Harmful Algal Blooms in Clear Lake and Impacts to Beneficial Uses

Sarah Ryan, Environmental Director, Big Valley Band of Pomo Indians

CyanoSymposium

3/25/26

Cyanobacteria Impacts

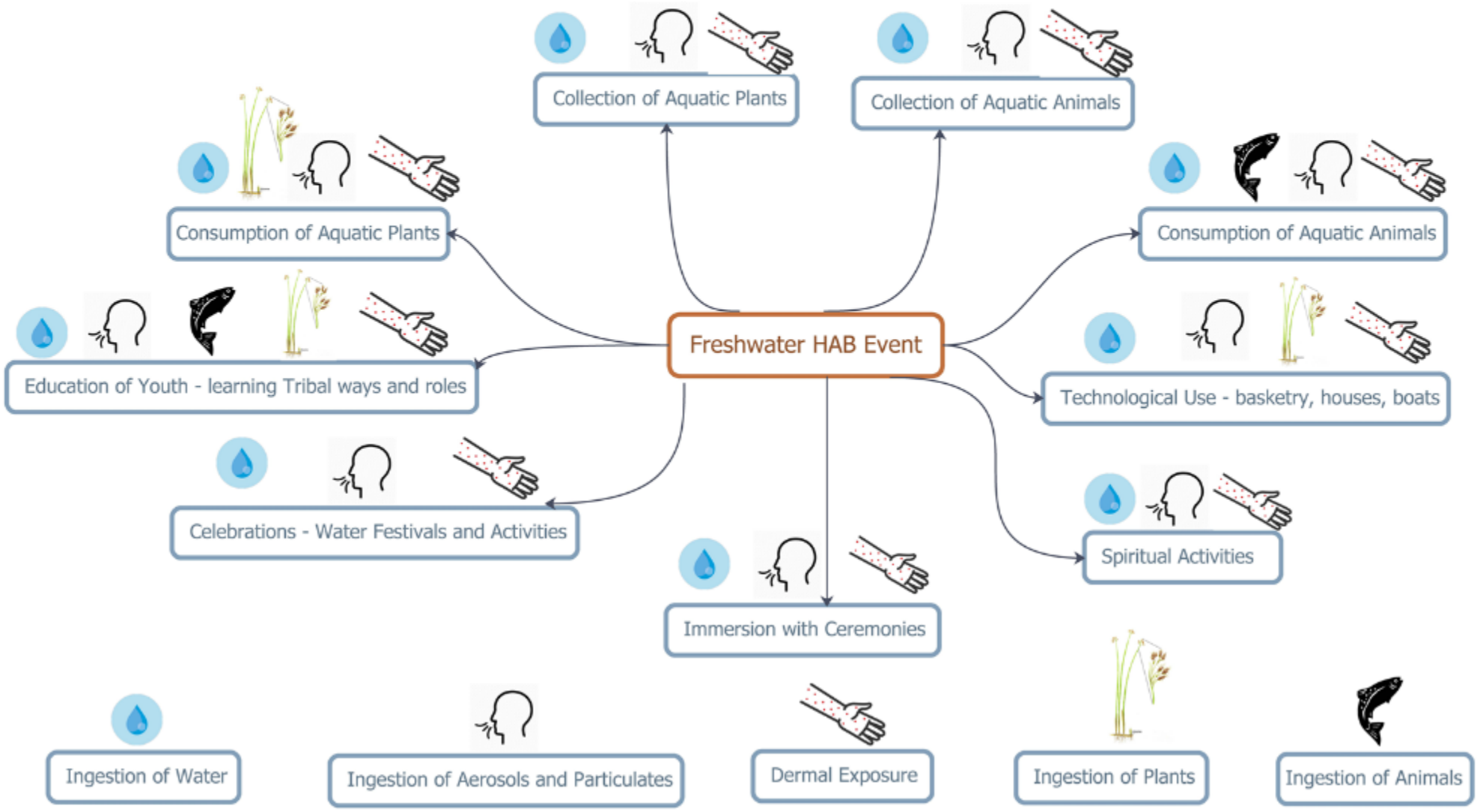
- Bloom proliferation ➡ reduced sunlight in water column, impacting plant growth
- Dying blooms ➡ oxygen depletion ➡ fish kills
- Questions about water safety
- Strong odor, visually unpleasing
- Increased filtration and treatment costs for drinking water systems
- Affects tourism

Clear Lake Cyanotoxin Monitoring Program

Initiated and developed by Big Valley Band of Pomo Indians and Elem Indian Colony, 2014. **https://bit.ly/ClearLakeCyanoMonitoringProgram**

Tribal Cultural Use Conceptual Freshwater Harmful Algal Bloom (FHAB) Impact Pathway

Native peoples were given their land by Creator and honor Creator and their Ancestors by maintaining traditions and cultural landscapes. This is the connection between the land and the people. Uses can be repetitive, gender assigned and long term. Exposures can occur second hand through the use and trade of plants and animals that have been in contact with HABs.



https://www.bvrancheria.com/epa

Tribal Cyanobacteria Monitoring Program

2014
- Formed Clear Lake Cyanobacteria Task Force, has continued to meet quarterly
- Focused on Microcystin levels at 8 shoreline sites– lab analysis and field Algal Toxin strips

2015
- 18 shoreline sites
- Cyanobacteria cell identification
- Lab analysis for Microcystin, Anatoxin-a, Cylindrospermopsin, Saxitoxin

2016
- Monitoring toxins in drinking water systems
- Chlorophyll-a and phycocyanin for TMDL
- Microcystin analysis at every site and every sampling event

2017
- Expanded sites to a few creeks and other waterbodies in Lake County
- Began sending samples for qPCR analysis (quantifying toxin producing genes)

2018
- Analysis of fish and shellfish for Microcystin
- Began collaboration with CA DWR to get water samples from interior of lake

2019
- Development of graphics and language about HABs and Tribal Beneficial Uses: Tribal conceptual FHAB Pathway

Fish die off during a cyanobacteria bloom, Clear Lake

Tribal Centric Program

- Includes locations that are Tribally important
- Monitoring to coin-cide with important dates of Tribal uses of the water
- Communicate with Tribes and the

2024
- Microcystin biomarker partner study
- Ongoing drinking water toxin testing

2023
- Program development for HABs mul-ti-jurisdictional community resiliency
- Training on ELISA lab equipment to analyze for microcystin in water and tissues

2022
- Program development for creek cyanotoxin monitoring using grab samples and SPATT bags
- Program development for cyanotoxin analysis of other traditional foods: waterfowl (mudhens) and tules

2021
- Analysis of private (self supplied) drinking water taps for cyanotoxins
- Work with local Public Health Officer to alert on cyanotoxins in private drinking water systems

2020
- Development of signage tracker for Lake County and other agencies to monitor the changing toxin levels and communication signage throughout the sampling season

