2020

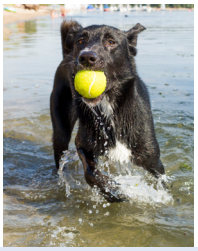
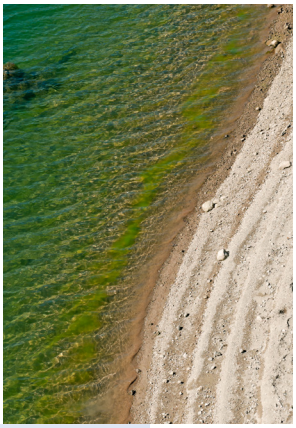
Cyanobacteria (Harmful Algae) Bloom Guidance

A resource for local public health authorities







Oregon Health Authority
PUBLIC HEALTH DIVISION

Acknowledgments

Author:
Kattaryna Stiles,
University of Washington, School of Public Health graduate student

Oversight:
Rebecca Hillwig,
Oregon Health Authority, Cyanobacteria Harmful Algae Bloom Program

Tania M. Busch-Isaksen, MPH, PhD,
University of Washington School of Public Health

Inspiration and review:
Ramona Quinn, registered environmental health specialist

Jim Carey of Klamath County Environmental Health

Review:
Emily Wegener of Jefferson County Public Health

For questions about this document or revision suggestions contact rebecca.hillwig@dhsoha.state.or.us.

2019 Published guidance for LPHAs, version 2.0, 2019

DISCLAIMER: LOCAL PUBLIC HEALTH DEPARTMENTS SHOULD NOT INTERPRET THIS GUIDANCE AS NEW REQUIREMENTS.

Contents

Contents

I. Purpose

There are health risks from local recreational waters affected by cyanobacteria (harmful algae) blooms. This document offers guidance to Oregon local public health authorities (LPHAs) that wish to respond to those risks.

The information here draws on existing Oregon Health Authority (OHA) guidance to:

- Strengthen the understanding of jurisdictional roles and capabilities, and
- Streamline coordination of actions that help minimize impacts of cyanobacterial blooms on the health of Oregonians

This document focuses on information about freshwater cyanobacterial blooms and actions LPHAs can take to reduce recreational exposures. It has less information about drinking water and marine waters because there are already monitoring and regulatory systems in place to address these risks.

This guidance is not meant to replace, interfere with or limit any action taken by a public agency while performing its official duties.

Preseason CHAB checklist for LPHAS

- ❑ Provide a single point of contact to the OHA Cyanobacteria Harmful Algae Bloom Program (CHAB).
- ❑ Enroll all Environmental Health (EH) and Public Health Emergency Preparedness (PHEP) and Natural Resource (NR) staff in GovDelivery to receive CHAB event alerts.
- ❑ Check in with area, state and local partners to verify contact information.
- ❑ Ensure there are educational signs at popular recreational water bodies. Post new signs if needed.

II. Introduction to cyanobacterial blooms

People commonly refer to cyanobacteria as blue-green algae. Cyanobacteria are naturally occurring single-celled bacteria found in both fresh and marine waters around the globe. Colonies we call blooms can occur in any water body under conditions that support an increase in the number of cells present. Cyanobacteria are not always harmful. However, when toxigenic cyanobacteria are present and the cells multiply into a bloom they can produce toxins which can be harmful to people, pets, livestock and wildlife.


Cullaby Lake, Aphanizomenon sp.

Cyanobacterial blooms are often confused with green algae. Both can produce dense mats that can impede activities such as swimming and fishing, as well as odor problems and oxygen depletion which is harmful to fish and other aquatic life. Unlike cyanobacterial blooms (33) that can produce potent cyanotoxins, green algae are plants, not bacteria and do not produce toxins.

An individual cyanobacteria cell requires a microscope to see. However, cyanobacterial blooms, both small and large, are visible to the naked eye. (28)

Blooms may look:

- Like strands or grass clippings
- Bunched together in mats or spherical clusters, or
- Thick on the water, like a paint spill.

These blooms are often dense and scummy. They tend to form:

- Along shorelines
- In sheltered coves,
- Around structures such as docks and dams, and
- Away from moving water.

Blooms cannot propel themselves. However, the wind and current will often blow blooms into different areas of a water body.

Some cyanobacteria can produce cyanotoxins. When present, the toxin produced is generally released when cells in the bloom begin to die and split open (called lysis). Still, toxins can also be high during bloom formation. Cells tend to leak small amounts of toxin over time, but usually not at harmful levels. (33)


Haystack Reservoir, Dolichospermum sp.

Cyanobacteria can often out compete other aquatic biota in their environment. Cells can multiply into small or very large, unpleasant looking blooms. The look and size of a bloom does not always match the level of toxins that may be produced. A very large, unpleasant looking bloom could be very low in toxins, while a small bloom could be extremely high. Therefore, toxin testing is the only way to determine when a bloom is harmful to public health. In Oregon and in other areas, blooms have lasted from a few days to several months. (28)

Scientists have concerns that human activities that influence the changes listed below are potentially increasing the frequency, intensity and distribution of cyanobacterial blooms over time.

- Increased nutrient loading in lakes
- Changes to water flow
- Climate change, and
- Introduction of new or invasive species. (28)

Cyanobacteria genera of concern in Oregon

Microcystis species (sp.) are the most common bloom-forming genera worldwide and almost always produce cyanotoxins called microcystins. Microcystis blooms look:

- Green
- Thick
- Paint-like, and
- Sometimes form green globs.

Microcystis blooms can cover a lake or be localized along the shoreline. High concentrations of cells called scum can dry along the lakeshore and on rocks. Microcystins found within dried cells can persist for weeks and may be rereleased back into the water body when water levels rise, even when the cells are no longer

alive or after a recently collapsed bloom. (33) Extremely low levels of cyanotoxins can be deadly to pets due to their size and level of activity. Exposures occur through drinking affected water, eating scum, and licking dried cells from rocks and their fur even after they are out of the water.


Lemolo Lake,Dolichospermum sp.

Dolichospermum (formerly known as Anabaena) is another dominant genus in many blooms in Oregon. Unlike *Microcystis sp.* that have the potential to produce two cyanotoxins, *Dolichospermum sp.* can potentially produce four. *Dolichospermum* blooms may develop quickly on the surface of shallow, nutrient rich lakes and reservoirs. The blooms look like green paint.

