Yahara Lakes Water Quality Monitoring

2019 Results

Overview

From May to September, volunteers at piers and beaches around the five Yahara lakes measured near-shore water clarity, air and water temperature, and noted several visual observations. Visual observations included presence of algal blooms (green/cyanobacteria), floating plant debris, swimmers, waterfowl, wave intensity, and general water appearance. Volunteers were asked to log condition reports at a twice weekly minimum on our website, Lakeforecast.org, where all data are updated in real time.

Highlights

- 71 near-shore and 7 offshore monitoring stations on all five Yahara lakes (Figure 1)
- Weekly off-shore measurement of Secchi depth on all five lakes
- Measured temperature and dissolved oxygen profiles on all five lakes (seven sites total)
- All 25 public beaches are monitored twice a week
- Collected continuous near-shore temperature measurements at 15 sites on lakes Mendota, Monona, Waubesa, and Kegonsa
- Continued microcystin testing at James Madison Park, in partnership with UW-Engineering
- Continued weekly Weekend Lake Reports with over 61,100 views on social media

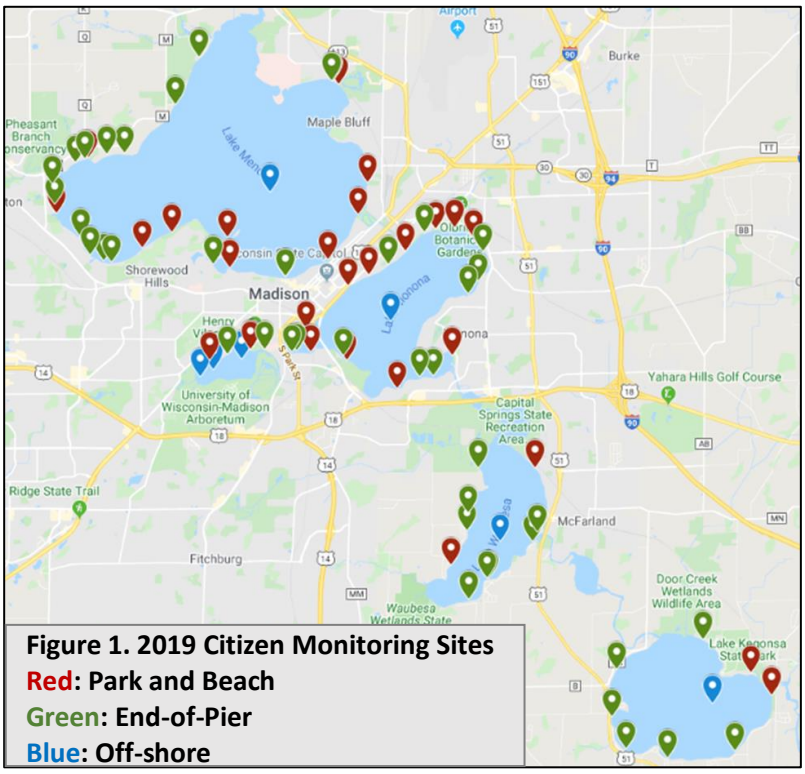


Figure 1. 2019 Citizen Monitoring Sites
Red: Park and Beach
Green: End-of-Pier
Blue: Off-shore

Table 1. Program overview by year.

Parameter	2013	2014	2015	2016	2017	2018	2019
Monitoring Stations	10	46	58	79	69	79	78
Volunteers	9	43	57	68	73	87	67
Volunteer Hours	224	446	463	610	550	732	501
Condition Reports	204	945	1,258	1,720	1,989	2,686	2,005

Rainfall

6 of the top 10 highest yearly precipitation totals on record have occurred in the last 13 years. (Source: Dane County Airport)

The last two years exhibited rainfall patterns that exceeded the Normal (average from 1981-2010) which is consistent with recent trends of greater rainfall frequency and intensity. Based on gauge data from the Dane County Airport, the greater Madison area experienced a lower total amount of precipitation in the summer of 2019 compared to the summer of 2018 (Figure 2). The decrease in rainfall was seen mostly in late spring and late summer. Only the months of July and September experienced greater accumulation than 2018. The month of August 2019 observed a total precipitation of 2.85 in. in stark contrast to the 10.40 in. observed in August 2018. This is certainly a reflection of the historic flooding events Madison endured in the summer of 2018.

