

Reconnaissance of Cyanobacteria and Associated Toxins in Illinois – August-October 2012

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A Little History

2005

- Hot and dry summer
- Problems identified at one lake in mid-July
- By mid-August, Illinois EPA sampled 22 lakes, incidences reported throughout Midwest

2006-2008

- Illinois EPA collected 366 samples
- 50+% detections of microcystin
- Maximum concentration 17.47 $\mu\text{g/L}$; median concentration 0.175 $\mu\text{g/L}$

2010

Scare at public recreational lake (dog death and child illness) – false alarms, low microcystin concentrations in samples

2011

Illinois EPA implemented Abraxis Microcystin Dipstick test kits for waters with suspect algal growth conditions. No alarming incidences.

2012

Another hot and dry summer....

World Health Organization (WHO) guidance values for Recreational Exposure to Microcystins and Cyanobacteria

Relative Probability of Acute health Effects	Microcystin-LR ($\mu\text{g/L}$)	Total Cyanobacterial Cells (cells/ml)
Low	<10	<20,000
Moderate	10-20	20,000-100,000
High	20-2,000	100,000-10,000,000
Very High	>2,000	>10,000,000

Back to 2012...

July

Illinois EPA noticed suspect conditions at a number of Ambient Lake Monitoring Program lakes

- Field test kits indicated microcystin >10 µg/L.

Samples sent to USGS Organic Geochemistry Research Lab in Kansas for ELISA analyses

- Results: 48 µg/L (new state record)....
- Other analyses then reported 14,800 µg/L.....then 31,500 µg/L!
(Recall that >20 µg/L is considered a high probability of acute health effects)

USGS Illinois Water Science Center becomes involved

2012 Investigations

10 lakes and 2 rivers sampled late August and late October

- Collected in lakes where algal blooms were reported or where blooms were known to have occurred in the past
- Collected near the shoreline or from a dock in areas of observed algal accumulation

Samples analyzed at the OGRL

- ELISA analysis for microcystin, cylindrospermopsin, saxitoxin
- LC-MS/MS analysis for additional toxins and other forms of microcystin

Samples analyzed for species identification and cell enumeration at GreenWater Labs.

