

Item 6

Overview of the State and Regional Freshwater Cyanobacteria Harmful Algal Bloom Monitoring and Response Programs

Rich Fadness & Katharine Carter

North Coast Regional Water Quality Control Board



February 6, 2020
Santa Rosa, CA

Keith Bouma-Gregson & Marisa Van Dyke

State Water Resources Control Board



Presentation Outline

1. Overview of Cyanobacteria & Harmful Algal Blooms (HABs)

2. California Freshwater Harmful Algal Bloom Program &
Assessment and Support Strategy

Keith Bouma-Gregson, PhD

Co-Lead Freshwater Harmful Algal Bloom Program, State Water Board

(20 minutes)

3. California Harmful Algal Bloom Program Infrastructure & Resources

-Where are they?

-How to stay safe?

-How are advisories issues & communicated?

-How to collect samples?

4. Assembly Bill 834 – Freshwater & Estuarine HAB Program

Marisa VanDyke

Co-Lead Freshwater Harmful Algal Bloom Program, State Water Board

(20 minutes)

5. North Coast Region Cyanobacteria Harmful Algal Bloom Program

Rich Fadness

Lead Freshwater Harmful Algal Bloom Program, North Coast Regional Board

(20 minutes)

Cyanobacteria: the good, the bad, the algae

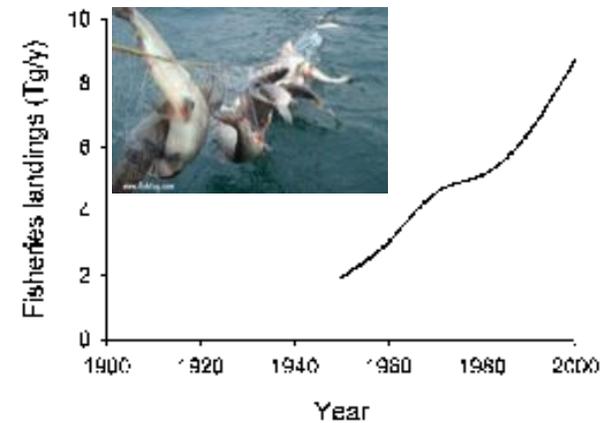
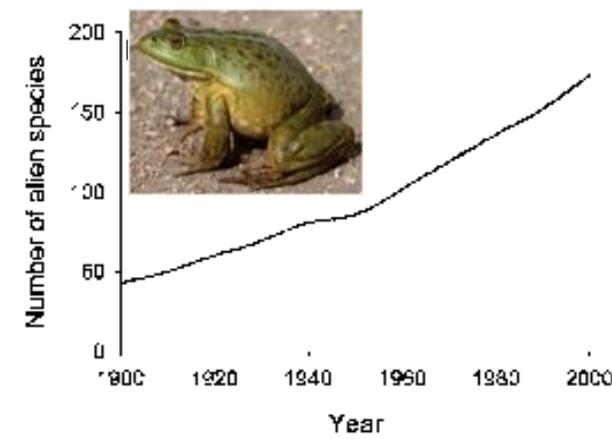
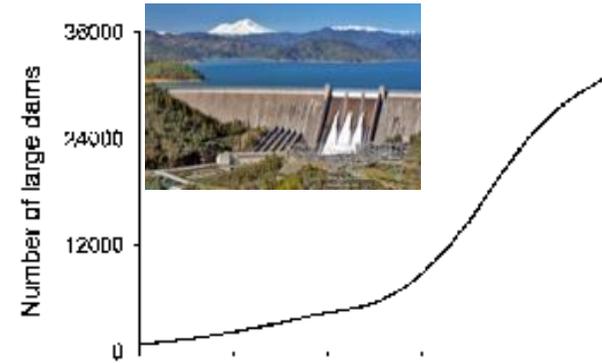
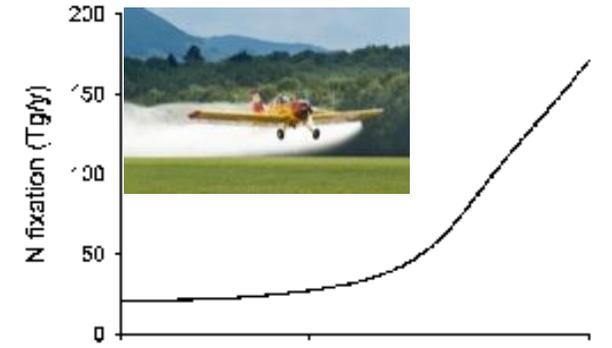
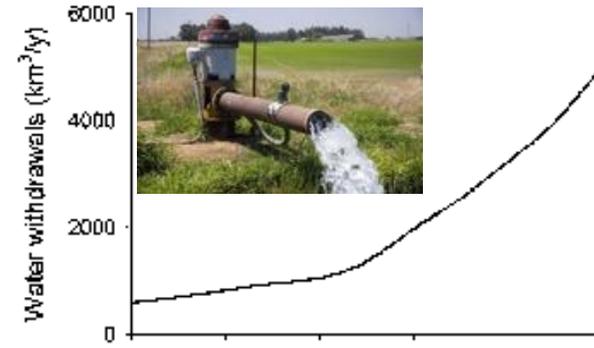


Keith Bouma-Gregson, Ph.D.

Co-Lead Freshwater Harmful Algal Bloom Program
California State Water Quality Control Board

February 6, 2020

Whiskey is for drinking ...

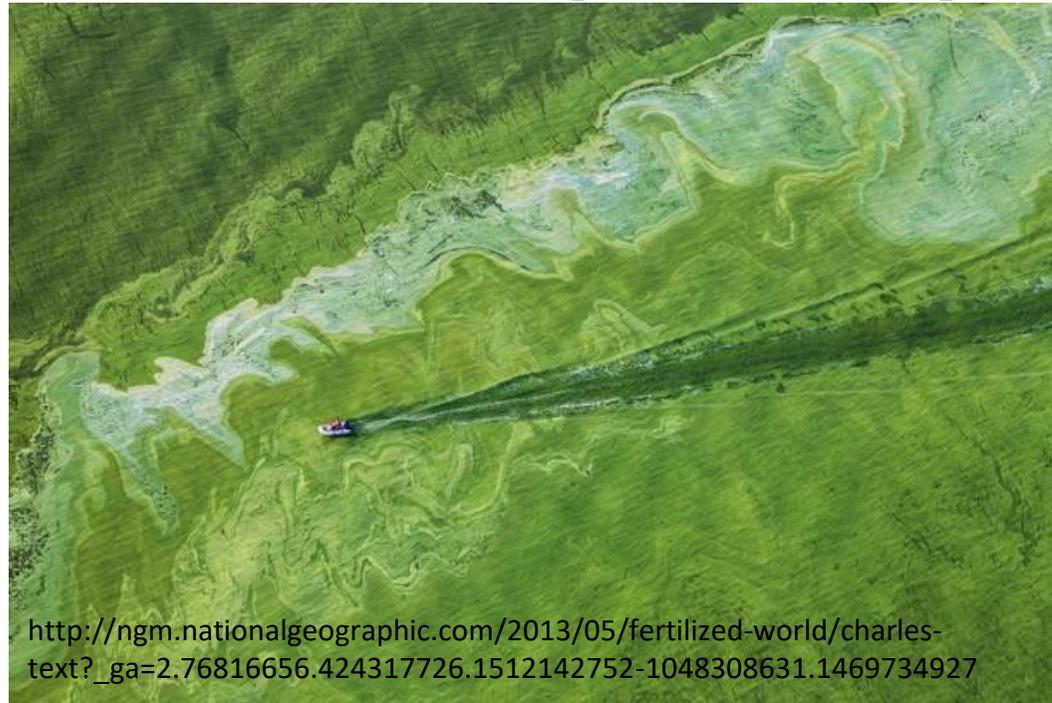


Strayer and Dudgeon 2010, *JNABS*

Harmful Algal Blooms (HABs)



Michalak et al. 2013, *PNAS*



http://ngm.nationalgeographic.com/2013/05/fertilized-world/charles-text?_ga=2.76816656.424317726.1512142752-1048308631.1469734927



<https://www.pbs.org/newshour/science/chinas-blueprint-clean-lakes-stop-algae-blooms-working>



Photo: Ohio EPA



Photo: Richard Graulich/The Palm Beach Post via AP

Impacts of blooms

- Ecosystem function (e.g. fish kills)
- Aesthetics
- **Toxins:** drinking water, recreation, agriculture



Photo: NOAA



Photo: Ohio EPA



<https://dogtrekker.com/usea/files/GreenDogCCJillSiegrist.gif>



Photo: NY Times

Getting our terms straight...

Algae

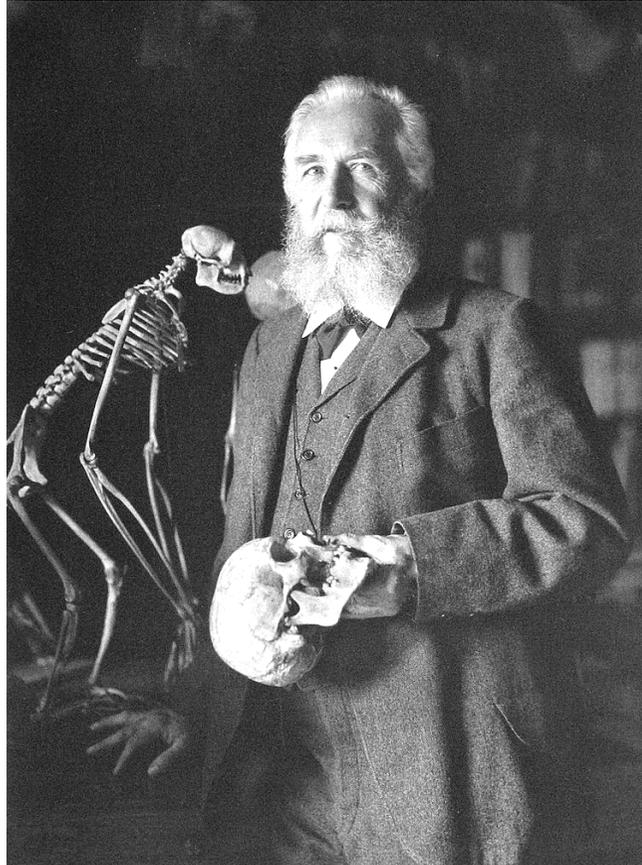
Blue-green algae

Cyanobacteria



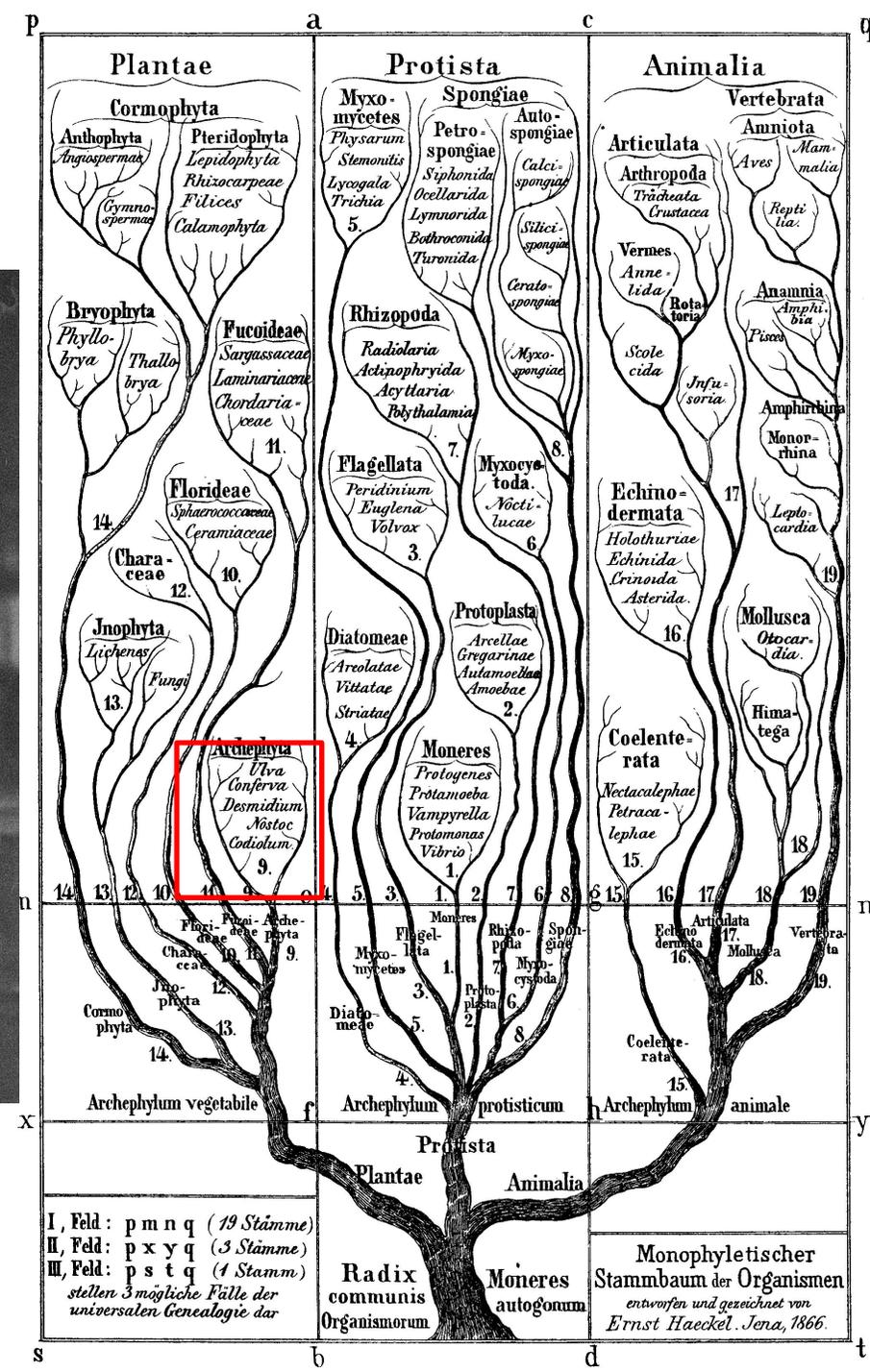
What are Algae?

- Imprecise term for simple photosynthetic organisms
- *Archeophyta* proposed by Ernst Haeckel in 1866
- Includes *Nostoc* a type of Cyanobacteria



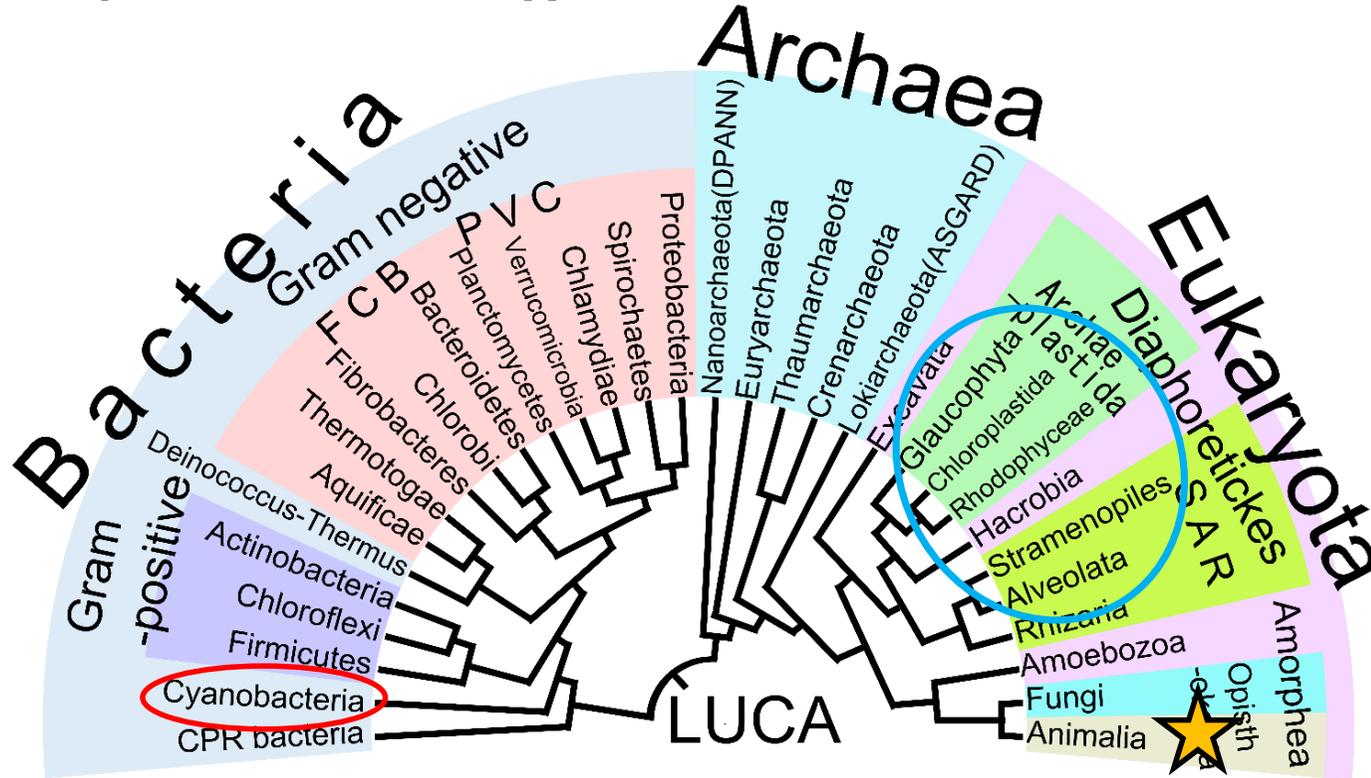
Ernst Haeckel (1904)

<http://resource.nlm.nih.gov/101417555>



What are Algae?

