

Using Chlorophyll *a* as a surrogate for exceeding Microcystin Health Advisory Concentrations

Cyanobacteria - Monitoring and Treating Drinking Water: A Workshop for Water Suppliers

Jeff Hollister and Betty Kreakie

2017-12-14

Worcester, MA

Problem: What is a bloom?

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So of course, I asked Twitter



Jeff Hollister
@jhollist



Some help, twitter. What is definition of an algal bloom? rate of increase? exceed some min conc? [@GLEONetwork](#)

[@KathyCottingham](#) [@not_Klaatu](#)

10:24 AM · Jun 17, 2015 · Kingston, RI

1 3 0

•

Problem: What is a bloom?

Got some of this variety



Jim Garvey
@fishysiu



@WiscLimnology @CareyLab @jhollist @GLEONetwork Snot
green water?

10:45 AM - Jun 17, 2015



1



1



1



Center for Limnology
@WiscLimnology



@jhollist @fishysiu @CareyLab @GLEONetwork I know it
when I see it?

1:51 PM - Jun 17, 2015



2



1



1



Problem: What is a bloom?

Got some of the more quantitative



GLEON

@GLEONetwork



2/2 @jhollist @fishysiu @WiscLimnology @CareyLab via
@caweirich @TrexLab definition: 1.5X baseline phycocyanin
above journals.plos.org/plosone/article...

2:16 PM - Jun 17, 2015



2



2



2



Problem: What is a bloom?

And then the one closest to reality



Kathy Cottingham
@KathyCottingham



@jhollist Alternative view: when the public notices and starts phoning?

4:08 PM - Jun 18, 2015



Problem: What is a bloom?

Take away message

- No real consensus
- Different definitions
 - Visual cues
 - Public concern
 - Health risk
- Still left with a decision on how to quantify



Problem: What is a bloom?

What could we use?

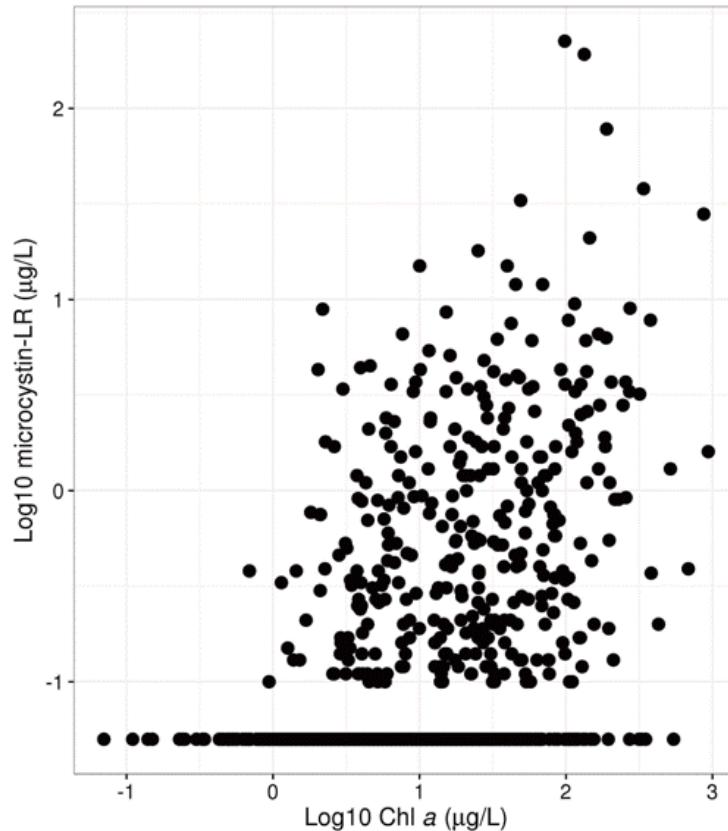
- Toxins
 - Most direct measure
 - Data not widely available
- Cell counts, bio-volume, etc.
 - Data not widely available
- Chlorophyll
 - Data available
 - Associated with cyanobacteria?



Possible Solution: Chlorophyll as a proxy for Microcystin

Possible Solution: Chlorophyll as a proxy

- 2007 NLA show association
- Yuan *et al* (2014).
Freshwater Biology
- But, what is a bloom?



