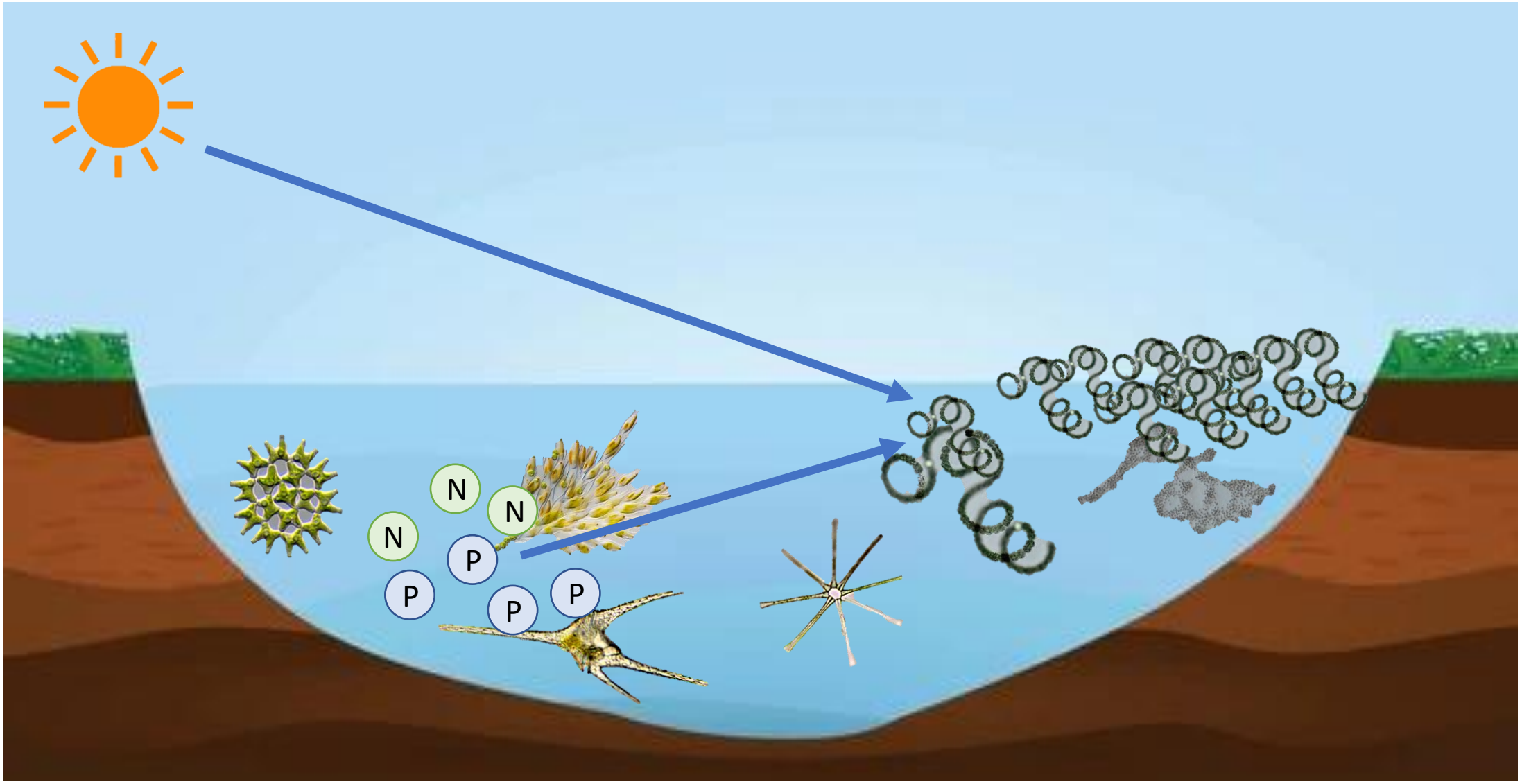
Cyanobacteria Blooms in New Hampshire's Lakes

Kate Langley Hastings

Cyanobacteria HAB Program Manager

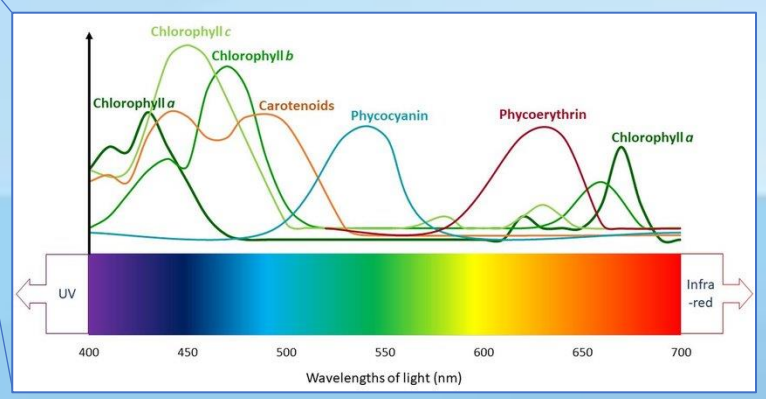
NHDES

Phytoplankton



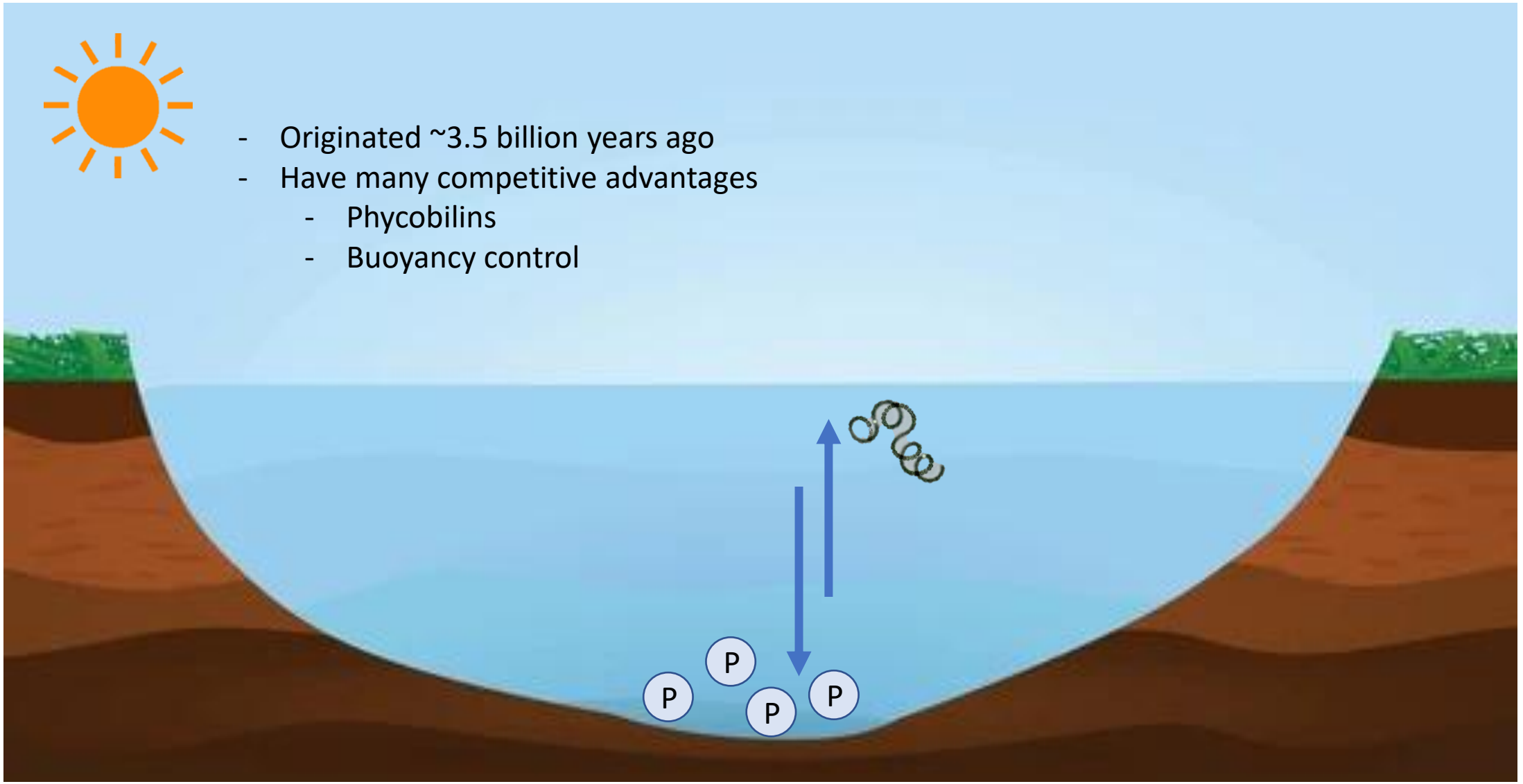
Cyanobacteria Competitive Advantages

- Originated ~3.5 billion years ago
- Have many competitive advantages
  - Phycobilins