- Blue-green algae = Cyanobacteria
- Cyanobacteria are bacteria (e.g. no nucleus or cell wall)
- Previous combining of cyanobacteria into algae lumps together very different organisms



https://upload.wikimedia.org/wikipedia/commons/1/19/Phylogenetic_Tree_of_Life.png

You are here!

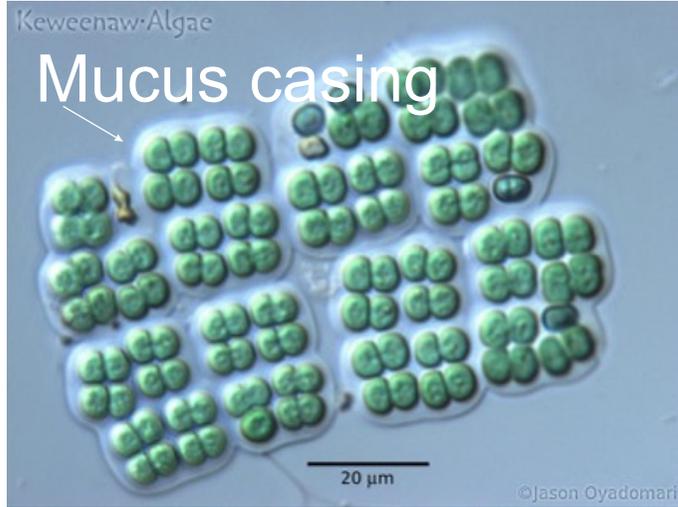
What are Cyanobacteria?

- Photosynthetic bacteria
- Evolved >2 billion years ago



Diversity of Cyanobacteria

Single celled

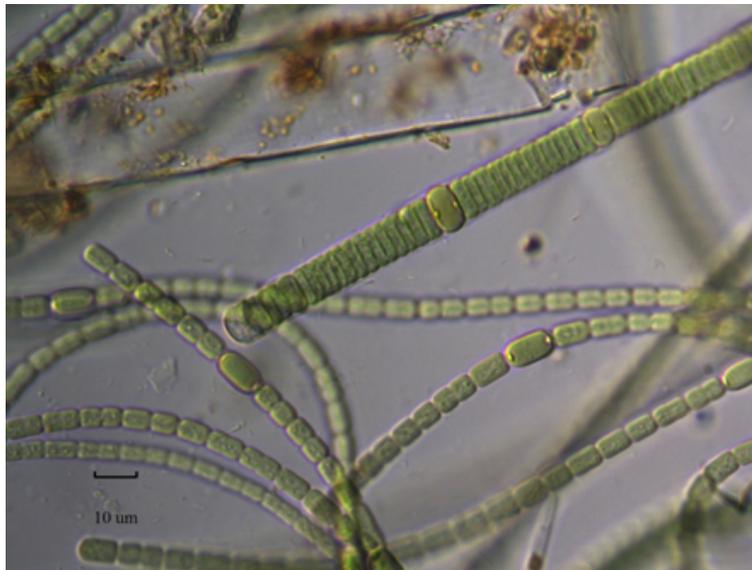
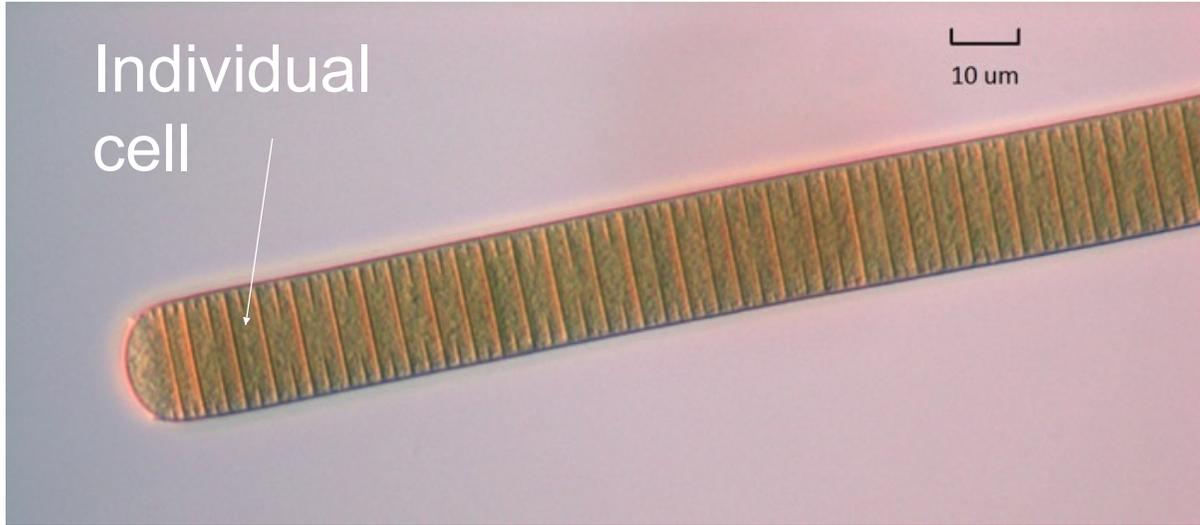


http://www.keweenawalgae.mtu.edu/gallery_images/cyanobacteria/Merismopedia_j72a-15_402z_ec_h.jpg



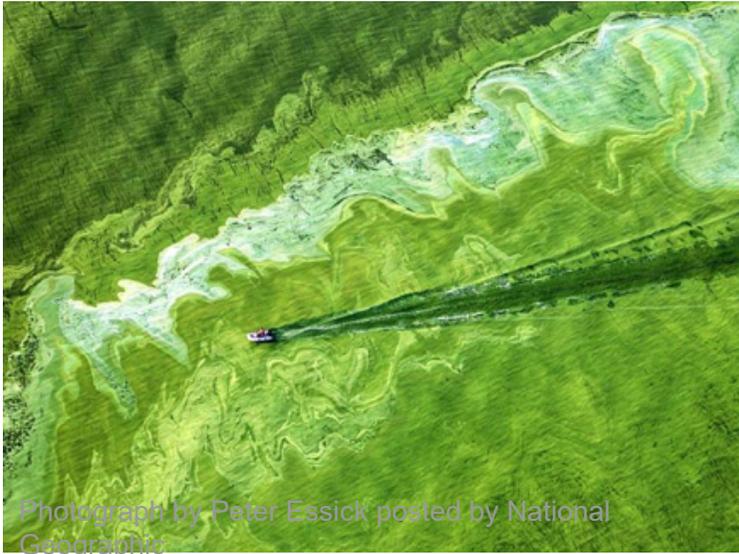
http://www.keweenawalgae.mtu.edu/gallery_images/cyanobacteria/Woronichinia_p5-8a_40125.jpg

Filamentous



Where do Cyanobacteria live?

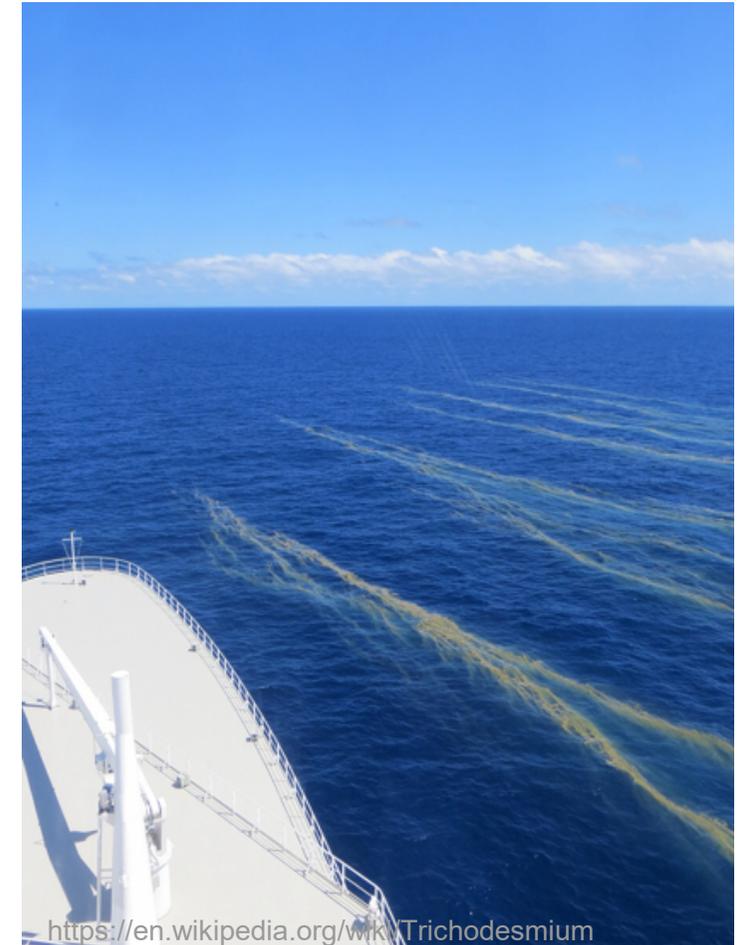
Lakes



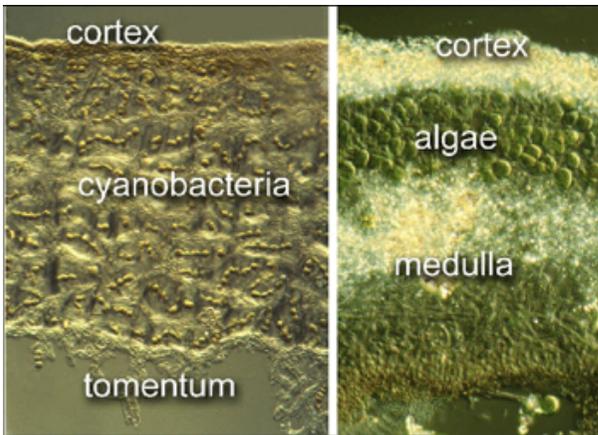
Deserts



Oceans



Symbioses



https://www.researchgate.net/figure/Cross-section-through-a-lichen-with-cyanobacteria-as-photobiont-left-and-green-algae-right-fig1_282031175

Antarctica



<https://www.nhm.ac.uk/discover/news/2018/april/blue-green-algae-from-legendary-expedition-help-study-of-climate.html>

HABs in California

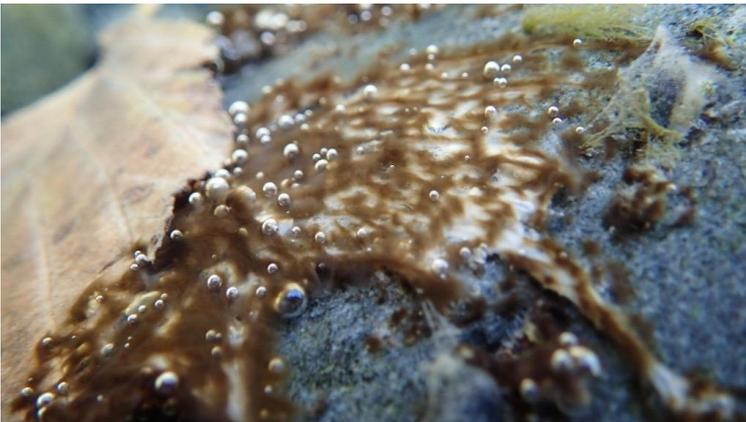
	2016	2017	2018	2019
Reports	91	181	190	241

- Oregon to Mexico
- High elevation to the coast
- Urban and rural areas
- Drinking water reservoirs and natural lakes
- Rivers
- Cyanotoxins in estuaries
- Occur every month, peak in summer

