

Citizen Science-Based Monitoring Framework for Chemicals of Emerging Concern (CECs) in New York State Lakes

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Human Subject Protection

- This project has been approved by the Syracuse University Institutional Review Board (IRB), Office of Research Integrity and Protections.
- IRB Protocol Number: 17-255
- Protocol Approval Date: 07/19/17
- Protocol Expiration Date: 07/18/22

Introduction

- There is growing concern about the challenges to the Nation's drinking-water system and the safety of the water systems that supply it.
- In citizen science, members of the public voluntarily assist in the scientific process, engaging in activities that may include conducting scientific experiments, collecting and analyzing data, making new discoveries, and helping to solve complex problems.

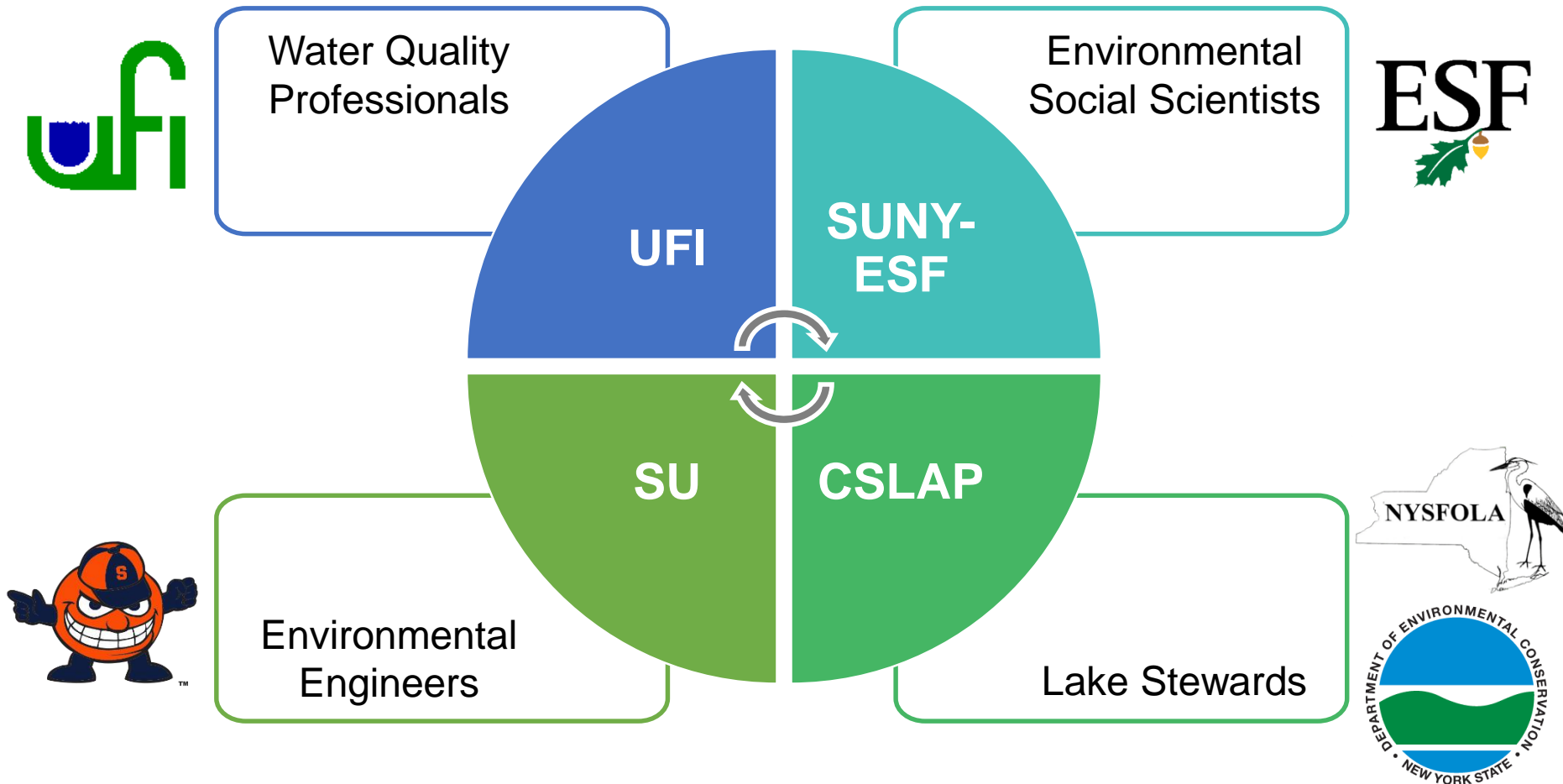
(Source: National Science Foundation Announcement, 2017)

This NSF grant is focused on Chemicals of Emerging Concern (CECs)/organic micropollutants

- refer to man-made organic chemicals (e.g., Atrazine, caffeine, sucralose)
- natural toxins (e.g., cyanotoxins)
- are being detected with increasing frequency at low levels
- can be found in aquatic environments such as lakes
- not regulated due to lack of information

An exploratory **collaborative** research project

- Interdisciplinary and integrative (multi-prong approach)
- Participation of both academic and practice-oriented investigators



An **exploratory** collaborative research project

Our goal is to “*Evaluate the feasibility of establishing an educational and training-based framework to facilitate citizen monitors in collaborating with professional researchers to investigate the prevalence of chemicals of emerging concern.*”

What does that mean in practice?