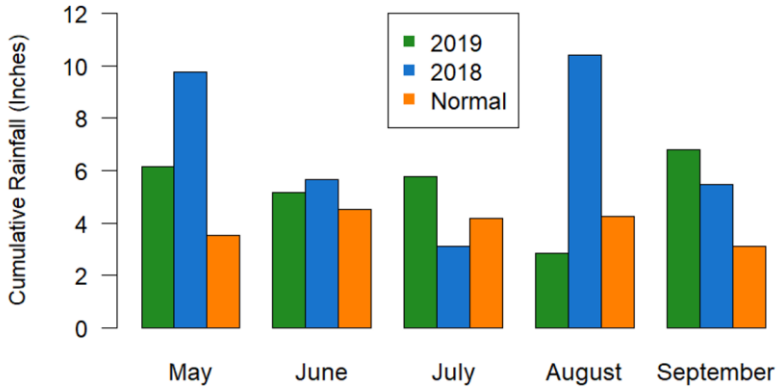


Figure 2. Rainfall totals depicted for 2019, 2018, and Normal

Lake Ice

The winter preceding the monitoring season (2018-2019) was slightly warmer with Lake Mendota freezing for 86 days in comparison to the winter of 2017-2018 with Lake Mendota freezing for 94 days. Additionally, both Lake Mendota and Lake Monona opened for approximately two and a half weeks starting in December of 2018 while neither lake opened throughout the winter of 2017-2018. Ice conditions are an excellent indicator of winter severity.

Algal Blooms

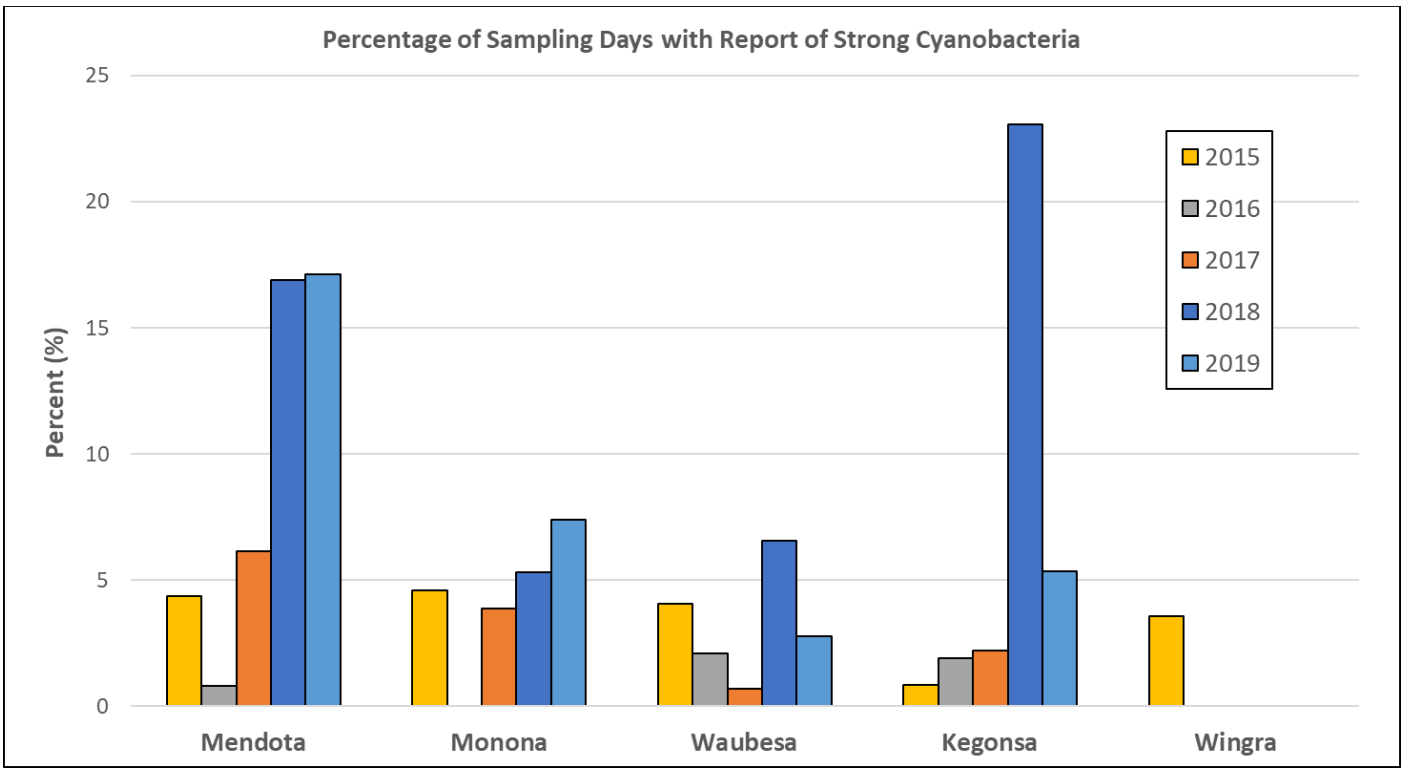
When documenting cyanobacteria reports, we continued to use the same method utilized in 2018. Instead of a simple count of all reports, the number of days when a strong cyanobacteria bloom was summarized for each lake. By comparing the number of 'algal days' to the total number of unique sampling days for each lake, we can generate a percentage that better represents the number of blooms witnessed each year (Figure 3). This method eliminates over reporting in situations when different monitors report the same algal bloom.

