Cyanobacteria

(Blue-green Algae)

Guidance for Vermont Communities

VERMONT
DEPARTMENT OF HEALTH

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Cyanobacteria (Blue-green Algae) Guidance for Vermont Communities

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Cyanobacteria (Blue-green Algae) Guidance for Vermont Communities

1. Introduction

Reason for this Guidance

Within the past decade, an increasing number of Vermont lakes and ponds have reported cyanobacteria (blue-green algae) blooms.
Cyanobacteria blooms can cause anxiety within a community because of the potential health effects of exposure to toxins, which may be present in these blooms. The Vermont Department of Health (VDH) and the Vermont Department of Environmental Conservation (DEC) have developed this document as a reference guide for communities whose lakes and ponds are impacted by cyanobacteria blooms.

The objectives of this community guide are to provide:

- tools for identification of cyanobacteria blooms;
- a quick reference guide on the nature of cyanobacteria
- tools to allow communities to develop and implement low-cost, sustainable monitoring programs for cyanobacteria blooms;
- assessment tools to determine public health risk from cyanobacteria blooms;
- guidance for determining use-restrictions of water impacted by cyanobacteria blooms to protect public health;
- guidance for public information strategies;
- appropriate contact information if additional state or federal resources are needed.

Basis for this Guidance

This guidance document has been developed using available scientific data. Guidance from federal and international health organizations: Centers for Disease Control (CDC), US Environmental Protection Agency (USEPA), World Health Organization (WHO) and other state and international protocols.

Additionally, the Lake Champlain Basin Program (LCBP), the University of Vermont (UVM), and the Lake Champlain Committee (LCC) have all provided valuable knowledge, data and experience which have been incorporated into this document.

Scope and Limitations of this Guidance

With increased climatic pressures and more intense use of Vermont lakes and ponds, the occurrence of cyanobacteria blooms may increase in the coming years. Lakes and ponds previously unaffected by cyanobacteria blooms may experience blooms.

This guidance is specifically intended for community members to identify and respond to the cyanobacteria blooms in their lakes and ponds to protect public and animal health.

This guide is not a regulatory guide, a prevention manual, nor a practice for public water system operation.

2. Background Information about Cyanobacteria

What are Cyanobacteria?

Cyanobacteria are common native aquatic microorganisms present in many surface waters. Cyanobacteria are single-celled microscopic bacteria and can be found in fresh, salt or brackish waters. Like plants, they use sunlight to make food and energy. Under most conditions they are too small to be seen by the human eye.

In waters where nutrients are readily available and certain environmental conditions exist, cyanobacteria can multiply rapidly to create visible floating colonies. If these growth conditions continue, large, floating, mat-like accumulations of cyanobacteria can form on the surface of the water. This abundant, visible growth is typically referred to as a 'bloom' or 'scum'. The thickest blooms usually occur in calm waters, such as near shorelines or in protected bays. In Vermont, blooms are most common in late summer or early fall.

Cyanobacteria have been commonly referred to as 'blue-green algae'. However, cyanobacteria blooms are not always blue-green. In fact, they can be blue, bright green, brown, white or red. A cyanobacteria bloom is best described as "pea soup" or "spilled paint" on the water's surface.
The following documents at the end of this guide may help in identifying a cyanobacteria bloom:
Appendix A: Ways to Identify a Cyanobacteria/Blue-green Algae Accumulation
Appendix B: Visual Assessment and Common Misidentifications (Photos)

Factors that May Influence the Formation of Blooms

Cyanobacteria are common in Vermont lakes and ponds, and the occurrence of blooms is becoming more frequent. Two suggested reasons for the increasing number of lakes and ponds impacted by blooms are (1) increased temperature of water and air and (2) increased nutrient content of waters. There may also be other unidentified factors which contribute to bloom formation.

Possible Harmful Effects of Cyanobacteria Blooms on an Ecosystem

Large accumulations of algae can block the sunlight needed by other animals or plants in the water body. These situations can also lead to a shortage of oxygen in the water during the bloom and afterwards as the cyanobacteria decompose. Fish and mussels can be stressed and/or die as a result of low oxygen conditions.

Common Misidentifications

Identification of cyanobacteria can be difficult. Because of their microscopic size, they are usually not visible to the human eye until colonies or blooms have formed. There are other floating organisms which may be misidentified as cyanobacteria, such as diatoms (single-celled algae), green algae, duckweed and pollen.

3. Public Health Concerns about Cyanobacteria

Cyanobacteria and Toxin Production

Some types of cyanobacteria will naturally produce compounds in their cells that can be toxic to humans and other animals (Table 1). Not all cyanobacteria produce toxins. Types of cyanobacteria that are known to produce toxins may not produce them under all conditions. Assessing the potential risk from a cyanobacteria bloom to humans and animals can be difficult.

Table 1. Cyanotoxins and associated types of cyanobacteria (Source EPA)

Cyanotoxin	Primary Organ Affected	Health Effects	Most Common Cyanobacteria Producing Toxin
Microcystin-LR	Liver	Abdominal pain Vomiting and diarrhea Liver inflammation and hemorrhage	*Microcystis* *Anabaena* *Planktothrix* *Anabaenopsis* *Aphanizomenon*
Cylindrospermopsin	Liver	Acute pneumonia Acute dermatitis Kidney damage Potential tumor growth promotion	*Cylindrospermopsis* *Aphanizomenon* *Anabaena* *Lyngbya* *Rhaphidiopsis* *Umezakia*
Anatoxin-a group	Nervous System	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death	*Anabaena* *Planktothrix* *Aphanizomenon* *Cylindrospermopsis* *Oscillatoria*

Toxins produced by multiplying cyanobacteria generally stay inside the cells, but some toxins may leak out into the surrounding water, particularly if the bloom has been growing over a long period of time.