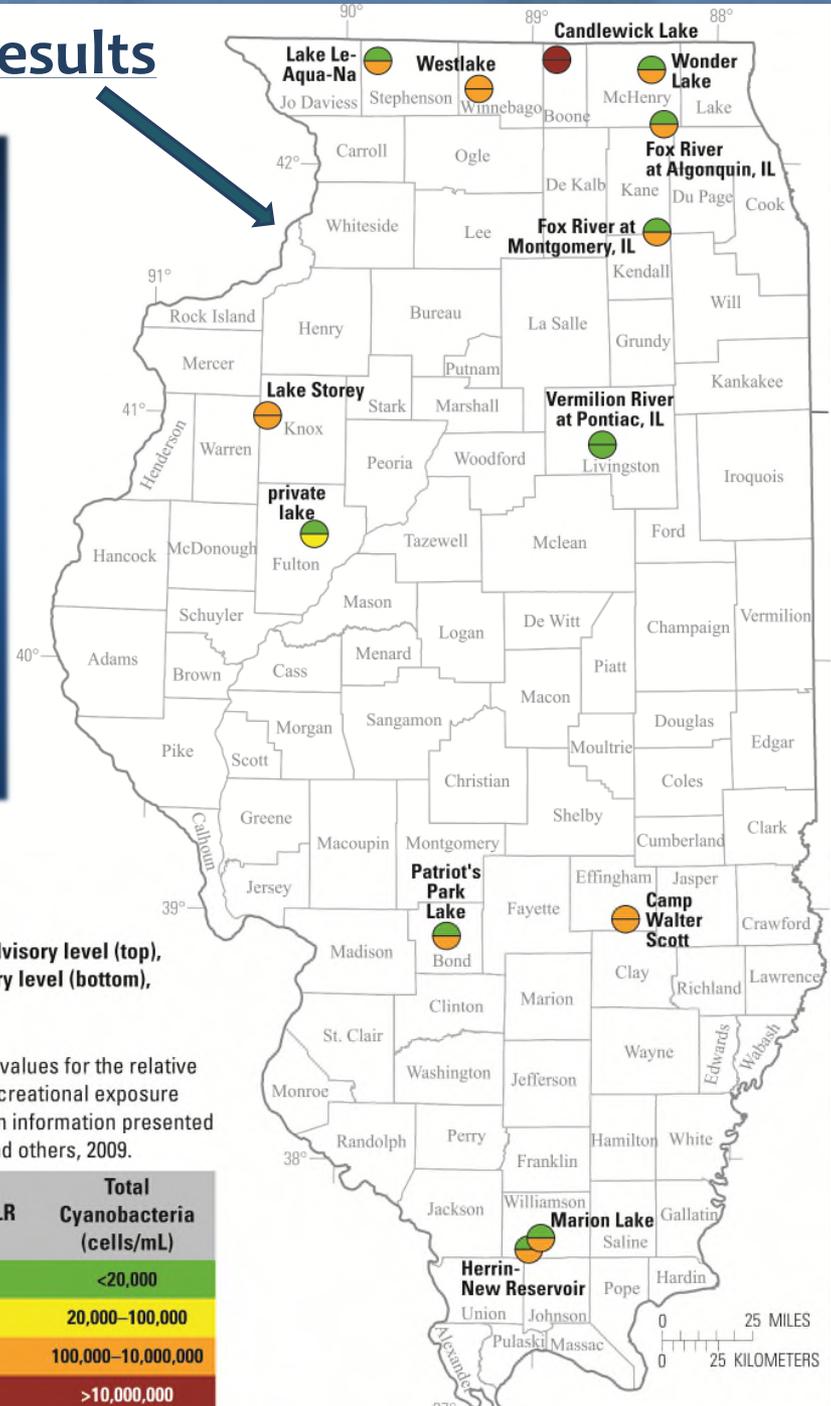
August 2012 Results

August 2012

- 4 of 13 water bodies were high/very high for microcystin
- 10 of 13 water bodies high/very high for cyanobacterial cell count

October 2012

- Microcystin concentrations had decreased substantially
- Cyanobacterial cell counts were still high



EXPLANATION

 **Marion Lake** Site with Microcystin-LR advisory level (top), Total Cyanobacteria advisory level (bottom), and name

World Health Organization (WHO) guidance values for the relative probability of acute health effects during recreational exposure to microcystins and cyanobacteria, based on information presented in Chorus and Bartram, 1999, and Graham and others, 2009.

Relative Probability of Acute Health Effects (Advisory Level)	Microcystin-LR (ug/L)	Total Cyanobacteria (cells/mL)
Low	<10	<20,000
Moderate	10–20	20,000–100,000
High	20–2,000	100,000–10,000,000
Very High	>2,000	>10,000,000

USGS Open-File Report 2013-1019

Fall 2012

- 4 of 13 water bodies were high/very high for microcystin
- 10 of 13 water bodies high/very high for cyanobacterial cell count
- Virtually no “moderate” level results
- No high cylindrospermopsin or saxitoxin results

Site Location	Date	Microcystin ADDA ELISA (ug/L)	WHO Human Health Recreational Advisory for Microcystin concentration	Total Cyanobacteria (cells /ml)	WHO Human Health Recreational Advisory for Cyanobacterial cell counts
Camp Walter Scott Lake	9/4/2012	1500	High	3,528,833	High
Wonderlake site 1	9/4/2012	0.88	Low	467,627	High
Wonderlake site 2	9/4/2012	0.56	Low		
Wonderlake site 3	9/4/2012	0.93	Low		
Fox River at Algonquin, IL - LB	8/30/2012	1.4	Low	2,205,706	High
Fox River at Algonquin, IL - RB	8/30/2012	1.1	Low		
Candlewick Lake *- boat launch	8/29/2012	4800	Very High	84,573,082	Very High
Westlake* - beach	8/29/2012	62	High		
West Lake - bay	8/29/2012	1700	High	302,526	High
Lake Le-Aqua-Na	8/29/2012	6.7	Low	1,178,963	High
Herrin New Lake	8/29/2012	0.23	Low	185,787	High
Patriots Park Lake	8/30/2012	9.8	Low	572,012	High
Marion Lake	8/29/2012	< 0.10	Low	240,370	High
Vermilion River at Pontiac, IL	8/29/2012	< 0.10	Low	11,051	Low
Vermilion River at Pontiac, IL	8/29/2012	< 0.10	Low		
Fox River at Montgomery, IL	8/30/2012	0.95	Low	2,030,414	High
Fox River at Montgomery, IL	8/30/2012	0.62	Low		
Fox River at Montgomery, IL	8/30/2012	0.17	Low		
Old Man's Lake	8/29/2012	0.13	Low	70,869	Moderate
Lake Storey	8/30/2012	20.15	High	472,258	High

