Harmful Algal Blooms in Iowa: A Multifaceted Approach to Understanding and Mitigating Risks

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Picture: Lake Darling, August 2022

Agenda

Iowa Healthy Lakes Initiative (IHLI)

Iowa Water Recreation Survey (IWRS)

Hazard Assessment

Recommendations

Iowa Healthy Lakes Initiative (IHLI)

Public Health, Communications, & Community Engagement (PHCE) Working Group

Funded by a Jumpstarting Tomorrow pilot grant from the University of Iowa Office of the Vice President for Research

"A multi-dimensional approach to measuring, informing, and solving Iowa's Harmful Algal Bloom Challenge"

Public Health

- Determine potential recreational exposure to cyanotoxins at select Iowa beaches by determining what cyanotoxins are present, quantifying concentrations, and understanding recreational behaviors.

Communication

- Gauge official and public knowledge of HABS
- Understand how people receive information on HABs
- Learn how they would want to receive information on HABs, if at all

DO YOU RECREATE IN IOWA'S WATERS?

SCAN ME

Or go to
https://redcap.link/IAWaterRecreation

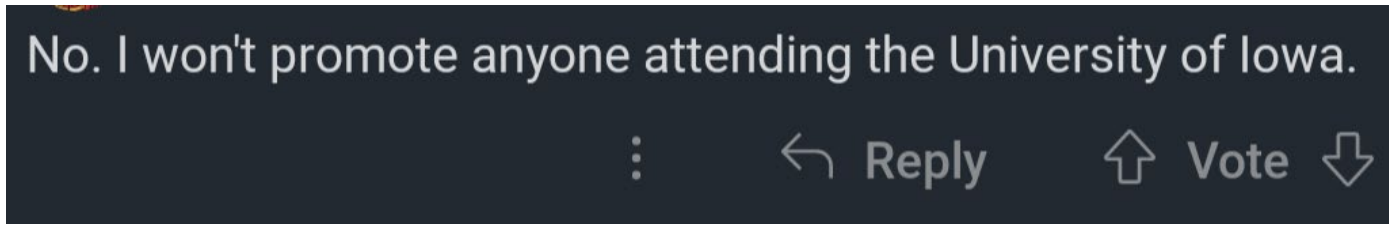
Iowa Water Recreation Survey

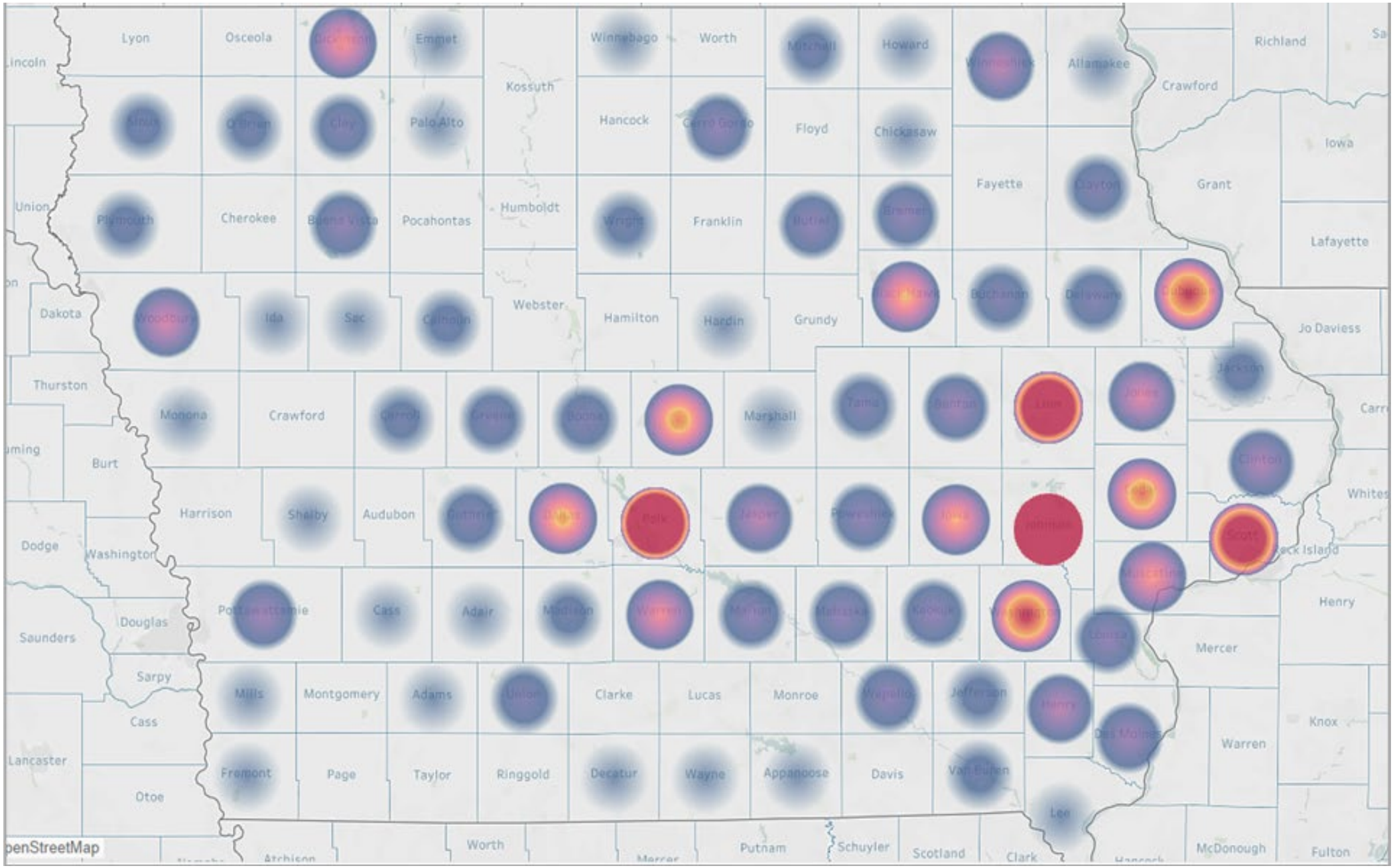
Survey Dissemination (N=1921) IRB #202211042

- Mass e-mail
- Flyers
- Social Media
- Newsletters

Organizations:

- IEC Water Watch
- Iowa Water Center
- ISU Extension Orgs.
- Friends of Lakeside Lab
- Legislators
- Conservation Networks



