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RESPONDING TO HARMFUL ALGAL BLOOMS:

A Guide for North Carolina Waterkeepers, Government Agencies, and Water Quality Advocates

Prepared by the Harmful Algal Bloom Workgroup of Waterkeeper Alliance's North Carolina Pure Farms, Pure Water Campaign

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1 INTRODUCTION

In response to numerous Harmful Algal Blooms (HABs) in North Carolina during the summer of 2019, Waterkeeper Alliance's North Carolina Pure Water, Pure Farms campaign established a HAB Workgroup to assess how to make the public more aware of HABs and their impacts on human health and the environment. To accomplish that goal, the HAB Workgroup developed this report to increase the public's awareness about HABs and guide other Waterkeeper groups, advocacy organizations, local government agencies, and property and business owners concerned about the impact of HABs on the state's environment and economy.

2 HARMFUL ALGAL BLOOMS DEFINED

Excess nutrients in our lakes and rivers can produce algal blooms. In some cases, blooms can be dominated by cyanobacteria, which may produce cyanotoxins that can adversely affect drinking water and endanger human health, fish, and animals.[1]

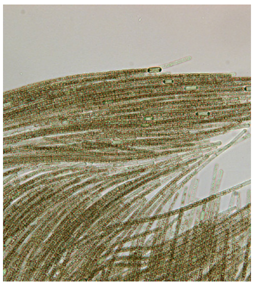
The state of North Carolina does not have an ambient water quality standard for cyanobacteria or related cyanotoxins. The U.S. Environmental Protection Agency (EPA) has recommended water quality criteria for two of the most common cyanotoxins, microcystins and cylindrospermopsin.[2] In addition to the concentration levels, these recommendations also take into consideration the duration and frequency of the blooms to assess threats to public health in recreational waters. But these recommendations are not enforceable in our state, absent adoption by the NC Environmental Management Commission. Similarly, although EPA has recommended health-advisory levels to protect drinking water supplies,[3] and the World Health Organization has set a preliminary guideline of 1ug/L microcystin-LR in drinking water,[4] these recommendations are not enforceable absent state rulemaking.

[1] US EPA, Cyanobacterial Harmful Algal Blooms (CyanoHABs) in Water Bodies (2020), available at https://www.epa.gov/cyanohabs [last accessed 27 October 2020].
[2] US EPA, Recommended Human Health Recreational Ambient Water Quality Criteria Or Swimming Advisories For Microcystins And Cylindrospermopsin (2020), available at https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-factsheet-2019.pdf [last accessed 27 October 2020].
[3] US EPA, Harmful Algal Blooms and Drinking Water (2016), available at: https://www.epa.gov/sites/production/files/2016-11/documents/harmful_algal_blooms_and_drinking_water_factsheet.pdf [last accessed 28 October 2020].
[4] World Health Organization, Guidelines For Drinking-Water Quality: 4Th Ed (2017), available at: https://www.who.int/water_sanitation_health/dwq/chemicals/microcystin-2017.pdf?ua=1 [last accessed 27 October 2020].

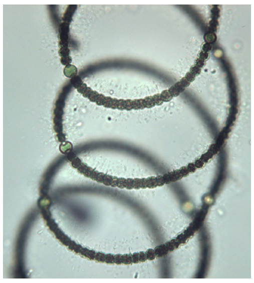
Despite the absence of regulation, the NC Department of Environmental Quality (DEQ) tracks algal blooms. For reporting and mapping purposes, the agency uses a cell density standard of greater than 10,000 units per mL or a biovolume of greater than 5,000 millimeters per cubic meter to designate an algal bloom.[5] DEQ distinguishes any algal bloom where cyanobacteria comprise the dominant alga group as a "cyanobacterial bloom."

For purposes of this report, algal blooms dominated by cyanobacteria with the potential to harm public health and aquatic ecosystems are called Harmful Algal Blooms or "HABs." These HABs can not only impact public health and aquatic systems; they can also impact local economies, drinking water supplies, property values, commercial and recreational fishing, and other water-based recreational activities.