- **Technological improvements** now make it easier for researchers and citizen scientists to look at Chemicals of Emerging Concern (CECs) in our lakes
- **There isn't much information** as to which CECs may be in lakes, in what concentrations, how widespread they are, and how significant the problem is
- This project provides an opportunity to do some **exploratory research** into these questions – to collect data for chemicals that we still don't know the benchmarks for and whether they are a significant health risk
- This project is primarily about the feasibility of a **collaborative effort** between citizens and researchers for **collecting information and documenting the nature and extent of CECs** in our lakes
- This is a learning process. **No regulatory actions** will be taken as a result of this project

Chemicals of emerging concern (CECs): Invisible yet ubiquitous

- News reports of CECs being detected in aquatic environments.

EPA Warns Hoosick Falls, NY: Don't Drink PFOA Contaminated Water

2015

POSTED ON [DECEMBER 18, 2015](#) BY [CHRIS BEMIS](#)

07.15.16 :: CATEGORIES: WATER QUALITY. NEWS TYPES: PRESS RELEASES.

Study finds diverse set of pharmaceuticals and other 'micropollutants' in Hudson River Estuary

2016

Cornell scientists test for pesticides, pharmaceuticals and personal care products; 83 of 117 substances are detected

For Immediate Release: July 15, 2016

Algae toxins in Syracuse water system: What we know so far (and what we don't)

2017

Updated Sep 20, 2017; Posted Sep 20, 2017



Gallery: Skaneateles Lake algae Bloom

2018

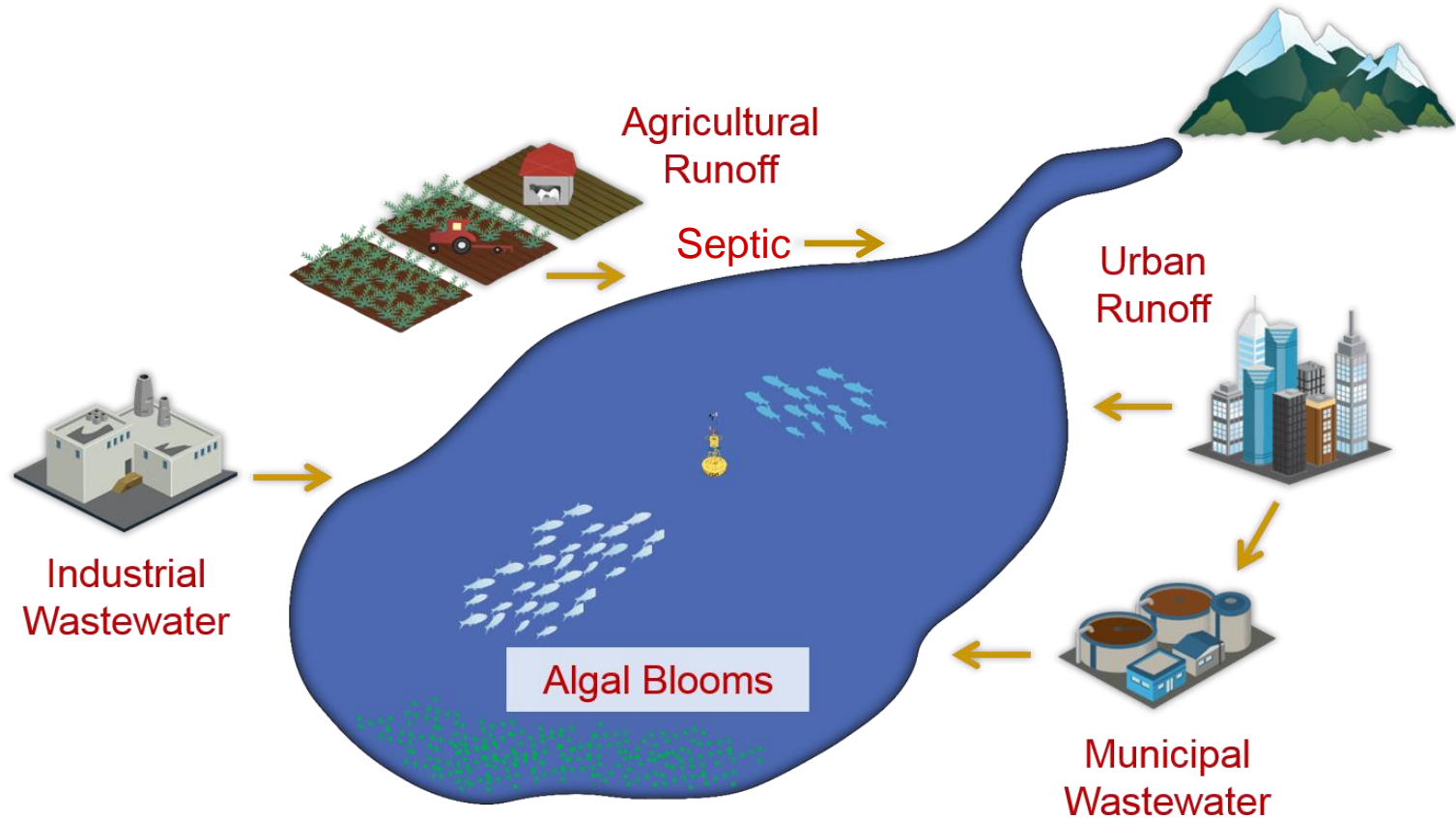
Testing reveals caffeine, other drugs lurking in Hudson River

Sewage systems dump medications for high blood pressure, ulcers, pain relief into the waters