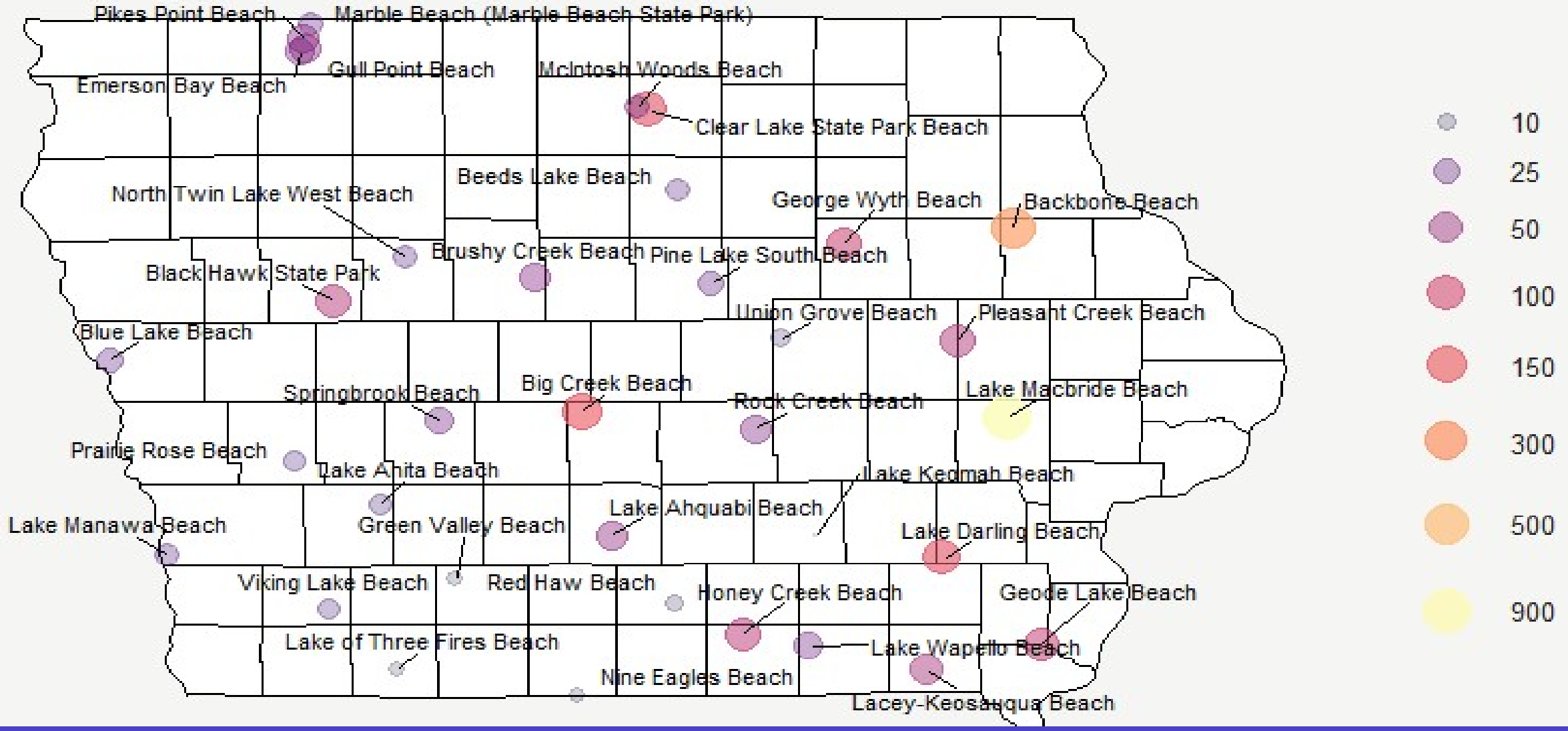


Respondents by County (N = 1800)

Characteristics		n	% (Survey)	% (State of Iowa)	p-value
Race	Asian or Pacific Islander	59	3%	3%	0.534
	Black or African-American	33	2%	4%	**<0.001**
	Hispanic or Latino	76	4%	7%	**<0.001**
	Native American or Indigenous	15	1%	1%	0.259
	White or Caucasian	1603	89%	90%	0.572
	Multi- or Biracial	34	2%	2%	0.413
	A race/ethnicity not listed	11	1%		
	Prefer not to say	53	3%		
Gender	Male	683	38.1%	50.2%	**<0.001**
	Female	1051	58.6%	49.8%	**<0.001**
	Non-binary	23	1.3%		
	Prefer not to say	36	2.0%		
Age	<18	4	0.2%	22.6%	**<0.001**
	18-25	417	23.3%		
	26-34	252	14.1%		
	35-44	349	19.5%		
	45-54	281	15.7%		
	55-64	264	14.7%		
	65+	172	12.6%	18.3%	**<0.001**

Characteristics		n	% (Survey)	% (State of IA)	
Education	Some high school	5	0.3	18	
	High school degree	32	1.8	22.6	
	Technical/Vocational School	40	2.2	7.4	
	Some college	287	16	16.2	
	College degree	630	35	25	
	Some higher education	62	3.5		
	Advanced degree	729	40.7	7.9	
					p-value
Occupation - Top 5	**Healthcare**	237	18	14	0.1096
	Educational Services	182	13.8	10	0.9567
	Life, Physical, & Social Science	123	9.3	4	**<0.001**
	Retired	98	7.4	6	
	Office & Admin. Support	85	6.4	4	**<0.001**

State Park Lake Beaches - Visitation Counts



WHERE are they recreating?

HOW are they recreating?

Recreation Type

- *Wildlife* (11.4%)
  - Viewing
  - Fishing
- ***Non-wildlife*** **(58.2%)**
  - **Swimming (41.2%)**
  - Hiking
  - Dog Walking
  - Kayaking
  - Boating
- ***Both*** **(30%)**

Do you leave IA for water recreation? (n = 1667)

- Yes (36.5%)
- No (34.7%)
- Sometimes (28.9%)

Would you use IA water resources more if there was better WQ? (n = 1478)

- **Yes (79.7%)**
- No (5.8%)
- Unsure (14.5%)

Do you have concerns about the water quality in Iowa?

74.5% said Yes

12.4% were unsure

n = 1,703

WHAT do they know about HAB's?

Have you HEARD of HABs?	• **Yes: 86%** • Unsure: 3%
Do you know what HABs are/what they look like?	• **Yes: 52%** • Unsure: 20%
Have you SEEN a HAB in Iowa?	• **Yes: 50%** • Unsure: 21%
Are you aware of the adverse health effects assoc. with exposure?	• **Yes: 55%** • Unsure:15%

HOW do they know about HAB's? (N = 1667)

Other
(n = 249)

U.S. ACE
(n = 214)

