



National Monitoring Conference

April 30, 2014



Harmful Algal Bloom Monitoring by Citizen Scientists to Protect Human Health and Strengthen Stewardship.

Dana Oleskiewicz, Ohio Lake Management Society

Robert D. Davic, Ohio State University

John R. Beaver and Erin Manis, BSA Environmental Services



Citizen Lake Awareness and Monitoring

- Nutrients accumulate in lakes
- Increase in nutrients (eutrophy) = low water quality
- In-lake management strategies = expensive
- IJC – 15 Recommendations for nutrient NPS loading
 - Focus on effective BMPs (voluntary, so **education**)
 - Establish **monitoring** network
- OLMS / CLAM = **education and monitoring!**

“A Balance Diet for Lake Erie: Reducing Phosphorus Loadings and Harmful Algal Blooms”, International Joint Commission, February 2014 (www.ijc.org)

Citizen Science

- 1900 - Christmas Bird Count
- a.k.a. 'volunteer monitoring'
- Definition - Public participation in scientific research
- Cost effective means of gathering information
- Data presented in peer reviewed journals
- Increase in numbers, credibility, and acceptance
- **Today**- nonscientists engaged in public policy decisions



Dick Zimmerman, Leesville Lake, 2010

Citizen Scientists

- Enhanced datasets
- Reliable and engaged
- Baseline and long-term
- Local and immediate
- Leads to Action



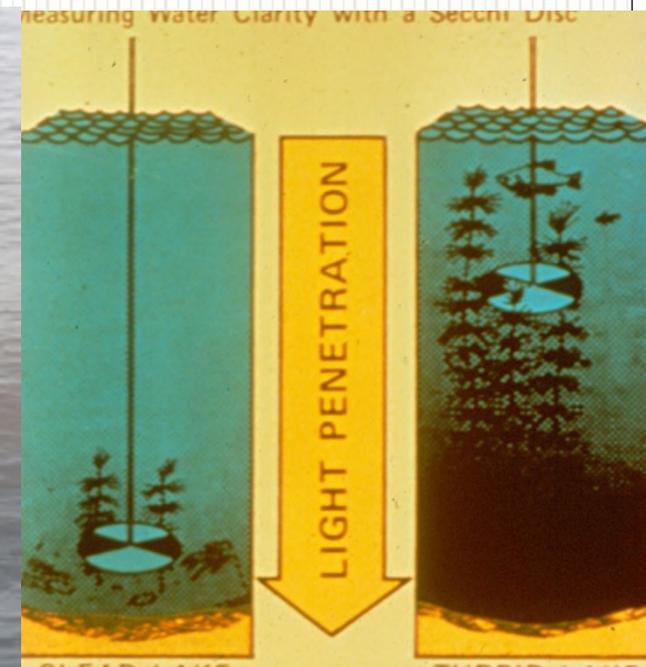
Portage Lakes CLAM Training, 2010.

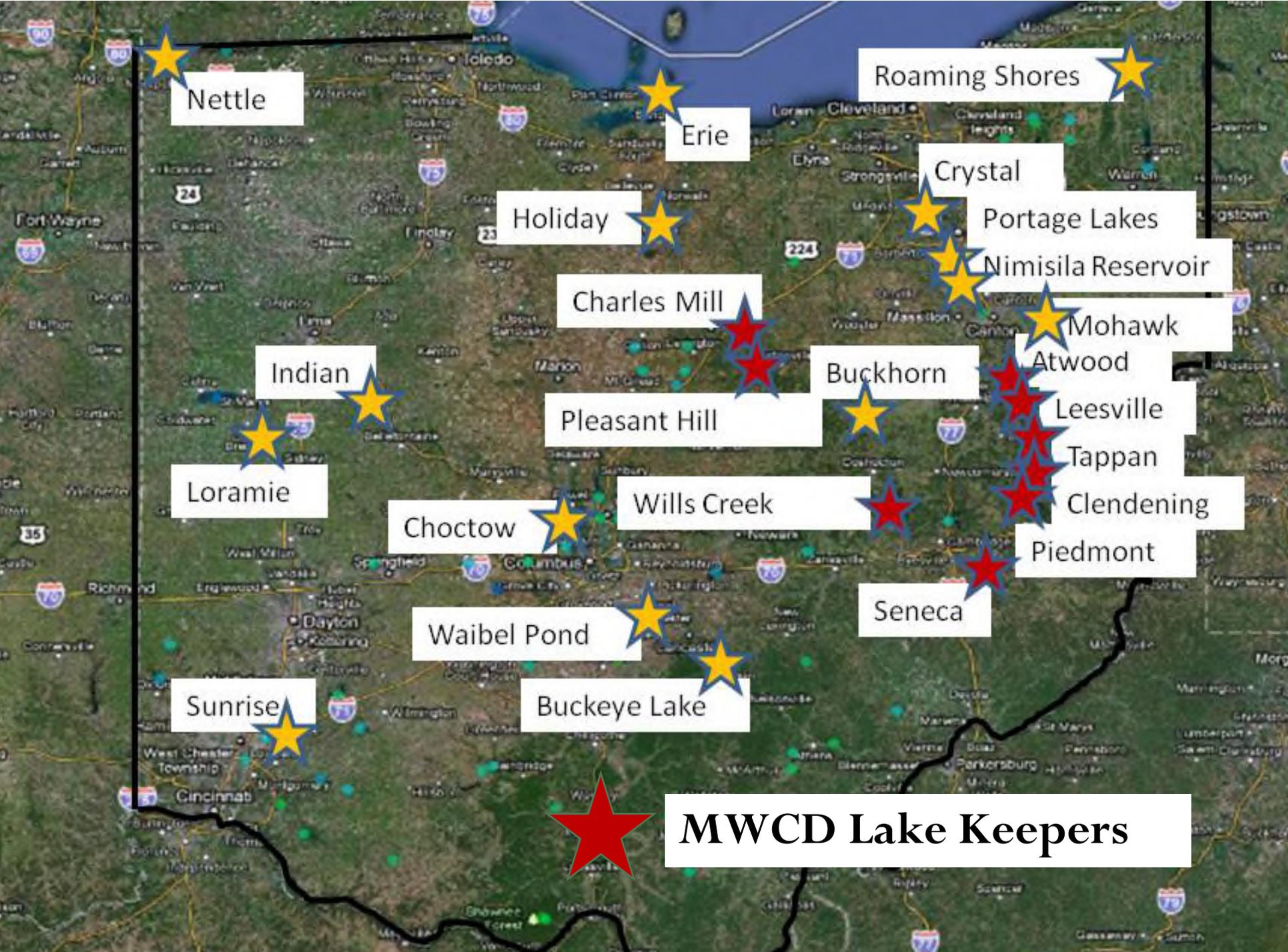
Photo by Lew Stamp: LewStampPhotography.com

Training Citizen Scientists since 1991.....



Citizen Lake Awareness and Monitoring





Nettle

Erie

Roaming Shores

Holiday

Crystal

Portage Lakes

Nimisila Reservoir

Charles Mill

Mohawk

Indian

Buckhorn

Atwood

Pleasant Hill

Leesville

Loramie

Wills Creek

Tappan

Choctow

Clendening

Piedmont

Waibel Pond

Seneca

Sunrise

Buckeye Lake

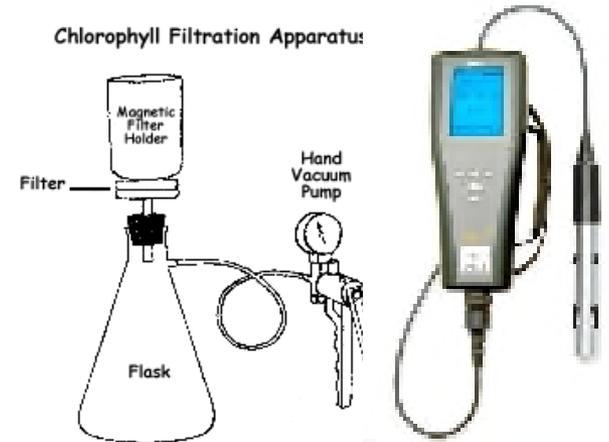
MWCD Lake Keepers

CLAM Parameters in QDC Program

Level 2 data



- Transparency
- Water temperature
- Water color
- Quality and lake use



Level 3 data

- Temp. / DO profiles
- Total nutrients
- Total suspended solids
- Chlorophyll *a*



www.eyesonthewater.org/olms



Ohio Lake
Management Society



11 November 2010

Lake Summary			Charles Mill Reservoir				ID:	210	
YEAR	SITE	Volunteer	Samples	SECCHI			Water Depth (FT)	Water Color	Water Temp.
				Avg	Min	Max			