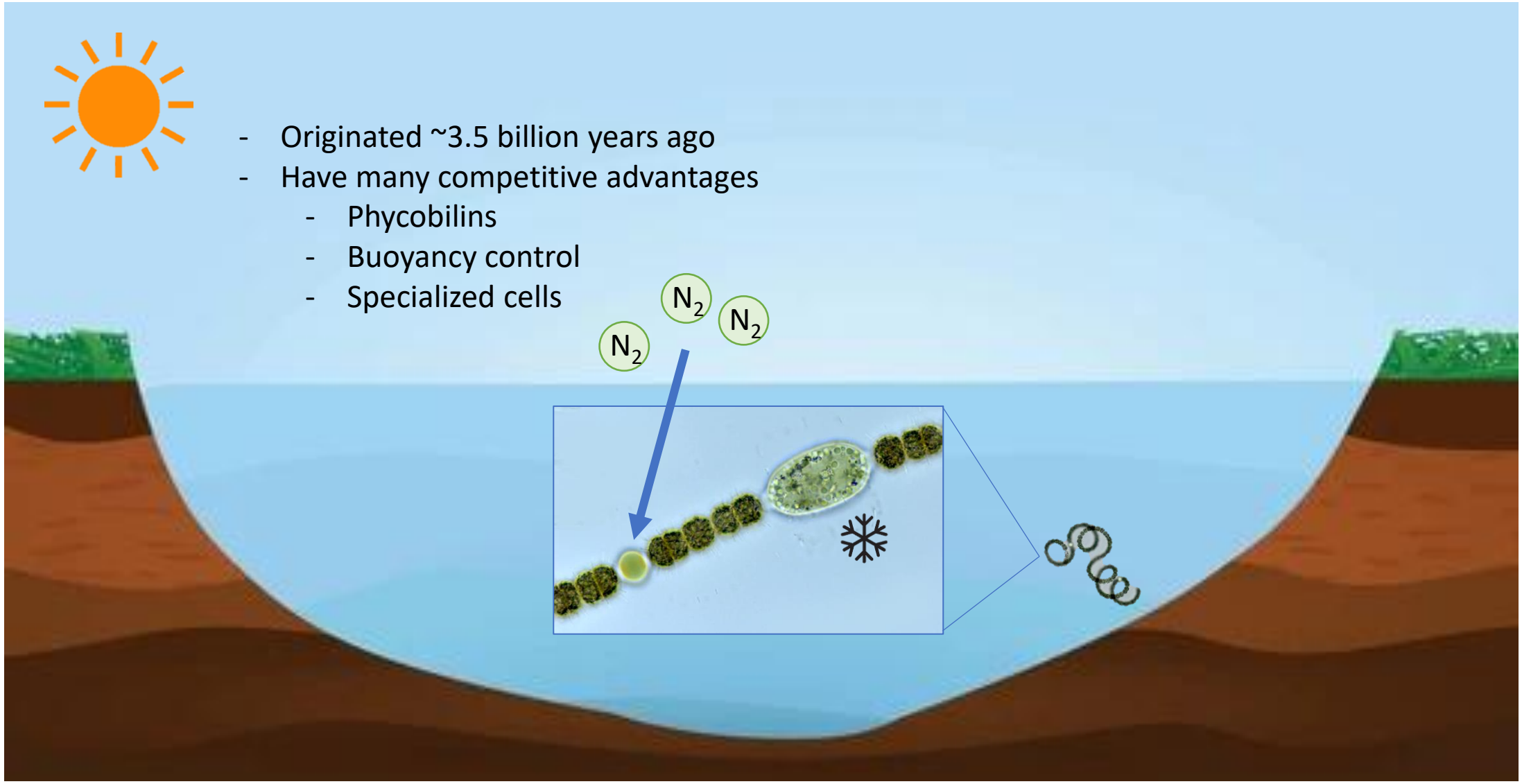


Cyanobacteria Competitive Advantages

- Originated ~3.5 billion years ago
- Have many competitive advantages
  - Phycobilins
  - Buoyancy control



Cyanobacteria Competitive Advantages



Bloom Basics

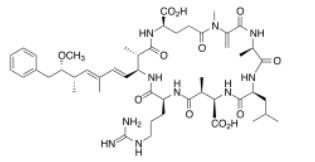
- Blooms are very dynamic!
  - Appearance
  - Time of day variation
  - Move around
  - Length of blooms

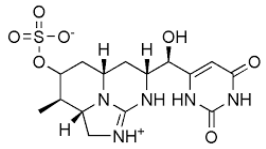
Bloom Basics

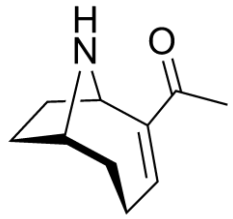
Why are blooms bad?

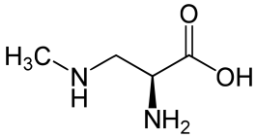
- Ecological damage

- Toxicity of blooms
  - Elevated concentrations
  - Toxicity (type of toxin and amount) can change rapidly over the course of a bloom