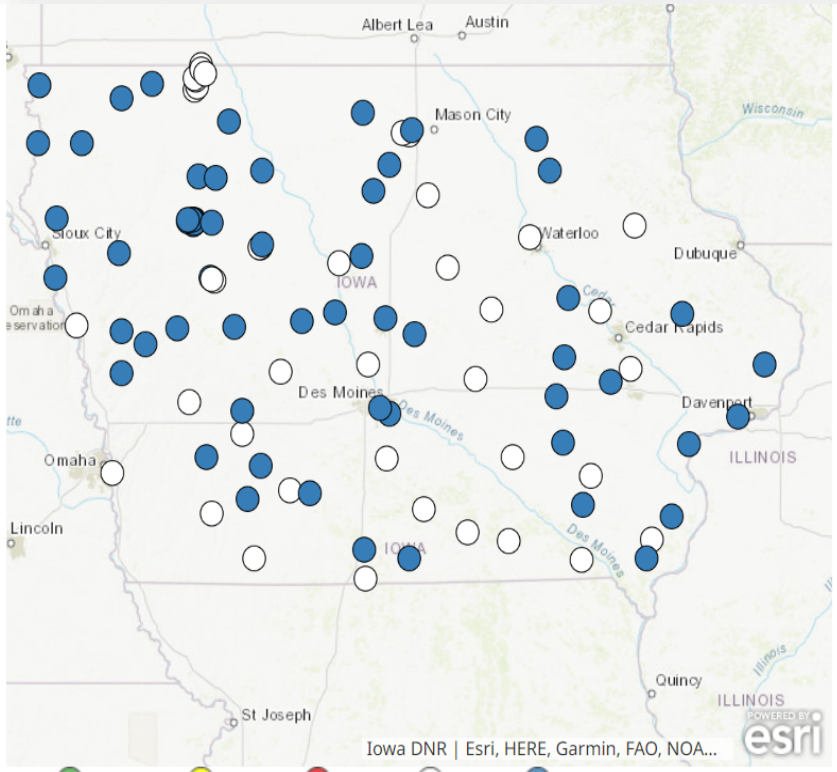
Community Groups
(n = 177)

IEC Water Watch
(n = 166)

Social Media
(n = 683)

None
(n = 442)

IA Dept. of Natural Resources
(n = 694)



DNR Beach Policy

State Standard

The bacteria standard for Iowa's recreational waters consists of two components:

- A geometric mean standard based on 5 samples in a 30-day period (126 colony-forming units of E. coli bacteria per 100 mL of water).
- A one-time maximum standard based on a single sample (235 colony forming units of E. coli bacteria per 100 mL of water).

State advisory threshold for Cyanobacteria Toxins (Blue-Green Algae Toxins)

The Iowa Department of Natural Resources, in partnership with the Iowa Department of Public Health (DPH), follows guidelines recommended by the US EPA in 2019 for monitoring cyanotoxins in recreational waters in order to safeguard public health.

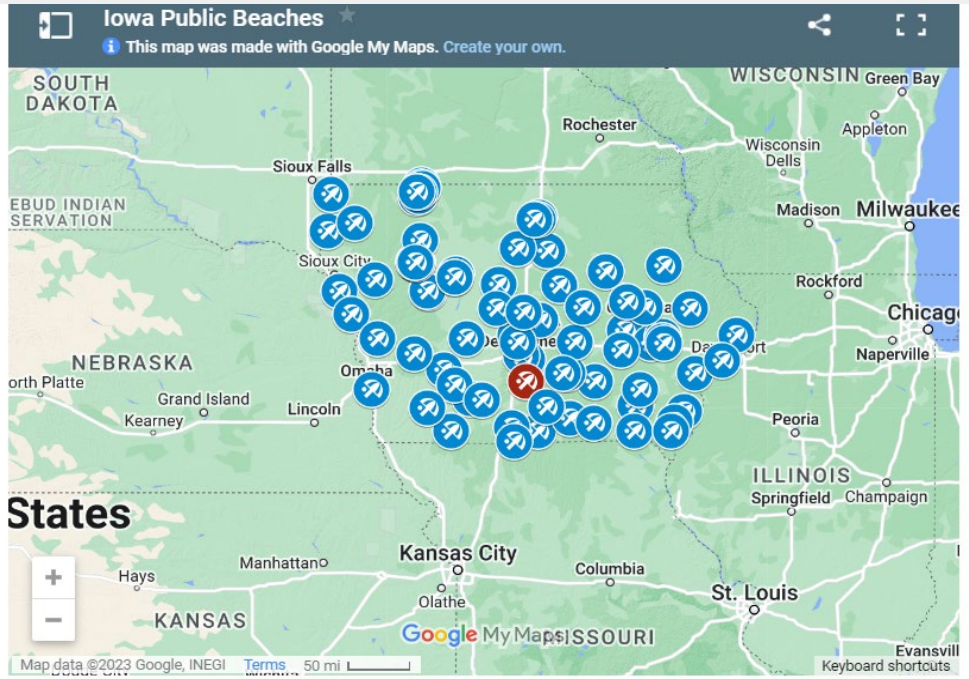
- 8 µg/L total microcystins from any composite beach sample.

Posting of Signs/Advisories

All State monitored beaches are posted with Information Signs on indicator bacteria and blue-green algae toxins that provide general information regarding ways to reduce the potential health risk associated with

DNR Beach Monitoring Site

IOWA DEPARTMENT OF NATURAL RESOURCES



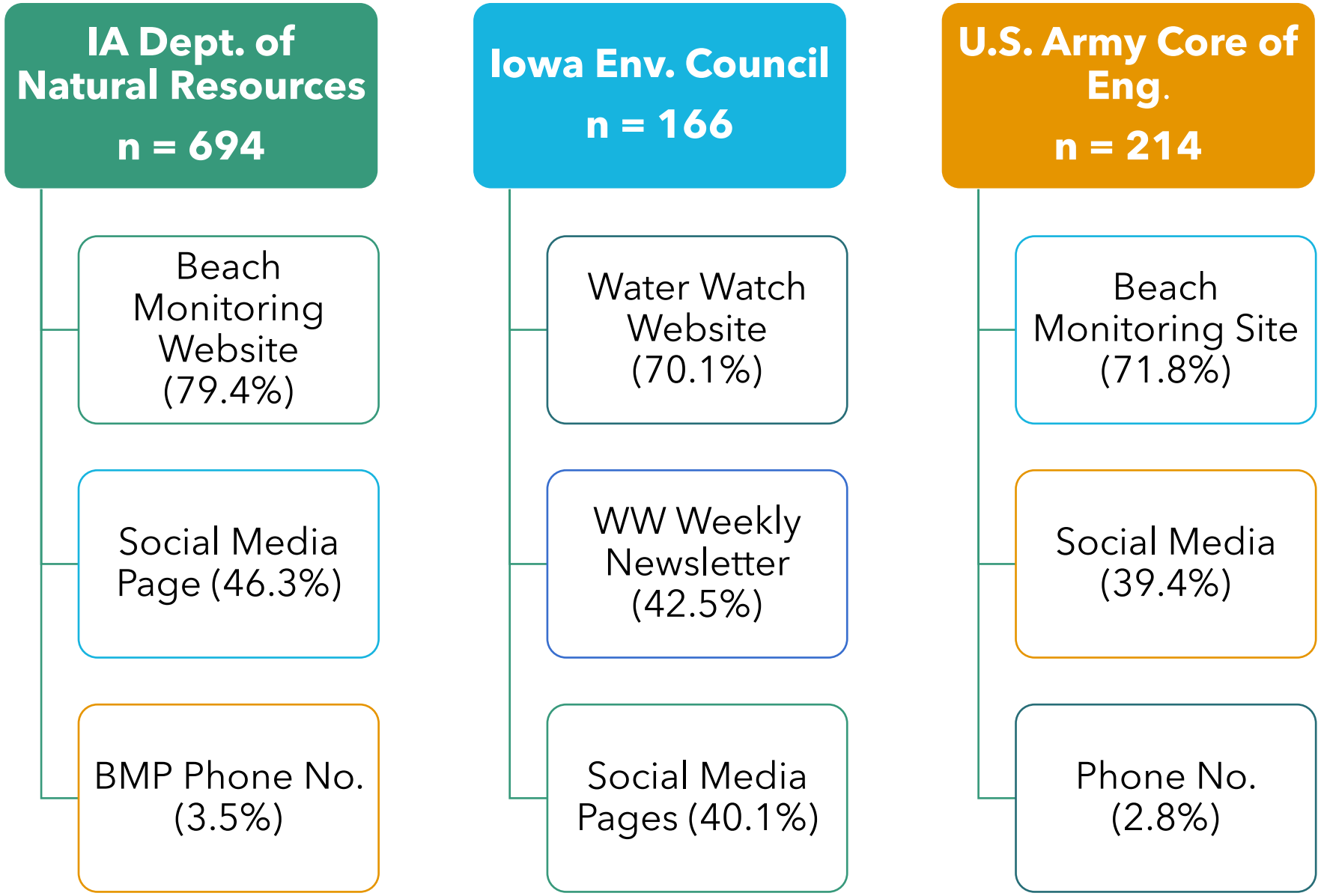
Beaches are updated each Friday with advisories Memorial Day weekend through Labor Day.

