Citizen-Led Environmental Observatory
At Lake Lillinonah

2016 Annual Report

Prepared by

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under the supervision of Jen Klug

Questions/Comments?

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Acknowledgements

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2. Executive Summary

The Citizen-Led Environmental Observatory (CLEO) was established in 2006 to monitor water quality on Lake Lillinonah, an impoundment on the Housatonic River, located in western Connecticut. The goals of the program are to

1) Provide credible information on water quality conditions to state and local agencies

2) Educate the public on water quality issues

3) Build a constituency of involved "citizen scientists".

The purpose of this report is to present the data collected during the summer of 2016. A brief summary of water quality conditions is presented here in the executive summary. The methods of collecting and results involving the data are presented in the main body of the report.

Across all sites, water temperature followed a seasonal pattern with the water warming throughout the summer, peaking in late July to mid-August before beginning to decline. Most sites in 2016 had average secchi depths between 1-2.5 meters making most of the lake qualify as eutrophic, except at one site where it classifies as Late Mesotrophic. Recreation potential related to algae growth was higher in 2016 compared to 2015. In 2015, at all sites except Lover's Leap, recreation was impaired or impossible 20 to 45% of days depending on site. This is a large change from earlier years. In contrast, in 2016 the majority of days at all sites were recorded as being "beautiful" and only one site reported any days as having "recreation impossible due to algae." Surface algae varied greatly depending on the location in the lake. Percentage of days with surface algae varied from 1% to upwards of 50% depending on location.

Monitors observed more debris in 2016 than in 2015. The highest percentage of debris days observed was ~34%. Only one day was reported as being recreationally impaired by debris in the lake. Trash is a new variable which was introduced in 2014 so volunteers would be able to distinguish between manmade and natural debris. Thirty-three instances were reported as having some trash out of all five sites, compared to the five instances reported in 2015.

We recommend continued monitoring to track changes in water quality over time. Based on previous work on Lillinonah (Klug and Whitney 2015), we recommend stakeholders continue to emphasize the importance of decreasing nutrient loading from the upstream watershed. In addition, we recommend that stakeholders continue their outreach to lake users cautioning them to minimize contact with surface blooms of algae.

3. Introduction

Lake Lillinonah was created in 1955 as a result of the construction of the Shepaug Dam whose purpose was to pond water for hydroelectricity generation. Lake Lillinonah extends 12 miles in West Central Connecticut and is surrounded by six towns: Bridgewater, Brookfield, New Milford, Newtown, Roxbury and Southbury. Since its creation, Lake Lillinonah has been a eutrophic system, with high nitrogen and phosphorus concentration and large summer algal blooms (Klug and Whitney 2015). Lake Lillinonah's watershed is large and as such the point and non-point sources of nutrient input to the lake are numerous. Summer algal blooms can be severe enough to impair recreation and create an oxygen depleted environment in deeper parts of the lake. Additionally, there is increasing concern that secondary compounds produced by certain algal groups may pose a danger to dogs and humans using the lake (CTDPH and CTDEEP 2013).

The Citizen-Led Environmental Observatory (CLEO) was established in 2006 to monitor water quality in Lake Lillinonah. Friends of the Lake (FOTL), a non-profit organization along with faculty and students from Fairfield University's Biology Department jointly manage the monitoring program.

Friends of the Lake is a volunteer based organization that encourages "citizen scientists" to provide water quality information to state and local organizations and to educate the public. The primary goals of the organization are as follows;

1) To increase the recreation potential for those who use the lake
2) To work towards having the lake meet the standards of the Clean Water Act
3) To implement long-term environmental goals that protect the lake and its watershed.

FOTL works closely with many local and federal organizations including Lake Lillinonah Authority, CT Department of Energy and Environmental Protection, the Housatonic Valley Association, United States Geological Survey, Environmental Protection Agency, Global Lakes Observatory Network, First Light Power Resources and Federal Energy Regulatory Commission. Through these relationships, they hope to promote community awareness about lake pollution and debris issues. They welcome membership from those who are eager to help protect the lake. More information about Friends of the Lake can be found at www.friendsofthelake.org.

4. Methods

Volunteers collect data from dock locations on water temperature, secchi depth, water color, debris, recreation potential, trash, particle type and surface scum from Memorial Day through Labor Day. To facilitate comparison among sites and because values of many of the variables may change throughout the course of the day (e.g. temperature), data are collected between 3:00pm and 7:00pm. In addition, volunteers collect water samples for chemical analysis of total phosphorus, total nitrogen and algal toxin concentration. Detailed methods are presented in the individual variable sections. A copy of the data sheet used by volunteers is provided in Appendix A.

Volunteers are required to attend a training session each spring. In the classroom portion of the training session, volunteers are educated on proper technique for recording each measurement and on the basic ecological meaning behind each variable. In the field component of the training session, volunteers practice taking each measurement. In addition to the training program, program managers maintain contact with volunteers through email and occasional group meetings and presentations. Volunteers return their completed data sheets to Jen Klug via email, postal mail or in person. Fairfield University interns or research students enter the data and data analysis is completed by Fairfield University faculty and students. Results are compiled into an annual report and distributed to all interested parties.

For categorical variables (e.g. recreation potential, surface algae, color, debris, and trash) we calculate the % of total monitored days falling in each category. For continuous variables (e.g. secchi depth) we present an average and time series for each site. In addition, we use a trophic status rubric published by the Department of Energy and Environmental Protection (DEEP) to classify sites based on total nitrogen, total phosphorus and secchi depth (Table 1, CTDEP 1991). The DEEP categories are oligotrophic, early mesotrophic, mesotrophic, late mesotrophic, eutrophic and highly eutrophic and represent the degree to which a lake is impaired due to excessive nutrient loading and/or poor water clarity.
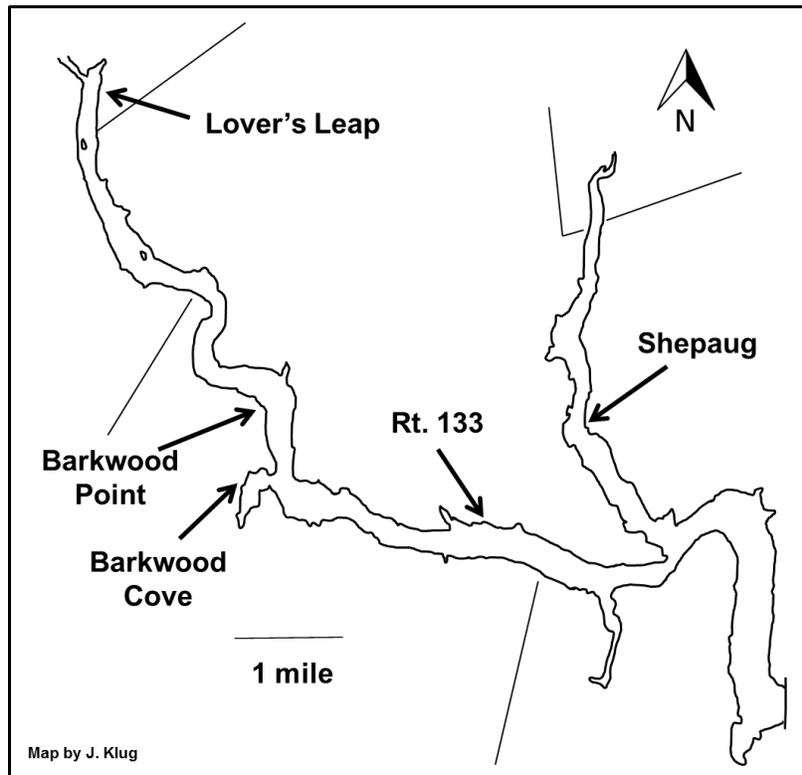

