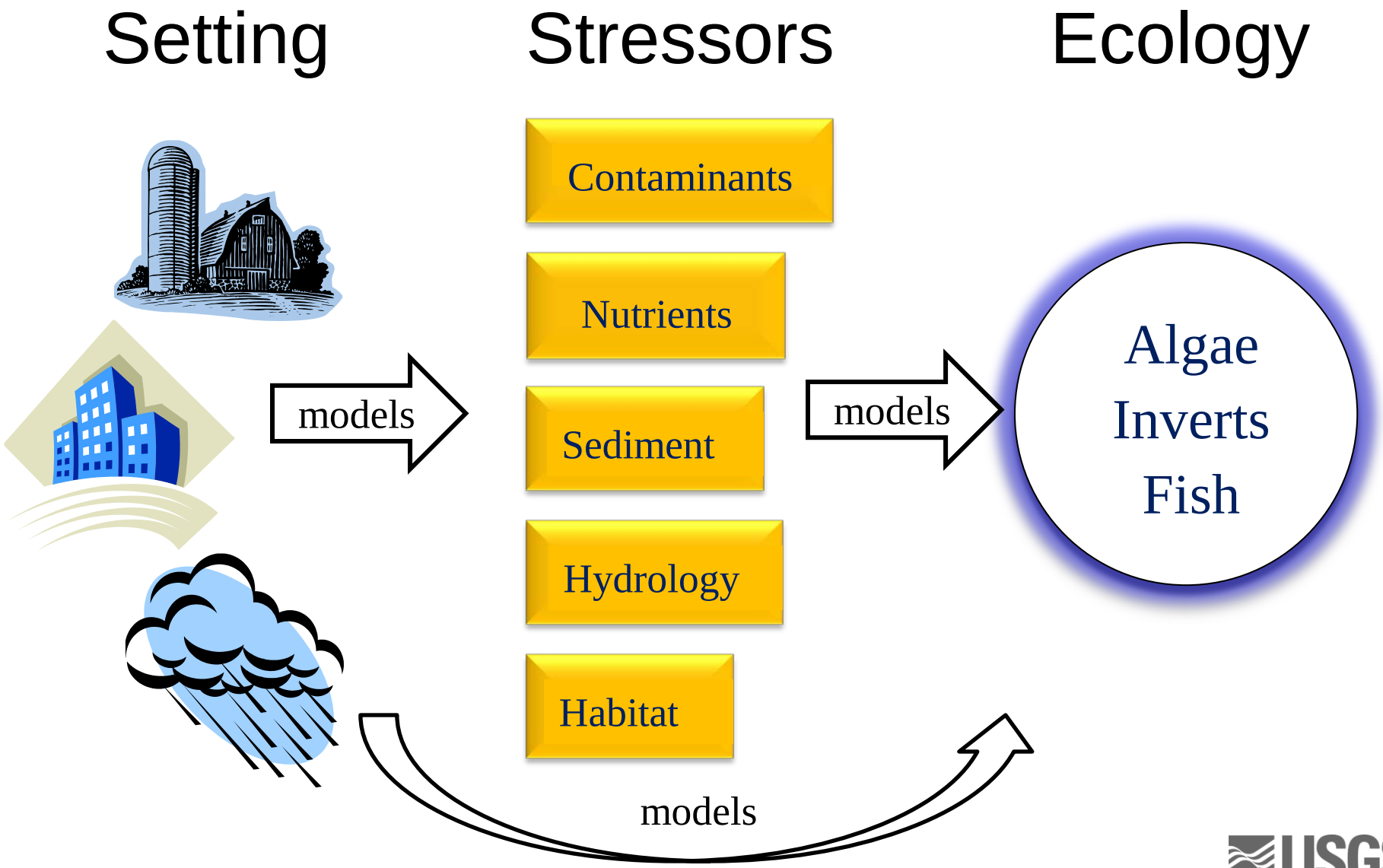
USGS NAWQA
Regional Stream-Quality Assessments

