

# The geographically expansive watershed and environmental monitoring by citizen scientists: A perfect storm?

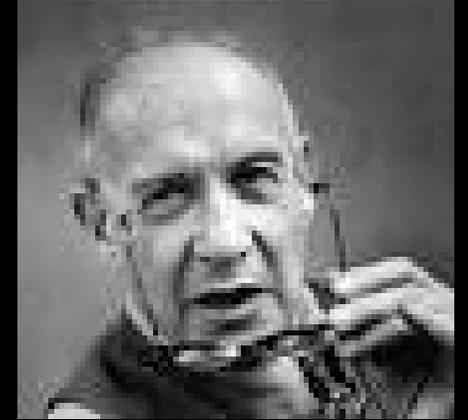
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- If you can't measure it, you can't manage it.
- Peter Drucker

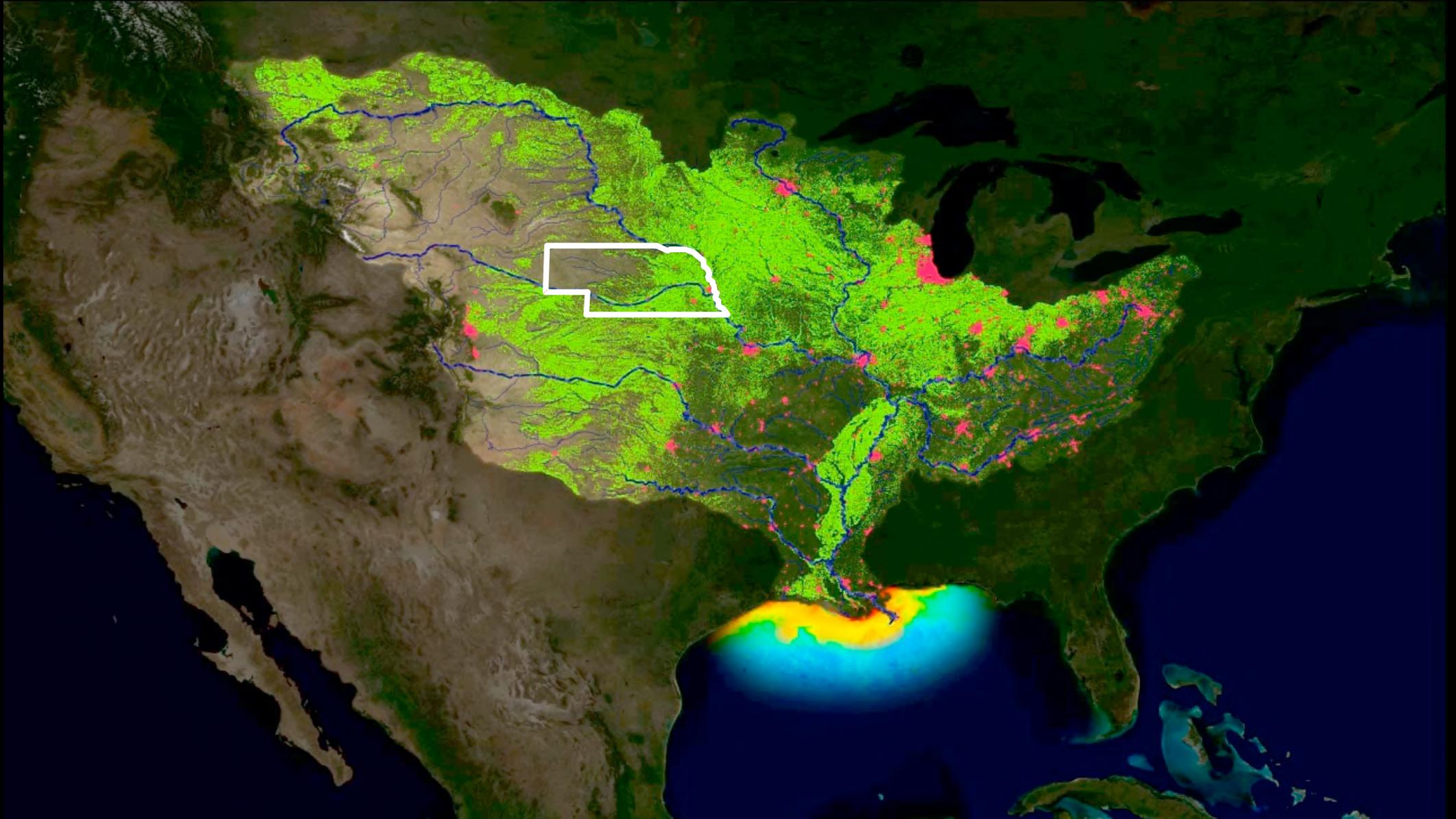


Float like a butterfly, sting like a bee,  
you can't hit, what you can't see.

