Creating cost-effective regional algal bloom monitoring networks

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Portland, Oregon
2 May 2012
Acknowledgments

• Collaborators
  – Academic scientists from AR, GA, LA, MS, NC, PR, SC, and TN
  – Federal, state, and local agency scientists in AL, AR, DE, FL, GA, KY, LA, MS, NY, TN, and TX
  – Friends at Georgia Power and Fort Smith Utility

• Funding
70% of Earth surface is water

Google Earth

WATER
70%

LAND
30%

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
70% of Earth surface is water
2% of water is fresh

Google Earth
70% of Earth surface is water
2% of water is fresh
<1% of freshwater is available for human use

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
FRESHWATER IS LIMITED AND SUFFERS FROM MULTIPLE STRESSORS
Global fertilizer use

Millions of tons
Lago de Pátzcuaro
Mexico, July 2008
Off-flavor compounds

Geosmin
2-Methylisoborneol

Alabama farm pond, 25 May 2010
MONITORING IS IMPORTANT
Eutrophication of lakes cannot be controlled by reducing nitrogen input: Results of a 37-year whole-ecosystem experiment

Fig. 4. Other measures of phytoplankton and nitrogen fixation, 1969–2005. (A) Chlorophyll a. (B) Ratio of chlorophyll a:phytoplankton biomass (μg/mm²). (C) Nitrogen fixation calculated from heterocyst counts. (D) Heterocyst counts. Vertical dashed lines are as in Fig. 2.
Kingston Coal Ash Spill

BEFORE SPILL

AFTER SPILL
MONITORING IS EXPENSIVE
Sample cost estimates

chlorophyll, nutrients, TSS, microcystin

- Consumables = $20
- People = $10
- Travel (mileage ($0.50/mi) + people) = depends
  - Nearby site = $40 + $40
Sample cost estimates

chlorophyll, nutrients, TSS, microcystin

- Consumables = $20
- People = $10
- Travel (mileage ($0.50/mi) + people) = depends
  - Nearby site = $40 + $40
  - Faraway site = $180 + $120
- Total = $110-$330/sample

Travel costs = 73-91%
MONITORING IS DIFFICULT TO FUND
Programs that fund monitoring studies

- NOAA – Monitoring and event response for HABs (MERHAB)
- NSF – Long-term ecological research (LTER)
- EPA – Wetlands grant program
- NPS-USGS – Water quality partnership program
- State specific programs
SO, WHAT IS THE SOLUTION?
COLLABORATION
SAMPLE AND
DATA SHARING
EXAMPLE LAKE SURVEY

- 717 samples from 238 waterbodies
- Sample analyses
  - phycocyanin and microcystin
- Consumables = $20
- People = $10
- Analyses cost = $21,510
- Mileage = $2,500-$136,318
- People = $1,667-$90,879
- Total = $25,676-$248,707
EXAMPLE LAKE SURVEY

- 717 samples from 238 waterbodies
- Sample analyses
  - phycocyanin and microcystin
- Consumables = $20
- People = $10
- Actual cost = $50,000
  (AL Ag Exp Station grant)

HOW?
SAMPLING EFFORTS
2008 - WilsonLab
2009 - WilsonLab + ADEM
2010 - many collaborators

Alabama
AL Dept of Environmental Management
Auburn University

Florida
FL Dept of Environmental Protection
Lakeland Lakes and Stormwater Division
Pinellas County Dept of Environ Management
Seminole County Public Works
Seminole County Water Quality Section
SW FL Water Management District

Georgia
Centers for Disease Control
Georgia Power, Southern Company
Georgia Southwestern State Univ
New Echota Rivers Alliance

Kentucky
KY Division of Water

Tennessee
TN Dept of Environment and Conservation
TN Division of Water Pollution Control
General data patterns

R² = 0.75

- **Secchi depth (m)**
  - 0.1
  - 1
  - 10

- **Chlorophyll (ug/L)**
  - 0.1
  - 1
  - 10
  - 100
  - 1000
General data patterns

Phycocyanin (ug/L) vs. Chlorophyll (ug/L)

$R^2 = 0.65$
General data patterns

\[ R^2 = 0.51 \]
USGS Project 2011AL121G
Forecasting toxic cyanobacterial blooms throughout the southeastern U.S.

Project Links

- Home
- News
- Schedule
- Protocols

USGS PROJECT HOMEPAGE

Protecting diminishing water resources is one of the most pressing global environmental issues and will become more challenging as climate change, species invasions, and eutrophication further degrade surface water quality and quantity. In lentic freshwater systems, bloom-forming cyanobacteria (i.e., blue-green algae) are the primary biological indicators of poor water quality and tend to dominate algal communities under nutrient enrichment. Some cyanobacterial genera produce potent secondary metabolites, such as the hepatotoxin, microcystin, or the neurotoxin, anatoxin-a, that have been shown to lead to the poisoning of drinking water supplies, aquatic foodwebs, pets, and in extreme cases, humans. Cyanobacteria are also responsible for common

http://wilsonlab.com/bloom_network/
Project information

• Project period: 2011-2014
• Sampling: July-August, 2012-2014
• Objective: Create network of scientists (agencies, academia, industry) interested in forecasting cyanobacterial blooms throughout Southeast
• Collaborative nature: Sample and data sharing
Project information

• Outreach: two free annual water quality workshops (Orlando and Auburn)

Orlando, FL
Feb 2012

Auburn, AL
Mar 2012
2012 project participants

• Alabama – AU, ADEM, ADCNR, USGS
• Arkansas – AUUEX, Fort Smith, UofArk
• Deleware – DNREC
• Florida – DEP, Pinellas, Seminole County, OCFL, FWC, SWFWMD, Altamonte, NWFSC, Lakeland
• Georgia – UGA, Southern Co., DNR, EPA, North Georgia College
• Kentucky – Army Corps, DEP
• Louisiana – Army Corps, LSU
• Mississippi – FWS, DEQ, USDA, Jackson State Univ
• New York – NYCEP
• North Carolina – UNC, DENR, NCSU
• Puerto Rico – UPR-Mayaguez
• South Carolina – USC
• Tennessee – DEC, Carson-Newman College
• Texas - LCRA, TCEQ, Waco, Trinity, Red River Water Authority
2012 sample site map

373 waterbodies
13 states & PR
distance from Auburn
148,625 miles

mileage cost =

$0
Suggestions

• Connect with colleagues
• Find mutual benefits
• Leverage existing resources
• Document variation in techniques for sampling and analyses
• Think big!