When a toxin- producing bloom dies and breaks up, toxins may be released into the surrounding water. This can be a concern for public health.

Health Effects that May be Caused by Cyanobacteria Toxins

The health effects from cyanobacteria toxins depend on the type of toxin, the amount someone is exposed to, and the route of exposure.

- Inhalation of water droplets that have toxins in them may cause allergic-like reactions, runny noses, or sore throats.
- Swallowing water that has high levels of cyanobacteria toxins in it may cause:

    - Severe stomach problems like abdominal pain, diarrhea and vomiting.
    - Liver damage which may take hours or days to show up in people or animals.
    - Numb lips, tingling fingers and toes, or dizziness.

- People may get rashes or other skin irritations from coming into contact with blooms. Usually these skin irritations are not associated with toxins, but rather other compounds in cyanobacteria cells such as lipopolysaccharides and endotoxins.

Additional Causes for Concern

Children and pets are at higher risk for illness from exposure to toxins because they can ingest a large dose of toxin relative to their size and body weight. They are also the most likely to play in thick blooms near the shoreline. There is currently no indication that pregnant women and unborn children are at a higher risk for illness than other adults.

To date in Vermont, there have been no known human deaths from cyanobacteria blooms. Multiple unconfirmed reports of human illness ranging from skin irritations to respiratory issues and severe gastrointestinal illness have been reported.

In previous summers, deaths of two dogs were thought to be a result of the dogs swallowing a large amount of cyanobacteria scum. Reports of animal illnesses and deaths have also been reported in other states.

Symptoms of toxin ingestion or contact may be relatively mild and appear as non-specific and may occur after a significant time delay. This leads to underreporting of illness in both people and animals associated with cyanobacteria exposure.

There is ongoing research on potential health effects of exposure to the toxins produced by some species of cyanobacteria. The Vermont Department of Health evaluates any new findings and makes updates to guidance materials as necessary.

4. Possible Exposure for Vermonters

Recreational

Swimmers can be exposed to toxins through skin contact, inhalation of water droplets or ingestion of water at recreational areas with blooms present or recent history of blooms.

Table 2. Activities and associated potential for exposure to cyanobacteria (Stone & Bress, 2007).

Level of Potential Exposure	Recreational Activity	Primary Exposure Pathway of Concern
High	Swimming/wading	Ingestion
	Diving	Ingestion
	Water skiing/wake boarding	Ingestion/inhalation
	Wind surfing	Ingestion/inhalation
	Jet skiing	Ingestion/inhalation
Moderate	Fish consumption	Ingestion
	Canoeing	Inhalation/skin
	Paddle Boarding	Inhalation/skin
	Rowing	Inhalation/skin
	Sailing	Inhalation/skin
	Kayaking	Inhalation/skin
	Motor boating	Inhalation
Low/none	Catch and Release fishing	Skin
	Hiking	Not applicable
	Picnicking	Not applicable
	Sightseeing	Not applicable
		(Based on Stone and Bress, 2007)

Drinking and Food Preparation from Lake Water

The Health Department recommends that untreated lake or pond water not be used for drinking or food preparation. Untreated water may contain cyanobacteria or cyanobacteria toxins, as well as other potentially pathogenic microorganisms.

5. Assessing Cyanobacteria Monitoring Needs in a Community

Using local visual monitoring programs for cyanobacteria blooms can be an effective management approach. It is more cost-effective and less time-consuming than analytical testing. To initiate a local monitoring program there are several suggested steps, outlined in section on page ten, **6. Developing a Monitoring Plan**.

The first step is to identify key community stakeholders – those who can provide the observations, those who determine the response, and those responsible for public health. Examples of community stakeholders include:

Local or Regional Watershed Groups or Associations: These groups have an interest in the water quality of the area. They know the lakes and ponds within their region and may already have monitoring or tracking programs in place for other water contaminants or aquatic nuisance species.

Vermont Watershed Management Division: This division is responsible for water quality issues in the state and can provide assistance in responding to the underlying causes of cyanobacteria blooms.
http://www.vtwaterquality.org/

Beach Managers: Private and public lakes and ponds may have managers already monitoring the waters to ensure safe recreational waters. They can include: State Parks, Local Parks and Recreation Departments, Army Corps of Engineers, and camp owners.

Health Officials: Local state or town health officials can assist with technical assessments and obtaining direct help from other state or federal agencies. Local district health offices may be able to provide guidance in environmental health issues. http://healthvermont.gov/local/district/district_office.aspx#find

District Health Office:
http://healthvermont.gov/local/district/district_office.aspx#find

Town Health Officers: http://healthvermont.gov/local/tho/tho_list.aspx

Local Science Teachers: Teachers may have access to microscopes or other equipment that may be useful in identifying types of cyanobacteria.

Agricultural and Veterinary Community: In Vermont, cyanobacteria illnesses have been reported in dogs. There is also concern about livestock, who ingest large quantities of water. Animal illness may provide the first indication of a cyanobacteria issue.

Public water supply operators: Operators who have surface water intakes that may be impacted by a cyanobacteria bloom play a key role in protecting public health.

Interested Community Members: Community members can be easily trained to assist in visual monitoring programs for cyanobacteria.

6. Developing a Monitoring Plan

The following steps are suggested to develop a local monitoring program:

A. Determine Where to Monitor

During the winter or early spring key stakeholders should begin to identify lakes and ponds of concern. Waters of highest concern can be those which have had cyanobacteria blooms in the past and pose a moderate to high risk related to the use of the water. To be considered in ranking:

Table 3. Priority ranking for potential monitoring sites.