Compared to 2018, monitors reported more "strong" cyanobacteria blooms on lakes Mendota and Monona. Lake Kegonsa reports returned to a more expected total after the drastic increase witnessed in 2018. Lake Waubesa also reported fewer blooms, and Wingra continued to have no reports of "strong" cyanobacteria blooms. Cyanobacteria blooms were reported fairly consistently across each month of monitoring (Table 2). Unlike previous years, monitors reported significantly more blooms in September, primarily on Lake Mendota where 9 blooms were documented. This may be a result of increased monitoring activity later into the season. However, as predicted by limnologists, we may be seeing blooms later into the year as climate patterns shift in the Greater Madison area. In fact, an early December bloom was spotted on Lake Mendota this year.

Table 2: Number of days with one or more reports of strong cyanobacteria blooms each month across all lakes

Month	2015	2016	2017	2018	2019
May	0	0	0	0	0
June	11	5	10	33	12
July	4	1	12	18	6
August	2	0	2	23	13
September	0	0	0	0	13

Figure 3. Percentage of all unique sampling days with one or more reports of a strong cyanobacteria bloom.



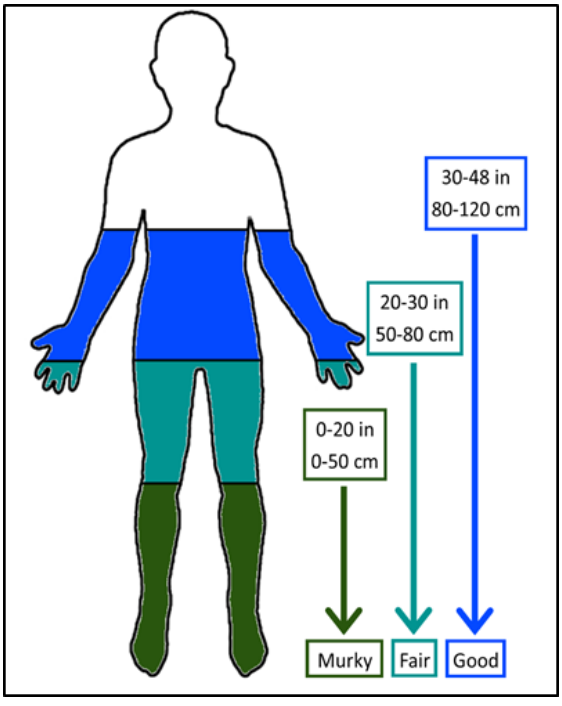
Clarity

Clarity readings averaged across each lake suggest a general decline in nearshore water clarity when compared to last year (Table 3). In fact, none of the lakes achieved a 100 cm average clarity, a first since the program was established in 2014. Increased rainfall frequency and intensity generate more overland flow throughout the watershed, resulting in a net influx of suspended solids and nutrients. Only Lake Kegonsa reported a small increase in average water clarity. Late season clarity readings tend to improve due to reduced rainfall and decreased biotic activity (Figure 4). This phenomenon is evident, however, the improvement in clarity was mitigated by the particularly low clarity witnessed in August. The trend is clearly depicted in Figure 3 for Lakes Monona, Waubesa, Wingra, and Kegonsa.

Table 3: Average clarity on each lake since 2015 (cm as measured by turbidity tube)

Lake	2015	2016	2017	2018	2019
Mendota	84.7	95.6	89.5	94.9	93.2
Monona	94.3	100.4	103.1	101.7	84.6
Wingra	107.3	101.9	71.4	82.1	74.3
Waubesa	90.2	94.4	96.6	99.4	85.1
Kegonsa	85.7	77.4	85.7	78.6	84.6

Figure 5. At what depths can you see your toes? We created this human representation to help visualize how a lake's water clarity conditions relate to measurements on a turbidity tube.



