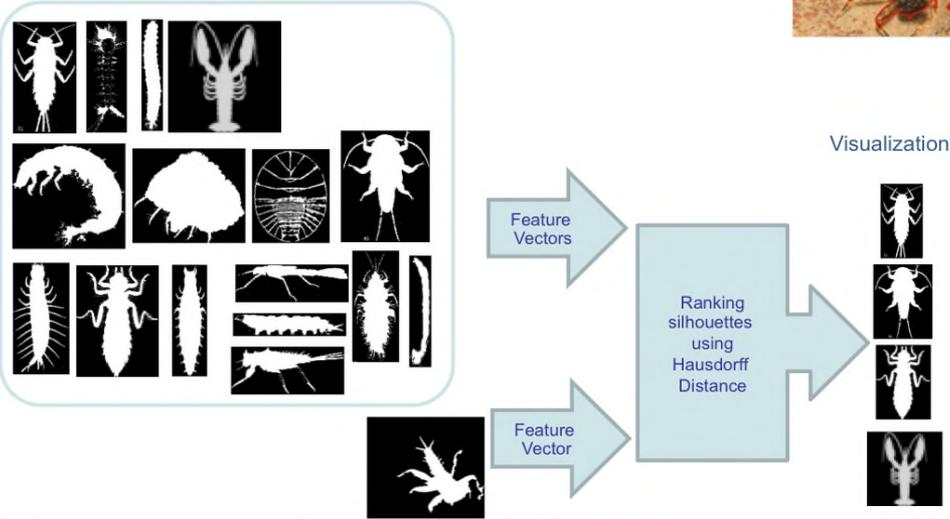
University Research: Mobile Technologies

Automatic Taxon Suggestions Using Image Detectors and Silhouette Matching Algorithm

Step 1: Finding the silhouette image



Step 2: Ranking Results



Credibility Filters - Image Detection Polychotomous Keys

BETTER DATA

TECHNOLOGY HAS CHANGED EVERYTHING!

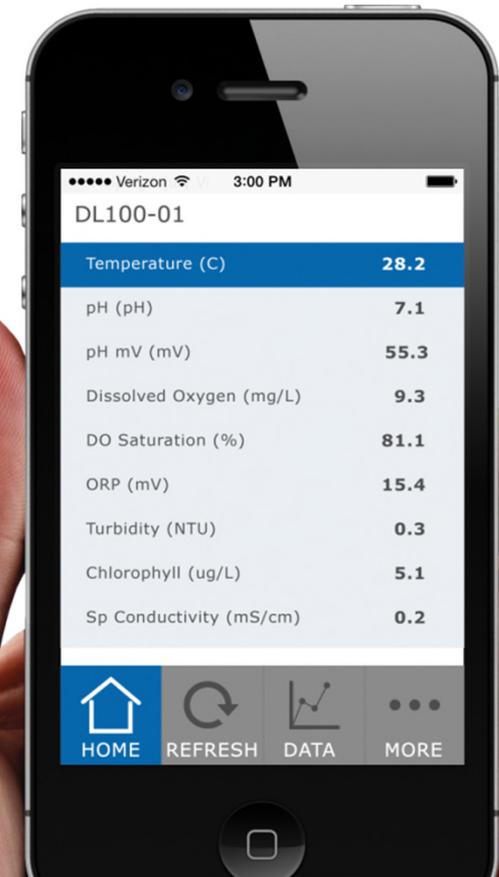
Steve Fondriest - Fondriest Environmental



SMARTPHONE

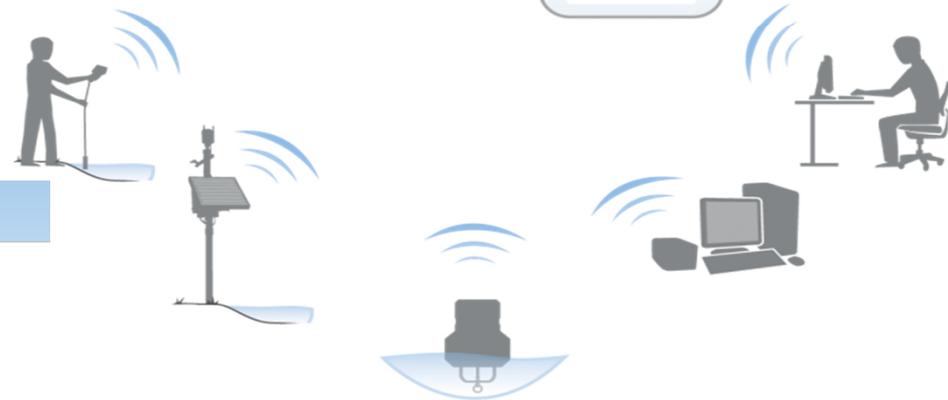


- Millions in use
- Powerful, long battery life
- Voice/Text communication
- Data entry
- Internet access
- Apps



CLOUD COMPUTING

- Connect via any browser
- Connect anywhere/anytime
- Stream data
- Central database with data feeds from staff, clients and others
- Share data
- Port data to other website using a web API
- Offload IT infrastructure



CROWD SOURCING

- University at Buffalo
- USGS-WI Water Science Center
- Crowd Hydrology

What's the water height today? Text us.

1 Find the ruler!

2 What's the height measurement at water surface?

3 Text "M11007" and the height from step 2.

Send to: 616-951-3218

What to do:

1. Look around for a ruler mounted in the water.
2. Read the measurement at the water's surface.
3. Text "M11007" and the height to 616-951-3218.