Some *Dolichospermum sp.* can also form blooms in less hospitable waters showing up as large, dark dots in water samples and on filters after filtration. (33) *Aphanizomenon flos-aquae (AFA)* can be found in fresh and somewhat salty waters such as marine estuaries. This genus and species has been harvested for many years from Upper Klamath Lake for use in supplements. Although it was once believed that AFA was not a toxin producer in Oregon, current research has shown that AFA can potentially produce the same four toxins as *Dolichospermum*. AFA can fix its own nitrogen which can promote the growth of other cyanobacteria as the cells die and release this nutrient into the water.

AFA forms long, slender, straight filaments like grass clippings that remain separated or clump together in small sheets.. It can be easily detected visually in the water or in a water sample. Even though they can form dense surface scums, it is easy to detect filaments visually in a water sample. (33)

Cyanotoxins

Some cyanobacteria species produce cyanotoxins. Toxins most often tested and detected in Oregon lakes and reservoirs are:

- Microcystins (the most common)
- Cylindrospermopsin, and
- Anatoxin-a. (28)

Saxitoxin has been detected only once and the levels were well below the RUVs. (21)

Table 1: Health impacts of cyanotoxins in Oregon

Toxin	Species that produce this toxin	Toxin type	Symptoms	Onset of symptoms
Microcystins	*Dolichospermum* *Planktothrix* *Microcystis* *Gloeotrichia*	Hepatotoxin	• Abdominal pain • Headache • Sore throat • Vomiting • Nausea • Dry cough • Diarrhea • Blistering around the mouth • Pneumonia (if inhaled) • Liver damage • Death	People: Within first 24 hours Pets: Immediate to within first 24 hours
Anatoxin-a	Dolichospermum Planktothrix Aphanizomenon sp	Neurotoxin	• Numbness or tingling in fingers and toes • Dizziness • Drowsiness • Incoherent speech • Salivation • Convulsions • Respiratory paralysis leading to death	People: Within first 24 hours Pets: Immediate to within 1-2 hours (has caused dog deaths)
Cylindrospermopsin	Planktothrix Cylindrospermopsis Aphanizomenon sp	Hepatotoxin Nephrotoxin	• Nausea • Vomiting • Bloody diarrhea • Abdominal pain • Kidney damage • Protein or blood in urine • Dehydration • Fever • Headache	Up to a week
Saxitoxin	*Dolichospermum* *Aphanizomenon sp.*	Neurotoxin	• Numbness or tingling around mouth • Numbness spreading to arms and hands • Muscle soreness • Muscle weakness • Paralysis • Difficulty breathing • Death	People: Within first 24 hours Pets: Immediate to within 1-2 hours
Lipopolysaccharides	All types	Dermatotoxin	• Skin irritation • Rashes	People: Within first 24 hours Pets: Within 1-2 hours

(1, 9, 35)

Microcystins:

- Are a family of cyclic peptides
- Have several variants (also called congeners)
- Are the most widespread cyanotoxins
- Are very stable in the environment
- Can become concentrated in common aquatic vertebrates and invertebrates, such as:
  - » Fish
  - » Mussels
  - » Zooplankton, and
- Affects the liver, primarily. (33)

Anatoxin-a:

- Is not as stable in the environment as microcystins
- Degrades relatively fast in sunlight (UV)
- Affects the central nervous system, primarily, and
- Can shut down an animal's central nervous system within several minutes, at very low levels. (33)

Cylindrospermopsin:

- Is relatively stable in the environment
- Can bioaccumulate in freshwater organisms, like microcystins, and
- Can cause damage to the liver and kidneys. (33)

Saxitoxin:

- Are representative of the large family of toxins that cause paralytic shellfish poisoning
- Can be produced by certain species of cyanobacteria, but is most often associated with marine organisms
- Is produced by marine dinoflagellates which shellfish consume, and
- Can be passed on by shellfish, when humans and animals consume them. (33)

III. Cyanobacterial blooms and public health concerns in Oregon

Exposure risks

Exposure to cyanobacteria and their toxins can lead to a variety of human health effects. (28) Cyanotoxins are classified by how they affect the human body. (5)

- Hepatotoxins affect the liver.
- Neurotoxins affect the nervous system.
- Nephrotoxins affect the kidneys.
- Dermatotoxins affect the skin.

Major routes of exposure for cyanotoxins are through:

- Incidental ingestion of water (swimming, water skiing, etc.)
- Ingestion of affected drinking water
- Inhalation of water droplets during high speed water activities (power boating jet skiing, etc.)
- Consumption of affected shellfish and invertebrates (crab)
- Contact with cells on skin or eyes. (28)

Table 2 outlines activities that may lead to exposure and the associated risk.

Drinking or swallowing: This is the primary pathway for exposure to cyanotoxins. Occurrence may be by accident or on purpose. Here are some things to look out for:

- The risk of children and pets accidentally swallowing water during outdoor activities is very high. Children and pets tend to play near shore areas where scum tends to collect. Pets will eat cells and lick cells and toxins off rocks and their fur, causing a potential secondary exposure.
- Intentional eating and drinking may occur when campers and hikers use affected lake water for drinking or cooking. Boiling and filtering or treating affected water with camping style equipment will not make the water safe. In fact, boiling affected water can cause the cells to lyse (split open) releasing more toxins into the water and potentially increasing toxin concentrations through evaporation.
- Intentional drinking may also occur when people draw in-home water directly from a lake or river affected by a cyanobacterial bloom. Many private treatment

systems have not been proven effective in removing cyanobacteria cells or toxins. (21)

- Cyanotoxins tend to accumulate in the organs and non-fillet portions of a fish. OHA recommends that people who catch fish in lakes affected by a bloom discard the head, tail and organs, and rinse fillets in fresh water. Shellfish harvested from marine waters affected by biotoxins such as saxitoxin, a neurotoxin, should not be eaten.
  - » To check on marine shellfish and invertebrate (crab) closures, check the Oregon Department of Agriculture website.

Breathing: This exposure may occur through activities where the toxin is aerosolized, such as:

- Water skiing
- Wake boarding
- High speed boating and jet skiing, or
- Splashing in affected waters. (21)

Skin contact: Effects from skin contact are possible from lipopolysaccharides found within the cell walls of cyanobacteria. Cyanotoxins are not known to be absorbed through the skin which acts as a very efficient barrier. Contact with the cells of cyanobacteria may result in skin irritation or a red, raised rash.