- Muhammad Ali



# The Mississippi River watershed and emerging contaminants: A super wicked problem.



# Super wicked problems.

(Lazarus 2009)

National to global in scale

No single point of  
contaminant release

Solutions are nuanced,  
not point-of-fact

Solutions that would have worked  
yesterday, may not necessarily  
work tomorrow.



# Emerging contaminants in massive watersheds is a super wicked problem.

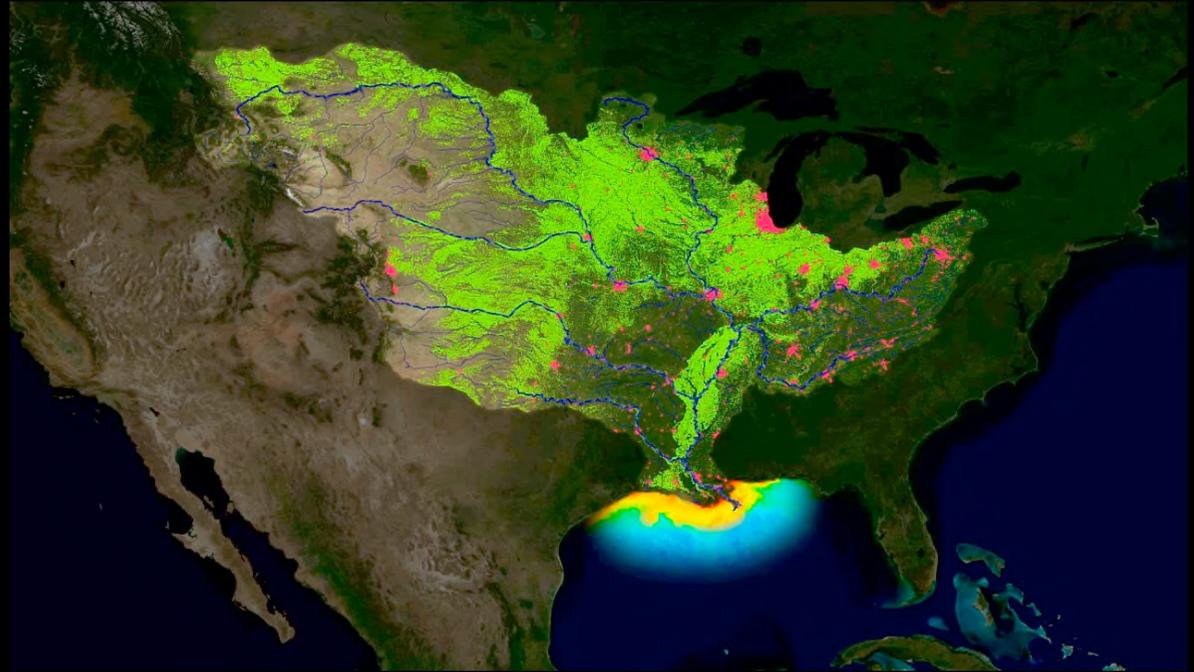
- Chemicals are in low concentration but are still biologically active



- Chemicals transform into metabolites that retain their biologic activity.

- There is a huge temporal and spatial variability.

**Can we use citizen scientists...**



**... to generate data on the occurrence of emerging contaminants across massive watersheds?**

# The basics of crowdsourced science:

- use of civilians
- extraordinary mobility
- unconventional tools
- mobilization of large numbers of individuals at one time



# Can citizens collect scientifically important data?

They already are!

The Christmas Bird Count  
- 114 years and counting

2015 Worldwide count

- 72,653 Citizen Scientists
- 68 million birds recorded
- 2,106 different species

Data from the Christmas Bird Counts have been used in numerous scientific papers.