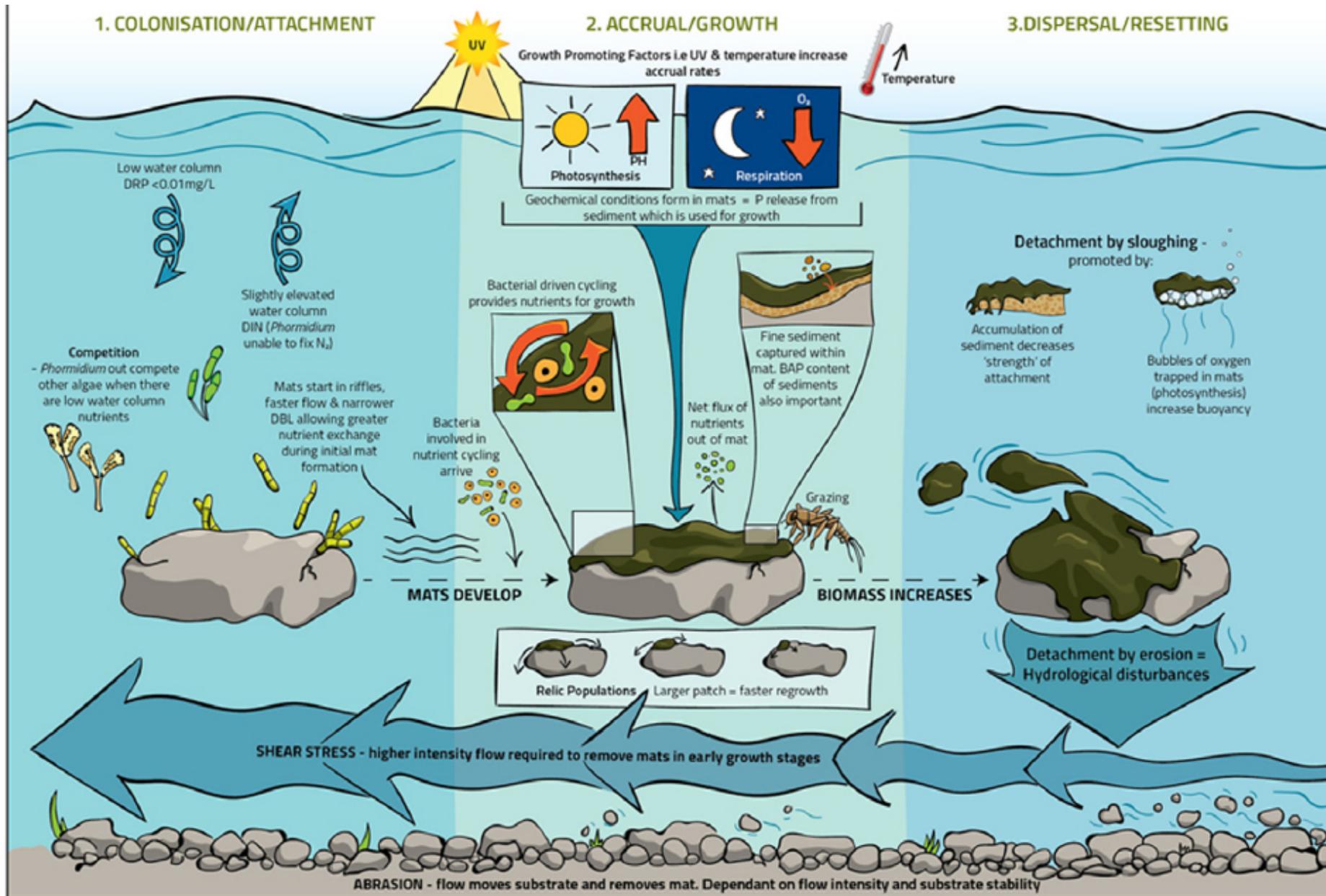


Cyanobacteria in rivers

Mucilaginous mats growing on riverbed



Cyanobacteria in rivers



Three phases

- 1) Colonization
- 2) Growth
- 3) Detachment

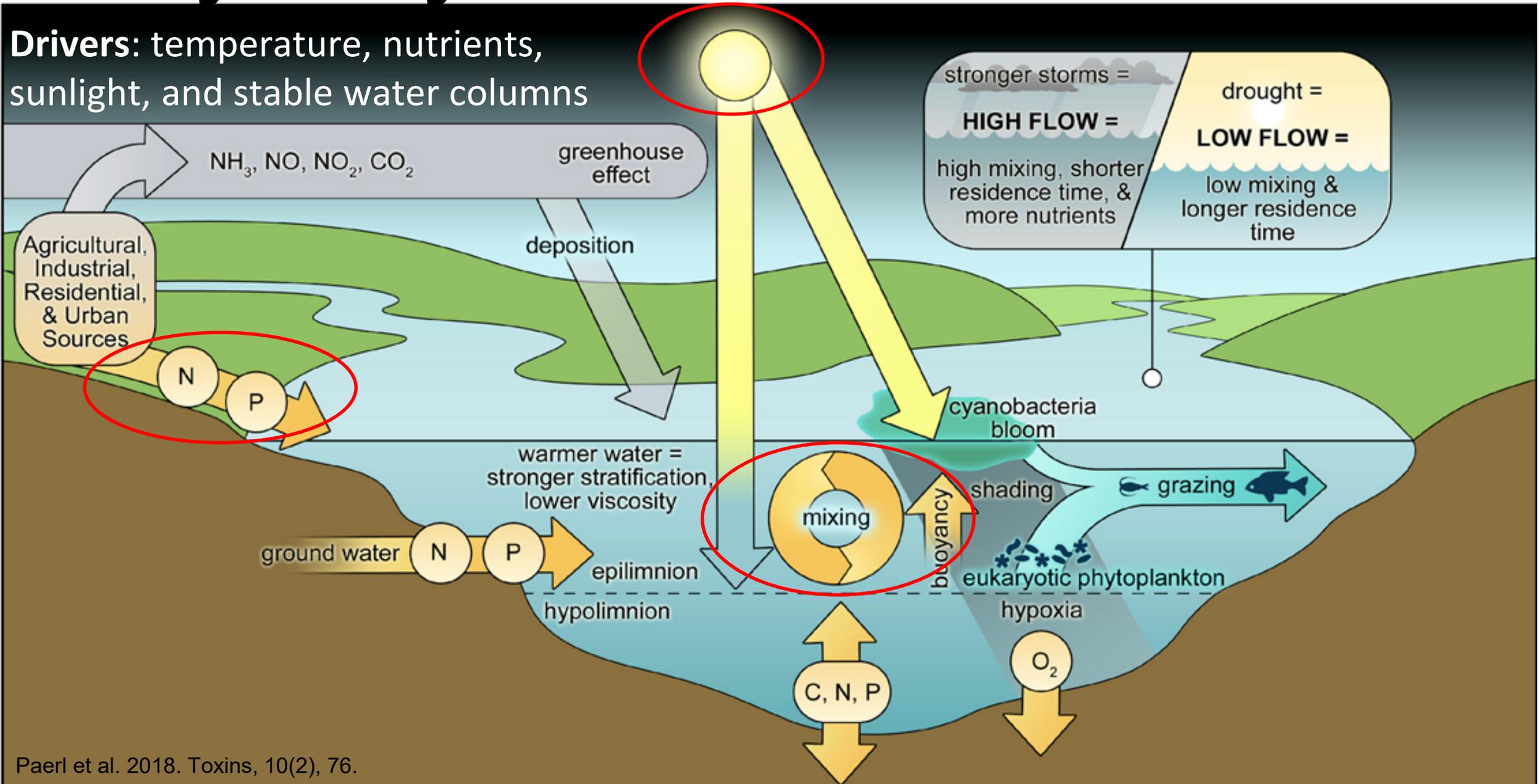
Cyanobacteria in rivers

Detachment and stranding on riverbank a public health risk

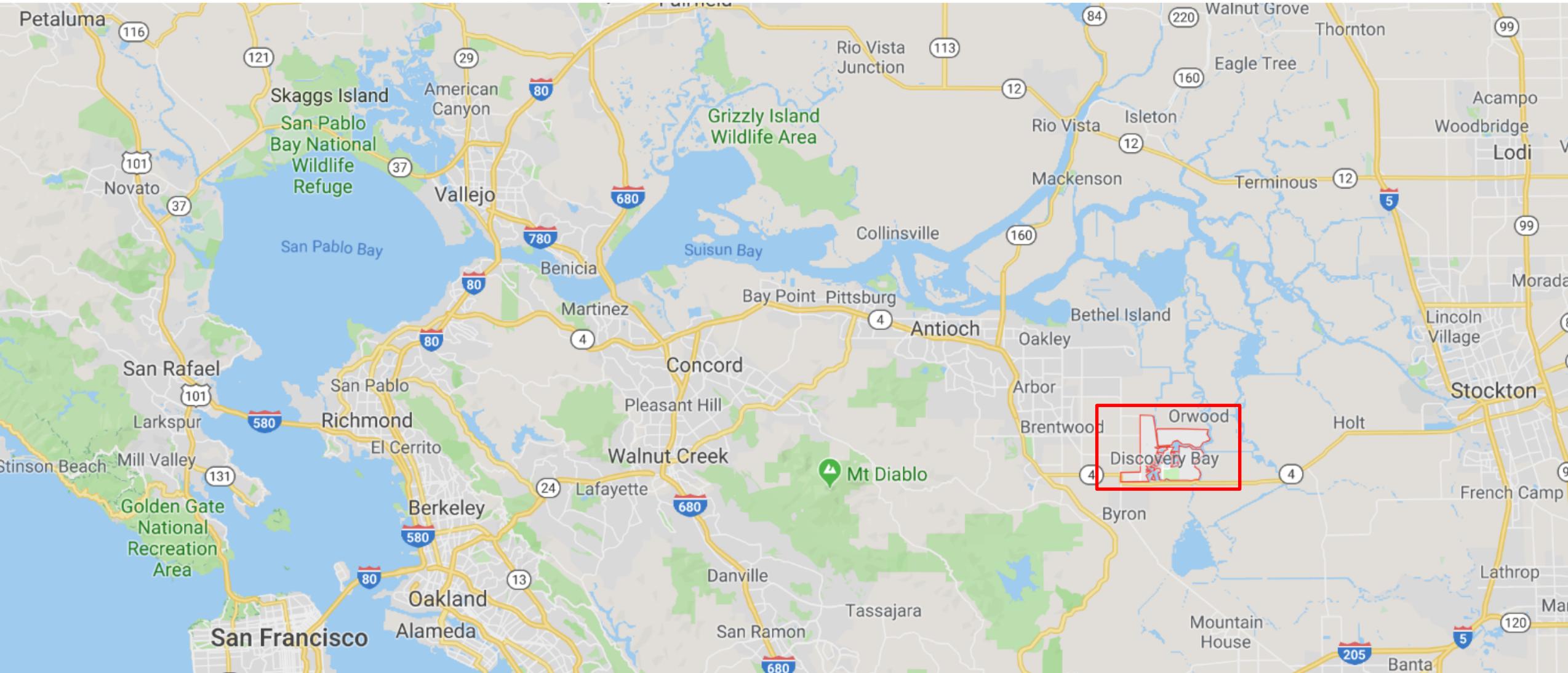


Why do cyanobacteria bloom?

Drivers: temperature, nutrients, sunlight, and stable water columns



Example of a bloom



Mitigating blooms

Physical treatments

- Aeration
- Mechanical mixing
- Hypolimnetic oxygenation

Watershed treatments

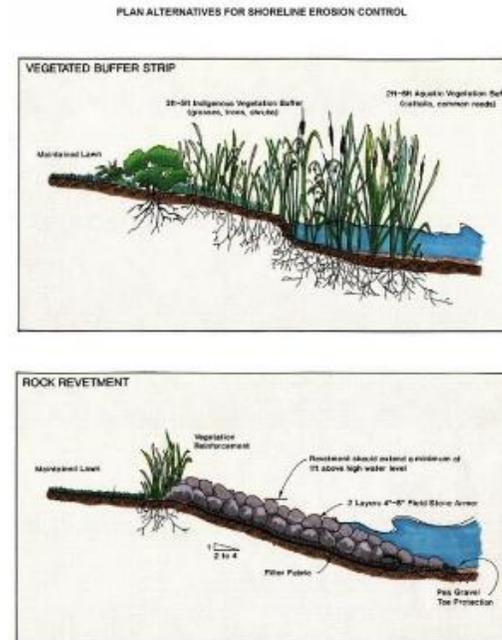
- Reduce erosion
- Reduce nutrient inputs
- Riparian vegetation
- Wetlands

Chemical treatments

- Alum, phoslock
- Algicides



<https://www.pe.com/2019/06/07/blue-green-algae-treated-at-lake-skinner-near-temecula-as-other-lakes-recover-from-blooms/>



NOTE: Design specifications shown herein are for typical structures. The detailed design of shoreline protection structures may vary based upon analysis of local conditions.

Source: GENWPC.



Cyanotoxins

Cyanotoxins

Types of effects

- skin
- liver
- kidneys
- nervous system



DANGER

Toxins from algae in this water can harm people and kill animals

  **Stay out of the water until further notice. Do not touch scum in the water or on shore.**

  **Do not** let pets or other animals drink or go into the water or go near the scum.

  **Do not** eat fish or shellfish from this water.

 **Do not** use this water for drinking or cooking. Boiling or filtering will not make the water safe.

For people, the toxins can cause:

- Skin rashes, eye irritation
- Diarrhea, vomiting

For animals, the toxins can cause:

- Diarrhea, vomiting
- Convulsions and death

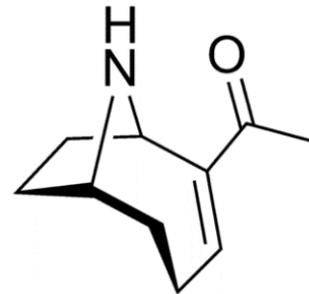
Call your doctor or veterinarian if you or your pet get sick after going in the water.

For more information on harmful algae, go to <https://mywaterquality.ca.gov/habs/index.html>

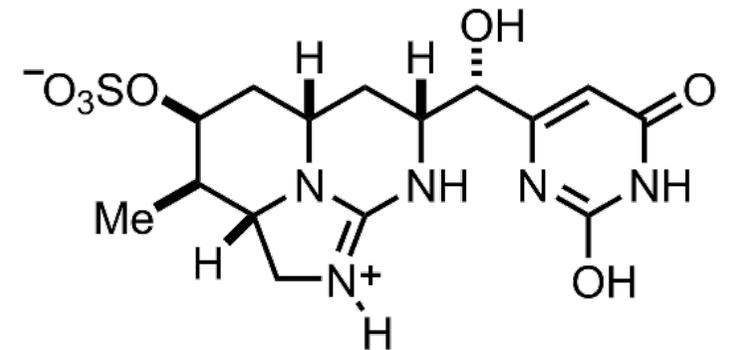
For local information, contact:

Toxin	Toxicity
Microcystin	Liver
Anatoxin	Neurotoxin
Cylindrospermopsin	Liver & kidney
Saxitoxin	Neurotoxin

Anatoxin



Cylindrospermopsin



Cyanotoxin exposure routes

Skin



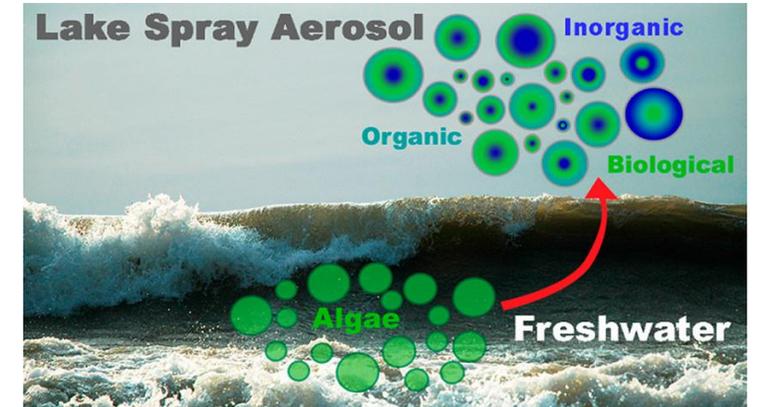
contact <https://esemag.com/wp-content/uploads/2018/07/Blue-Green-Algae.jpg>

Ingestion



<https://www.housebeautiful.com/lifestyle/kids-pets/a28723484/blue-green-algae-killing-dogs/>

Inhalation



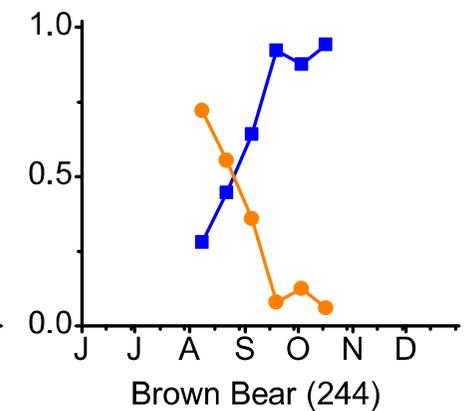
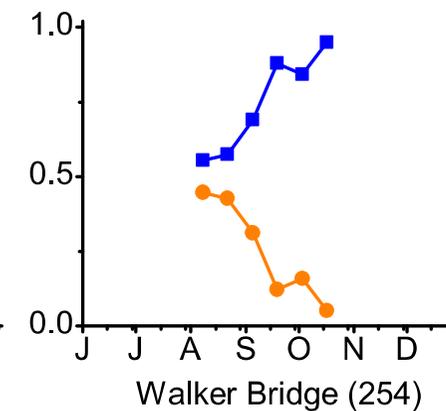
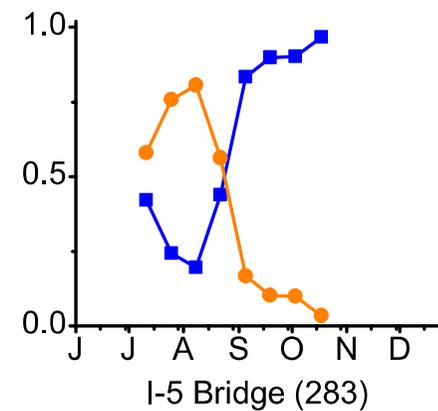
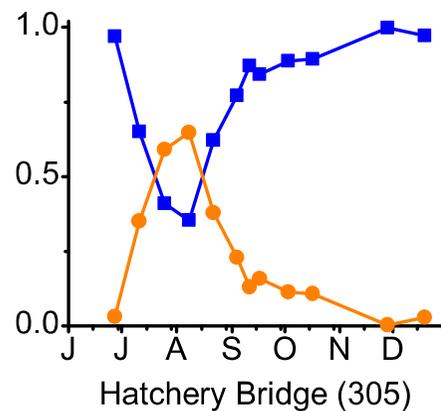
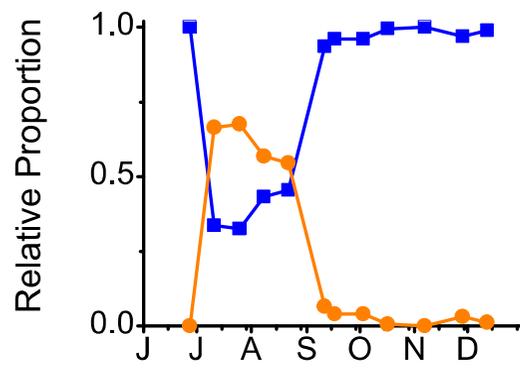
<https://www.kwrwater.nl/en/actueel/airborne-dispersal-of-cyanobacteria/>



https://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/programs/convention/2019/FR-Session6/AmandaKoch_Cyanobacteria_talk_WPLC_4.12.19.pdf

Cyanotoxin production

- Toxin production controlled by genes
- Not all species and strains contain toxin synthesis genes
- Changes in bloom toxicity often driven by changes in number of toxin and non-toxin producing strains in the bloom



Cyanotoxins – need to test water to determine toxicity



Pinto Lake

**Toxins
Present**



Lake

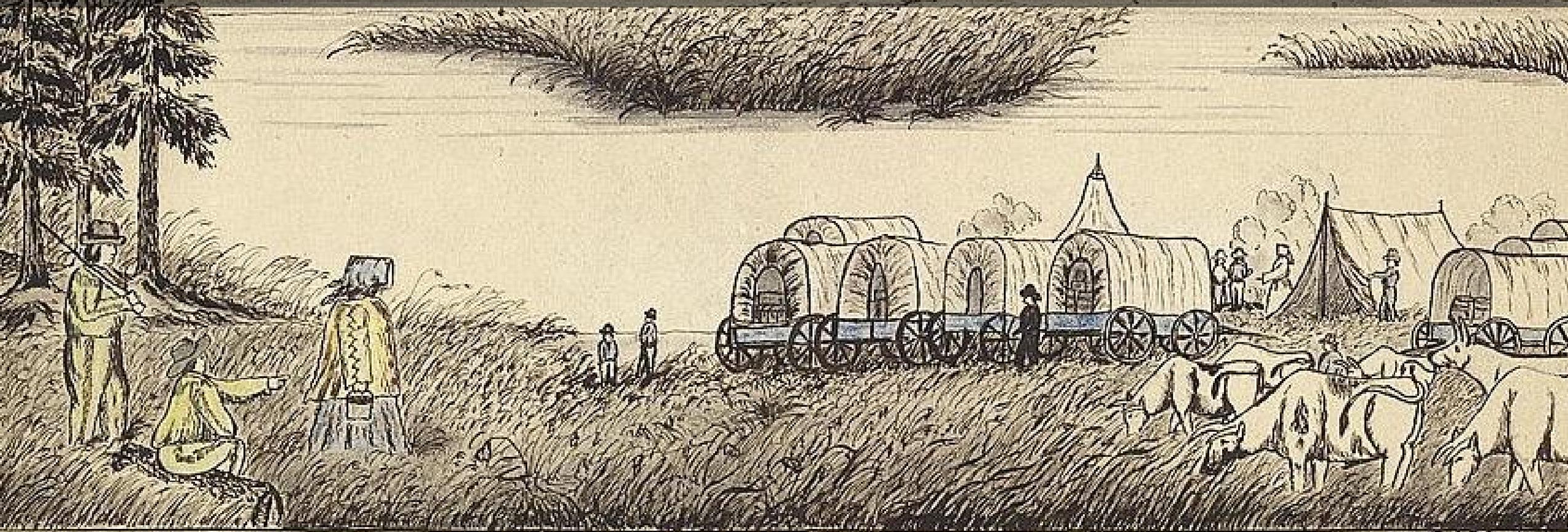
Pillsbury

**No Toxins
Present**



CA freshwater HABs program

The past



Camp 120 - Eagle Lake - Sierra Nevada, s

History of FHABs in California

1970s: Clear Lake blooms; Horne and Goldman

2000s: Klamath reservoirs bloom and formation

2006: CCHAB network formed

2014: Toledo, OH water crisis

2016: FHABs Strategy document, CA FHAB program begins, and formal tracking of FHABs



Strategic Plan – Phase 1

2016

California Freshwater Harmful Algal Blooms Assessment and Support Strategy

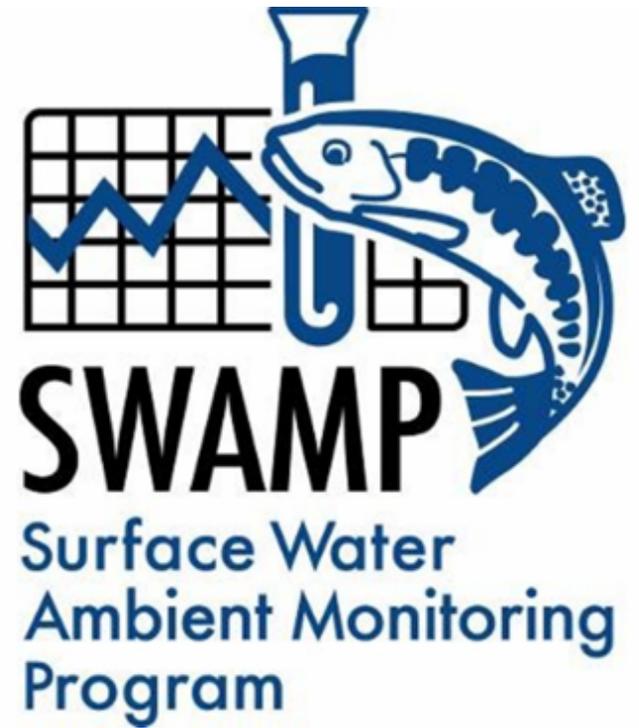
**Beverley Anderson-Abbs
Meredith Howard
Karen Taberski
Karen Worcester**

SWAMP-SP-SB-2016-0001

January 2016

What is SWAMP?