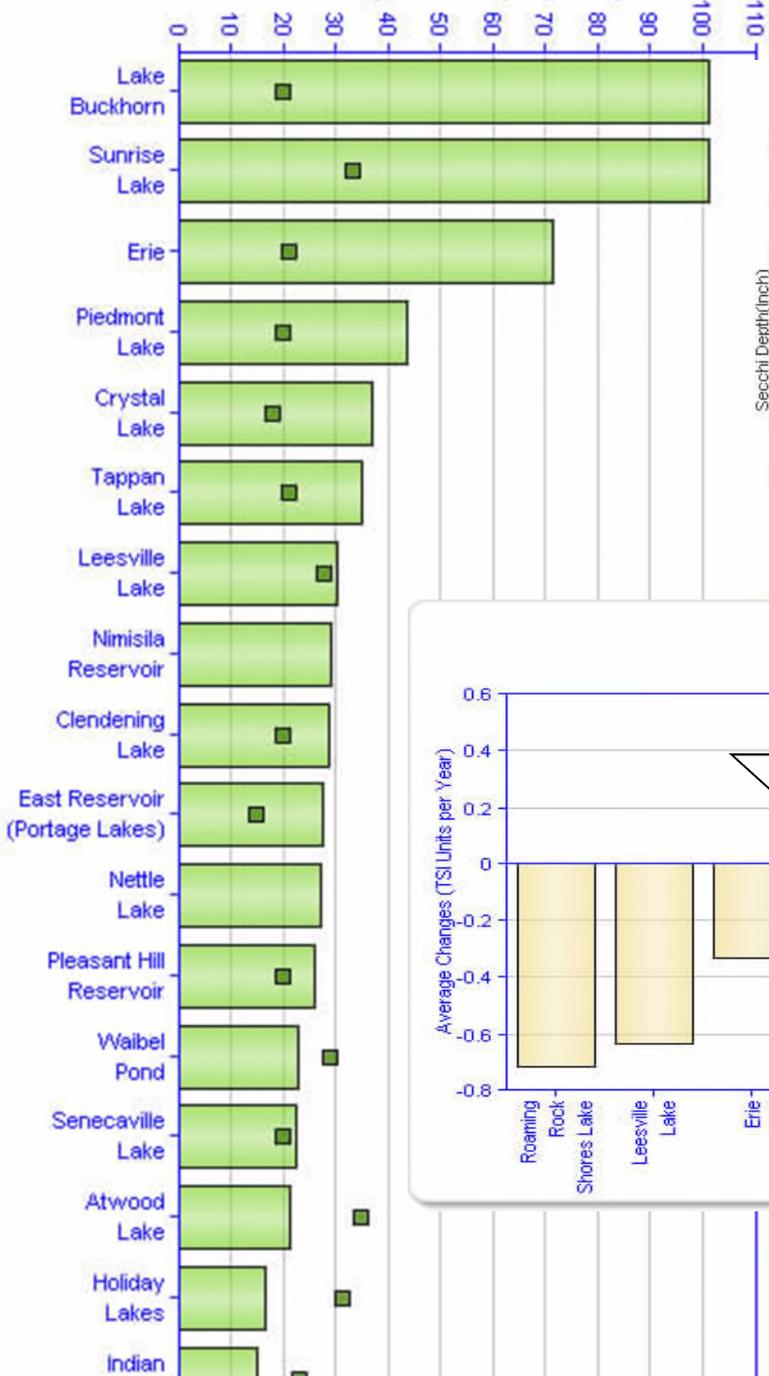
1995

0	Marion Zaugg	5	15.20	11	20	7.20	6.20	79.80	
1	Roger Clay	1	20.00	20	20	6.50	5.00	79.00	
10	Jim and Bev Pelc	10	8.00	6	12	3.75	3.30	74.60	
11	Larry Giannetto	3	13.67	11	16	23.37	6.33	74.67	
2	Robert Ledvina	3	23.33	18	26	12.93	5.00	74.00	
3	Robert Ledvina	3	25.33	16	30	9.77	3.33	73.33	
4	Dick and Marlene Groff	10	11.80	8	17	6.00	7.00	70.80	
5	Dick and Marlene Groff	10	12.80	10	19	6.55	7.20	70.40	
6	Nelson Shogren	8	10.63	5	15	5.36	4.88	70.50	
7	Nelson Shogren	8	9.38	4	12	4.27	4.50	74.63	
8	Jim and Bev Pelc	10	9.10	6	12	5.45	3.20	74.10	
9	Jim and Bev Pelc	10	9.20	6	12	4.05	3.40	74.20	
Averages for 1995			81	11.75	10.08	17.58	6.37	4.89	73.41

