Status of Harmful Algal Blooms in Kansas Lakes and Reservoirs

Why are Harmful Algal Blooms a problem for Kansas?

Lakes and reservoirs in Kansas play a vital role in providing water to many communities. Protecting these water bodies from contamination is essential to ensure clean and safe water for everyone. Harmful algal blooms can cause serious environmental and health concerns. In Kansas, most harmful algal blooms are made up of cyanobacteria, which can release toxins that are harmful to humans, wildlife, and livestock, and can disrupt local ecosystems (Grattan et al., 2016). Addressing harmful blooms in a timely manner is critical for maintaining public health, protecting aquatic life, and ensuring economic stability in industries dependent on water quality, such as agriculture and tourism in Kansas.

What is a Harmful Algal Bloom, or HAB?

Harmful algal blooms (HABs) occur when there is a rapid increase in dense and floating phytoplankton that contains cyanobacteria, commonly known as blue-green algae (Figure 1). These blooms often include potentially toxic bacteria, such as from the genera *Microcystis* and *Dolichospermum*. HABs are primarily driven by an excess of nutrients, especially nitrogen and phosphorus, entering water bodies through runoff from agricultural and urban areas. These blooms develop under conditions of high nutrient levels, warm temperatures, stagnant or slow-moving water, and plenty of sunlight. The timing of HABs often coincides with periods of warm weather when people engage in outdoor activities, particularly around recreational water bodies, making people more susceptible to exposure to toxins.

Algal blooms can produce toxins that affect human health or cause various detrimental effects such as oxygen depletion and fish kills, as shown in Figure 2. People who swim in or drink water contaminated with algal toxins can experience stomach pain, nausea, and other more serious health issues. Coming into direct contact with the toxins can lead to asthma and skin irritations, while swallowing them can cause vomiting, muscle weakness, and, in rare cases, death. Additionally, HABs produce substances that make raw drinking water taste and smell earthy or musty, leading to many customer complaints about water utilities. All of the issues associated with HABs can be costly both for recreational areas and water utilities.

HAB Advisories

Since 2010, the Kansas Department of Health and Environment (KDHE) has been monitoring HABs through its HAB Response Program (KDHE, 2024), which focuses on public waterbodies in Kansas during the water recreation season (April 1 to October 31). This response-based program collects data on the occurrences of HABs based on complaints and