Priority Ranking	Description of blooms	Implications for monitoring
1	Waters where blooms occur annually for at least a short period of time	Monitoring will enhance capability to detect sporadic blooms that otherwise go unreported. Regular monitoring also helps determine changes in bloom frequency over time.
2	Waters that have periodic blooms, not necessarily annually	Monitoring will help identify conditions and locations that may cause blooms. Routine monitoring of these waters may not be cost- effective because of the limited appearances and typically low health threat.
3	Waters that have never had a bloom reported	Routine monitoring will likely indicate no blooms or health concerns and would be unnecessary.

Key criteria for concern:

Areas with a history of cyanobacteria blooms in the past and

- Recreational beaches
- Boat launches or fishing access areas (particularly where dogs may play in the water)
- Areas near surface drinking water intakes (public or private)
- Likelihood of other recreational activities (jet skiing, kayaking etc.)
- Areas that provide water for livestock or field irrigation.

B. Determine How Frequently to Monitor

Frequency of monitoring or inspecting lakes and ponds will depend on water use, exposure frequency and past occurrences of blooms.

Designated areas with a historical record of blooms should be monitored on a

consistent basis. At the beginning of the summer, a visual assessment should be done weekly. Postings at the designated beach area with a local contact number could help with passive monitoring; allowing beach users to report any possible sightings to the local contact and initiate consistent monitoring by trained volunteers.

C. Become Trained to Identify Cyanobacteria

Initially, the correct identification of cyanobacteria can be challenging. Contact VDH or LCC for training on how to identify cyanobacteria.
Photos and guidance for determining what is or is not cyanobacteria are provided at the end of the guidance document:
Appendix A: Ways to Identify a Cyanobacteria/Blue-green Algae Accumulation
Appendix B: Visual Assessment and Common Misidentifications (Photos)

D. Determine What Data to Collect

When monitoring, assign the waterbody to a standard category based on the guide in:
Appendix B: Visual Assessment and Common Misidentifications (Photos).
Sample data sheets are provided in:
Appendix H: Sample Data Sheet

It is important to note:

- Name of the waterbody;
- Identifiable location on the water (*e.g.,* access point, public beach name);
- Date of observation;
- Time of observation;
- Rating of Visual Observation (*i.e.,* Category 1, 2, or 3);
- Approximate size of area affected (*e.g.,* entire bay, sporadic shoreline accumulations).

Other data may be collected such as recent precipitation, air and water temperature and wind direction.

Suggested Actions Based on Visual Monitoring System:

i) ***Category 1*** indicates little to no cyanobacteria. Health risks from the cyanobacteria are not likely.
(1) *Notifications:* Not needed
(2) *Further monitoring*: Continue on same frequency
(3) *Posting:* Not needed
(4) *Other actions*: None

ii) ***Category 2*** indicates that cyanobacteria are present in low to moderate amounts. Depending on size of the bloom, toxin concentrations are likely below recreational guidelines

(1) *Notifications*: Local notifications may be appropriate so that surveillance for potential health effects are increased and

preparations for possible testing are initiated. If the area is publicly used, notify the local Town Health Officer, local District Health Office, the Watershed Management Division and Beach Manager.

(2) *Further monitoring*: Visual Monitoring of a Category 2 area should be increased to weekly.

(3) *Posting:* May be appropriate to alert water users to be on the *lookout* for possible blooms and to avoid them. (**Appendix G: Template Signs for Postings**:) (Page 34)

(4) *Other actions:* None

iii) ***Category 3*** indicates cyanobacteria are present in moderate to high amounts. Potential for adverse health effects are possible if toxins are present and people or animals are exposed.

(1) *Notifications*: Continued local notifications are appropriate. If not previously notified, contact the local Town Health Officer, local District Health Office, the Watershed Management Division and the Beach Manager. If all water users cannot be contacted directly *via* postings or other methods, a media release may be appropriate (See **Appendix C: BGA Health Alert Template** for sample). Consider notifications to local healthcare providers and veterinarians.

(2) *Further monitoring:* Continue weekly monitoring until two consecutive weeks without a bloom presence.

(3) *Posting:* Public areas that have heavy blooms may be posted to alert water users to potential issues and closed for recreation. (**Appendix G: Template Signs for Postings**:) (Page 35)

(4) *Other actions*:

(a) It is recommended that recreational beaches with blooms should be posted and closed. Toxin testing should be considered prior to reopening. See Beach reopening guidance in **Appendix D: Recreational (Public) Beach Guidance**.

(b) Upon notification to the Vermont Department of Health, the website can be updated to add the public beach closings due to the cyanobacteria bloom. The public can also find links to FAQs and other informational materials.

7. What to do if a Bloom Occurs

Closing the Beach

When a cyanobacteria bloom appears at a public beach, the Vermont Department of Health recommends beach closure. As the bloom clears, beach managers should coordinate with Environmental Health to test toxin levels to ensure that they are below established guideline values before reopening the beach. Current Vermont Department of Health beach guidelines and values can be found in: **Appendix D: Recreational (Public) Beach Guidance**.

Toxin Testing

The Vermont Department of Health recommends testing for toxins when blooms appear at public beaches and at drinking water intakes.

The Vermont Department of Health Laboratory has the capability to test for three toxins from cyanobacteria blooms. The Laboratory can test for microcystin, anatoxin-(a), and cylindrospermopsin. In most cases toxin testing is not required for periodic blooms. Contact VDH for advice on when and how to conduct toxin testing.

Kits can also be bought from the VDH Laboratory by calling 1-800-660-9997.