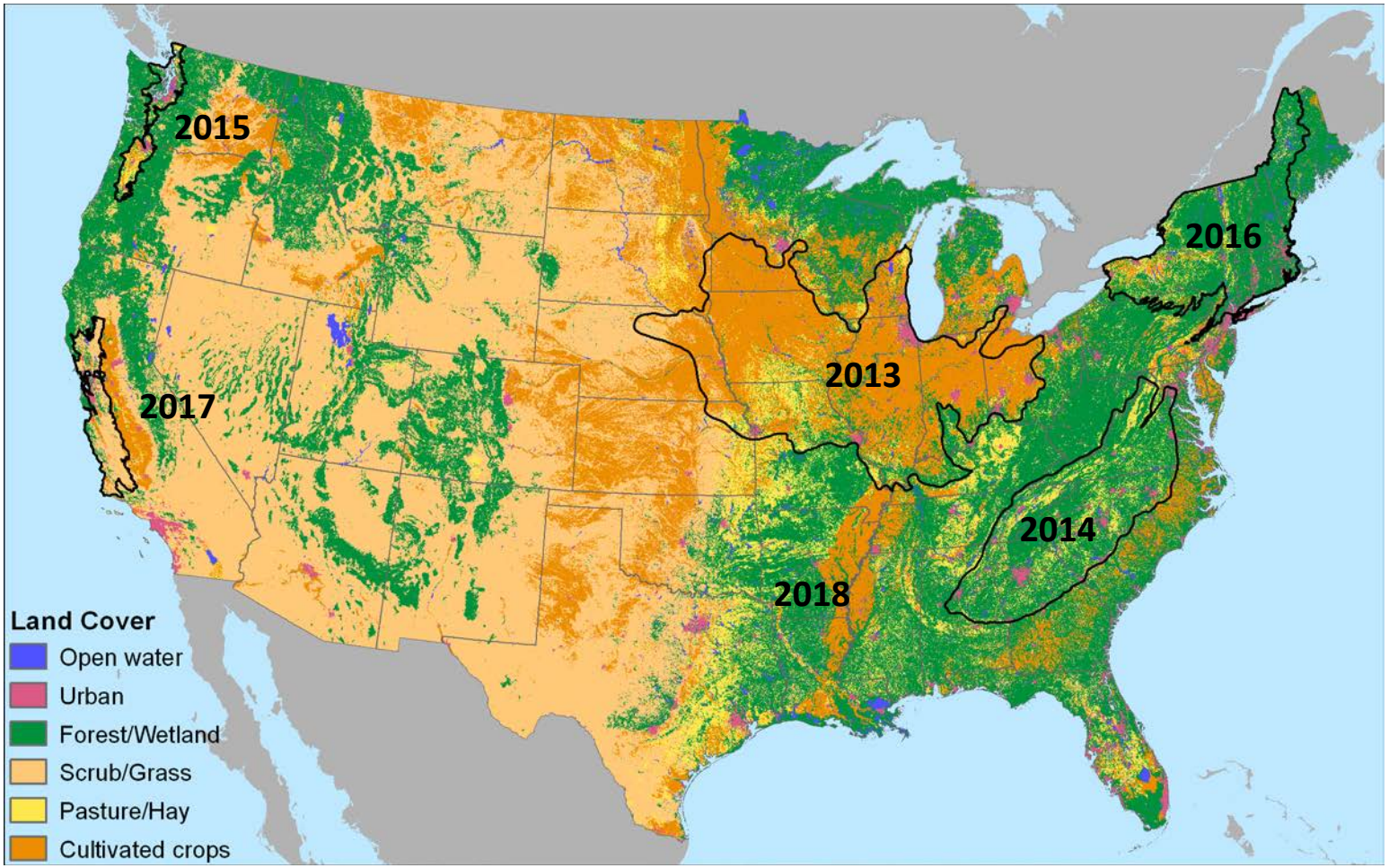
Peter Van Metre

National Water Quality Program (NAWQA)
U.S. Geological Survey

Multistressor Analysis



RSQA 2013-2018



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Sampling

- Water
  - **Weekly samples at all sites:** pesticides, glyphosate, nutrients, major ions, sediment, and organic carbon
  - **Selected weeks:** mercury, waste indicator compound, pharmaceuticals, and N and O isotopes
  - **POCIS:** pesticides, waste indicator compound, pharmaceuticals, and estrogen assay test
- Sediment
  - **Chemistry:** metals, PAHs, organohalogens, hormones, waste indicator compounds, radionuclides
  - **Toxicity:** *Hyalella*, *Chironomus*, mussels
- Ecology inverts, algae, fish, and habitat
- Mercury concentration & Hg isotopes in fish

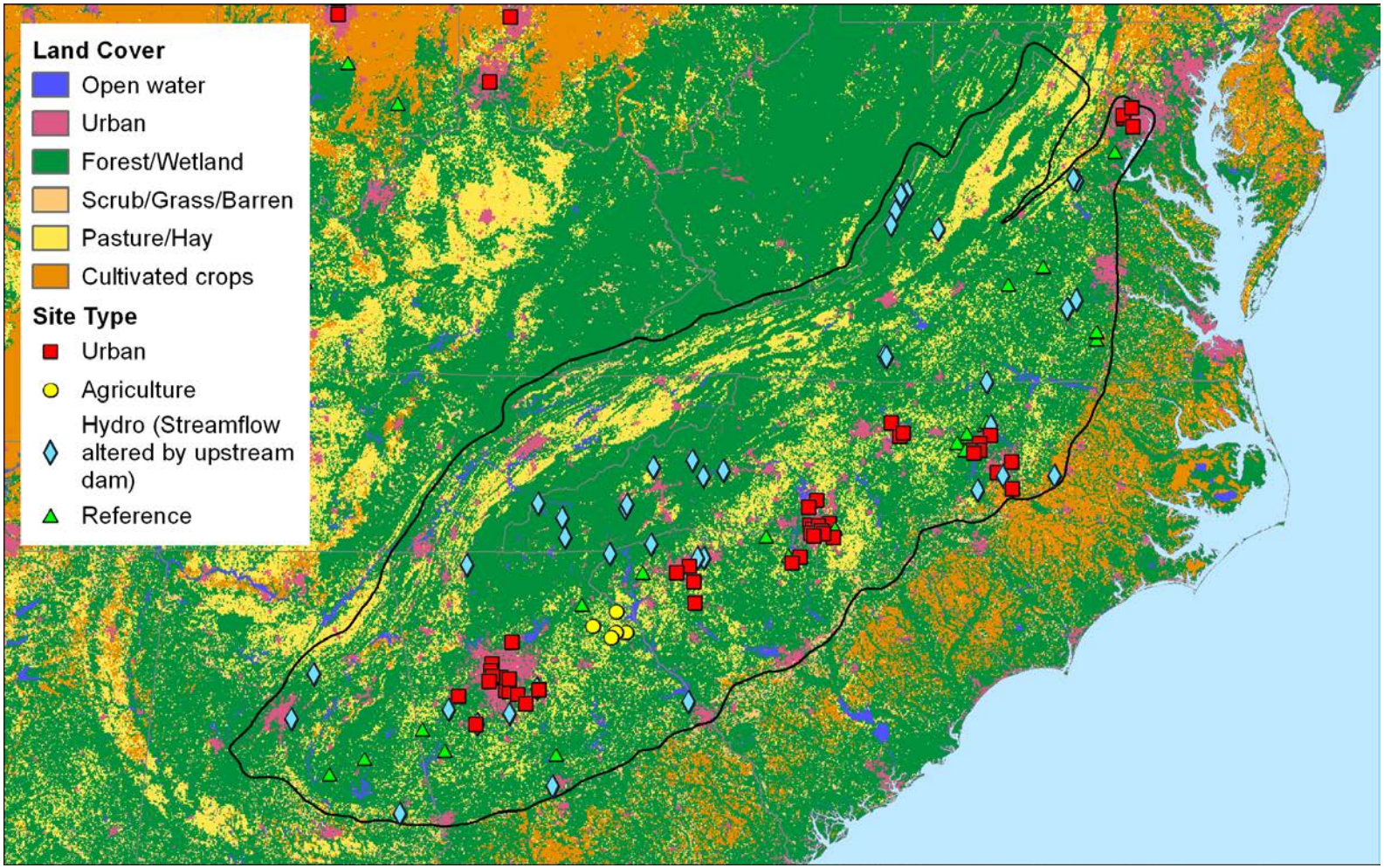
USGS

Example Timeline – PNSQA

Site type	Sampling	13-Apr	20-Apr	27-Apr	4-May	11-May	18-May	25-May	1-Jun	8-Jun	15-Jun	22-Jun
Regular Sites	WATER CHEM	1	2	3	4	5	6	7	8	9	10	
n=76	POCIS						POCIS					
	SED CHEM/TOX											
	ECO SURVEY											
Reference Sites	WATER CHEM							1	2	3	4	
n=12	POCIS						POCIS					
	SEDIMENT CHEM											
	ECO SURVEY											