# Can citizens collect scientifically important chemical data?

They already are!

The medical community has developed analytical tools for home use.



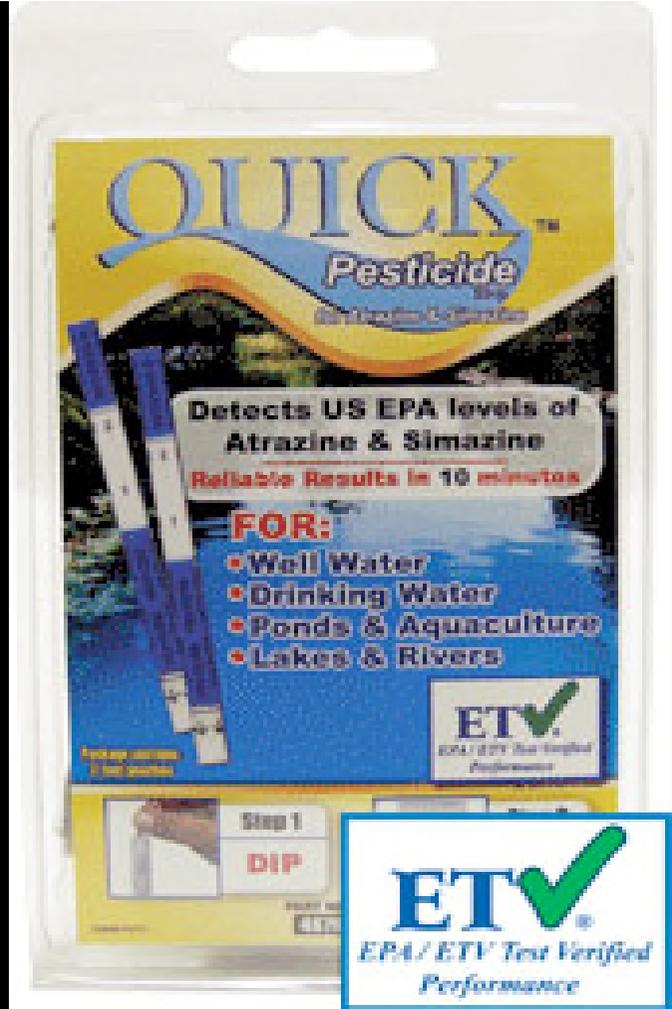
Ovulation testing  
Leutinizing Hormone



Blood  
glucose

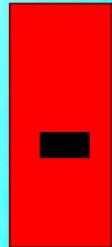


Pregnancy test strips  
Human chorionic  
Gonadotropin



Atrazine testing strips:

Fast, inexpensive, accurate



Immediate reporting time (10 min)

Inexpensive (\$10 / sample)

Discriminates presence at 3 ppb

# 2011, “What’s in your watershed Day?”

Citizen Scientists, including members of Boy Scout Troop 597 collected data on atrazine throughout the entire Elkhorn River basin.