By Brian Nearing Updated 5:15 pm, Monday, February 19, 2018

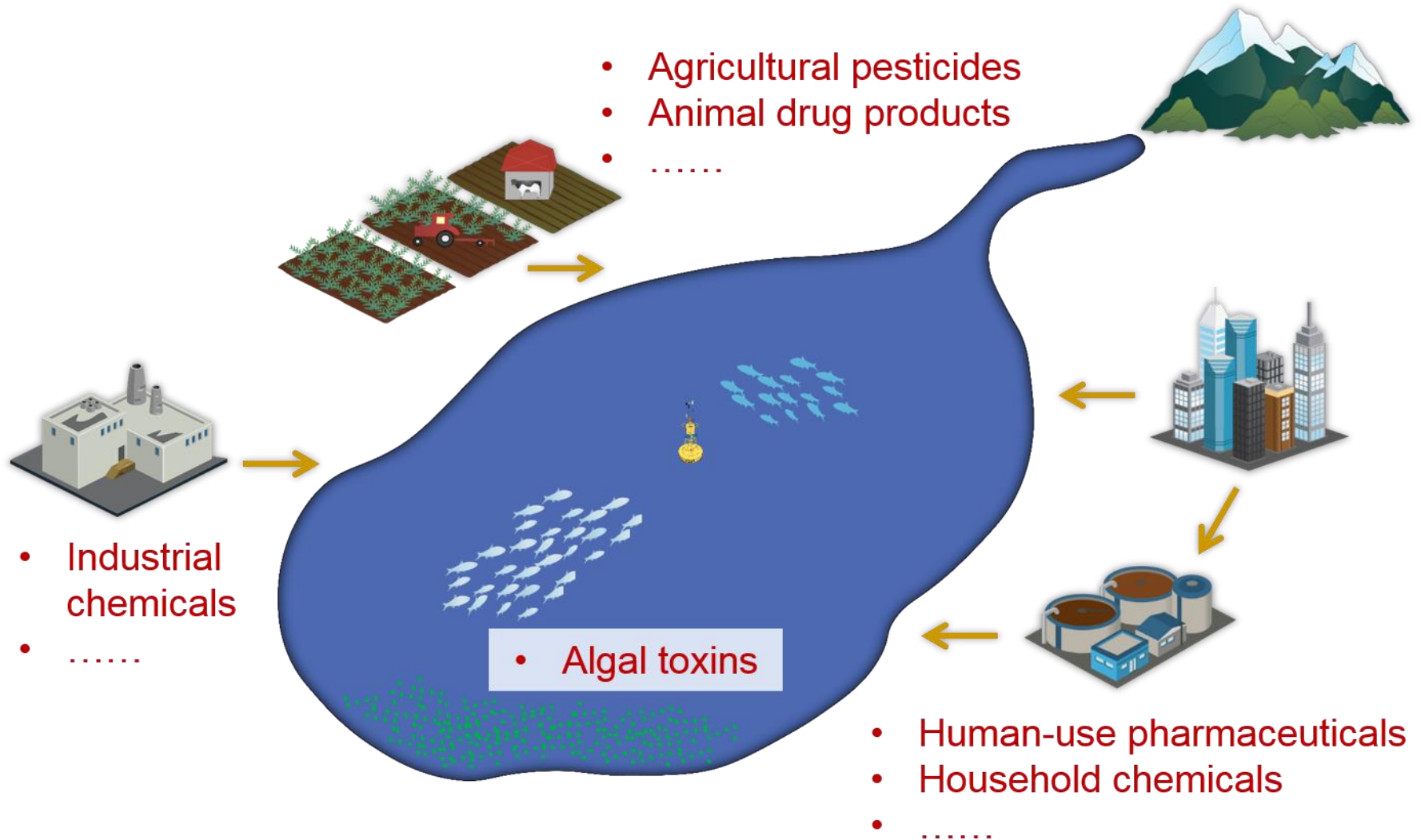


CECs originate from diverse points and diffuse sources



Algae blooms are a potential source of cyanotoxins but algae and the nutrients necessary for their growth are not considered contaminants themselves.

CECs occur as complex mixtures in the receiving water bodies



Under certain conditions, blue-green algae may produce cyanotoxins within a lake. Cyanotoxins have been categorized as CECs due to their potential health effects on humans and animals.

CECs may cause adverse (and often unknown) ecosystem effects

Agricultural insecticides threaten surface waters at the global scale

Sebastian Stehle and Ralf Schulz

PNAS May 5, 2015. 112 (18) 5750-5755; published ahead of print April 13, 2015.

<https://doi.org/10.1073/pnas.1500232112>

Organic chemicals jeopardize the health of freshwater ecosystems on the continental scale

Egina Malaj, Peter C. von der Ohe, Matthias Grote, Ralph Kühne, Cédric P. Mondy, Philippe Usseglio-Polatera, Werner Brack and Ralf B. Schäfer

PNAS July 1, 2014. 111 (26) 9549-9554; published ahead of print June 16, 2014.

<https://doi.org/10.1073/pnas.1321082111>

Collapse of a fish population after exposure to a synthetic estrogen

Karen A. Kidd, Paul J. Blanchfield, Kenneth H. Mills, Vince P. Palace, Robert E. Evans, James M. Lazorchak and Robert W. Flick

PNAS May 22, 2007. 104 (21) 8897-8901; <https://doi.org/10.1073/pnas.0609568104>

Reproductive Disruption in Fish Downstream from an Estrogenic Wastewater Effluent

Alan M. Vajda[†], Larry B. Barber[†], James L. Gray[†], Elena M. Lopez[†], John D. Woodling[†] and David O. Norris[†]
Department of Integrative Physiology, University of Colorado, UCB 354, Boulder, Colorado 80309, and U.S. Geological Survey, 3215 Marine Street, Boulder, Colorado 80303