Cyanobacteria bloom, Clear Lake

Year	Maximum Microcystin Value (µg/L)	Location	Arm of Lake
2024	16,025	LC01	L
2023	16,821	JB	L
2022	790	SBMMEL01	O
2021	160,378	RED01	L
2020	1,146	LUC01	U
2019	150	LC01	L
2018	4,800	SBMMEL01	O
2017	5,554	AP01	L
2016	0.67	SBMMEL01	O
2015	10,162	AP01	L
2014	16,920	CLOAKS01	O

Trainings with Tribes – 20 Tribes since 2022

Kickstarting a Tribal Monitoring Program For Harmful Algal Blooms, Cyanotoxins, and Fish Kills

Spring 2022

BIG VALLEY RANCHERIA

U.S. DEPARTMENT OF THE INTERIOR 1824 BUREAU OF INDIAN AFFAIRS

BAYAREA COUNCIL

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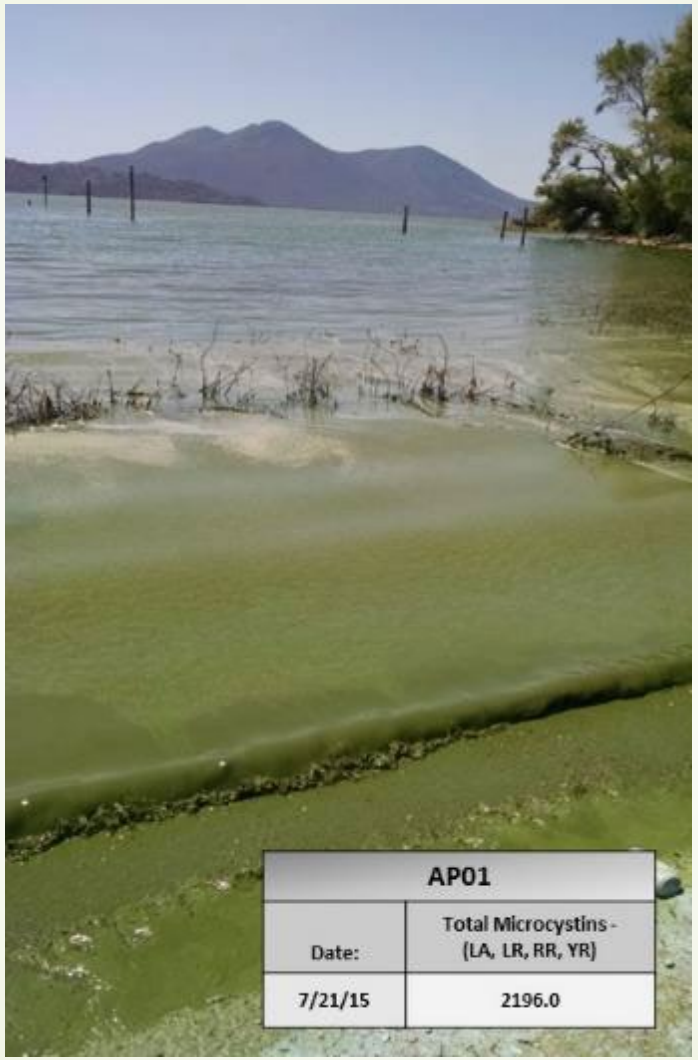
Cyanotoxins' Impacts on Beneficial Uses



HUMAN EXPOSURE

Freshwater cyanotoxin producers chart

California State Water Boards Freshwater Harmful Algal Bloom Program | mywaterquality.ca.gov/habs

Toxin types[a]	
Liver toxins	microcystin (MC), nodularin (NOD), cylindrospermopsin[b] (CYN)
Neurotoxins	anatoxins (ATX; including homoanatoxin and derivatives), saxitoxins (STX), guanitoxin[c] (GTX)
Skin toxins[a]	lyngbyatoxin (LTX), debromoaplysiatoxin (DAT), aplysiatoxin (AT)

[a] In addition to the toxins listed, all cyanobacterial cell membranes contain lipopolysaccharides, which can irritate the gastrointestinal tract[1]
[b] Cylindrospermopsin also impacts the kidney[2]
[c] Previously anatoxin-a(s)[3].

Genus	Liver toxins			Neurotoxins			
	MC	NOD	CYN	ATX	STX	GTX	LTX
Anabaena	X[4]		X[5]		X[6]		
Anabaenopsis	X[7]						
Anagnostidinema[8] (prev. *Geitlerinema*)	X[9]				X[6]		
Aphanizomenon			X[10]	X*[11,12]	X[13,14]		
Aphanocapsa	X[15]						
Chrysosporum			X[16]				
Coelosphaerium	O[17]						
Cuspidothrix[18] (prev. *Aphanizomenon*)				X[19]	X[20]		
Cylindrospermum				X[11]	X[6]		
Dolichospermum[21] (prev. *Anabaena*)	X[22]		X[5]	X[13]	X[23]	X[3]	
Fischerella	X[24]						
Geitlerinema	X[9]			X[9]	X[6]		
Gloeotrichia	X[25]						
Hapalosiphon	X[26]						
Iningainema		X[27]					
Kamptonema				X[28]			
Leptolyngbya	X[4]						
Limnospira[29] (prev. *Arthrospira*)	X[30]			X[30]			
Limnothrix	X[31]				X[32]		
Merisimopedia	X[33]						
Microseira wollei[34] (prev. *Lyngbya*)			X[35]		X[36,37]		

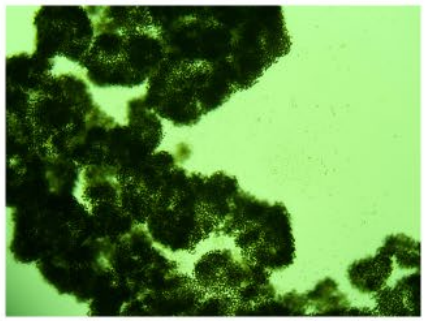
In house microscopy on cyanobacteria allows us to determine toxins to test

https://drive.google.com/file/d/1jSK9zEW-POTlLXB0S60KQB7ksNEvc0nP/view

Cyanobacteria Cell ID Documentation

SEPTEMBER, 2021

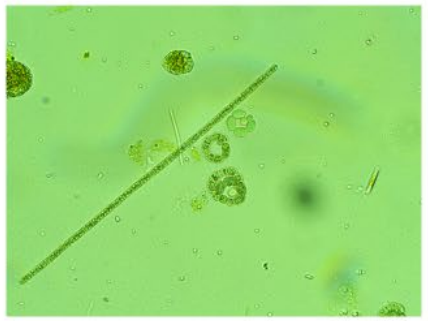
- Big Valley continued to sample 15 sites on a bi-monthly basis around the shoreline of Clear Lake
- Microscopy: dominance of *Microcystis* with a secondary dominance of *Planktothrix*
- Other genera observed: *Oscillatoria*, *Pseudanabaena*, and *Aphanizomenon*