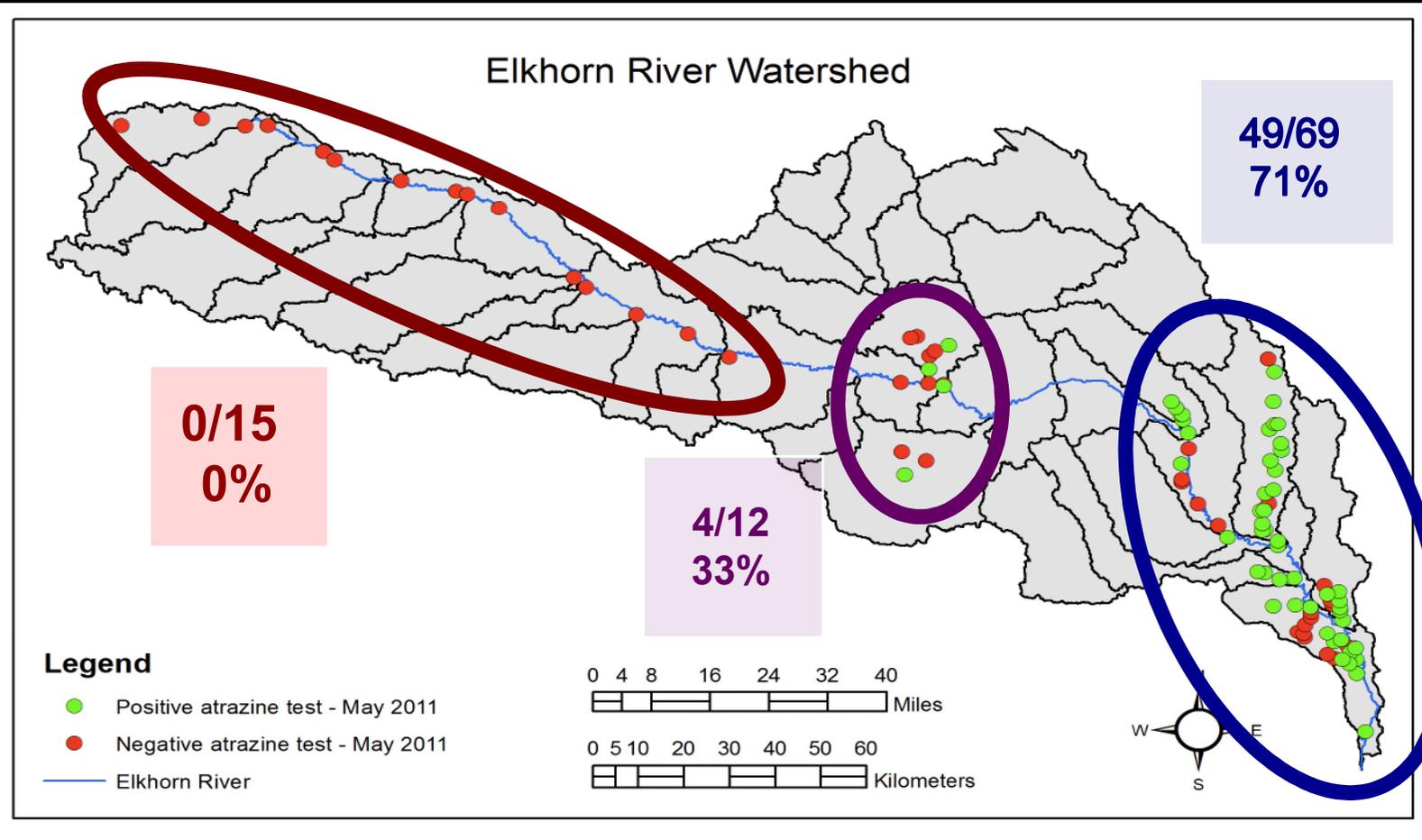
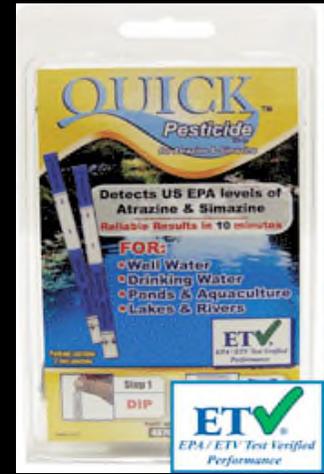
Over 110 data points were collected and routed to a GIS dataset and map, all in one day.



Omaha Boy Scout Troop 597 at the Elkhorn River Research Station.