Species of Cyanobacteria that Produce Toxins *Cyanobacteria and Known Toxins Chart*

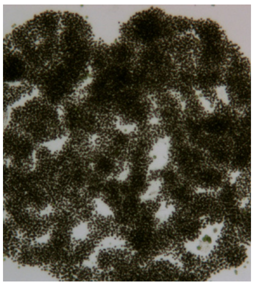


Aphanizomenon

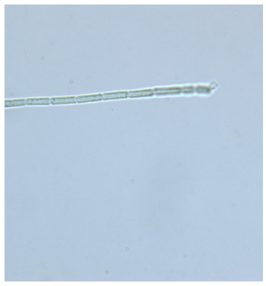


Dolichospermum

Cylindrospermopsis



Microcystis



Pseudanabaena

Photos provided by the NC Division of Water Resources Water Science Section

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[5] *NC DEQ, NCDWR Algal Bloom Map (2020), available at: https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=58e9afca8b724b3f82cc81a8b825f83e*

Table

Most Commonly Found Cyanotoxins in the US EPA Fact Sheet:
Cyanobacteria and Cyanotoxins: Information for Drinking Water Systems

<table>
<tr><th>Cyanotoxin</th><th>Number of Known Variants or Analogues</th><th>Primary Organ Affected</th><th>Health Effects[1]</th><th>Most Common Cyanobacteria Producing Toxin[2]</th></tr>
<tr><td>Microcystin-LR</td><td>80~90</td><td>Liver</td><td rowspan="2">Abdominal pain
Vomiting and diarrhea
Liver inflammation and hemorrhage
Acute pneumonia
Acute dermatitis
Kidney damage
Potential tumor growth promotion</td><td>Microcystis
Anabaena
Planktothrix
Anabaenopsis
Aphanizomenon</td></tr>
<tr><td>Cylindrospermopsin</td><td>3</td><td>Liver</td><td>Cylindrospermopsis
Aphanizomenon
Anabaena
Lyngbya
Rhaphidiopsis
Umezakia</td></tr>
<tr><td>Anatoxin-a group[3]</td><td>2-6</td><td>Nervous System</td><td>Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death</td><td>Anabaena
Planktothrix
Aphanizomenon
Cylindrospermopsis
Oscillatoria</td></tr>
</table>

3 Causes of Algal Growth

Algal growth is influenced by numerous factors, including available nutrients, water-flow rates, and water temperature. Nitrogen and phosphorus are prime nutrients that contribute to algal growth, with phosphorus being the limiting nutrient in nearly all cases in freshwater systems. Availability of nutrients can directly affect growth rates and total biomass, with low-nutrient oligotrophic waters typically remaining clear year-round, while high-nutrient eutrophic waters may experience seasonal growth that can result in conditions from slightly turbid to extreme turbidity in the case of blooms.

Heavy algal growth is often noted in farm ponds where runoff from surrounding pasture or feeding areas is allowed to drain directly into the pond, resulting in a thick green mat that may entirely cover small (< 1 acre) ponds. In larger water bodies subject to more water flow and wind disturbance, heavy algal growth may be dispersed and result in high turbidity without forming a visible mat of surface material. These waters may also experience enhanced algal growth due to vertical mixing bringing nutrients from deeper water into the growth zone.[7]

Increased nutrient loading from wastewater treatment plants, urban stormwater, residential fertilizer, and agricultural runoff is compounded by elevated water temperatures due to climate change, further fueling the growth of HABs. Warmer surface water temperatures enhance algal growth, with the heaviest growth or blooms often seen in mid to late summer when the water body has warmed sufficiently to lessen nocturnal cooling of the surface. As global warming affects average temperatures, we expect to see both more intense and longer-lasting algal growth. This trend has been noted in waters throughout the Southeastern U.S. as well as the North American Great Lakes. Increased periods of drought and stagnation will further exacerbate the problem in some water bodies.