Private Swimming Waters: KIT BGA-3 and KIT ANA.
Private Drinking Water Supplies: KIT BGA-2A and KIT ANA

Protecting Private & Public Water Supplies

Private:
If a bloom appears near or over a private drinking water intake pipe, VDH recommends switching to a known safe source of water (bottled or other) for all water uses except flushing toilets and sanitation. Private water supplies can be tested for toxins after the bloom has gone away.

Public:
If a bloom appears near a public water intake, the operator should consult with the Drinking Water & Groundwater Protection Division of the Department of Environmental Conservation for testing and operational guidance.

State Assistance for Drinking Water Supply Concerns

Private:
The Vermont Department of Health Laboratory can test for the presence of cyanotoxins in private drinking water supplies using KIT BGA-2A and KIT ANA. To purchase a kit call the Vermont Department of Health Laboratory at 1-800-660-9997.

Public:
Operators of Public Water Supplies that have concerns regarding cyanobacteria blooms should call the **Drinking Water & Groundwater Protection Division of The Vermont Department of Environmental Conservation** for advice and

consultation. Guidance documents for cyanobacteria toxins in public drinking water are maintained by the Drinking Water & Groundwater Protection Division.

Drinking Water & Groundwater
Protection Division 1 National Life Drive,
Main 2 Montpelier, VT 05620-3521

Phone: 802-828-1535

For After-Hour Water System Emergencies: Dial 802-741-5311 - then enter your phone number

8. Voluntary Reporting

Reporting Suspected Blooms

Reporting blooms to the state is very helpful to assist efforts to protect public health, water quality and recreational opportunities. Reporting of a bloom is coordinated through the Vermont Department of Health. Anyone suspecting a bloom can call 1-800-439-8550 or e-mail: AHS.VDHBlueGreenAlgae@state.vt.us to report the sighting. Additionally, any data collected by monitoring groups can provide valuable insight into the health of Vermont lakes and ponds and can be submitted at the end of the monitoring season, usually late September.

Reporting Suspected Health Effects

Any health effects for animals and humans are very important to track. There is no requirement to report health effects, but if an individual, a treating healthcare provider, or a veterinarian suspects ill health effects due to algal contact, VDH would appreciate the information.

Callers should be encouraged to contact their health care provider to discuss their health concerns. If the health care provider suspects health symptoms related to cyanobacteria exposure, they should call the Vermont State Toxicologist at **1-800-439-8550.**

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Appendices

Appendix A: Ways to Identify a Cyanobacteria/Blue-green Algae Accumulation

STEP 1 Examine the material visually:

NOT cyanobacteria if:

- you can see leaf-like structures or roots
- the material is long and stringy, or can be lifted out of the water on a stick
- if it is firmly attached to plants, rock or the bottom (e.g. you can't lift it out)

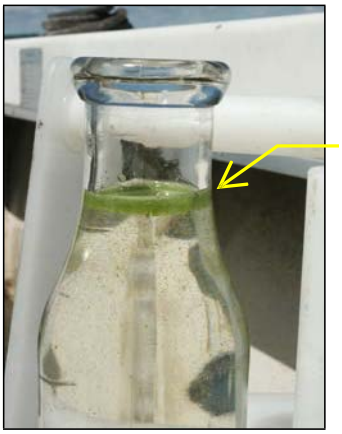
MAY be potentially hazardous cyanobacteria if:

- the material consists of small particles that are pinhead size or smaller
- the material is collecting in a layer at the surface or along the shoreline; the surface layer may appear oily
- the water is murky and colored a brownish green, milky green or blue

STEP 2 Do the "float" test:

Many cyanobacteria can regulate their buoyancy and will float to the top of the water when it is calm. Most other algae don't have this ability. Most debris and plant material will sink or be identifiable as debris. Microscopic animals will swim randomly and often with a jerky motion.

You can check to see if cyanobacteria are present by filling a clear two liter bottle or a bucket with water. The water should be collected away from any debris or large plant material floating along the shoreline. Allow the bucket or bottle to stand in a quiet sunny place, out of the wind. If present, cyanobacteria will often begin to move toward the surface. Wait 15 – 30 minutes and observe the upper portion of the container. Cyanobacteria, which may be a mix of several different kinds, will tend to accumulate in the upper portion of the water while debris and plant material will be at the bottom. There may be smaller material in the middle, which will remain suspended for some time. When filling the container from a dense accumulation, minimize skin contact with the material by wearing gloves or a plastic bag over your hands.



Be aware that the concentration of cyanobacteria at a location can change daily, even hourly, as the weather conditions change. If you do the float test routinely, you will begin to become familiar with how the water and cyanobacteria look under different conditions. Also, cyanobacteria may not always move to the surface in 30 minutes. If there is a bloom in progress, with a large amount of cyanobacteria in the water, at least a portion should move toward the surface.

With experience, you will become familiar with how your lake looks and when conditions warrant a closer examination.

Appendix B: Visual Assessment and Common Misidentifications (Photos)

A Visual Assessment of Cyanobacteria (Blue-green Algae) Presence

The goal is to assist you in ranking the level of concern of cyanobacteria in your water. Begin by observing the water or the shoreline. Don't disturb it or create waves. Select the best description from the following options:

CATEGORY 1 – LOW RISK OF CYANOBACTERIA

Category 1a: Little or no cyanobacteria present-clear water

The water is clear. There is no visible floating material. There are few visible particles. The water does not look cloudy brown or green. If near shore, the bottom is clearly visible more than 5 feet out. If offshore, canoe paddles or boat hook clearly visible well below the surface.

Category 1b: Little or no cyanobacteria present-brown and turbid water
The water is mostly clear. The bottom is visible several feet out from shore. Canoe paddle or boat hook is visible several feet below the surface.