# May 21, 2011 What's in your Watershed Day

## 96 tests, 53 positive hits

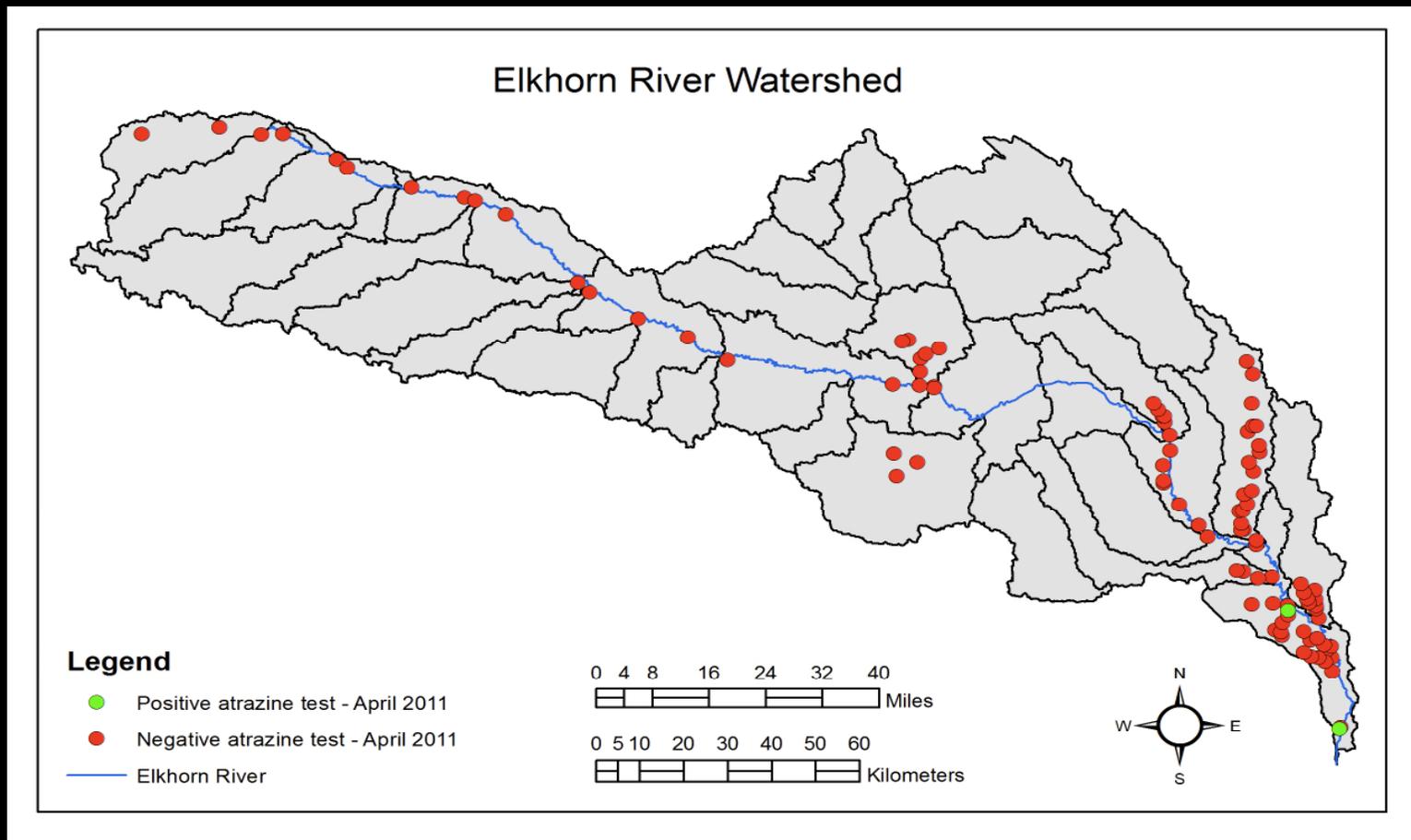


$\text{Chi}^2 = 27.81, P < 0.00001$

# Quality control / rates of error

135 tests, 2 positive hits.

Probability of Type 1 error 1.5%



## Quality control / rates of error

### Type 1 error (false positive)

- evaluated in the field 1.5% (n-135)
- evaluated in the laboratory 2.1% (n=91)