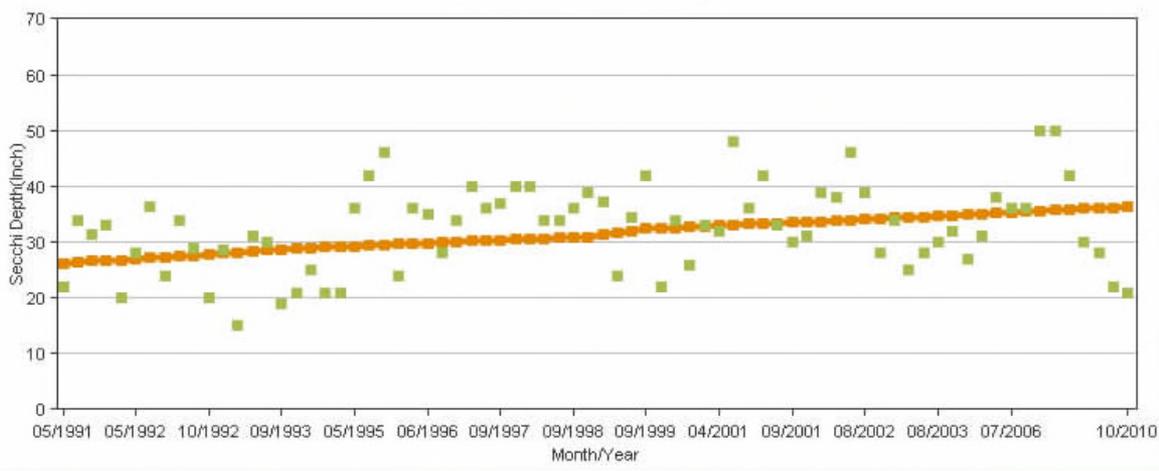
1996

10	Jim and Bev Pelc	8	6.75	6	8	3.63	4.38	79.13
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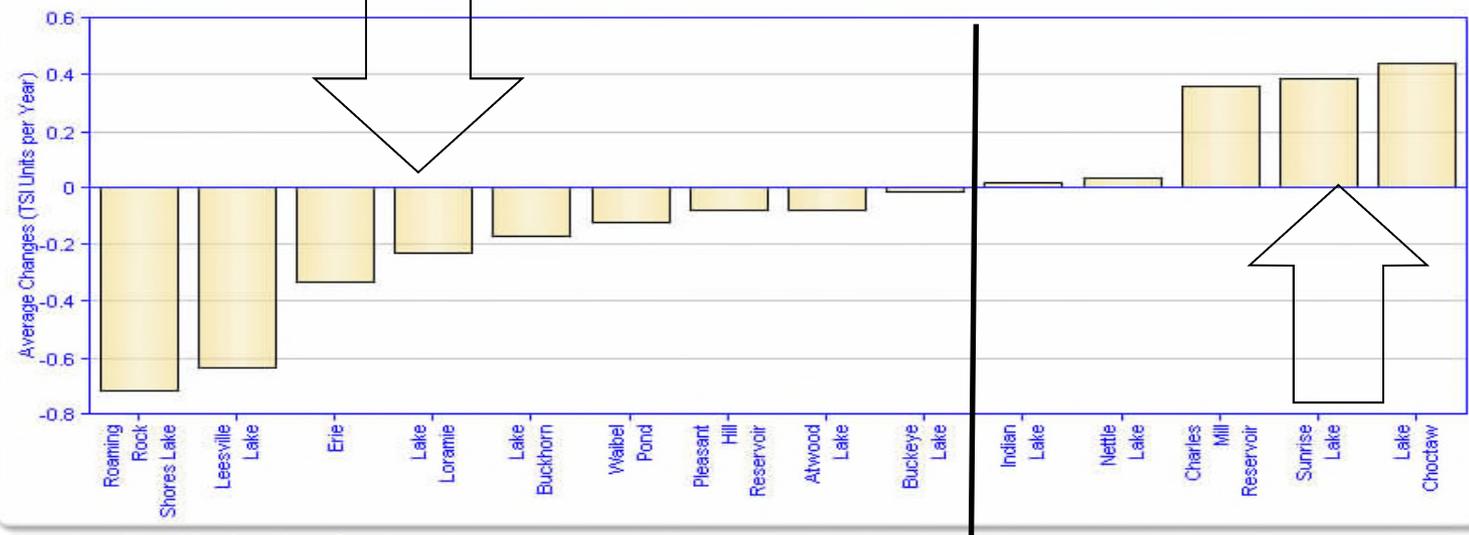
Average Secchi Depth (Inches)



Secchi Disk Transparency



Transparency Trends in Ohio Lakes: 2011



Trophic State Application

Mesotrophic
SD > 78"



Eutrophic
20" - 78"