Category 1c: Little or no cyanobacteria present-other material present

Material is present in long strands or hairs that tangle around paddles or boat hooks **OR** material is made of small particles bright mustard yellow or grass green in color.

Pine pollen- Lake Champlain

Duckweed - Lake Champlain

Floating green algae

Attached green algae

Category 1d - Little BGA present - recreation not impaired

Water appears clear

But close inspection shows some cyanobacteria are present

(Category 1d photos courtesy of Lake Champlain Committee)

CATEGORY 2 – CYANOBACTERIA ARE PRESENT IN LOW NUMBERS

Small particles are not mustard yellow or bright green **OR** particles can be seen distributed in a thin dispersed layer at the surface or along the shore.

Cyanobacteria

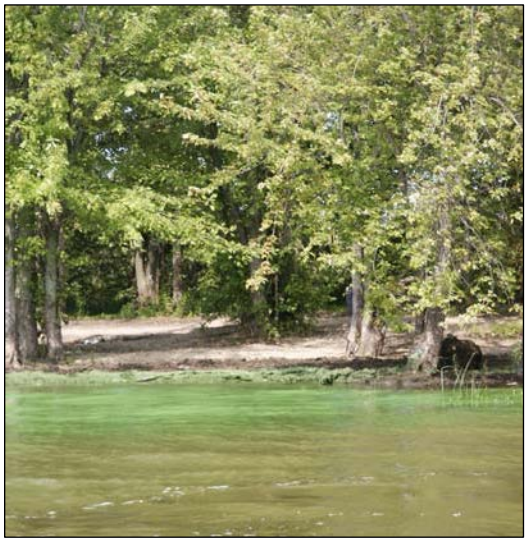
Cyanobacteria (photo courtesy of Mel Effron, 2006)

CATEGORY 3 – CYANOBACTERIA ARE PRESENT IN HIGH NUMBERS

The water is discolored and cloudy. The bottom is not visible close to shore. Canoe paddles or boat hooks are not easily distinguished below the boat.

Cyanobacteria particles are easily seen throughout the water. They may resemble tiny hairs, pinheads, or globs. Though not in a clear layer, there are visibly more particles near the surface or along the shoreline.

Particles are present in a thick layer at the surface or along the shoreline. The accumulated material may be pale green, greenish-blue or blue in color.



Appendix C: BGA Health Alert Template

Blue-green algae blooms have recently been observed in areas near _____ . (If toxin testing performed then: Samples from toxin tests indicated levels of toxin which/did not exceeded Vermont beach health guidelines. Based on conditions in these areas the following recommendations to residents and lake users have been advised:

- Avoid contact with algae contaminated water (swimming, bathing etc.). Pay close attention to children as they are at higher risk.
- Monitor drinking water intakes for private residences, if algae are present near intake, switch to alternate known safe source of water. Do not use algae contaminated water to prepare meals or brush teeth. Note that boiling water will not remove toxins.
- Do not allow pets in algae contaminated water.

Public water suppliers in the area are monitoring water supplies closely. (if appropriate)

Skin contact with algae contaminated water can cause irritation or rashes. If people or pets come into contact with water, promptly shower or rinse off in uncontaminated water. Swallowing algae contaminated water can result in diarrhea, vomiting, or nausea. Seek medical attention if you feel you have been exposed to blue green algae and are having adverse health effects.

The Vermont Department of Health Laboratory can test for blue green algae toxins. Call 1-800-660-9997 to purchase a kit. (Kit BGA-2A and Kit ANA Drinking Water Supplies or BGA-3 and Kit ANA for Private Swimming Waters)

For photos, information visit the Vermont Department of Health's website at: http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx.

Also contact the_____for more information.

Appendix D: Recreational (Public) Beach Guidance

Close and post any public beach if **any** of the following conditions are met:

- Visible known blue-green algae bloom/scum or an unknown, potentially blue-green algae (*i.e.,* **not** pollen), bloom/scum
- Microcystin-LR (equivalents) concentration greater than or equal to 6 ug/L micrograms per Liter or parts per billion (ppb)
- Anatoxin-a concentration greater than or equal to 10 ug/L (ppb)
- Cylindrospermopsin concentration greater than or equal to 10ug/L (ppb)

Reopen beach only if **all** three of these conditions are met:

- No visible blue-green algae bloom/scum
- Microcystin-LR (equivalents) concentration is less than 6 ug/L (ppb)
- Anatoxin-a concentration is less than 10 ug/L (ppb)
- Cylindrospermopsin concentration is less than 10 ug/L (ppb)

Stipulations:

A.) If the type of blue-green algae bloom at the beach can be identified and the toxin(s) produced by the identified type(s) is (are) known, laboratory testing and criteria for toxins may be narrowed to those specific toxins. (For instance, DEC personnel identify species in the field/laboratory)

For example, a blue-green algae bloom is identified as containing only algae that produces microcystin (no anatoxin-a or cylindrospermopsin). Anatoxin-a and cylindrospermopsin criteria for reopening will be assumed to be met and not need to be sampled/analyzed. Only the other two conditions will need to be met.
That is:

- No visible blue-green algae scum **and**
- Microcystin concentration is less than 6 ug/L (ppb)

B.) For instances where Microcystin, Anatoxin-a and / or cylindrospermopsin are found greater than the reporting limit, but less than their respective individual guidance value, a case-by-case evaluation can be performed by the State Toxicologist to determine if the concentrations of the toxins poses a threat to public health at the beach.

Any questions regarding blue-green algae beach closings can be directed to Environmental Health section of the Vermont Department of Health at 1-800-439- 8550.