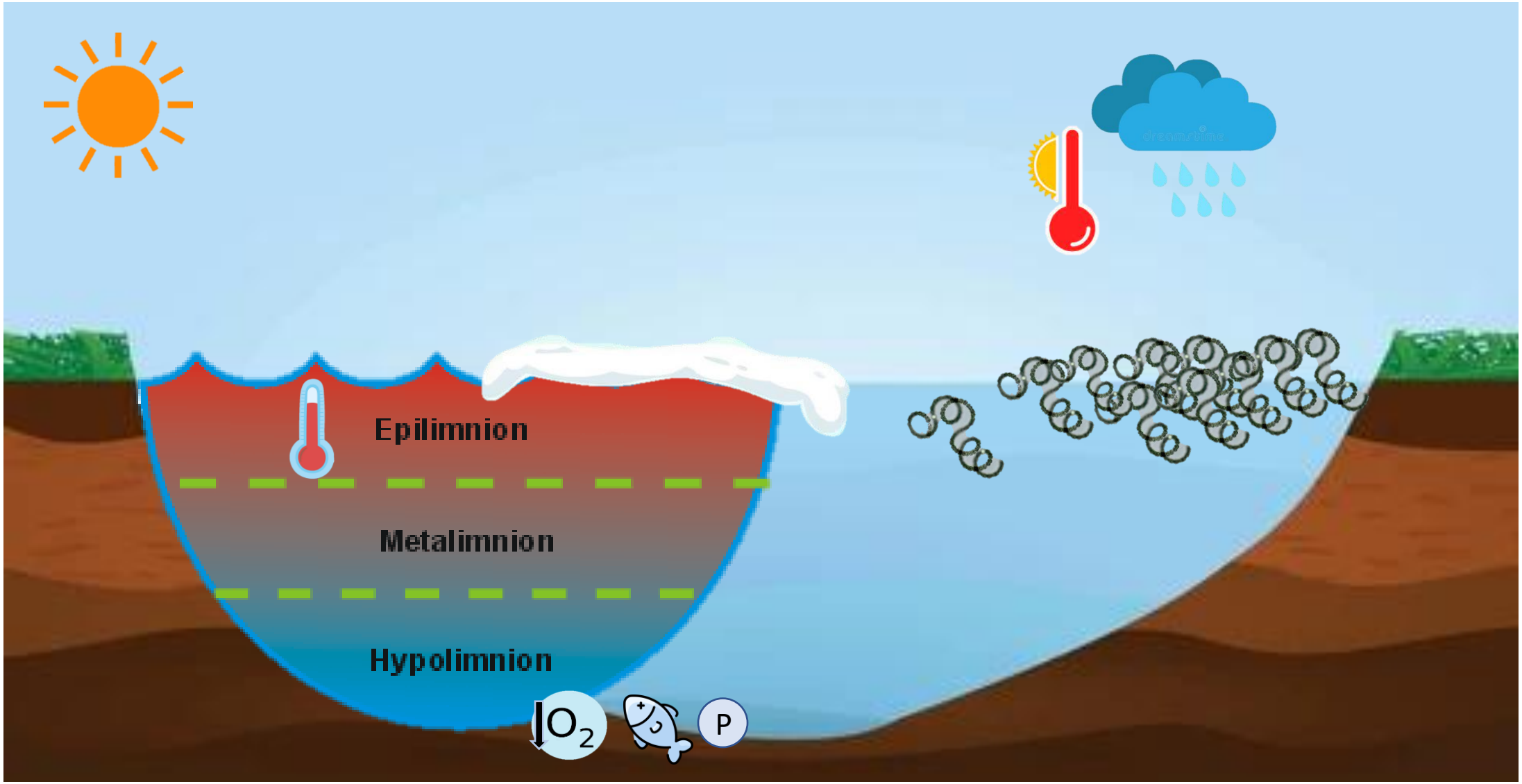




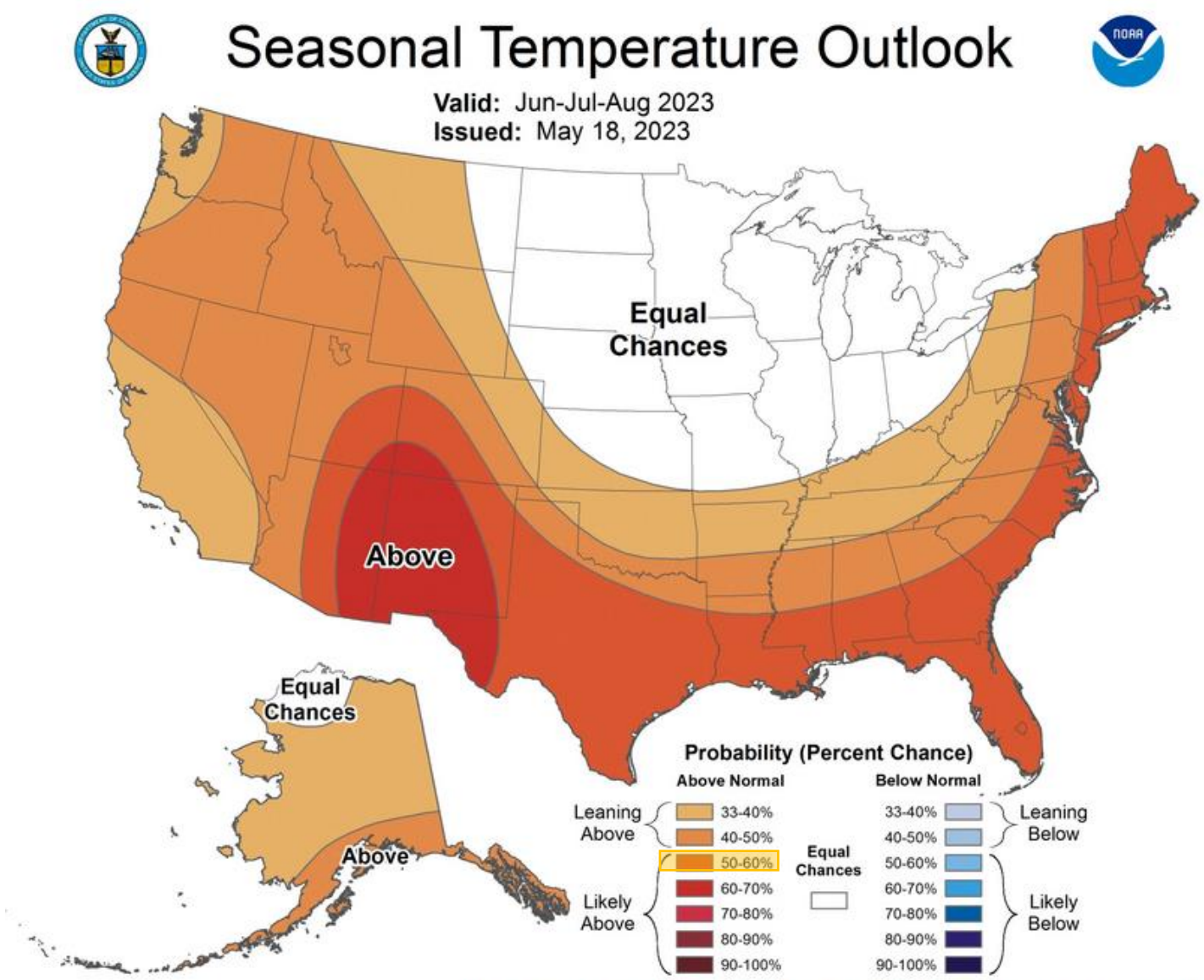




Human Contribution to Cyanobacteria Blooms: Climate Change

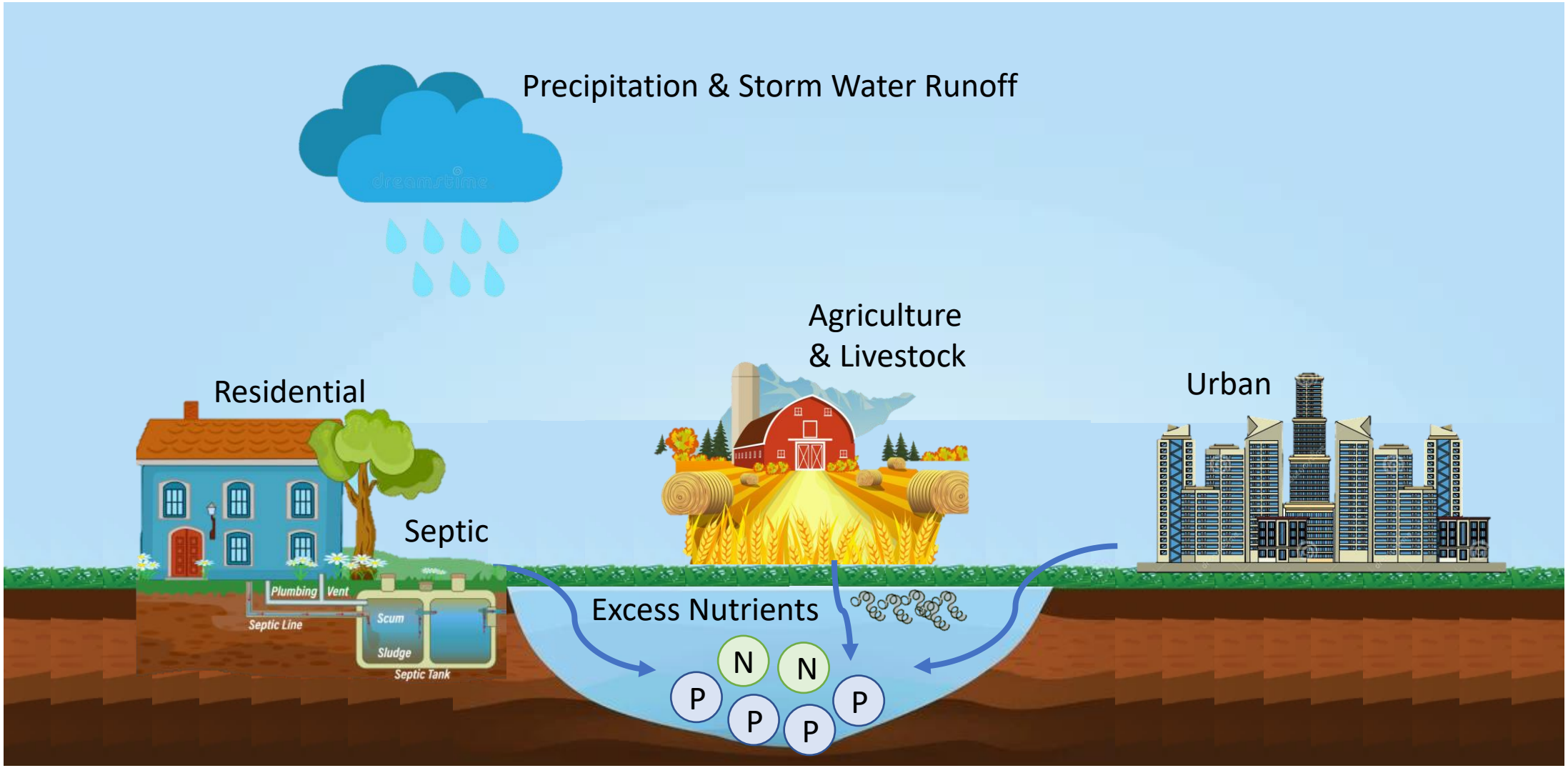


Human Contribution to Cyanobacteria Blooms: Climate Change



- Number of days each year with a heat index over 90 degrees has doubled since 1980s
  - From 8 days to 15 days

Human Contribution to Cyanobacteria Blooms: Excess Nutrients



Human Contribution to Cyanobacteria Blooms: Excess Nutrients

Reducing Nutrient Inputs
- Improve stormwater management
- Shoreland vegetation
- Reduce fertilizer use
- Maintain septic systems

Watershed Management Plans
- Prioritized to-do list for how to protect / restore a specific waterbody
  - Identifies sources of nutrients and pollutants
  - Describes actions to address sources
  - Develops outreach/education projects
  - Support funding applications

LakeSmart
NH LAKES
Award for lake-friendly living
www.nhlakes.org

LakeSmart

Soak Up the Rain
New Hampshire

Soak Up the Rain

Cyanotoxins

Cyanotoxin	Mode of action and/ or symptoms
Microcystins (over 200 variants)	Hepatotoxic, targets the liver and digestive organs, tumor promoting, inhibition of protein phosphatases. Acute gastroenteritis, chronic tumor promotion.
Nodularins (similar in structure to microcystins)	Similar to microcystins, but not as toxic and common in brackish or marine systems.
Anatoxin-a	Neurotoxic, inhibits acetylcholine receptors (neurotransmitter). Fast-acting and may cause seizures or death (i.e. common for dogs or others animals to ingest and die).
Anatoxin-a (S)	Neurotoxic, similar to anatoxin-a
Saxitoxins	Neurotoxic, blocking voltage gate of sodium ion channels. More common to marine organisms.
Cylindrospermopsins	Toxic to multiple organs, neurotoxic and genotoxic, affecting neurons and genes.
Lyngbyatoxins	Tumor promotion
BMAA/DAB	Neurotoxic, chronic exposure may be linked to neurodegenerative diseases such as ALS. (Though individuals may have a genetic precursor).

Notes:

- **This is not a complete list of the cyanotoxins.**
- **Exposure can occur through drinking, food, dietary supplements, inhalation, and/ or by dermal contact, and has occurred by haemodialysis (with contaminated water). Dermal-toxins, causing rashes on skin may occur. Synergistic effects of the cyanotoxins may also occur.**
- **Cyanotoxins may have varying effects on individuals with higher implications for those with a compromised immune system.**

Credit: Amanda McQuaid

Cyanotoxins

- Acute and chronic toxicity in humans, wildlife and pets
  - Individuals with compromised immune systems may have worse reactions

- Documented cyanotoxicity symptoms
  - Dermal irritations, eye and nose irritations, general malaise, fever
  - Nausea, vomiting, diarrhea, gastroenteritis
  - Tingling, numbness, seizures
  - Nervous system and organ failure
  - Death

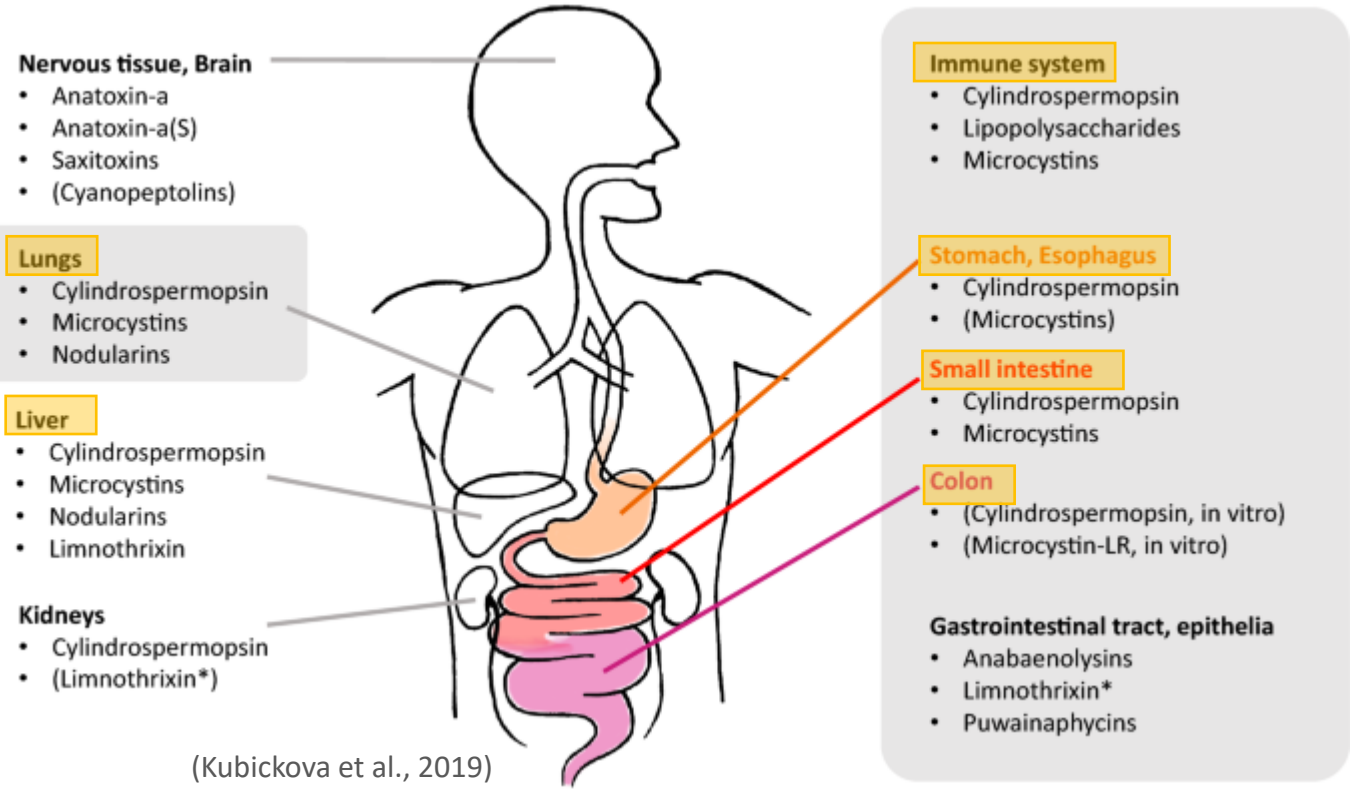
Table. Recommended magnitude for cyanotoxins.

