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Pond and Lake Management
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Water Quality Management

2019

LAKE SURVEY

PAUPACKAN LAKE

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INTRODUCTION

At the request of Paupackan Lake Association, an assessment of Paupackan Lake was conducted on September 4, 2019. The major questions to be examined were: 1) What is the condition of the water quality in the lake? 2) What should the focus be for the vegetation management program?

MATERIALS AND METHODS

It was recommended that the survey be made on the lake during the summer, since problems with aquatic weed growth and water quality are more noticeable during that time.

Water samples were taken from the center of the lake. Water samples from that location were tested for pH, Total Hardness and Total Alkalinity. A Secchi Disk Reading was also taken at that location. A YSI Model 57 Oxygen Meter was used to record dissolved oxygen levels and temperatures. These readings were taken at surface and then at 0.5 meter intervals up to 5.5 meters in depth. A water sample was taken from the beach and tested for e-coli bacteria.

In September of 2019, a visual inspection of the nuisance aquatic vegetation was conducted. The inspection team used a probe to sample the shoreline areas around the entire lake to determine the species of plants present and the distribution of these species.

AQUATIC VEGETATION RESULTS

Aquatic vegetation has many important biological functions in a lake. It provides habitat for fish and other aquatic invertebrates. Aquatic plants also help to cycle nutrients from the system and produce the valuable oxygen that is necessary for life in the lake. Six species of aquatic vegetation that have caused problems with excessive growth were collected during the survey period. These species were bladderwort (Uticularia spp), big leaf pondweed (Potamogeton amplifolius), watermilfoil (Myriophyllum spp.), watershield (Brasenia schreberi), fanwort (Cabomba caroliniana) and white water lily (Nymphaea sp.). Big leaf pondweed, bladderwort, cabomba and watermilfoil are the noxious submerged plant species. Watershield and waterlily are the problematic floating plant species.

During 2019, submerged vegetation was treated in two different areas of the lake. These areas were the north end of the lake above the islands to create access from boat basin #4 to the main lake. The east cove area was also treated. The primary target of these treatments was cabomba. Boat basins and some shoreline docks were also treated in August for cattails and water lily.

In 2007, a full lake treatment was conducted using Sonar aquatic herbicide. In 2010 a partial treatment was conducted using a pellet formulation of Sonar. Cabomba is the primary plant species that was the target of the Sonar treatment. No treatment of the Cabomba was conducted in 2008, 2009, 2011, 2012, 2013 or 2014. Several areas of the lake were treated for cabomba in 2015 and 2016 using contact herbicides. Treatment areas were expanded in 2017 from what was treated in 2016 in an attempt to control the spreading cabomba. A full lake treatment of Cabomba was started in 2018, but was never completed as the lake had to be drained because of a sink hole in the dam breast. The East Cove and North End of the lake were treated with contact herbicides again in 2019. During the August visit, a survey was conducted around the entire shoreline of the lake. Cabomba was found growing in the north end of the lake outside of the area that was treated in the spring of 2019. Cabomba was growing between the islands as well.

Emergent vegetation has been a problem in some areas of the lake. The areas of the lake that have had the greatest impact from the overgrowth of emergent vegetation were the boat basin areas and the northern most end of the lake. The channel at the north end of the lake as well as boat basis four were treated for emergent vegetation in September of 2019.

Filamentous algae was observed growing in large areas of the north end of the lake. Filamentous algae should be treated in 2020 if it continues to be a problem. Treatment should be planned in advance as this treatment would need to be added to the NPDES permit.

The overgrowth of cabomba will require a full lake treatment at some point in the future using a systemic herbicide. This will be the same type of treatment that was conducted in 2007 and was started in 2018. In order to address future aquatic plant management needs we are recommending an annual budget of $45,000 to $50,000. Some years the management program will only require a portion of this budget but other years will require additional funds.

Aquatic Environment Consultants, Inc. will continue to work with Paupackan Lake Association, Inc. to determine the proper management approach for managing the aquatic vegetation in Paupackan Lake.

Table 1 summarizes the results obtained at the sample station during the visits to the lake.

TABLE 1

Date: 9-4-19

Secchi Disk Reading: 1.1 Meters
pH: 7.34
Total Hardness: 22.0 mg/l
Total Alkalinity: 29.8 mg/l

TEMPERATURE/DISSOLVED OXYGEN PROFILE

DEPTH (m)	TEMPERATURE (°C)	DISSOLVED OXYGEN (ppm)
SURFACE	23.1	8.5
0.5	22.9	8.4
1.0	22.9	8.4
1.5	22.5	8.3
2.0	22.4	7.9
2.5	22.3	7.4
3.0	22.2	7.2
3.5	22.1	6.7
4.0	22.1	6.7
4.5	22.0	5.8
5.0	21.7	3.0
5.5	21.5	0.6

DISCUSSION OF WATER QUALITY RESULTS

The water quality parameters that were tested during the survey indicate that there is good water quality for fish production and other recreational activities. The greatest water quality concern at this time is controlling nutrients that enter the lake. The faster nutrients enter a lake, the faster it will age; resulting in more management problems. The importance of controlling nutrients from entering your lake cannot be stressed enough. It is our recommendation that you work diligently to inform the lake residents about the importance of proper septic tank maintenance and other nutrient control measures.