- Surface Water Ambient Monitoring Program (SWAMP)
- SWAMP provides water quality resources and information to decision makers and the public about the condition of **surface waters** in California.
- SWAMP is the designated agency lead for the Freshwater Harmful Algal Bloom (FHAB) Program.



SWAMP FHABs program

The freshwater Harmful Algal Bloom program's purpose is to:

- lead freshwater HAB event response,
- assessment, and
- communication

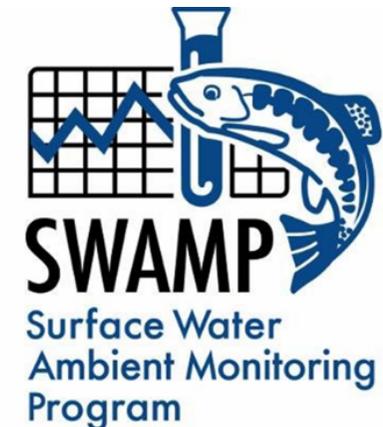
Focus on recreational exposures, and source water protections where recreational and drinking water uses overlap

California Freshwater Harmful Algal Blooms Assessment and Support Strategy

**Beverley Anderson-Abbs
Meredith Howard
Karen Taberski
Karen Worcester**

SWAMP-SP-SB-2016-0001

January 2016





The present



Freshwater Harmful Algal Bloom Program Infrastructure & Resources

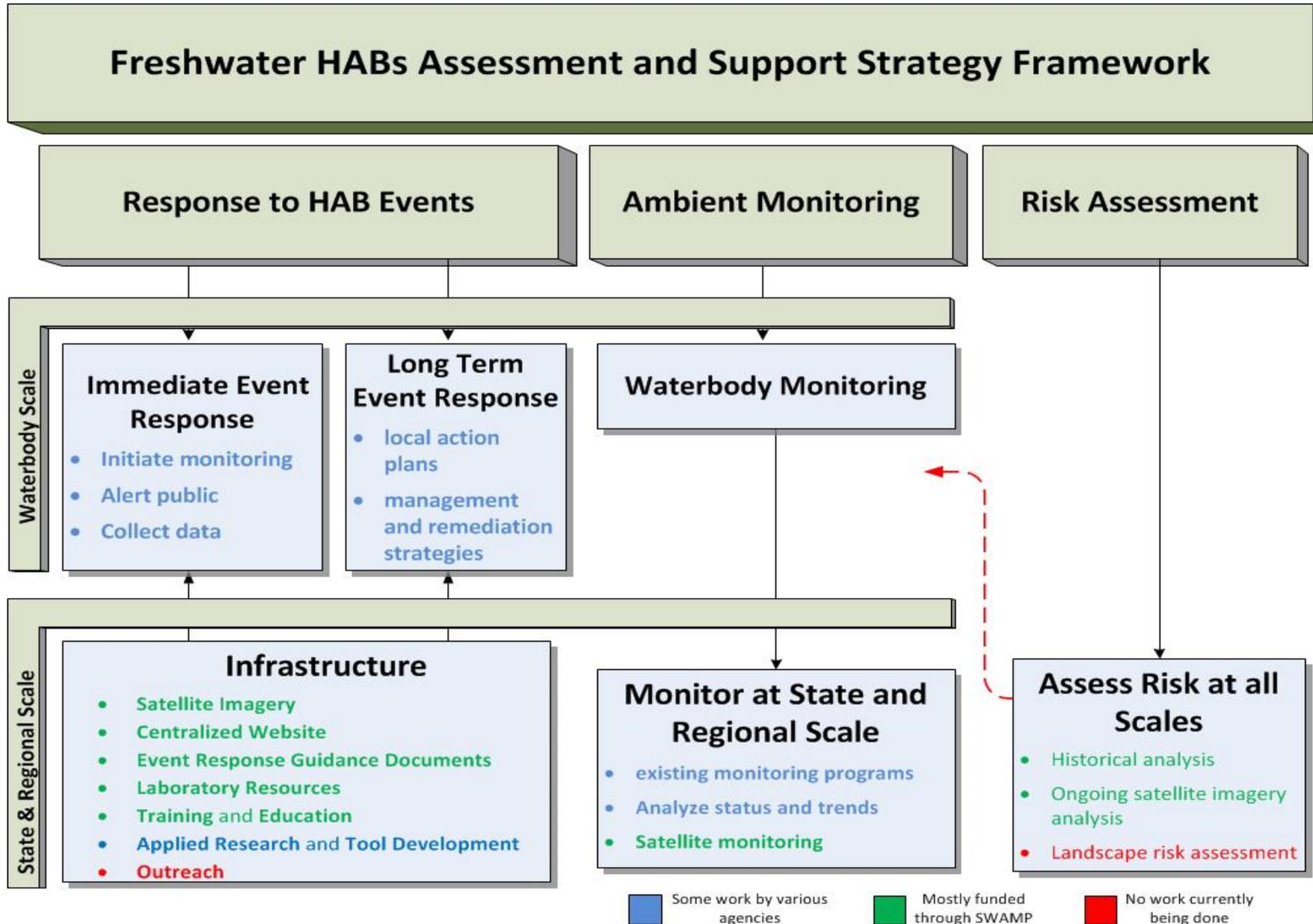


Marisa Van Dyke

Co-Lead Freshwater Harmful Algal Bloom Program
California State Water Quality Control Board

February 6, 2020

FHABs assessment and support strategy (2016)



Program Infrastructure Development



- Infrastructure developed to support immediate and long-term event response
- Centralized website launched in 2016
 - CA HABs Portal <https://mywaterquality.ca.gov/habs/index.html>
 - Created a platform to bring together all resources for the public and support coordination with partner organizations
 - Water Boards manages the Portal
- Developed other infrastructure including:
 - Response procedures, field SOPs, lab capacity, satellite imagery tool
 - Supported limited outreach, education and applied research

Central Themes of HAB Resources

Where are
HABs?



How to stay
safe?



How are
advisories
issued and
communicated?

WARNING

Toxins from algae in this water can harm people and kill animals

 No swimming.	 Do not let pets or other animals go into or drink the water, or go near the scum.
 Stay away from scum, and cloudy or discolored water.	 Do not eat shellfish from this water.
 Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.	 For fish caught here, throw away guts and clean fillets with tap water or bottled water before cooking.

For people, the toxins can cause:

- Skin rashes, eye irritation
- Diarrhea, vomiting

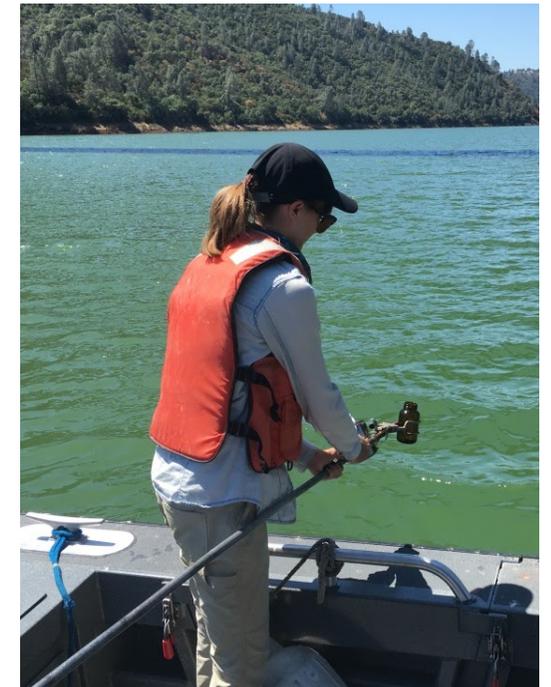
For animals, the toxins can cause:

- Diarrhea, vomiting
- Convulsions and death

Call your doctor or veterinarian if you or your pet get sick after going in the water.

For information on harmful algae, go to mywaterquality.ca.gov/monitoring_council/cyanohab_network
For local information, contact:

How to
collect
samples?



Where are HABs?

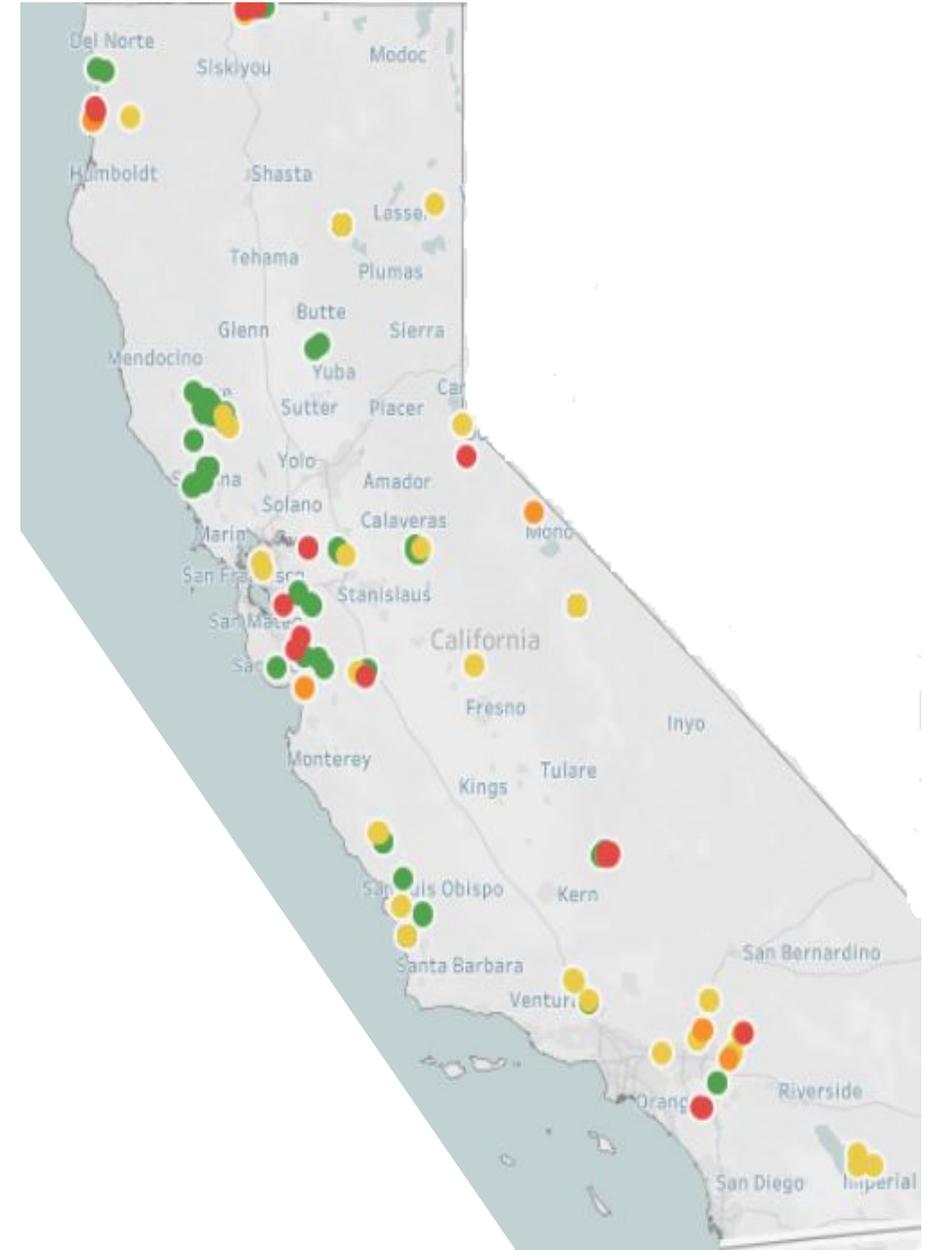


Where are HABs?

HAB Incident Reports Map

https://mywaterquality.ca.gov/habs/where/freshwater_events.html

- Map is populated from the Water Boards reporting and database system
 - Reporting is voluntary
- Anyone can submit a report or an update by:
 - Online report form, phone, or email
- Reports include:
 - Suspected or confirmed blooms
 - Data from some monitoring programs
 - Human or animal illness
- An interagency illness workgroup leads response and reports to the Centers for Disease Control (CDC) database

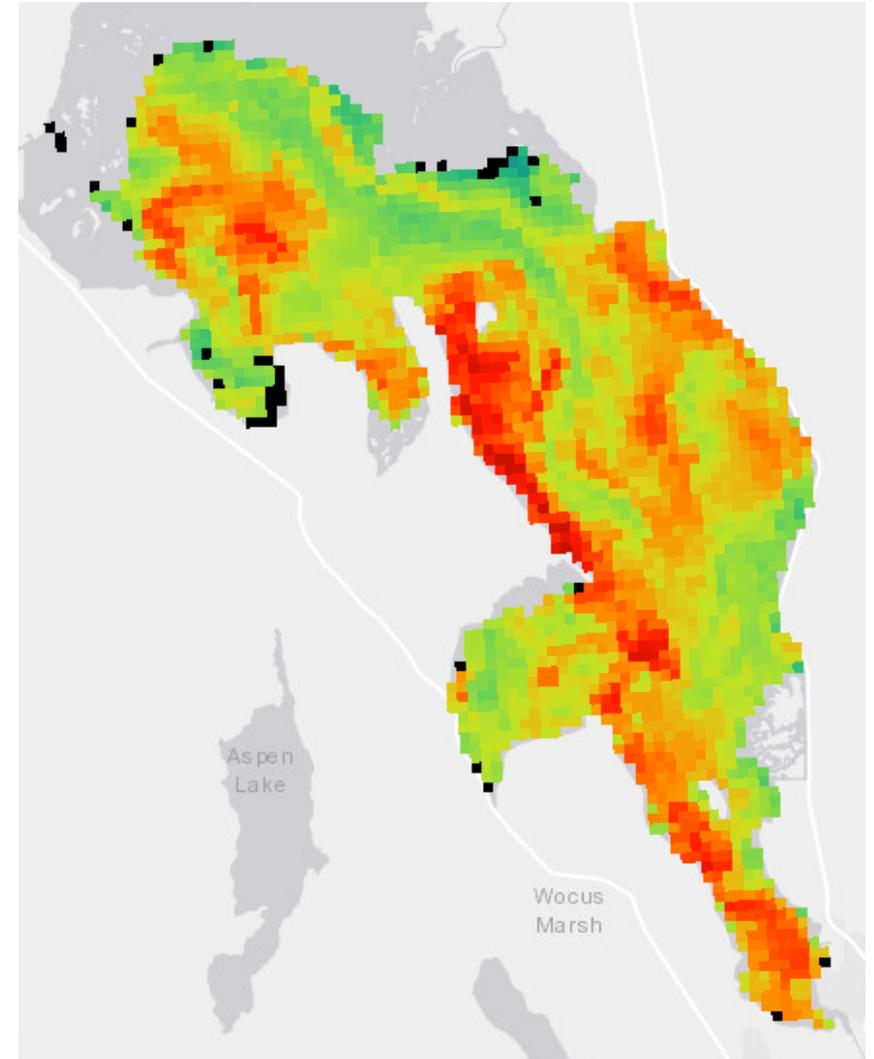


Where are HABs?