### Type 2 error (false negative)

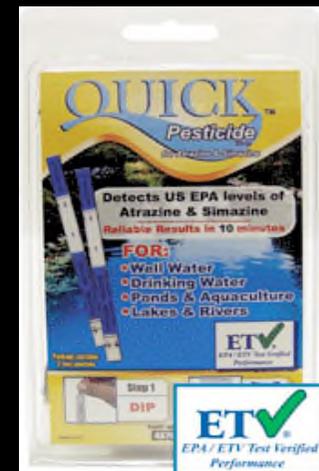
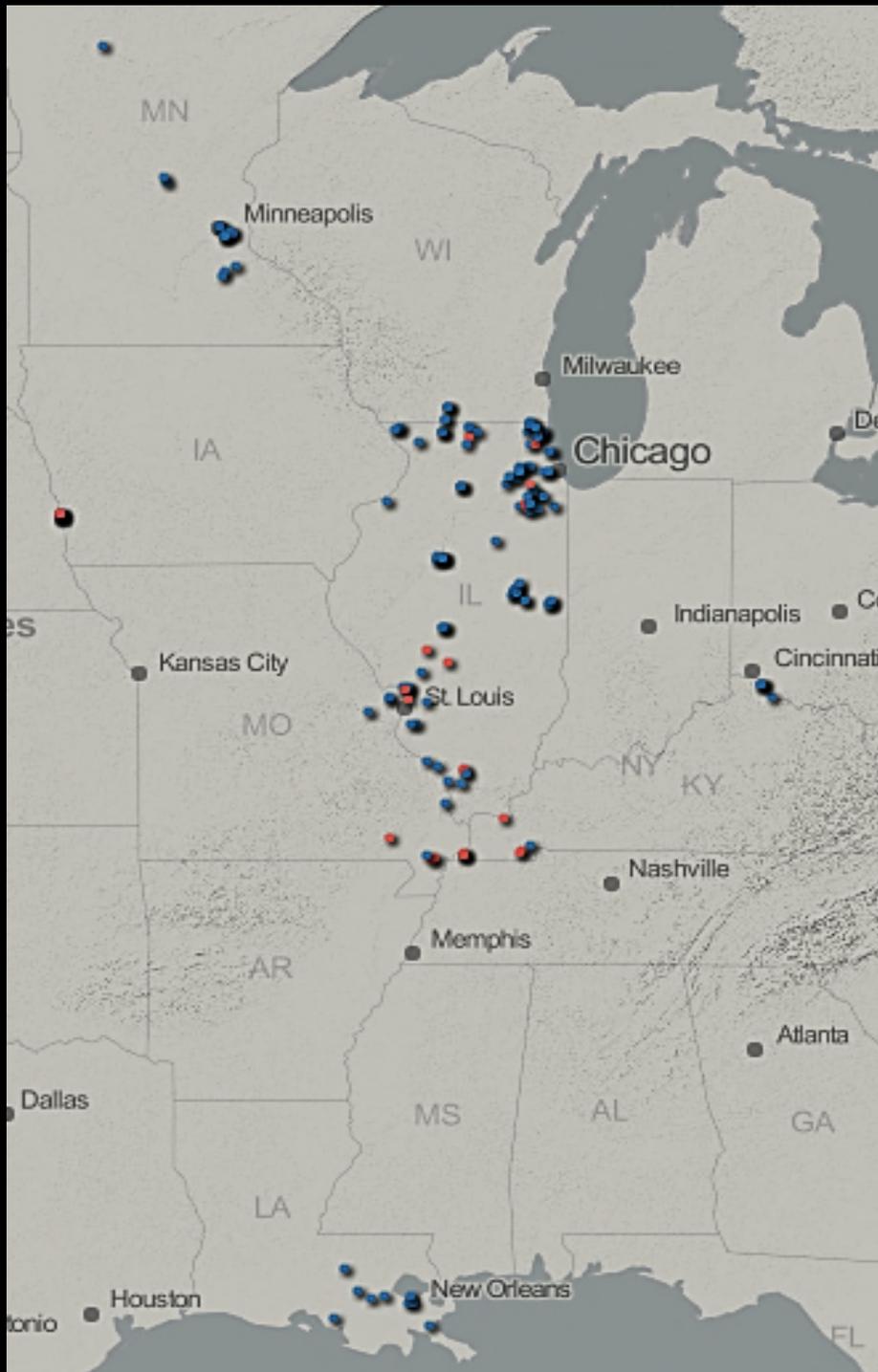
- evaluated in the laboratory 6.0% (n=45)





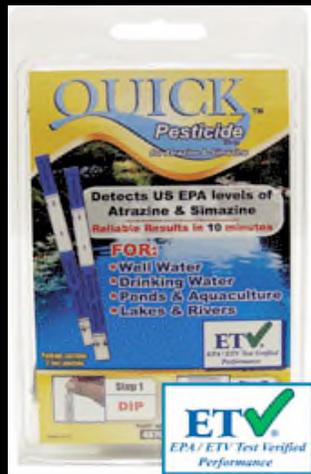
Minnesota  
Illinois River  
Missouri River  
Ohio River  
Arkansas River  
New Orleans

Li'l Miss Atrazine – monitoring the occurrence of atrazine throughout the Mississippi River basin.