*Candlewick = 14,800 ug/L, Westlake = 31,500 ug/L in earlier independent analyses

Samples with at High or Very High concentrations or counts (Microcystin ruled in 2012)

Site Location	WHO Advisory Microcystin	WHO Advisory Cyanobacteria Cells	Number of toxins Detected	Cylindro spermopsin ELISA	Saxitoxin ELISA	Anatoxin	Homoana toxin	Lyngbya toxin	Nodularin	Various Microcystin Toxins										
										A	B	C	D	E	F	G	H	I	J	K
Camp Walter Scott Lake (Beach)	High	High	6	0.03	<	<	<	<	<	0.5	<	> 400	<	0.9	48	<	<	0.28	<	<
Camp Walter Scott Lake (Beach)	High	High	8	<	<	<	<	<	<	0.2	<	45	<	0.80	14	<	0.6	38	0.3	2.2
Wonderlake RTZC-97	Low	High	1	<	<	<	<	<	<	<	<	<	<	<	0.13	<	<	<	<	<
DT-06 Fox River at Algonquin, IL	Low	High	0	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
DT-06 Fox River at Algonquin, IL	Low	High	0	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
RPV-99 Candlewick Lake	Very High	Very High	12	0.04	<	<	<	<	<	4.2	0.2	1.7	3.0	3.1	110	18	1.4	190	0.9	1.4
RPV-99 Candlewick Lake	High	High	4	<	<	<	<	<	<	<	<	<	<	<	0.56	0.1	<	0.56	<	0.1
RPZK-98 West Lake	High	High	10	<	<	<	<	<	<	7.2	0.3	> 400	<	5.5	> 400	0.3	3.1	> 400	53	4.6
RPA-99 Lake LE-AQUA-NA	Low	High	2	<	<	<	<	<	<	<	<	<	<	<	0.18	<	<	0.95	<	<
RNZC-99 Herrin New Lake	Low	High	1	0.02	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
ROY-99 Patriots Park Lake	Low	High	5	<	<	<	2.5	<	<	0.6	<	<	<	1.1	49	<	<	0.81	<	<
RNL-99 Marion Lake	Low	High	0	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
DT-38 Fox River at Montgomery, IL	Low	High	3	<	<	0.28	<	<	<	<	<	<	<	<	0.36	<	<	0.32	<	<
Lake Storey	High	High	5	<	<	0.16	<	<	<	<	<	12	<	<	0.78	<	<	2.6	<	0.2

Lake Le-Aqua-Na

- Illinois Department of Natural Resources owned/managed
- 43 acres / 2,348 acre watershed
- Constructed 1956
- Past history of algal growth
- Recipient of Federal Clean Lakes Program project ('84-'86)
 - ✓ Aeration
 - ✓ Macrophyte control
 - ✓ Shoreline erosion control
 - ✓ Watershed management
 - ✓ Monitoring



Lake Le-Aqua-Na

2012

- July 10 – bad smell, algal bloom visually evident, sample collected
- closed to public use July 11, 2012
- July 10 sample results (OGRL) = 48 $\mu\text{g/L}$ microcystin
(State record; “one of highest results seen in 2012 thus far”)
- August 8 – samples collected by Illinois EPA, 0-1 $\mu\text{g/L}$ microcystin
- August 29 – additional samples collected (<10 $\mu\text{g/L}$)

***Lake Le-Aqua-Na, Wednesday,
August 29, 2012***



Photo by Illinois EPA

N 42°25'12.55
W 89°49'39.54

Lake Le-Aqua-Na September 2013



Site Location	Microcystin in $\mu\text{g/L}$	Cylindrospermopsin in $\mu\text{g/L}$	Saxitoxin in $\mu\text{g/L}$
Lake Le-Aqua-Na Boat Ramp	<0.10	<0.05	0.29
Lake Le-Aqua-Na Mid-Lake	0.75	<0.05	0.59
Lake Le-Aqua-Na Swim Beach	<0.10	<0.05	0.84