The combination of higher temperatures and climbing nutrient loads in many NC water bodies indicates that algal blooms will continue to increase. With that increase comes the possibility of more HABs and associated toxins adversely affecting both human and environmental health.

[6] US EPA, Causes Of Cyanohabs (2020), available at: https://www.epa.gov/cyanohabs/causes-cyanohabs [last accessed 27 October 2020].

4 HAB Impacts

HABs pose threats to humans when they come into contact with or ingest water or food containing cyanotoxins. According to EPA, human exposure to elevated levels of cyanotoxins can impact the kidneys, liver, and the neurological system. According to the Centers for Disease Control and Prevention, depending on the particular cyanotoxin, symptoms may range from skin, eyes, nose, and throat irritation, to headaches and abdominal pains, to more serious neurological or respiratory system impacts.

Similarly, pets that have come into contact with toxic algae or ingested water contaminated with cyanotoxins may also experience adverse health impacts. The recent death of two dogs near Wilmington, NC, and several other pet mortalities have been attributed to high concentrations of cyanotoxins in water bodies. Exposure can cause health impacts that include too much salivation, general weakness, staggered walking, and difficulty breathing. In some severe cases, animals exposed to toxic algae may die within hours or days of exposure.

Even without the production of toxins, HABs have the potential to cause catastrophic impacts on an ecosystem. HABs may keep sunlight from reaching deeper in the water and may remove dissolved oxygen from the water as they decompose, leading to hypoxia or reduced dissolved oxygen levels, which have potential to harm fish and plant life.

HABs can also have significant negative impacts on local economies. Health and swim advisories resulting from HABs directly affect recreational uses and limit related economic activity. In addition, HABs may reduce property values if the problem is not addressed and/or becomes dangerous. Waterfront property on lakes and rivers is often a major source of local property tax revenues, which will decline with reductions in property values. In cases where HABs impact aquatic ecosystems, fisheries may suffer, limiting commercial and recreational fishing opportunities.

Perhaps the most significant risk posed by HABs is to community drinking water supplies, which may be directly threatened by contamination from cyanotoxins, resulting in expensive treatment costs and potential negative health effects and related health care costs.

[7] US EPA, Health Effects From Cyanotoxins (2020) available at: https://www.epa.gov/cyanohabs/health-effects-cyanotoxins [last accessed 27 October 2020].
[8] US DHHS, Centers for Disease Control and Prevention, Harmful Algal Bloom-Associated Illnesses (2020), available at: https://www.cdc.gov/habs/illness.html [last accessed 27 October 2020].
[9] WWAY TV, Toxic Algae Found In Wilmington Pond After Death Of Dogs - WWAY TV (2020), available at: https://www.wwaytv3.com/2019/08/27/toxic-algae-found-in-wilmington-pond-after-death-of-dogs/ [last accessed 27 October 2020].

5 HABs and Hypoxia

Hypoxia is a condition of low dissolved oxygen in the water, which may be caused by a variety of factors.[10] One of the more common causes of hypoxia is decaying organic material, as may result after a large algal bloom. While dissolved oxygen levels may climb during an algal bloom due to the algae's photosynthetic activity, the die-off of the bloom results in a high load of decaying organic material. As this material decays, oxygen in the water is used during the process, resulting in low dissolved oxygen levels and even "dead zones" where the oxygen level falls below levels required for aquatic life. This phenomenon is seen regularly in the Gulf of Mexico each year[11] and also affects freshwater systems such as the North American Great Lakes.[12] Algal blooms are often traceable to human activity, particularly activity contributing to high nutrient loads of nitrogen and phosphorus, stimulating algae growth and leading to large quantities of organic material, which use oxygen during the decomposition process.