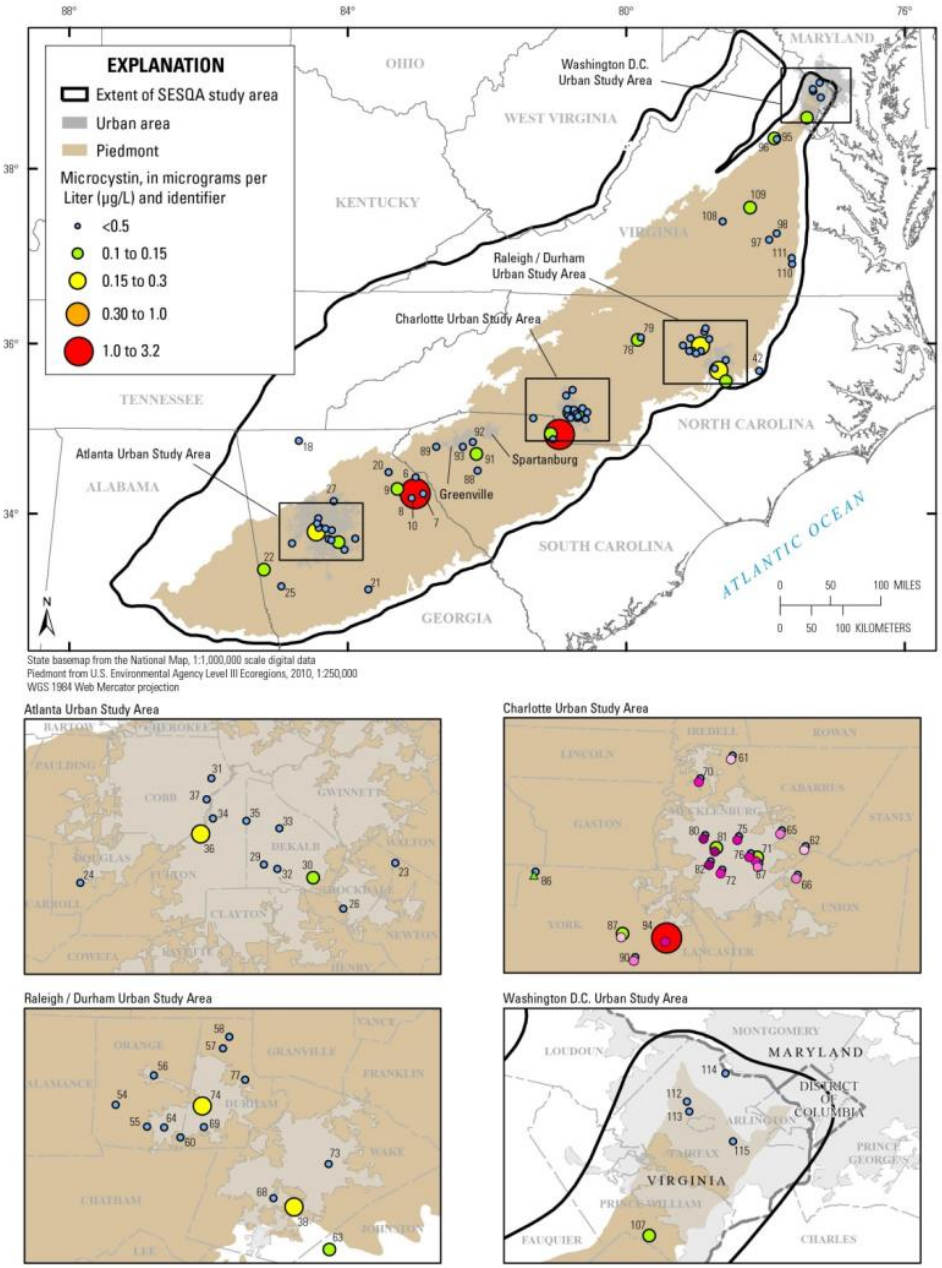
Southeastern Stream Quality Assessment:

Urban gradient with CAFO and flow alteration sites



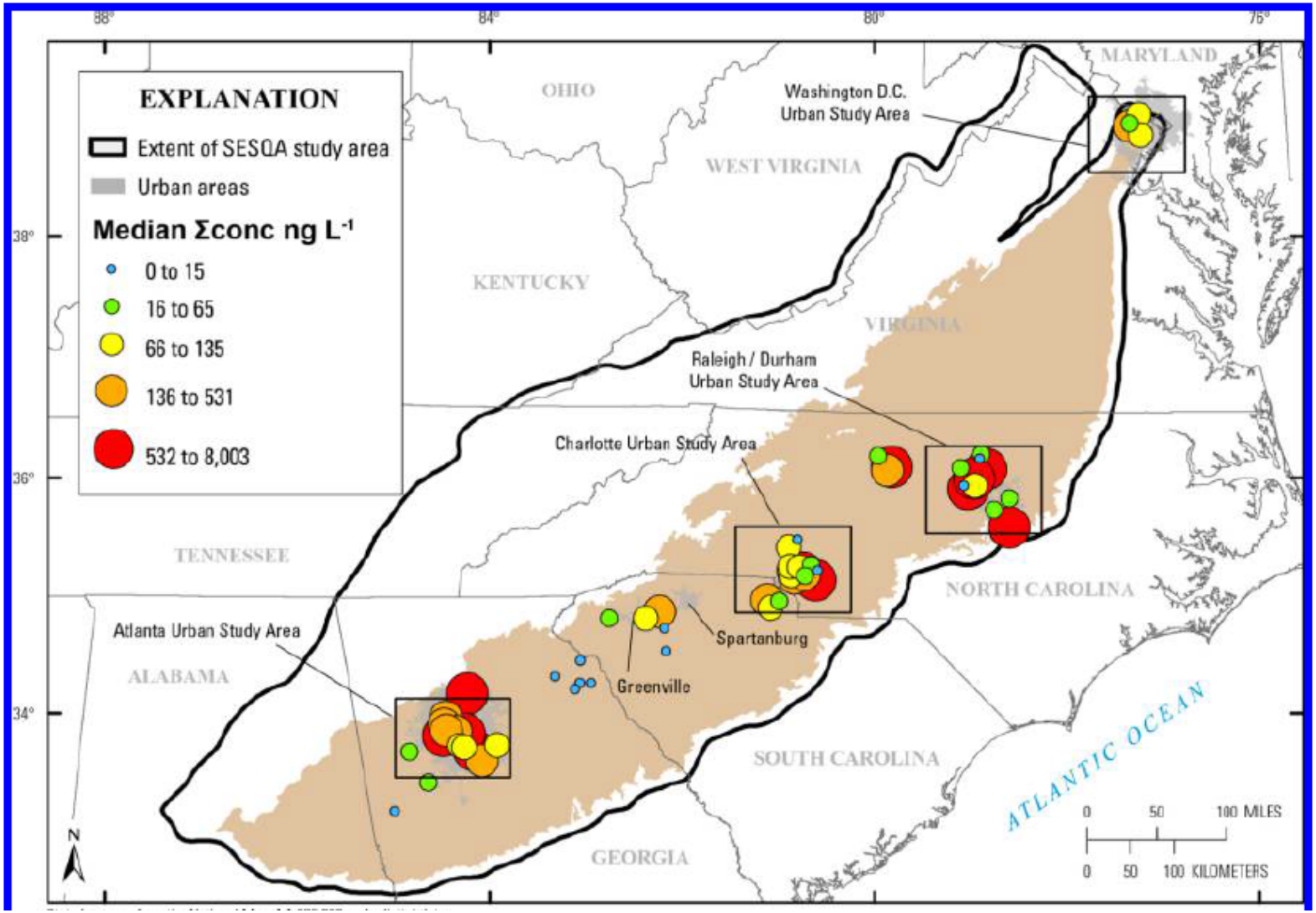
Microcystin in SESQA streams, 2014

NASA image of Lake Erie bloom.