Microcystis – KP01: 09/09/2021

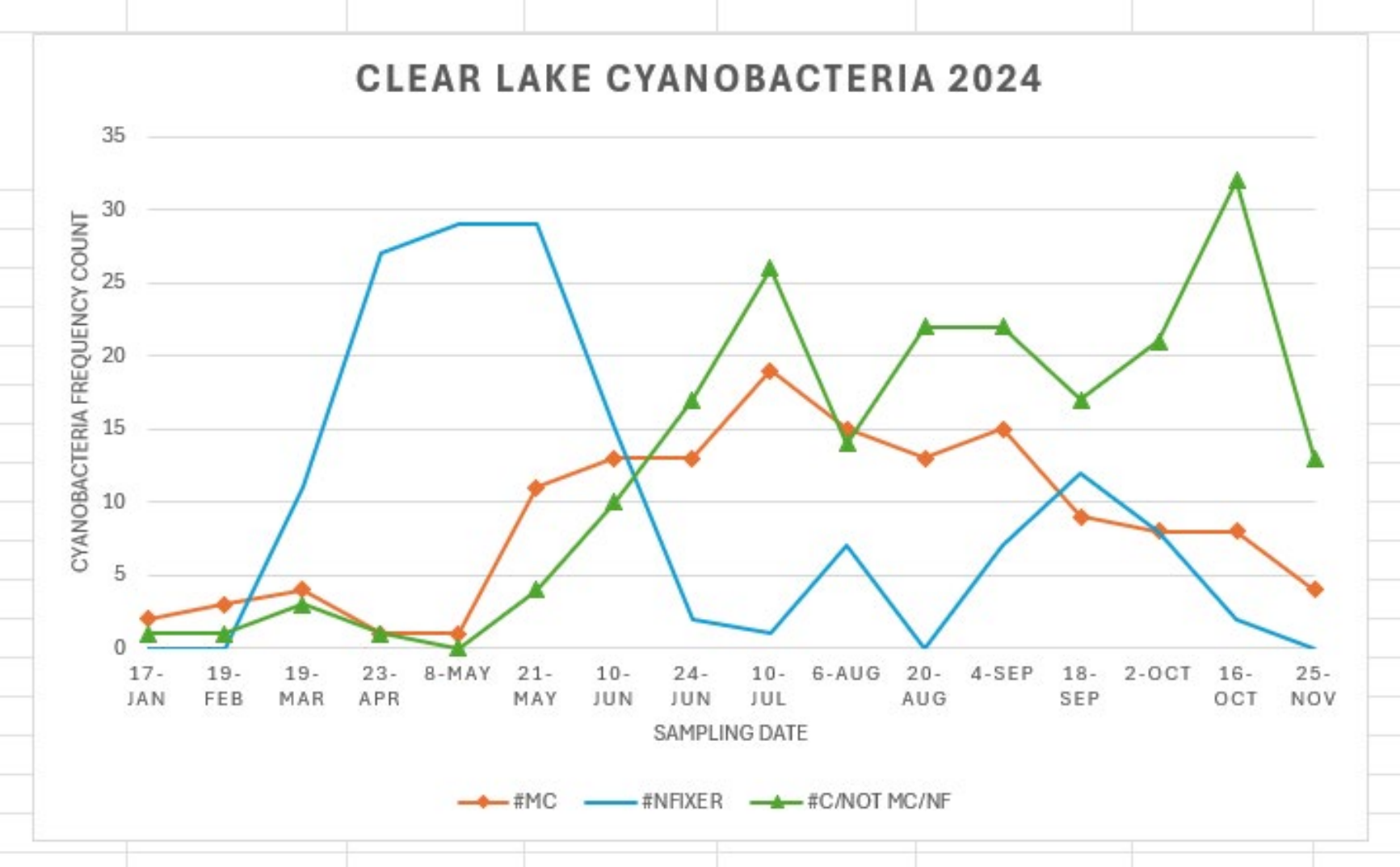
Microcystis – BP: 09/09/2021

Planktothrix – LPTNT 09/22/2021



Planktothrix – LPTNT: 09/22/2021

Tracking the Types of Cyanobacteria Blooms



California Cyanotoxin Guidelines

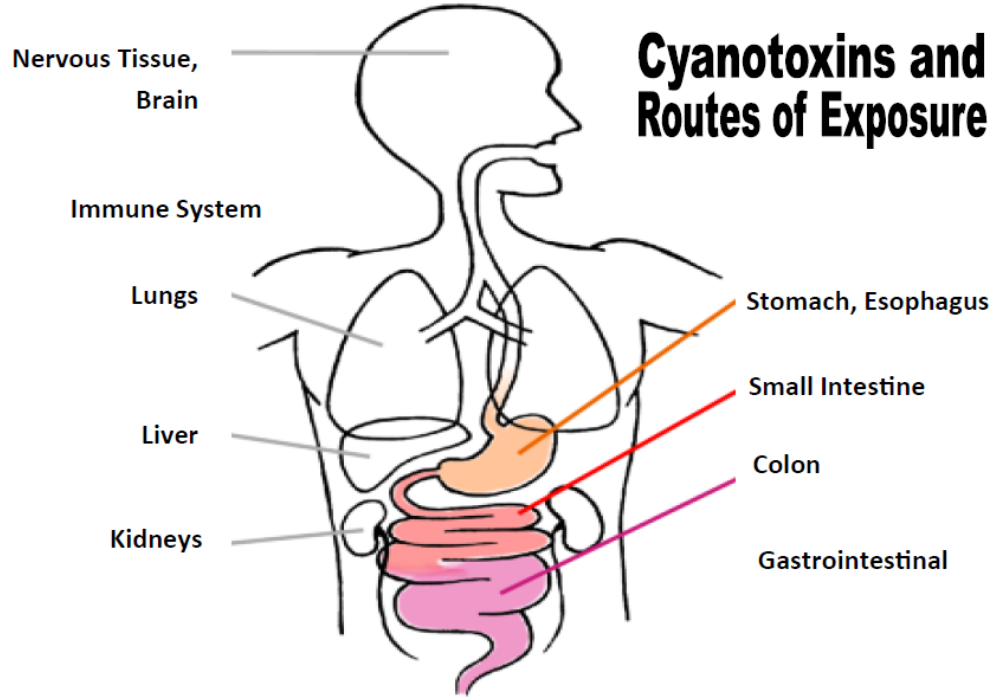
Action levels for selected scenarios

	Microcystins[1]	Anatoxin-a	Cylindro-spermopsin	Media (units)
Human recreational uses[2]	0.8	90	4	Water (µg/L)
Human fish consumption	10	5000	70	Fish (ng/g) ww[3]
Subchronic water intake, dog[4]	2	100	10	Water (µg/L)
Subchronic crust and mat intake, dog	0.01	0.3	0.04	Crusts and Mats (mg/kg) dw[5]
Acute water intake, dog[6]	100	100	200	Water (µg/L)
Acute crust and mat intake, dog	0.5	0.3	0.5	Crusts and Mats (mg/kg) dw[5]
Subchronic water intake, cattle[7]	0.9	40	5	Water (µg/L)
Subchronic crust and mat intake, cattle[7]	0.1	3	0.4	Crusts and Mats (mg/kg) dw[5]
Acute water intake, cattle[7]	50	40	60	Water (µg/L)
Acute crust and mat intake, cattle[7]	5	3	5	Crusts and Mats (mg/kg) dw[5]