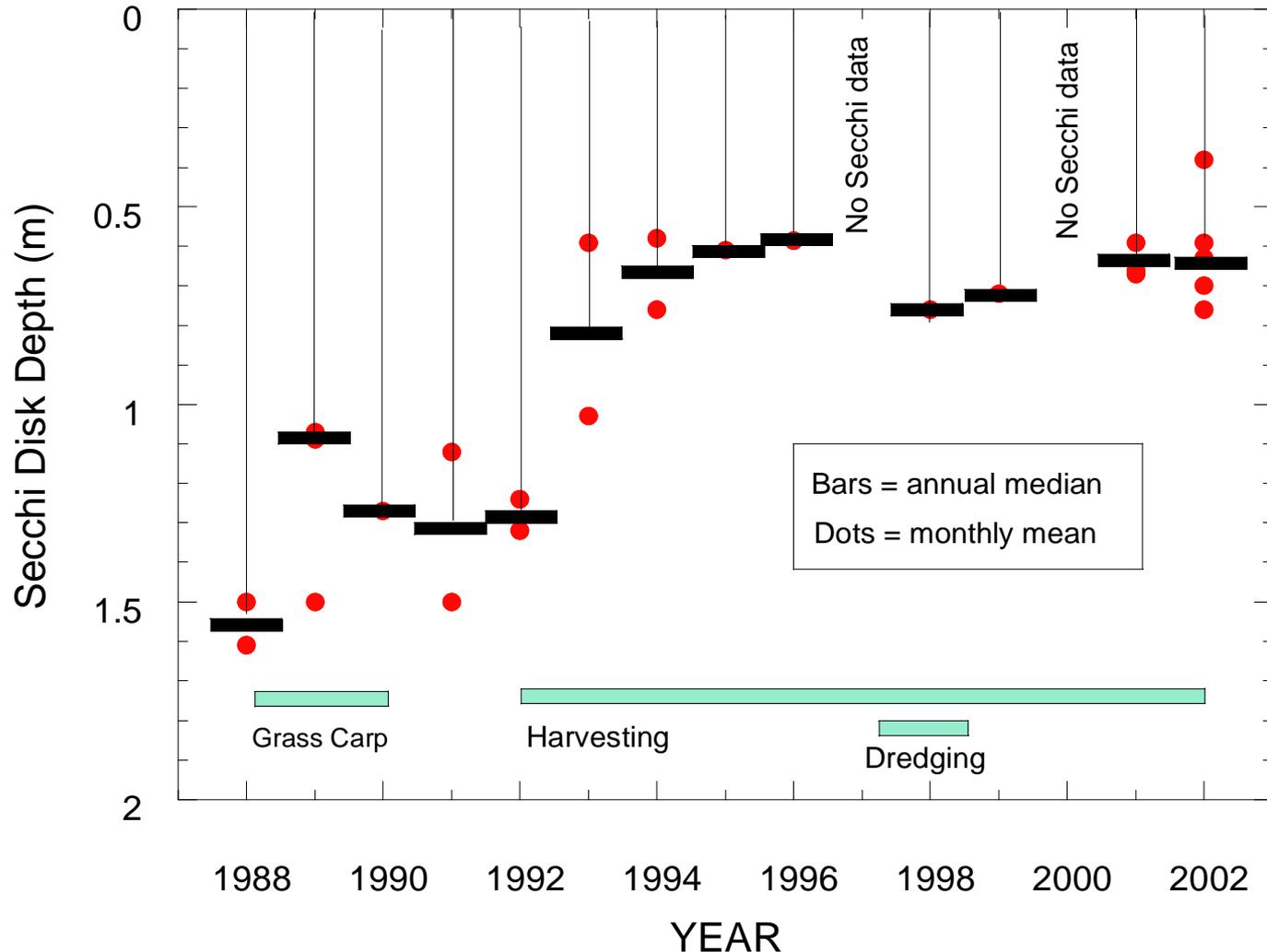
Hypereutrophic
SD < 20



earthobservatory.nasa.gov/Features/WaterQuality/water_quality2.php

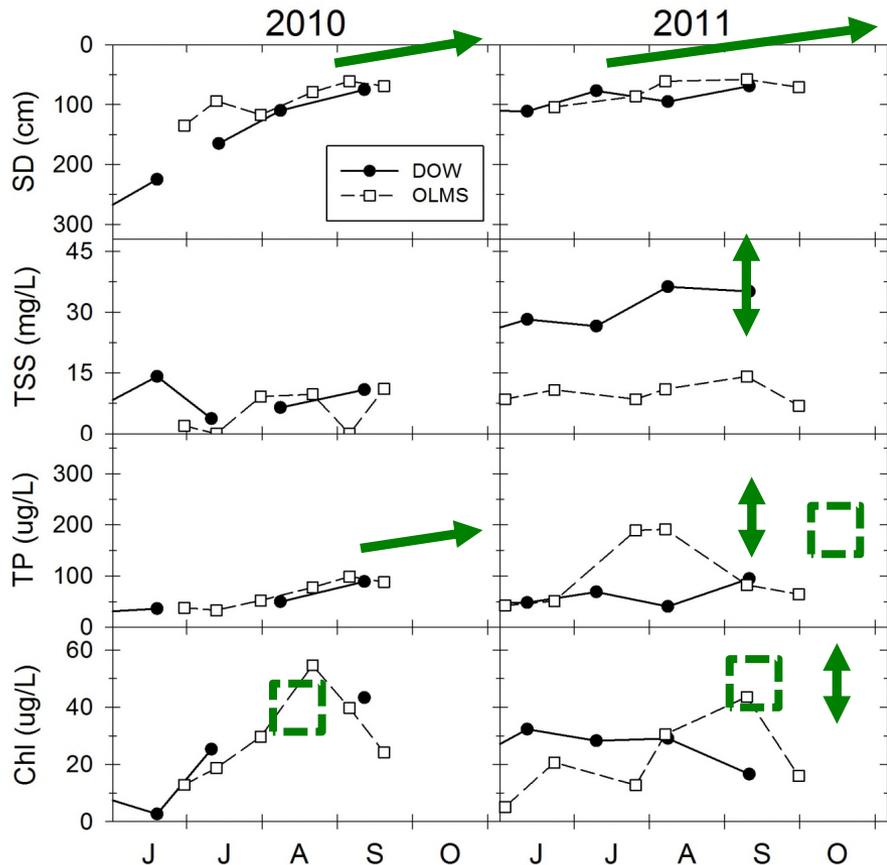
Lake Management Application

Sippo Lake, Stark County

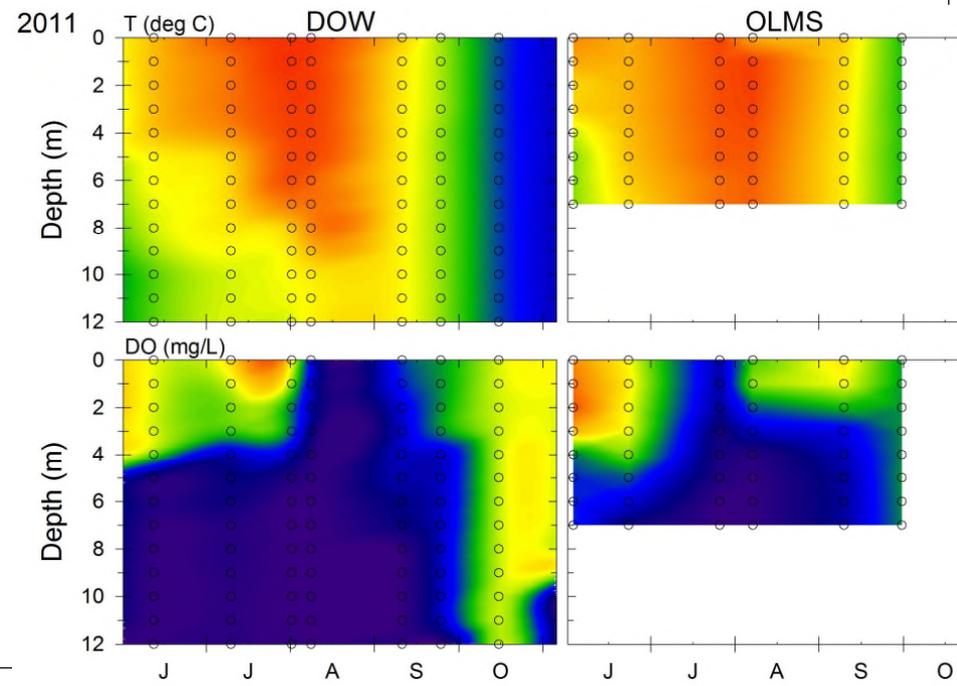


Fisheries Application

Pleasant Hill Reservoir, Richland County



- DOW and OLMS compared
- Different sites and dates
- Values similar, strong trends



Harmful Algal Blooms in Ohio

Human Health Issue

- 2009 high microcystin in Grand Lake St. Marys
- 2009 OEPA - Cyanotoxin monitoring
- 2010 ODH - 41 human illnesses, 5 dog deaths
- 2011 response strategy - ODH, ODNR, and OEPA
- 2012 strategy updated (www.ohioalgaeinfo.com)

Citizen Lake Awareness Monitoring

- **2011-2013 MWCD lakes being watched**
- **2013 expanded watch in Ohio with OEEF project**

Raymond, H., Merchant-Masonbrink, L, and Shaskus, M. (2012). *Ohio's Experience with HABs*. LakeLine, NALMS publication, vol.32: no.3, pgs. 26-30

CLAM - HAB Program

- Education statewide - 300+ attendees!
- 18 Lake Keepers on 19 lakes
- MWCD – 9 reservoirs 2011-2013
- OEEF – 2013 added 10 CLAM lakes
- Evaluate protocol (QA/QC) & program
- BSA Environmental Services, Inc.
 - Phytoplankton identification
 - Cyanobacteria counts
 - Microcystin and Cylindrospermopsin



2011 HAB Training, Tappan Lake



Maureen Coleman, June 2011,
Charles Mill Reservoir

Bloom Report Form

Please provide information about the potential blue-green algae bloom observed. Information can be entered into this electronic form and saved on your computer using Word or Adobe Reader (version 9+).

Please save and email a completed copy of this form to HABmailbox@epa.state.oh.us.

You are encouraged to include digital photographs as additional email attachments (close-up, and landscape showing extent and location of bloom).

If possible, consider including an image from an online mapping application such as Google, Bing or Yahoo Maps, with a marker at the bloom location. For more information go to the ohioalgaefinfo.com website.

Bloom Location:

Water body:	Date bloom observed: / /
County (optional):	Drinking water source? Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/>
Publicly Owned Lake? Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/>	Attached map with bloom location noted (e.g. Google Map image)? Yes <input type="checkbox"/> No <input type="checkbox"/> Digital photos attached? Yes <input type="checkbox"/> No <input type="checkbox"/>

Report Completed By:

Name:	Organization:	
Title:	Phone: () - ext.	Email:

Bloom Description and Sampling Information:

Please describe the location of the bloom in the water body (e.g. center of lake, at the boat dock, at the beach):

Do you notice any colors in the water column? Yes No

Please check any colors you see, or describe the color(s) below: Green Blue Red Rust Brown Milky White Purple Black

Please estimate the size (sq. feet) or the extent of bloom:

Can you see a surface scum (an accumulation at the surface) or algae floating near the water surface?

Algae floating at the surface can look like grass clippings, green cottage cheese curds, or spilled paint. Yes No Uncertain

Is the bloom near a public beach? If yes, please specify the beach name or location below. Yes No Unknown

Is the bloom near a drinking water intake? (Specify water system name if known) Yes No Unknown

Were samples taken? Yes No

If yes, what type of samples; when and where were they collected; and where were they sent for analysis?

Do you know if other water quality information is available? (Specify what data is available and where) Yes No

HAB Monitoring Protocol



**Robert David and Jim Swihart,
Choctaw Lake, Aug 2013**

- Modified from OEPA methods
- Equipment bag, 6-7 mailing boxes
- Site selection, beaches, contact areas
- Composite, along a shoreline transect
- Twice per month, Jul - Aug - Sep
- Mail to BSA Environmental Services
- Toxin data weekly
- Phytoplankton data monthly
- 2014 - add parameters and 'hot spots'

Quality Assurance / Quality Control

Site	Time	Date Sampled	Date Analyzed	Microcystin (µg/L)
Sippo - Driven	10:05	7/26/2011	8/10/2011	0.381
Sippo - Driven	10:07	7/26/2011	8/10/2011	0.838
Sippo - Driven	10:09	7/26/2011	8/10/2011	0.451
			average:	0.557
Sippo - Mailed	10:05	7/26/2011	8/10/2011	0.399
Sippo - Mailed	10:07	7/26/2011	8/10/2011	0.603
Sippo - Mailed	10:09	7/26/2011	8/10/2011	0.612
			average:	0.538
Sippo - Driven	10:05	8/1/2011	8/10/2011	0.295
Sippo - Driven	10:10	8/1/2011	8/10/2011	0.240
Sippo - Driven	10:15	8/1/2011	8/10/2011	0.380
			average:	0.305
Sippo - Mailed	10:05	8/1/2011	8/10/2011	0.307
Sippo - Mailed	10:10	8/1/2011	8/10/2011	0.483
Sippo - Mailed	10:15	8/1/2011	8/10/2011	0.442
			average:	0.410
Sippo - Driven	10:45	8/2/2011	8/10/2011	2.015
Sippo - Driven	10:50	8/2/2011	8/10/2011	1.961
Sippo - Driven	10:55	8/2/2011	8/10/2011	2.290
			average:	2.089
Sippo - Mailed	10:45	8/2/2011	8/10/2011	2.328
Sippo - Mailed	10:50	8/2/2011	8/10/2011	2.120
Sippo - Mailed	10:55	8/2/2011	8/10/2011	2.892
			average:	2.447



Robert David and Betty Lyle Kaser ,
Indian Lake, Aug 2013

MWCD - Cyanobacteria Genera (2011-2013)