Microcystins	Cylindrospermopsin
8 µg/L	15 µg/L

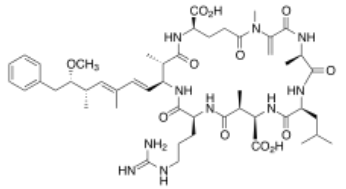
(EPA, 2019)

Cyanotoxin	Drinking Water Health Advisory (10-day)	
	Bottle-fed infants and pre-school children	School-age children and adults
Cylindrospermopsin	0.7 µg/L	3.0 µg/L
Microcystins	0.3 µg/L	1.6 µg/L

(EPA, 2019)



(Kubickova et al., 2019)

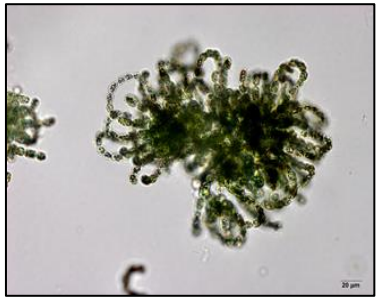


Microcystins

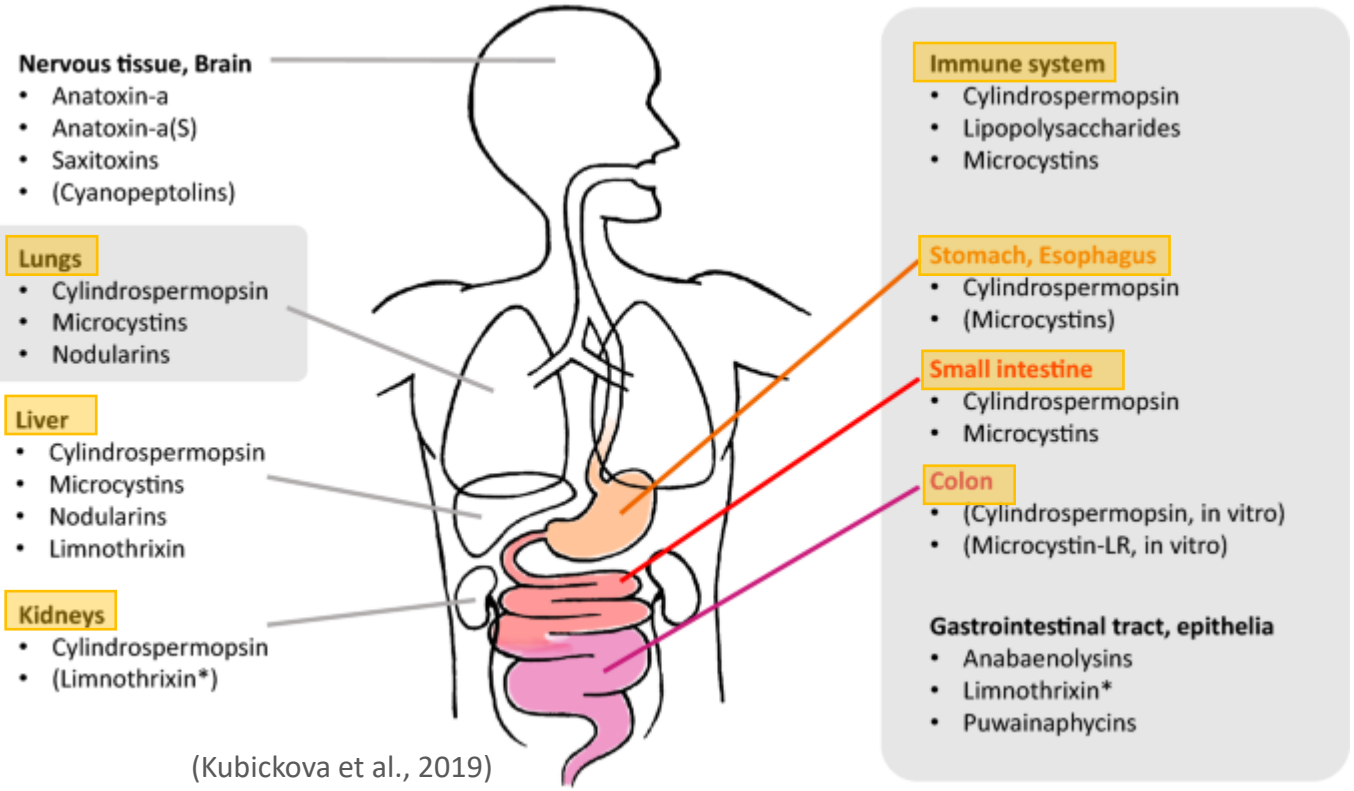
- Most common cyanotoxins found worldwide, and in NH
- Potent hepatotoxin and tumor promoter
  - Acute and chronic toxicity
- MCs are extremely stable compounds (4-14 days)

Microcystis

Dolichospermum (Anabaena)



Planktothrix (Oscillatoria)



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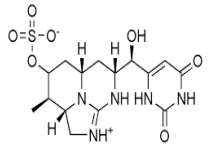
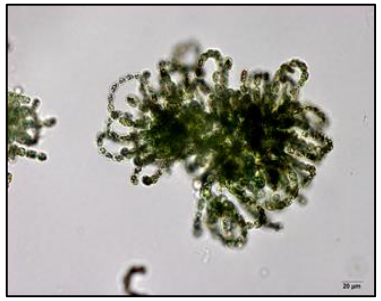


Cylindrospermopsin

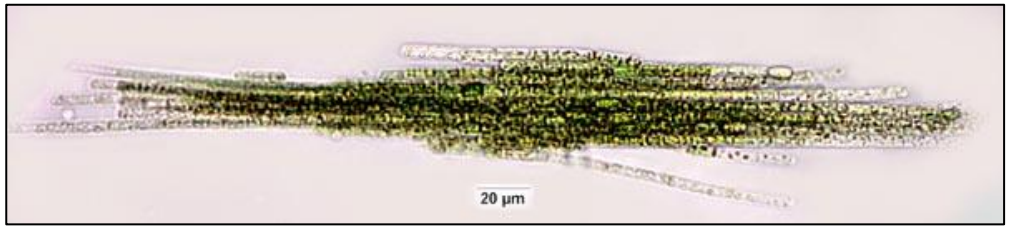
- Not found as frequently in NH freshwater
- Toxic to multiple organs, neurotoxic and genotoxic
  - Toxicity exerted on kidney, spleen, thymus, heart and gastrointestinal tract
- Not always cell bound – released into the water column during cell growth
- Stable in the environment

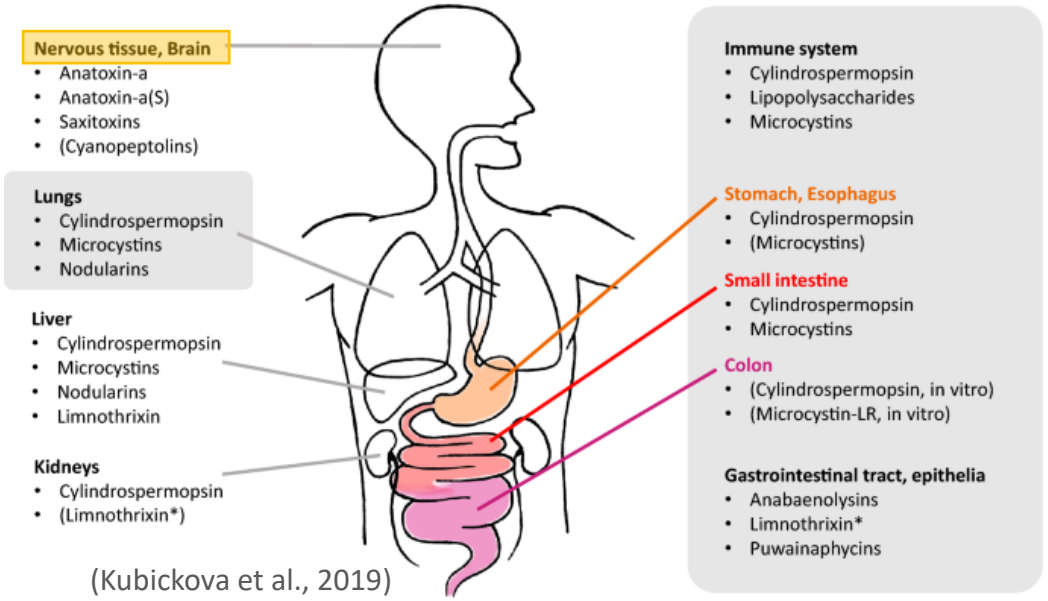
Dolichospermum (Anabaena)



Planktothrix (Oscillatoria)

Aphanizomenon





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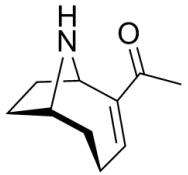
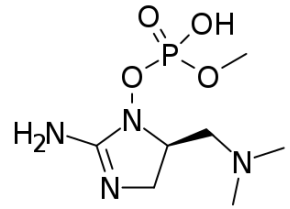


Anatoxin-a

- Acute toxicity: Very fast death factor
  - Potent neurotoxin
  - Inhibits acetylcholine receptors (neurotransmitter)
  - Seizures and death (common for dogs and other animals to ingest and die)
- Not stable compounds



Guanatoxin (formerly anatoxin-a(S))

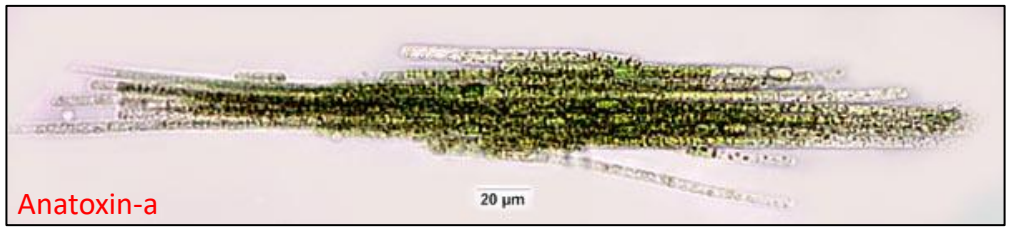
- Inhibits acetylcacetylcholinesterase (neurotransmitter)
  - Causes excess salivation, tears, urinary incontinence, muscle weakness, twitching, convulsion, respiratory distress

Dolichospermum (Anabaena)

Microcystis

Planktothrix (Oscillatoria)

Aphanizomenon



Routes of exposure to cyanotoxins

Ingestion
- Drinking water
- Recreation
- Contaminated food (fish or vegetable)
- Supplements

US FDA Microcystins

Inhalation
- Recreation
- Showering

Skin Contact
- Swimming
- Boating
- Water skiing

Eye Contact
- Swimming
- Recreation
- Aerosols

(CDC, 2022)

NHDES Cyanobacteria HAB Program Overview ★

Personal Risk Assessment

- Look at the water prior to recreating
  - Discoloration, unusual growth
  - Check the Healthy Swimming Mapper
  - Consider look-alikes
  - Report it

  When in doubt, stay out!