'Suggested Action Levels and Six Cyanotoxins', CA OEHHA, 2012

https://oehha.ca.gov/risk-assessment/document/toxicological-summary-and-suggested-action-levels-reduce-potential-adverse

Cyanotoxins and Human Usage



https://enveurope.springeropen.com/articles/10.1186/s12302-019-0212-2#Fig1

Ingestion	Direct Contact
Swallowing water contaminated with cyanobacteria or toxins	Skin contact with water that is contaminated with cyanobacteria or toxins
Eating contaminated fish or dietary supplements	Other exposure routes of Cyanotoxins are Inhalation and Dialysis

Signage for Toxin Levels

Toxin levels above 0.8 µg/L

CAUTION - PRECAUCIÓN

Harmful algae may be present in this water.
Puede haber algas dañinas en estas aguas.

Stay away from algae and scum in the water.
Aléjese de las algas o espuma lamosa en el agua.

Keep children away from algae in the water or on the shore.
Mantenga a los niños alejados de algas en el agua u orilla del agua.

For fish caught here, **throw away guts and clean fillets** with tap water or bottled water before cooking.
Al pescado que pesque aquí, **quítele los intestinos y tírelos a la basura.** Limpie el filete con agua de la llave o embotellada antes de cocinarlo.

Do not let pets and other animals go into or drink the water, or eat scum on the shore.
No deje que sus mascotas o animales se metan o beban el agua, o se acerquen a la espuma lamosa.

Do not drink this water or use it for cooking.
No beba de esta agua o use para cocinar.

Do not eat shellfish from water.
No coma mariscos de esta aguas.

Toxin levels above 6 µg/L

WARNING - ADVERTENCIA

Toxins from algae in this water can harm people and kill animals
Toxinas de algas en estas aguas pueden causar daño a la gente y matar animales

No swimming.
Prohibido nadar.

Stay away from scum, and cloudy or discolored water.
Manténgase alejado de la espuma lamosa, y agua turbia o descolorida.

Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.
No use esta agua para beber o cocinar. Hervir o filtrar el agua no hace que sea segura.

Do not let pets or other animals go into or drink the water, or go near the scum.
No deje que sus mascotas o animales se metan o beban el agua, o se acerquen a la espuma lamosa.

Do not eat shellfish from this water.
No coma mariscos de estas aguas.

For fish caught here, **throw away guts and clean fillets** with tap water or bottled water before cooking.
Al pescado que pesque aquí, **quítele los intestinos y tírelos a la basura**. Limpie el filete con agua de la llave o embotellada antes de cocinarlo.

DANGER - PELIGRO

Toxins from algae in this water can harm people and kill animals
Toxinas de algas en estas aguas pueden causar daño a la gente y matar animales

Toxin levels above 20 µg/L

Stay out of the water until further notice. Do not touch scum in the water or on shore.
Manténganse fuera del agua hasta nuevo aviso. No toque la espuma lamosa en el agua o en la orilla.

Do not let pets or other animals drink or go into the water or go near the scum.
No deje que sus mascotas o animales beban o se metan al agua, o se acerquen a la espuma lamosa.

Do not eat fish or shellfish from this water.
No coma pescados o mariscos de estas aguas.

Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.
No use esta agua para beber o cocinar. Hervir o filtrar el agua no hace que sea segura.

2024 Toxin Level Trends

SITE ID	ARM	6/10	6/25	7/10	8/6	8/20	9/4	9/18	10/2	SAMPLING EVENTS	# CAUTION	# WARNING	# DANGER	SUMMER % TIMES AT C/W/D (6/10 - 10/2
AP01	L	DANGER	DANGER	DANGER	DANGER	WARNING	WARNING	CAUTION	CAUTION	8	2	2	4	100%
BP	L	NONE	CAUTION	CAUTION	CAUTION	CAUTION	CAUTION	WARNING	NONE	8	5	1	0	75%
BVCL6	U	NONE	NONE	NONE	CAUTION	NONE	CAUTION	NONE	NONE	8	2	0	0	25%
CL-1	U	NONE	N/A	NONE	N/A	N/A	NONE	N/A	N/A	3	0	0	0	0%
CL-3	L	CAUTION	N/A	CAUTION	N/A	N/A	WARNING	N/A	N/A	3	2	1	0	100%
CL-4	O	CAUTION	N/A	CAUTION	N/A	N/A	CAUTION	N/A	N/A	3	3	0	0	100%
CLOAKS01	O	NONE	DANGER	DANGER	DANGER	WARNING	CAUTION	NONE	CAUTION	8	2	1	3	75%
CLV7	U	NONE	WARNING	WARNING	WARNING	NONE	NONE	NONE	NONE	8	0	3	0	38%
CP	U	NONE	NONE	NONE	CAUTION	NONE	CAUTION	NONE	NONE	8	2	0	0	25%
FC3	U	NONE	WARNING	WARNING	N/A	N/A	N/A	N/A	N/A	3	0	2	0	67%
ELEM01	O	CAUTION	N/A	DANGER	WARNING	WARNING	WARNING	NONE	NONE	7	1	3	1	71%
GH	O	CAUTION	DANGER	WARNING	CAUTION	CAUTION	CAUTION	NONE	CAUTION	8	5	1	1	88%
HB	U	N/A	CAUTION	CAUTION	CAUTION	NONE	NONE	NONE	CAUTION	7	4	0	0	57%
JB	L	DANGER	CAUTION	WARNING	WARNING	WARNING	WARNING	DANGER	CAUTION	8	2	4	2	100%
KEYS03	O	NONE	DANGER	DANGER	DANGER	DANGER	DANGER	WARNING	CAUTION	8	1	1	5	88%
KP01	U	NONE	CAUTION	DANGER	NONE	NONE	NONE	NONE	CAUTION	8	2	0	1	38%
LC01	L	NONE	DANGER	DANGER	DANGER	CAUTION	DANGER	CAUTION	CAUTION	8	3	0	4	88%
LPTNT	U	NONE	NONE	DANGER	NONE	NONE	CAUTION	CAUTION	NONE	8	2	0	1	38%
LUC01	U	NONE	NONE	NONE	NONE	NONE	CAUTION	NONE	NONE	8	1	0	0	13%
RED01	L	DANGER	DANGER	DANGER	WARNING	WARNING	DANGER	CAUTION	CAUTION	8	2	2	4	100%
RODS	U	NONE	NONE	NONE	N/A	NONE	CAUTION	NONE	NONE	7	1	0	0	14%
SBMMEL01	O	NONE	DANGER	DANGER	WARNING	WARNING	DANGER	NONE	NONE	8	0	2	3	63%
SHADY01	L	CAUTION	WARNING	CAUTION	CAUTION	CAUTION	WARNING	CAUTION	CAUTION	8	6	2	0	100%