The federal government has long recognized the connection between HABs and hypoxia. The U.S. Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act of 1998, and subsequently amended the legislation in 2004, 2014, and 2017 as concerns over HABs and hypoxia grew.[13] The 2014 amendments extended the scope of the legislation to freshwater ecosystems.

In response to the 2014 amendments, a 2016 interagency report prepared by the National Science and Technology Council's Subcommittee on Ocean Science and Technology concluded, "HABs and hypoxia pose a significant challenge to the ability to safeguard the health of the nation's coastal and freshwater ecosystems."[14] The report also notes that the causes and impacts of HABs and hypoxia are linked in many cases and that the incidence of hypoxia has increased thirtyfold in U.S. waters since 1960, with more than 300 aquatic systems being impacted. A recent report completed by the NC Nutrient Criteria Science Advisory Council after an analysis of High Rock Lake found a direct, positive correlation between Dissolved Oxygen (DO) levels and chlorophyll-a levels during the spring and summer growing season, and a negative correlation in the fall and winter.[15] This 2016 report by the National Science and Technology Council Subcommittee on Ocean Science and Technology includes more information on the links between HABs and hypoxia and the most recent recommendations to prevent and reduce those impacts.

[10] NOAA, Hypoxia (2020), available at: https://oceanservice.noaa.gov/hazards/hypoxia/ [last accessed 27 October 2020].
[11] Lopez, C.B., Dortch, Q., Jewett, E.B., Garrison, D., Scientific Assessment of Marine Harmful Algal Blooms (2008), Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Healtth of the Joint Subcommittee on Ocean Science and Technology, Washington, D.C., available at: http://aquaticcommons.org/14920/1/assess_12-08.pdf [last accessed 27 October 2020].
[12] Kim, D., Zhang, W., Watson, S., & Arhonditsis, G., A commentary on the modeling of the causal linkages among nutrient loading, harmful algal blooms, and hypoxia patterns in Lake Erie, Journal of Great Lakes Research, 40(3), 117–129, (2014), https://utsc.utoronto.ca/~georgea/resources/80.pdf
[13] US EPA, The Harmful Algal Bloom and Hypoxia Research and Control Amendments Act (HABHRCA) (2020), available at: https://www.epa.gov/cyanohabs/harmful-algal-bloom-and-hypoxia-research-and-control-amendments-act-habhrca [last accessed 27 October 2020].
[14] National Science and Technology Council Subcommittee on Ocean Science and Technology, Harmful Algal Blooms and Hypoxia Comprehensive Research Plan and Action Strategy: An Interagency Report (2016), available at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/final_habs_hypoxia_research_plan_and_action.pdf [last accessed 27 October 2020].
[15] N.C. Nutrient Criteria Science Advisory Council, A Chlorophyll-a Criteria for High Rock Lake, North Carolina Nutrient Criteria Science Advisory Council, 30-34 (2020), available at: https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ECO/NutrientCriteria/ChlaCriteriaDoc-May26-2020--SAC-final-.pdf [last accessed 28 October 2020].

6 Monitoring and Sampling HABs

There are multiple metrics for measuring algal blooms, including sampling for toxicity, cell density, or for chlorophyll-a as an indicator measurement. [16] Sampling for toxicity can be expensive, and many state labs do not have state-certified tests that can be used.

EPA's Cyanobacteria Assessment Network (CyAN) is a customizable Android app that provides access to algal bloom satellite data for over 2,000 of the largest lakes and reservoirs across the United States. EPA scientists developed the CyAN app to help local and state water-quality managers make faster and better-informed management decisions related to cyanobacterial blooms. The imagery is updated weekly. Resources including a webinar, a guide, and list of ground-truthed lakes can be found on EPA's website. [17]

Abraxis is a laboratory supply company that sells microcystin testing kits. There are two types available; ELISA and dip strips. The ELISA is more accurate and EPA-approved but requires specialized lab equipment. Because toxins can rapidly form and are not homogenous in a bloom, there are few situations where toxin testing is recommended.
For more information, please see below:

- ELISA - Laboratory Techniques for Detecting Microcystins in Water Using Enzyme-Linked Immunosorbent Assay (ELISA). [18] As of May 2020, these kits cost $75 to $3000, depending on the specific toxin to be measured and tolerance. They require a fluorometer and pipettor.