- No advisories
- *E. coli* advisory
- Microcystin advisory
- *E. coli* and microcystin advisories
- Exceeds state advisory threshold for *E. coli* (what does this mean?)
- Beach closed

IEC Water Watch Site

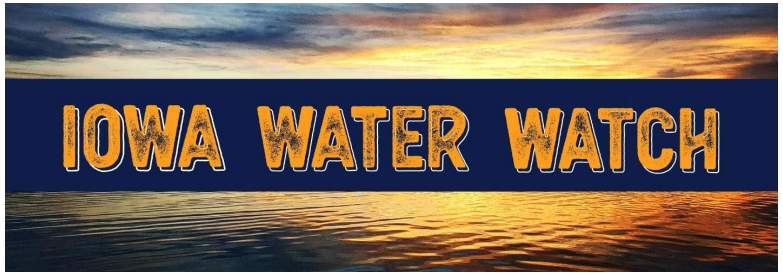
Iowa Environmental Council

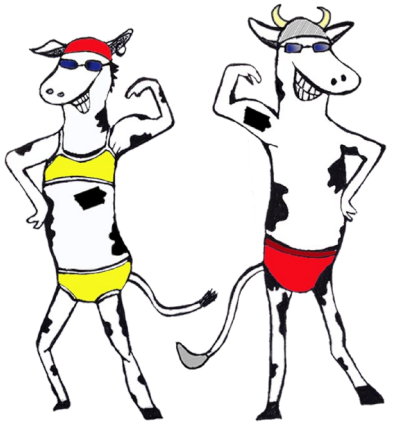
The Big Three



Social Media, Community Orgs., Other

- Facebook
- IDNR, City, County Conservation
- Parents/word of mouth
- Conservation groups, IEC
- Recreational groups/rowing, paddling, or swim clubs





How do they WANT know about HAB's? n = 1,666

Check a Website (1,292)

Call a phone number (71)

Social Media (763)

Newsletter/Weekly E-mail (432)

Physical Postings (792)

Other (60)

Do HABs change the way people recreate?

Would a harmful algal bloom (HAB) advisory determine whether you visit a recreational area of land?

- **Yes** (67.7%)
- Unsure (5.6%)
- Depends (20.1%)

Does a HAB advisory change the way you recreate?

- **Yes** (84.5%)
- Depends (8%)

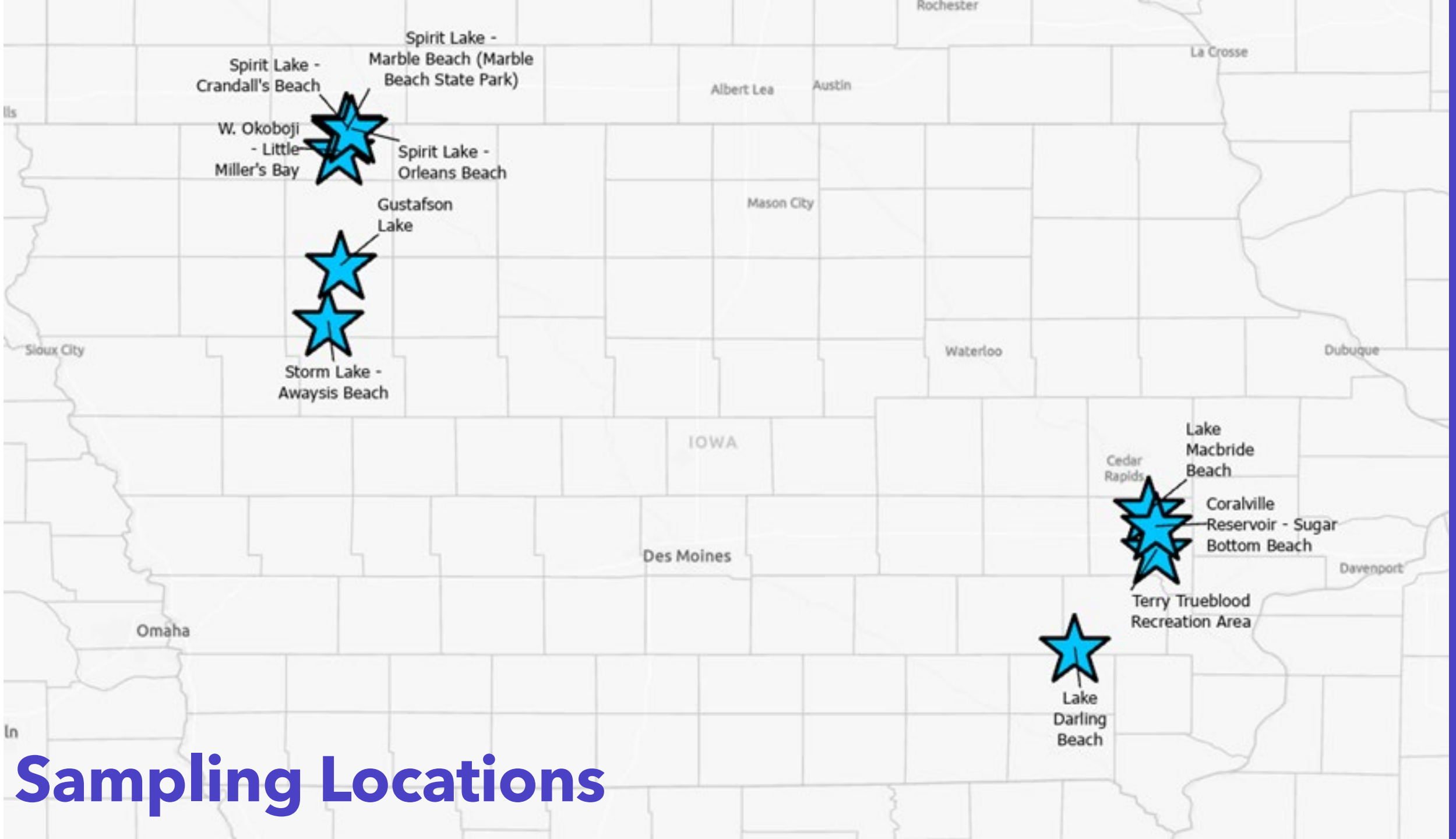
Lake Darling, Aug. 2022

How would an advisory change your behavior?