Loftin et al., 2016, ET&C

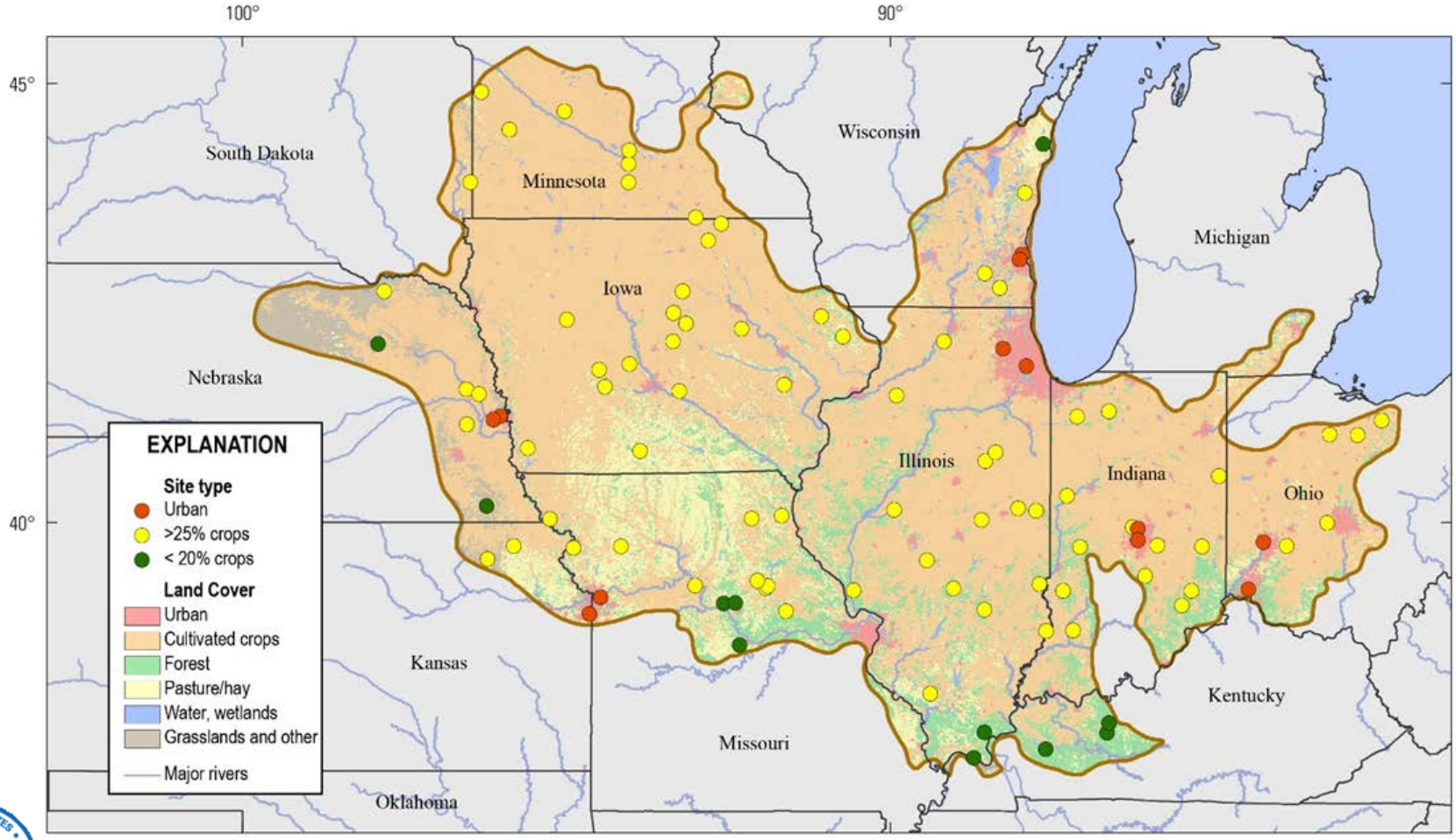
Pharmaceuticals



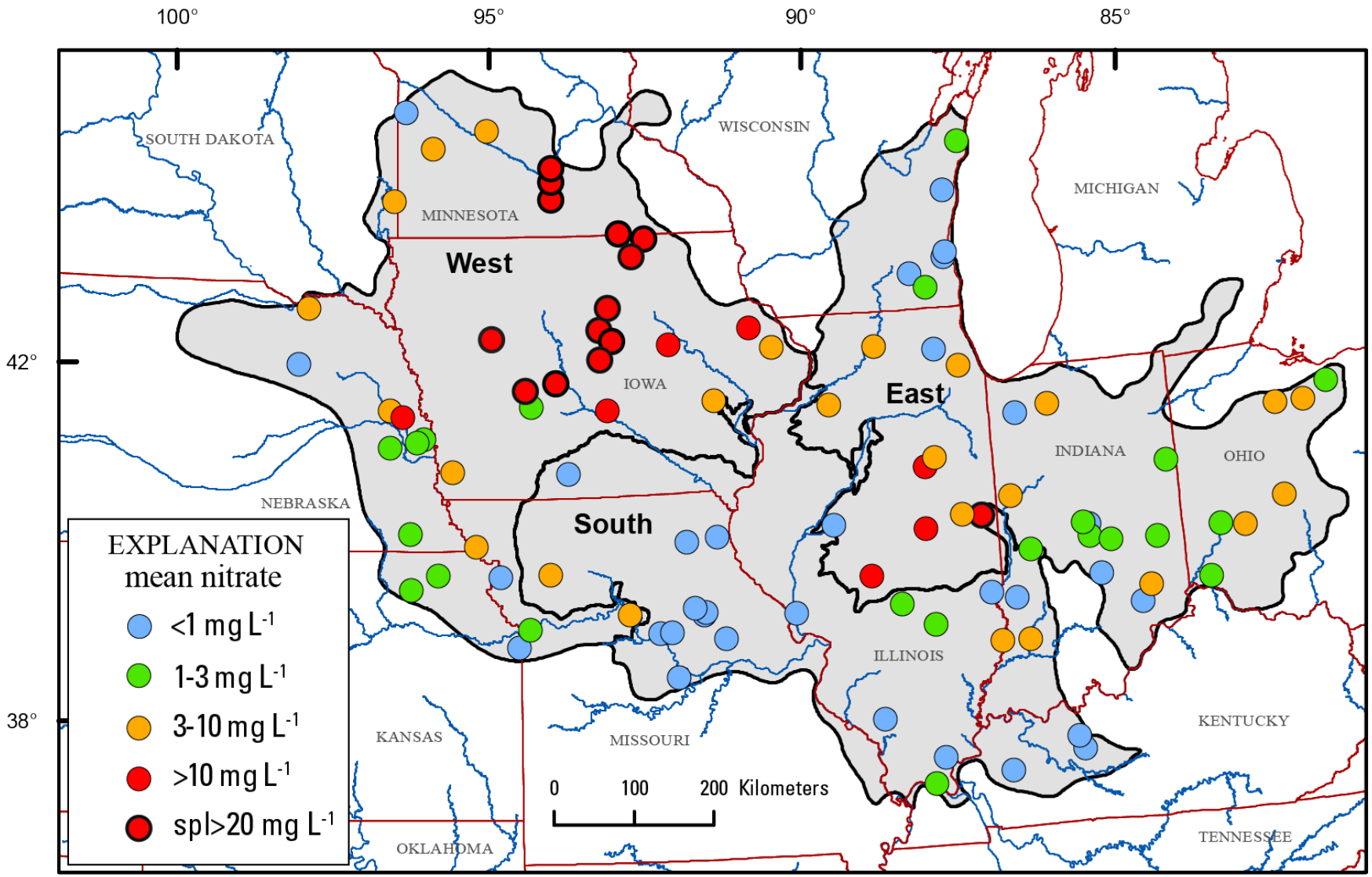
Bradley et al., 2016, ES&T

Midwestern Stream Quality Assessment:

Agricultural gradient with urban indicator sites

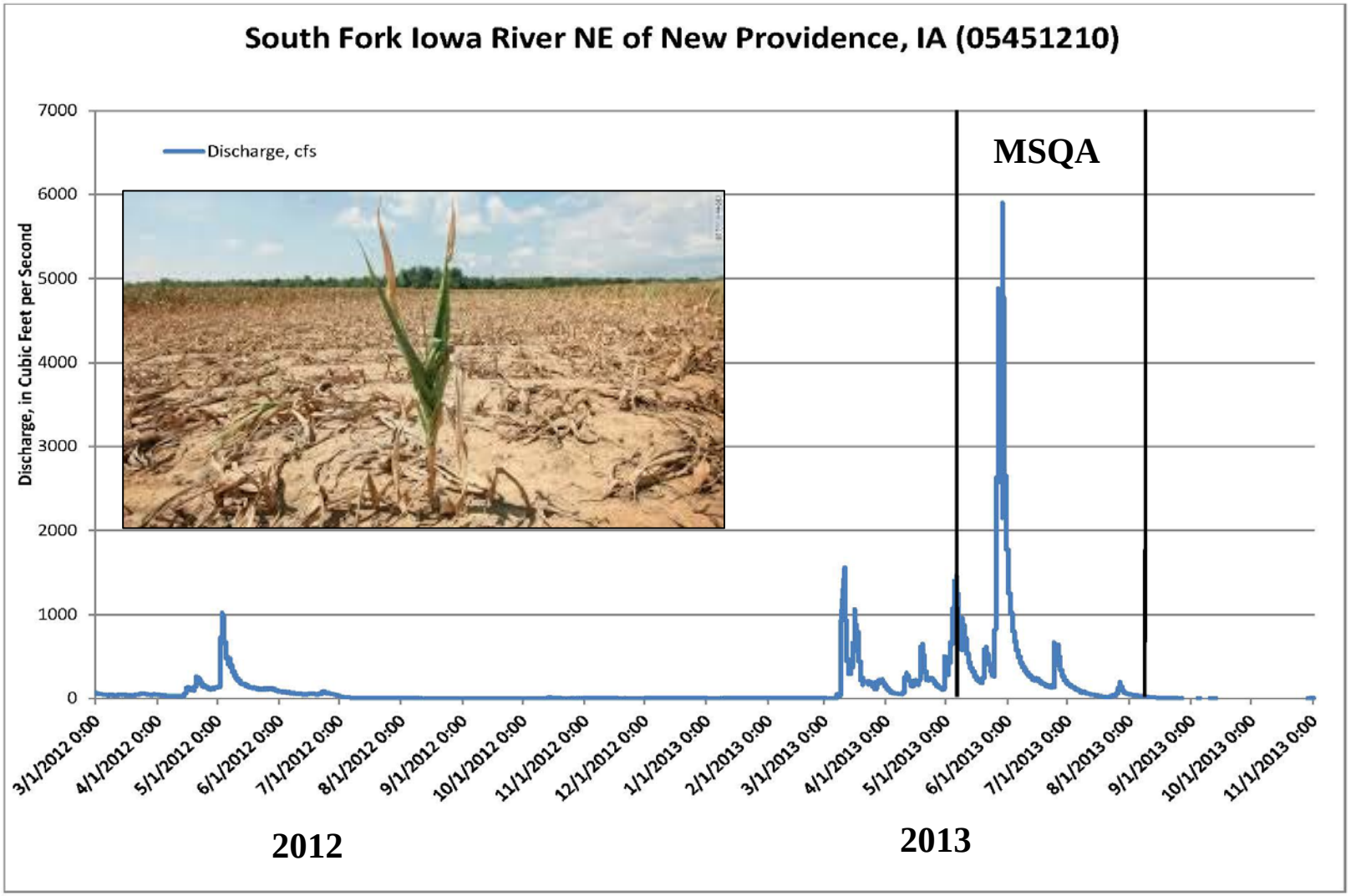


2013 – record high nitrate in IA and MN



Van Metre et al., 2016, Env. Poll.

Nitrate and dry-year wet-year cycles

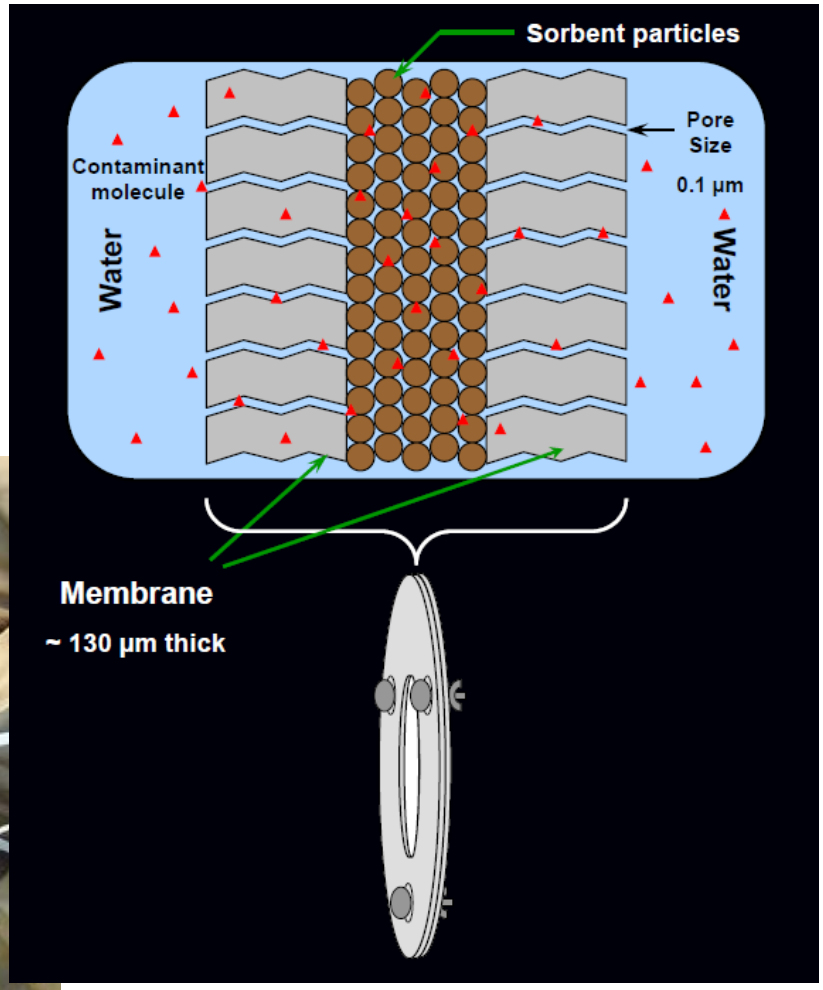


Dissolved pesticides in water

Provisional data removed pending publication

Polar Organic Chemical Integrative Sampler – POCIS

Median of 62 compounds detected per POCIS
(compared to 46 in matching discrete samples)



Dave Alvarez
Pete Van Metre

Occurrence in water and POCIS generally were similar

Provisional data removed pending publication

Pesticides in daily autosamplers

Julia Norman

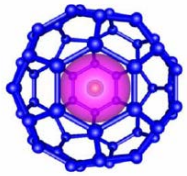
High short-term variability in pesticides at Goodwater Creek, MO