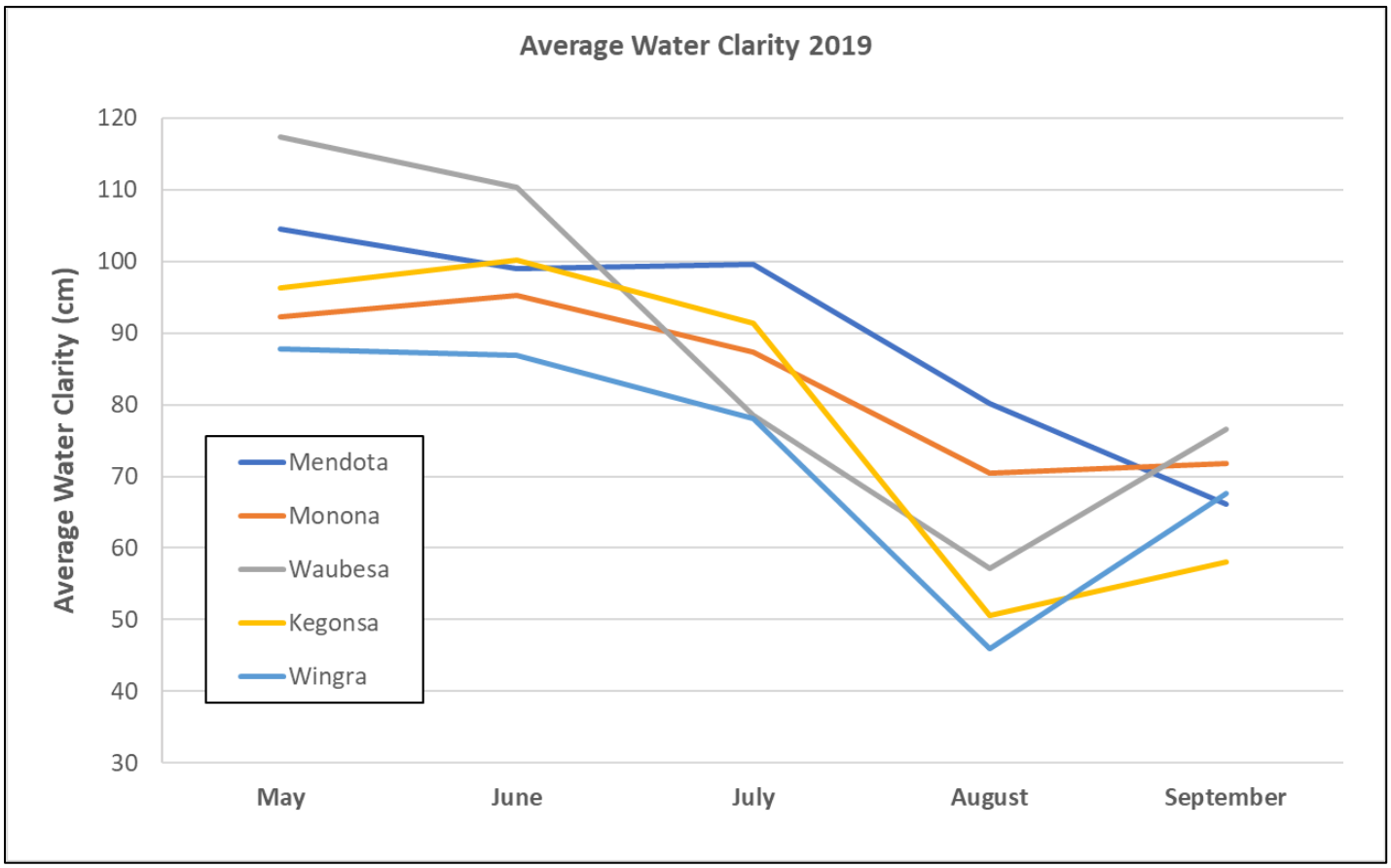