- **Refrain from swimming** (44.6%)
- Not putting head underwater while swimming (1.7%)
- **Actively avoiding water** (53.7%)

Microcystin, Anatoxin-a, Saxitoxin

Hazard Assessment



Sampling Locations

Water Sampling & ELISA

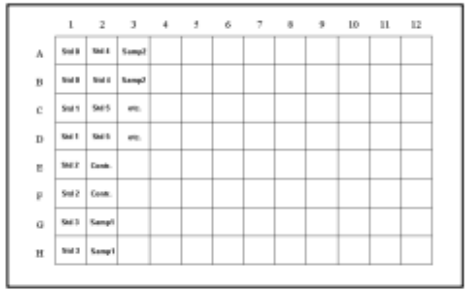
Methods

- PETG plastic sample dipper
- Samples held 250 mL in amber glass jars on ice for transport
- Stored in -20-degree Celsius freezer
- Cell lysing procedure: freeze & thaw
- Filtered with 42.5 mm glass filter
  - 1st filtrate discarded
  - 2nd filtrate used for analysis

F. Working Scheme

The microtiter plate consists of 12 strips of 8 wells, which can be used individually for the test. The standards must be run with each test. Never use the values of standards which have been determined in a test performed previously.

Std 0-Std5: Standards
Contr.: Control
Samp1, Samp2, etc: Samples

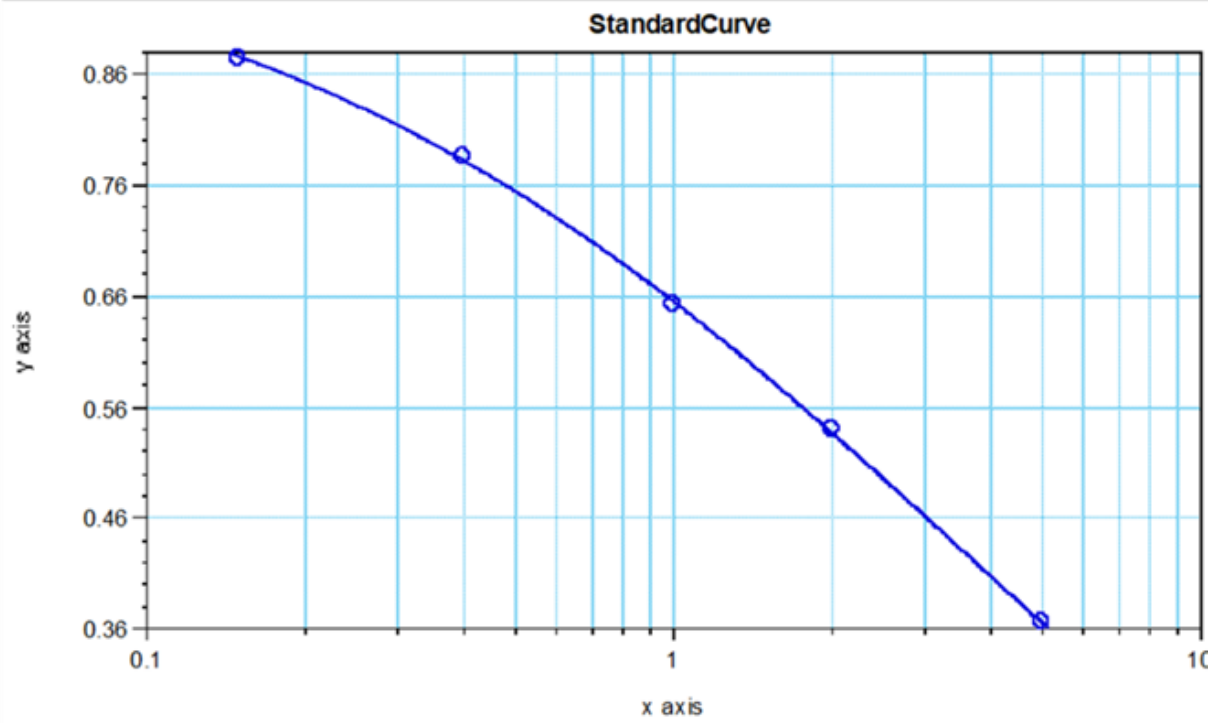


G. Assay Procedure

1. Add **50 µL of the standard solutions, control, or samples** into the wells of the test strips according to the working scheme given. Analysis in duplicate or triplicate is recommended.
2. Add **50 µL of the antibody solution** to the individual wells successively using a multi-channel pipette or a stepping pipette. Cover the wells with parafilm or tape and mix the contents by moving the strip holder in a circular motion on the benchtop for 30 seconds. Be careful not to spill the contents. Incubate the strips for **90 minutes** at room temperature.
3. Remove the covering, decant the contents of the wells into a sink, and blot the inverted plate on a stack of paper towels. Wash the strips **three times** using the diluted wash buffer. Please use at least a volume of **250 µL of 1X wash buffer** for each well and each washing step. ***Blot the inverted plate after each wash step*** on a stack of paper towels. After the last wash/blot, check the wells for any remaining buffer in the wells, and if necessary, remove by additional blotting.
4. Add **100 µL of the enzyme conjugate solution** to the individual wells successively using a multi-channel pipette or a stepping pipette. Cover the wells with parafilm or tape and mix the contents by moving the strip holder in a circular motion on the benchtop for 30 seconds. Be careful not to spill the contents. Incubate the strips for **30 minutes** at room temperature.
5. Remove the covering, decant the contents of the wells into a sink, and blot the inverted plate on a stack of paper towels. Wash the strips **three times** using the diluted wash buffer. Please use at least a volume of **250 µL of 1X wash buffer** for each well and each washing step. ***Blot the inverted plate after each wash step*** on a stack of paper towels. After the last wash/blot, check the wells for any remaining buffer in the wells, and if necessary, remove by additional blotting.
6. Add **100 µL of substrate (color) solution** to the individual wells successively using a multi-channel pipette or a stepping pipette. Cover the wells with parafilm or tape and mix the contents by moving the strip holder in a circular motion on the benchtop for 30 seconds. Be careful not to spill the contents. Incubate the strips for **20-30 minutes** at room temperature. Protect the strips from sunlight.
7. Add **50 µL of stop solution** to the wells in the same sequence as for the substrate (color) solution using a multi-channel pipette or a stepping pipette.
8. Read the absorbance at 450 nm using a microplate ELISA photometer within 15 minutes after the addition of the stopping solution.