- Dip Strip kits - Best for screening. As of July 2019, $180-5 pack or $520-20 pack. With tax, it is about $39 or $28 each. Microcystins, 0-10(20) ppb, Recreational Water with QuikLyse® Feature. These are good for low-cost screening without the need for expensive equipment, but they are less precise.

[16] US EPA, Recommendations for Cyanobacteria and Cyanotoxin Monitoring in Recreational Waters (2019), available at: https://www.epa.gov/sites/production/files/2019-09/documents/recommend-cyano-rec-water-2019-update.pdf, [last accessed 27 April 2021].
[17] US EPA, Cyanobacteria Assessment Network Mobile Application (CyAN app) (2020, available at: https://www.epa.gov/water-research/cyanobacteria-assessment-network-mobile-application-cyan-app [last accessed 27 April 2021].
18 US EPA, Lab Techniques for Detecting Microcystins in Water Using Enzyme-Linked Immunsorbent Assay (2015), available at: https://www.youtube.com/watch?v=YOWNA6VSQkA [last accessed 27 April 2021].

NC DEQ HAB Monitoring Protocol

In January 2020, DEQ published standard operating procedures for sampling algal blooms and cyanotoxins.[19] This document provides a comprehensive set of state agency procedures for sampling and assessing algal blooms. However, it does not provide guidance for making public health and safety advisories. That determination is currently the responsibility of the NC Department of Health and Human Services, in partnership with local county health departments.

1.

Current NCDEQ criteria for designation are as follows:

- **Algal Bloom:**
  Density ≥ 10,000 units/mL
  (AND/OR)
  Biovolume ≥ 5,000 mm3/m3
- **Cyanobacterial Bloom:**
  Algal bloom where cyanobacteria comprise the dominant algal group. Some species of cyanobacteria have the ability to produce toxins that may cause illness in people and pets.

2.

Reporting

a. NC DEQ Algal Bloom Map - The NC Division of Water Resources is updating this map. The current online version is several years out-of-date but still provides numerous historical examples of HABs and algal blooms in the state's water bodies [20]
b. To report a potential HAB, go to DWR Citizen Report [21]
c. National water quality data can be found on the National Water Quality Monitoring Portal [22]

[19] *NC DWR Intensive Survey Branch Standard Operating Procedures Manual: Algal Bloom and Cyanotoxin Field Collection, January 2020 Version 1.0, available at: https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ECO/algae/Algal-Bloom-Field-Collecton-Method-FINAL-6.15.20.pdf*
[20] *NC DWR Fish Kill and Algal Bloom Report Dashboard, available at: https://ncdenr.maps.arcgis.com/apps/dashboards/7543be4dc8194e6e9c215079d976e716*
[21] *NC DWR Citizen Report, available at: https://survey123.arcgis.com/share/c23ba14c74bb47f3a8aa895f1d976f0d?portalUrl=https://ncdenr.maps.arcgis.com*
[22] *USGS et al., Water Quality Data Home (2020), available at: https://www.waterqualitydata.us/ [last accessed 27 April 2021].*

7 Communicating Risks Associated with HABs to the Public

In assessing and communicating the risk posed by HABs, it is important to understand the magnitude, duration, and frequency of the algal blooms. Identifying the species of algae or cyanobacteria and testing for cyanotoxins associated with that species is critical for determining the relative risk to human health and the environment. Unfortunately, most state and local environmental and public health agencies lack the capacity and resources to test for cyanotoxins; currently, the state of North Carolina only has the capacity to test for microcystins.