Figure 1: 2016 Site Locations on Lake Lillinonah

In 2016, there were five dock sites (Figure 1) on the lake and there were 1-3 volunteers at each dock. Data was recorded throughout the week. Some volunteers chose to record data more frequently and/or beyond the required Memorial Day through Labor Day timeframe. For the purpose of comparability across sites, summary data includes only the data collected from Memorial Day to Labor Day, May 30, 2016-September 5, 2016. The total number of days that data was collected at each site and the number of days that data was collected from Memorial Day to Labor Day is listed in Table 2. Water samples for nutrient concentration and algal toxin concentration were collected according to the schedule listed in Table 3.

Table 1: DEEP Water Quality Classification for Trophic Status

	Oligotrophic	Early Mesotrophic	Mesotrophic	Late Mesotrophic	Eutrophic	Highly Eutrophic
Secchi Depth (m)	>6	>4-6	>3-4	>2-3	>1-2	<1
Total Nitrogen (µg/L)	0-200	>200-300	>300-500	>500-600	>600-1000	>1000
Total Phosphorus (µg/L)	0-10	>10-15	>15-20	>25-30	>30-50	>50

Table 2: Number of Days Data was Collected and Number of Days from Memorial Day to Labor Day 2016

Site	Number of Days Data Collected	Number of Days Memorial Day-Labor Day
Barkwood Point	59	41
Rt 133	106	89
Shepaug	65	61
Barkwood Cove	43	39
Lover's Leap	34	31

Table 3: 2016 Water Sample Collection Dates.

Up to three extra toxin samples were collected during algal blooms.

Date	Nutrients	Toxins
May 28	X	X
June 11	X	X
June 25	X	X
July 9	X	X
July 23	X	X
August 6	X	X
August 20	X	X
September 3	X	X
September 17	X	X

5. Water Temperature

Water temperature in a lake is important in understanding the types of organisms that can survive, their biological activity and the amount of oxygen available (Dodds 2010). Predictable temperature changes occur at different depths of the lake, at different times of the day and at different times of the year. Water temperature is positively correlated to an increase in algal growth, as higher temperatures are optimal for algae growth. Related to this, water temperature affects the amount of oxygen that is available for organisms to use. As temperatures become warmer, the amount of available oxygen decreases because warm water holds less oxygen then cold water. Finally, temperature monitoring can be especially important in understanding the impact of storms and any other unusual weather patterns.

At the beginning of the summer, the volunteer tied the provided thermometer to the dock so that the bottom of the thermometer was 1 meter below the water. Throughout the summer, once a month, the volunteer checked the depth of the thermometer to make sure that it was still at 1 meter. When sampling, he or she pulled the thermometer up and recorded the temperature to the nearest 0.5 degree Celsius. The volunteer quickly recorded the reading because of the temperature change that occurs once the thermometer is taken out of water.

Water temperature peaked at all sites by mid-August and was in steady decline by the end of August (Figure 2). During the period from Memorial Day to Labor Day, the temperatures ranged from a minimum of 18℃ (at Lover's Leap and Rt. 133) to a maximum of 31℃ (at Lover's Leap).
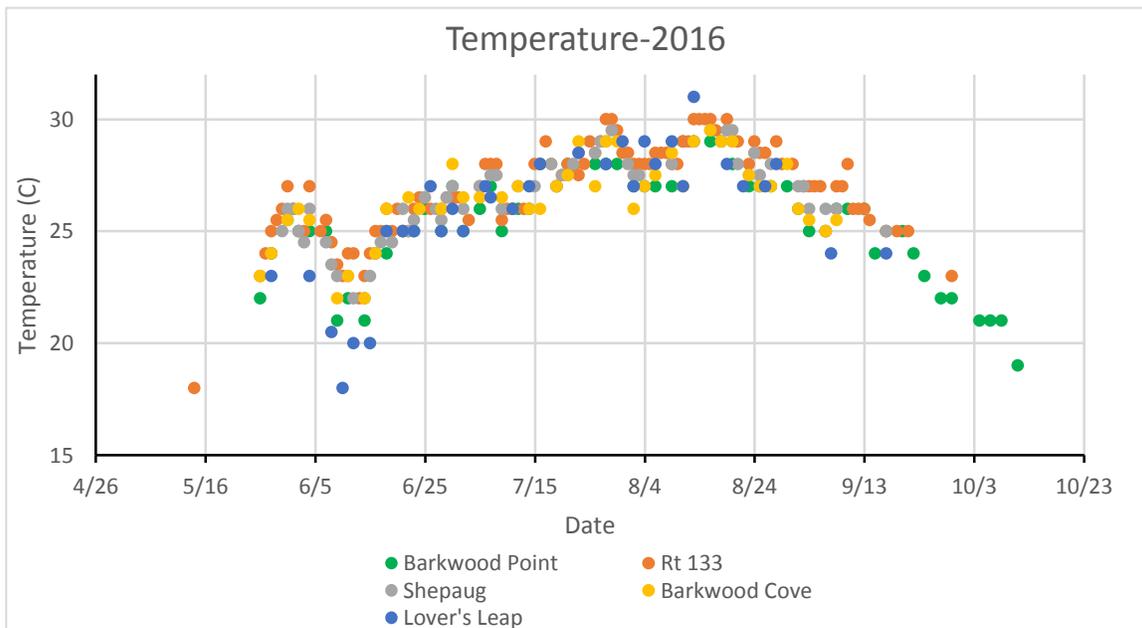

Figure 2: Water temperature across all sites

6. Secchi Disk Depth Monitoring

Secchi disk depth is a common measure of water clarity. It is directly related to the presence or absence of algae and other particles such as sediment. This is due to the fact that when light enters a lake, it can either be transmitted, absorbed or reflected. Light is reflected off and absorbed by particles and as the number of particles increases, less light will be transmitted (Dodds 2010). Consequently, a lake with more particles has lower secchi depth. Secchi depth can help interpret information regarding particle content and recreation potential. Additionally, water color can be important in determining if algae or silt is the main factor behind a lower secchi depth. Changes in secchi depth follow seasonal changes that are most closely coordinated with temperature and algal growth. Typically, as the weather gets warmer in the summer, secchi depth decreases. It is generally lowest in mid-summer and then slowly begins to increase in the fall.