Environ. Sci. Technol., 2008, 42 (9), pp 3407–3414

DOI: 10.1021/es0720661

Publication Date (Web): March 25, 2008

✓ Cite this: *Environ. Sci. Technol.* 42, 9, 3407-3414

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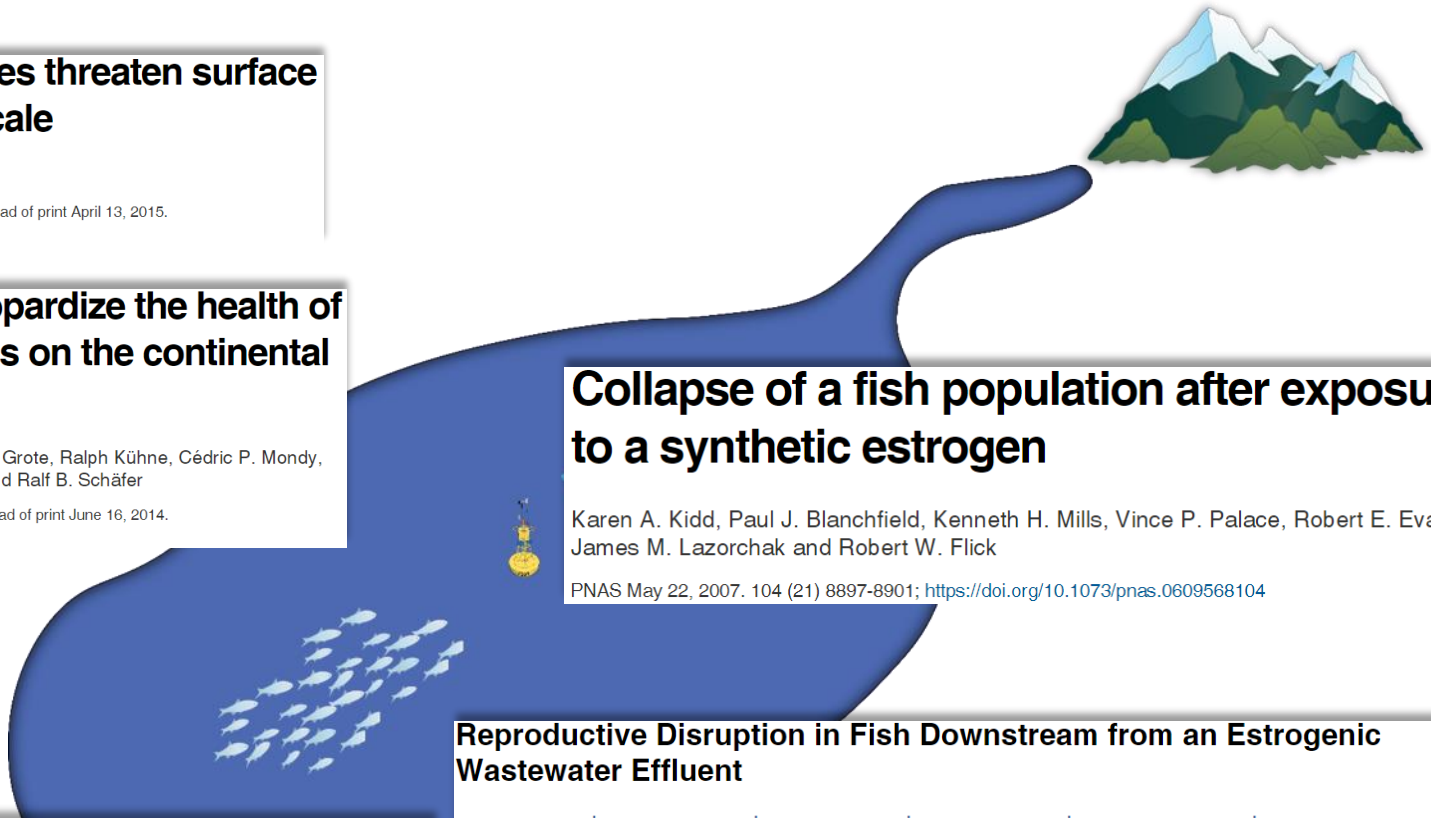
ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Article | Open Access  

Urban stream microbial communities show resistance to pharmaceutical exposure

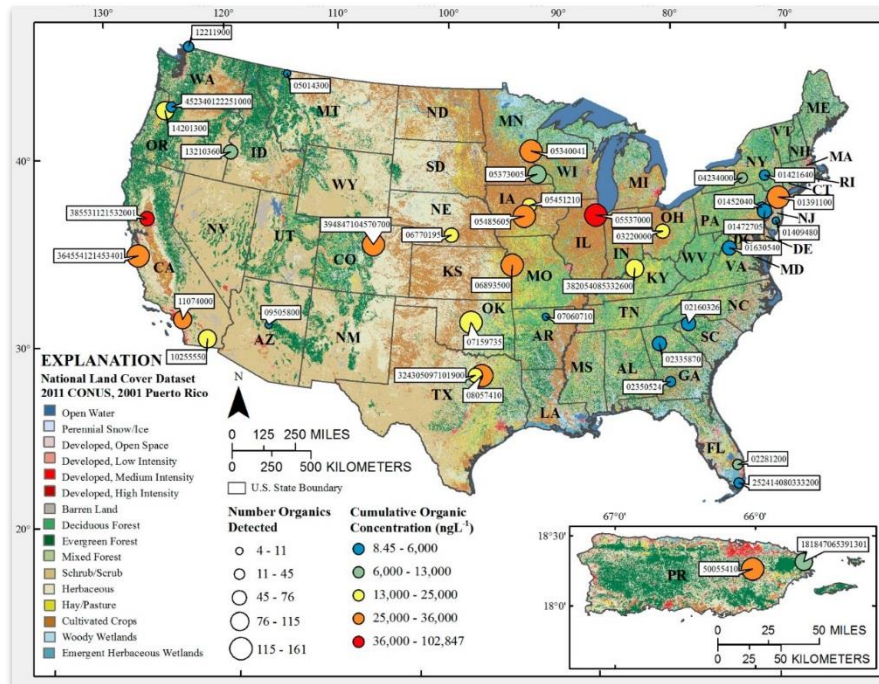
E. J. Rosi , H. A. Bechtold, D. Snow, M. Rojas, A. J. Reisinger, J. J. Kelly