Skin reactions are self-limiting and should go away within 72 hours of exposure. However, a reaction can be more severe in areas where cyanobacteria cells are:

- Trapped against skin and clothing
- When longer contact with a bloom and cells occurs, or (28)
- When contact occurs around the eyes, nose and mouth

Table 2: Recreational risk of exposure during cyanobacterial blooms

Exposure risk	Outdoor activity	Route of exposure	Cautions
High	• Swimming • Diving • Bathing • Showering	• Drinking • Swallowing • Breathing • Skin contact	Avoid areas where visible scum is present and areas around scum as toxins can be dispersed.
	• Water skiing • Wake boarding • Jet skiing • Wind surfing • Jet boating		
	• Wading • Swimming	• Skin contact	
	• Fishing	• Eating	OK to eat fish from the water body • Remove head, tail and organs • Rinse fillets with clean water before cooking or freezing Cooking increases toxins present through the lysing of cells and evaporation. This type of filtration does not filter out cyanotoxins.
	• Cooking with affected water • Drinking affected water after using camping/hiking filters	• Ingestion • Drinking	
Moderate	• Canoeing • Kayaking • Sailing • Rowing • Paddle boarding • Wading	• Skin contact • Swallowing (if you fall in)	OK if: • Skill level is high enough; and • Conditions make falling in, spraying or splashing less likely.
Low to none	• Motor boating: moderate to low speed	• Skin contact	OK
	• Catch and release fishing • Hiking • Picnicking • Sightseeing	n/a	OK

(21)

Animal exposure

Accounts of cyanobacteria-related deaths have been reported in Oregon in pets, wildlife and livestock. (27, 29) Exposure can occur through drinking affected water. However, exposure to toxins found in the following are of special concern:

- Dried bloom material on the shoreline
- The bottom of shallow bedrock pools,

- Dried cells on animal fur or hide, and
- Benthic genera that grow from sediment and on rocks.

Dogs have died after drinking affected water from shorelines, bedrock pools, and in shallow calm areas of rivers like coves, wetlands, and docks. Dogs should not be allowed to eat cyanobacteria cells from a suspected bloom, lick cells off rocks near a bloom, or lick their fur if they come into contact with a bloom. If contact with a bloom occurs, it should be washed with clean water from a separate source as soon as possible. Contact a veterinarian immediately if a dog eats, drinks, swallows or enters affected waters and shows any of these signs:

- Drooling
- Weakness
- Diarrhea
- Vomiting
- Staggering
- Convulsions (28)

Buildup of toxins in fish

Studies have shown that cyanotoxins can buildup in the liver and viscera of fish. There has been the detection of microcystin in the fillet at low levels. There is no definitive research at this time about the risk to human health nor reports of people becoming sick from eating fish caught during a bloom. Still, people who catch fish from waters affected by a cyanobacterial bloom should take caution. Remove and discard fat, skin and organs and wash fillets with clean water before cooking or freezing to reduce any potential toxins. (18, 37, 38)

Buildup of toxins in plants

Water that contains cyanotoxin levels less than OHA's recreational use values (RUVs), Table 3, page 20 can be used for irrigation. However, safeguards must be in place to make sure no children or animals drink the irrigation water. Food crops irrigated with cyanotoxin-affected water should dry completely in sunlight before harvest and consumption. Water should not be used for irrigation if cyanotoxin levels are equal to or greater than the recreational use guideline values. (21)

IV. Interagency coordination

The Oregon Health Authority's Cyanobacteria Harmful Algae Bloom Program (CHAB) resides within the Environmental Public Health Section of the Public Health Division. It is the primary point of contact and source of technical assistance for LPHAs regarding CHABs in recreational waters.

Appendix A details recommended actions during a CHAB event and the relationship between LPHAs and OHA. OHA recognizes LPHAs ability to respond to a CHAB event varies and that they may rely heavily on external partners. Programs and partners that can offer more support are listed in Appendix B. LPHA environmental health staff should become familiar with state and federal partners in their area.

Oregon Cyanobacteria Harmful Algae Bloom Program

971-673-0400
HAB.Health@dhsoha.state.or.us
8 a.m. to 5 p.m. Monday–Friday

V. Monitoring and sampling

The best way to know if toxins are present when a cyanobacteria bloom is identified is to take a water sample per instructions in OHA's Sampling Guidelines. Because OHA does not have the resources or expertise to conduct water monitoring and sampling, the agency must rely on sampling data submitted by its partners. When sampling data is available, OHA uses it to advise the public about blooms and in making recommendations about recreational activities. (24)

Most LPHAs have strong knowledge of recreational water bodies that regularly produce CHABs within their jurisdictions. OHA encourages LPHAs, at minimum, to conduct visual monitoring of these water bodies on a regular schedule. If a bloom is identified, please notify OHA CHAB Program staff even if no sampling or analysis is performed.

The LPHA may choose to collect samples and send laboratory results to OHA when:

- There is no Designated Management Agency (DMA)* for the water body; or
- The DMA chooses not to sample when a cyanobacterial bloom is identified on a water body where potential public exposure is high.

Sampling and analysis for purposes of issuing an advisory should only be done if the LPHA is committed to more sampling and the posting and removing of signage. (21)

OHA cannot lift an advisory until sampling data determines toxin levels have dropped below OHA's RUVs. Although OHA no longer issues advisories based on enumeration (cell counts), because there is currently no established method for this practice, identification of the cyanobacteria is still necessary for the lab to determine what toxins they should analyze. Comprehensive monitoring and sampling guidance is available in the OHA Sampling Guidelines. (23) The LPHA should review these and OHA's Recreational Use Public Health Advisory Guidelines (21) to understand its responsibilities before making a commitment to perform sampling.

Visual assessment

It is understood that LPHAs have limited capacity for monitoring. Therefore, visual assessments of water bodies can help identify areas with reoccurring issues. This helps OHA to better tell the public about potential blooms on recreational waters. There are several sources with pictures of CHABs and real green algae. Two sources are below:

* To find out if there is a DMA for a water body in your region, contact the OHA CHABS Program.

Field and Laboratory Guide to Freshwater Cyanobacteria Harmful Algal Blooms for Native American and Alaska Native Communities, published by the United States Geological Survey.

Harmful Algal Blooms Photo Gallery, New York State Department of Environmental Conservation.

Visual assessment steps:

1. Determine if a bloom is present based on:
    a. Water color, and
    b. The presence of visible scum on the surface of the water, or
    c. Suspended in the water column.
2. Describe the location of any areas of concentrated scum, blobs or floating mats, such as in and around swimming areas.
3. Take photos of the affected areas.
4. Record the results of the visual assessment on a field data sheet. (23)
5. Contact OHA if you believe, based on your visual observations, that a bloom may be present. OHA staff can help you determine if a cyanobacterial bloom is present from the photos. OHA can also advise you about follow-up activities based on circumstances and LPHA capacity.
6. If a bloom is present, but sampling is not possible, warnings and educational signage should be posted in the area. Posters can be found on OHA's Education and Outreach webpage.