LOD: 0.15 µg/L
Advisory issued at: 8 µg/L (IDNR)

Microcystin



R-squared = 1

- **Macbride 4, Angler's Point**: 36.864 µg/L
- **Lake Darling 2**: 35.946 µg/L
- **Lake Darling 1**: 35.406 µg/L

n=	29
Mean	4.93
Median	0.478
Min.	0.0028
Max.	36.864
Range	36.8617
Std. Dev.	11
W-test of log-transformed data	0.979

~13% of the time, exposures will exceed 8 µg/L

Microcystin

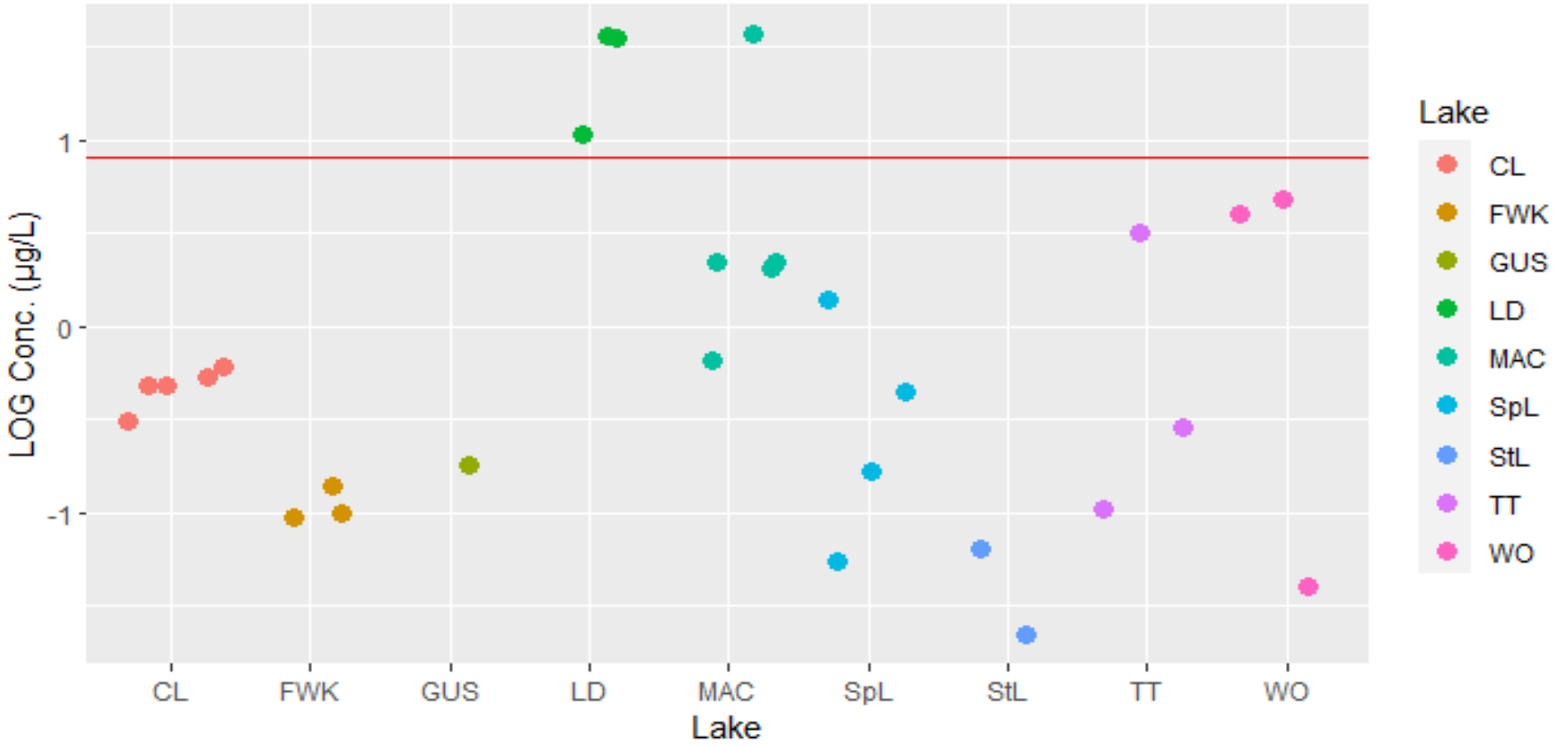


Figure 3.3: MC Log-transformed Conc. (µg/L) by Lake (N = 30)