Satellite CyanoHAB Map Tool

https://mywaterquality.ca.gov/habs/data_viewer/

- Developed for water managers and agencies
- Currently displays satellite imagery for ~250 largest waterbodies
- Purpose to inform where cyanobacteria blooms are developing and prioritize field assessments
- Imagery does not show toxin concentrations from blooms
- SWAMP is conducting research to improve data quality, current the data is provisional



**How to stay
safe?**



How to stay safe?

Fact Sheet What

IDENTIFYING Non-toxic Algae

This quick guide provides a visual key to identify non-toxic green algae and cyanobacteria in California's coastal waters and estuaries.

APPEARANCE



Rooted Plants



Floating Plants



Plant-like Algae



Filamentous Algae



WHAT ARE CYANOBACTERIA (ALSO KNOWN AS HARMFUL ALGAE)? Cyanobacteria (also known as blue-green algae) are found in all water bodies. Algae are found around for billions of years and are essential components of ecosystems that are vital to our health. They are a food source for many organisms, and when certain species of these organisms, they can rapidly grow causing cyanobacterial blooms (HABs). Cyanobacteria can produce toxins and taste and smell bad. In some health risks to humans and animals. In some blooms pose a risk to the environment, they are called cyanobacterial blooms (HABs).

HOW DO I KNOW IF I HAVE A HAB IN THE WATER? Sometimes the bloom is visible as a "scum" or discoloration on the water's surface or on the bottom. Blooms can appear green, brown, or blue. Cyanobacteria cannot be visually identified. Several guides are available to help identify cyanobacteria.

1— <https://mywaterquality.ca.gov>
2— <https://drive.google.com/view>

Human Health

- Frequently Asked Questions (FAQs) for Human Health
- Resources for Medical Professionals
- One Health Harmful Algal Bloom System (OHHABS)

FAQs for Human Health

How can I or my family be exposed to cyanobacteria?

Human exposure to cyanobacteria occurs through ingestion or skin contact with cyanobacteria. Cyanobacteria concentrations in water can be high, and cyanobacteria can produce toxins that can cause health effects from cyanobacteria that are not visible to the eye.

How can I keep myself and my family safe from cyanobacteria?

- Check if a waterbody has a reported bloom by checking the [HAB Reports Map](#), contacting the waterbody manager, and looking for [posted advisory signs](#).
- Check to see if the water is scummy, discolored, or has a strong, earthy, or musty odor.
- Practice [Healthy Water Use](#).
- [Report any suspected cyanobacteria](#).

What are signs of possible cyanobacterial toxin poisoning in humans?

The following symptoms may indicate cyanobacterial toxin poisoning:

- sore throat or congestion
- coughing, wheezing, or difficulty breathing
- red, or itchy skin, or skin blisters or hives;
- earache or irritated eyes
- diarrhea or vomiting;
- agitation;
- headache; and/or,
- abdominal pain.

If people show symptoms of cyanobacterial toxin poisoning, they should receive medical attention. For more information, contact the [Centers for Disease Control and Prevention](#) (1-800-222-1222).

Fish and Wildlife

- Frequently Asked Questions (FAQs) for Fish and Wildlife
- FAQs for Wildlife (Wild Birds and Fish)
- One Health Harmful Algal Bloom System (OHHABS)

FAQs for Fish

How can fish be exposed to HABs?

Fish can be exposed to HABs and associated toxins by:

- Direct contact with cyanobacteria
- Ingestion of cyanobacteria

What are signs of possible cyanobacterial toxin poisoning in fish?

Fish may become sick or die from exposure to cyanobacteria. Symptoms of cyanobacterial toxin poisoning in fish include:

How can I report fish kills?

Fish kills that may be related to a cyanobacterial bloom should be reported to the [California Department of Fish and Wildlife \(CDFW\)](#) and assist in collecting samples for analysis.

What are Golden Algae Blooms?

Southern California is experiencing a cyanobacterial bloom in inland saline (salty) waterbodies. This bloom causes illness and death. For more information, contact the [California Department of Fish and Wildlife \(CDFW\)](#).

FAQs for Wildlife (Wild Birds and Fish)

How can wildlife be exposed to HABs?

Wildlife can be exposed to HABs and associated toxins by:

Animals can be at risk even when they are not drinking water. Animals can be exposed to cyanobacteria when they eat algal material growing in the water. Such poisonings typically affect benthic cyanobacteria.

How can I report sick or dead wildlife?

Sick or dead wildlife that may be related to a cyanobacterial bloom should be reported to the [California Department of Fish and Wildlife \(CDFW\)](#) and assist in collecting samples for analysis.

Pets, Livestock, and HABs

- Frequently Asked Questions (FAQs) for Dogs
- Frequently Asked Questions for Livestock and other Large Animals
- Resources for Veterinarians
- Online Toolkit
- One Health Harmful Algal Bloom System (OHHABS)

FAQs for Dogs

How can dogs be exposed to HABs?

Animals can be exposed to HABs and associated toxins by:

- Contacting any affected water body including lakes, rivers, or ponds. Because animals are attracted to cyanobacteria (blue-green algae), they drink the water and eat algal material. Dogs in particular lick algae caught in their fur after being in the water.
- Consuming water and algae from residential pools or decorative ponds.
- Ingesting blue-green algae health supplements.

How can I keep my dog safe from HABs?

- Check if a waterbody has a reported bloom by checking the [HAB Reports Map](#), contacting the waterbody manager, and looking for [posted advisory signs](#).
- Check to see if the water has a scum, algal mats, or is discolored.
- Do not let your dog drink, wade, or swim in HAB-affected water.
- Do not let your dog eat scum or algal material.
- Wash your pets with clean water after lake or river play. Provide clean drinking water.

What are signs of possible cyanobacterial toxin poisoning in dogs?

Animals can experience symptoms within minutes to days following exposure to the cyanobacterial toxins (cyanotoxins). Symptoms they might experience include vomiting, diarrhea, weakness, difficulty breathing, seizures, or death. There were 18 reported dog deaths in 2017. See OHHABS section below for HAB-related illnesses from 2018.

If your pet experiences these symptoms after exposure, contact your veterinarian immediately. A [veterinarian fact sheet](#) is available. For additional assistance, contact the 24-hour [ASPCA Animal Poison Control Center](#) hotline at (888) 426-4435. A \$65 consultation fee may be applied.

RESOURCES:

- [1-page Fact Sheet for Pet Owners](#) (June 2018)
- [California Waterfowl - Keeping Your Dog Safe From Harmful Algal Blooms](#) (September 10, 2018)
- [USEPA - How to keep your Dog Safe from Toxic Algae](#)

FAQs for Livestock and Other Large Animals



How are advisories issued and communicated?

WARNING

Toxins from algae in this water can harm people and kill animals

 No swimming.	 Do not let pets or other animals go into or drink the water, or go near the scum.
 Stay away from scum, and cloudy or discolored water.	 Do not eat shellfish from this water.
 Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.	 For fish caught here, throw away guts and clean fillets with tap water or bottled water before cooking.

For people, the toxins can cause: <ul style="list-style-type: none">• Skin rashes, eye irritation• Diarrhea, vomiting	For animals, the toxins can cause: <ul style="list-style-type: none">• Diarrhea, vomiting• Convulsions and death
---	--

Call your doctor or veterinarian if you or your pet get sick after going in the water.

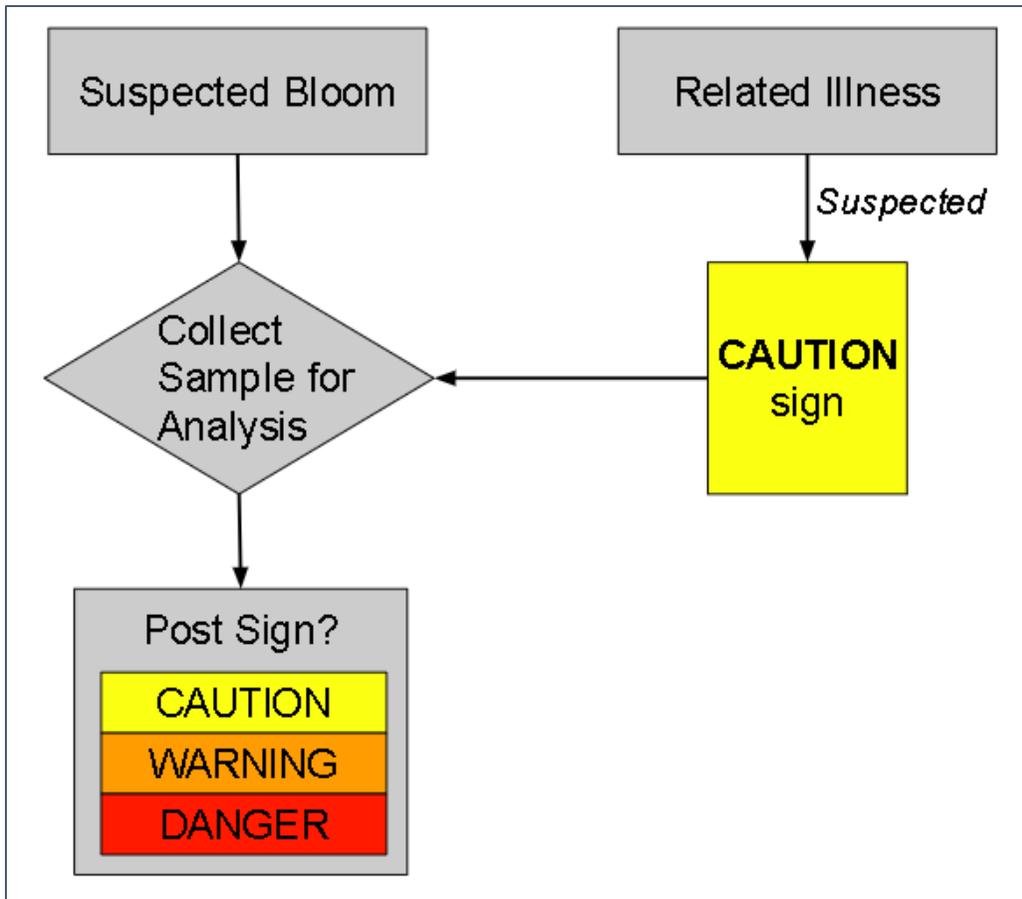
For information on harmful algae, go to mywaterquality.ca.gov/monitoring_council/cyanohab_network

For local information, contact:

How are advisories issued and communicated?

Voluntary CA Cyanobacteria Guidelines for Recreational Waters

https://mywaterquality.ca.gov/habs/resources/habs_response.html



CAUTION

Harmful algae may be present. For your safety, please follow these guidelines:

- You can swim in this water, but stay away from algae and scum in the water.
- Keep children away from algae in the water or on the shore.
- For fish caught here, throw away guts and clean fillets with tap water or bottled water before cooking.

Call your doctor or veterinarian if you are sick. For information on harmful algae, go to mywaterquality.ca.gov. For local information, contact: _____

WARNING

Toxins from algae can harm people. Please follow these guidelines:

- No swimming.
- Stay away from scum, and cloudy or discolored water.
- Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.

Call your doctor or veterinarian if you are sick. For information on harmful algae, go to mywaterquality.ca.gov. For local information, contact: _____

DANGER

Toxins from algae in this water can harm people and kill animals. Please follow these guidelines:

- Stay out of the water until further notice. Do not touch scum in the water or on shore.
- Do not let pets or other animals drink or go into the water or go near the scum.
- Do not eat fish or shellfish from this water.
- Do not use this water for drinking or cooking. Boiling or filtering will not make the water safe.

For people, the toxins can cause:
• Skin rashes, eye irritation
• Diarrhea, vomiting

For animals, the toxins can cause:
• Diarrhea, vomiting
• Convulsions and death

Call your doctor or veterinarian if you or your pet get sick after going in the water. For information on harmful algae, go to mywaterquality.ca.gov/monitoring_council/cyanohab_network. For local information, contact: _____

How are advisories issued and communicated?

What are the

- Are there any g
- If it is not safe t
- Is my tap water
- How can cyanot
- Does my home

Cyanobacterial and a toxins. The cyanotoxi depth, or attached to We are still learning f and domestic animals cyanotoxins, microcys

It is important to keep recreational water bo drinking water on an this portal. Water utili regulations that requi

Are there an

In 2015, the US Envir

- Detailed inform

The health advisories exposure durations. f including California, a are listed in microgra

PROTECT YOUR PETS FROM HARMFUL ALGAL BLOOMS

What are cyanobacteria algal blooms?

Cyanobacteria (also called b algae can form harmful alg lakes, ponds, and rivers. Many that can harm animals and p have a scum or be discolored yellowish, red, or brown). Some along the bottom of the w detached and float to the s shoreline. A [visual factsheet](#) i public identify HABs.¹ To k [California HABs Portal](#).²



How can dogs be expos

- By swimming in lakes, r affected water body, drinkin algal material. Animals are and smell of HABs. Dogs lic coat after being in the wat around the shore may ing algae.
- By consuming water and residential pools or decorat
- By ingesting health supplements containing blue-green algae, which may unintentionally include HAB toxins.

Additional information:

- ¹ Visual fact sheet. https://mywaterquality.ca.gov/habs/what/visualguide_fs.pdf
- ² California HABs portal. <https://mywaterquality.ca.gov/habs/> HAB report map, adviso information.
- ³ Veterinarian fact sheet. <https://nehha.ca.gov/risk-assessment/fact-sheet/blue-green>

CalEPA Office

Resources for Ve

Resources are available to a funding for confirmatory test State or local agencies can

CLINICAL SIGNS, DIAGNOSI hepatic symptoms. See the 1 successful treatment of micr

POTENTIAL FUNDING: Limit when reimbursement for tes

- live canine physical ex
- canine necropsy at yo
- algal toxin analysis
- canine clinical specime
- specimen shipment to

Apply for funding by comple

REPORTING: Reporting co illness Information Section o

RESOURCES:

- Veterinarian Fact Sheet
 - Online version
 - PDF
- 2019 Bloom Season C
- 2018 Bloom Season C
- Bates (2018) review o
- Dreher et al. (2019) pl
- Rankin et al. (2013) ca
- Foss et al. (2019) pub
- 2018 presentation on

potential r Please report related illness calling (844) 729-6466. [CyanoHAB.Re](#)

Blue-Gree

IDENTIFYING IL

✓ Exposure History ✓ C

DESCRIPTION OF THE PROBL

Blue-green algae (also known as in outdoor water bodies and prod They can grow quickly and form l

Scope of the problem in Califo

- Toxic blooms occur throughou
- Dog and livestock deaths in C

EXPOSURE

Animals can be exposed to blu

- Contacting any infected water attracted to blue-green algae, algae caught in their fur after f
- Consuming water and algae f
- Ingesting blue-green algae he

CLINICAL SIGNS, DIAGNOSIS a cover physical examination of ill d

BIOSPECIMEN COLLECTION, H be available to collect and analyze

REPORTING: Reporting confirm exposures to blue-green algal toxi Form available at <https://drinc.ca.g> Board at (844) 729-6466.



Resources for Medic

Medical professionals can be alerted be present. Medical professionals sh the HAB Portal bloom incident form.

RESOURCES:

- 2019 Bloom Season Outreach Related Illnesses (July 2019)
- 2018 Bloom Season Outreach
- CDC Physician Reference Card
- USEPA Health Effects from Cya
- USEPA HABs Infographics to ed
 - Abbreviated infographic
 - Detailed infographic



Harmful algal bloom in XXXXXXXXXXXXXXX; Caution Urged in Water Contact

News Release: xxxxxxxx, 201x

Contact: xxxxxxxx xxxxxxxxxxxxxx

Sacramento – xxagency namexxxx is urging boaters and recreational users to avoid direct contact with or use of waters affected by harmful algal blooms (HABs)in xxwater body namexxx in xxxxxxxx County.

The recommendation is based on the potential health risks from toxins produced by cyanobacteria, which is currently blooming in xxwater bodyxx. Algae and cyanobacteria, the organisms that cause HABs, have existed for billions of years as essential components of freshwater ecosystems. But when certain conditions favor their growth - warm temperatures, stagnant water flows, excessive nutrient inputs - they can multiply very rapidly creating "blooms." These blooms can produce toxins, and taste and odor compounds, that pose health risks to humans and animals. When blooms pose a risk, they are referred to as harmful algal blooms (HABs).