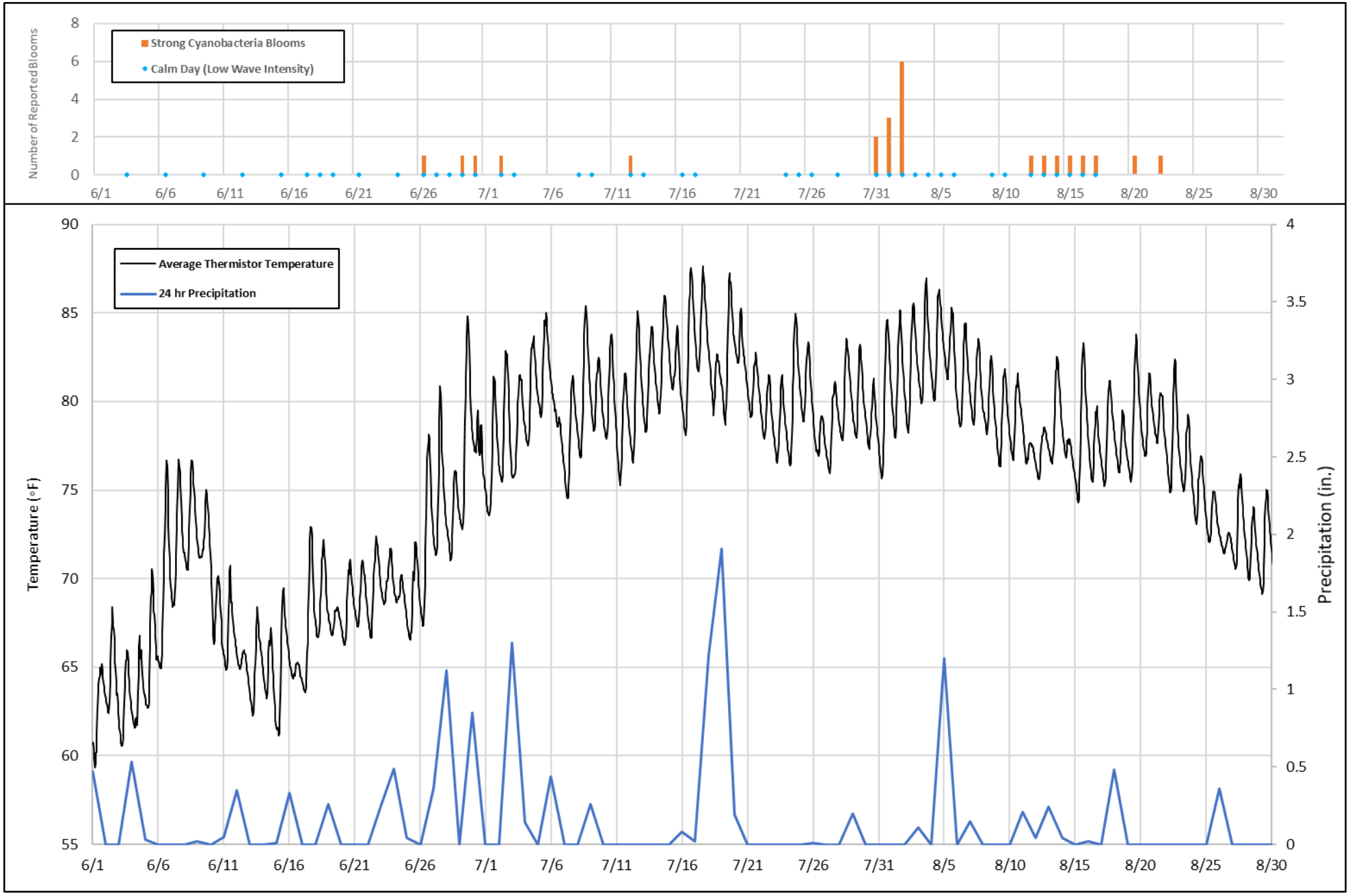