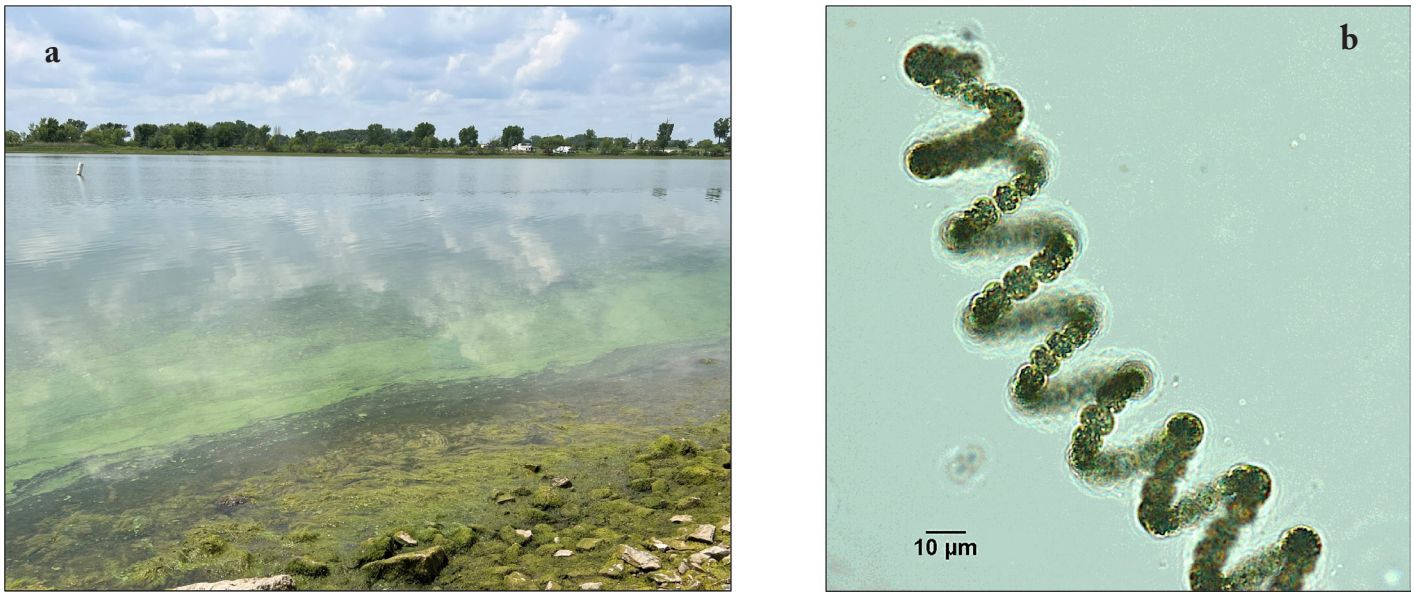

Figure 1. (a) Scum of blue green algae in Marion reservoir during a HAB event in 2023 (Source: Laura Krueger). (b) Microscopic view of Cyanobacteria (Source: Masa Zupancic).

information received from the general public, lake managers, and program partners. Water samples are collected from reported water bodies and tested for blue-green algae cells and concentrations of microcystin, a commonly detected cyanotoxin in Kansas. Samples are usually taken from designated public access locations within the water body. If blue-green algae cell counts or microcystin concentrations exceed established thresholds, KDHE issues an advisory for the water body to communicate the level of severity of the potential bloom (Figure 3).

KDHE provides a map of current lake advisories at *https://maps.kdhe.state.ks.us/habkscounty/* as well as a listing at *https://www.kdhe.ks.gov/777/Harmful-Algal-Blooms*. They also work with lake managing authorities at affected waterbodies to post appropriate advisory signage during the water recreation season. Although advisory thresholds have changed several times since the HAB response program began, cyanobacteria cell counts and microcystin toxin concentrations remain the primary determinants of advisory levels.

Status of HABs in Kansas

Both large and small waterbodies in Kansas have experienced HAB events in the past (Figure 4). Since 2010, HAB advisories have been issued for 165 waterbodies in Kansas, including 21 federal reservoirs. Out of all water bodies, Marion Reservoir in Marion County had the highest frequency of HAB reports, with advisories issued in 13 out of 14 years (all but 2018). Milford Reservoir in Clay County and South Park Lake in Johnson County followed with 11 years of reported advisories. The year 2021 had 48 affected water bodies, which was the highest number of affected water bodies in the record. A number of public water bodies in Kansas have not reported or confirmed HAB. Private water bodies are outside the scope of KDHE's HAB response program and are not considered herein.

Indicator	WATCH	WARNING	HAZARD
	Harmful Algal Bloom is possible and may be present	Harmful Algal Bloom is Expected or present	Harmful Algal Bloom is present and extreme conditions exist
Blue-green cell counts (cells/ml)	80,000	250,000	10,000,000
Microcystin toxin level (µg/L	4	8	2,000
Visual identification	Visual confirmation	Major blue-green algae scum	N/A

Figure 3. Three types of lake HAB advisories issued in 2024 by KDHE (adapted from KDHE, 2024).