Visit www.crowdhydrology.org to see your measurement. (It will take a few minutes to load your point.)

CrowdHydrology collects water data using social media and citizen science. When you text us today's water height, we use your measurement to create a historical record of this lake or stream. If enough people send data, we can help predict floods and droughts.

State and local agencies don't get automatic monitoring equipment on every water body, but CrowdHydrology provides a way for local communities to track any lake or stream that's important to them. Help support CrowdHydrology by sending a measurement every time you visit the area.

CrowdHydrology

USGS

social water



SMART SENSORS



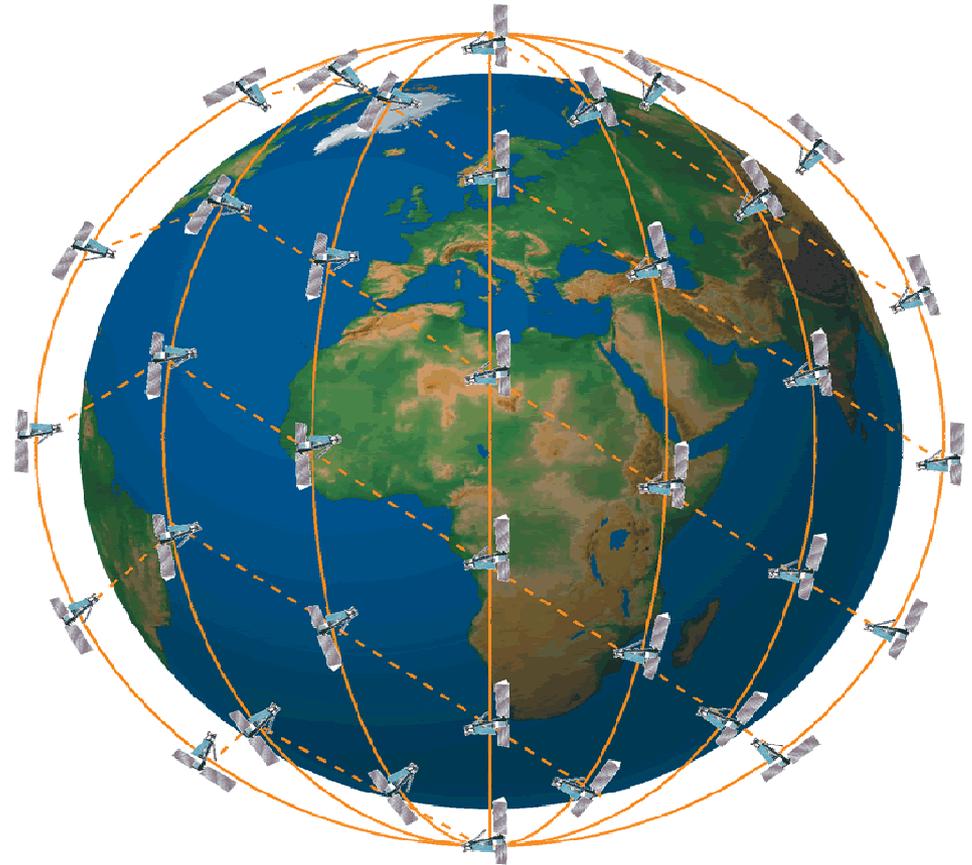
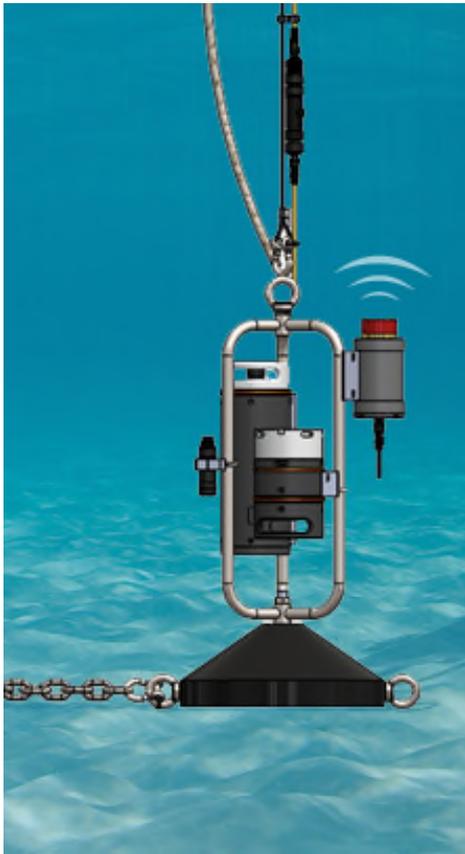
PATTERN RECOGNITION SOFTWARE

- LeafSnap - Tree ID Software
- iCAD – Computer Aided Detection for cancer
- Facial Recognition – Security, people identification



COMMUNICATIONS

- Satellite – global coverage
- Cellular – where coverage available
- Radio – few miles LOS
- Acoustic – subsea



PRIVATE INDUSTRY

- Leverage the technologies (smartphone, cloud computing, crowd sourcing, smart sensors, pattern recognition, communications)
- Improve the affordability but more importantly improve the **reliability, robustness and ease to use**
- Develop technologies that work for both professionals and citizens, thus distributing the development cost over a larger user base.
- Build in QA/QC features (i.e. GLP, calibration tracking, meta data) and help debunk the perception/concerns of lower quality data.