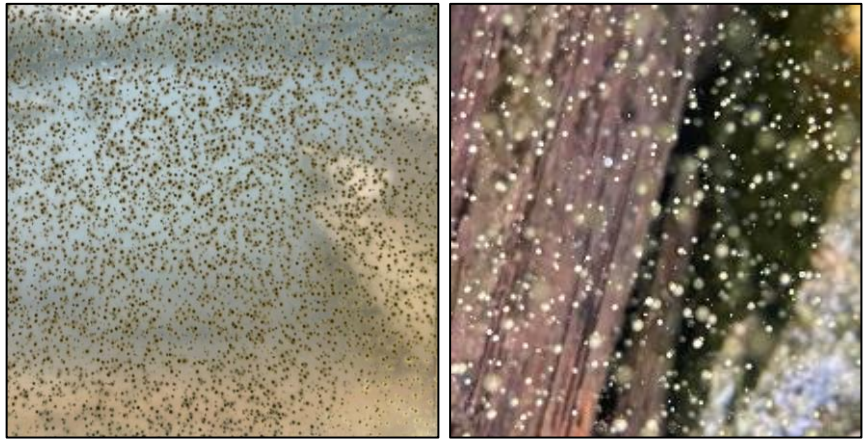
Cyanobacteria


Green Filamentous Algae


Duckweed


Unique Cyanobacteria

Gloeotrichia



Nostoc

Benthic Cyanobacteria

NEW Bloom Report

[Bloom Report Link]

More efficient

Cyanobacteria Bloom Report
NHDES-W-07-092
Updated 19 April 2023

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

If you notice anything resembling cyanobacteria, please refrain from wading, swimming, or drinking the water. Keep all pets out of the water.

Examples of cyanobacteria blooms

Cyanobacteria harmful algal blooms (CyanoHABs) can look very different. Cyanobacteria can look like scum, mats, spilled paint or paint chips. The color of the water can turn blue, green, white, yellow or brownish.

look very different. Cyanobacteria can look like scum, mats, spilled paint or paint chips. The color of the water can turn blue, green, white, yellow or brownish.

Bloom Information

Bloom Image

Waterbody Information

Sampling

Reporter Information

Submit

Sampling

Are you able to collect a sample?*

Public health notices will be issued if cyanobacteria densities exceed recreational health guidance levels.

Results will be expedited if you are able to collect a sample.

Yes

Take a screenshot!

Sampling instructions

As a reminder, these blooms are potentially toxic, so please take the necessary precautions – wear gloves and a mask, and wash your hands well with freshwater when done.

Label a sample jar (clean glass or hard plastic jars are best):
- Sampler's full name and contact information (phone number and email)
- Waterbody Name and Town
- Address or specific location sample collection
- Date

- Collect a sample by skimming the bottle on the surface of the water to sample the most concentrated part of the bloom, or scoop clumps of concentrated material
- Use a new bottle for different sampling locations
- Rinse bottle off if bloom residue covers the outside of the bottle
- Wash hands after handling bloom material
- Place sample on ice or in a refrigerator until it is delivered to the Concord NHDES lab or picked up by NHDES

**** If you collect a sample over the weekend, please take an additional sample Sunday evening or Monday morning prior to sample drop off / pick up. ****

Report information private to NHDES

Thank you for reporting.
Your response was submitted successfully.

Remember - when in doubt, stay out! Please refrain from wading, swimming, or drinking the water. Keep all pets out of the water.

We are not open on the weekends. The NHDES Jody Connor Limnology Center is open from 8 AM to 4 PM Monday through Friday. If you are submitting a bloom report outside of these hours, you will hear from us as soon as we return.

Potential cyanobacteria material should not be touched, raked or moved until an identification has been made.

Healthy Swimming Mapper
FAQs (Includes Sampling Instructions)

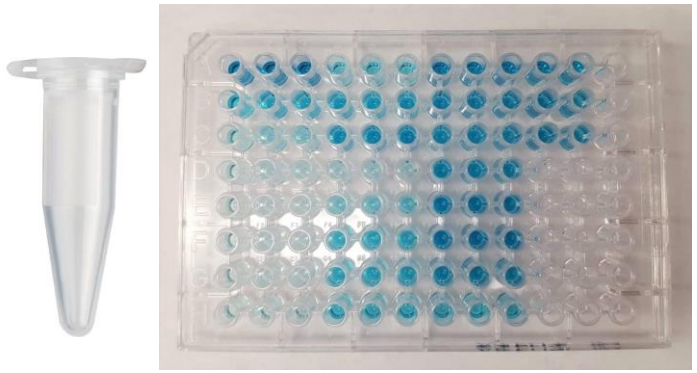
CDC Health Care Provider Info
CDC Veterinarian Info

Please contact HAB@des.nh.gov with any further questions.

Submit another response here.

NHDES

Toxin Analysis



- Subsamples are taken for future toxin analysis via ELISAs

Table. Recommended magnitude for cyanotoxins.

Microcystins	Cylindrospermopsin
8 µg/L	15 µg/L

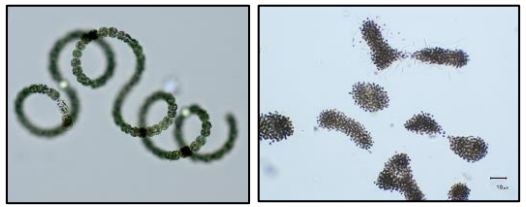
(EPA, 2019)

70,000 cells/mL

- Limitations: expensive, time intensive, delayed results, many different cyanotoxins

Microscopic Analysis

Samples are identified and enumerated within 24 hours



< 70,000 cyanobacteria cells/mL **ALERT** may be issued

> 70,000 cyanobacteria cells/mL ★**WARNING (ADVISORY)** issued

Two-tiered response based on cyanobacteria density

ALERT

- Be on the lookout for cyanobacteria
  - Cyanobacteria below the advisory threshold, but could develop
  - If the bloom has passed by the time the sample is analyzed (weekends!)
  - Issued based on a photo and description of the bloom prior to sampling

- Resampled if residents inform us about continued presence / changing conditions
- Active for a week

WARNING (ADVISORY)

- **Lake wide** warning that water is currently unsuitable for wading or swimming, do not come in contact with bloom material, keep children and pets out of the water
  - Cyanobacteria density exceeds 70,000 cells/mL

- Lakes are resampled weekly, until the cyanobacteria cell concentration declines below 70,000 cells/mL

ALERT and WARNING (ADVISORY) communication

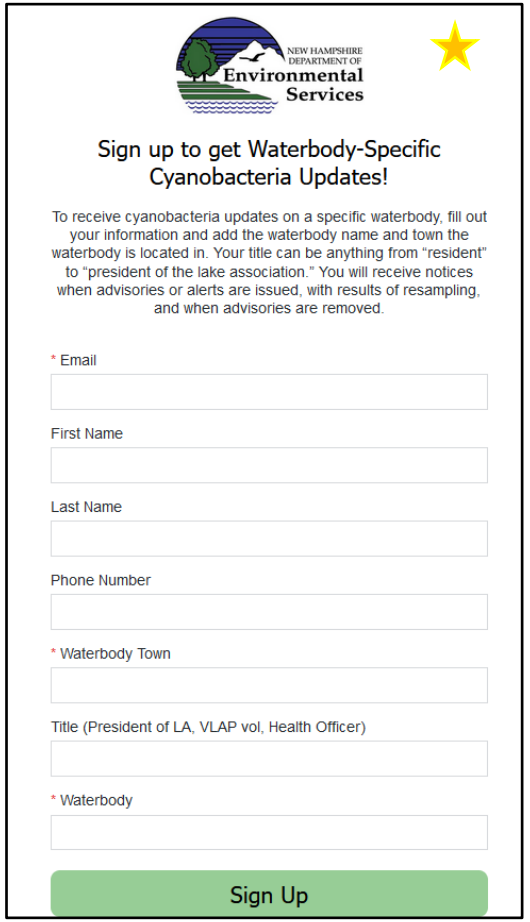
ALERT
- Alert statement shared:
  - Waterbody specific email lists
  - ★ Posted on the Healthy Swimming Mapper

WARNING (ADVISORY)
- Advisory statement shared:
  - Waterbody specific email lists
  - Posted on the Healthy Swimming Mapper
  - Signs
  - NHDES Social Media

@NHDES

@nhenvironmentalservices

Sign up for waterbody specific information



ALERT and WARNING (ADVISORY) communication

WEEKLY UPDATES

- Constant contact email
- Posted on NHDES website
- Emailed to press

[Sign up for weekly reports]

[NHDES website cyanobacteria weekly reports]

FOR IMMEDIATE RELEASE
DATE: 18 May 2023
CONTACT: Kate Hastings, **HAB@des.nh.gov**
Healthy Swimming Mapper
des.nh.gov
twitter.com/NHDES

Cyanobacteria Updates for May 15 to May 18, 2023

Check out the NHDES Healthy Swimming Mapper for more details and daily updates.

Healthy Swimming Mapper

Active Cyanobacteria Warnings (Advisories):

New Warnings
- Arlington Mill Pond, Salem, issued 16 May 2023

Continuing Warnings
- No continuing warnings

Active Cyanobacteria Alerts:

- No active alerts

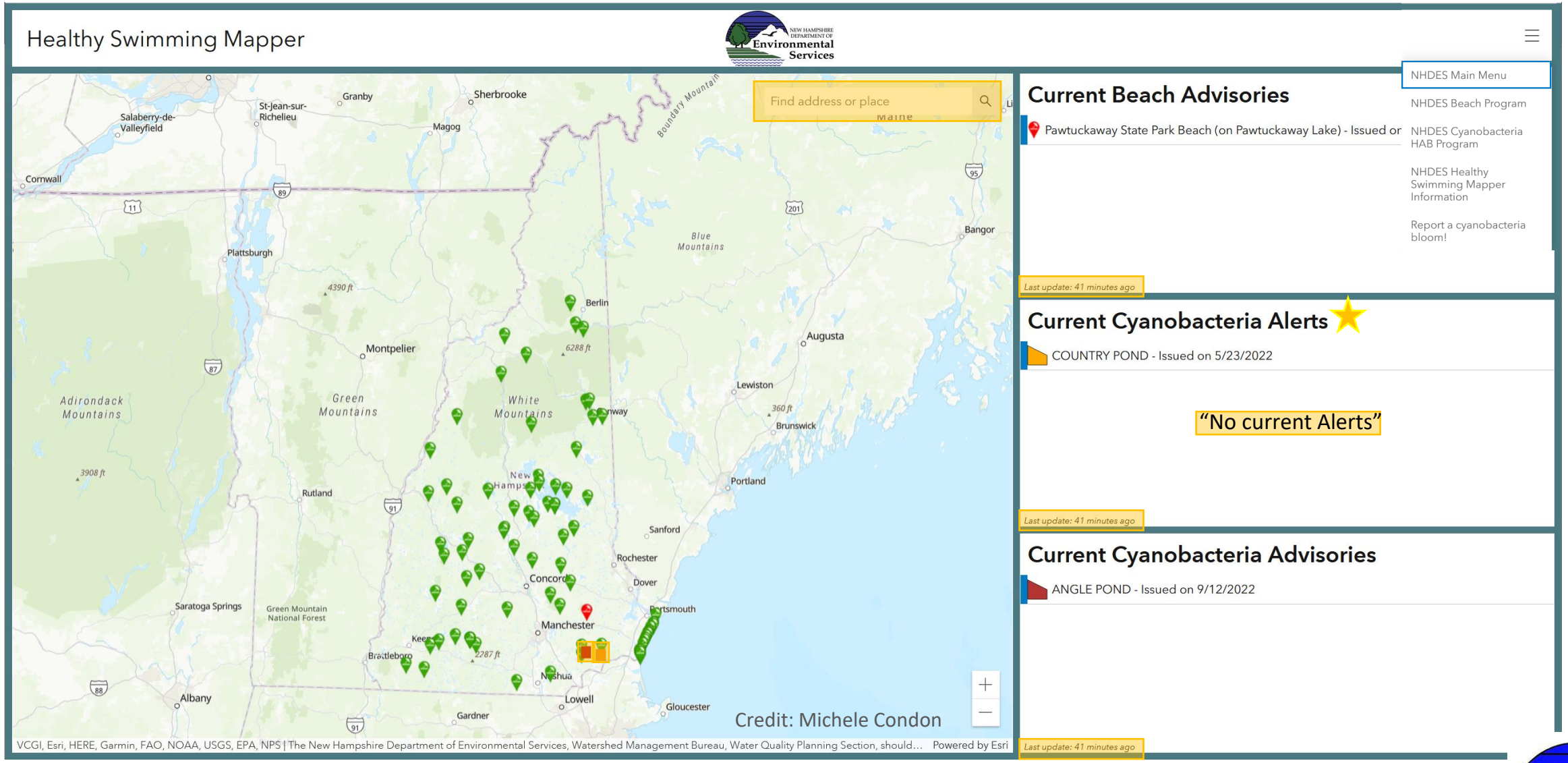
Cyanobacteria Warnings (Advisories) Removed:

- No warnings closed

If you notice anything resembling cyanobacteria, please refrain from wading, swimming, or drinking the water. Keep all pets out of the water and report it to NHDES immediately. Remember, ***when in doubt, stay out.***

Report A Bloom

Plus more info!



New Healthy Swimming Map

Healthy Swimming Mapper

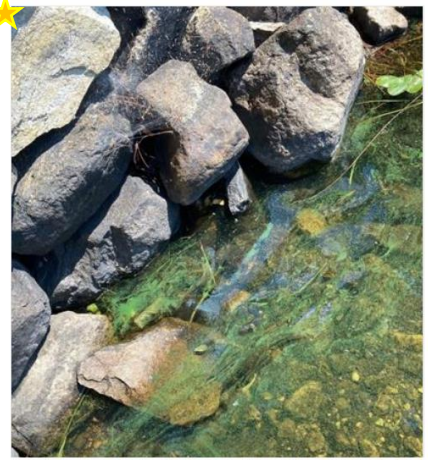
NEW HAMPSHIRE DEPARTMENT OF Environmental Services

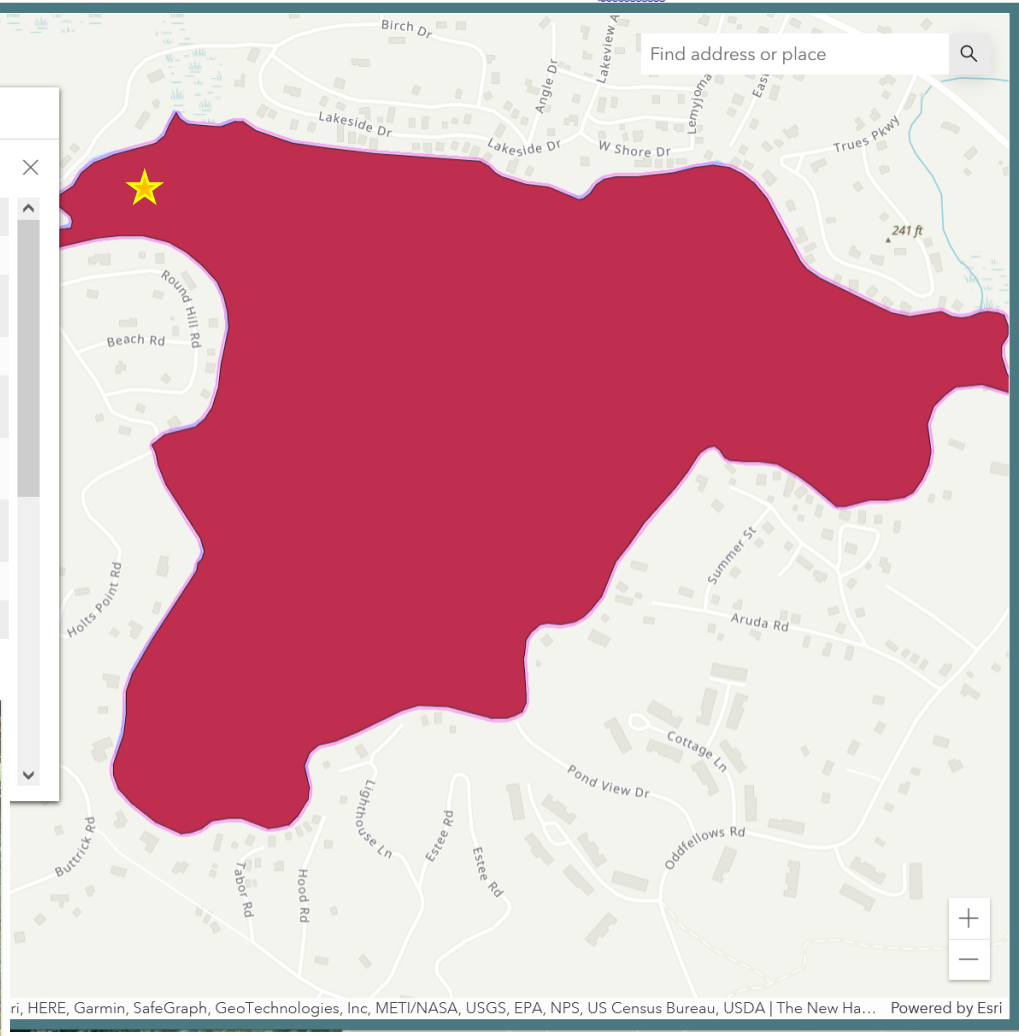
Zoom to Pan

ANGLE POND

Status	Advisory
Town	Sandown/Hampstead
Most Recent Sampling Date	9/12/2022
Date Issued	9/12/2022
Bloom Description	Green clouds and surface streaks.
Initial Cyanobacteria Identified	Dolichospermum
Initial Total Cyanobacteria Density (cells/mL)	138,200
2023 Advisory History	No advisories issued
Historical Advisories	View