Figure 4. 2019 Average water clarity by month for each lake. 120 cm is the maximum clarity reading measured by the turbidity tube.

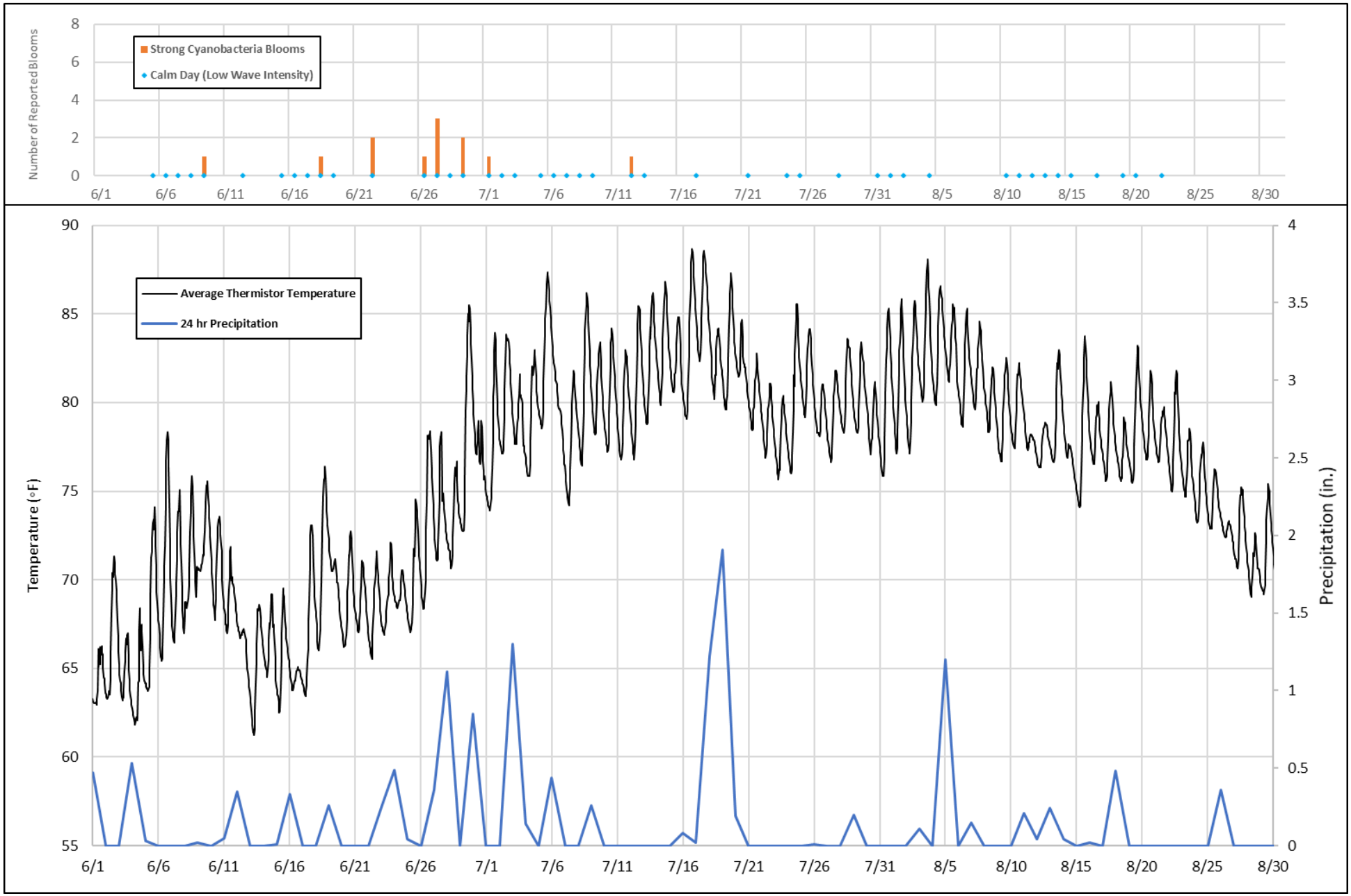
Lake Summaries

The following charts depict a summary of conditions from June 1st to August 31st on each lake. The bottom portion of the chart displays the average temperature of all hourly thermistor readings on each lake. This provides a generalized nearshore temperature profile for the monitoring season. Additionally, the 24-hr precipitation totals are overlain and are represented by the blue line. The rainfall totals were recorded at the Dane County Regional Airport and obtained from the National Oceanic and Atmospheric Administration (NOAA). The upper portion depicts all reports of "strong" cyanobacteria blooms, and the blue dot represents a calm day, a typical condition advantageous for surface algae accumulation. Each graph aids in visualizing the dynamic interactions between precipitation, temperature, wind conditions, and cyanobacteria growth. For example, on Lake Mendota around July 31st, we experienced moderate rainfall followed by increased temperatures and minimal wind. Shortly after monitors reported strong cyanobacteria blooms with more blooms being reported the next two days. While there are additional examples of this phenomenon occurring on the other lakes, it is important to note that cyanobacteria growth is not driven by the simple cause and effect of three variables. The Yahara Lakes are part of a dynamic ecosystem consisting of urban and rural inputs, complicated by a changing climate and invasive species. Volunteer monitoring data will continue to be an important part of data driven decision making.