When taking a reading, the volunteers stood on the dock and lowered the secchi disk over the shady side of the dock. They slowly lowered the secchi disk into the water until they could no longer see it (no white glow). They then lowered it a little further and raised it to the point of which the white just reappears. The disk was slowly pulled up and down until the exact disappearing point was reached. The volunteers leaned over to see the disk but did not kneel or sit until they were ready to mark the rope. They then used their fingers to pinch or clip a clothespin to the rope at the point at which the rope hits the water. They pulled the disk up and recorded the depth to the nearest ¼ meter. They also noted whether the secchi disk hit the bottom of the lake and what depth it hit.

In 2016, all of the sites, except for Shepaug, had average secchi depths between 1 and 2 meters classifying them as eutrophic (Figure 3). Shepaug had an average secchi depth of about 2.5 meters, classifying it as late mesotrophic.
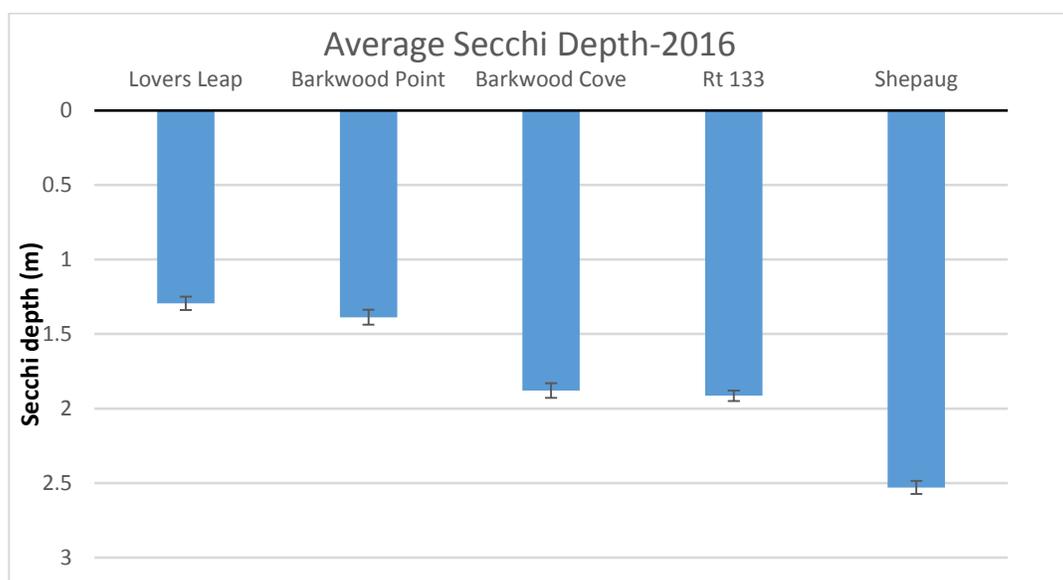

Figure 3: Average Secchi Depth across Sites

Figure 4 shows the time series of secchi depth at all sites. The distinct high values in late spring (early to mid June for 2016) correspond to the clear water phase, a seasonal marker characterized by low algal concentration due to high zooplankton abundance (Dodds 2012). In most years, Lover's Leap has the lowest water clarity and Shepaug has the highest water clarity throughout the year. This pattern was evident early in the year and continued through the majority of the summer, unlike past years.
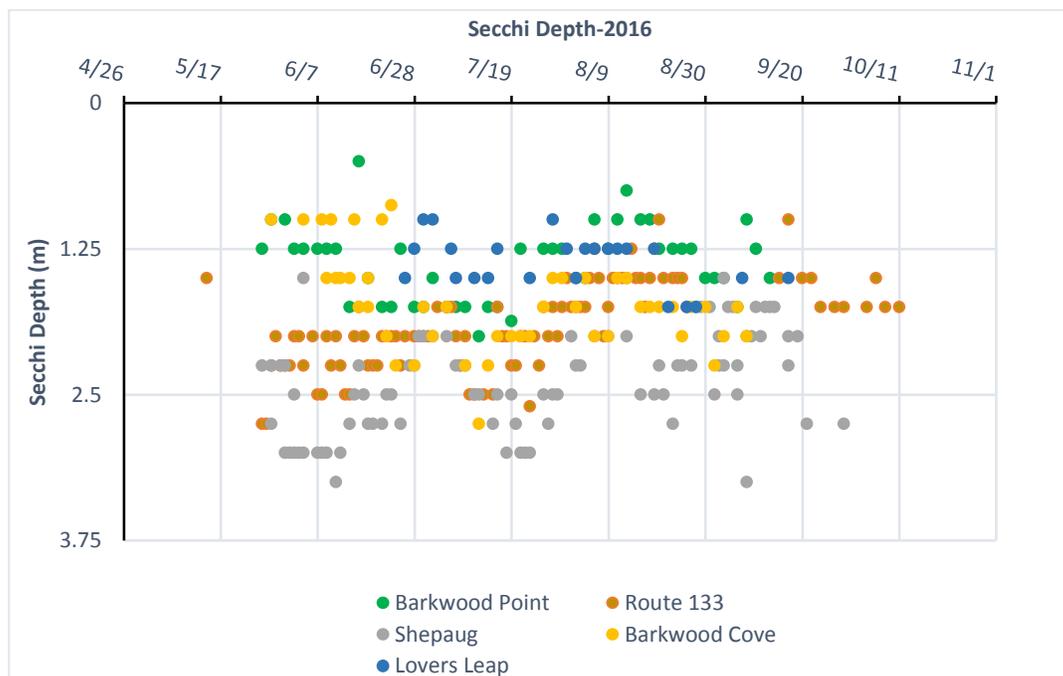

Figure 4: Secchi Depth over time

7. Debris Monitoring

The presence of large floating debris (trees, logs etc.) is a recurring problem in Lake Lillinonah. The debris poses a hazard to boaters and impairs recreation. Nonetheless, it can also provide shoreline habitat for many organisms, including fish (Dodds 2010). Floating debris is particularly prevalent during high water periods when wood floats off the shores or out of coves into the main channel of the lake. The purpose of debris monitoring is to observe the presence or absence of floating woody material at each sampling.

The volunteer looked around the general vicinity of the dock when judging the level of debris. They then used a rubric to classify the amount of debris present. The first category of the rubric says "No debris present". The second category says "Some debris present but not enough to affect boating". The third category says that water is "Boating impaired because of debris".