Sampling and testing

If a bloom is present on a water body used for public drinking water, the public water system operator should contact the OHA Drinking Water Program to coordinate sampling and analysis in and around the treatment facilities source water intake and beyond as necessary.

Some drinking water facilities are required to conduct monitoring and testing for cyanotoxins, May through October. If system operators are unsure about whether they are required to test, they should contact OHA. OHA's Drinking Water Program has limited funding available for small treatment facilities to test at their intake when a bloom is present in their raw water supply. Water treatment operators should contact the Drinking Water staff to determine if their facility qualifies for this funding. Information about cyanotoxins and drinking water can be found on OHA's Drinking Water Services webpage. (10)

Laboratories for cyanotoxin testing

Testing can be expensive. Depending on the number of toxins that must be analyzed, the cost can range from $125-$500 per test. A list of available laboratories for identification and cyanotoxin testing can be found on OHA's Advisory and Sampling Guidance webpage. (23)

Marine biotoxin monitoring

Oregon Department of Agriculture (ODA) monitors for marine biotoxins for commercial and recreational shellfish fisheries. The agency issues shellfish safety closures to alert commercial and recreational harvesters when the biotoxins in clams, mussels or crab are above ODA's alert levels. (20) Biotoxin testing is performed during harvest season (22) OHA does not monitor marine biotoxins.

The Oregon Beach Monitoring Program, run by the Department of Environmental Quality (DEQ) with OHA issuing advisories based on elevated bacteria levels, is funded by the EPA. The program runs between the Memorial Day and Labor Day weekends. This program evaluates a specific set of beaches each summer for elevated levels of bacteria. When levels are above Oregon's beach action value, OHA alerts the public by issuing an advisory press release. Beach advisories can be found on OHA's Beach Water Quality webpage.

VI. Evaluation

Submitting test results to OHA

When a laboratory completes its testing, it typically emails an electronic copy to the sampler. The sampler should forward the results to OHA as soon as possible for evaluation. When cyanotoxin levels are above the recreational use values found in Table 3, page 20, the lab may call the sampler ahead of sending results. When this occurs, the sampler should call or email OHA immediately. That way, OHA can issue an immediate recreational use health advisory as warranted, based on the assessment.

Health-based guidelines

In May 2019, the EPA published recommended advisory values for recreational waters for microcystin and cylindrospermopsin. Prior to the availability of EPA's recommended values, OHA developed its own provisional health-based guideline values for use in Oregon. In addition to microcystin and cylindrospermopsin, OHA developed RUVs for anatoxin-a and saxitoxin. OHA adopted EPA's published health-based values for recreational waters and used the updated health criteria to recalculate the guideline values for anatoxin-a and saxitoxin. As mentioned previously, OHA no longer uses cell count data to issue or lift recreational use health advisories.

Values are not provided for the lipopolysaccharides in the cell walls of the cyanobacteria as these compounds are not toxins. Lipopolysaccharides are produced by most species of cyanobacteria and exposure to these compounds typically produces a red raised self-limiting rash in sensitive individuals. (21)

Table 3: Health-based recreational use values for cyanotoxins measured in µg/L (ppb)

Water use	Anatoxin-a	Cylindrospermopsin	Microcystins	Saxitoxin
Recreational	15	15	8	8
Drinking water (age 6 and older)	3	3	1.6	1.6
Drinking water (children age 5 and younger)	0.7	0.7	0.3	0.3
Dogs*	0.4	0.4	0.2	0.02

* Advisories are not issued based on these values. Dog values are used for educational purposes to ensure owners know how susceptible their pets are to toxins. The Drinking Water Program recommends you follow the drinking water health-based guideline values for children age 5 and younger when using drinking water in your pet's water bowl.

VII. Advisories

Issuing and lifting of cyanobacterial (harmful algae) bloom advisories

OHA is the lead agency for issuing and lifting advisories. (19) OHA can perform this work only by collecting and reviewing information it receives from partners. Comprehensive guidelines on how OHA decides to issue and lift advisories are available in OHA's Advisory Guidelines. (21)

It is important that partners recognize that a water body with no advisory is not a sign that a bloom is not present. (11) More often than not it is a sign that no sampling or testing is being performed.

Notification to LPHAs of cyanobacterial (harmful algae) bloom advisories

Each LPHA should designate a contact to receive emails and texts about recreational use health advisories. The LPHA contact can go to the cyanobacteria blooms webpage and sign-up to receive automatic alerts through GovDelivery (6) on the right navigation. Also, OHA recommends that all LPHA environmental health and public health emergency preparedness staff enroll to receive alerts so that a notification is not missed. If LPHA contacts have questions about signing up for alerts, they can contact the OHA CHAB program coordinator listed in Appendix B for help. Once subscribed, LPHA contacts will be notified via email and text whenever an advisory has been issued or lifted. Any new or additional LPHA employees dealing with or interested in cyanobacterial blooms should sign-up for alerts as soon as possible once assigned.

Permanent advisories

A permanent advisory is issued in Douglas County for the cyanobacteria blooms that develop in the small bedrock pools along the South Umpqua from Canyonville downstream to the confluence with the mainstem Umpqua River, and the mainstem Umpqua River downstream past Elkton to Lawson Bar. These blooms can be harmful to pets when they drink water from the pools or lick the rocks. Several dog deaths occurred from these areas due to exposure to anatoxin-a, a neurotoxin.

Signage was posted at several access areas along the river about the permanent advisory however, many of the signs have been vandalized or removed. Anyone taking their dog to this area should be aware of the advisory in place. This permanent advisory is listed on the Current Cyanobacteria Advisories webpage. (11)

VIII. Risk communication

Seasonal public awareness

Because resources for monitoring are limited, LPHAs should implement community-based messaging to ensure that both residents and visitors are aware of the risks of cyanobacterial blooms and potential toxins. Messaging should include:

- Basic education on the health risks of cyanobacteria blooms and the toxins they can produce
- Physical characteristics of blooms depending on the dominant genera present
- Frequently affected waterbodies
- How to report a suspected bloom, and
- When a person or dog owner should seek treatment from a doctor or veterinarian.

A sample press release is included in Appendix C.