First published: 9 January 2018 | <https://doi.org/10.1002/ecs2.2041>



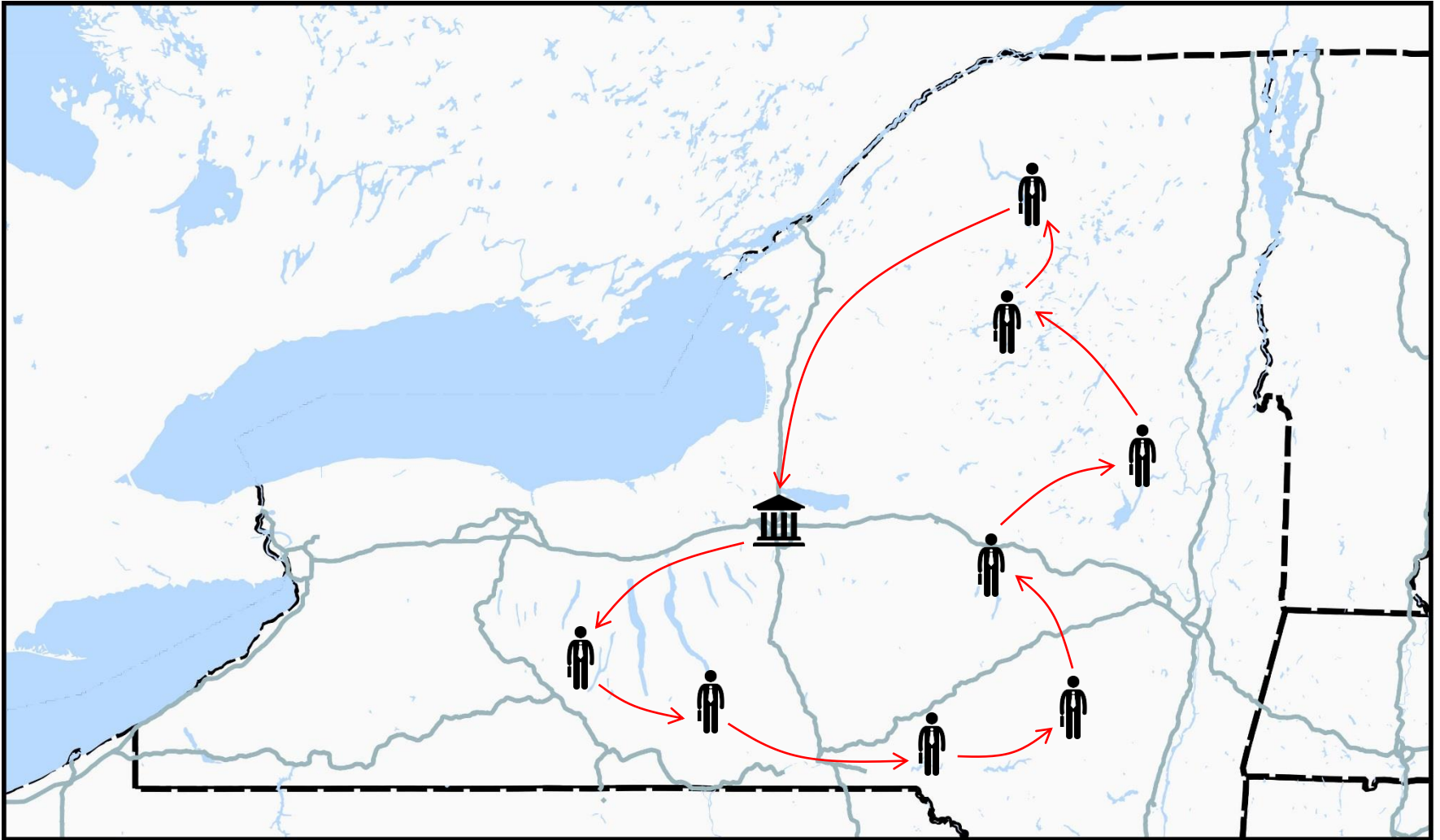
Current CEC monitoring by professional researchers

- Government agencies
 - U.S. EPA
 - U.S. Geological Survey
- Intergovernmental research consortia
 - NORMAN Network