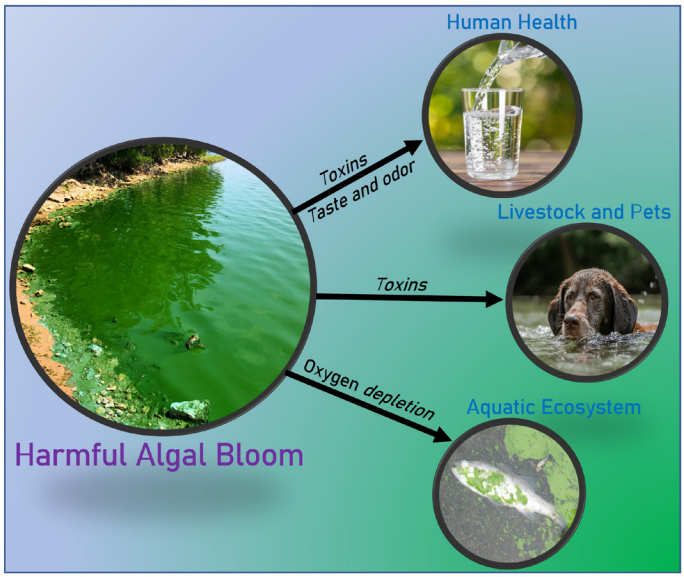

Figure 2. Diagram showing the impacts of HABs on human health, animals (livestock, pets), and aquatic ecosystem.

Water Sample Data in Five High Priority Reservoirs

KDHE collected and tested more than 3,000 water samples from 2010 to 2023 from various lakes and reservoirs throughout Kansas. The five lakes with the most water samples tested were Milford Lake in Clay County, Marion Reservoir in Marion County, Webster Lake in Rooks County, Lovewell Lake in Jewell County, and Lake Afton in Sedgwick County (KDHE, 2024). According to the current advisory guidelines in Figure 3, 22% of all samples resulted in 'Watch,' 34% in 'Warning,' and 12% in 'Hazard' advisories. Cyanobacteria or toxin concentrations fell below designated thresholds for advisories in 32% of samples and no action was taken. As expected, there was a strong positive correlation between blue-green algae cell count and mycrocystin toxin concentration measured in this set of five water bodies.

Milford Lake had the highest number of samples tested (n=594) since 2010 (Figure 5), and it is classified as impaired and hypereutrophic due to excessive nutrient loading, particularly from biologically available forms of phosphorus (Leiker et al., 2021). Marion Reservoir had the highest percentage of samples that exceeded the advisory threshold of 'Hazard,' at 2.3% of the samples tested (see Figure 1a for a picture of contaminated water during a HAB event in the summer of 2023).

The blue-green algae cell count data from all samples was aggregated monthly as shown in Figure 6. The highest median algae count was observed in April, but with a relatively small sample size (n = 15) due to only a few bloom events reported. KDHE sampling intensity is adjusted on the basis of the observed concentration of algae, with more frequent sampling in areas or periods where algae concentrations are high, and less frequent sampling when concentrations are low. This, coupled with the smaller number of samples in April, may explain the elevated median value. From May through October, the data show consistently high algae counts, with many outliers exceeding the hazard threshold.