Possible Solution: Chlorophyll as a proxy

Existing Microcystin Advisory Levels

Source	Type	Concentration
USEPA	Infant and Pre-school Child Drinking Water Advisory	0.3 µg/L
WHO	Drinking Water	1 µg/L
USEPA	School Age Child and Adult Drinking Water Advisory	1.6 µg/L
WHO	Recreational: Low Prob. of Effect	2-4 µg/L
WHO	Recreational: Moderate Prob. of Effect	10-20 µg/L
WHO	Recreational: High Prob. of Effect	20-2000 µg/L
WHO	Recreational: Very High Prob. of Effect	>2000 µg/L

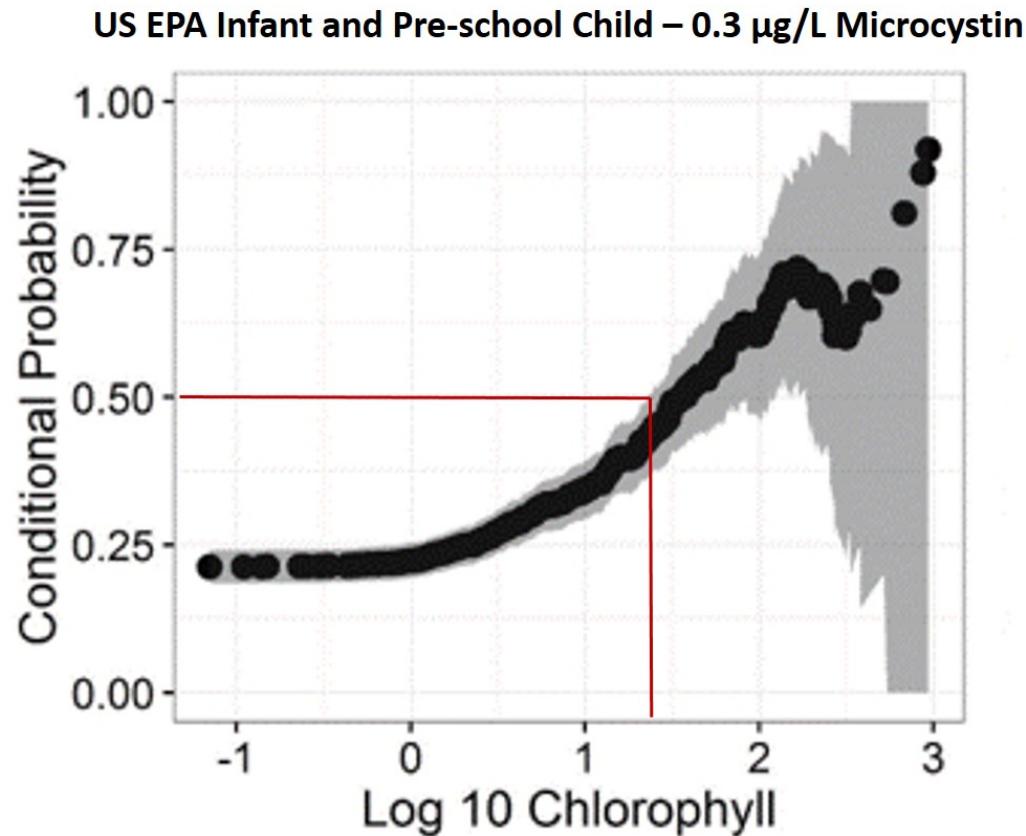
Our Solution: Chlorophyll and Microcystin

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Associating chlorophyll *a* concentration with Microcystin guidance levels

- Hollister and Kreakie (2016) Associations between chlorophyll a and various microcystin health advisory concentrations.
<https://f1000research.com/articles/5-151/v2>
- Conditional probability
 - Probability of one event happening, given another has already happened
 - Our approach based entirely on data
 - History in environmental applications
- Data
 - 2007 NLA
 - EPA and WHO guidance levels

Results: Chlorophyll *a* and Microcystin



Results: Chlorophyll *a* and Microsystin

Results

Cond. Probability	USEPA Child (0.3 µg/L)	WHO Drink (1 µg/L)	USEPA Adult (1.6 µg/L)	WHO Recreational (2 µg/L)
0.1	0	0	0	1
0.2	0	4	11	19
0.3	3	17	30	50
0.4	11	37	66	80
0.5	23	68	83	110
0.6	39	97	113	185
0.7	66	126	256	871
0.8	116	271	871	871
0.9	170	516	871	871

Our Solution: Chlorophyll *a* and Microsystin

Validation with 2012 National Lakes Assessment

- EPA Infant and pre-school children - 50% Cond. Prob. (23 µg/L Chl *a* - 0.3 µg/L Microcystin)
 - Total Accuracy: 79%
 - False Negative: 6%

Infant and Pre-school - 50% Cond. Prob.

	FALSE	TRUE
FALSE	833	77
TRUE	176	134

Applications and Caveats

Applications and caveats

- Identify potential past bloom events
- Screening tool
 - Helps with limited resources
 - Test for microcystin only when more likely to find it
 - Caveat: Current numbers based on National data
 - Caveat: Analyzing for toxins, if possible, still better
- Chlorophyll a cutoff to use is management decision



Thanks!

Jeff Hollister

US EPA
Atlantic Ecology Division
Narragansett, RI

✉: hollister.jeff@epa.gov
🐦: [jhollist](#)
👤: [jhollist](#)

Betty Kreakie

US EPA
Atlantic Ecology Division
Narragansett, RI

✉: kreakie.betty@epa.gov
👤: [BKreakie](#)