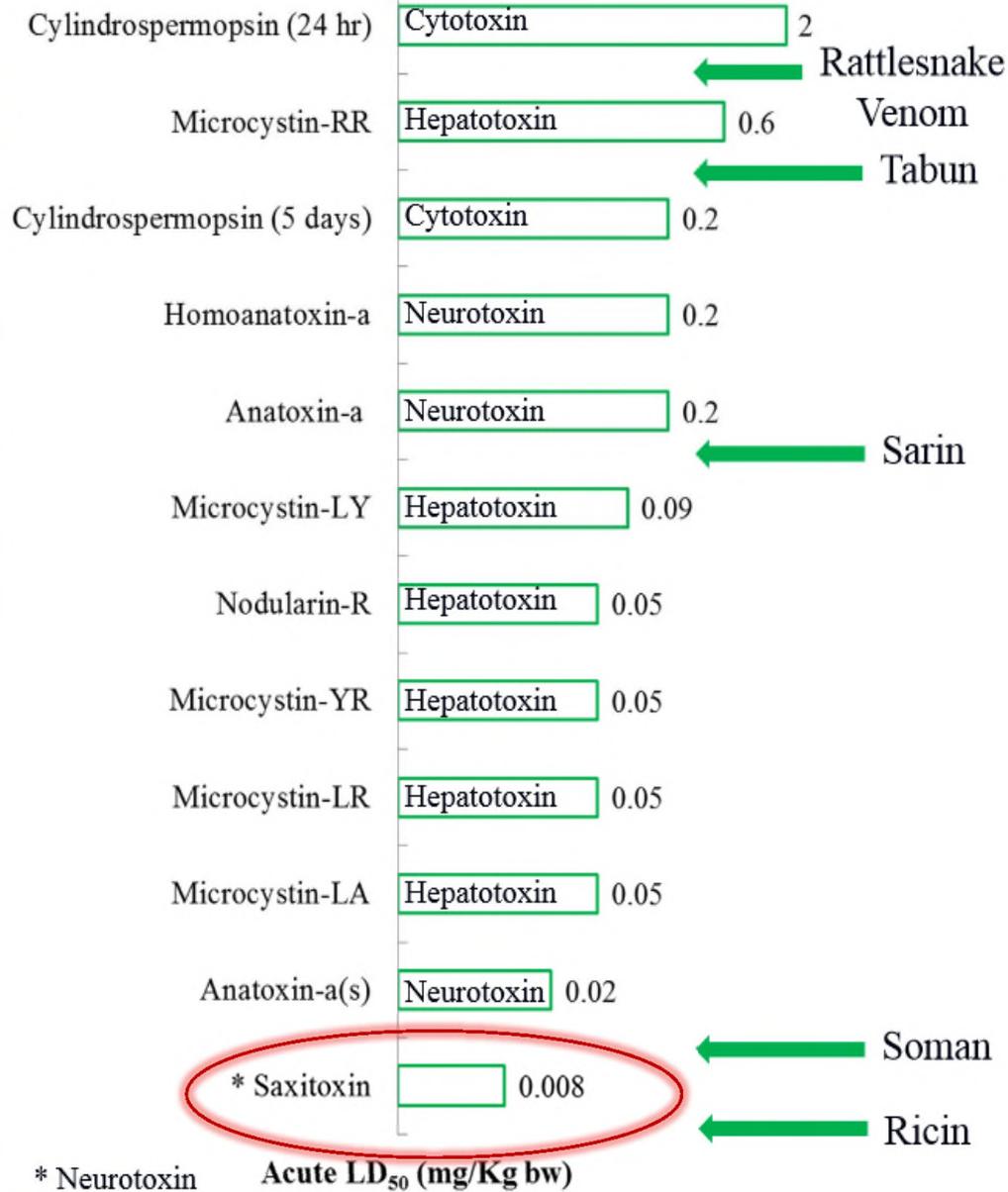
Toxicity of Known Cyanotoxins

Acute Toxicity

- Cytotoxic
- Neurotoxic
- Hepatotoxic
- Dermatotoxic
- Respiratory Distress

Chronic Toxicity

- Carcinogen
- Tumor Promotion
- Mutagen
- Teratogen
- Embryoletality



Conclusions

- HAB monitoring and response program in Illinois is developing
- Hard to predict when toxins are present, even when physical evidence would seem to indicate it is likely
- Is routine screening for less common toxins warranted?
- Would sure be nice to know when / why toxins are produced and released.