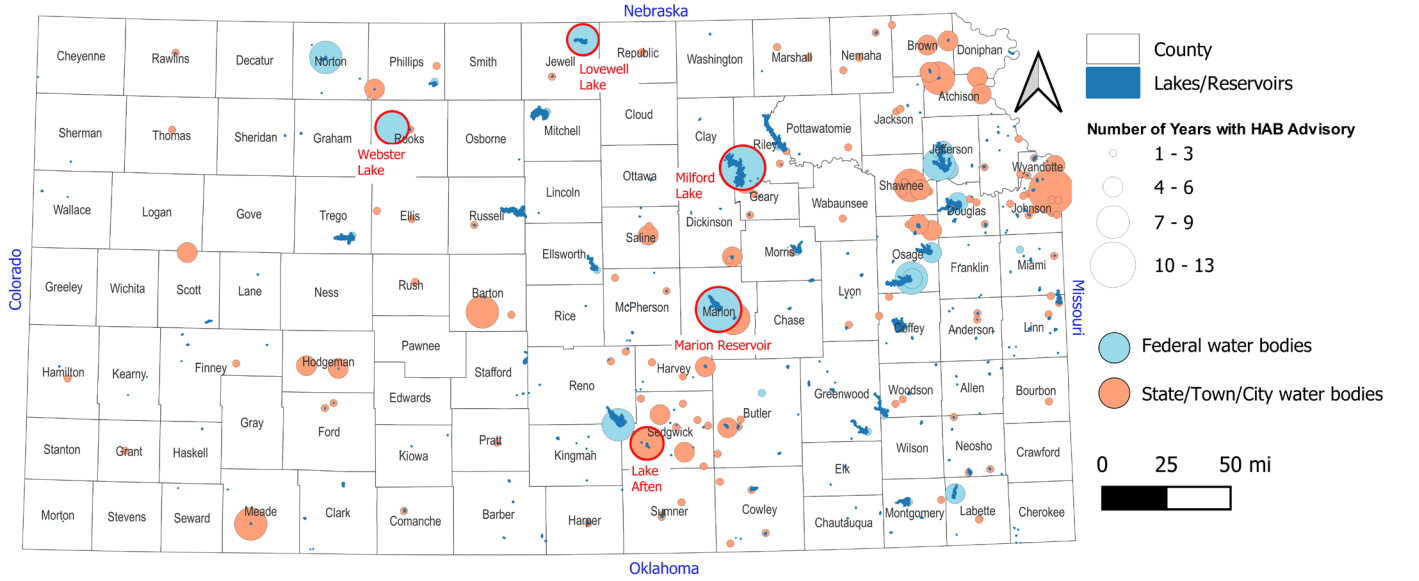

Figure 4. Map of HAB-affected water bodies and frequency of HAB occurrences in Kansas from 2010 to 2023 (14 years). Original data compiled from KDHE [weblink: https://maps.kdhe.state.ks.us/habresultspublic/]. This assessment is based on the current HAB advisory thresholds (Figure 3).

Human and Animal Exposure

Cases of human exposure to HABs in Kansas are presented from 2018 to 2023 in Figure 7 (next page). The cases were categorized into suspect, probable, and confirmed cases. No confirmed cases of exposure were recorded. Although some potential cases of human exposure are documented due to the severity of the effect, there are likely many other cases that were not reported. Cases of animal exposure were not considered in this analysis, as they are often underreported because such incidents are not classified as diseases that must be reported (Steve Ensley, Personal Communication, 5/7/2024).

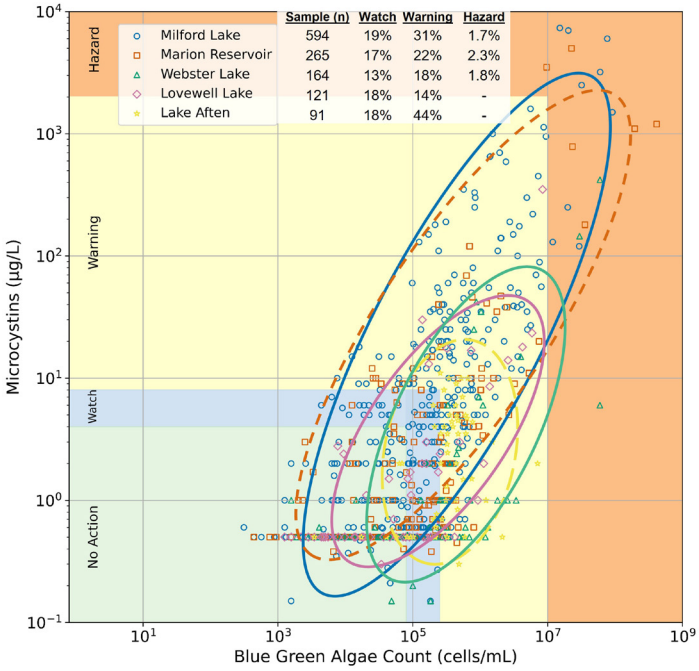

Figure 5. Blue Green Algae and toxin concentrations in the five most frequently sampled public water bodies in Kansas. Original data source – KDHE (same data used as in Figure 4).