2025 Toxin Level Trends

SITE ID	ARM	6/11	6/23	7/8	8/6	8/19	9/3	9/17	10/1	SAMPLING EVENTS	# CAUTION	# WARNING	# DANGER	SUMMER % TIMES AT C/W/D (6/11 - 10/1)
AP01	L	NONE	CAUTION	CAUTION	CAUTION	CAUTION	NONE	NONE	NONE	8	4	0	0	50%
BP	L	NONE	NONE	NONE	CAUTION	CAUTION	NONE	NONE	NONE	8	2	0	0	25%
BVCL6	U	NONE	NONE	NONE	NONE	N/A	NONE	NONE	NONE	8	0	0	0	0%
CL-1	U	NONE	N/A	NONE	N/A	N/A	N/A	NONE	N/A	3	0	0	0	0%
CL-3	L	NONE	N/A	CAUTION	N/A	NONE	N/A	NONE	N/A	4	1	0	0	25%
CL-4	O	NONE	N/A	CAUTION	N/A	N/A	N/A	NONE	N/A	3	1	0	0	33%
CLOAKS01	O	NONE	CAUTION	DANGER	CAUTION	NONE	NONE	NONE	NONE	8	1	0	1	25%
CLV7	U	NONE	NONE	NONE	NONE	NONE	CAUTION	NONE	NONE	8	1	0	0	13%
CP	U	NONE	NONE	NONE	CAUTION	CAUTION	NONE	NONE	NONE	8	2	0	0	25%
ELEM01	O	NONE	WARNING	DANGER	DANGER	NONE	NONE	NONE	NONE	9	0	1	2	33%
GH	O	NONE	NONE	NONE	NONE	CAUTION	NONE	NONE	NONE	8	1	0	0	13%
HB	U	N/A	NONE	NONE	CAUTION	N/A	NONE	NONE	NONE	6	1	0	0	17%
JB	L	NONE	WARNING	CAUTION	CAUTION	NONE	NONE	NONE	NONE	8	2	1	0	38%
KEYS03	O	NONE	NONE	WARNIN	DANGER	CAUTION	NONE	NONE	NONE	8	1	1	1	38%
KP01	U	NONE	NONE	NONE	NONE	CAUTION	NONE	NONE	NONE	8	1	0	0	13%
LC01	L	NONE	NONE	CAUTION	WARNING	NONE	NONE	NONE	NONE	8	1	1	0	25%
LPTNT	U	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	9	0	0	0	0%
LUC01	U	NONE	NONE	NONE	NONE	CAUTION	NONE	NONE	NONE	8	1	0	0	13%
RED01	L	NONE	NONE	NONE	CAUTION	NONE	NONE	NONE	NONE	8	1	0	0	13%
RODS	U	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	8	0	0	0	0%
SBMMEL01	O	NONE	CAUTION	NONE	DANGER	CAUTION	NONE	NONE	NONE	8	2	0	1	38%
SHADY01	L	NONE	CAUTION	CAUTION	CAUTION	NONE	NONE	NONE	NONE	8	3	0	0	38%

Cyanotoxins' Impacts on Beneficial Uses

FISH CONSUMPTION

INVENTORY NAME	SITE ID	DATE COLLECTED (see seasonal color chart at bottom of spreadsheet)	SPECIES NAME *species are categorized by different colors	Microcystin RESULT TISSUE (ng/g)
83	M4	4/21/2015	CRAYFISH	5.94
84	609	4/22/2015	BLACK CRAPPIE	4
85	762	4/23/2015	TULE PERCH	3.02
86	609	4/22/2015	TULE PERCH	4.56
87	AC1	3/25/2010	HITCH	13.34 ☆
88	AC1	3/25/2010	HITCH	16.5 ☆
89	AC1	3/25/2010	HITCH	9.08
90	AC1	MAY, 2010	HITCH	8.47
91	215	5/26/2015	LM BASS	1.94
93	BVCL6	12/12/2017	MUSSEL	28.6 ☆
100	BVCL6	12/12/2017	MUSSEL	17.25 ☆
101	BVCL6	12/12/2017	MUSSEL	15.21 ☆
103	CP	12/14/2017	MUSSEL	12.73 ☆
104	CP	12/14/2017	MUSSEL	19.53 ☆
105	CP	12/14/2017	MUSSEL	22.95 ☆

Table 12: Sport Fish and Shellfish Action Levels for Consumption (ng/g, ww[1])

	Microcystins	Anatoxin-a	Cylindrospermopsin
Sport fish tissue level	☆10	5000	70

Cyanotoxins in Fish, Big Valley 1st Study

Summaries of the average microcystin toxin levels per fish species, season caught, arm of lake caught, and year caught are below. The yellow highlights are those items that are above the Action Levels.

FISH	AVERAGE MICROCYSTIN IN TISSUE NG/G	COUNT
CRAPPIE	4.15	7
BLACKFISH	6.91	1
BLUEGILL	ND	2
CARP	13.60	2
CATFISH	2.02	6
CRAYFISH	4.19	23
HITCH	9.81	8
BASS	1.85	7
MUSSEL	10.33	26
TULE PERCH	ND	4

SEASON	AVERAGE MICROCYSTIN NG/G	COUNT
FALL	12.10	27
SPRING	6.88	35
SUMMER	2.84	15
WINTER	3.51	14

YEAR OF SAMPLE	AVERAGE MICROCYSTIN NG/G	COUNT
2010	11.85	4
2015	5.34	32
2017	10.69	41
2018	3.51	14

ARM OF LAKE	AVERAGE MICROCYSTIN NG/G	COUNT
LOWER	2.02	7
OAK	2.85	10
UPPER	8.21	74

Cyanotoxins in Fish, Big Valley 2nd Study

	TOTAL	# WITH DETECTS		LOWEST #	HIGHEST #
CRAPPIE	6	1	17%	ND	2.79
BLUE GILL	2	1	50%	ND	1.92
CATFISH	8	2	25%	ND	7.01
CARP	8	1	13%	ND	3.77
CRAYFISH	1	1	100%		6.8
GOLDFISH	14	7	50%	ND	3.81
HITCH	30	30	100%	1.72	6.49
REDEAR SUNFISH	2	0	0%	ND	ND
SACRAMENTO BLACKFISH	5	5	100%		7.19
SACRAMENTO SUCKER	3	3	100%	2.43	3.42