Image taken on 9/9/2022





Current Beach Advisories

Pawtuckaway State Park Beach (on Pawtuckaway Lake) - Issued on 8/9/2022

Last update: 35 minutes ago

Current Cyanobacteria Alerts

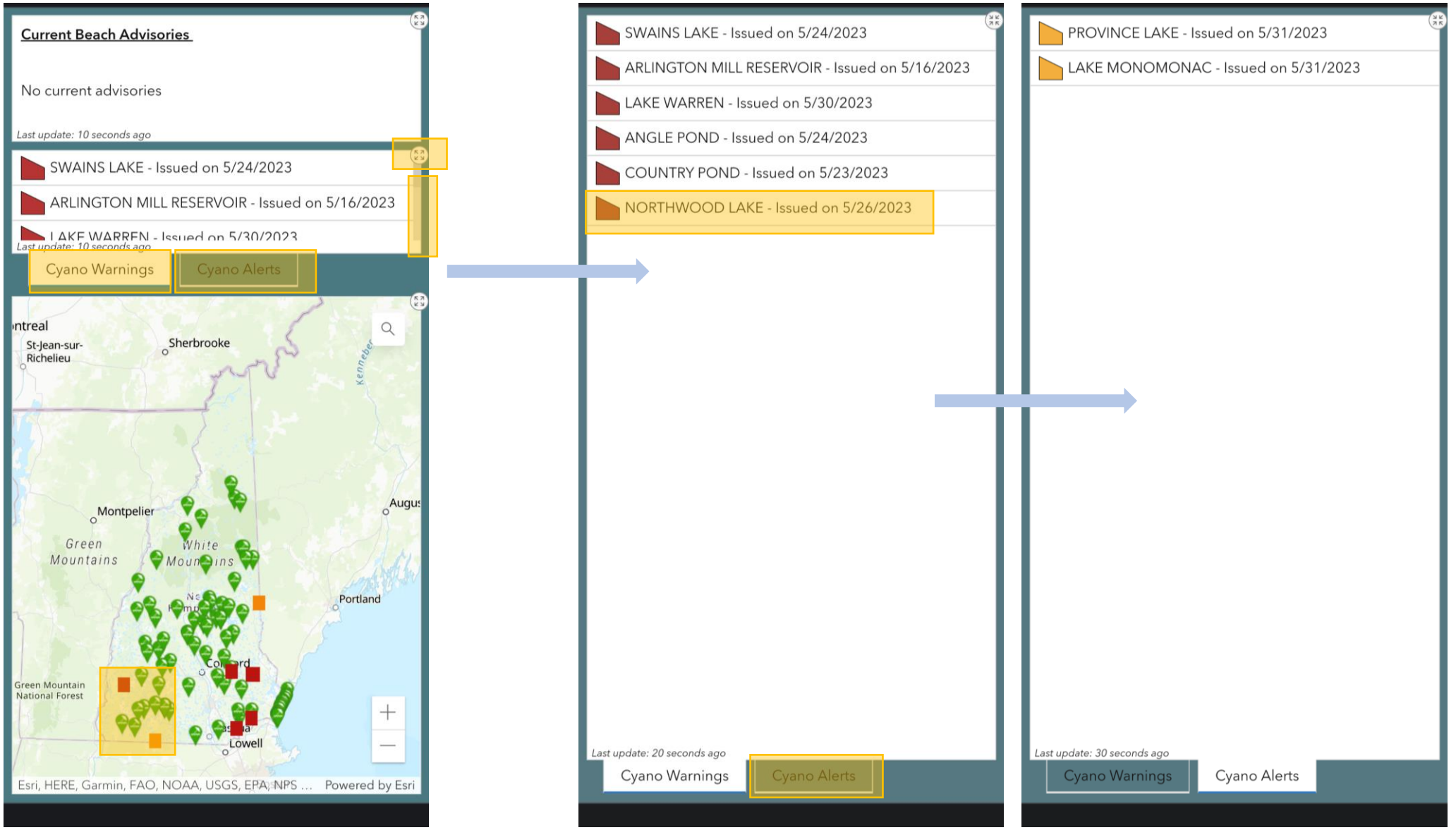
COUNTRY POND - Issued on 5/23/2022

Last update: 35 minutes ago

Current Cyanobacteria Advisories

ANGLE POND - Issued on 9/12/2022

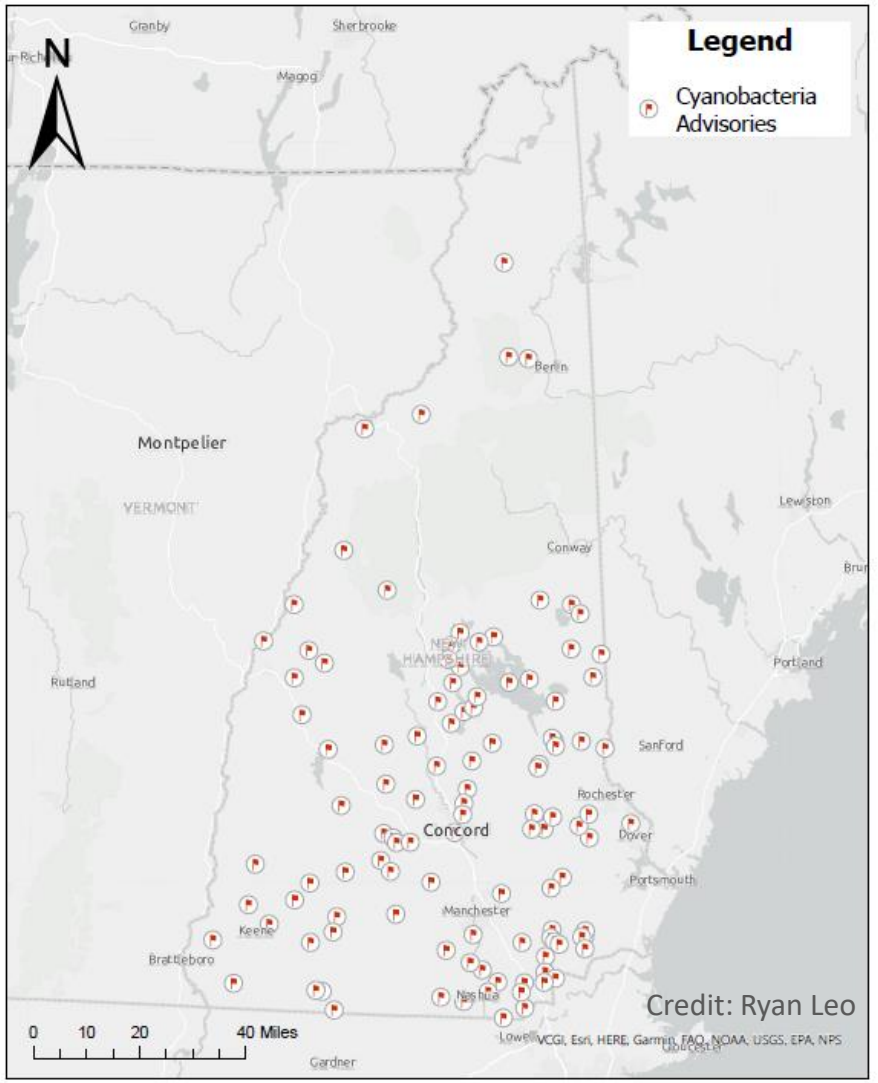
Last update: 35 minutes ago


Current Beach Advisories
No current advisories
Last update: 10 seconds ago
SWAINS LAKE - Issued on 5/24/2023
ARLINGTON MILL RESERVOIR - Issued on 5/16/2023
LAKE WARREN - Issued on 5/30/2023
Last update: 10 seconds ago
Cyano Warnings
Cyano Alerts
Sherbrooke
St-Jean-sur-Richelieu
Montpelier
Green Mountains
White Mountains
Portland
Green Mountain National Forest
Lowell
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS ...
Powered by Esri
SWAINS LAKE - Issued on 5/24/2023
ARLINGTON MILL RESERVOIR - Issued on 5/16/2023
LAKE WARREN - Issued on 5/30/2023
ANGLE POND - Issued on 5/24/2023
COUNTRY POND - Issued on 5/23/2023
NORTHWOOD LAKE - Issued on 5/26/2023
Last update: 20 seconds ago
Cyano Warnings
Cyano Alerts
PROVINCE LAKE - Issued on 5/31/2023
LAKE MONOMONAC - Issued on 5/31/2023
Last update: 30 seconds ago
Cyano Warnings
Cyano Alerts

NH Cyanobacteria Advisory Trends Over Time

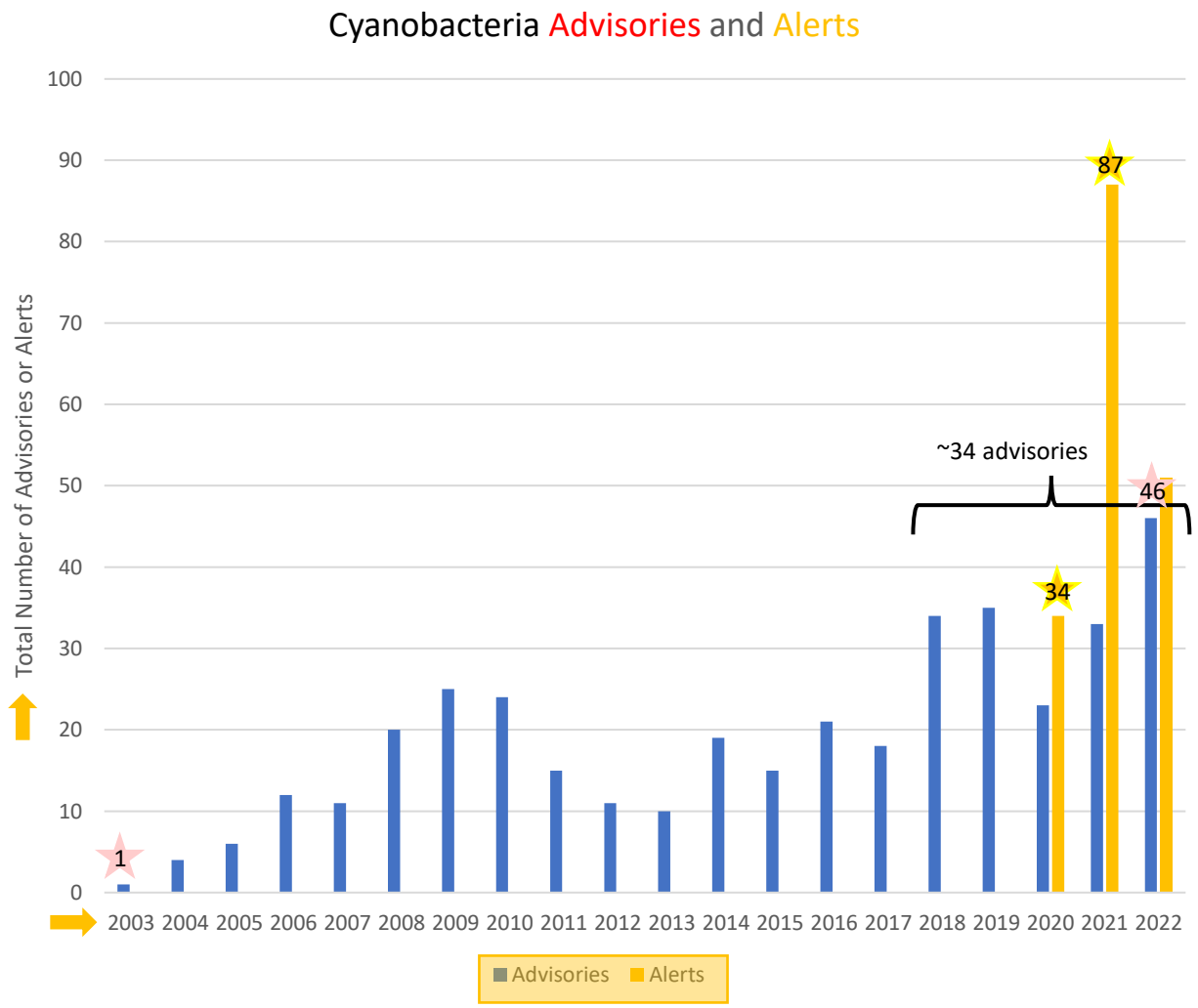
NH Cyanobacteria Advisories

- Issued at 113 different lakes
- Issued across the whole state



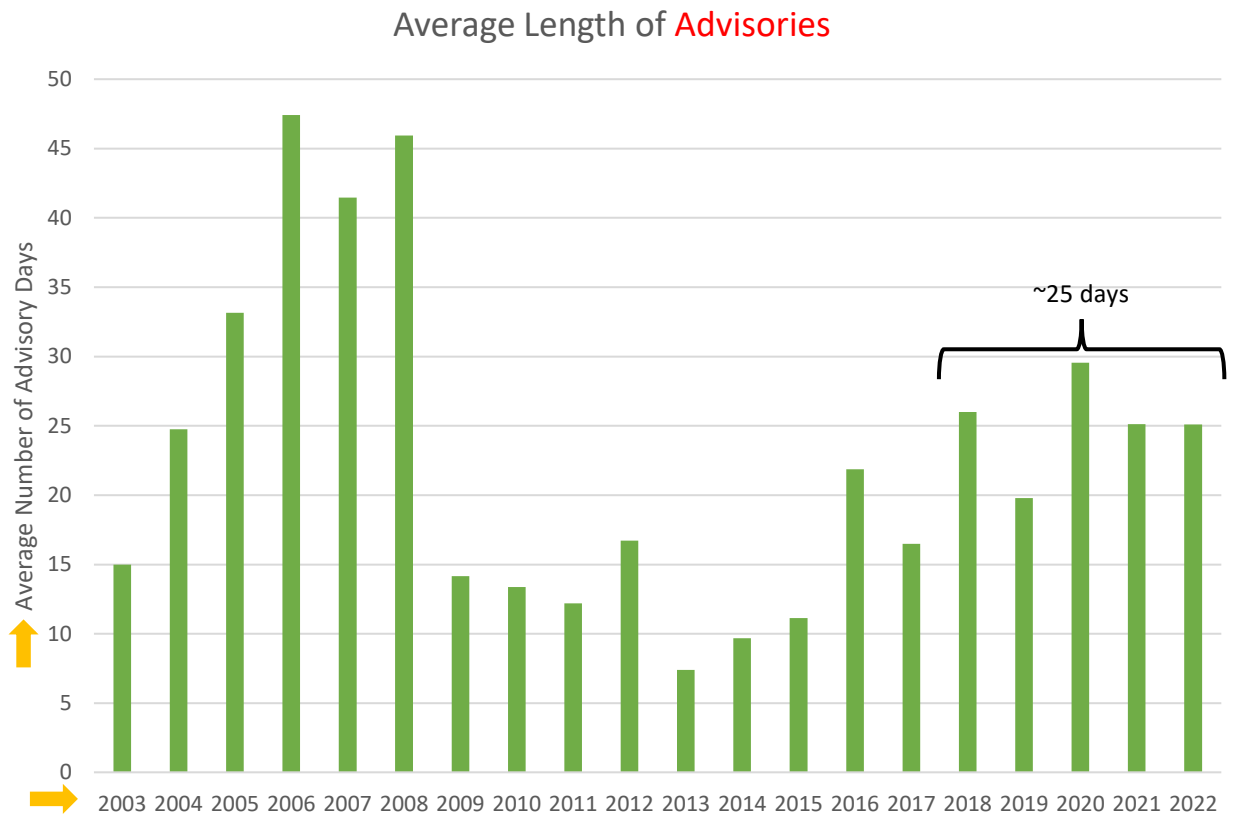
New Hampshire Cyanobacteria Bloom Advisories (2004-2022)