	ATWOOD	CHARLES MILL	CLENDENING	LEESVILLE	PIEDMONT	PLEASANT HILL	SENECA	TAPPAN	WILLS CREEK
Anabaena	X	X	X	X	X	X	X	X	X
Anabaenopsis	X	X	X	X	X	X	X	X	X
Aphanizomenon	X	X	X	X	X	X	X	X	X
Aphanocapsa	X	X	X	X	X	X	X	X	X
Aphanothece	X	X		X	X	X	X	X	X
Chroococcus	X	X	X	X		X	X	X	X
Coelosphaerium								X	
Cylindrospermopsis	X	X	X	X	X	X	X	X	X
Eucapsis sp.	X								
Geitlerinema sp.							X		
Komvophoron							X		
Leptolyngbya sp.	X								
Limnothrix	X	X	X	X	X	X	X	X	X
Merismopedia	X	X	X	X	X	X	X	X	X
Microcystis	X	X		X		X	X	X	X
Oscillatoria		X		X	X	X			X
Pannus sp.		X				X		X	
cf. Phormidium sp.	X		X	X	X	X	X	X	X
Planktolyngbya	X	X	X	X	X	X	X	X	X
Planktothrix	X	X	X	X		X	X	X	X
Pseudanabaena	X	X	X	X	X	X	X	X	X
Raphidiopsis	X	X	X	X	X	X	X	X	X
Rhabdoderma						X	X		
Romeria sp.	X						X		
Snowella sp.						X			
cf. Synechococcus	X								
Woronichinia sp.	X								

- 27 genera found
- Seven common toxin-producing types

Microcystin

Cylindrospermopsin

MWCD – Common Genera (2011-2013)

	ATWOOD	CHARLES MILL	CLENDENING	LEESVILLE	PIEDMONT	PLEASANT HILL	SENECA	TAPPAN	WILLS CREEK
Anabaena	X	X	X	X	X	X	X	X	X
Anabaenopsis	X	X	X	X	X	X	X	X	X
Aphanizomenon	X	X	X	X	X	X	X	X	X
Aphanocapsa	X	X	X	X	X	X	X	X	X
Cylindrospermopsis	X	X	X	X	X	X	X	X	X
Limnothrix	X	X	X	X	X	X	X	X	X
Merismopedia	X	X	X	X	X	X	X	X	X
Planktolyngbya	X	X	X	X	X	X	X	X	X
Pseudanabaena	X	X	X	X	X	X	X	X	X
Raphidiopsis	X	X	X	X	X	X	X	X	X

- Ten genera found in all nine lakes
- Two produce microcystin, three produce cylindrospermopsin

Cyanobacteria Bloom Densities

4,000 - 10,000 cells/mL	=	Minor Bloom
10,000 - 100,000 cells/mL	=	Moderate Bloom
>100,000 cells/mL	=	Severe Bloom

Ohio EPA
Ohioalgaeinfo.com

Total Cyano-HAB Cell Densities

2011 Density Totals (cells/mL)	Jul-11	Jul-11	Jul-11	Aug-11	Aug-11	Sep-11	Sep-11
ATWOOD	231,777	468,902	665,667	441,398	408,515	387,005	387,005
CHARLES MILL	39,999	36,255	-	8,287	13,400	5,730	9,653
CLENDENING	519,767	1,032,047	755,498	1,066,689	905,804	869,219	296,046
LEESVILLE	2,909	3,123	308,811	699,254	242,282	195,266	242,729
PIEDMONT	51,816	21,603	100,057	42,491	274,254	316,040	161,819
PLEASANT HILL	132,378	104,885	107,803	98,999	341,517	199,541	126,575
SENECA	1,212	8,556	173,315	574,161	710,494	116,736	208,031
TAPPAN	556,027	294,361	365,098	468,638	35,505	339,260	203,852
WILLS CREEK	20,439	224,858	50,602	1,851	21,069	14,704	2,398

	2012 Density Totals (cells/mL)	Jul-12	Jul-12	Aug-12	Aug-12	Sep-12	Sep-12
=No Bloom	ATWOOD	150,920	333,677	243,509	93,575	592,908	52,097
	CHARLES MILL	38,600	9,326	10,542	18,257	12,093	12,750
=Minor Bloom	CLENDENING	817,589	996,873	97,750	1,709,626	562,546	480,463
	LEESVILLE	215,286	287,608	232,368	56,936	114,755	12,114
=Moderate Bloom	PIEDMONT	85,264	209,716	155,537	65,238	107,151	69,043
	PLEASANT HILL	49,131	78,475	77,002	9,126	12,184	4,748
=Severe Bloom	SENECA	10,582	17,374	98,419	88,536	56,950	43,062
	TAPPAN	264,270	357,208	368,430	141,257	137,270	76,351
	WILLS CREEK	538	157	53	1,647	599	30

2013 Density Totals (cells/mL)	Jul-13	Jul-13	Aug-13	Aug-13	Sep-13	Sep-13	Sep-13	Sep-13
ATWOOD	11,687	459,608	145,917	193,082	306,506	261,640		
CHARLES MILL	9,925	15,075	14,652	408,541	113,684	63,741		
CLENDENING	674,298	496,849	975,212	1,142,916	715,267	613,524		
LEESVILLE	12,508	14,288	3,346	58,052	68,447	450		
PIEDMONT	6,712	48,568	260,972	165,667	32,098	332,296		
PLEASANT HILL	18,039	2,571	48,947	4,021	7,353	39,653		
SENECA	48,449	47,742	9,946	62,565	209,489	203,691		
TAPPAN	517,485	114,010	32,352	99,034	98,285	158,283	204,690	194,110
WILLS CREEK	1,798	3,576	110,524	20,634	82,050	2,075		

