

Report to Town of White Lake May, 2021

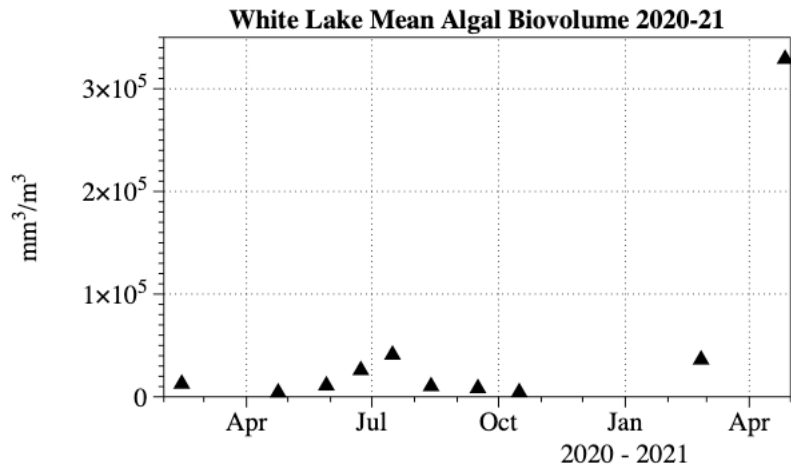
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LIMNOSCIENCES

Monthly Rainfall (inches) for White Lake 2012-2021

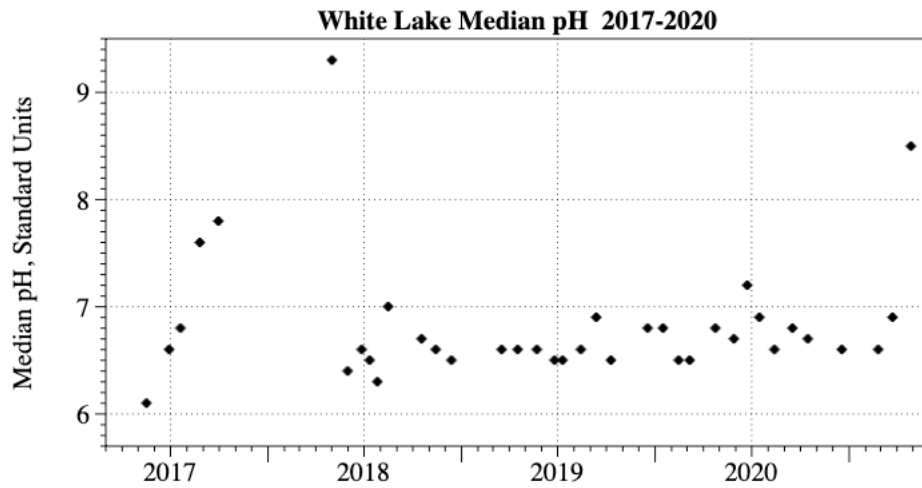
| Month | 2021 | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | Monthly Average for Region |
|-------------------------|------|-------|-------|-------|------|-------|-------|------|-------|-------|----------------------------|
| January | 8.25 | 4.5 | 2.75 | 4.20 | 7.0 | 3.0 | 2.5 | 2.0 | 1.75 | 2.75 | 3.81 |
| February | 9.2 | 6.7 | 2.25 | 2.00 | 1.5 | 10.7 | 5.5 | 1.5 | 2.5 | 4.0 | 3.44 |
| March | 2.7 | 3.7 | 3.25 | 3.95 | 3.7 | 1.55 | 4.15 | ND | 1.0 | 7.0 | 3.91 |
| April | 1.75 | 5.1 | 7.25 | 6.75 | 6.75 | 6.75 | 4.55 | ND | 1.75 | 2.25 | 3.12 |
| May | | 12.25 | 1.20 | 7.70 | 2.7 | 4.5 | 4.20 | ND | 2.25 | 9.25 | 3.67 |
| June | | 7.15 | 5.25 | 10.00 | 4.5 | 3.65 | 8.70 | 3.0 | 17.0 | 2.0 | 4.70 |
| July | | 6.85 | 6.00 | 4.75 | 6.75 | 3.75 | 3.0 | 4.65 | 11.25 | 8.6 | 5.75 |
| August | | 7.55 | 5.35 | 6.25 | 5.6 | 4.12 | 9.4 | 9.75 | 8.25 | 9.75 | 5.95 |
| September | | 5.95 | 5.00 | 29.45 | 5.2 | 15.0 | 4.7 | 7.0 | 1.0 | 5.0 | 5.29 |
| October | | 3.35 | 3.60 | 2.25 | 2.95 | 14.25 | 9.75 | 1.7 | 1.75 | 2.25 | 3.38 |
| November | | 7.5 | 4.90 | 4.25 | 1.0 | 0.50 | 7.25 | 4.15 | 0 | 2.25 | 3.16 |
| December | | 4.25 | 6.00 | 7.5 | 5.45 | 5.1 | 6.5 | 3.7 | 5.75 | 4.25 | 3.14 |
| Total | | 74.85 | 52.80 | 89.05 | 53.1 | 72.87 | 70.20 | | 54.25 | 59.35 | 49.32 |
| % of Lake Volume | | 97 | 69 | 116 | 69 | 95 | 91 | | 70 | 77 | 64 |