HAB Mitigation Actions

Harmful algal blooms have increasingly affected freshwater bodies, with numerous incidences and exposure cases reported in Kansas. By understanding the causes of HABs and how excess nutrient loading from human activities contributes to their growth, proactive steps can be employed to reduce the occurrence and harmful effects. Effective mitigation includes smart fertilizer use, proper maintenance of septic systems, and supporting statewide efforts to protect water quality. In addition to these actions, various in-lake treatment methods can directly target and minimize blooms. Increasing water flushing and enhanced mixing dilute nutrient concentrations and oxygenate water bodies, making them less hospitable for algae (Anderson et al., 2017). Ultrasonic treatments and chemical controls target algal cells, inhibiting bloom formation, while sediment dredging removes nutrient-laden sediments to prevent future blooms (Paerl et al., 2016). Combining these community-based and technical approaches can significantly reduce HAB occurrences and help keep Kansas' waters safe and

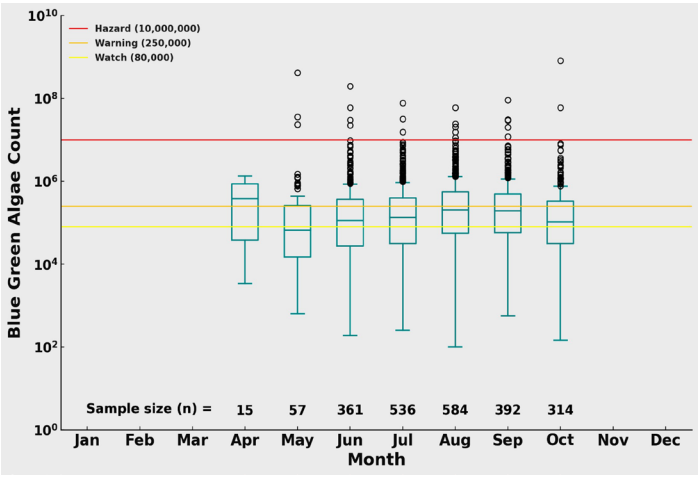

Figure 6. Monthly variation of the Blue Green Algae count in statewide lake monitoring data from 2010 to 2023. Original data source – KDHE (same data as in Figure 4).

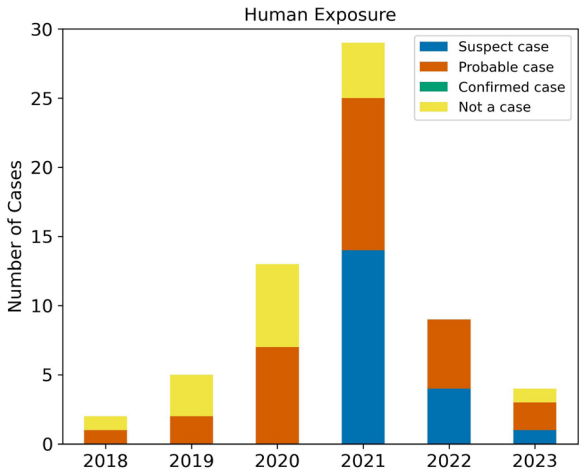

Figure 7. Cases of human exposure to HABs in Kansas. Original data source: KDHE (web link: https://storymaps.arcgis.com/stories/c070c80592934730834c194280300ecb).

clean. Protecting our water from algal blooms helps ensure safe and enjoyable waterways for everyone.

Reporting HABs

To report a HAB in a public waterbody or a health incident potentially caused by exposure to HAB, visit the website of the KDHE's HAB program (*https://www.kdhe.ks.gov/777/Harmful-Algal-Blooms*) and use the following links to submit a report.

Human illness reports can be submitted at:
https://www.kdhe.ks.gov/FormCenter/Epi-Public-Health-Informatics-11/Human-AlgaeRelated-Illness-Submission-Fo-99

Animal illness reports can be submitted at:
https://www.kdhe.ks.gov/FormCenter/Epi-Public-Health-Informatics-11/Animal-AlgaeRelated-Illness-Submission-F-100

Water testing for private lakes/reservoirs is available at K-State's Veterinary Diagnostic Laboratory: *https://vetview2.vet.k-state.edu/DLABPortal/catalogSearch.zul*

Additional resources related to HABs can be found in the Small Business Environmental Assistance Program of the Pollution Prevention Institute at K-State: *https://www.sbeap.org/water-quality/harmful-algal-blooms*

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