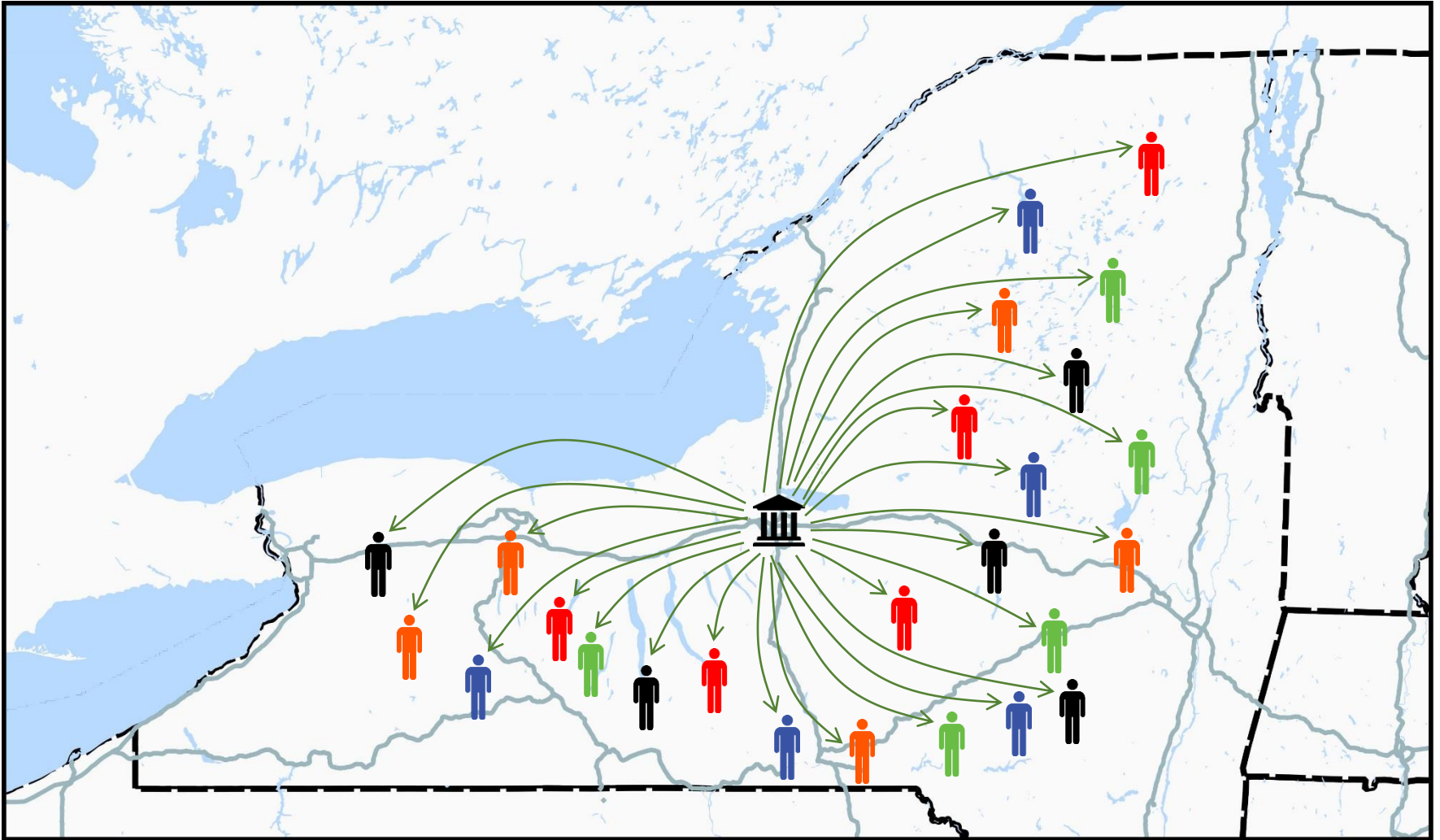
Current CEC monitoring by professional researchers

- Bottleneck: Monitoring across broad geographic ranges in short time frames?



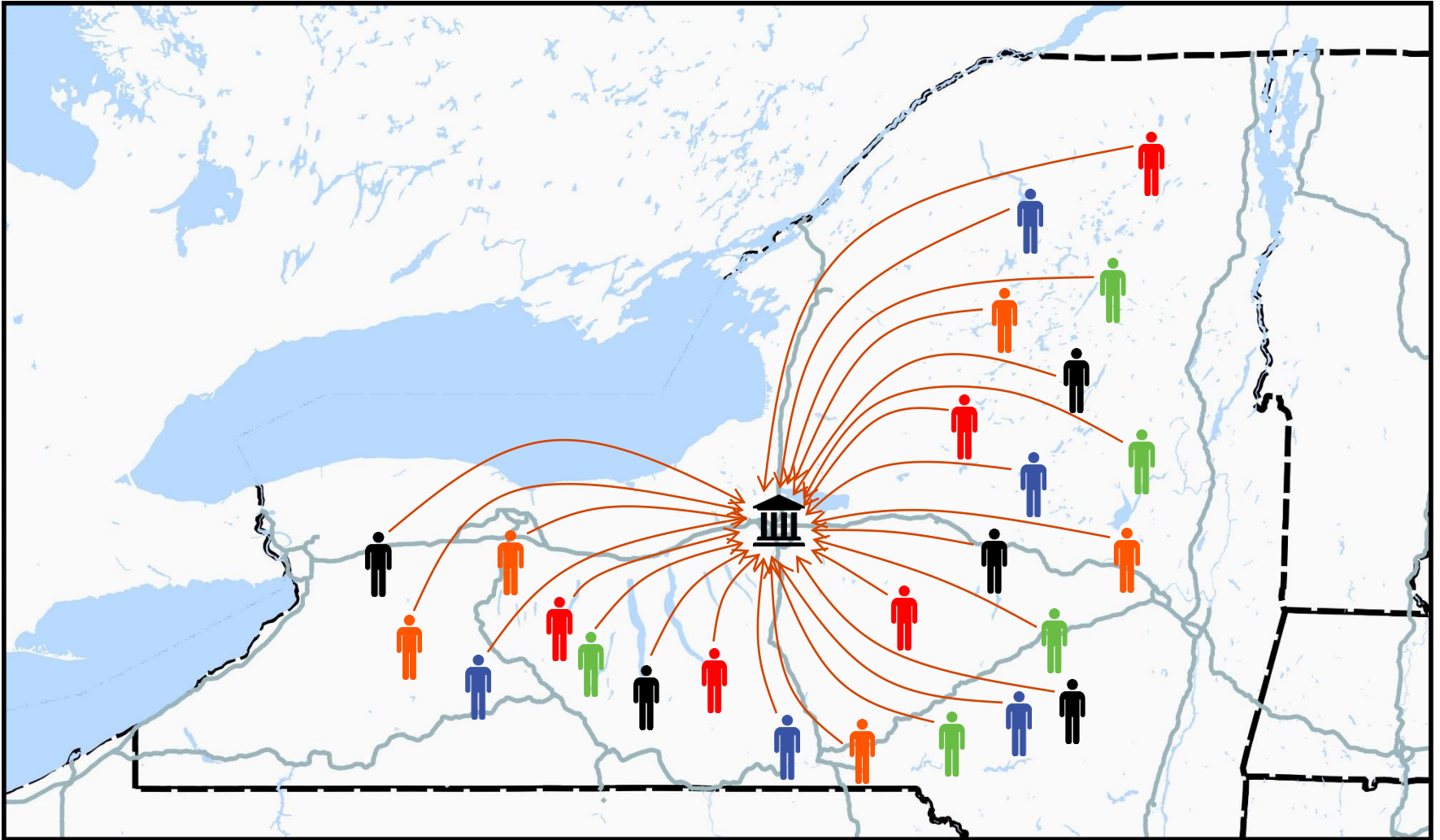
Future CEC monitoring through citizen-based framework