For information on Laboratory testing and kits call the Vermont Department of Health Laboratory at (800)-660-9997 (VT only) or (802)-863-7335.

Information, photos and answers to Frequently Asked Questions can be found at the Vermont Department of Health website:http://healthvermont.gov/bg_algae.aspx

Appendix E: Cyanobacteria (Blue-Green Algae) Fact Sheet

VERMONT DEPARTMENT OF HEALTH

Cyanobacteria (Blue-Green Algae)

What are cyanobacteria?

Cyanobacteria (also known as blue-green algae) are naturally found in fresh water in the U.S. and throughout Vermont. Cyanobacteria grow well in water that has high amounts of nutrients like phosphorous and nitrogen. Under the right conditions, cyanobacteria can multiply quickly to form surface scums and dense populations known as blooms, especially during the warm days of late summer and early fall.

Characteristics of a Cyanobacteria Bloom:

- May resemble thick pea soup or spilled paint on the water's surface
- May create a thick mat of foam along the shoreline
- Generally green or blue-green in color, but can be brown, purple, red or white
- Made of small specks or blobs floating at or below the water surface

A Cyanobacteria Bloom is NOT:

- Stringy, bright grass-green, long strands that feel slimy or cottony—this is harmless green algae
- Mustard yellow in color—this is probably pollen

For a video and photos of what cyanobacteria look like and what is not cyanobacteria, visit: healthvermont.gov/cyanobacteria.

Why should I be concerned about cyanobacteria?

General health effects caused by exposure to cyanobacteria cells (not their toxins) include:

- Rashes or skin irritation
- Allergy-like reactions such as a runny nose or a sore throat

Additionally, some cyanobacteria may produce harmful compounds called cyanotoxins. When these toxins are swallowed in large amounts, they can cause the following health effects:

- Sharp, severe stomach problems like diarrhea and vomiting
- Liver damage that may take hours or days to show up in people or animals
- Numb limbs, tingling fingers and toes or dizziness

Cyanobacteria toxins can also cause illness and sometimes death in pets and livestock. Possible symptoms animals may show after being exposed to a toxic bloom include:

- Weakness or staggering
- Difficulty breathing
- Convulsions
- Vomiting or diarrhea

It is not possible to tell if a bloom contains harmful toxins just by looking at it. Only laboratory tests of water samples can confirm whether a bloom is toxic. Signs that a bloom may be toxic include:

- Dead fish, ducks, geese or other animals
- Sudden and unexplained sickness or death of a pet that has been exposed to a bloom

There is ongoing research on potential health effects of exposure to cyanobacteria toxins. The Health Department looks at any new findings and updates health guidance materials when necessary.

How might I be exposed to cyanobacteria?

Activities that might expose you to cyanobacteria include:

- Swimming
- Boating or jet-skiing
- Water-based activities near or in blooms
- Drinking untreated surface water

Children and pets have a higher risk of being exposed to cyanobacteria because they are more likely to play near the shoreline where blooms are often the thickest. They are also more likely to swallow water, either on purpose or accidentally.

Public water systems on Lake Champlain work with state partners to monitor blooms that might impact the quality of drinking water.

How can I protect myself from cyanobacteria?

Do not come in contact with surface scums of cyanobacteria or with water that is deep green, blue or white in color.

Cyanobacteria Tracker Map

During the summer and early fall, the locations of blooms on Lake Champlain and some inland Vermont lakes are tracked on the Health Department's online Cyanobacteria Tracker Map at healthvermont.gov/tracking/cyanobacteria-tracker.

Data for the map are provided by a network of volunteers trained and coordinated by the Lake Champlain Committee and by scientists from the Vermont departments of Health and Environmental Conservation. Volunteers submit weekly visual observations of water conditions from sites around Lake Champlain.

The map provides information on bloom conditions at the time of the report, but *lake conditions can change very quickly*. It is important to **learn to identify signs of a bloom and use your best judgment** when thinking about swimming or doing other activities in the water.

What should I do if I see a bloom?

- Do not come in contact with the water
- Keep pets and livestock away from the water
- Call your town health officer or town office
- Contact the Health Department to report a bloom at BloomAlert@vermont.gov with the location and photos a suspected bloom or call 800-439-8550 during business hours

What can I do to prevent blooms?

Reducing phosphorous in our waters is the main way to limit cyanobacteria blooms. You can help by:

- Using only the recommended amount of phosphorous-free fertilizer if fertilizing your lawn
- Keeping fertilizers off driveways and sidewalks and out of storm drains
- Caring for and maintaining your septic system properly

Where can I get more information?

Vermont Department of Health
Call: 800-439-8550
Website: healthvermont.gov/cyanobacteria
Email: BloomAlert@vermont.gov

Vermont Department of Environmental Conservation
Call: 802-490-6130
Website: dec.vermont.gov/watershed/lakes-ponds/learn-more/cyanobacteria

Lake Champlain Committee
Call: 802-658-1414
Website: lakechamplaincommittee.org
Email: lcc@lakechamplaincommittee.org

Lake Champlain Basin Program
Call: 802-372-3213 or 800-468-5227 (NY & VT)
Website: www.lcbp.org
Email: lcbp@lcbp.org