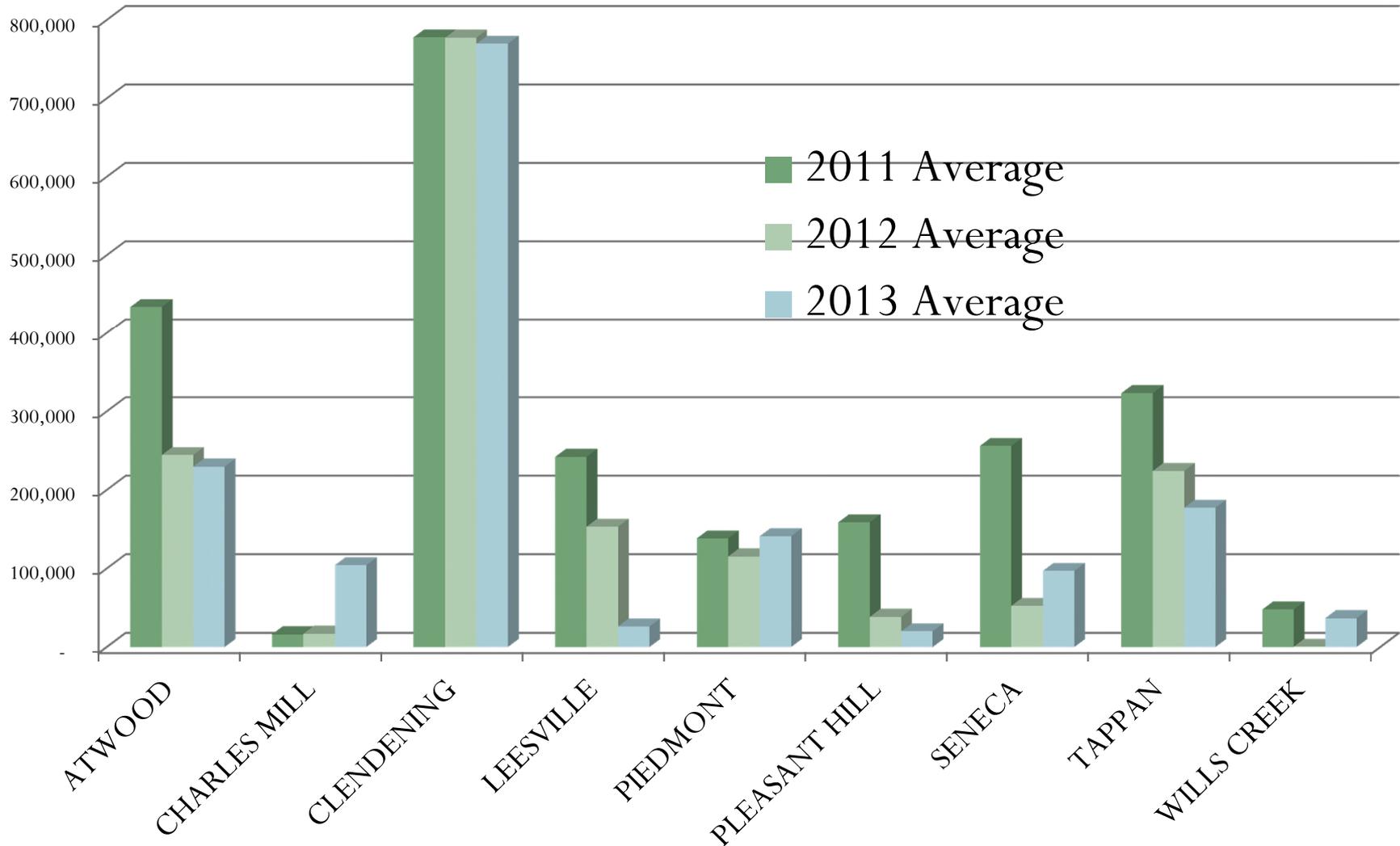
Average Cyano-HAB Density

Density Totals (cells/mL)	2011 Average	2012 Average	2013 Average
ATWOOD*	498,378	244,448	229,740
CHARLES MILL	16,189	16,928	104,270
CLENDENING*	777,867	777,475	769,678
LEESVILLE	242,053	153,178	26,182
PIEDMONT*	138,297	115,325	141,052
PLEASANT HILL	158,814	38,444	20,097
SENECA	256,072	52,487	96,980
TAPPAN*	323,249	224,131	177,281
WILLS CREEK	47,989	504	36,776

*Lakes experienced severe blooms on average for all three years.

Cyano-HAB Densities

cells/mL



Total Cyano-HAB (2011-2013)

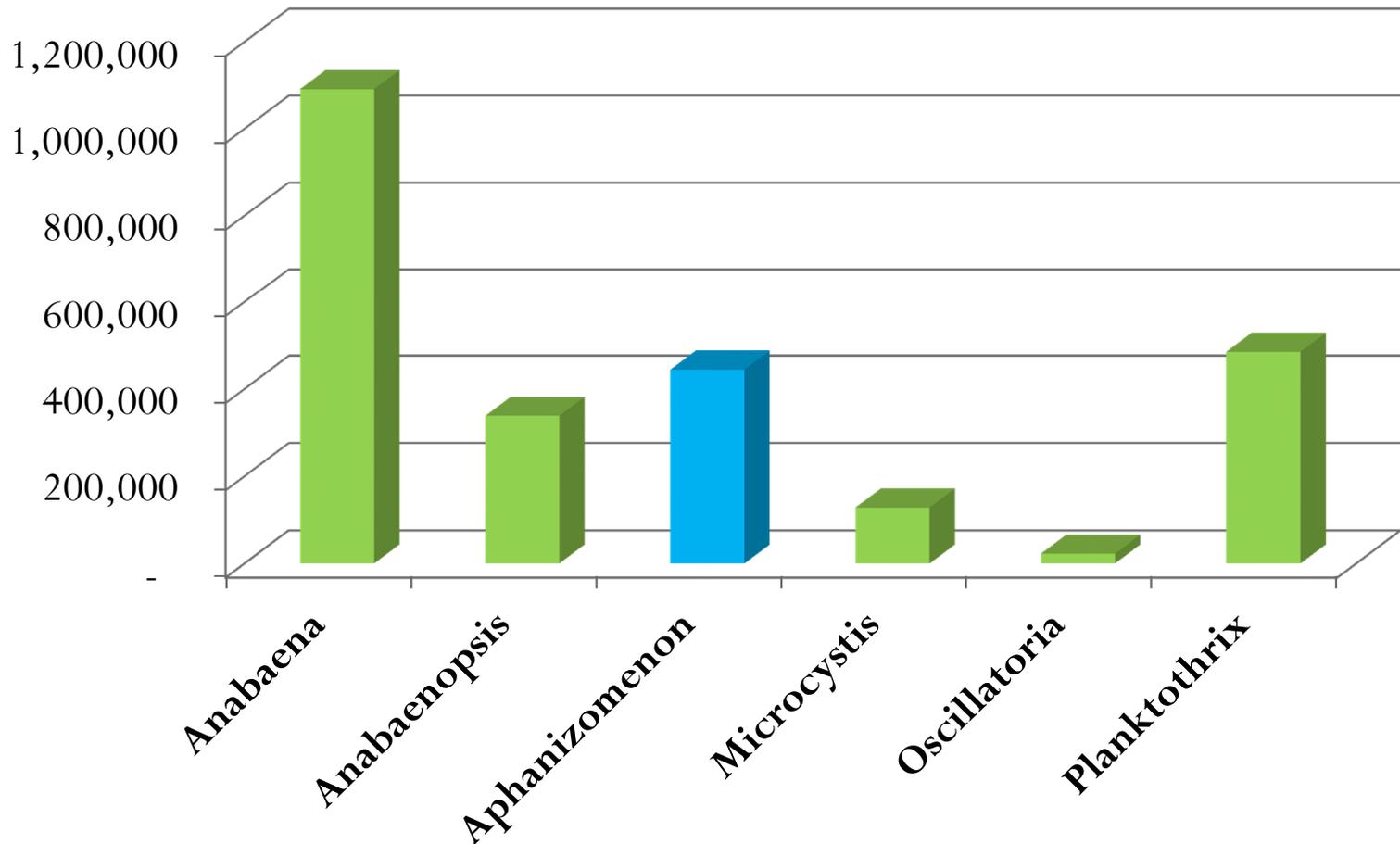
cells/mL

	ATWOOD	CHARLES MILL	CLENDENING	LEESVILLE	PIEDMONT	PLEASANT HILL	SENECA	TAPPAN	WILLS CREEK
Anabaena	239,298	17,721	31,238	116,613	41,637	328,829	216,988	63,333	35,541
Anabaenopsis	81,174	51,589	22,655	7,778	32,648	8,763	36,211	91,692	5,775
Aphanizomenon	44,622	5,269	22,263	65,456	40,051	31,952	75,687	98,178	60,972
Cylindrospermopsis	5,067,205	562,568	14,630,481	2,544,314	2,388,282	852,111	2,352,656	4,698,785	424,767
Microcystis	8,388	45,648	-	1,990	-	63,318	2,286	6,885	26
Oscillatoria	-	11,416	-	1,675	3,724	1,851	-	-	3,739
Planktothrix	7,706	146,297	21,348	32,704	-	176,125	5,481	66,904	28,783

- Cylindrospermopsis was found in the highest number for all lakes
- Piedmont count < Atwood, Clendening, Leesville, and Tappan

Total Cyano-HAB (2011-2013) cells/mL

33,521,168 *Cylindrospermopsis*



Cyanotoxin	Number of known variants or analogues	Primary organ affected	Health Effects¹	Most common Cyanobacteria producing toxin²
Microcystin-LR	80~90	Liver	Abdominal pain Vomiting and diarrhea Liver inflammation and hemorrhage	<i>Microcystis</i> <i>Anabaena</i> <i>Planktothrix</i> <i>Anabaenopsis</i> <i>Aphanizomenon</i>
Cylindrospermopsin	3	Liver	Acute pneumonia Acute dermatitis Kidney damage Potential tumor growth promotion	<i>Cylindrospermopsis</i> <i>Aphanizomenon</i> <i>Anabaena</i> <i>Lyngbya</i> <i>Rhaphidiopsis</i> <i>Umezakia</i>
Anatoxin-a group ³	2-6	Nervous System	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death	<i>Anabaena</i> <i>Planktothrix</i> <i>Aphanizomenon</i> <i>Cylindrospermopsis</i> <i>Oscillatoria</i>

“Cyanobacteria and Cyanotoxins: Information for Drinking Water Systems”, U.S. Environmental Protection Agency, Office of Water, July 2012 (EPA-810R11001) (water.epa.gov)

Cyanotoxin Thresholds

Threshold (µg/L)	Microcystin	Cylindrospermopsin
Algae Bloom Advisory	identified	identified
Recreational Public Health Advisory	6	5
Recreational No Contact Advisory	20*	20*
Drinking Water - Do Not Drink	1	1
Drinking Water - Do Not Use	20	20

*Concentration levels, along with confirmed illness or death.