Once a bloom with the potential to produce cyanotoxins has been identified, it is important for clean water advocates to encourage state and local authorities to test for cyanotoxins to determine if hazardous conditions exist. In the absence of definitive data, and to err on the side of caution, once a cyanobacterial bloom has been positively identified, the public should be made aware of its presence and instructed to take the necessary precautions to avoid unnecessary exposure to humans and pets. If cyanobacteria known to produce toxins have been detected, state and local authorities should assume it is producing toxins and consider monitoring for changes in toxicity levels over time.

EPA compiled a list of best practices for Communicating About Cyanobacterial Blooms and Toxins in Recreational Waters to assist state and local governments in responding to HABs and informing the public about the relative risks.[23]

In 2019, the agency also published recommended recreational ambient water quality criteria reflecting the latest scientific knowledge on the potential human health effects from recreational exposure to these two cyanotoxins:

- Microcystins Concentration: 8 ug/L
- Cylindrospermopsin Concentration: 15 ug/L.[24]

The World Health Organization recommends evaluation of cyanobacteria cell counts to inform swim advisories.[25] Cyanobacteria cell count action levels recommended by the WHO are as follows:

- Exceedance of 20,000 cyanobacteria cells/mL or chlorophyll-a levels of 10 microgram/L—Public Health Advisory issued in the affected area

- Exceedance of 100,000 cyanobacteria cells/mL or chlorophyll-a levels 50 micrograms/L—Advisory against contact issued in the affected area

WHO equates the second level with a projected microcystin level of 20 micrograms/L, which exceeds the recommended levels for safe recreational use.

Several states use a tiered system for assessing and evaluating HABs, including what and when they communicate to the public. For more information on that approach, please see Appendix 1.

[23] US EPA, Communicating about Cyanobacterial Blooms and Toxins in Recreational Waters (2020), available at: https://www.epa.gov/cyanohabs/communicating-about-cyanobacterial-blooms-and-toxins-recreational-waters [last accessed 27 April 2021].
[24] US EPA, Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin (2019), available at: https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf [last accessed 27 April 2021].
[25] WHO, Chorus, I., & Bartram, J. (Eds.), Toxic Cyanobacteria in Water: A Guide to Their Public Health Consequences, Monitoring and Management (1999); World Health Organization, Guidelines for Safe Recreational Water Environments (2003), (Vol. 1, pp. 149–152).

CASE STUDIES

A

Case Study: Lake Erie

Lake Erie is home to one of the nation's largest and well-documented recurring algal blooms. Fertilizer, animal waste, and leaking septic systems contribute massive amounts of nutrients to the lake each year. This bloom grabbed national attention in 2014 when a HAB poisoned the drinking water for 400,000 Toledo residents for three days.

In response, Ohio, Michigan, and Ontario committed to a 40% reduction of phosphorus, the limiting nutrient, by 2025. In 2018, Ohio added Lake Erie to its Clean Water Act section 303(d) list of impaired waters. A total maximum daily load (TMDL) is currently in development. Toledo citizens also voted to create a Bill of Rights for the lake. However, this was challenged by agricultural interests and declared unconstitutional. There are many organizations, including Lake Erie Waterkeeper, working to protect this watershed.

B

Case Study: Cape Fear River - Lock and Dam 1

Throughout the summers of 2009-2012 and 2014, the Cape Fear River in North Carolina experienced harmful Microcystis blooms on lower sections of the river. Nutrient loading, slow flow, and elevated water temperature provided optimal conditions for the formation and growth of the blooms.

The harmful algal blooms were documented throughout lower sections of the river, with primary concern placed on blooms occurring at the drinking water intake at Lock and Dam 1 in Riegelwood, NC. This intake provides water for three counties, New Hanover, Brunswick, and Pender counties. Elevated levels of toxic microcystins were documented at Lock and Dam 1. Ozonation and carbon filtration were successful at treating contaminated water at additional expenses for municipalities.