In Figure 5 we can see that for most sites, the majority of lake days were free in terms of debris. Barkwood Point reported the most days with debris

(~30%). Lover's Leap and Shepaug also reported a high amount of days with debris (~20%). This is a high amount of days with debris compared to 2015, where the sites with the most days were about 10%. Rt. 133 was the only site that reported any days of boating being impaired by debris.
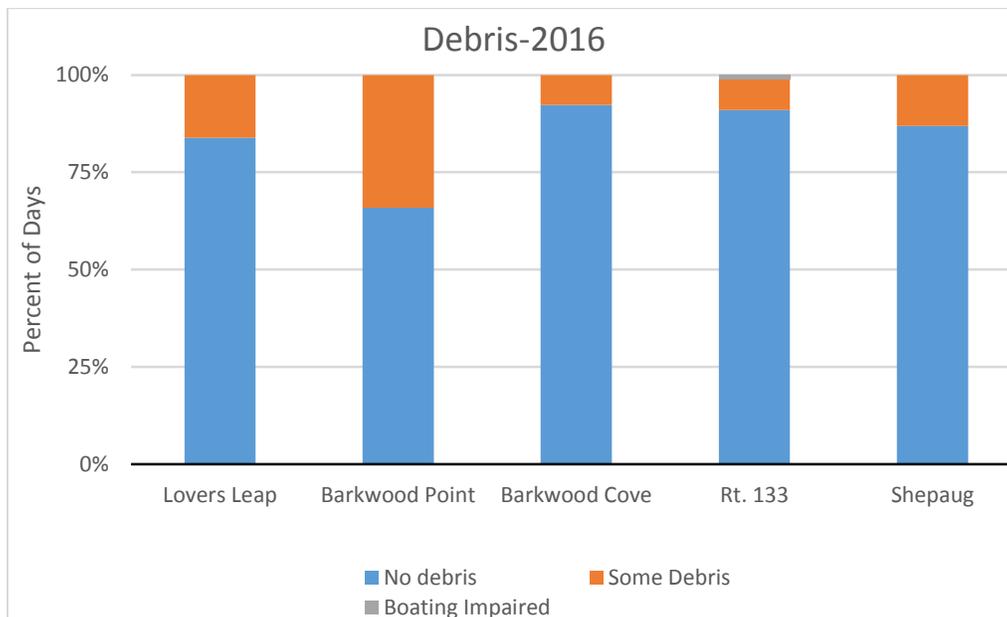

Figure 5: % of Days of Particular Debris Content from Memorial Day to Labor Day

8. Trash

This was the third year volunteers were asked to record observations of manmade trash on the lake. Volunteers were told to keep an eye out for bottles, tires, plastic bags etc. and to record their observations by putting either a 1, 2 or 3 in the trash column of their observations. The numbers respectively represent "no trash present", "some trash present but not enough to affect recreation" and "recreation impaired due to trash". There were 33 days throughout the summer months which reported trash presence, almost 6 times the amount of days reported in 2015. But, just as 2015, there were no days where recreation was impeded.

9. Water Color Monitoring

Water color can be an important indication of water quality and can be especially important in determining what is in the water. Water color is not definitive but gives us an idea of what types of materials may be in the water. Using a chart provided by the Colorado Volunteer Lake Monitoring Program, specific guidelines were utilized for matching a certain water color with a particular lake condition. For example, brown can indicate the presence of sediment or diatom algae and blue-green can indicate cyanobacteria. The color categories are brown, blue-green, green, yellow-green, light blue and clear. Light blue is indicative of certain types of sediment that are not typically seen in Lake Lillinonah. Water color

has been especially important in post-storm analysis where secchi depth was low due to sediment in the water column.

The volunteers recorded the water color and particle reading after taking the secchi depth reading. Using the same location that they took the secchi depth reading, they lowered the secchi disk into the water to one half of the secchi depth. E.g. If secchi depth is 1 meter, then the color reading was taken at 0.5 meters. This ensured that the color was observed at the same light level at each sampling period. They observed the water color against the white part of the disk and then chose the color on the color chart that most closely corresponded to the color observed. The volunteer kneeled or sat when taking the color and particle readings.

The color chart that the volunteers used has been widely used in other monitoring programs such as Colorado Volunteer Lake Monitoring Program. In this report however, we combined the green, blue-green and yellow-green categories into one general "green" category. The modification was used because difference in the shades of green may have been indistinguishable to some volunteers and we were most interested in whether the lake was green due to algae, brown due to sediment, or clear.

Green was the only color recorded across all sites, except Lover's Leap and Shepaug. This color is indicative of the presence of a diversity of algae. Shepaug and Lover's Leap both reported one brown day. The percentage of brown days at Lover's Leap more closely resembles the percentages reported in 2013 and 2012 than in 2014 and 2015. For example, in 2013 and 2012 this site reported 2.6% and ~3% brown days respectively while in 2015 and 2014 the site reported ~25% and ~40%. The frequency of brown days at Lover's Leap in 2014 and 2015 suggests that some of the days with low secchi depth in those years were caused by sediment in the water column rather than algae.
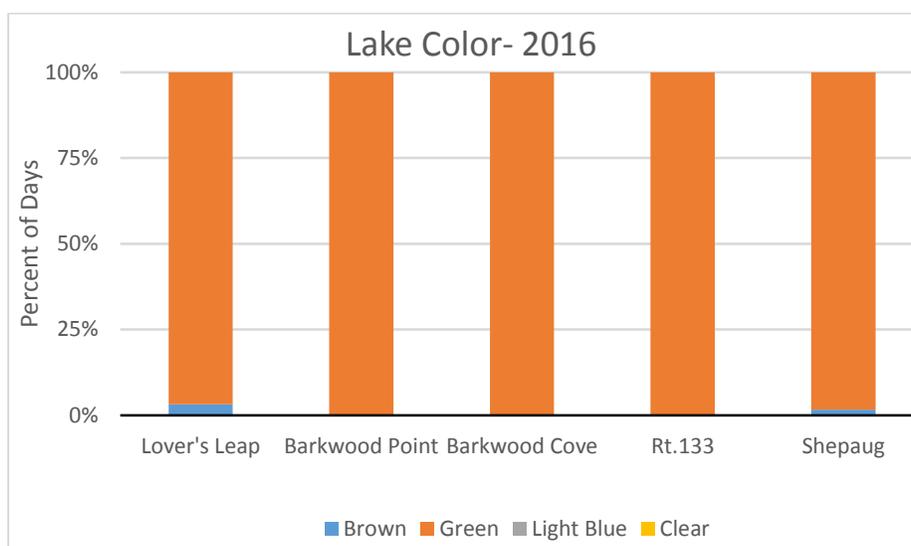

Figure 6: % of Days of Particular Color Across all Sites

10. Particle Monitoring

Particle type is important in knowing whether potential bloom forming algae are present and in what quantities. The assigned categories that volunteers could choose from were "none", "unidentified particles", "visible algae" and "algae bloom". The "none" category was chosen when the water had no visible particles. The "unidentified particle" category was chose when the volunteers could see particles but couldn't tell whether they were sediment or algae. The "visible algae" category was recorded when they could see particles that were distinctly green. Here, they determined that there were clear patches between the algal particles. The "algal bloom" category was chosen when they could see green particles and there were no clear spots between the clumps. The water is typically determined to be cloudy and has been described as looking like pea soup.