- Public Health Advisory: Orange sign
- No-Contact Advisory: Red sign

ohioalgaeinfo.com



Microcystin Results

- 75% = limited or no detection
- 6 lakes with values
- All < 6 µg/L threshold
- Highest value only 1.5 µg/L
- 2011 more 'hits' (>.1 µg/L)
- Tappan Lake with greatest frequency and highest value

Lake	Time	Date Sampled	Microcystin (µg/L)
Atwood Marina - A1	12:35	9/18/2013	0.151
Charles Mill	17:45	8/24/2011	0.225
Charles Mill	14:00	7/9/2012	0.193
Leesville	11:15	7/5/2011	0.239
Leesville	10:45	9/6/2011	0.203
Pleasant Hill	14:00	7/5/2011	0.153
Pleasant Hill	14:30	7/5/2011	0.149
Pleasant Hill	13:39	7/25/2011	0.220
Pleasant Hill	14:32	8/9/2011	0.253
Pleasant Hill	13:40	8/29/2011	0.749
Pleasant Hill	11:30	9/27/2011	0.216
Pleasant Hill	13:15	8/5/2013	0.171
Pleasant Hill	13:05	8/19/2013	0.181
Tappan	14:32	7/5/2011	0.692
Tappan	14:51	7/5/2011	0.526
Tappan	14:40	7/19/2011	0.813
Tappan	10:53	8/2/2011	0.170
Tappan	10:28	8/29/2011	0.540
Tappan	11:50	9/12/2011	0.512
Tappan	2:00	9/27/2011	0.991
Tappan	10:05	7/17/2012	0.556
Tappan	14:30	7/29/2012	1.446
Tappan	16:04	8/7/2012	0.179
Tappan	10:25	8/21/2012	0.896
Tappan	10:30	9/3/2012	0.909
Tappan	15:05	9/24/2012	0.320
Tappan	11:45	7/1/2013	0.212
Tappan	13:30	7/21/2013	0.236
Tappan	10:45	8/5/2013	0.177
Tappan	10:05	8/20/2013	0.166
Tappan	11:00	9/9/2013	0.264
Tappan	13:30	9/29/2013	0.372
Tappan - Wye Cove	9:50	9/9/2013	0.220
Tappan - Wye Cove	14:30	9/29/2013	0.642
Wills Creek	2:00	8/28/2011	0.349
Wills Creek	14:00	7/22/2012	0.177
Wills Creek	16:00	8/5/2012	0.151

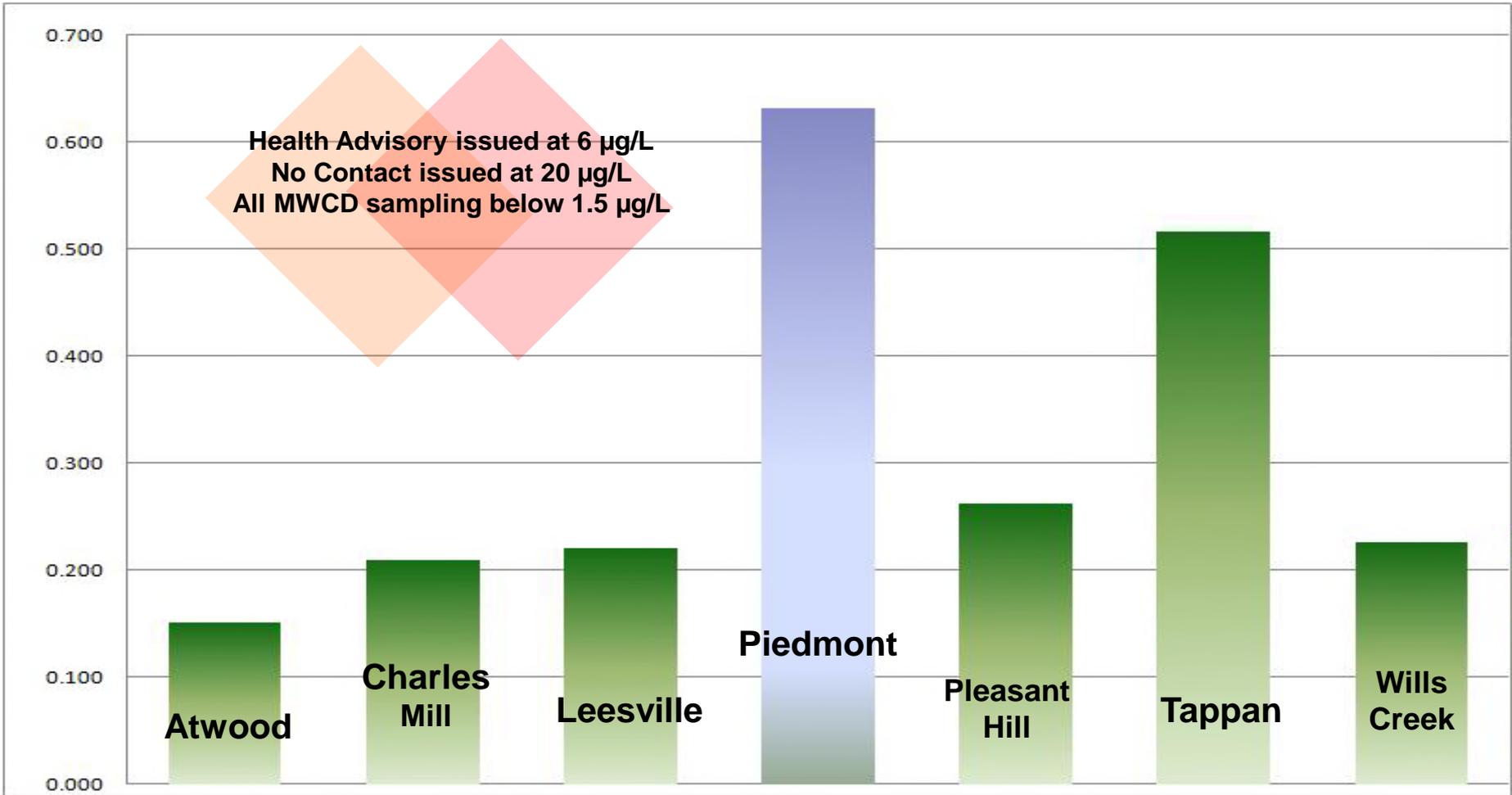
Cylindrospermopsin Results

- 95% = limited or no detection
- Only Piedmont Lake with 'hits'
- Values < 6 µg/L threshold
- Highest value only 1.2 µg/L

Lake	Time	Date Sampled	Cylindrospermopsin (µg/L)
Piedmont	15:15	8/12/2012	0.12
Piedmont	17:00	8/28/2012	0.65
Piedmont	15:05	9/10/2012	1.21
Piedmont	17:20	9/17/2012	1.14
Piedmont	17:15	8/5/2013	0.102
Piedmont	15:30	8/18/2013	0.589
Piedmont	17:50	9/9/2013	0.559
Piedmont	17:03	9/23/2013	0.682

Average Toxin Concentration (2011 - 2013) $\mu\text{g/L}$

Microcystin Cylindrospermopsin



- Clendening and Seneca did not experience 'hits' ($>.1 \mu\text{g/L}$)

Microcystin Results OEEF Lakes - 2013

- 27% = limited detection
- 50% above .15 µg/L but still < 6 µg/L
- 23% above 6 µg/L representing 4 lakes
- 12% = 'no contact' above 20 µg/L



Health Advisory issued at 6 µg/L
No Contact issued at 20 µg/L

Site	Date Sampled	Microcystin (µg/L)
Choctaw Lake	9/17/2013	6.563
Choctaw Lake	7/15/2013	7.95
Choctaw Lake	8/12/2013	10.002
Buckeye Lake	7/8/2013	11.18
Choctaw Lake	8/27/2013	12.562
Grand Lake St. Mary's	7/29/2013	12.833
Choctaw Lake – QAQC	8/27/2013	13.844
Grand Lake St. Mary's	7/1/2013	25.954
Grand Lake St. Mary's	8/26/2013	31.739
Grand Lake St. Mary's	7/15/2013	34.180
Indian Lake	7/29/2013	38.1531
Grand Lake St. Mary's – QAQC	8/15/2013	42.407
Grand lake St. Mary's	9/9/2013	50.896
Buckeye Lake	8/18/2013	68.736
Buckeye Lake – QAQC	9/9/2013	106.41
Buckeye Lake	9/9/2013	107.14