- Agency Links
- Air
- Land
- Water
- Offices & Projects »
- About the IEPA »
- Site Fact Sheets
- Calendar of Events
- Statutes & Rules
- Forms & Publications »
- Vehicle Testing
- Internships »
- Kids & Education
- USEPA's TRI
- FOIA Requests
- Right-to-Know
- Recycling
- Contact IEPA
- Quick Answer Directory
- Info Centers
- Agriculture
- Citizens
- Local Government
- Permits
- Program Fees
- Small Business
- State Links
- Search
- Go
- Illinois EPA
- All Illinois Gov't
- To report environmental emergencies only, call the Illinois Emergency Management Agency
- 800-782-7860
- 217-782-7860
- (24 hrs/day)
- Notice of Nondiscrimination
- Notificación Sobre Actos Discriminatorios
- Inspector General
- Agencies Boards and Commissions
- Illinois Legislature

[Bureau of Water](#)

Harmful Algal Blooms (HABs) and Algal Toxins

What are Blue-Green Algae?

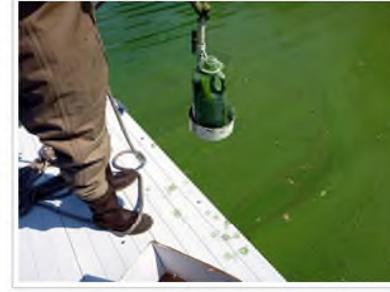
Blue-green algae are microscopic organisms that occur naturally in Illinois lakes and streams. Despite their name, blue-green algae are actually types of bacteria known as cyanobacteria. When certain conditions are present, such as high nutrient and light levels, these organisms can reproduce rapidly. This dense growth of algae is called a "bloom." Blue-green algal blooms can discolor the water or produce floating scums on the surface of the water, especially along shorelines. While blooms can occur at any time of year, they are primarily a concern during the summer months because that is when people are likely to come in contact with them.

What are Harmful Algal Blooms?

While most blue-green algal blooms are not harmful, some can be. Under certain conditions that are not well understood, some blue-green algae are capable of producing algal toxins that could pose a health risk or harm people and animals when exposed to them in large enough quantities (Harmful Algal Blooms, or "HABs").

Is there a Concern about Algal Toxins in Illinois?

Yes. While there are many different known algal toxins, the most common one found in Illinois is called microcystin, a known liver-damaging toxin. Adverse health effects could occur when waters exhibiting a blue-green algal bloom are swallowed, come in contact with skin, or when airborne droplets containing toxins are inhaled while swimming, boating, waterskiing, tubing, bathing or showering. Pets are also at risk when allowed to drink or swim in surface water containing a blue-green algal bloom. Health effects can include asthma-like symptoms, abdominal pain, vomiting, diarrhea, rashes, or nervous system effects depending on the exposure level and type of toxin present in the water.



Monitoring conducted by the Illinois Environmental Protection Agency (Illinois EPA) from 2005-2008 showed that microcystin was frequently detected in Illinois lakes and streams (50.5% of the samples collected), but concentrations were generally below levels of concern. Unfortunately, monitoring conducted during the 2012 summer drought revealed a different story. (See "[2012 Drought and HAB Reconnaissance Monitoring Effort](#)")

What should I do if I see a bloom?

People should use common sense when dealing with algae. It is impossible to tell from a visual inspection whether an algal bloom is toxic. The safest thing to do is to treat every algal bloom as if it could be dangerous.

People	Pets
Do not swim or wade through algal scums.	Do not let dogs drink lake water during an algal bloom.
Do not boat, water ski or jet ski through algal blooms.	Do not let dogs eat algal scum, or lick it off their fur.
Do not fish from lakes where algal scum is present.	Wash your dog off with clean water immediately if your dog swims or wades in water during an algal bloom.
Always shower off with soap and water after swimming in a lake.	

- Harmful Algal Bloom Menu
- Harmful Algal Blooms (HABs) and Algal Toxins
- Identifying and Reporting Harmful Algal Blooms (HABs) in Illinois
- Harmful Algal Bloom Report Form
- 2012 Drought and HAB Reconnaissance Monitoring Effort
- Working Together Toward a Statewide Harmful Algal Bloom Program in Illinois
- Statewide Harmful Algal Bloom Program Initiated in 2013
- Links to Other Resources
- Contact Information For Further Assistance