In determining the presence or absence of particles, the volunteer kept the secchi disk in the water at ½ secchi depth. They looked at the white part of the disk and noted whether they could see particles in the water. They then chose the value on the particle chart that most closely corresponded to the particles that were observed in the water.

Particles were noted in the water column on most days in 2016. Lover's Leap and Barkwood Cove were both sites where unknown particles were most common. Shepaug was the only site at which Visible algae was the most common particle type. In 2016, only Rt. 133 reported days with algal blooms, compared to the three sites that reported blooms in 2015.
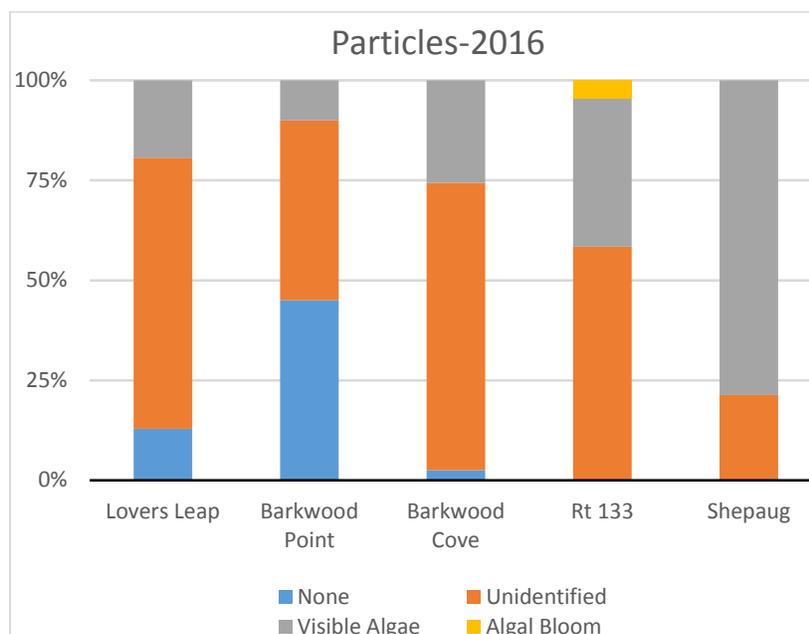

Figure 7: % of Days of Particular Particle Content Across all Sites

11. Recreation Potential Monitoring

Recreation potential relates lake conditions to the aesthetic qualities of the system and the ability of people to use the lake. Recreation potential of Lake Lillinonah is particularly important because the lake is highly utilized and enjoyed by both those that live on the lake and those that visit the area. Recreation potential is an important variable at Lake Lillinonah as it may either encourage or discourage boating, swimming and fishing. Recreation potential may be correlated with other variables, including algal levels and secchi depth. Documentation of poor recreation potential can be used to convince local officials that initiatives must be taken to better protect the lake and the people using it. Similarly, increased recreational use of the lake may subsequently lead to people having a greater incentive to protect the lake.

Recreation potential is based on the volunteer's opinion of general lake conditions with a specific focus on algal content. Four categories were established with the best possible recreation potential being "beautiful could not be better" (Smeltzer and Heiskary, 1990). From there the categories go from "minor aesthetic problems due to algae, still good for swimming and boating", "desire to swim and enjoyment of lake substantially reduced because of algae (boating still ok)" and "swimming and aesthetic enjoyment of lake nearly impossible because of algae". Recreation potential may be the most influential category concerning citizen's use of the lake.

Most sites had increased recreation potential compared with 2015. In 2016, the majority of days at all sites were recorded as being "beautiful" and only one site reported "recreation impossible". In contrast, in 2015 at all sites except Lover's Leap, recreation was impaired or impossible 20 to 45% of days depending on site.
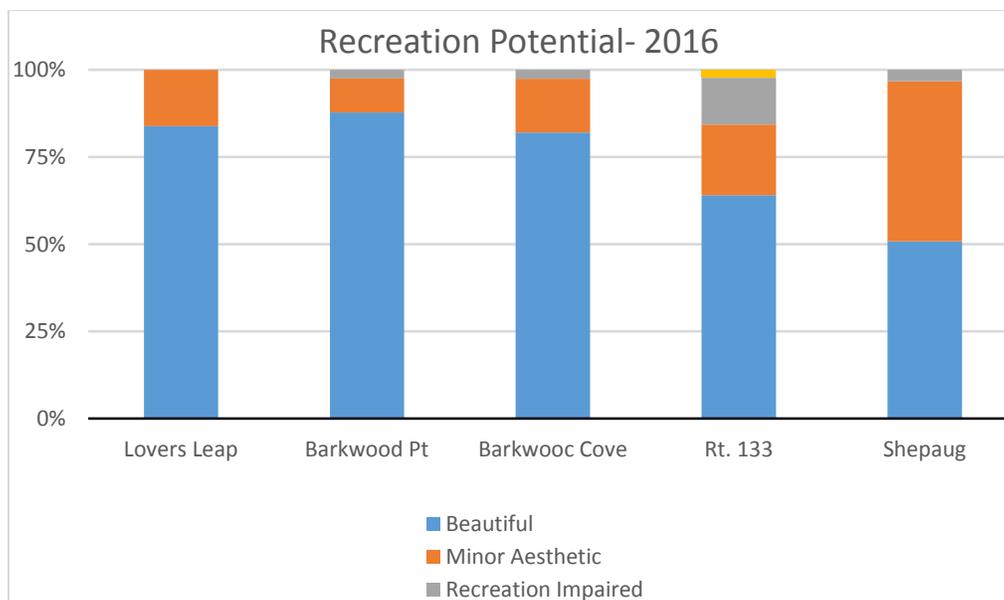

Figure 8: % of Days of Particular Recreation Potential Across all Sites

12. Surface Algae Monitoring

Algal scums represent a concentration of algae on the surface of water and may be indicative of high cyanobacteria concentrations. Scum is also related to weather as the presence of wind will cause the surface algae to mix more into the water column.

Volunteers observed the water surrounding their sample site and recorded what they saw. They knew that they may not see surface algae at the exact secchi depth location because they had disturbed that part of the water. They recorded that surface algae was present if they saw algae concentrated on the surface of the water in the general vicinity of their sampling site. They were given two categories to choose from. The first was "no algae concentrated on the surface of the water". The second was "algae concentrated on the surface of the water".