Microcystin - Region

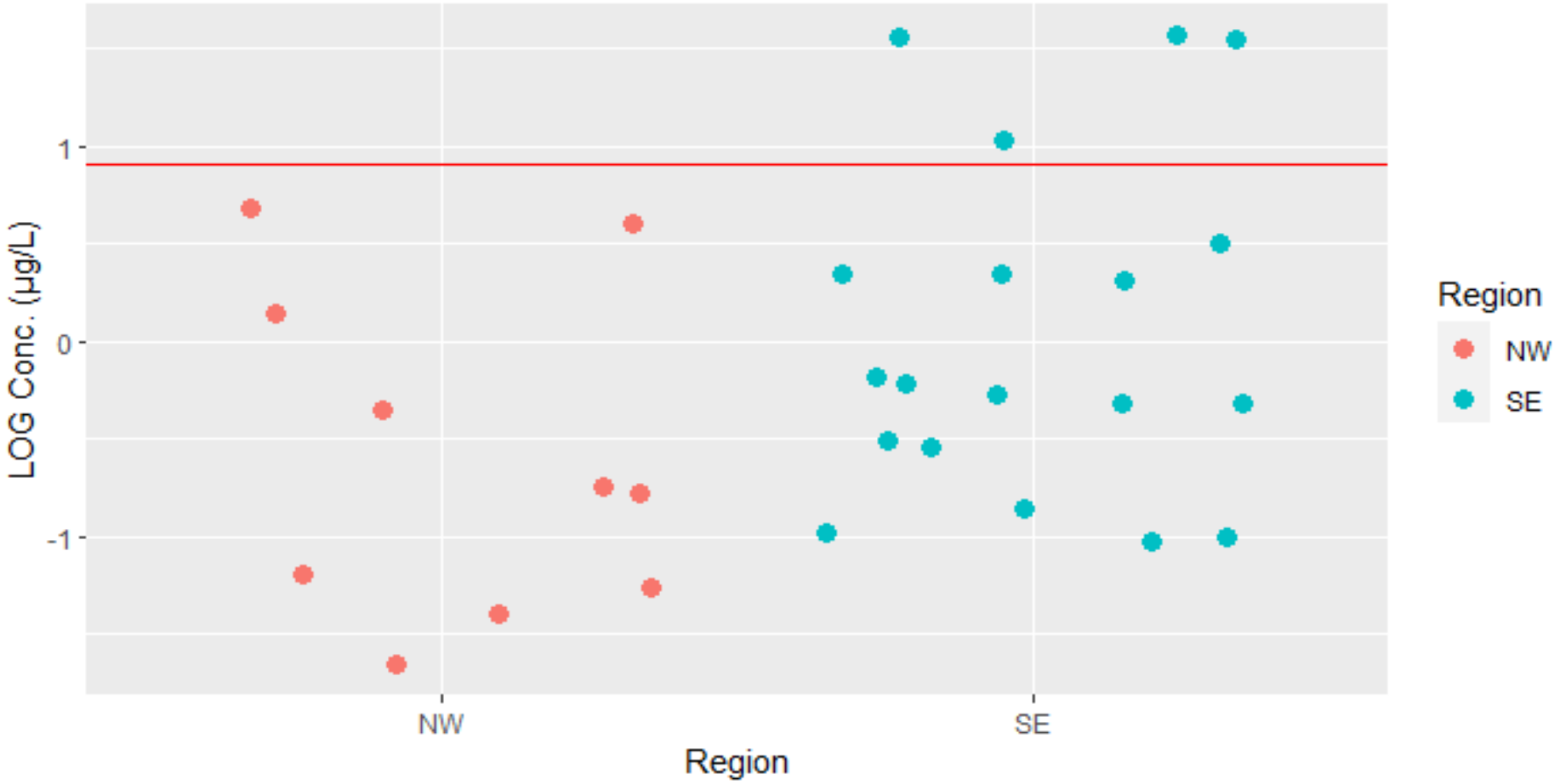
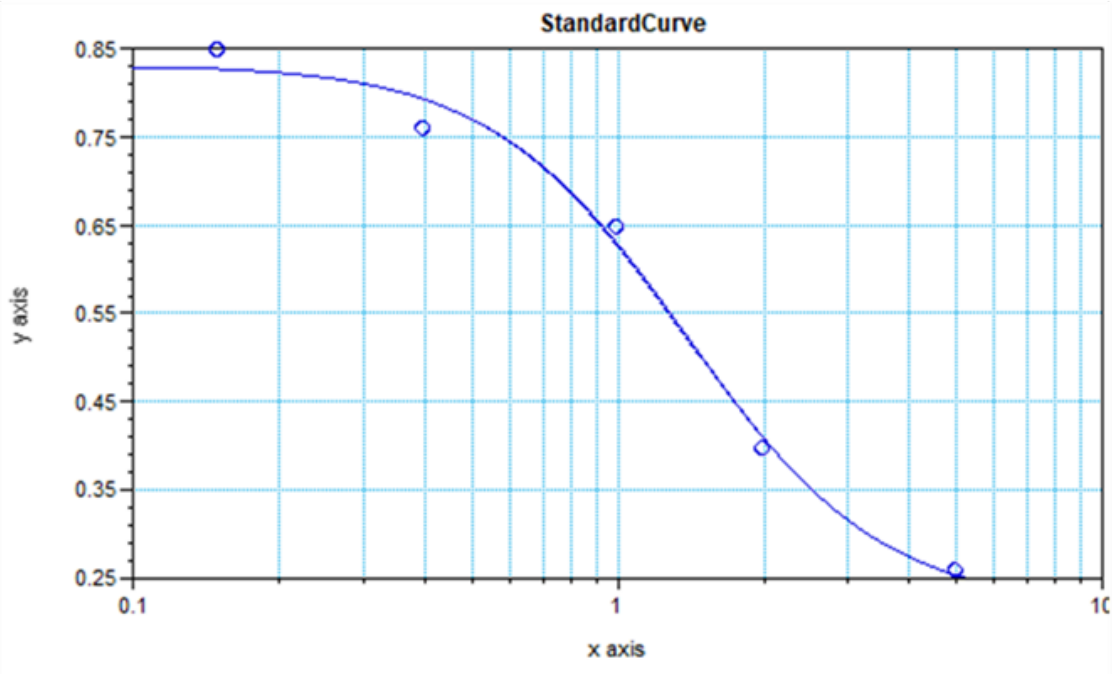


Figure 3.4: MC Log-transformed Conc (µg/L) by Region (N = 30)

Anatoxin-a

LOD: 0.15 µg/L

Advisory issued at: 7 µg/L (MPCA), 1 µg/L (WA DOH)

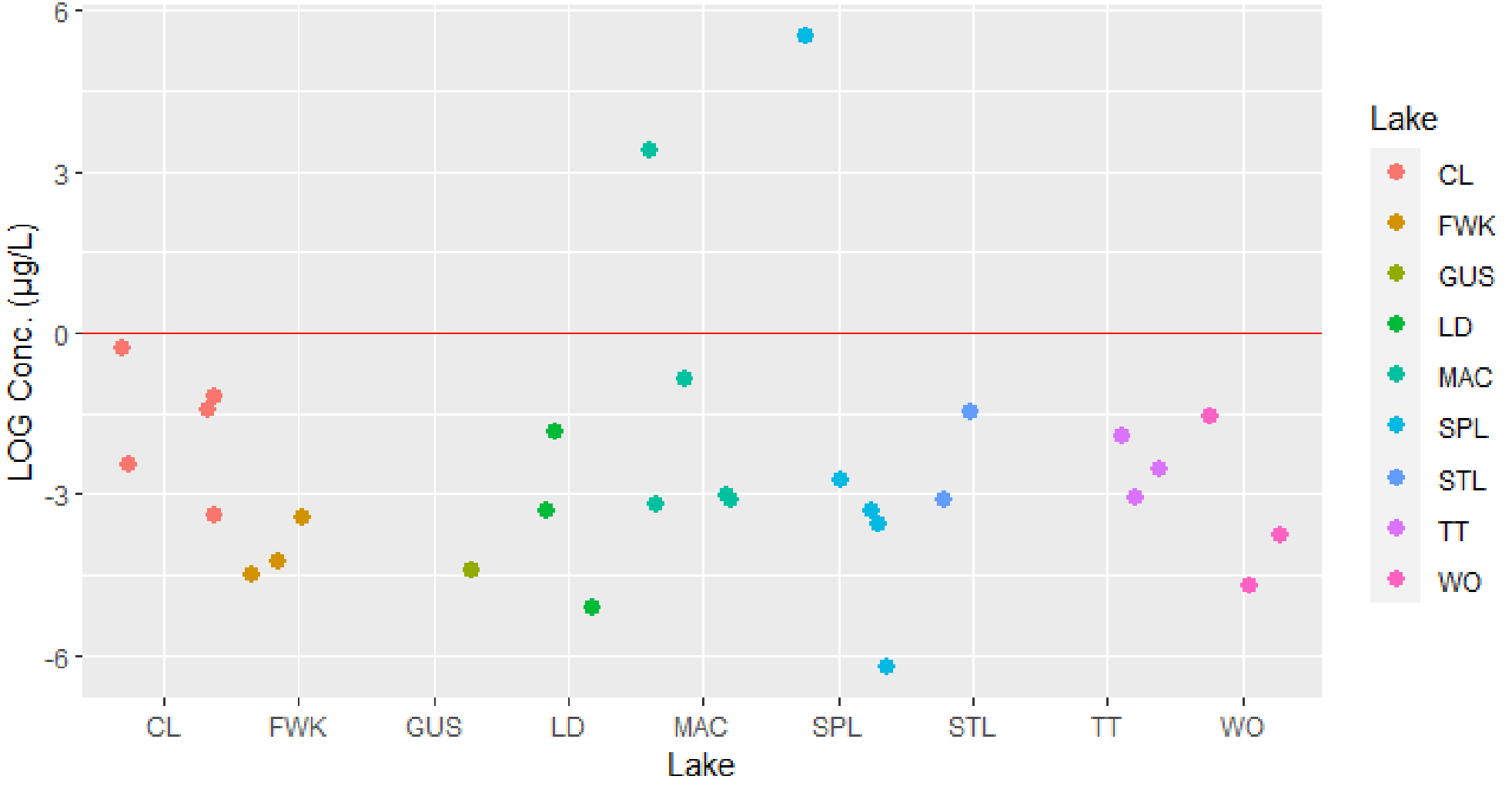


- **Spirit Lake, Marble Beach**: 248.03 µg/L
- **Macbride 4, Angler's Point**: 29.498 µg/L