Since cyanobacterial blooms can occur in any water body under the right conditions, OHA provides educational posters and flyers covering blooms, pet exposure, fishing, etc. (14, 15). Water body managers or LPHAs are encouraged to print and post these at any of the water bodies they manage or have concerns about. These posters should be left up year round as they prevent reliance on advisories. Because only a handful of the many waterbodies in Oregon are monitored and sampled, there are many places where blooms can develop, producing toxins at levels that can be harmful to people and especially pets and small children. The absence of an advisory on a waterbody creates a false sense of security that the water is safe. Educational signs can help people to know what to look for and how to protect themselves. If LPHA's would like to post an alert or warning sign at a popular waterbody that is not monitored or sampled, OHA can provide a template to print and post.

Advisory signage

If sampling data indicates that an advisory is warranted, OHA CHAB staff can provide an advisory sign for LPHA's to print and post.

Currents and winds can move a bloom from one area to another in hours.(26) Therefore, OHA recommends you post advisory signage at all major access points

to a water body. This helps alert the public to the bloom. This is more effective than signage only at the location of the bloom. Warning signs can be adjusted to mention the location of the bloom as necessary, but all public access areas should be posted for awareness.

Community-based public information during an advisory

When a recreational use advisory is issued or lifted, OHA issues a press release and distributes this information to the public via email and text to anyone signed up to receive alerts. These emails go via GovDelivery and through FlashAlert* to media markets with access to this system. In addition, the press release is posted on the OHA and PHD web pages and linked to the advisory webpage on the CHAB web site.

Although OHA sends the state press release to local media outlets LPHAs, particularly in rural communities, are encouraged to issue their own press releases to local media outlets. LPHAs may also wish to ensure that local media outlets received the OHA press release. If not, then provide the release to these rural outlets. OHA wishes to ensure community members are aware of each advisory and the associated health risks. LPHAs can customize the sample press releases in Appendix C.

Besides traditional media, OHA uses social media. OHA encourages LPHAs to use these outlets to provide additional community coverage. LPHAs can also use other locally approved messaging systems, such as bulletin boards and community reader boards, to reach the public. LPHAs may also wish to reach out to health providers through their local health alert network, blast-faxing or other local protocols.

* www.FlashAlert.net

IX. Epidemiological surveillance

Reporting illnesses associated with cyanotoxins produced by cyanobacteria

Except for Paralytic Shellfish Poisoning, illnesses or reactiones caused by exposure to toxins produced by cyanobacterial blooms is not specifically reportable under the Oregon Disease Reporting Rules. However, any known or suspected disease outbreak, infection, microorganism or any uncommon illness of potential public health significance must be reported immediately to the Oregon Public Health Division. 971-673-1111. (3).

A person should contact the OHA CHAB Program if they show symptoms described in Table 1, page 9 and suspect they or their pet have been exposed to a cyanobacterial bloom or cyanotoxins. Symptoms of cyanotoxin exposure in people are self-limiting and should go away within 72 hours. However, if symptoms persist they should seek medical attention. If a pet is suspected of being exposed and shows any abnormal activity or symptoms, the owner should get their pet to a veterinarian immediately and then notify the OHA CHAB Program. There is currently no antidote for cyanotoxin exposure. Medical treatment will be provided to ease any symptoms experienced. When talking with their pets veterinarian, owners should be sure to alert him or her of their pets exposure to a bloom and potential toxins so that the appropriate tests can be performed.

Illness reports from the public are taken over the phone and reported to the Communicable Disease Program where water-related illnesses are tracked. Illnesses are tracked in EPA's national One Health Harmful Algal Bloom System (OHHABS) illness database. LPHAs should also report the illness through the Communicable Disease Reporting webpage.

Keep in mind that many of the symptoms of exposure to cyanotoxins mimic those of food poisoning. Therefore, they tend to go unreported. If you receive a call about a person or a pet with these symptoms, be sure not to assume they are related to food poisoning. They may be, but it is critical for OHA to be able to interview the caller to find the source and potential cause of the symptoms.

ESSENCE

OHA has provided query parameters and guidance for Oregon's Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE). This allows users to watch emergency department data for potential CHAB-related illnesses during an outbreak. Each LPHA should have two persons on staff with access to ESSENCE. If you are not sure who in your agency has access or if you would like to request access, contact Oregon.Essence@state.or.us. (25)

Archival data

The OHA maintains a public facing online archive of past advisories and internal records of any data submitted to its program filed according to water body. (12) LPHAs are not required to create data sets to archive monitoring sites however, be sure that the data submitted to the LPHA is forwarded to the OHA CHAB Program Coordinator. You can find the contact information for the program on the CHAB website.

Appendix A

Recommended public health department actions

Agency	Recommended action	Thresholds for action
Monitoring		
LPHAs	Monitor water bodies through onsite observations for evidence of cyanobacterial blooms.	When there is a history or report of CHABs.
OHA	Provide guidance for establishing a monitoring program.	Update guidance as needed.
Sampling		
LPHAs	Obtain water samples using procedures in the OHA Sampling Guidelines.	When visual monitoring indicates a bloom may be present.
OHA	Provide guidance to LPHAs and partners on sampling technique.	Update guidance as needed.
Testing		
LPHAs	Contract with and submit samples to qualified laboratories. (7)	When monitoring indicates a bloom may be present.
OHA	Maintain a list of qualified laboratories.	Update list as needed.
Evaluation		
LPHAs	Submit laboratory data to OHA for evaluation.	Upon receipt of laboratory data.
OHA	Evaluate laboratory data against established recreational use values to decide whether an advisory is needed.	When an LPHA submits laboratory data from a sample.
Advisories		
LPHAs	Provide a primary point of contact for OHA to share advisory information. Ensure that contacts and Environmental Health and Preparedness staff sign-up to receive GovDelivery email and text alerts.	Update annually prior to April or as staff changes occur.
OHA	Determine if there is a need to issue or lift an advisory. Contact LPHA before issuing or lifting advisories.	When data meets or exceeds recreational use values.
Risk communication		
LPHAs	Inform community and user groups using LPHA protocols. Inform local providers using LPHA protocols. Post and remove advisory signs.	When OHA issues or lifts an advisory.
OHA	Provide risk communication materials to LPHAs. Issue electronic alerts to stakeholders via the OHA electronic Health Alert Network. Inform the public through advisory press releases via email from the Strategic Partnerships county contact to statewide media, GovDelivery messages, a toll-free hotline and the OHA website.	When OHA issues or lifts an advisory.