Xxxsentence on where the bloom has been observed in the water bodyxxx. Bloom conditions can change rapidly and wind and waves may move or concentrate the bloom into different regions of the xxwater bodyxx. Xxsentence detailing results of water sampling, whether to xins confirmed or notxxx

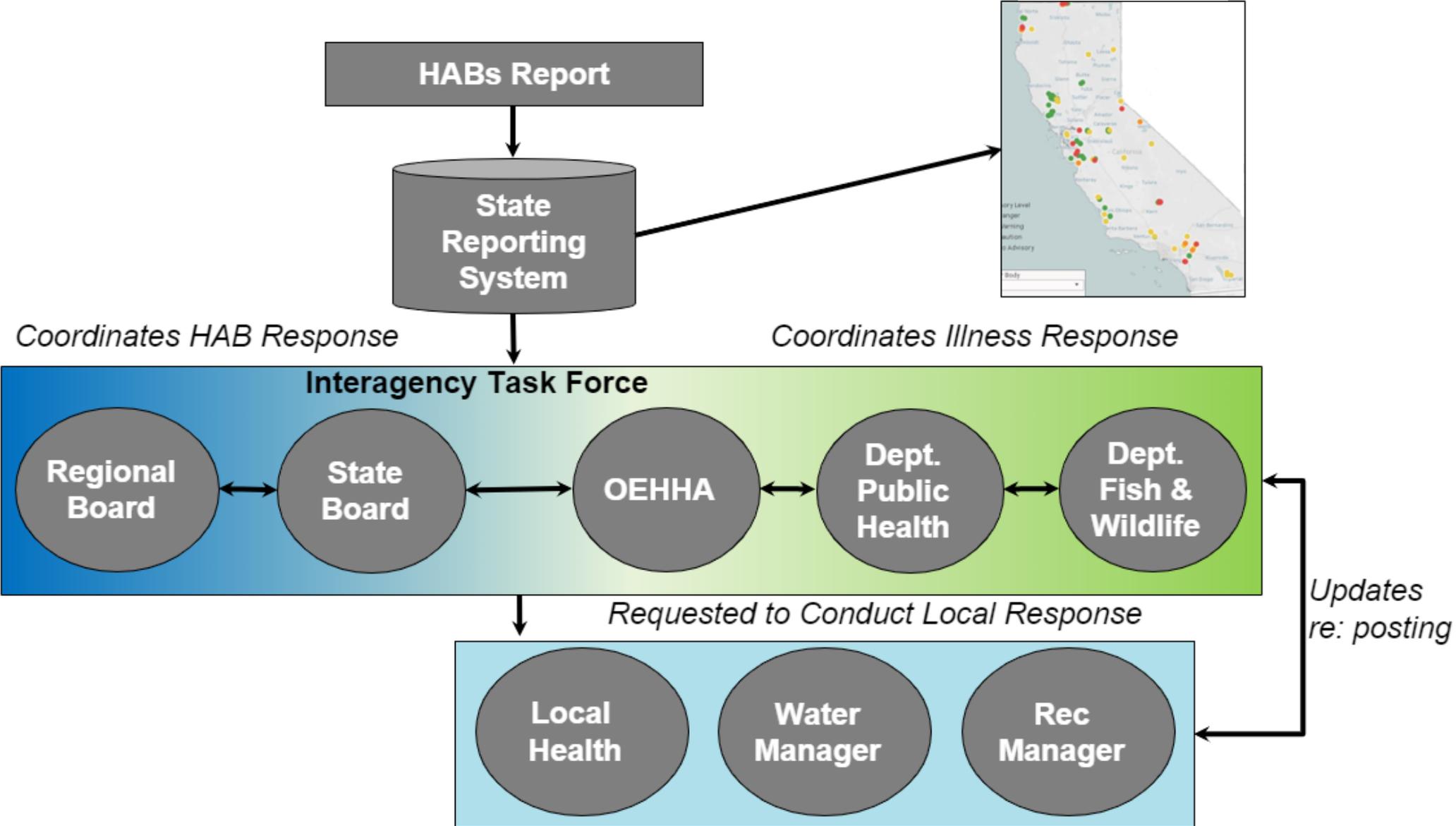
(insert map, pictures if available).

xxDescription of water body, who operates itxx. xxThe water body (is/is not) used for drinking water supply, further detail if it isxx. Xx <Caution/Warning/Danger> signs have been posted at these locationsxxx

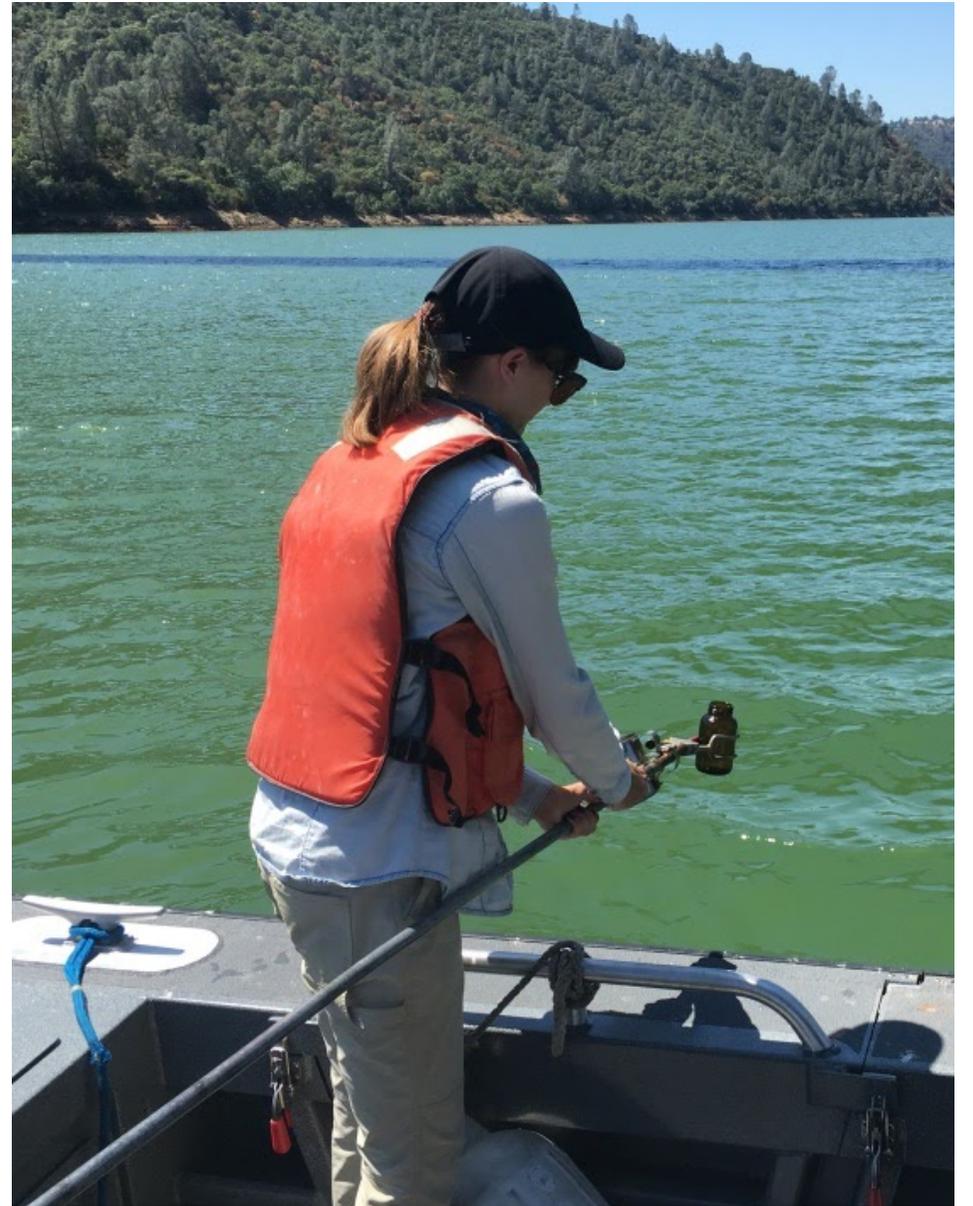
Cyanotoxins and algal toxins pose risks to the health and safety of people and pets, drinking water, and recreating in water bodies affected by blooms. They can also accumulate in fish and shellfish to levels posing threats to people and wildlife. [Symptoms of HAB-related illness](#) in people and animals are available from the Centers for Disease Control and Prevention (CDC), and by contacting the California Poison Control Center (1-800-222-1222).

Pets, especially dogs, are susceptible to HABs because they swallow more water while swimming and playing in the water. They are also less deterred by green, smelly water that

How are advisories issued and communicated?



How to collect samples?



Looking Forward



Looking Forward



HAB-related Assembly Bill 834

https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200AB834

- Approved by Governor in September 2019
- Establishes formal Freshwater and Estuarine HAB Program, led by the Water Boards in coordination with resource agencies, Dept. of Human Health, CA Native American Tribes, and others
- Funding was not allocated with the bill, Water Boards submitted a Budget Change Proposal (BCP) to request funding
 - BCP request mirrored bill's recommended funding amounts for new staff and contracting funds for monitoring
 - BCP funding is in the Governor's draft state budget, we are awaiting final state budget

Looking Forward



HAB-related Assembly Bill 834

https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200AB834

- Bill mandates many objectives for the Water Boards, briefly includes:
 - Coordinate immediate and long-term event response, as well as communicate notifications and risks broadly
 - Conduct monitoring and assessment at the state, regional, watershed, and site-specific waterbody scales
 - Identify and prioritize at risk waterbodies
 - Conduct applied research and tool development
 - Provide outreach, education, centralized website, and data management
- Bill requires a formal report, first report due by July 1, 2021

Looking Forward



FHAB Monitoring and Research Strategy

- To address the unmet need of establishing statewide monitoring for HABs in freshwater and estuarine environments
- Inform the condition, health risks, and trends at many scales (waterbody, watershed, statewide)
- Includes implementation framework and approximate costs to help inform management decisions and priorities
 - Framework includes citizen and volunteer based monitoring
- Anticipated final report in Fall 2020; projects implemented from the strategy depends on new funding

Regional Freshwater Cyanobacteria Harmful Algal Bloom Program Update



Rich Fadness

Lead Freshwater Harmful Algal Bloom Program
North Coast Regional Water Quality Control Board

February 6, 2020

Dog dies on Russian River, tests positive for toxic algae

THE PRESS DEMOCRAT | September 3, 2015

Mendocino County issues algae alert for Eel River after dog's death

THE PRESS DEMOCRAT | September 25, 2015



North Coast Water Board Hosts Public Workshop on Cyanobacteria Harmful Algal Blooms

**For Immediate Release:
Feb. 18, 2016**

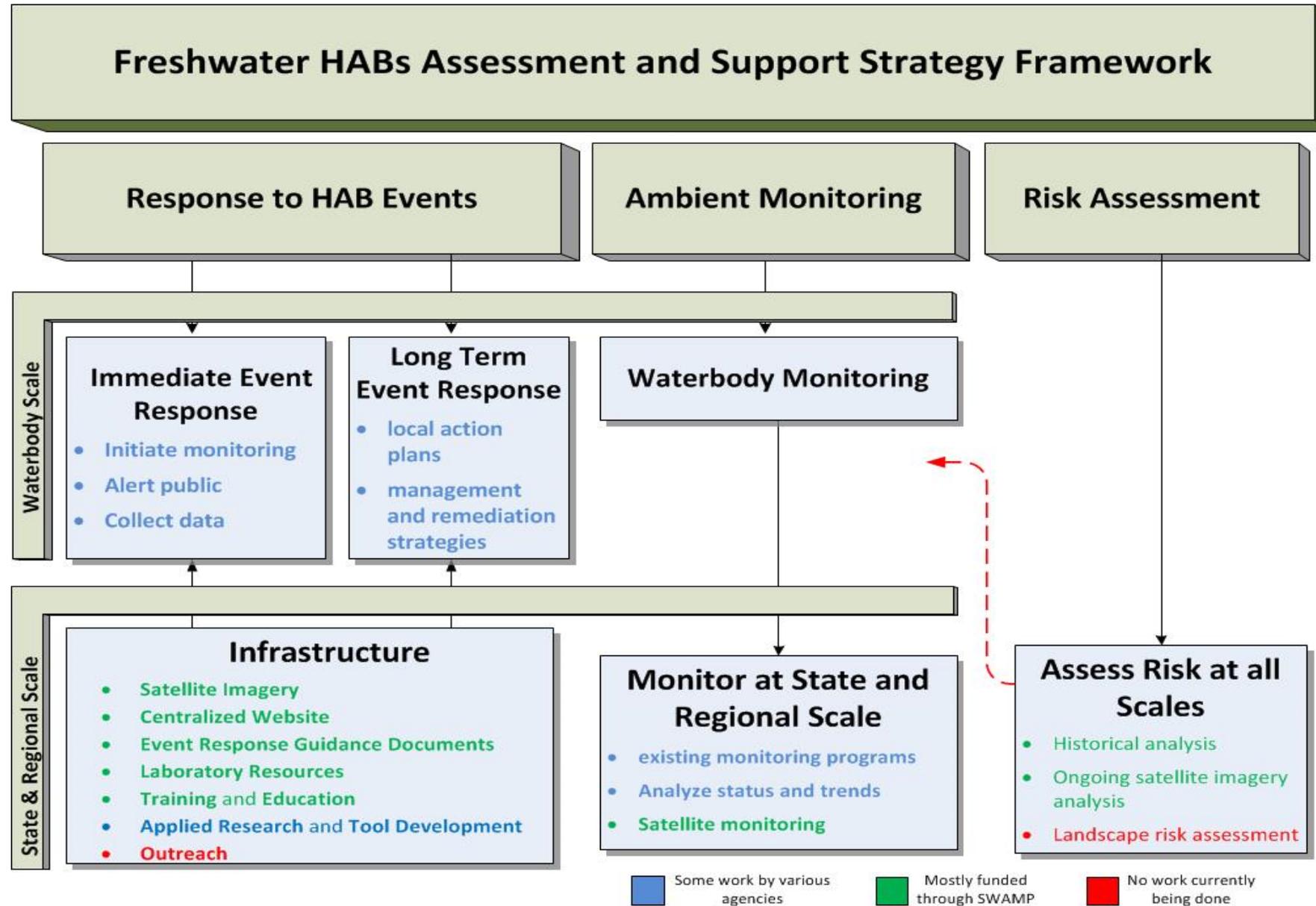
**Contact: Katharine Carter
(707) 576-2290**

A public workshop on freshwater harmful algal blooms in North Coast waterways will be held from 9 a.m. to 4:30 p.m. Feb. 24 in Santa Rosa, hosted by the staff of the North Coast Regional Water Quality Control Board (Regional Water Board).

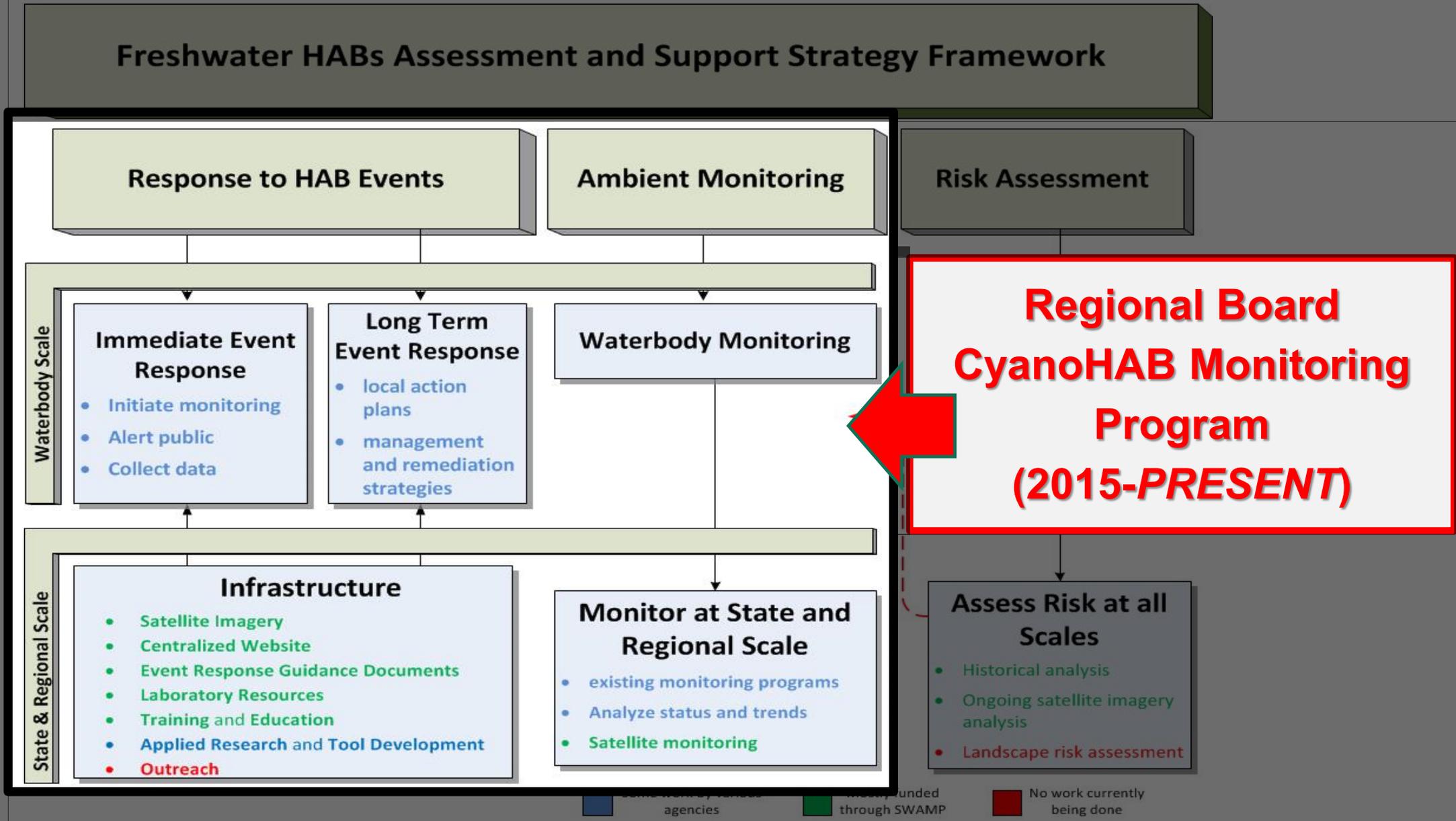
The workshop will discuss monitoring, assessment and response strategies for freshwater cyanobacteria harmful algal blooms (cyanoHABS), and provide information on the prevalence and effects of cyanoHABS.