There was a single rainfall event in the month of April, and the lake level dropped 3.6”, resulting in an elevation of 64.6 feet NAVD 88 at the end of the month.

The data in the first graph below are preliminary but show the trend of greatly increased algal biovolume over a two-month period (Feb-Apr). Thanks to data sharing by DEQ, we now know that it is the same algal taxon (a very small single-celled desmid [this group of algae is characteristic of White Lake]) that was responsible for the bloom in July 2013, which occurred after multiple extreme rainfall events in June-July of that year. Very small algae have the ability to respond quickly to the nutrients found in the rainfall, as they have a relatively large surface area to volume ratio.



Two +3" rains in February 2021
Cosmarium tinctum bloom
 10x increase in biovolume from Feb-Apr



1.5-unit increase in pH and 12° F increase water temp in 5 weeks (Mar-April)
 (*Cosmarium* bloom in July 2013 increased pH 2 units, from 6 to 8, in 4 weeks)

What is different now compared with July 2013? There are good indications that the tiny animals that graze on phytoplankton have become well-established, so they can respond relatively quickly to the increased food supply.

Lake Ecosystems:

Nutrients fuel algae and plant growth, which is consumed by grazers such as zooplankton, aquatic insects and small fish, and these small things are consumed by larger fish (predators).

Another way of looking at it:

Primary *producers* (algae and aquatic plants) are *nutrient managers*, and *consumers* (zooplankton in particular) are *managing the producers*.

The algae that dominated in 2017 and 2018 (filamentous cyanobacteria) were not a preferred food for the tiny grazers, while the algae dominant now (and in the 2013 bloom) are. The types of algae dominant now are considered to be characteristic of low-nutrient, acidic systems, and the phytoplankton community can be considered to be natural and quite unique.

What to Know About White Lake

It is small and shallow so can change relatively quickly

Source water = rainfall



Recent rainfall pH change = +1 unit
Normal lake pH now 6-7

Water chemistry does not provide a buffer against pH change
Algae blooms can increase pH up to 2 units

Nutrients

Total Phosphorus levels similar to historic values

At low pH and high pH, phosphorus from sediments can be released = internal P loading, which can sustain algae blooms

At pH range 6-8, P is bound (not available to algae) to naturally-occurring aluminum in sediments

Aluminum also found in groundwater and acidic swamp water

Total Nitrogen levels much higher now
Same for other Bay Lakes

Rainfall is the primary source of nitrogen

Five-fold increase in ammonia deposition, which can be rapidly utilized by algae



Big rains more frequent due to climate change

Algae blooms can result from big rains