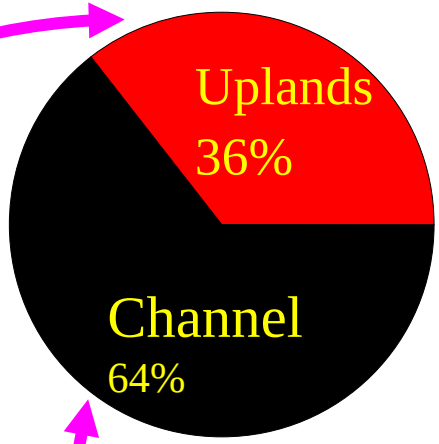
Provisional data removed pending publication

Sources of fine sediment

$^{210}Pb_{ex}$

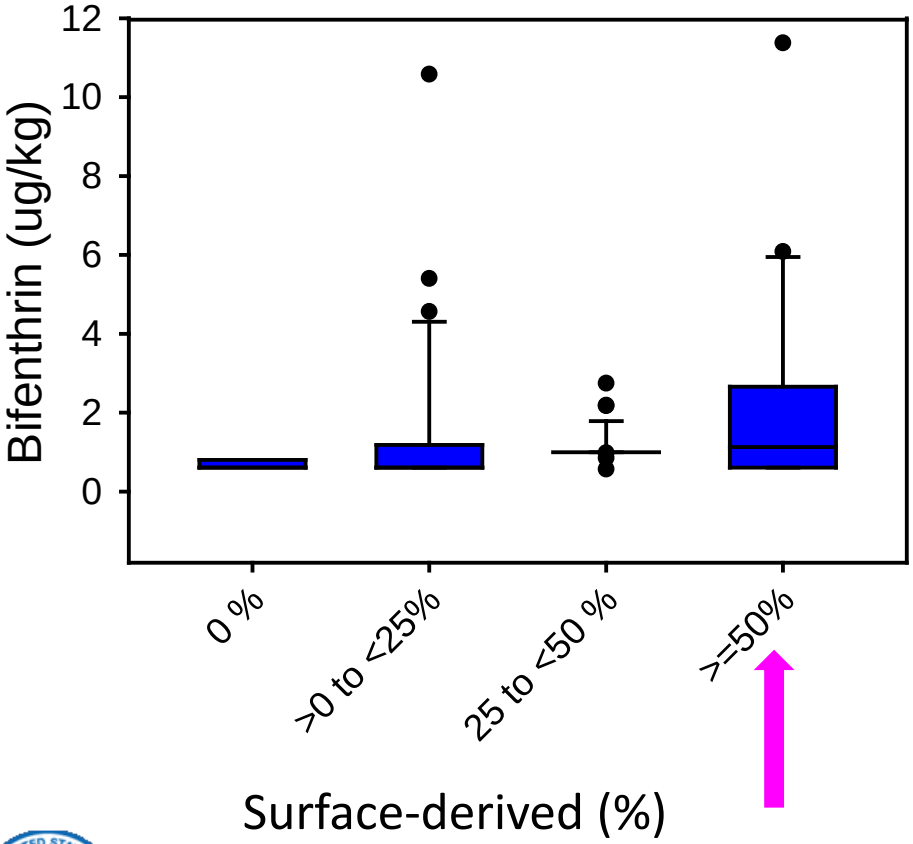
$t_{1/2}$ 22 y

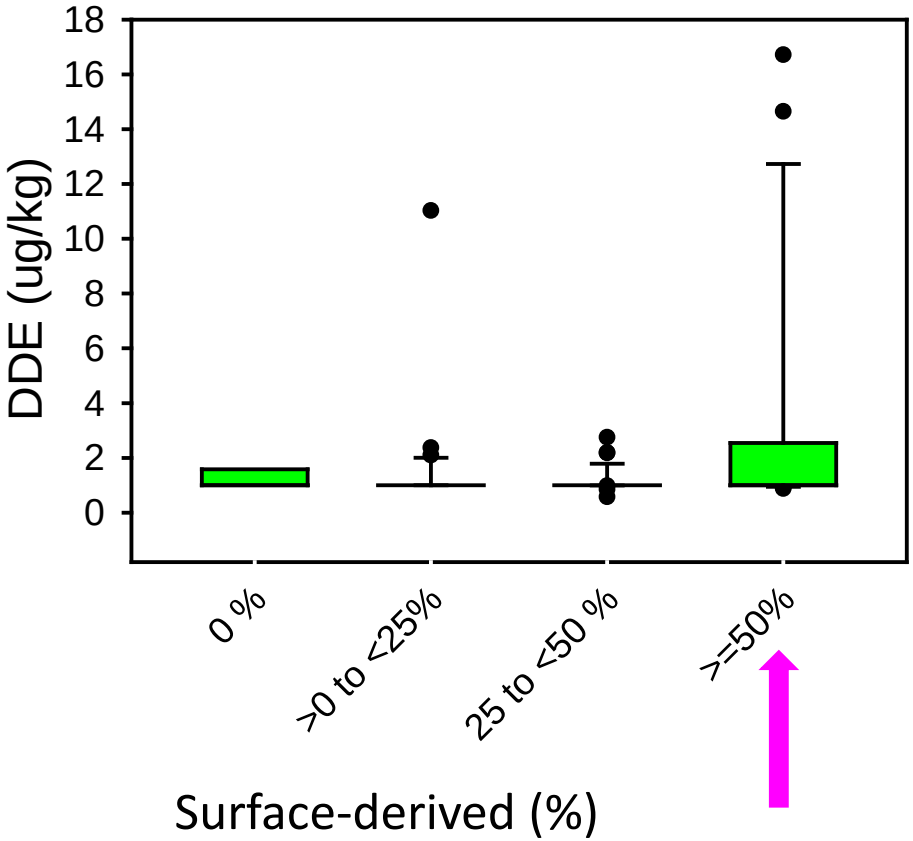




Gellis et al., in press, J Environ Manage

Bifenthrin and DDE concentrations correlate to surface sediment sources





Invertebrate metrics modeled using Boosted Regression Tree methods

Example model:

Invertebrate Metric

- Multimetric Index (MMI)

4 Explanatory Variables:

- Contaminants: Pyrethroid degradates (POCIS)
- Nutrients: Ammonia
- Habitat: Channel geometry
  Substrate

Ian Waite

To evaluate stressor conditions at each site:
Rate each site as High-Medium-Low for each stressor

Provisional data removed pending publication

Focused Studies

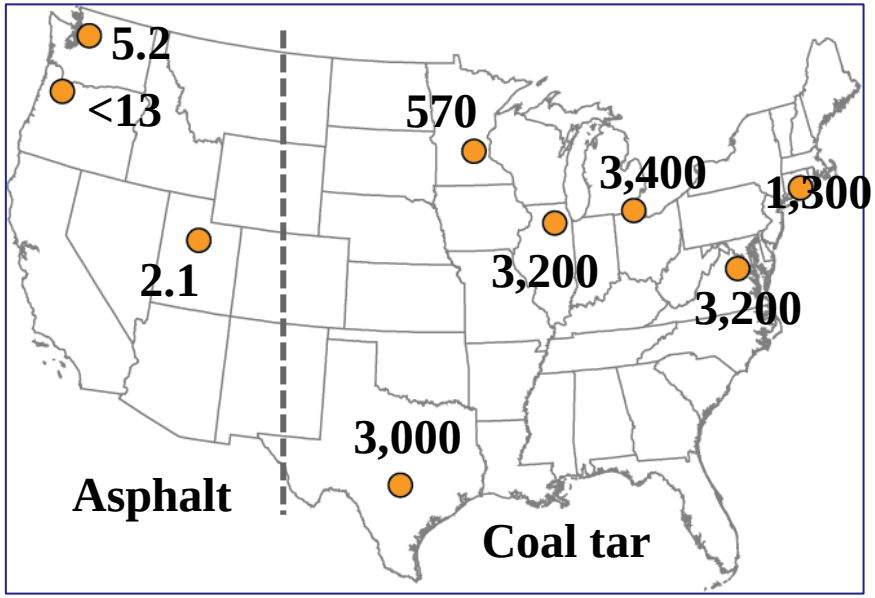
- Nitrogen cycling using continuous nitrate monitoring
- Daily pesticide micro-auto samplers
- Suspended and bed sediment sources
- Algal toxins
- eDNA – metagenomics identification of microbial, algal, and invert communities
- Mercury in fish
- Urban PAH and metal sources
- Pharmaceuticals in invertebrates (bugs on drugs)