In 2016 (between Memorial Day to Labor Day), Lover's Leap and Rt. 133 had very few days with surface algae, as in 2015. The amount of days reported with surface algae decreased in 2016 at the rest of the sites.
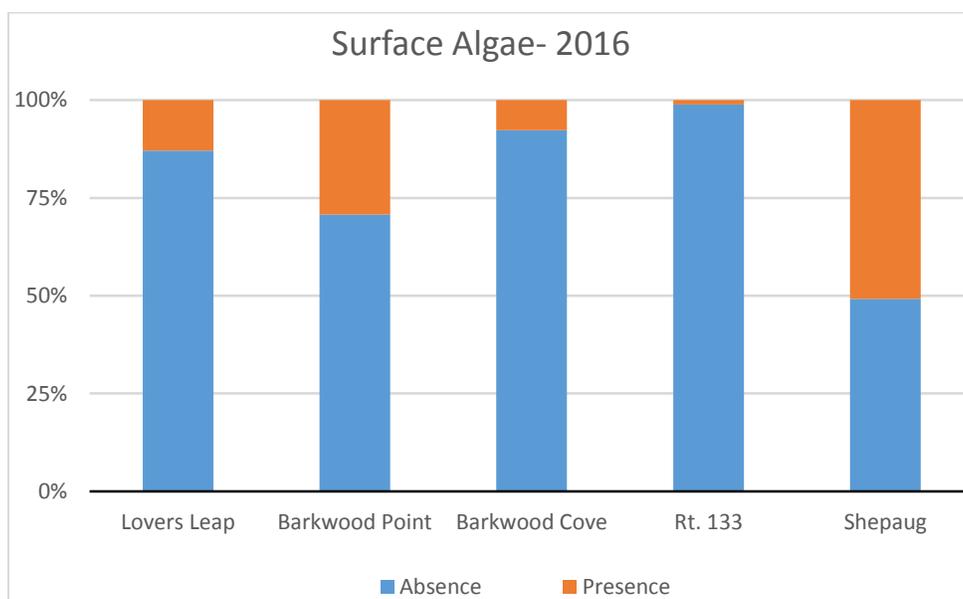

Figure 9: % of Days with Presence or Absence of Surface Algae Across all Sites

13. Nutrient Monitoring

Phosphorus and nitrogen are essential nutrients whose increased levels foster growth of plants and algae. As total phosphorus and total nitrogen levels increase, the presence of algal blooms also tends to increase. Lower secchi depth and thus lower water clarity, results from this increase in algal biomass. In many freshwater systems, phosphorus is considered the most important nutrient limiting algal growth but nitrogen also plays a role (Dodds 2010).

Nitrogen and phosphorus are transported to lakes from a variety of sources, including fertilizer runoff and wastewater treatment plants. Lake Lillinonah has a very large watershed and nutrients are collected from a large number of point and non-point sources. Understanding how nutrient concentration within the lake changes over time and across sites will help us evaluate how changes in watershed management have affected water quality.

Total phosphorus and total nitrogen concentration was measured at all sites. To collect nutrient samples, the volunteers were given bottles that were pre-labeled with date and location. They wrote the name of the collector with a permanent marker in the space provided. They then rinsed the bottle three times with lake water. From there, they submerged the bottle upside down until their wrist was in the water and then turned it right side up to fill it. They poured some of the water out until the bottle was 2/3 full and placed the bottles in the freezer. Samples were sent to the University of Connecticut's Center for Environmental Sciences and Engineering for analysis.

Nutrient concentrations are presented in two ways. Average (Memorial Day-Labor Day) concentrations are presented in the first graph whereas the second graph for each nutrient shows all data collected. Breaks in the line indicated dates for which no sample was collected for that particular site.

Average total nitrogen concentration varied more across sites than it did in 2015. Figure 11 shows the variability in concentration across time for each site. Most sites had their lowest concentrations towards the end of the summer, while Barkwood Point has its highest concentration during that time.
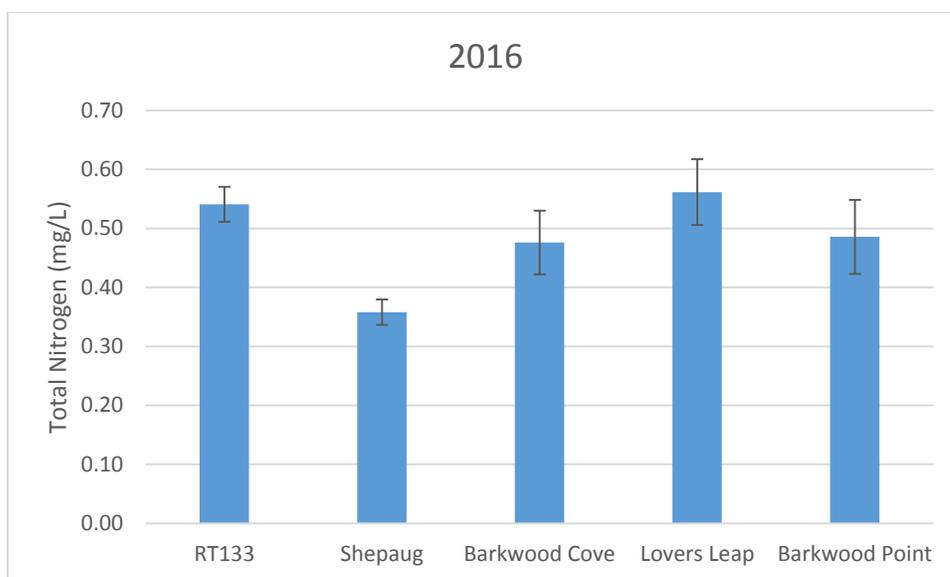
Figure 10: Average (Memorial Day – Labor Day) Total Nitrogen Concentration.

Figure 11: Total Nitrogen Concentration across all sites.