79 FISH (10 SPECIES) FROM 2017-2023
51 HAD DETECTS, OR 65%
5 UPPER ARM SPECIES HAD HIGHEST DETECTS
1 LOWER ARM SPECIES HAD HIGHEST DETECTS
3 OAKS ARM SPECIES HAD HIGHEST DETECTS
HIGHEST DETECT - SACRAMENTO BLACKFISH SPRING 2018 UPPER ARM

SPECIES	AVERAGE MC ng/g	COUNT	% WITH DETECTS
CRAPPIE	0.54	6	17%
BLUE GILL	1.01	2	50%
CATFISH	1.44	8	25%
CARP	0.55	8	13%
CRAYFISH	6.8	1	100%
GOLDFISH	1.84	14	50%
HITCH	3.7	30	100%
REDEAR SUNFISH	ND	2	0%
SACRAMENTO BLACKFISH	4.46	5	100%
SACRAMENTO SUCKER	3.17	3	100%

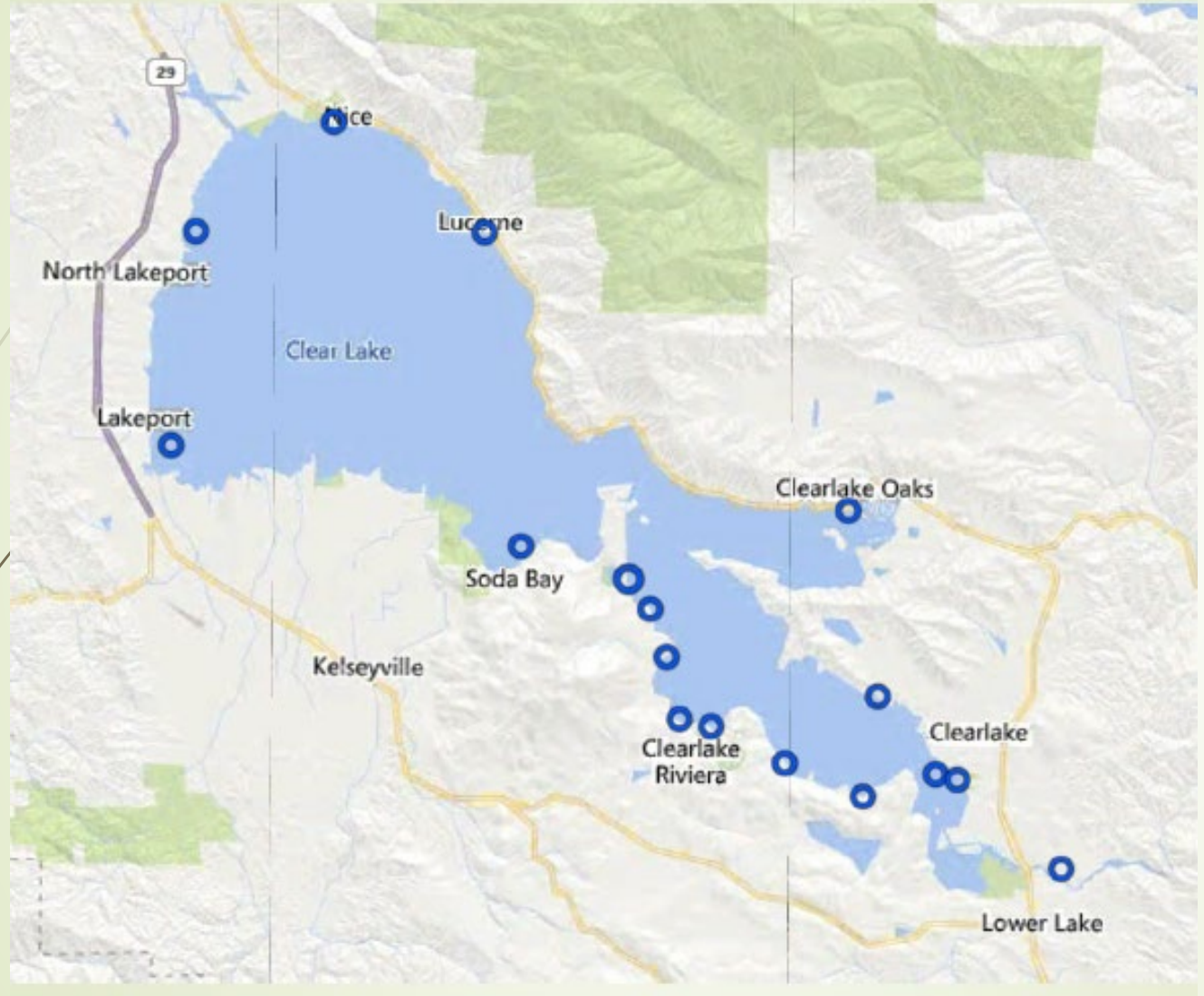
SEASON	AVERAGE MC ng/g	COUNT
FALL		0
SPRING	4.15	31
SUMMER		0
WINTER	1.41	48

YEAR COLLECTED	AVERAGE MC ng/g	COUNT
2017	6.8	1
2018	5.15	6
2022	2.43	52
2023	1.63	20

ARM OF CLEAR LAKE	AVERAGE MC ng/g	COUNT
UPPER	2.44	58
OAKS	2.55	12
LOWER	2.75	9

fish meal/week	suggested action level
1	10 ng/g
5	2 ng/g

Cyanotoxins' Impacts on Beneficial Uses



Surface Water Public Water Systems, Clear Lake

DRINKING WATER

Clear Lake surface water serves approximately 60% of Lake County residents through 17 Public Water Systems.