Appendix F: Cyanobacteria in Vermont: What Veterinarians Should Know

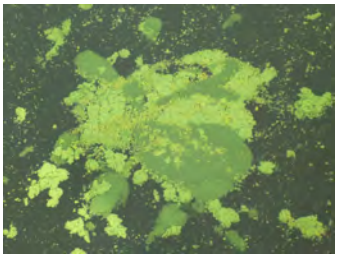
Cyanobacteria in Vermont

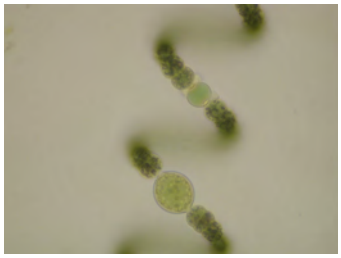
What Veterinarians Should Know

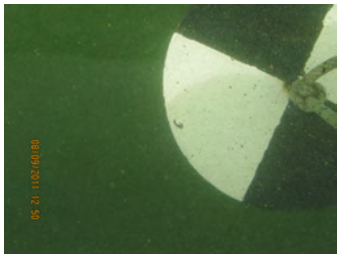
July 2014

Cyanobacteria, also known as blue-green algae, are common aquatic organisms found in freshwater and marine environments. Cyanobacteria thrive in nutrient-rich waters and can multiply rapidly, resulting in cloudy water and visible surface scums. These conditions, called blooms, are most likely to occur in summer and early fall in Vermont.

Cyanobacteria can produce potent toxins that have been implicated in pet and livestock deaths around the world. Dogs are particularly susceptible but livestock can also be affected. It is not possible to tell whether a bloom is toxic by looking at it and there are no known antidotes for many of these toxins. Cyanobacteria can also cause a variety of non-lethal illnesses.







Recognizing Cyanobacteria in the Water

- Scum layer on the surface, typically green or blue-green in color but may be brown, purple or white. The layer is often described as 'pea soup' or spilled paint. Typically thickest on downwind or protected shores.
- Thick layer of foam and/or highly discolored water
- Look like small specks or grass-like clusters at or just below the surface.

Stringy, bright green strands are not cyanobacteria.

For a photo gallery and additional descriptions, visit

http://healthvermont.gov/enviro/bg_algae/photos.aspx

To see current conditions on Lake Champlain and selected inland lakes, visit
http://healthvermont.gov/enviro/bg_algae/weekly_status.aspx

Signs of Cyanotoxin Exposure in Animals

- Weakness or staggering
- Difficulty breathing
- Convulsions
- Vomiting or Diarrhea
- Foaming at the mouth
- Dark urine or blood in the urine
- Algae in the vomitus or stool

Microcystin, a hepatotoxin, has been documented frequently in Lake Champlain and occasionally in other Vermont lakes. Anatoxin, a neurotoxin, has also been found in Lake Champlain.

Treatment Options

Most cyanotoxins have no known antidote and there are no widely available rapid diagnostics for confirmation of cyanotoxin poisoning. In the most severe cases, the animals succumb or are euthanized. There have been a limited number of successful recoveries after intensive care and support treatment (see **Resources**).

To help us better understand the extent of the problem, please report cyanobacteria-related illness to the Vermont Department of Health:

AHS.VDHBlueGreenAlgae@state.vt.us or 1-800-439-8550

Preventing Exposure

- Keep pets and livestock away from suspected cyanobacteria blooms.
- Do not allow dogs to lick their fur if they have come in contact with blooms. Rinse them well with clean water to remove algae.
- Do not allow pets and livestock to eat algae or debris along shorelines.
- Provide alternate source of clean water if suspicious algae are present in ponds or watering troughs.

Reducing the Frequency of Cyanobacteria Blooms

Cyanobacteria are common native organisms found in water and damp soil around the world. They are of ecological importance and it is not possible, or prudent, to eliminate them. We can, however, reduce the frequency and duration of blooms by keeping nutrients and sediments out of our waters.

Numerous products are advertised to control algae. Many of these cannot be used in Vermont without obtaining a permit from the VT Department of Environmental Conservation. Some cannot be used at all. For more information, see the Resource List.

Caution: Using chemicals or other means to disrupt an active bloom may release cyanotoxins directly into the water.

Resources

S. Kahn, 2014
veterinarymedicine.dvm360.com/vetmed/Toxicology/The-poison-in-the-pond-Blue-green-algae-toxicosis-/ArticleStandard/Article/detail/834356

D. van der Merwe, 2012 – HAB impacts on domestic animals. Lakeline Magazine, Fall 2012, pages 25-27

L. Backer, J. Landsberg, M. Miller, K. Keel and T. Taylor. 2013. Canine cyanotoxin poisonings in the US (1920s–2012): a review of suspected and confirmed cases from three data sources. Toxins 2013, 5, 1597-1628; www.mdpi.com/2072-6651/5/9/1597 (open source)

K. Rankin, K. Alroy, R. Kudela, S. Oates, M. Murray, and M. Miller. 2013. Treatment of cyanobacterial (microcystin) toxicosis using oral cholestyramine: case report of a dog from Montana. Toxins 2013, 5,1051-1063; www.mdpi.com/2072-6651/5/6/1051 (open source)

LakeWise – learn how to manage your property to protect Vermont's lakes. This guidance is useful for small ponds as well. www.anr.state.vt.us/dec/waterq/lakes/htm/lp_lakewise.htm

Learn how to recognize cyanobacteria blooms following the system used by the Lake Champlain Committee's volunteers each summer. www.lakechamplaincommittee.org/get-involved/volunteers/bga-monitors/algaebloomintensity/

Controlling nuisance aquatic plants and algae
www.watershedmanagement.vt.gov/lakes/docs/lp_controlplants.pdf - zoom=100

Contact Information

Vermont Department of Health, (800) 439-8550, healthvermont.gov/enviro/bg_algae/bgalgae.aspx

Vermont Department of Environmental Conservation, (802) 490-6130, www.watershedmanagement.vt.gov/lakes/htm/lp_cyanobacteria.htm

Vermont Agency of Agriculture, Food and Markets, (802) 828-2421, agriculture.vermont.gov/animal_health

VERMONT
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AGENCY OF AGRICULTURE, FOOD & MARKETS
DEPARTMENT OF HEALTH

Appendix G: Template Signs for Postings:

VERMONT
DEPARTMENT OF HEALTH

HEALTH ALERT

Keep children and pets

away from

CYANOBACTERIA

(BLUE-GREEN ALGAE)

Water may be green, blue, brown, red or appear cloudy. A thick foam or mat may be on the shoreline. Some cyanobacteria may cause illness.