Agency	Recommended action	Thresholds for action
Surveillance		
LPHAs	Monitor ESSENCE for potential events. Contact OHA if you suspect an illness related to a cyanobacterial bloom and potential toxins as an illness outbreak may be occurring.	During CHAB season and especially when a bloom is present.
OHA	Provide query parameters and guidelines for LPHAs to monitor ESSENCE for syndromes that may be related to exposure to cyanotoxins from a cyanobacterial bloom.	Update guidelines as needed.

Appendix B

List of partner agencies and organizations

Agency	CHAB role	Contact information
Federal		
U.S. Army Corps of Engineers	Conduct outreach and education. Perform limited monitoring on targeted water bodies.	http://www.usace.army.mil/Contact/Office-Locator/ Tina Lundell Tina.M.Lundell@usace.army.mil
U.S. Centers for Disease Control and Prevention	Conduct outreach and education. Provide guidance on cyanotoxins	https://www.cdc.gov/habs/
U.S. Environmental Protection Agency	Conduct outreach and education. Provide guidance and recommended advisory values for cyanobacteria and cyanotoxins in recreational and drinking water. Perform National Lakes Assessment on selected water bodies on a five-year sampling schedule.	https://www.epa.gov/national-aquatic-resource-surveys/nla https://www.epa.gov/cyanohabs
U.S. Forest Service, Pacific Northwest Region	Perform limited monitoring on targeted water bodies. Conduct outreach and education.	https://www.fs.usda.gov/main/r6/home Al Johnson. ajohnson@fs.fed.us
U.S. Geological Society	Provides expertise on identification of cyanobacteria and the blooms they form. Monitoring for CHABs limited to study sites such as Detroit Lake and the Clackamas, Santiam and McKenzie rivers.	Kurt Carpenter kdcar@usgs.gov
State		
Oregon Department of Agriculture (ODA)	Perform monitoring of specific marine fisheries for biotoxins and provide closure notices via the ODA shellfish web page.	Food Safety: 503-986-4720 Hotline: 800-448-2474 http://www.oregon.gov/ODA/programs/FoodSafety/Shellfish/Pages/ShellfishClosures.aspx
Oregon Department of Environmental Quality (DEQ), Water Quality Monitoring Program	Perform limited monitoring on water bodies with no DMA or where DMA is unwilling or unable to sample. Water body must meet OHA and DEQ criteria for sampling. Can contact OHA for criteria. Provide OHA with consultation and expertise related to water quality issues. Maintain protection of Oregon's rivers, lakes, streams and groundwater quality as part of its agency mission.	Alison Minerovic (503) 693-5727 | Cell: (503) 979-5910 (preferred) minerovic.alison@deq.state.or.us Aaron Borisenko (503) 693-5723 Aaron.N.Borisenko@state.or.us
Oregon Department of Fish and Wildlife (ODFW)	Does not monitor for cyanobacteria, cyanotoxins or marine biotoxins. Enforces regulations on harvest limits for both freshwater and marine fisheries.	http://www.dfw.state.or.us/mrp/shellfish/razorclams/harmful_algae.asp

OHA Drinking Water Services (DWS) Program	Work with public water supply system staff to administer drinking water quality standards for Oregon public water systems, including required monitoring and sampling when a bloom is identified, and the appropriate response to cyanotoxins when raw or finish water data indicate levels over drinking water values for microcystin or cylindrospermopsin and response to cyanobacterial blooms detected in source water.	Program contact can be found on the DWS Contact Us webpage. Contact the emerging contaminants lead.
Cyanobacteria Harmful Algae Bloom Program (CHAB)	Lead state agency for cyanobacterial blooms in Oregon. Refer also to Appendix A.	Program contacts can be found on the CHAB Contact Us webpage.
Regional and local		
Local Public Health Authorities	Lead local agency for cyanobacterial blooms within their jurisdiction. Refer also to Appendix A.	https://public.health.oregon.gov/ProviderPartnerResources/LocalHealthDepartmentResources/Pages/lhd.aspx
Devils Lake Water Improvement District	Performs monitoring at Devils Lake when a cyanobacterial bloom is identified.	http://dlwid.org/water-quality/
Partnership for the Umpqua Rivers	Coordination with area partners and limited monitoring in the Umpqua Basin.	http://www.umpquarivers.org/
Tenmile Lake Basin Partnership and Coos Health and Wellness	Limited monitoring at Tenmile Lake when cyanobacterial blooms present, and resources are available to sample.	Contact the Coos County environmental health director.

Appendix C

Press release templates

Press release templates are provided for use by LPHAs who should modify them as needed to communicate appropriately within their jurisdictions. If you have any questions about the content or how these templates should be used, contact OHA.

Press release template: Early Season Education. (Appendix C.1)

Press release template: CHAB Advisory Issue. (Appendix C.2)

Press release template: CHAB Advisory Lift. (Appendix C.3)

General CHAB information educational materials

Poster: Algae Blooms in Oregon – recommended for seasonal informational posting. (14)

YouTube video: Algal Blooms can Harm Your Health – Recommended for social or other electronic media. (32)

Webpage: Cyanobacteria Harmful Algae Bloom Frequently Asked Questions. (17)

Tri-fold brochure: Harmful Algae Blooms in English and Spanish. (17)

Handout: Fishing and Blue-Green Algae Blooms FAQ. (18)

Animals and CHABS

Poster: Dog Safety Alert. (16)

Brochure: Animal Safety Alert. (15)

CHAB information for medical professionals
Flyer: CDC Physician Reference Card. (30)

Flyer: CDC Veterinarian Reference Card. (31)

Public points of contact

Email notification of CHABs: Partners and the public can sign up through GovDelivery to receive email and text notifications immediately after a news release is issued for a CHAB advisory issue or lift. (6)

CHAB hotline. 877-290-6767: The OHA's CHAB hotline is toll free and provides current advisory information to the public.

CHAB online information: OHA maintains a web page where advisory information is immediately posted, providing real-time access to advisory information. Resources for water samplers, prevention tips and general information about CHABs can also be accessed. www.healthoregon.org/hab.

Shellfish biotoxin hotline. 800-448-2474 and biotoxin webpage: The ODA's shellfish biotoxin hotline is toll free and is updated immediately when shellfish toxins reach the alert level. The hotline is the public's best source for up-to-date clam, crab and mussel closure information. (4)

Suspected blooms: If a citizen identifies what they believe to be a bloom upstream from a private water intake or wants to test private water for cyanotoxins, they may contact OHA at 971-673-0400 and press 3 for environmental public health or hab.health@dhsoha.state.or.us for guidance on which toxins to test for and which labs to use. (9) Publicly funded testing of private water sources is not available.