USGS

PAH sources

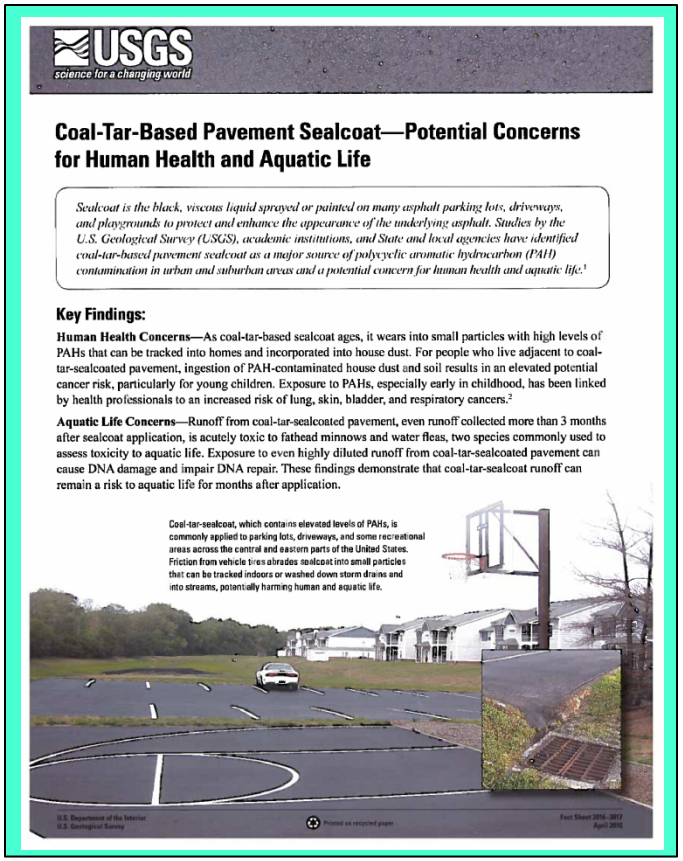
- Coal-tar sealcoat
- 85 million gallons used annually in central and eastern US
- Largest PAH source to urban lakes

Sealed pavement dust Total PAH (mg/kg)



Van Metre et al., 2009, *Env. Sci. Technol.*
Mahler et al., 2012, *Env. Sci. Technol.*

Risks to aquatic life and human health



USGS
science for a changing world

Coal-Tar-Based Pavement Sealcoat—Potential Concerns for Human Health and Aquatic Life

Sealcoat is the black, viscous liquid sprayed or painted on many asphalt parking lots, driveways, and playgrounds to protect and enhance the appearance of the underlying asphalt. Studies by the U.S. Geological Survey (USGS), academic institutions, and State and local agencies have identified coal-tar-based pavement sealcoat as a major source of polycyclic aromatic hydrocarbon (PAH) contamination in urban and suburban areas and a potential concern for human health and aquatic life.[1]

Key Findings:

Human Health Concerns—As coal-tar-based sealcoat ages, it wears into small particles with high levels of PAHs that can be tracked into homes and incorporated into house dust. For people who live adjacent to coal-tar-sealcoated pavement, ingestion of PAH-contaminated house dust and soil results in an elevated potential cancer risk, particularly for young children. Exposure to PAHs, especially early in childhood, has been linked by health professionals to an increased risk of lung, skin, bladder, and respiratory cancers.[2]

Aquatic Life Concerns—Runoff from coal-tar-sealcoated pavement, even runoff collected more than 3 months after sealcoat application, is acutely toxic to fathead minnows and water fleas, two species commonly used to assess toxicity to aquatic life. Exposure to even highly diluted runoff from coal-tar-sealcoated pavement can cause DNA damage and impair DNA repair. These findings demonstrate that coal-tar-sealcoat runoff can remain a risk to aquatic life for months after application.

Coal-tar-sealcoat, which contains elevated levels of PAHs, is commonly applied to parking lots, driveways, and some recreational areas across the central and eastern parts of the United States. Friction from vehicle tires abrades sealcoat into small particles that can be tracked indoors or washed down storm drains and into streams, potentially harming human and aquatic life.