To report cyanobacteria or for more information call
1-800-439-8550

or visit healthvermont.gov

ATTENTION

SWIMMING AREA CLOSED

CYANOBACTERIA

(BLUE-GREEN ALGAE)

Water may be green, blue, brown, red or appear cloudy. A thick foam or mat may be on the shoreline. Some cyanobacteria may cause illness.

For more information contact:

_____

_____

Phone: _____

Email: _____

VERMONT

DEPARTMENT OF HEALTH

healthvermont.gov/cyanobacteria

Appendix H: Sample Data Sheet

Monitoring Data Sheet for Cyanobacteria Blooms in Vermont

Date of Assessment:_____
Weather Conditions (sunny, rainy, approximate temperature):

_____

_____

Name of Waterbody and Owner:

_____

Location (as specific as possible, town, beach name or other easily identifiable landmarks nearby):

Category of Bloom (1, 2, or 3):_____

Previous Occurrences of Blooms?

- ☐ Never
- ☐ Occasional (short periods of blooms, not on annual basis)
- ☐ Occasional (short periods of blooms, annually)
- ☐ Frequent (blooms annually)

Usage at this location.

- Number of people (approximate) who use water daily:_____
- Number of animals (approximate) who use water daily:_____
- Type of water usage (check all that apply):
  - ☐ Swimming or other full body contact activities (posted as a beach)
  - ☐ Swimming or other full body contact activities (not a posted beach area, i.e.., swimming hole)
  - ☐ Boating (non-motorized)
  - ☐ Boating (motorized)
  - ☐ Drinking Water (Private Intake)
  - ☐ Drinking Water (Public Intake)
  - ☐ Fishing

Appendix I: References

Centers for Disease Control
Harmful Algal Blooms (HABs)
http://www.cdc.gov/nceh/hsb/hab/default.htm

Lake Champlain Committee
Blue Green Algae
http://www.lakechamplaincommittee.org/lcc-at-work/algae-in-lake/

NSW Government | Department of Primary Industries Office of Water
An analysis of cyanobacterial bloom occurrence in Missisquoi Bay (Québec, Canada) between 2000 and 2008, and possible environmental factors underlying them
http://www.water.nsw.gov.au/__data/assets/pdf_file/0007/548521/algal_missisquoi-bay-report-april2014.pdf

Vermont Department of Environmental Conservation
Cyanobacteria in Vermont
http://www.watershedmanagement.vt.gov/lakes/htm/lp_cyanobacteria.htm

Vermont Department of Health
Cyanobacteria, Blue-Green Algae
http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx

U.S. Environmental Protection Agency
Health Advisories for Microbiological Contaminants
http://water.epa.gov/drink/standards/hascience.cfm#micro

World Health Organization
Guidelines for Safe Recreational Waters, 2009
http://www.who.int/water_sanitation_health/bathing/srwe1/en/

U.S. Environmental Protection Agency
Nutrient Policy Data, Cyanobacteria/Cyanotoxins, 2014
http://www2.epa.gov/nutrient-policy-data/cyanobacteriacyanotoxins
http://www2.epa.gov/nutrient-policy-data/cyanohabs

Toxins
Harmful Algal Blooms (HABs) and Public Health: Progress and Current Challenges, December 2015
http://www.mdpi.com/journal/toxins/special_issues/HABs

Appendix J: Abbreviations

BGA	**Blue-green Algae**
CDC	**Centers for Disease Control**
DEC	**Department of Environmental Conservation**
LCBP	**Lake Champlain Basin Program**
LCC	**Lake Champlain Committee**
USEPA	**United States Environmental Protection Agency**
UVM	**University of Vermont**
VDH	**Vermont Department of Health**
WHO	**World Health Organization**

Appendix K: Vermont Contacts

To report blooms, health effects or for questions about test results:

The Vermont Department of Health
Environmental Health 108 Cherry Street
PO Box 70; Drawer 30
Burlington, VT 05402-0070

Toll-free in Vermont: 1-800-439-8550
Outside Vermont:1-802-863-7220

Email: AHS.VDHBlueGreenAlgae@state.vt.us

To Purchase Laboratory Kits:

The Vermont Department of Health Laboratory
359 South Park Drive
Colchester, VT 05446

Toll-free in Vermont:
1-800-660-9997 Outside
Vermont:1-802-338-4736
Website: http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx

For Technical Assistance with Identification:

Vermont Department of Environmental Conservation:
Watershed Management Division
http://www.watershedmanagement.vt.gov/wqdhome.htm1
National Life Drive, Main 2
Montpelier, VT 05620-3522
(802) 828-1535

For Technical Assistance for Public Water Suppliers:

Vermont Department of Environmental Conservation:
Drinking Water and Groundwater Protection Division
www.vermontdrinkingwater.org
1 National Life Drive, Main 2
Montpelier, VT 05620-3522
Toll-free in Vermont: 1-800-823-6500
Outside Vermont: 1-802-828-1535

For Cyanobacteria Monitor Training:

Lake Champlain Committee
www.lakechamplaincommittee.org/
208 Flynn Avenue
Burlington, VT 05401
(802) 658-1414