C.1. Press release template: Early season public education

News release

(Date)

As temperatures heat up watch for cyanobacterial blooms when recreating in Oregon waters

The Oregon Health Authority (OHA) issues a recreational use health advisory warning when people need to stay out of affected waters to avoid illness. OHA does so when a cyanobacteria bloom is found and lab results show cyanotoxin levels over OHA recreational use values.

We send recreational use health advisories via GovDelivery and FlashNews media, and we post this information on the "CHAB" website. Sign up to receive email/text alerts.

Symptoms

Exposure to cyanotoxins can be serious and result in a range of symptoms. This includes:

- Diarrhea
- Cramps
- Vomiting
- Numbness
- Dizziness
- Fainting

Contact with a bloom can cause a puffy, red rash. Children, people with weakened immune systems are most vulnerable to illness.

Pets are at risk, too

Due to their size and level of activity, dogs are very vulnerable to the effects of cyanotoxins. Dogs can have exposure through:

- Drinking affected water
- Eating cells from the bloom
- Licking cells off rocks, and

- Licking their fur after exposure.

Symptoms can occur very quickly and owners of a dog exhibiting abnormal behavior after being in the water should call a veterinarian.

In the past, OHA has heard reports of dog deaths due to exposure to bloom-affected water. Outreach efforts and widespread publicity of dog deaths has increased public concern. This increased awareness among pet owners has caused them to take extra action to protect their pets.

When to avoid water contact

Because only a fraction of Oregon's fresh waters are visually monitored and sampled, the public can't be notified about all cyanobacterial blooms. Therefore, there are certain conditions you can identify to stay safe and healthy. It's best to stay out of an area if the water smells bad or looks:

- Foamy, scummy, thick like paint, and
- Pea-green, blue-green or brownish-red in color.

Recreational work by this program has no funding source. However, staff continue to alert the public about blooms and cyanotoxins to protect public health.

Be safe,

(Signature)

C.2. Press release template: Recreational use health advisory issued

News release

(Date)

Recreational use advisory issued for Name of Water Body XX date

PORTLAND, Ore. — The Oregon Health Authority (OHA) issued a recreational use health advisory today for (name of body of water) due to the presence of a cyanobacteria bloom and cyanotoxins above recreational use values for human exposure. The lake is in (name of county).

You should avoid swimming and high-speed water activities, such as water skiing or power boating, in areas of the lake where blooms are. Toxins are not absorbed through the skin. However, if you have skin sensitivities you may get a puffy red rash.

You are encouraged to visit (name of body of water) and enjoy activities such as fishing, camping, hiking, biking, picnicking, and bird watching. Boating is safe as long as speeds do not create excessive water spray. Sprays could lead to the risk of inhaling cyanotoxins.

Drinking water

Drinking water directly from areas of the lake affected by a bloom is especially dangerous. Toxins cannot be removed by boiling, filtering or treating water with camping-style filters. Contact campground management or the local health department with questions about water available at nearby campgrounds or day use areas.

If you do not use a well or a public water system and draw in-home water directly from an affected area you are advised to use an alternative water source. This is because not all private treatment systems are effective in removing cyanotoxins.

Children and pets

Children and pets are at increased risk for exposure because of their size and level of activity. If you bring your pets to a lake with areas with a bloom take special precautions to keep them from drinking from or swimming in these areas. This is regardless of a recreational use health advisory in place. Dogs can be exposed to cyanotoxins when present by licking their fur, licking cyanobacteria off rocks or eating cells from a bloom and can become violently ill or even die when exposed to low levels of toxin.

Fishing

Fish caught from areas where cyanobacteria blooms are present should have fat, skin and organs removed before cooking or freezing. Toxins are more likely to collect in these tissues. Fillets should also be rinsed with clean water.

Symptoms

Exposure to cyanotoxins can be serious and cause a range of symptoms. Symptoms may be similar to food poisoning such as stomach cramping, diarrhea, nausea and vomiting. Symptoms may also be more serious, such as numbness, tingling, dizziness and shortness of breath. These symptoms may require medical attention.

For health information or to report an illness, contact the Oregon Health Authority (OHA) at 971-673-0482.

Learn more here.

Media contact:

Jonathan Modie, 971-246-9139, phd.communications@dhsoha.state.or.us

C.3. Press release template: Recreational use health advisory lifted

News release

(Date)

(Name of Boy of Water) recreational use health advisory lifted

PORTLAND, Ore. — The Oregon Health Authority (OHA) has lifted the recreational use health advisory issued for (name of body of water) in (name of county). The OHA issued the advisory (date).

Water monitoring has confirmed that the level of cyanotoxins in (name of body of water) are below recreational guideline values for people. However, officials advise recreational visitors to be alert to signs of cyanobacteria blooms. This is because blooms can develop and disappear on any water body at any time when bloom conditions are favorable. Only a fraction of waterbodies in Oregon are monitored for blooms and toxins.

People and especially small children and pets should avoid recreating in areas where:

- The water is foamy, scummy, thick like paint
- The color of the water is pea-green, blue-green or brownish red, or
- A thick mat of blue-green algae is visible or bright green cells are suspended in the water.

If you see these signs avoid activities that cause you to swallow water or inhale droplets, such as swimming or high-speed water activities.

Cyanotoxins can still exist in clear water. When a bloom dies toxins released may reach into clear water around the bloom. Blooms can be pushed into other areas, leaving behind the toxins released. Toxins can also be produced and released by cyanobacteria that:

- Anchor themselves at the bottom of a water body
- Live in the sediment, or
- Grow on aquatic plants.

For health information or to report an illness, contact OHA at 971-673-0482.

Learn more here.

Media contact:

Jonathan Modie, 971-246-9139, phd.communications@dhsoha.state.or.us

Appendix D

Acronyms

CHAB	Oregon Health Authority's Cyanobacteria Harmful Algae Bloom Program
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
EPA	United States Environmental Protection Agency
ESSENCE	Oregon's Electronic Surveillance System for the Early Notification of Community-based Epidemics
LPHA	Local public health authority
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
OHA	Oregon Health Authority

Appendix E

References

1. Hubler, Shannon. "2017 National Lakes Assessment." *Lake Wise*, May 2017. https://www.oregonlakes.org/resources/Documents/Lakewise/2017_05/May%202017%20Lake%20Wise%20Newsletter%20Final%20Draft%204_13_17.pdf.