The Safe Drinking Water Act guidelines on cyanotoxins:

https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisory-documents-cyanobacterial-toxins

Cyanotoxins and Drinking Water

COUNTY OF LAKE
Health Services Department
Public Health Division
922 Bevins Court
Lakeport, California 95453-9739
Telephone 707/263-1090
FAX 707/263-4395

Denise Pomeroy
Health Services Director

Gary Pace, MD, MPH
Public Health Officer

Angela de Palma Dow
Invasive Species Program Coordinator

Craig Wetherbee
Environmental Health Director

Sarah Ryan
Environmental Director, Big Valley Band of Pomo Indians

Joint Press Release from the County of Lake Health Services and Water Resources Departments and Big Valley Band of Pomo Indians

PRESS RELEASE
FOR IMMEDIATE RELEASE

Tap Water Taken Directly from Clear Lake (not through a Public Treatment System or Groundwater Well) in the Oaks and Lower Arms Should Not Be Consumed Due to High Cyanotoxin Levels

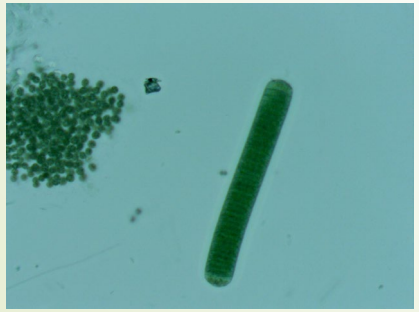
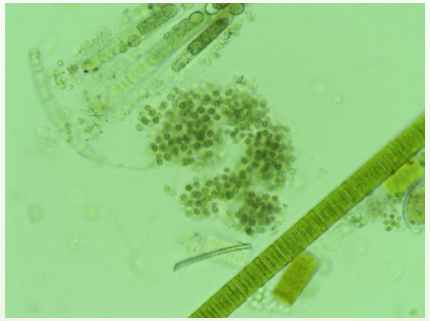
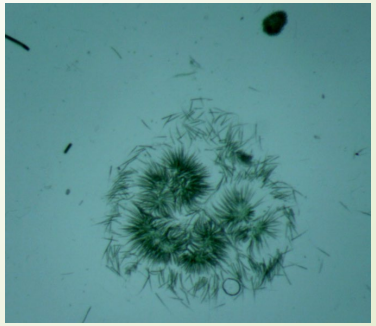
Multifaceted Treatment Processes Utilized by Public Water Systems Can Effectively Treat Water

NOTE: a map demonstrating locations of concerning test results is included with this release, for your use.

Lake County, CA (September 16, 2021) – Clear Lake is a large natural, biologically diverse lake. As such, it is dynamic in water quality. Due to severe drought and heat, we are seeing unprecedented levels of cyanotoxins in some areas of Clear Lake. For Lake County residents with individual water systems that draw water directly from the lake using a private intake, drinking water may become unsafe when high levels of toxins are present.

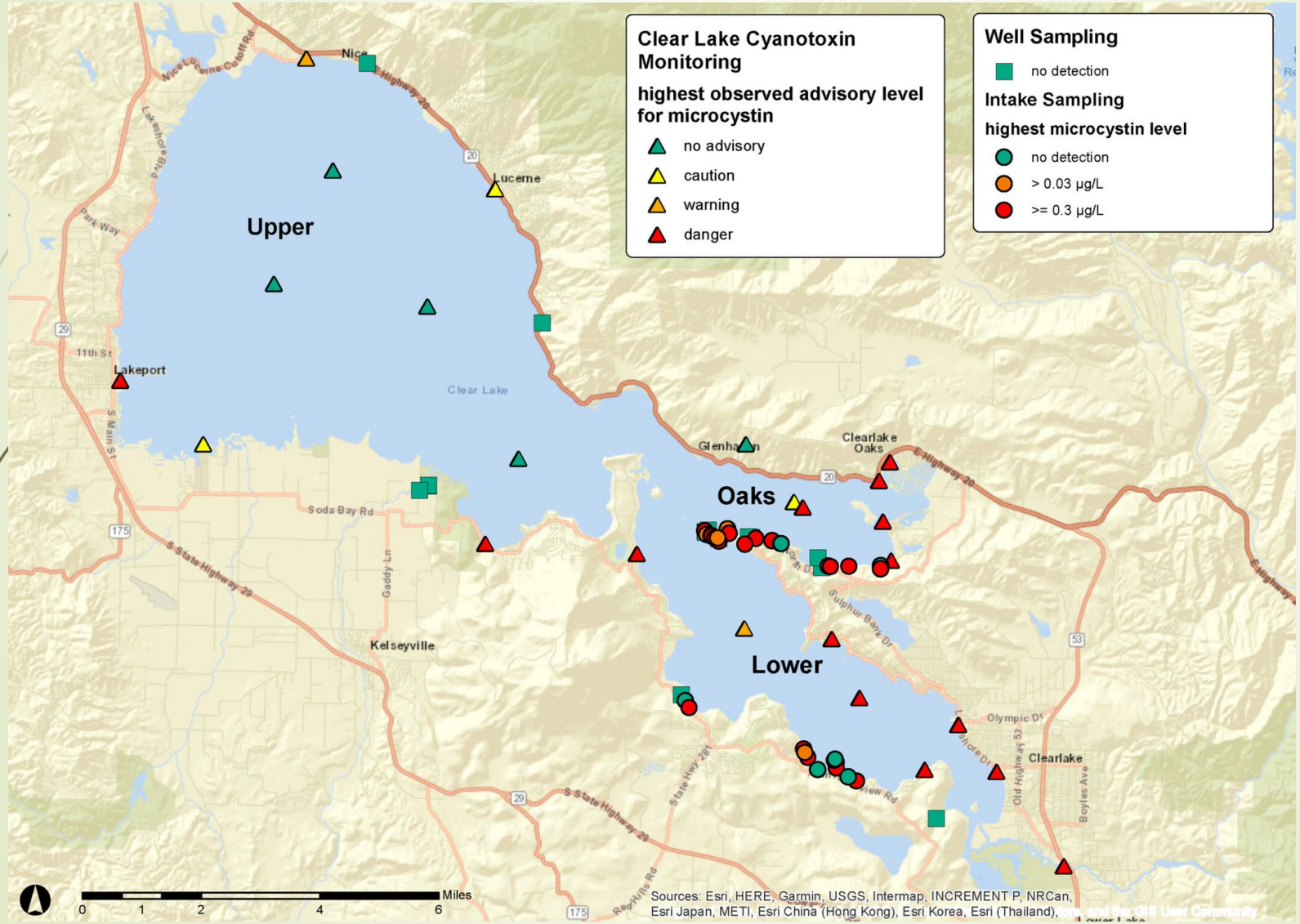
Results of Drinking Water Testing– self supplied systems on Clear Lake, 2021

- June-October 2021, self supplied (private) tap water from 36 homes collected and analyzed.
- Microscopy identified *Microcystis, Gloeotrichia, Kamptonema spp*. in samples.
- Of the 36 homes, 20 had detectable microcystin in them, with 13 homes above the US EPA Health Advisory of 0.3 µg/L. The highest value in the tap water was 3.85 µg/L.
- Ambient lake microcystin levels reached 160,378 µg/L during September.

Photos from tap water samples from private intakes, Clear Lake.

Review of Public Water Systems vs Private and cyanotoxin detects



- https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/aws2.1337 - Vulnerabilities of self-supplied water systems with intakes to source water microcystin and cyanobacteria compared with more advanced monitoring and treatment capabilities at public water systems.