Cyanobacteria Advisories Over Time



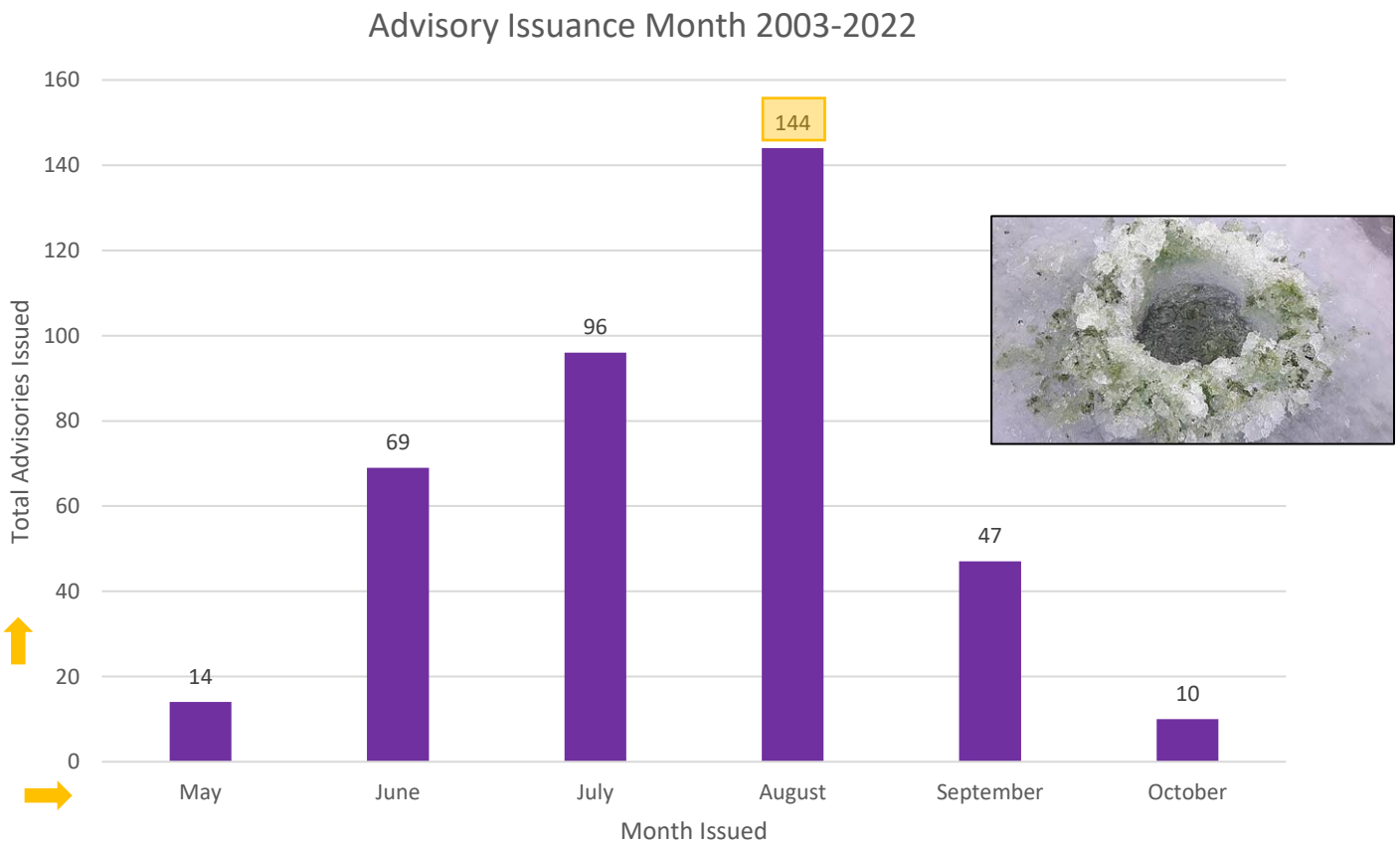
- Some water bodies have multiple advisories and alerts
  - 2022, 46 advisories, 36 waterbodies
- Significant increase in advisories since 2003
- Reaction-based program
  - Samples are primarily collected when they're reported
  - Increased public awareness
  - More reports = more advisories
- Advisories keep people and pets safe!

“How long is this going to last”



- Depends on many factors
  - Water body, nutrient inputs, weather, etc.
- 2018-2022:
  - Shortest advisory was 2 days
  - Longest advisory was 132 days

Seasonality of Advisories

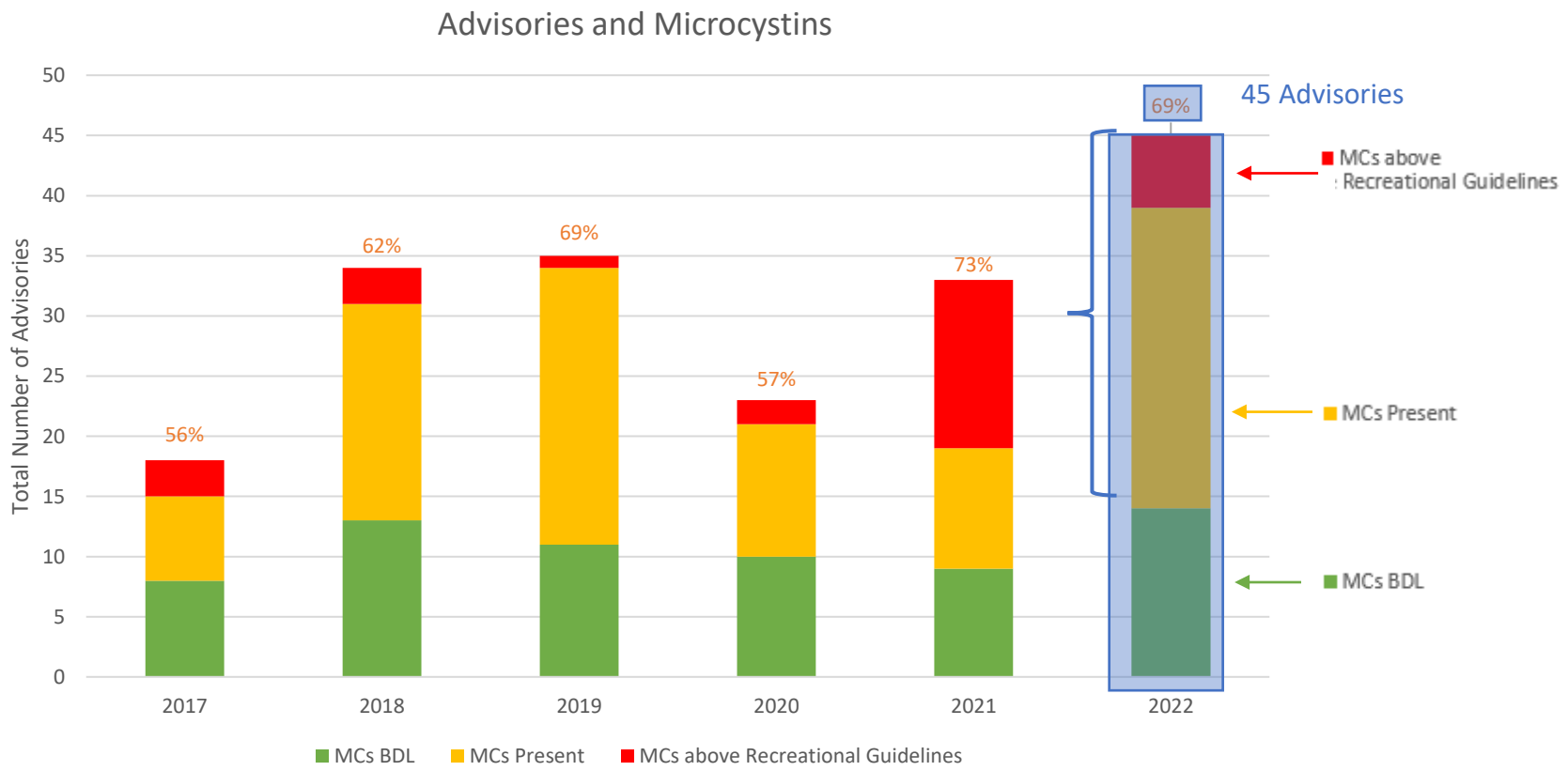


- NHDES has issued cyanobacteria advisories from May through October
  - Most advisories issued during peak summer
  - Colder temperatures mean less recreation, and fewer reports
  - They can bloom under ice!

- Earliest advisory dates
  - 16 May 2023
  - 20 May 2022
  - 23 May 2010
- Last advisory dates
  - 7 Dec 2021
  - 1 Dec 2016
  - 30 Nov 2022

6 advisories in May 2023

Microcystins (MCs) in NH Cyanobacteria Blooms



- Percent of advisories with detectable MCs varies
  - 56% to 73%
- Number of advisories with MCs above the 8 µg/L recreational limit varies
  - 1 to 14
  - 6 above in 2022

- **Bloom toxicity can change over the duration of a bloom**

Microcystins are not the only cyanotoxin. . .

Thank you!
Questions?

Report a bloom!
https://arcg.is/1e8Tfy

Healthy Swimming Mapper:
https://www4.des.state.nh.us/WaterShed_BeachMaps/

NHDES Cyanobacteria Page:
https://www.des.nh.gov/water/healthy-swimming/harmful-algal-blooms

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