The workshop will be held at the Regional Water Board's headquarters, 5550 Skylane Blvd, Suite A, Santa Rosa, 95403. Agencies and entities responsible for drinking water, public health, and recreational water safety in the North Coast Region are encouraged to attend. Members of the general public are welcome.

FHABs assessment and support strategy (2016)



FHABs assessment and support strategy (2016)



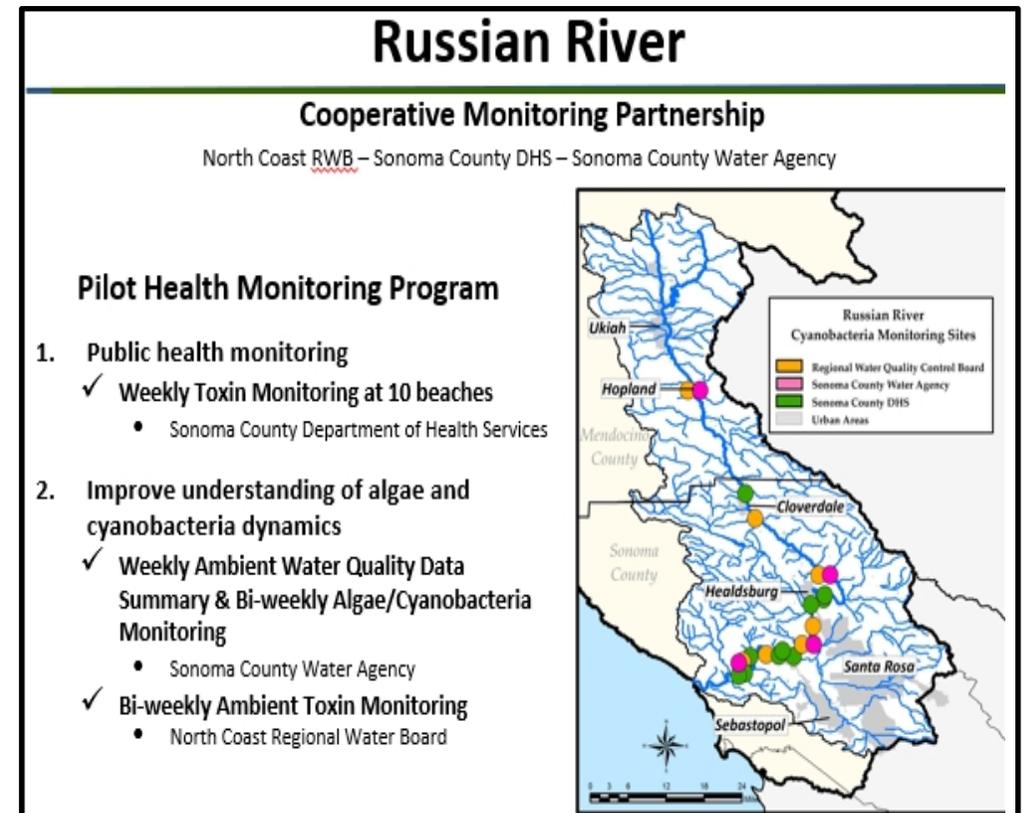
Regional CyanoHAB Monitoring and Response Strategy

- **Four Strategy Elements:**
 - Coordination
 - Monitoring and Response
 - Outreach and Training
 - Research and Tool Development

Regional CyanoHAB Monitoring and Response Strategy

■ Four Strategy Elements:

- **Coordination**
- Monitoring and Response
- Outreach and Training
- Research and Tool Development



Regional CyanoHAB Monitoring and Response Strategy

- **Four Strategy Elements:**
 - Coordination
 - **Monitoring and Response**
 - Outreach and Training
 - Research and Tool Development



Regional CyanoHAB Monitoring and Response Strategy

- **Four Strategy Elements:**
 - Coordination
 - Monitoring and Response
 - **Outreach and Training**
 - Research and Tool Development



Regional CyanoHAB Monitoring and Response Strategy

- **Four Strategy Elements:**
 - Coordination
 - Monitoring and Response
 - Outreach and Training
 - **Research and Tool Development**

KlamathValley.com, Klamath Lake, OR



Lake Wilson, Riverfront Park, Santa Rosa



PLANKTONIC

Russian River, Cloverdale



Russian River, Guerneville



BENTHIC

CyanoHABs Monitoring Program

Data Collection

- **Four Assessment Tools:**
 - Visual Assessment and Identification
 - Water Column Grab Sampling
 - Cyanobacteria Mat Grab Sampling
 - SPATT Passive Samplers

CyanoHABs Monitoring Program

Data Collection

- **Four Assessment Tools:**
 - **Visual Assessment and Identification**
 - Water Column Grab Sampling
 - Cyanobacteria Mat Grab Sampling
 - SPATT Passive Samplers



CyanoHABs Monitoring Program Data Collection

- **Four Assessment Tools:**
 - Visual Assessment and Identification
 - **Water Column Grab Sampling**
 - Cyanobacteria Mat Grab Sampling
 - SPATT Passive Samplers



CyanoHABs Monitoring Program Data Collection

- **Four Assessment Tools:**
 - Visual Assessment and Identification
 - Water Column Grab Sampling
 - **Cyanobacteria Mat Grab Sampling**
 - SPATT Passive Samplers



CyanoHABs Monitoring Program

Data Collection

- **Four Assessment Tools:**
 - Visual Assessment and Identification
 - Water Column Grab Sampling
 - Cyanobacteria Mat Grab Sampling
 - **SPATT Passive Samplers**





California Harmful Algal Blooms (HABs) Portal

The CA HABs Portal is the central resource for HABs in the state of California. HABs can pose a health risk to people and animals, harm aquatic ecosystems, and limit the use of drinking and recreational waterbodies due to the toxins, odors, and scums or mats they can produce.

The Portal is an informational resource for the public and also functions as a tool to support coordination with statewide partners to address HABs. The content is developed by the CA Cyanobacteria and HAB Network and participating state agencies.

Note: Much of the content included here focuses on freshwater and estuarine HABs; similar content for marine (coastal) HABs is included on the California Harmful Algal Bloom Monitoring and Alert Program (CalHABMAP) webpages.

Healthy Water Habits Video

Understanding the Dangers of Blue-green Algae (Cyanobacteria)

Credit: Department of Water Resources



Toolbox

- [Report a Bloom](#)
- [HAB Incident Reports Map](#)
- [Frequently Asked Questions](#)
- [Signs and Guidance for HAB Response](#)
- [Field Guide and Forms](#)

Resources

- [Announcements](#)
- [HAB Data Viewer](#)
- [Healthy Water Habits](#)
- [Human Health Impacts](#)
- [Domestic Animal Impacts](#)
- [Fish and Wildlife Impacts](#)

- [Training and Collaboration](#)
- [Drinking Water](#)
- [Monitoring](#)
- [Laboratory Resources](#)
- [Resources for Mitigating HABs](#)
- [HAB Freshwater Incident Response and Interagency Coordination](#)
- [State Agency Contacts](#)
- [Related Programs and Organizations](#)
- [Other Resources](#)



Related Topics: [Cyanobacterial HABs](#)

| [Ground Water and Drinking Water](#)

| [Water Quality Criteria](#)

CONTACT US

SHARE



Benthic HABs Discussion Group

Mission Statement:

The mission of this international collaborative is to accelerate mutual understanding of benthic HABs in rivers and lake systems, by sharing data and monitoring protocols, experiences and lessons learned.

Calendar of Webinars:

- Benthic HABs Discussion May 22, 2018
 - [Benthic HABs Workgroup Agenda](#)
 - [Presentation: Identification of Toxic Benthic Cyanobacteria in Three California Rivers](#)
 - [Agenda Item 3 – Announcements](#)
 - [Benthic HABs Workgroup Recording](#)
- Benthic HABs Discussion January 23, 2018
 - [Benthic HABs Workgroup Contacts and Survey Summary \(Excel\)](#) (1 pg, 29 K)
 - [Benthic Cyanobacteria: Drinking Water Reservoirs](#)
- Benthic HABs Discussion July 10, 2017
 - [Benthic Cyanobacteria in the Eel River](#)

Looking Forward



FHAB Monitoring and Research Strategy

- To address the unmet need of establishing statewide monitoring for HABs in freshwater and estuarine environments
- Inform the condition, health risks, and trends at many scales (waterbody, watershed, statewide)
- Includes implementation framework and approximate costs to help inform management decisions and priorities
 - Framework includes citizen and volunteer based monitoring
- Anticipated final report in Fall 2020; projects implemented from the strategy depends on new funding

DRAFT

Benthic Cyanobacteria Signage

CHECK FOR ALGAE

Toxic algal mats may be present in this water
 Algal mats can be attached to the bottom, floating, or washed up on shore.

Common examples



Blue-green colored mats



Dark colored slimy mats



Detached clumps

If you see algal mats:

Do not let dogs eat algal mats or drink water with algal clumps.

Do not let children or adults eat, swallow, or touch any algal mats.

Call your doctor or veterinarian if you or your pet get sick after contacting or ingesting algae. For more information on toxic algae visit: mywaterquality.ca.gov/habs

For local information, contact:

Do not let dogs eat algal mats or drink water with algal clumps.

Do not let children or adults eat, swallow, or touch any algal mats.

CHECK FOR ALGAE

Toxic algal mats may be present in this water
 Algal mats may be attached to rocks, floating, or washed up on shore.

Do not let children or adults, eat, swallow, or touch any algal mats

Do not let dogs eat any algal mats or swallow algae. Quickly, rinse off any algal material on your pets fur.

Keep children away from algae, do not let them eat algae

Look out for



Attached filamentous algae



Floating clumps washed on shore

Call your doctor or veterinarian if you or your pet get sick after contacting or ingesting algae. For more information on harmful algae visit: mywaterquality.ca.gov/habs

For local information, contact:

CHECK FOR ALGAE

Toxic algal mats may be present in this water
 Algal mats can be attached to rocks, floating, or washed up on shore.



Attached Filamentous



Dark colored slimy mats



Floating clumps washed on shore

If you see this type of algae:

Do not let dogs eat algal mats or drink from the water

Call your doctor or veterinarian if you or your pet get sick after contacting or ingesting algae. For more information on harmful algae visit: mywaterquality.ca.gov/habs

For local information, contact:

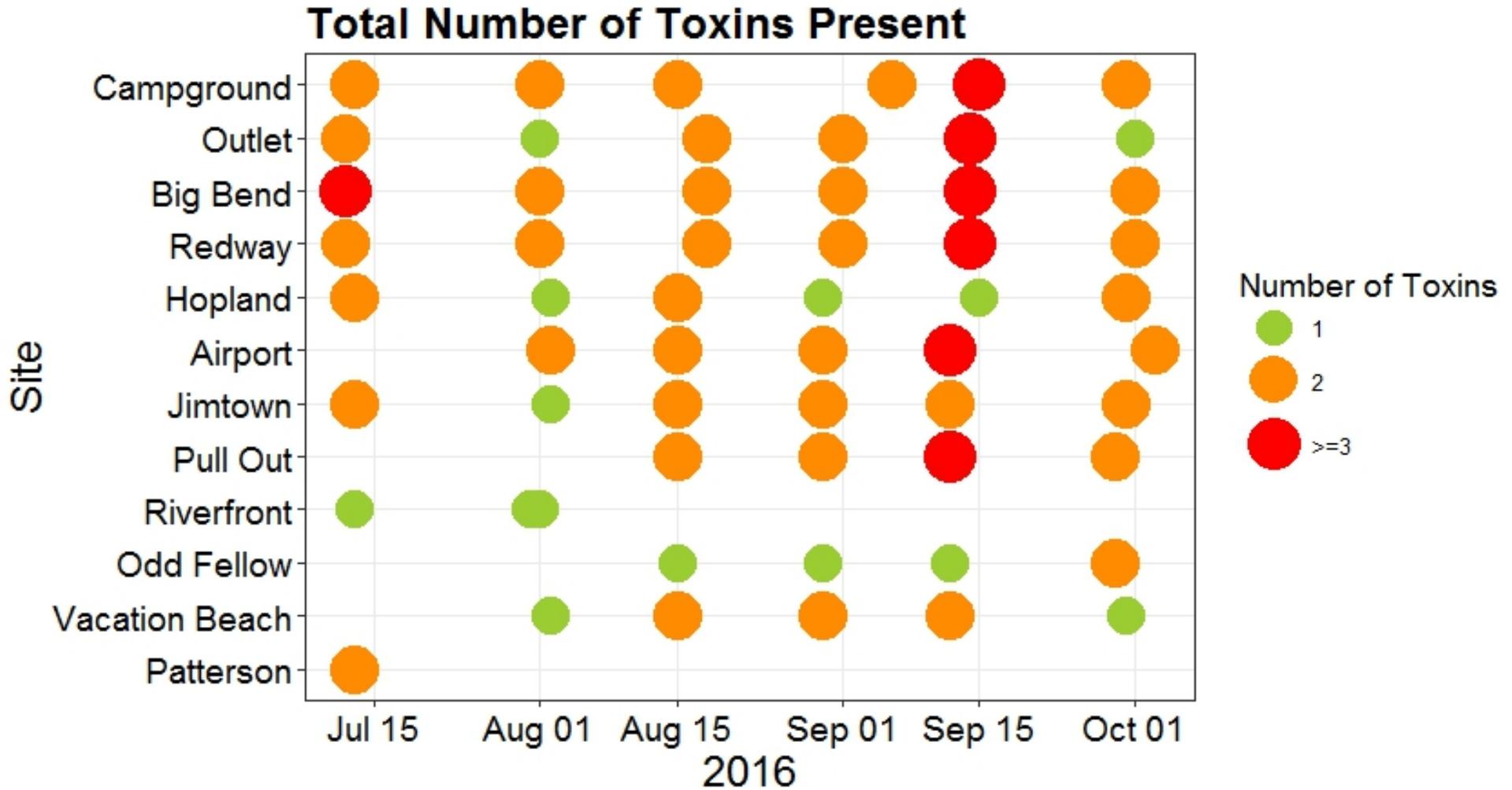
Do not let children or adults eat, swallow, or touch any algal mats

Cyanobacteria and Cyanotoxins

- Many benthic cyanobacteria genera are present in Northern California
 - *117 unique species, of which their toxicity is unknown*
- Constant presence of cyanotoxins in low-level concentrations in North Coast Rivers?
 - *At least 1 cyanotoxin has been detected at every site, every time*

Simultaneous Detection of Multiple Toxins

Russian and Eel Rivers
2016

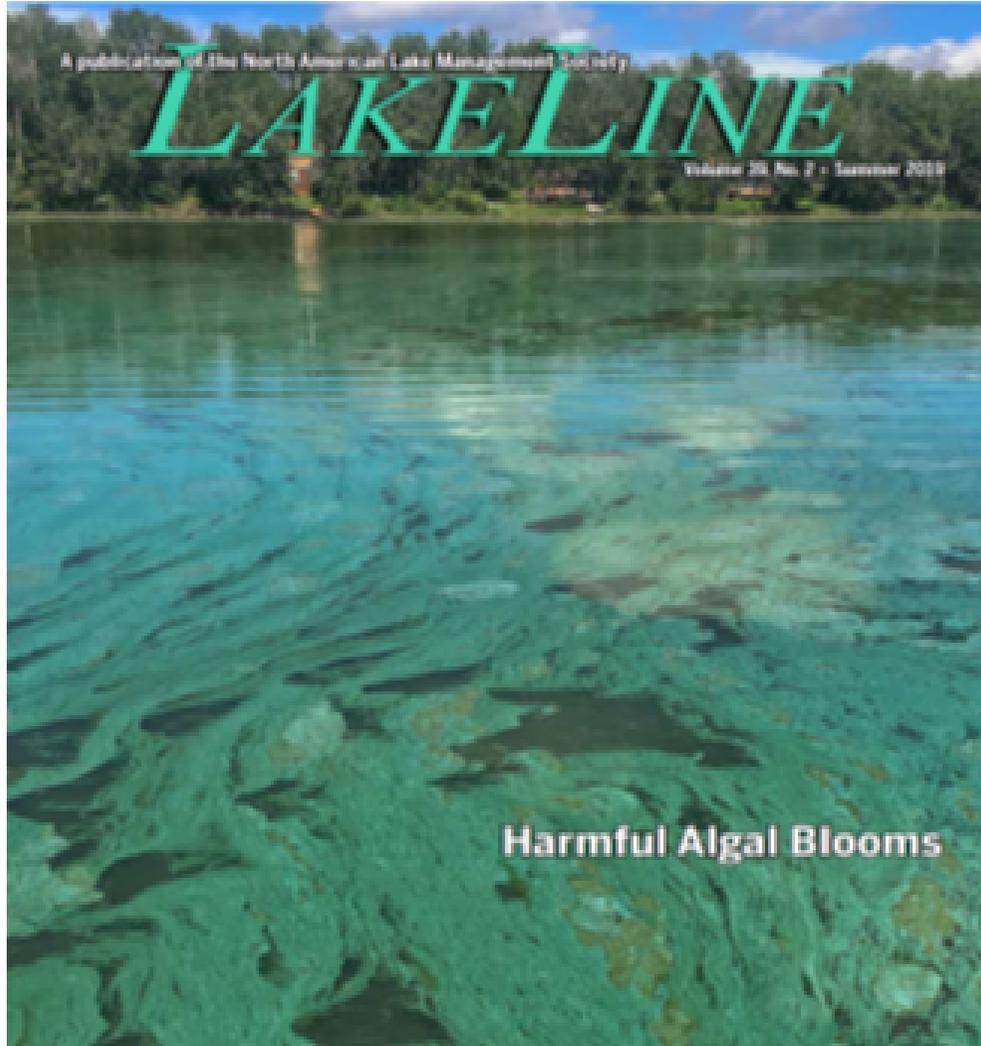


		Algal Mat Grab Results (ug/L)						
Campground			0.25	0.12	0.51	<0.10	0.86	1.56
Big Bend			1.11	<.010	0.84	0.32	1.79	2.13
Jimtown	Campground		<.010	<.010	0.63	0.14	0.24	4.67
	Pull Out							
Location	Airport	6/15 to 6/27	6/27 to 7/12	7/12 to 8/1	8/1 to 8/15	8/15 to 8/29	8/29 to 9/11	9/11-10/2
		SPATT Bag Results (ng/g resin)						
Campground	Campground	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Pull Out	Pull Out				<MDL	<MDL	<MDL	<MDL
Airport	Airport			<MDL	<MDL	<MDL	<MDL	<MDL
		Water Grab Results (ug/L)						
Campground	Campground	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Pull Out	Pull Out				<MDL	<MDL	<MDL	<MDL
Airport	Airport			<MDL	<MDL	<MDL	<MDL	<MDL
		ELISA						
		Algal Mat Grab Results (ug/L)						
Campground	Total		0.64	1.29	18.5	13.6	45.3	6.94
Pull Out	Anatoxins				2204	2054	>15750	8143
Airport				53.5	1002	619	3396	1217