CalWATCH Tap Water Treatment and Microcystin Results

TABLE. Drinking water sampling results, by private water source and treatment system — Clear Lake, California, 2021

Private water source/Treatment system	No.*	Result, no.	
		Microcystin detected†	Microcystin ≥0.3 µg/L
Lake water intake			
Chlorination and filtration	20	11§	9
Chlorination, filtration, and ultraviolet disinfection	3	3	2
Chlorination, filtration, and ozone treatment	1	1	1
Filtration only	4	4	4
Filtration and ultraviolet disinfection	2	2	1
Filtration and ozone treatment	1	1	1
Total	**31**	**22**	**18**
Well			
Chlorination and filtration	6	0	0
Filtration and ultraviolet disinfection	1	0	0
Filtration, ultraviolet disinfection, and ozone treatment	1	0	0
Filtration only	1	0	0
None	6	0	0
Total	**15**	**0**	**0**

* Water was sampled multiple times at several homes. For those homes, the highest result was used.
† Limit of detection for most assays was 0.1 µg/L.
§ Does not include one value from a lake water intake system with chlorination and filtration that was listed as "detected not quantifiable."

- https://www.cdc.gov/mmwr/volumes/71/wr/mm7141a3.htm

Clear Lake Recreational Use HABs Survey Fact Sheet

FOR MORE INFORMATION:

Email:
info@trackingcalifornia.org

Website:
Cal-watch.org

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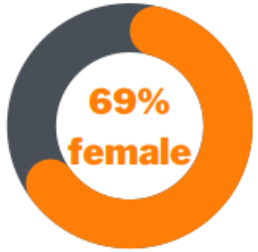
METHODS

Our online survey was advertised on local radio and news and promoted through facebook posts by Big Valley Rancheria. Spanish and English language posters were posted along the perimeter of the lake. In late July, our team also distributed and collected surveys around Clear Lake in person.

RESULTS

412 total responses

- 94% of respondents are aware of HABs in Clear Lake
- 64% of respondents live in Clear Lake full time
- 44% experienced a health issue potentially related to HABs
- 37% of respondents with pets or livestock reported them experiencing symptoms potentially related to HABs



https://bit.ly/HABsImpacts

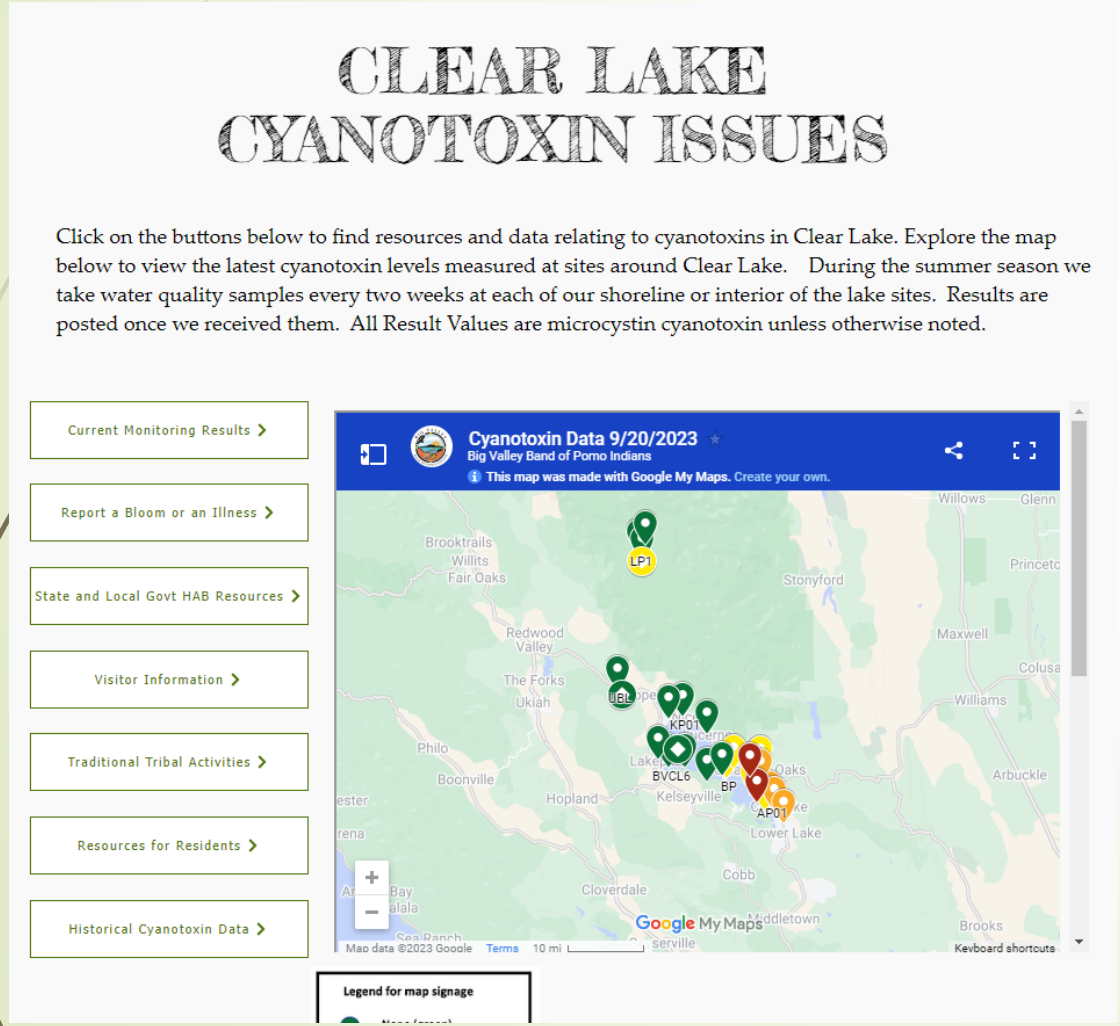
The Cal-WATCH team sought to collect data on awareness of harmful algal bloom (HABs), resident and visitor behavior and experiences, and the utility and effectiveness of HAB outreach in Clear Lake Area.

Around Clear Lake the influence of the monitoring program keeps growing. The data informs warning signs that the county posts at parks and boat launches. Ryan tallies the results on the Big Valley website, too. There have been follow-on studies of toxins in fish tissue and in private drinking water intakes. Public drinking water providers check the data for toxin levels around their intakes.

***Source**: Brett Walton, Circle of Blue, 2021. "California tribes call out degradation of Clear Lake: A monitoring program tracks toxic cyanobacteria and influences change. May 3, 2021, Center for Collaborative Investigative Journalism. https://ccij.io/article/california-tribes-call-out-degradation-of-clear-lake/*

Educating the Public About Water Quality Conditions

- https://www.bvrancheria.com/clearlakecyanotoxins
- https://www.facebook.com/ClearLakeWaterQuality



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