- Enhances spatiotemporal coverage and data interconnectedness



Future CEC monitoring through citizen-based framework

- Increases public participation and awareness

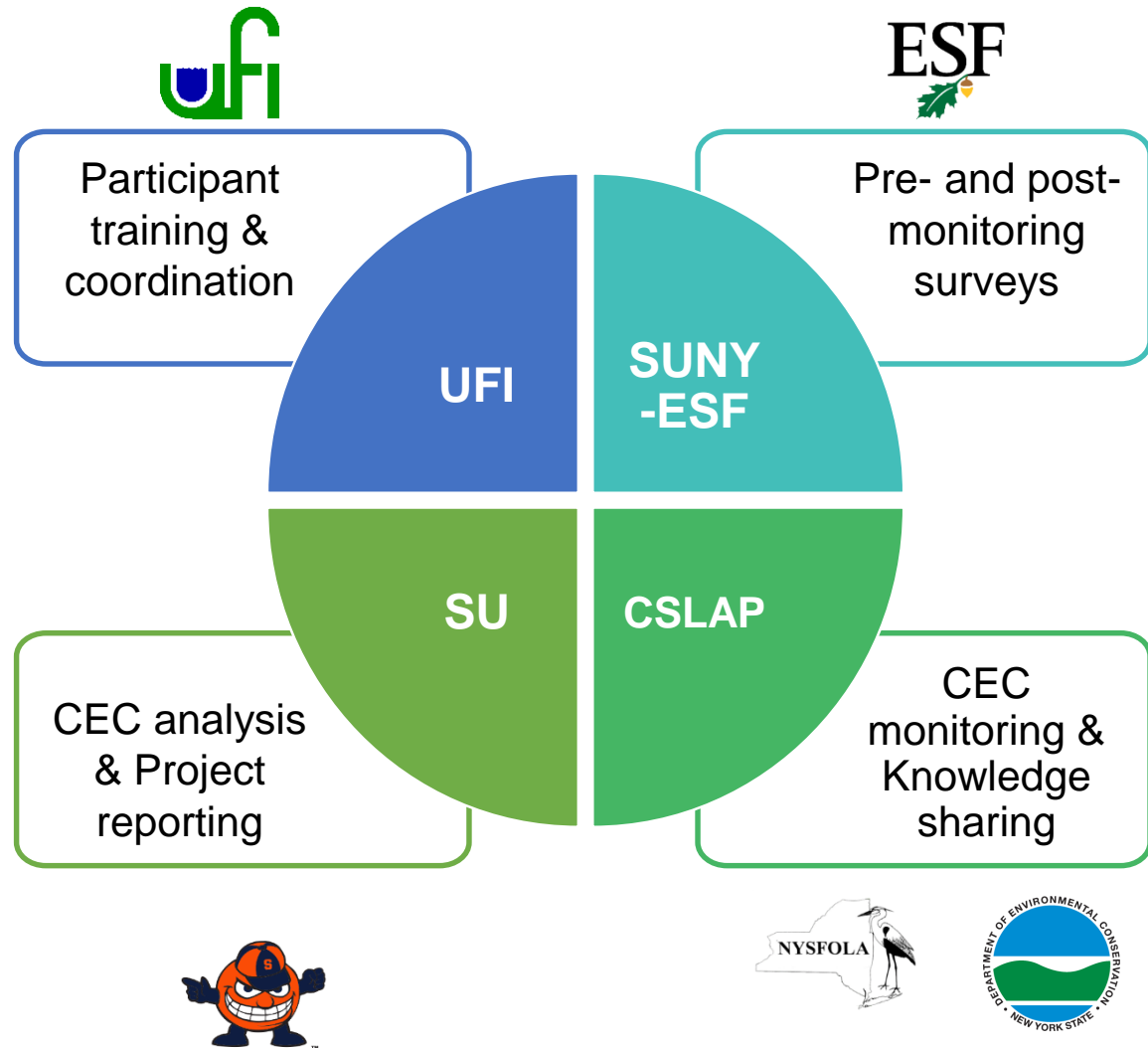
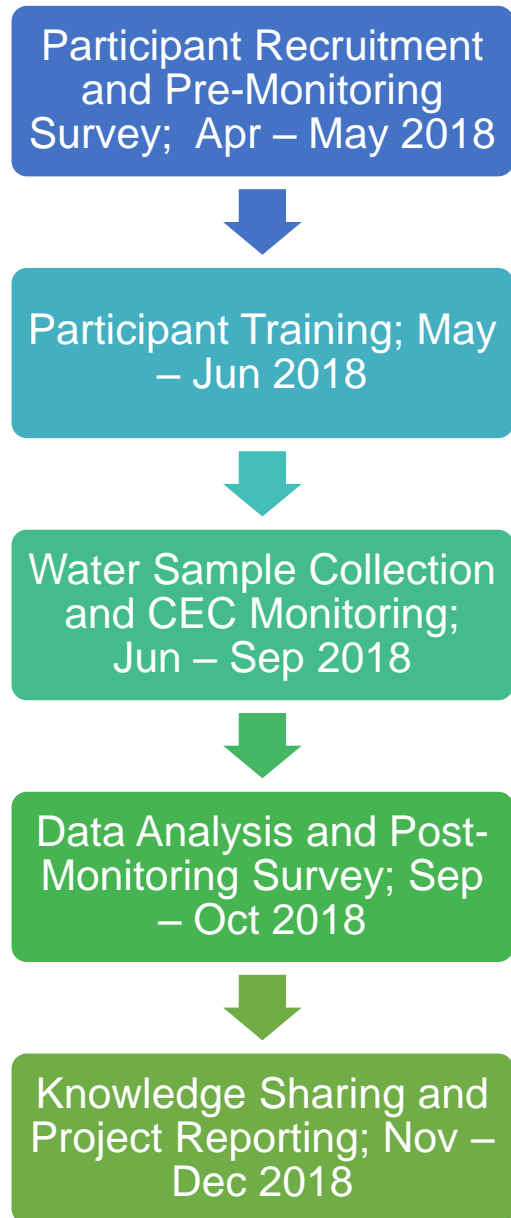