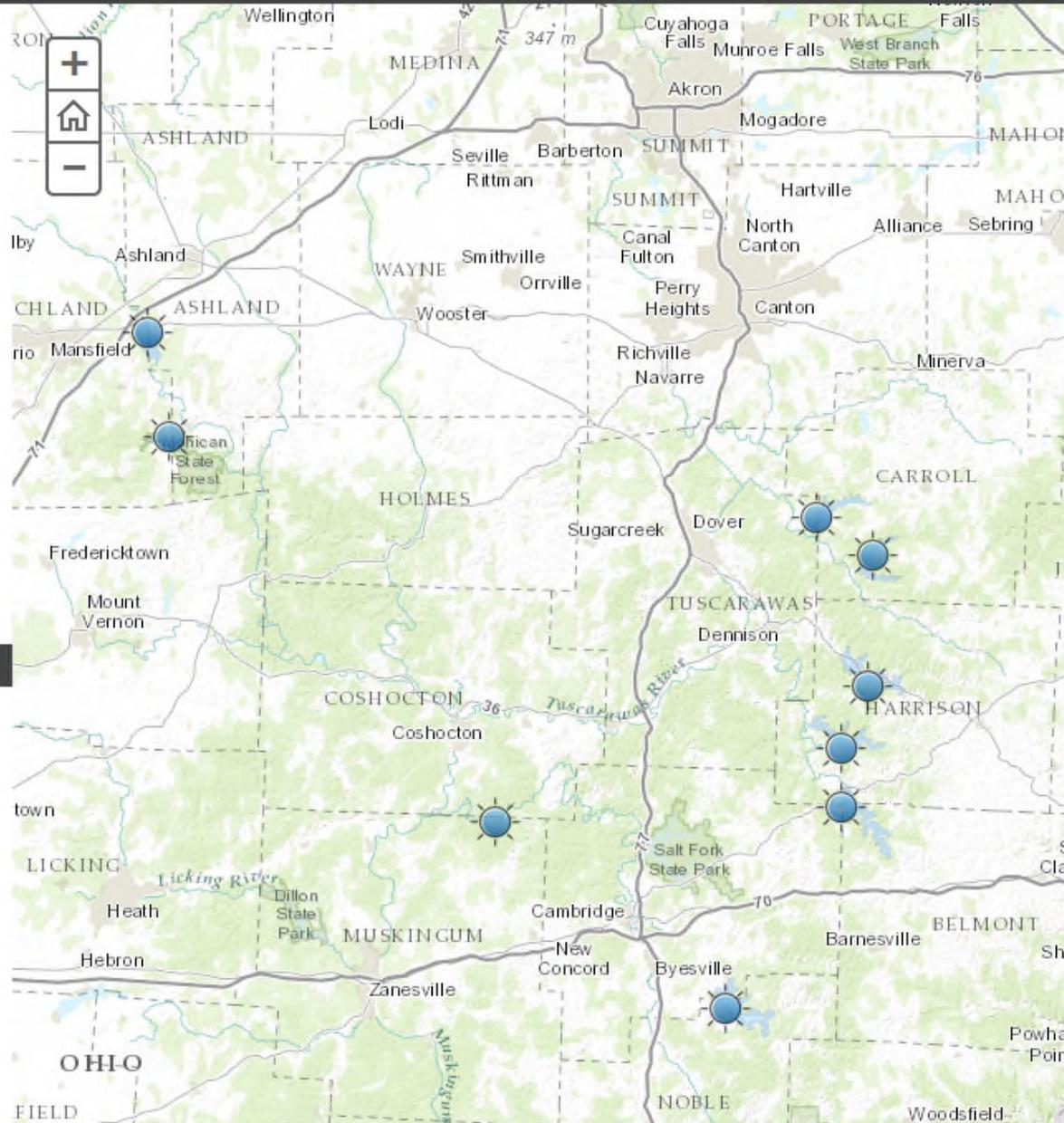
Monitoring for a Harmful Algal Bloom at Muskingum Watershed Lakes

Most recent HAB TOX results from BSA Environmental Services

MWCD Lakes are sampled every 2 weeks July - September by [Citizen Lake Awareness and Monitoring \(CLAM\)](#) volunteers through [Ohio Lake Management Society \(OLMS\)](#) and a grant awarded by [MWCD](#). The samples are sent to a certified lab (BSA Environmental Service, Inc) to be analyzed. All seasonal results are available by contacting OLMS at 330-466-5631 as only most recent results are displayed on the map.

Levels of advisory were developed following the Ohio EPA public health thresholds.

Map Compiled by
Skyler Dewey, MWCD



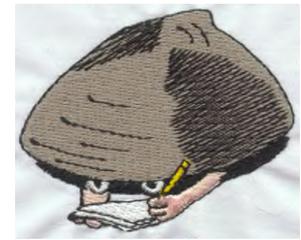
LEGEND

HAB Advisory- Most Current Results

-  No Recreational Public Health Advisory
-  Recreational Public Health Advisory
-  Recreational No Contact Advisory

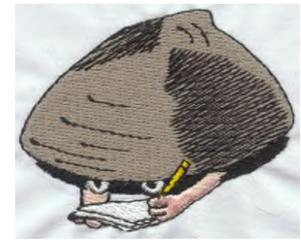


Genera Conclusions



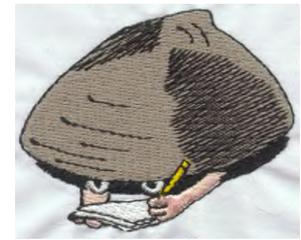
- Large genera assemblage, but some in low numbers
- All lakes experienced periods of severe blooms
- Charles Mill, Leesville, Pleasant Hill, Seneca, and Wills Creek reported no blooms and/or minor blooms
- Cyano-HAB density was greatest in Clendening
- Bloom densities were higher in 2011
- Cylindrospermopsis dominated all lake systems
- Anabaena was dominate 'microcystin' genera

Toxin Conclusions



- All toxin levels were low based on warning thresholds
- Only Clendening and Seneca did not see 'hits'
 - Yet Clendening experienced greatest density of Cyano-HABs all three years
- Microcystin greatest in Tappan Lake
 - Yet density similar to other lakes
- Cylindrospermopsin not found in lakes (only Piedmont)
 - Yet this genera found in largest density in all lakes
 - Piedmont density was not high relative to other lakes

Recommendations



- Based on density and toxin, Atwood, Clendening, Piedmont, and Tappan need close watch
- Only spot check for cylindrospermopsin (not Piedmont)
- Review genera and toxins, by lake and by season
- Add 'hot spots' in the lake
- Add nutrients, Chl *a*, and TSS at site and at dam
- Explore use of flourometer

Lessons Learned

Citizen science is cost effective monitoring

- Hold convenient trainings, at pre-scheduled events
 - Go to them, not them to you
 - Rely on local networks
 - Offer food!
- Use small stipend to encourage involvement
- Be flexible and realistic on level of doing and expectation
- Keep reports simple, short and relevant

Lessons Learned

Citizen science is cost effective monitoring

- Show appreciation, send frequent and varied 'thank you's'
 - Written formal recognition
 - Appreciation luncheons and awards
 - Thank you cards
- Resident monitors know THEIR lake the best
 - Feedback on protocols
 - Site selection and sampling design
 - Rapid response to issues
- Volunteers hate wearing goggles!



Partnerships and Stewardship

- Working together towards protected water resources
 - Nonprofit – OLMS, Mohican Outdoor School
 - Public – Ohio EPA, Division of Wildlife, MWCD
 - Private – BSA Environmental, Beagle Bioproducts, AquaDoc
- Combined resources, strengths are magnified
 - More legitimate, credible, and relevant
 - Increased ability for long-term effort towards desired result
 - Longevity of effort leads to stewardship and action
- Action (and only action) will protect our water!





www.eyesonthewater.com/olms
www.olms.org



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