U.S. Department of the Interior
U.S. Geological Survey

Printed on recycled paper

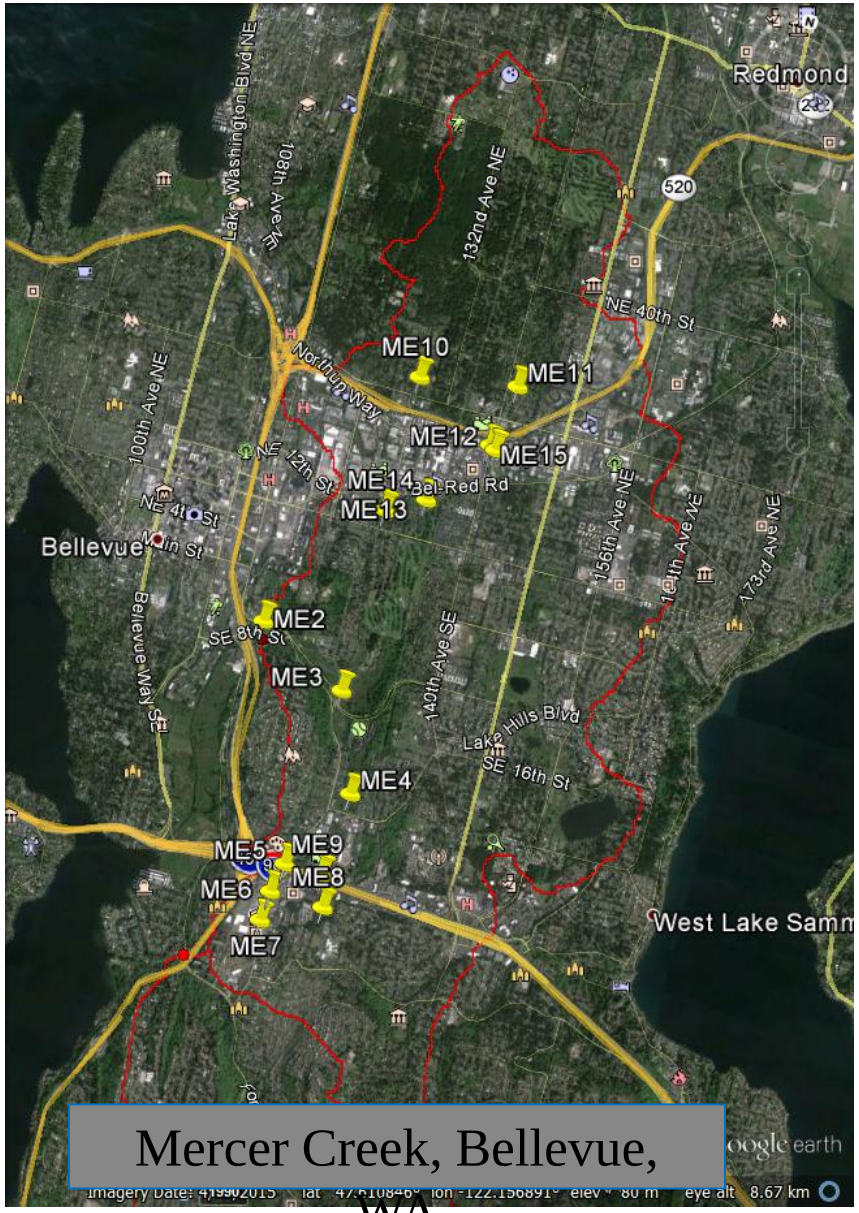
Fact Sheet 2016–3017
April 2016

- Elevated PAHs in runoff for months to years after application
- Runoff acutely toxic and causes DNA damage for months after sealcoat application
- Elevated cancer risk for people living near coal-tar-sealed pavement

https://pubs.er.usgs.gov/publication/fs20163017

From a sealcoat-related fish kill in NC

Watershed mapping for PAH and metal sources



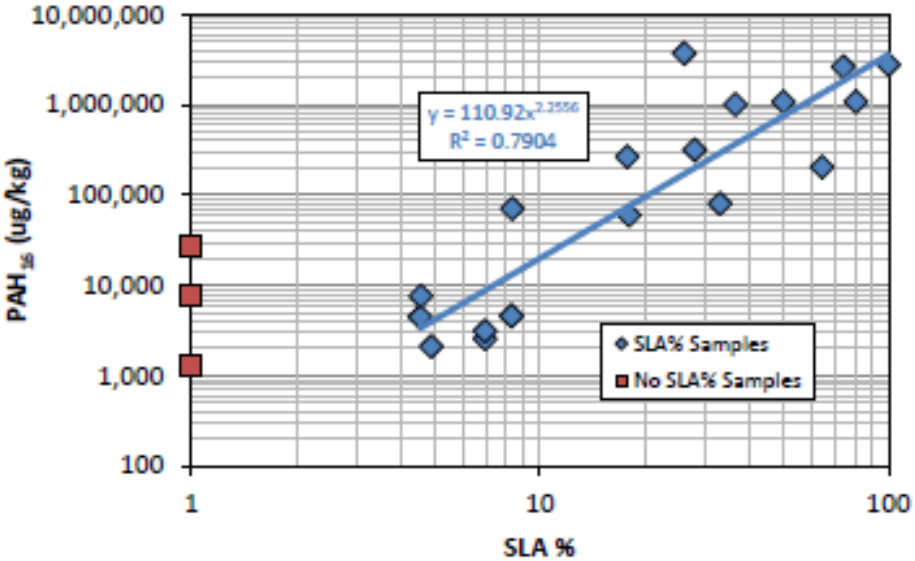


Figure 8. PAH_{16} Relationships to Seal-Coated Lot Area

Pavlowski, 2013

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- Amanda Egler
- Daren Carlisle
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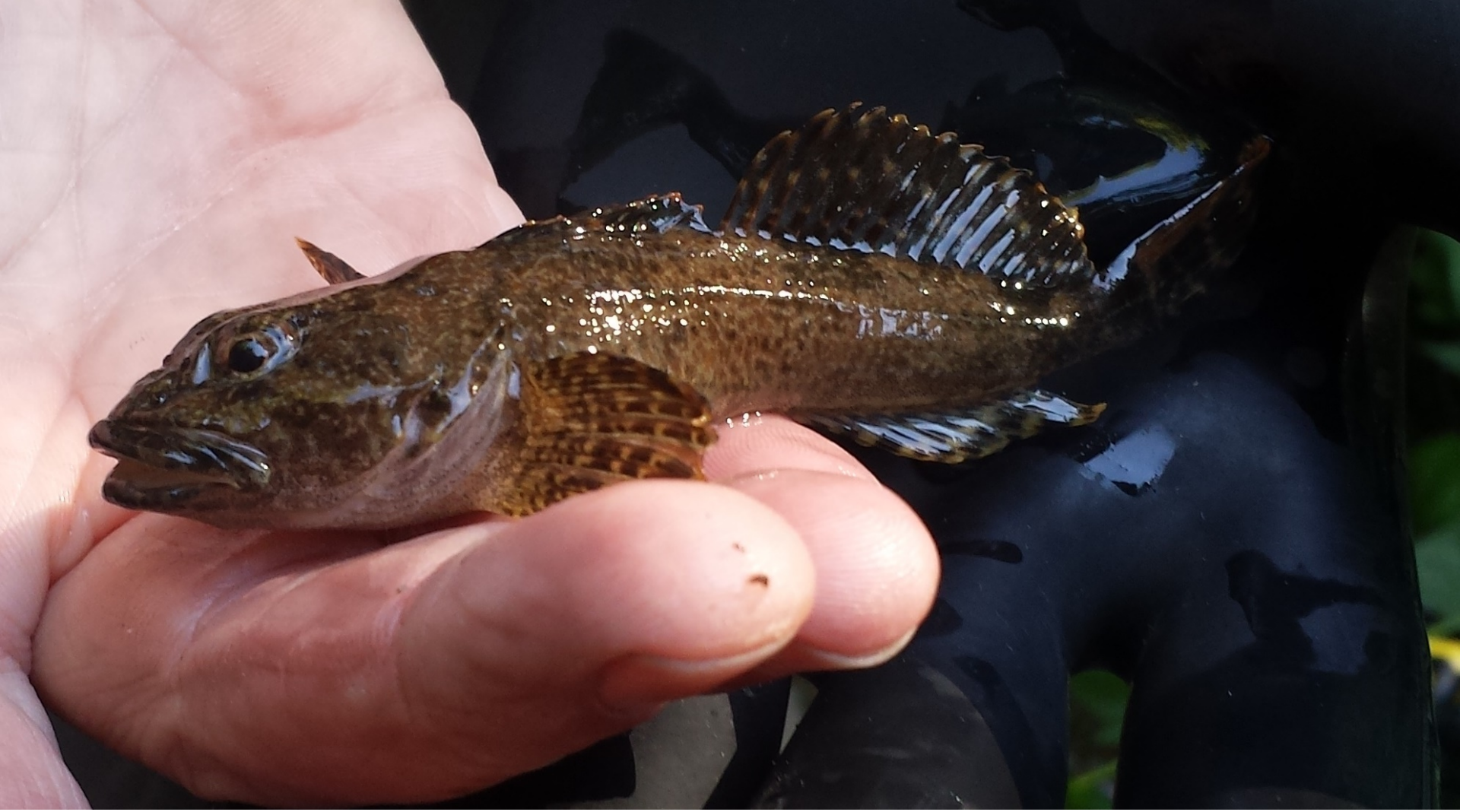

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