As we've observed in past years, average total phosphorus concentration was highest at Lover's Leap (Fig. 12). Figure 13 shows that phosphorus concentration at Lover's Leap was similar to other sites in the beginning of the summer and the end of the summer but was really high in July.
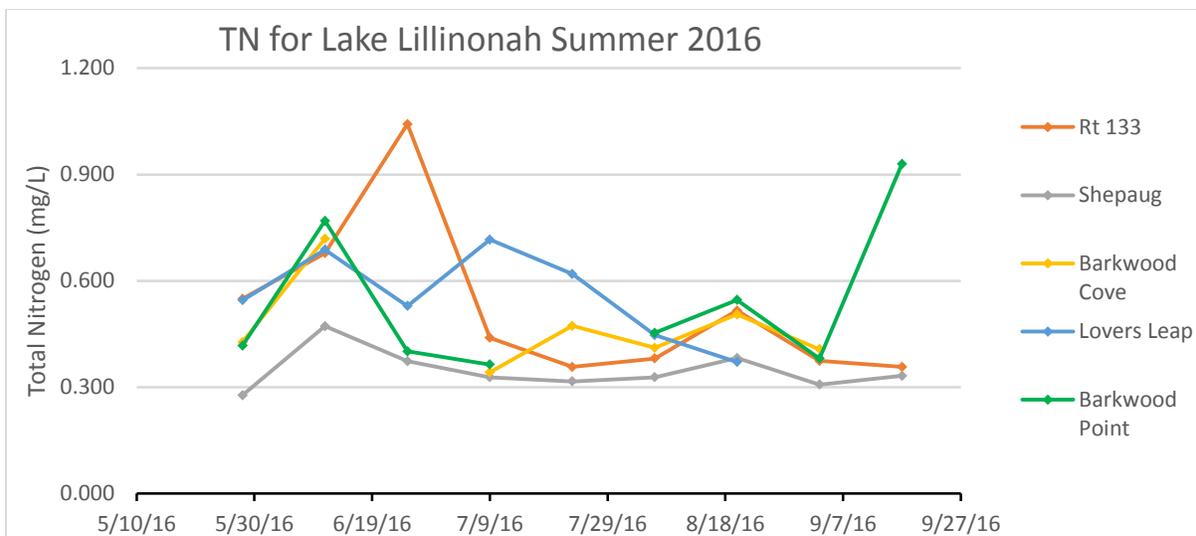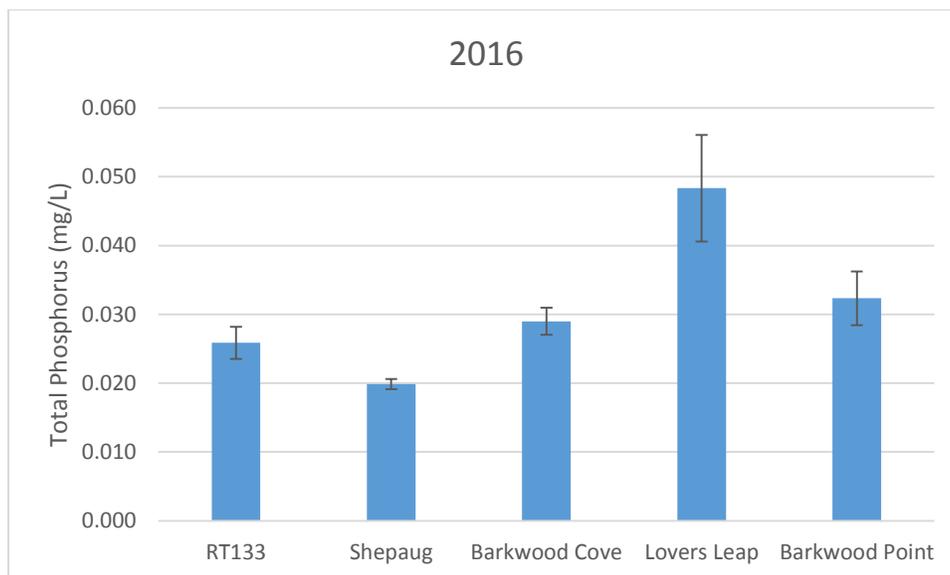
Figure 12: Average (Memorial Day – Labor Day) Total Phosphorus Concentration.
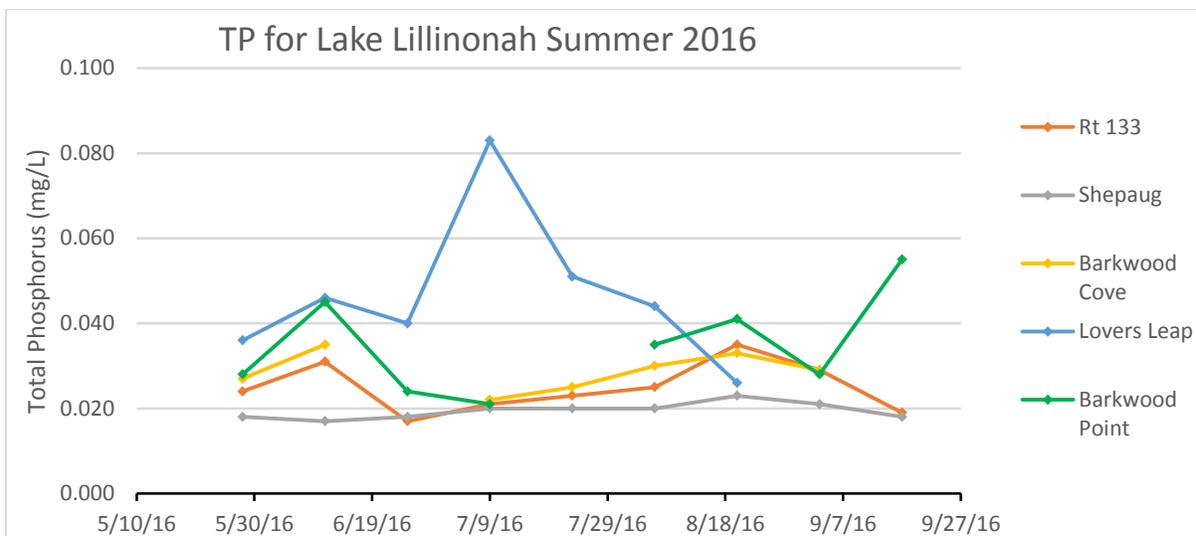
Figure 13: Total Phosphorus Concentration across all sites.

14. Algal Toxin Concentration Monitoring

The type of phytoplankton that forms the surface algal blooms that we see in Lake Lillinonah is called cyanobacteria. As their name suggests they are a form of bacteria, though they are typically grouped with algae because they are ecologically very similar. Many of the bloom-forming cyanobacteria produce compounds that may be harmful to aquatic organisms as well as other organisms, including humans and their pets, which drink or swim in the water. Several hypothesis exist for the ecological role of the toxins including

1. That they are a chemical defense against being eaten by zooplankton.
2. That they are chemicals that harm other algal competitors giving the cyanobacteria more access to light and nutrients
3. That they serve an unknown physiological purpose for the cyanobacteria cell.

Regardless of their ecological role, water quality managers have become increasingly concerned that during bloom conditions, toxin concentration may reach levels that could pose a threat to public health. Many of the species that are common in algal blooms in Lake Lillinonah have the potential to produce toxins. These include: *Anabaena, Aphanizomenon, Lyngbya and Microcystis*. Worldwide, the most well studied toxin is microcystin which is produced by two common Lake Lillinonah species, *Microcystis* and *Anabaena*.