Total Alkalinity

Total alkalinity refers to the total concentration of bases in water expressed as milligrams per liter of equivalent calcium carbonate. Waters with total alkalinity of less than 20 mg/liter usually have little available carbon dioxide to permit growth of plankton which is the main source of food for bluegills and other forage fish in your Lake. Since the alkalinity in your lake is greater than 20 mg/liter, there is no need for the addition of lime to the water.

Total Hardness

Desirable levels for total hardness for fish production usually fall in the range of 20 to 300 milligrams per liter. Hardness is not as important as alkalinity but should be of about the same numeric value. The hardness of your lake falls within this recommended range and indicates a suitable level for fish production.

pH

The desirable range for fish production is pH 6.5 to 9.0. Any pH value found in the range pH 4.0 to 6.5 is in the slow growth range. Very little if any reproduction will occur if the pH is in the range of pH 4.0 to 5.0. The acid death point for fish is around pH 4.0 or less. The pH in a lake will vary during the day based on weather conditions. Usually a lake's pH will be higher on a sunny day in the afternoon than it is in the morning. This is a result of the phytoplankton and other plants that are present in the lake. The pH of your water falls within the desired range, and should continue to be checked on an annual basis.

Secchi Disk Readings

The transparency, or clarity, of water is most often reported in lakes as the Secchi depth. This measurement is taken by lowering a circular white or black-and-white disk, 20 cm (8 Inches) in diameter, into the water until it is no longer visible. Secchi disk transparency or Secchi depth, corresponds to the depth where light penetration is 10 percent or less, and approximates the lower limit of major photosynthetic activity.

Observed secchi depths range from a few centimeters in very turbid lakes to over 40 meters in the clearest known lakes. Although somewhat simplistic and subjective, this testing method probably best represents the conditions which are most readily visible to the common lake user. Secchi depths of less than 6.6 feet (2.0 Meters) are usually considered undesirable for recreational lake uses.

Secchi disk transparency is related to the transmission of light in water, and depends on both the absorption and scattering of light. The absorption of light in dark-colored waters reduces

light transmission. Light scattering is usually a more important factor than absorption in determining Secchi depths. Scattering can be caused by color, by particulate organic matter, including algal cells, and by inorganic materials, such as suspended clay particles in water.

The secchi disk reading is a measure of water clarity and is often used to determine the concentration of algae (phytoplankton and zooplankton) in a lake. Your reading was 1.1 meters indicates reduced water clarity due to the growth of phytoplankton in the lake. This reading will usually decrease as the water warms into late summer.

Temperature/Dissolved Oxygen Profiles

The amount of oxygen, which can dissolve in water, is subject to fluctuations caused in part by variations in temperature, photosynthetic activity and stream flow. Respiratory processes, oxidation of inorganic wastes, and the decomposition of organic matter deplete oxygen, while photosynthesis and re-aeration by contact with the atmosphere increase oxygen concentrations in water. Dissolved oxygen concentrations are of concern because oxygen is essential for the survival of fish and many other aquatic organisms.

Most desirable aquatic organisms require a dissolved oxygen concentration of 4.0 mg/L or greater for long-term survival. At 1.0 ppm to 5.0 ppm fish can survive, but growth is slow if prolonged exposure occurs. Less than 1.0 ppm is lethal if fish are exposed for prolonged periods. As you can see from the tables, dissolved oxygen levels in the lake were maintained throughout the summer in the upper levels of the lake. As the summer progressed, dissolved oxygen levels at 4 meters and lower began to deteriorate. The reason for this decrease is that organic material in the bottom of the lake uses the oxygen for decomposition. During the summer, the water in the deeper part of the lake does not mix with the surface water and, therefore, this oxygen cannot be replaced. When the lake "turns over" in the fall, the oxygen level in the bottom of the lake will increase.

CONCLUSION

Paupackan Lake is a valuable aquatic resource that with proper management can continue to produce exceptional recreational opportunities for years to come. The overall condition of the water quality sampled was normal for lakes in your region; however, you still must be concerned about further accumulation of nutrients in the water body. Residents living around the lake need to understand the importance of maintaining their septic systems. Runoff from fertilizers and other nutrient sources also needs to be controlled.

The management of aquatic vegetation and the growth of algae need to be a high priority if the lake is going to continue serving the recreational needs of the residents. Aquatic Environment Consultants, Inc. should continue to monitor the plant growth in future years and work closely with the association board to determine control methods. It is our recommendation that continued study of the plant growth and water quality in the lake be conducted in 2020.

RECOMMENDATIONS TO FOLLOW

- Budget approximately $45,000.00 to $50,000.00 for annual aquatic plant management
- Control nutrients entering the lake.
- Educate the residents on the proper management and care of their septic systems.
- Control noxious native plant growth in problem areas.

Submitted by: Bill Kirkpatrick October 2019