All samples were collected within a 24 hr period on June 7, 2014.

211 useable data points were collected from 7 states.



**Region**

**n > 3 ppb (%)**

**Far North (Minnesota)**

**23 0%**

**North (N. Illinois)**

**63 9.5%**

**St. Louis region**

**15 26%**

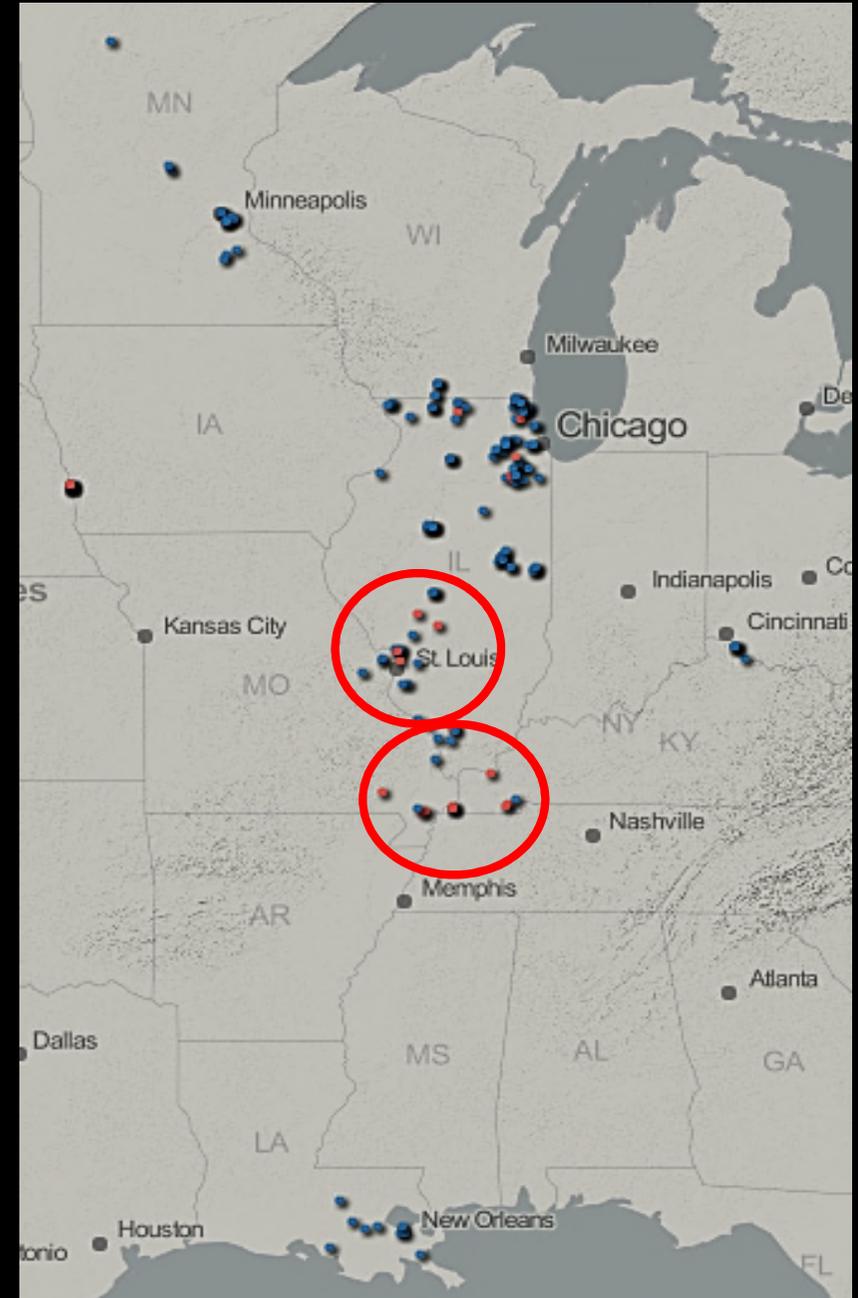
**Central (Ky/Mo)**

**37 45%**

**Lower (Louisiana)**

**9 0%**

**Chi<sup>2</sup> = 31.8, P < 0.00001**



# Partners/ Funding agencies



## Collaborators:

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