The World Health Organization (WHO) guideline for microcystin in drinking water is 1 µg/L. Although water from Lake Lillinonah is not used for drinking, accidental ingestion of toxins through recreational contact is common and it is possible that repeated ingestion could lead to sub-lethal liver damage (Chorus 2001). In addition, microcystin has been implicated in a number of dog deaths in

New England. The WHO does not have an official recommendation for recreational contact but states there is a "moderate probability of adverse health effects" when recreating in waters with microcystin concentration above 20µg/L (WHO 2003). The Connecticut Department of Energy and Environmental Protection has recently published guidance for local health departments recommending that beaches in Connecticut be closed at microcystin concentrations greater than 15µg/L (CTDPH and CTDEEP 2013).

Samples for toxin analysis were collected fortnightly. Volunteers were given pre-labeled bottles which they were told to rinse three times with water, submerge the bottle upside down until their wrist was in the water and then fill it up. They then poured out some of the water until the bottle was 2/3 full to allow room for expansion once the sample was frozen. Volunteers were given several extra bottles and instructed to take samples of algal blooms.

Water samples were analyzed using the EnviroLogix QualiTube Kit for microcystin by Fairfield University students under the supervision of Jen Klug. The kit is used to detect levels of microcystin from 0.5-3.0 ppb. Microcystin concentrations were evaluated based on color development and an analysis of absorbance. The analysis allows us to place each sample into one of three categories: less than 0.5 ppb, between 0.5 ppb and 3 ppb, and above 3 ppb. Samples above 3 ppb were diluted and re-run to give us more information about whether concentrations in those samples approached or exceeded the recreational guidance of 15 ppb. Results were then grouped into 4 categories: no detect (less than 0.5 ppb), low detect (between 0.5 ppb and 3 ppb), medium detect (between 3 ppb and 15 ppb) and high detect (15 ppb).

Table 4 shows results from microcystin analysis. These results present all toxin samples collected, including those collected after Labor Day. The routine fortnightly samples show that the toxin concentration varies over time and location. Majority of routine samples came back with no detect which is in contrast with 2015, where majority of samples in July and August came back with some sort of microcystin detection. Volunteers also collected water samples on days other than the fortnightly samples if they noticed an algal bloom. Each spot sample came back with some detect of microcystin, one being a high detect. This high detect indicated that microcystin concentration was near or above the recreational guideline of 15 ppb. Most microcystin detections occurred at Barkwood Point, while Lover's Leap and Barkwood Cove had none.
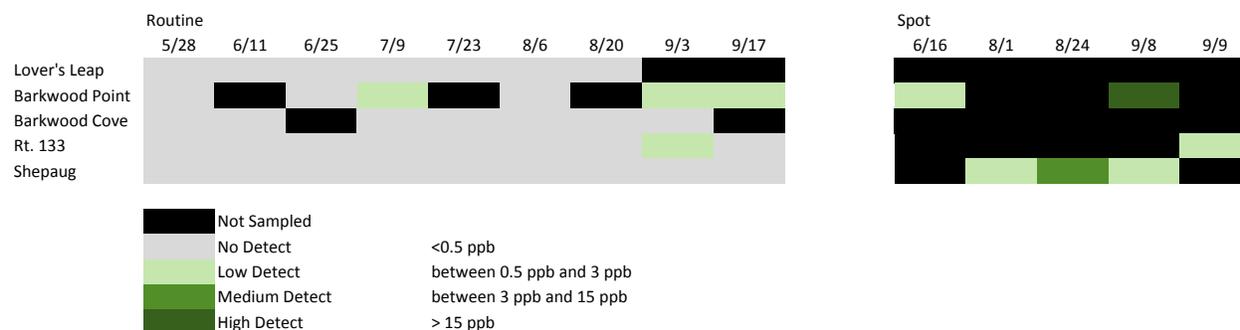
| | Routine 5/28 | 6/11 | 6/25 | 7/9 | 7/23 | 8/6 | 8/20 | 9/3 | 9/17 | | Spot 6/16 | 8/1 | 8/24 | 9/8 | 9/9 |

Legend:
- Not Sampled (black)
- No Detect — <0.5 ppb
- Low Detect — between 0.5 ppb and 3 ppb
- Medium Detect — between 3 ppb and 15 ppb
- High Detect — > 15 ppb

Table 4: Microcystin concentration across sites- Summer 2016

15. Conclusions

As in past years, the data collected from lake volunteers has allowed us to compile an overall assessment of Lillinonah's water quality. Using the ten variables discussed, we are able to better discuss what is happening to the lake environment and ecosystem. The various lake sites allow us to monitor the status of the lake as a whole which allows us to have a fuller understanding of Lake Lillinonah.

Table 5: Classification of Lake Sites Based on DEEP Trophic Status Classification (see Table 1)

Site	Average Secchi Depth	Average Nitrogen Level	Average Phosphorus Level
Lovers Leap	Eutrophic	Late Mesotrophic	Eutrophic
Barkwood Point	Eutrophic	Mesotrophic	Eutrophic
Barkwood Cove	Eutrophic	Mesotrophic	Late Mesotrophic
Rt. 133	Eutrophic	Late Mesotrophic	Late Mesotrophic
Shepaug	Late Mesotrophic	Mesotrophic	Mesotrophic

Based on the classification system used by the Connecticut Department of Energy and Environmental Protection, Lake Lillinonah in 2016 was mostly Eutrophic (based on secchi depth) or was between Late Mesotrophic and Mesotrophic (based on nutrient concentration). In 2015, we did not see as much variability among sites, almost all were categorized Late Mesotrophic (for nutrient concentration) and all were Eutrophic for secchi depth. Like past years, in 2016 Shepaug was classified as having higher water quality than other sites.

In terms of visual indicators (recreation potential and surface algae) water quality at most sites in 2016 was better than in 2015 (Figs. 8 and 9, Noyes and Klug 2016).

Algal blooms occur when nutrient concentrations are sufficient and certain physical conditions are met (high temperature and calm conditions). Results from

CLEO volunteers as well as other observers suggest that algal blooms in 2016 were less intense than 2015. Lake Lillinonah continues to be impaired due to the presence of algal blooms and lake stakeholders should continue their focus on reducing nutrient loading from the watershed.

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Citizen-Led Environmental Observatory: Lillinonah Data sheet   **Site name:**   **Year:**

Date	Time	Name of Observer	Temp	Secchi	Color	Particles	Surface scum	Recreation Potential	Debris	Trash	Notes
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	
					1 2 3 4 5 6	1 2 3 4	1 2	1 2 3 4	1 2 3	1 2 3	

Use the Notes column to record any other observations (weather events etc.) Circle only one number per column

Abbreviated instructions are found on the back of this data sheet. For more detailed instructions please see the CLEO protocol in your binder

Contact the volunteer coordinator with any questions or concerns.

Thank you for your commitment to help us better understand Lake Lillinonah!