Big Bend	MCY-NOD		1.11	<.010	0.84	0.32	1.79	2.13
Jimtown	MCY-NOD		<.010	<.010	0.63	0.14	0.24	4.67

Location	Toxin Analysis	6/15 to 6/27	6/27 to 7/12	7/12 to 8/1	8/1 to 8/15	8/15 to 8/29	8/29 to 9/11	9/11-10/2
		SPATT Bag Results (ng/g resin)						
Campground	Anatoxin-a (only)	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Pull Out					<MDL	<MDL	<MDL	<MDL
Airport				<MDL	<MDL	<MDL	<MDL	<MDL
		Water Grab Results (ug/L)						
Campground	Total Anatoxins	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Pull Out					<MDL	<MDL	<MDL	<MDL
Airport				<MDL	<MDL	<MDL	<MDL	<MDL
		ELISA						
		Algal Mat Grab Results (ug/L)						
Campground	Total		0.64	1.29	18.5	13.6	45.3	6.94
Pull Out	Anatoxins				2204	2054	>15750	8143
Airport				53.5	1002	619	3396	1217

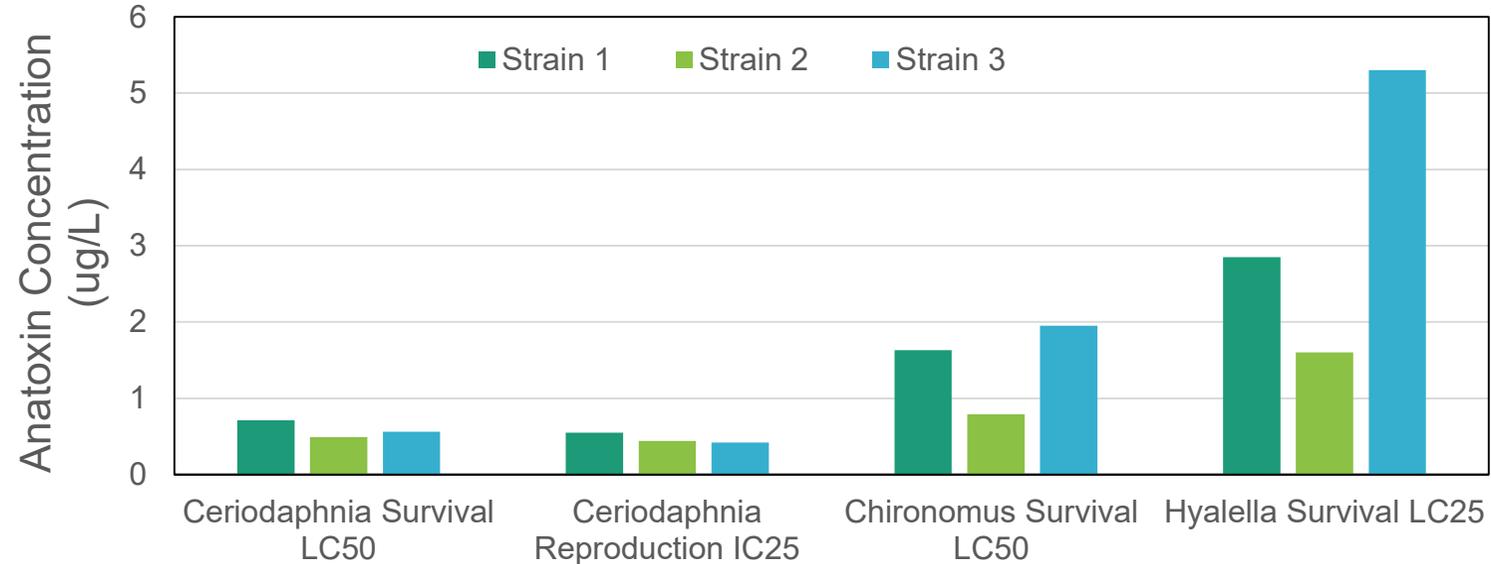
North American Lake Management Society



“A Deeper Look at HABS”

- benthic cyanobacteria are a concern in both river and lakes, and
- lake managers need to be aware that surface waters may not be the only source of harmful toxins.

Extracts from benthic anatoxin-producing *Phormidium* are toxic to three macroinvertebrate taxa at environmentally relevant concentrations.



Phormidium strain	02/11/2016	6/28/2016	03/28/2017			
	Total Anatoxin (µg/L) - ELISA	Anatoxin-a (µg/L) - LCMS	Anatoxin-a (µg/g of dry culture) - LCMS	Homoanatoxin-a (µg/g of dry culture) - LCMS	Dihydro-anatoxin-a (µg/g of dry culture) - LCMS	Dihydro-homoanatoxin-a (µg/g of dry culture) - LCMS
Strain 1	525	ND	0.66	ND	331.2	ND
Strain 2	343	ND	0.38	ND	363.4	ND
Strain 3	193	ND	0.47	ND	483.3	ND

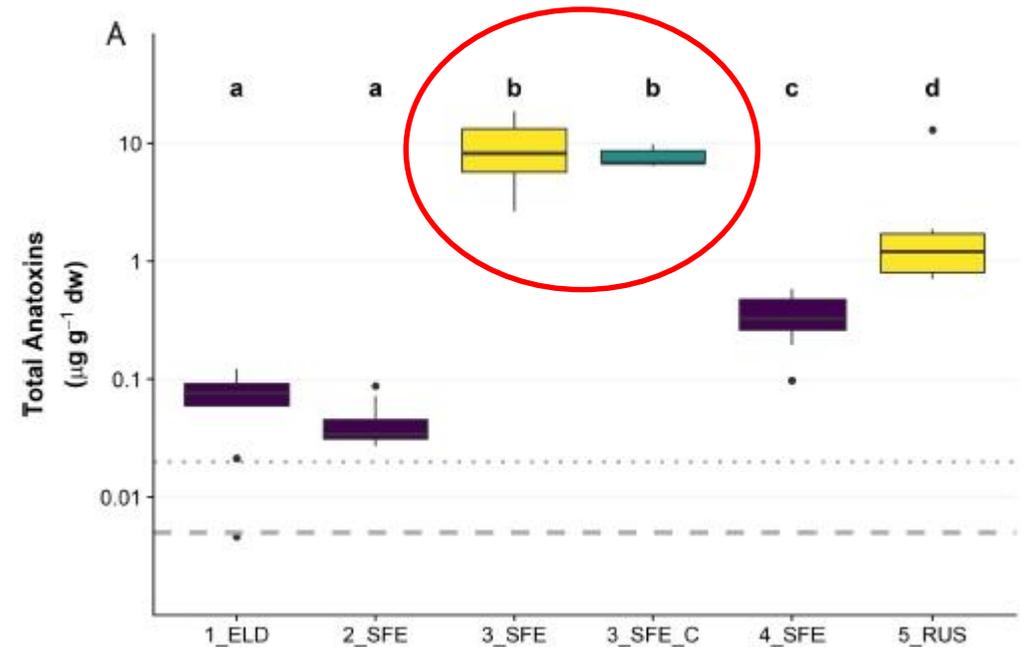
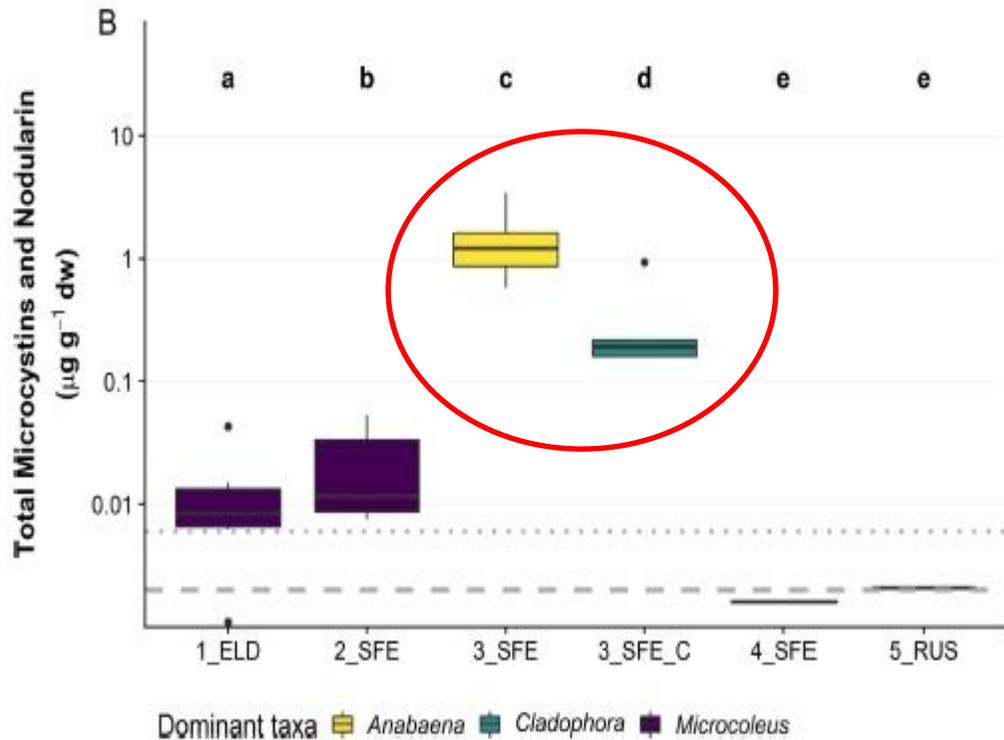
Molecular and morphological characterization of a novel dihydroanatoxin-a producing *Microcoleus* species (cyanobacteria) from the Russian River, California, USA

ATX-a (µg/L)	dhATX (µg/L)	Method	Genus
maybe	maybe	LC-MS/MS	<i>Anabaena oscillarioides</i>
0.66	331	LC-MS/MS	<i>Phormidium</i>
0.38	363	LC-MS/MS	<i>Phormidium</i>
0.47	483	LC-MS/MS	<i>Phormidium</i>
Total Anatoxin (µg/L)	Method		Genus
0.14	ELISA		<i>Phormidium</i>
0.10	ELISA		<i>Anabaena+Geitlerinema</i>
>125	ELISA		<i>Phormidium</i>
3.36	ELISA		<i>Phormidium</i>
2.86	ELISA		<i>Phormidium</i>
0.10	ELISA		<i>Anabaena</i>
0.65	ELISA		<i>Phormidium</i>
2.60	ELISA		<i>Phormidium</i>

**Microcoleus
anatoxicus**

Multiple cyanotoxin congeners produced by sub-dominant cyanobacterial taxa in riverine cyanobacterial and algal mats

- Even when cyanobacteria are not dominant, the mats may still pose a serious health risk to the public*



Additional Reporting

Data Report

- *Analysis of cyanotoxins, locations, and seasonality*

SPATT Bag Deployments

- *Appropriate time deployment length to assure accurate documentation of conditions*

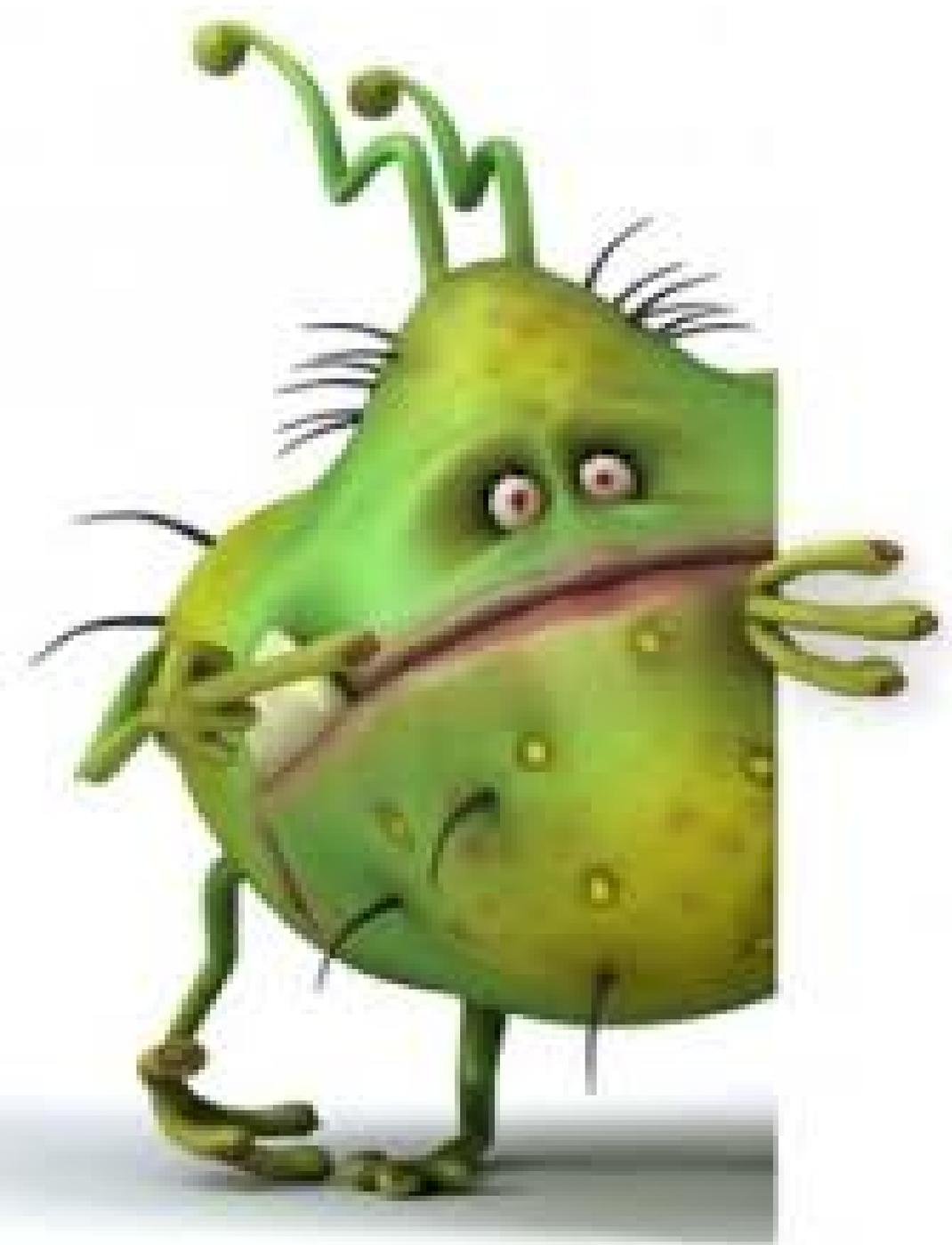
DNA Analysis

- *Identification of species of concern*
- *Further evaluation of the role that sub-dominant species play in public health risk*

Regional CyanoHAB Monitoring and Response Strategy

**The North Coast Region has been a leader in CyanoHAB
monitoring and research**

- A model for collaboration, outreach, and training
- Development of monitoring and assessment tools
- Publications and articles to inform a wider audience of researchers and resource managers
- Research furthering our understanding of cyanobacteria issues, and most importantly
- Leading the way in benthic cyanobacteria research and understanding



Thank you

**Any
Questions?**