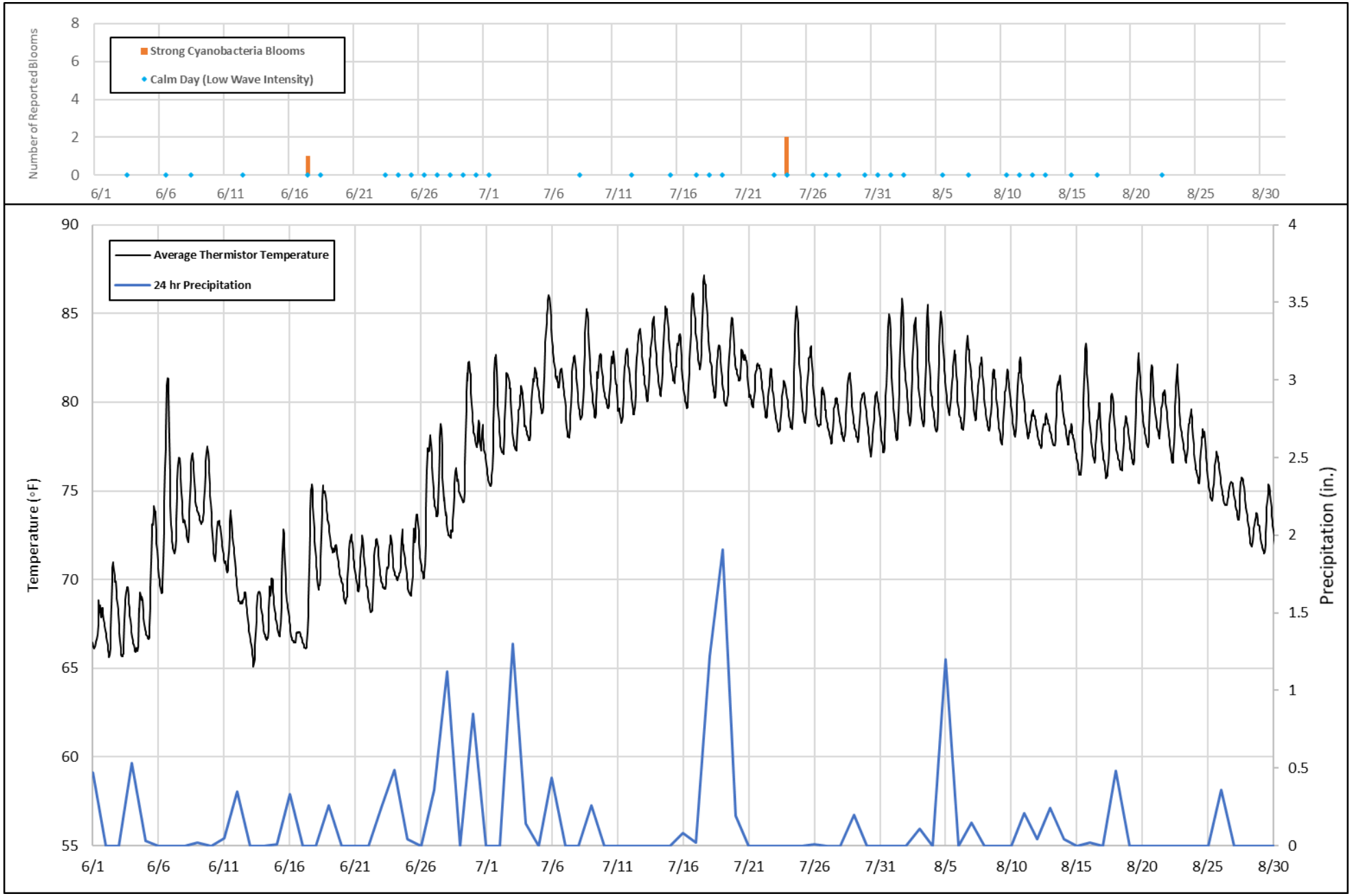
Lake Mendota Summary



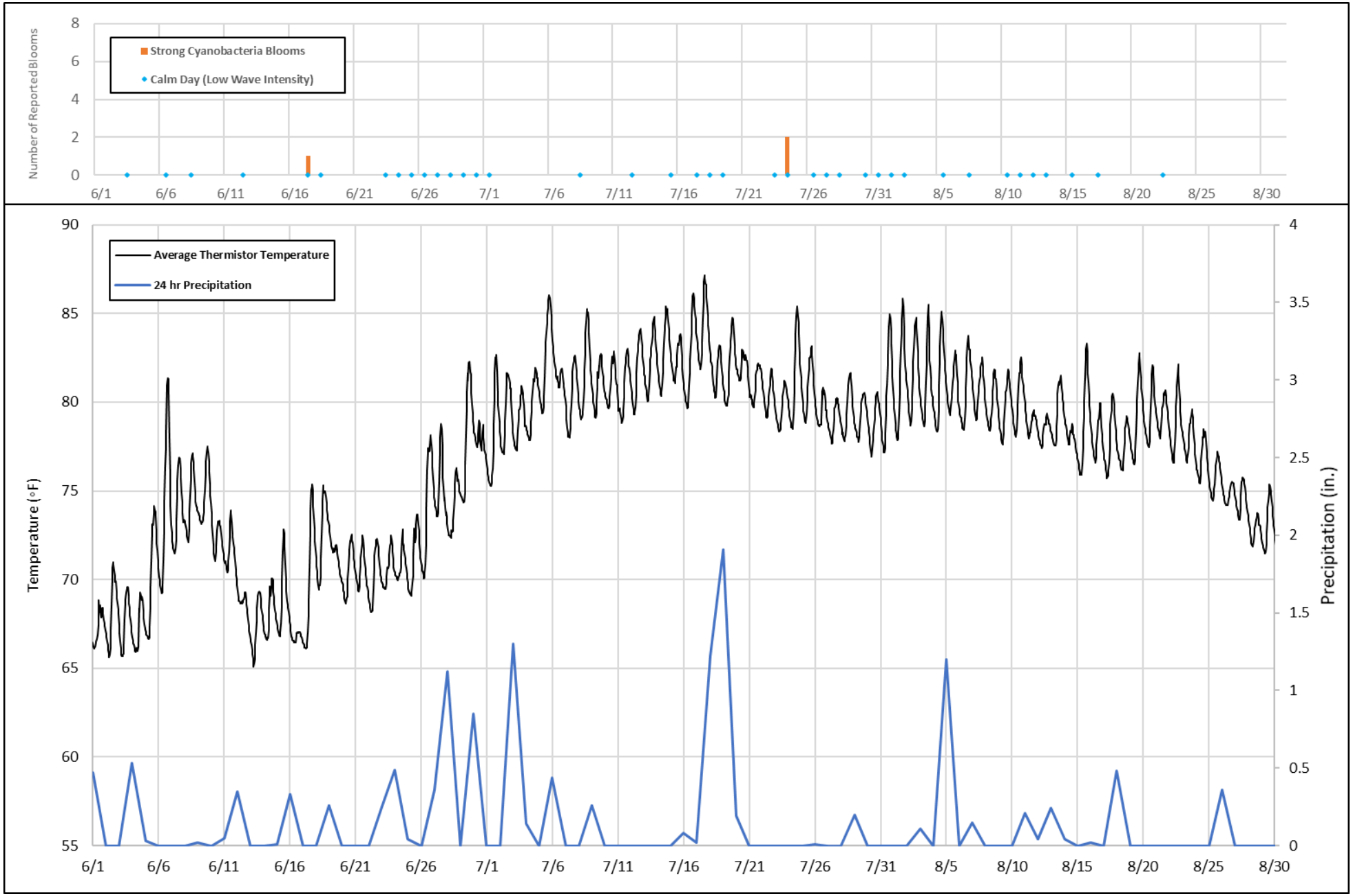
Lake Monona Summary



Lake Waubesa Summary



Lake Kegonsa Summary



Turbidity, Clarity, and Total Suspended Solids (TSS)

Parameters	Clarity	Turbidity	Total Suspended Solids (TSS)
Definition	How far light can pass through the water column.	Measure of the degree to which water loses its transparency.	Particles that are larger than 2 microns found in the water column.
Comments	Turbidity and clarity are directly related. In fact, turbidity is a measure of water clarity. *High turbidity = Low clarity* *Low turbidity = High clarity*		While TSS affect turbidity, turbidity is not a direct measurement of TSS.
What is measured?	Organic and inorganic suspended solids, like clay, silt, sediment, algae, and bacteria + Dissolved colored materials (smaller than 2 microns)		Organic and inorganic suspended solids + Settleable solids (Solids that are moved along the bottom of a body of water by strong flow)
How is it measured?	<u>Direct measurement</u>: Turbidimeter or Turbidity Sensor <u>Indirect measurement</u>: Secchi disk or Turbidity Tube Indirect methods are quick and inexpensive but are dependent on the visual acuity of the observer		To measure TSS, a water sample is filtered, dried, and weighed.