C

Case Study: Chowan River and Albemarle Sound

During the summer of 2019, officials with the North Carolina Department of Health and Human Services issued warnings urging the public to stay out of the Chowan River near Indian Creek due to high levels of cyanotoxins. Test results indicated this HAB was producing microcystins at greater than 620 micrograms/liter, which state officials considered extremely high risk for acute health effects during recreational exposure based on studies and recommendations from the World Health Organization. State health officials said exposure could result in skin irritation and respiratory problems to people and animals that came into contact with the bloom or ingested untreated water containing the cyanotoxins. State health officials noted that because the toxicity of HABs can change rapidly over time and with location, it is best to stay away from the blooms altogether.

Also during the late summer of 2019, officials with the NC Division of Water Resources urged the public to avoid contact with blue-green water in the Albemarle Sound and adjoining water bodies due to the presence of a HAB that had lingered since May of that year. State officials identified the cause of the HAB to be Dolichospermum, a type of cyanobacteria known to produce cyanotoxins.

While no adverse human health impacts have been identified with either of these cases, state officials urged the public not to come into contact with the HAB and to prevent pets and children from swimming or ingesting water in the vicinity of the HAB.

8 Policy Recommendations

To address ongoing concerns about the proliferation of HABs in North Carolina's rivers and lakes, state and federal elected officials and agencies should pursue the following policies:

1. Sampling of cyanobacteria and cyanotoxins where indicated due to past occurrences, taking into account species of cyanobacteria, density, size, and toxicity levels.
2. Establish waterbody specific chlorophyll-a standards as an indicator of excess nutrients and potential HAB occurrences in High Rock Lake.
3. NC Environmental Management Commission should adopt the 2019 EPA-recommended cyanotoxin ambient water-quality criteria for recreational use.
4. Establish statewide water-quality standards for nutrients (nitrogen and phosphorus) and develop management strategies tied to watershed-wide reductions in nonpoint and point source nutrient pollution.
5. Improve communications between state departments and local agencies in defining and responding to HABs and increase funding for NCDEQ (including regional offices), NC DHHS, and county health departments to monitor, sample, and assess HABs and cyanotoxins, and notify the public with swim advisories when needed.
6. Increase funding for implementing agricultural best management practices, stormwater management, and stream restoration.
7. More research and development on the fate and transport of cyanotoxins produced by HABs and their correlation with hypoxia and low dissolved oxygen.

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WARNIN
BLUE-GREEN ALGAE MAY BE PRESENT IN THIS POND
KEEP OUT OF THE WATER
UNSAFE FOR PEOPLE AND PETS

Conclusion

Harmful algal blooms are clearly an emerging threat to North Carolina's rivers and lakes. State regulatory agencies are beginning to address the problem and have developed standard operating procedures for identifying and sampling algal blooms and cyanotoxins, but have limited capacity to respond to potential HAB reports.[26] The NC Division of Water Resources Ecosystem Branch is updating the agency's on-line algal bloom reporting system and is continuing to refine its approach to responding to potential HABs, particularly in the Chowan River and Albemarle Sound where high levels of cyanotoxins have been documented.

Waterkeeper groups across North Carolina will continue to work with the relevant state agencies to assist them in identifying and monitoring HABs and other algal blooms that impact water quality. Given the potential for HABs to limit the recreational use of lakes and rivers and to increase drinking water costs, it is imperative to focus public attention and resources on the existence and causes of HABs to avoid potential negative impacts on public health and local economies.

Implementing the policy recommendations in this report will help the state develop a comprehensive response to HABs and lay the groundwork for a monitoring program and regulatory framework that protects public health and ensures the safety of our state's water resources. This document also provides information that can be used by Waterkeeper groups and other water-quality advocates to make the public more aware of the causes and impacts of HABs.