2. Oregon Administrative Rule 333-017-0015.

3. Oregon Department of Agriculture. *Recreational Shellfish Biotoxin Closures.* https://www.oregon.gov/ODA/programs/FoodSafety/Shellfish/Pages/ShellfishClosures.aspx

4. Oregon Department of Environmental Quality. *Oregon DEQ Harmful Algal Bloom Strategy.* (June 2011). http://www.deq.state.or.us/wq/algae/docs/HABstrategy

5. Oregon Department of Human Services. https://public.govdelivery.com/accounts/ORDHS/subscriber/new

6. Oregon Health Authority, *Available Laboratories for Cyanobacteria Analysis.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/Laboratories-Cyanobacteria-Analysis.pdf

7. Oregon Health Authority, Drinking Water Services. Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water. (June 2015). https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/OPERATIONS/TREATMENT/Documents/algae/EPA-cyanotoxin-recommendations.pdf

8. Oregon Health Authority, Drinking Water Services. *Cyanotoxins in Drinking Water: Frequently Asked Questions.* FAQs are posted on the Drinking Water Program web page when a drinking water advisory is in place. Once posted they can be found here:

9. Oregon Health Authority, Drinking Water Services. *Rules for Cyanotoxin Monitoring in Drinking Water.* https://www.oregon.gov/oha/PH/HealthyEnvironments/DrinkingWater/Operations/Treatment/Pages/algae.aspx

10. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Current Cyanobacteria Advisories.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/Blue-GreenAlgaeAdvisories.aspx

11. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Cyanobacteria Advisory Archive.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/archive.aspx

12. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Cyanobacteria Bloom Photo Gallery.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/AlgaeBloomPhotoGallery.aspx

13. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Algae Blooms in Oregon.* http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Documents/HABSinOregon_FINAL_Web.pdf.

14. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Animal Safety Alert.* http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Documents/HAB-animal-safety.pdf.

15. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Dog Safety Alert.* http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Documents/HAB-dog-safety.pdf.

16. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Frequently Asked Questions.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/faqs.aspx

17. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Fishing and Blue-Green Algae Blooms.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/fishermanAlgae_factsFINAL.pdf

18. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Cyanobacteria Blooms.* http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Pages/index.aspx.

19. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Partners.* http://public.health.oregon.gov/HealthyEnvironments/Recreation/

HarmfulAlgaeBlooms/Pages/partnerspage.aspx.

20. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Advisory Guidelines for Harmful Cyanobacterial Blooms in Recreational Waters.* (June 2019). https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/Advisory-Guidelines-Harmful-Cyanobacterial-Blooms-Recreational-Waters.pdf

21. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Current Cyanobacteria Advisories.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/Blue-GreenAlgaeAdvisories.aspxhttps://www.oregon.gov/oha/PH/NEWSADVISORIES/Pages/RecreationalAdvisories.aspx

22. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *Sampling Guidelines: Harmful cyanobacterial Blooms in Recreational Waters.* (Sept 2018). https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/Sampling-Guidelines-Cyanobacterial-Blooms-Recreational-Waters.pdf

23. Oregon Health Authority, Cyanobacterial (Harmful Algae) Bloom Program. *The Water Sampling Process.* https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/The-Water-Sampling-Process.aspx

24. Oregon Health Authority, Preparedness, Surveillance, and Epidemiology Program. *Oregon ESSENCE: Oregon's Syndromic Surveillance Project.* https://www.oregon.gov/oha/PH/DiseasesConditions/CommunicableDisease/PreparednessSurveillanceEpidemiology/essence/Pages/index.aspx

25. Otten, Timothy G., Crosswell, Joseph R., Mackey, Sam, and Dreher, Theo W. Application of Molecular Tools for Microbial Source Tracking and Public Health Risk Assessment of a Microcystis Bloom Traversing 300 Km of the Klamath River. *Harmful Algae.* 46: June 2015. 71-81. https://www.sciencedirect.com/science/article/pii/S1568988315000700?via%3Dihub

26. Partnership for the Umpqua Rivers. *Toxic Blue Green Algae and Nutrient Pollution.* http://www.umpquarivers.org/toxic-algae-blooms.

27. Stone, David and Hitchko, Kara. "Toxic Blooms in Oregon Waters." *Extension Catalog 1631.* (July 2009). https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/ec1631.pdf.

28. Terry, Lynne. "Two More Dogs Die from Blue-Green Algae in South

Umpqua River." The Oregonian. (August 17, 2011). https://www.oregonlive.com/environment/2011/08/two_more_dogs_die_from_blue-gr.html

29. United States Centers for Disease Control and Prevention. *Physician Reference*. https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/CDCHABSphysician_update.pdf.

30. United States Centers for Disease Control and Prevention. *Veterinarian Reference*. https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Documents/CDCHABSphysician_update.pdf.

31. United States Environmental Protection Agency. *Algal Blooms Can Harm Your Health*. (January 9, 2017). https://www.youtube.com/watch?v=00j0Yef9oJU.

32. Public Health Division, *beach and fresh water advisories* https://www.youtube.com/watch?v=aTVzy_D_zZI

33. United States Environmental Protection Agency. CyanoHABS. https://www.epa.gov/cyanohabs.

34. United States Environmental Protection Agency. EPA. *National Beach Guidance and Required Performance Criteria for Grants, 2014 Edition*. (July 2014). https://www.epa.gov/sites/production/files/2014-07/documents/beach-guidance-final-2014.pdf.

35. United States Environmental Protection Agency. *Health and Ecological Effects: What Health Risks do Humans Face as a Result of Exposure to Cyanotoxins?* https://www.epa.gov/nutrient-policy-data/health-and-ecological-effects#what1.

36. United States Environmental Protection Agency. *Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin*. (May 2019) https: https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf

37. Vasconcelos, V M. "Cyanobacterial Toxins in Portugal: Effects on Aquatic Animals and Risk for Human Health". *Brazilian Journal of Medical and Biological Research*, 32:3, 249-54. https://www.researchgate.net/publication/12950662_Cyanobacterial_toxins_in_Portugal_Effects_on_aquatic_animals_and_risk_for_human_health.

38. Washington State Department of Ecology. *Blue-Green Algae Toxins in Washington Lakes: Screening Fish Tissues for Microcystins and Anatoxin-a*. (March 2010). https://fortress.wa.gov/ecy/publications/documents/1003011.pdf

Oregon Health Authority
PUBLIC HEALTH DIVISION
Phone: 971-673-0482
Fax: 971-673-0979

This document can be provided upon request in an alternate format for individuals with disabilities or in a language other than English for people with limited English skills. To request this publication in another format or language, contact the contact Environmental Public Health at 971-673-0482, 711 for TTY, or email epht.ohd@dhsoha.state.or.us.

OHA 8284 (12/20)