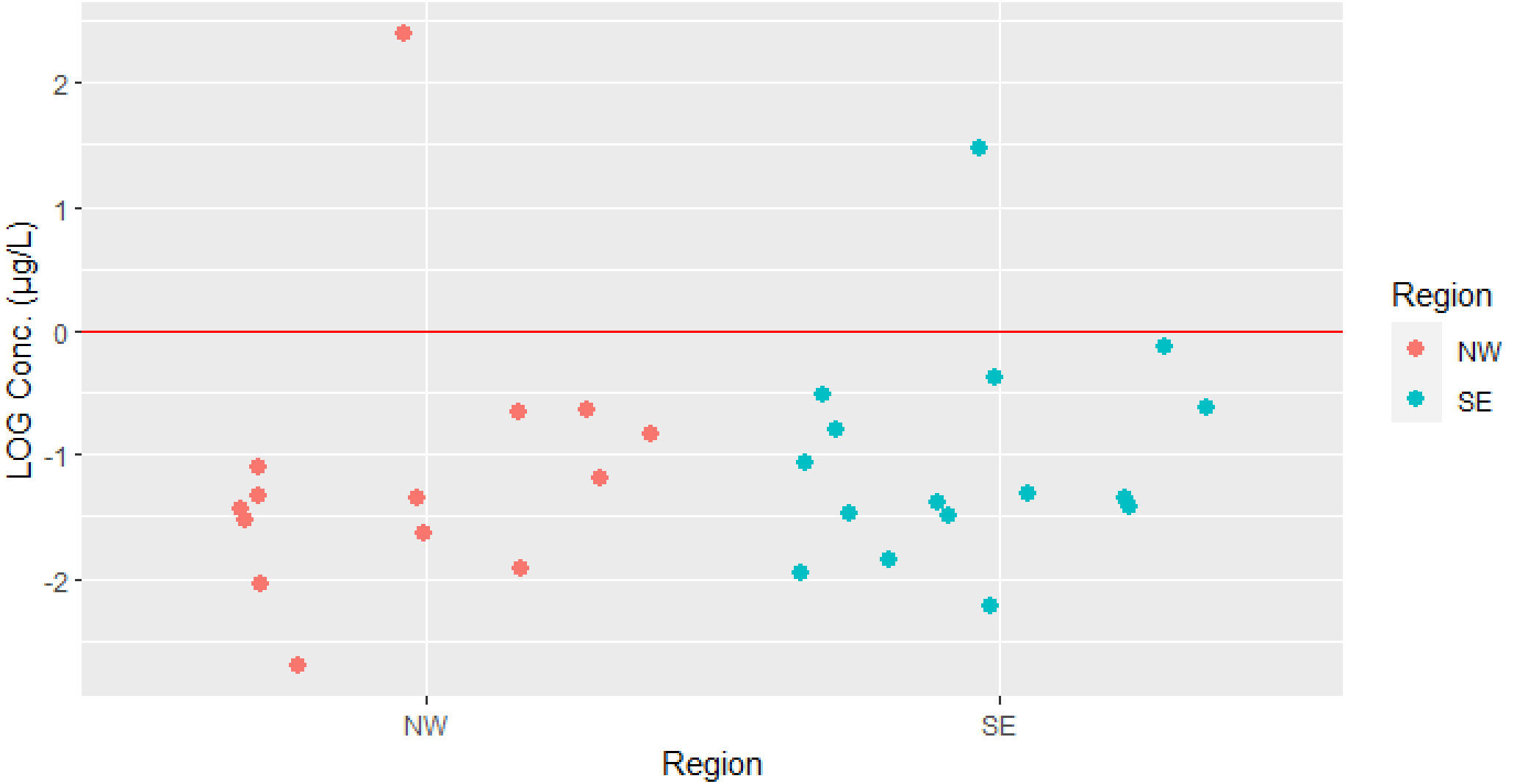
n=	30
Mean	9.34
Median	0.00433
Min.	6.6E-08
Max.	248.03
Range	248.03
Std. Dev.	45.4
W-test of log-transformed data	0.989

~13% of the time, exposures will exceed 8 µ/L

Anatoxin-a


6
3
0
-3
-6
LOG Conc. (µg/L)
CL
FWK
GUS
LD
MAC
SPL
STL
TT
WO
Lake
Lake
CL
FWK
GUS
LD
MAC
SPL
STL
TT
WO

Anatoxin-a



Saxitoxin

LOD: 0.02 µg/L

Advisory Level: 30 µg/L (WHO, using body weight of a child)

Highest Samples

- **Lake Darling 1**: 0.114 µg/L
- **Macbride 4, Angler's Point**: 0.106 µg/L

n=	8
Mean	0.052
Median	0.028
Min.	0.023
Max.	0.114
Range	0.091

No exceedance

Conclusion & Recommendations

- Increased testing suite
- The use or development of a reporting website
- Signage evaluation
- Availability of advisory/recreational information through multiple channels
- Increase in funding/expansion of programs

Limitations

Exposure Assessment

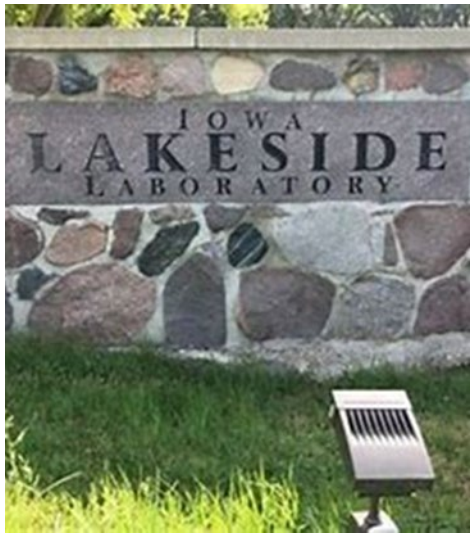
- Toxin selection
- Quality over quantity
- Supply chain issues
- Cost

Survey

- Leading questions
- Ordering of questions
- Clarity

Current Work

- Conducted extended 12-week sampling campaign summer 2023 at the Iowa Lakeside Lab
- ELISA analysis of backlogged CLAMP samples
- Developing HAB-related materials for Dickinson Co. Public Health Dept.



Thanks! Questions?

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Green Iowa Americorps

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