CSLAP is a unique program for future CEC monitoring

What makes the CSLAP program a good fit for this NSF grant?

- CSLAP has pre-trained volunteers
- Many of the volunteers live close to the lakes
- CSLAP is one of the longest running citizen monitoring programs in the U.S.:
 - **Approximately 120** participating lakes with **trained** volunteers
 - Biweekly collection of water quality data and samples from June through October for **almost 30 years**
 - **Over 113,800** total observations, including nutrients (N, P), chlorophyll-a, and other water quality parameters, were made during 2000 – 2016.
- The CSLAP program can provide lake specific water quality data to support this project and aid in interpretation of results
- CSLAP offers a unique platform for us to evaluate the feasibility of integrating CEC monitoring into an already-established and successful citizen-based monitoring program.

Project timeline



Selection of participating CSLAP lakes

- Watershed characteristics
 - Land use patterns (forest vs. urban vs. agriculture)
 - Septic systems/wastewater discharges into lakes
 - Watershed-to-lake area ratio
 - Mean lake depth
- Lake water quality
 - Chlorophyll-a levels
 - History and severity of harmful algal bloom events
- Geographical distribution

Selection of source-specific CECs for monitoring

- **Microcystins**: A group of algal toxins produced by harmful algal blooms

- **Atrazine**: A widely-used herbicide found in agricultural runoff



- **Caffeine**: A stimulant found in sewage discharged from failing septic systems



- **Sucralose**: An artificial sweetener found in sewage discharged from sewage treatment plants



Participant training: On-site monitoring

- Use colorimetric strip tests on site to analyze for **microcystins** and **atrazine** in water samples. Strip results will be used as a “screening” tool.
- A trained UFI scientist will visit each lake to answer questions and perform a side-by-side sampling for replicate comparison.

Microcystins test strips



Atrazine test strips



Participant training: What to expect?

- Small group training with UFI research staff at several locations around NYS
 - Locations will be in or near Syracuse, Rochester, and Saratoga
 - Participants will learn how to use the *Abraxis* Microcystins test strips and Atrazine test strips
 - Microcystins test takes approximately 30 minutes to run; Atrazine test takes approximately 10 minutes to run
- Participants will be provided with small sample kits that include:
 - 8 Microcystins strips, sample vials, reagents, and droppers
 - 8 Atrazine strips, sample vials and droppers
 - A timer for timing each of the incubation steps
 - Sample forms for reporting results
 - Plastic bags for test strips and test kit waste
 - Forms, strips, and waste materials will be mailed back in the CSLAP box with your regular CSLAP samples to UFI

Participant training: Water sample collection

- Collect water samples for CEC analysis at Syracuse University
 - Participants will be provided with **1-liter Teflon bottles** that are filled with **unfiltered** water from the “surface” (1.5 m) depth using the Kemmerer
 - The bottles will be shipped back to UFI with the other CSLAP samples
 - Syracuse University will analyze the water samples for caffeine, sucralose and other CECs



CEC knowledge assessment

Pre- and post-project surveys

Our research explores awareness of risks associated with CECs

- *for those lake association members who use the microsystems and atrazine strip tests on-site, and for those who do not*
- *before the CEC project begins, and once it has been completed*
- The surveys inquire about: environmental literacy, knowledge of watershed management issues, and worldview relative to science, environment, and management
- We plan to measure people's knowledge of, and engagement with, water quality management issues
- We will explore the extent to which lake association members will have the capacity to engage with other stakeholders



Project result dissemination

- Next year's NYSFOLA conference - we should have a good story to tell!

In addition, specific results and/or aggregate results will be available through a variety of other formats.

- Annual CSLAP reports
- NYSFOLA website and Facebook page
- NYSFOLA and Lake Association newsletters
- National Science Foundation (we received a request from them on Feb 28, 2018)

Project deliverables

- New data on the occurrence patterns of CECs in New York state lakes
- New knowledge about the feasibility of citizen-based CEC monitoring
- New partnerships and infrastructure for environmental education and research

NYSFOLA 35th Annual Conference

Thank you!

Questions
Welcome.

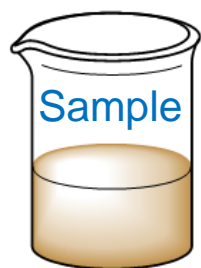


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CEC analysis at Syracuse University



CEC Extraction



CEC Screening



Solid-Phase Extraction



Liquid Chromatograph-
High Resolution Mass Spectrometer