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[26] *NCDEQ Water Sciences Section of the Division of Water Resources, Standard Operating Procedures Manual: Algal Blooms and Cyanotoxins-Field Collection (2020).*

Reference Links and Additional Resources

- » NCDEQ 2020 Standard Operating Procedures: Algal Blooms and Cyanotoxins-Field Collection, https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/ECO/algae/Algal-Bloom-Field-Collecton-Method-FINAL-6.15.20.pdf
- » Document: Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin, https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf
- » 2019 Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin, https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-factsheet-2019.pdf
- » 2019 EPA Recommendations for Cyanobacteria and Cyanotoxin Monitoring In Recreational Waters, https://www.epa.gov/sites/production/files/2019-09/documents/recommend-cyano-rec-water-2019-update.pdf
- » 2017 EPA Guidelines and Recommendations for HABs, https://19january2017snapshot.epa.gov/nutrient-policy-data/guidelines-and-recommendations_.html
- » 2016 Draft Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin, https://www.epa.gov/sites/production/files/2016-12/documents/draft-hh-rec-ambient-water-swimming-document.pdf
- » Cyanobacteria and Known Toxins Chart, https://www.ccamp.net/Swamp/images/4/49/Cyanobacteria_and_Known_Toxins_Chart.pdf
- » Harmful Algal Blooms and Hypoxia Comprehensive Research Plan and Action Strategy: An Interagency Report, https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/final_habs_hypoxia_research_plan_and_action.pdf
- » Cyanobacterial Harmful Algae Blooms (CyanoHABs) in Waterbodies, https://www.epa.gov/cyanohabs
- » Cyanobacteria Assessment Network Mobile Application (CyAN app), https://www.epa.gov/water-research/cyanobacteria-assessment-network-mobile-application-cyan-app
- » Catawba Blog, https://www.catawbariverkeeper.org/2019/08/15/algae-update/
- » EWG August 2019 article, https://www.ewg.org/interactive-maps/2019_microcystin/
- » Cyanobacteria and Known Toxins Chart, http://www.ccamp.net/Swamp/images/4/49/Cyanobacteria_and_Known_Toxins_Chart.pdf
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Appendix I

HAB Identification, Testing, and Public Advisory Recommendations

Proposed Tiered System for Public Advisories

1. Identification of a Cyanobacterial Harmful Algal Bloom
    a. Water discoloration (bright green, blue, red, or brown)
    b. Floating or submerged scum visible in waterbody
    c. Odor
    d. If a potential HAB is confirmed through visual observation, relevant state and local officials should consider posting a general public health advisory to avoid contact with the bloom in the affected area
    e. State authorities should sample the waters and determine the algal/cyanobacterial species present
    f. If the majority of the cells are found to be cyanobacteria, further testing for cyanotoxins associated with the cyanobacteria in the HAB should be conducted

2. Cell Count
    a. If cell count concentrations exceed 20,000 cyanobacteria cells/mL, toxin analysis is to be performed and the public health advisory is to remain posted
    b. Waterbody monitoring should continue until visual indicators of the bloom have dissipated and cell densities fall below 20,000 cyanobacteria cells/mL (NCDEQ Standard Operating Procedures, January 2020)

3. Toxin Analyses
    a. Toxin analysis performed on bloom in affected areas
    b. If cyanotoxin levels exceed recommended EPA guidelines for cyanotoxin concentrations of 8 ug/L for microcystin and/or 15 ug/L for cylindrospermopsin, an advisory against contact is to be posted in the affected area by the relevant state and local agencies
    c. Closure of affected area if elevated levels are noted
    d. Sampling is to occur in 7-10 day periods if bloom is still visibly present. Re-sampling is to occur when visible bloom diminishes

4. Testing Frequency
    a. Due to the nature of cyanobacteria, frequent testing is to be performed on affected water bodies
    b. Sampling is to occur in 7-10 day periods using cell counts or toxin analyses

5. Advisory Lifting
    a. Advisory may be lifted after two representative sampling rounds of affected areas at least 7-10-days apart that show toxin levels below recommended thresholds
    b. Public Advisory/Closure active until subsequent sampling results over two 7-10 day periods demonstrate toxin concentration or cell counts below the recommended thresholds

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