# An In Depth Look at How Monthly Integrated Pond Management and Change an Ecosystem for the Better 

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#### Abstract

: The maintenance of a pond can quickly get away from a pond owner when the proper tools and nutrient remediation techniques are not utilized or a pond owner is too relaxed on early stages of management. In order to show how much improvement a client can see through the use of proactive products and methods, the biologists at Wisconsin Lake and Pond Resource were able to show how beneficial bacteria and enzymes are able to aid in improving ecosystems through natural processes which also helps reduce the dependency of pesticides. The pond used in this study was one that when originally built in 2010 and early on the pond owner utilized do it yourself techniques before having our team assist once again with management. In the early stages it was evident that Mother Nature had started the eutrophication process of the pond. This allowed our staff to incorporate our Integrated Pond Management techniques, specifically bacteria and enzymes applications, to restore the pond's ecosystem and aesthetic appeal to what the pond owners remembered when it first had been constructed. The goal of the study was to reduce nutrient loading that had occurred, decrease growth potential, and improve water clarity.


## INTRODUCTION:

In the aquatic management industry, the coined phrase of "Integrated Pond Management (IPM)" can be a pond owner's best friend. Simply stated, this is a handsfree approach for the homeowners that centralizes around scheduled management based on biological and seasonal changes. One myth that arises on many sites is that treating when the problem arises can keep the pond healthy, but this is not the case as this reactive management only covers up the real problem that is going on underneath the water's surface.

This plan thrives on the understanding that having a professional aquatic biologist managing your pond(s) will help with improving water quality parameters and get to the root of the problem by not taking the "band-aid" approach. The basis of an IPM plan is to reduce a pond's dependency on pesticides and to essentially slow down or sometimes even stop the clock on Mother Nature. This is achieved by not only looking at the surface, but by looking at the entire ecosystem.

A proper IPM plan utilizes a line of products and tools that improve the quality of water, reduce nuisance algae bloom potential, increase water clarity, and lower excess nutrients and nutrient loading. Examples of products being used in these programs are beneficial bacteria, natural enzymes, phosphorus reduction agents, and pond colorants. Biologists use these products to target the real issue behind water quality; nutrient loading. If the nutrient levels can be kept in check, and at a healthy level, a balance can be created in the ecosystem. These tools, along with other proactive methods, will enable biologists to keep ponds looking great and keep them healthy. As stewards of the environment, we should always strive to reduce pesticide use and keep our resources in a superior state of health. For this study we focused on the benefits that can be achieved through routine use of beneficial bacteria and enzymes. Microbial beneficial bacteria and enzymes have been proven to be a very effective management tool in lakes and ponds as seen in this four (4) year study. Beneficial bacteria clarify lake and pond water, break down organic matter, reduce accumulated bottom sludge, remediate ammonia and phosphates, minimize odors, eliminate excess nutrients, and safely accelerate biological activity to fortify overall pond health. Even though natural bacteria are present in every aquatic ecosystem, routine applications help to boost their populations so that all biological process can occur at an accelerated rate. A combination of the cultured bacteria and a proper aeration system can begin the "healing" process of a pond. We must note that the bacteria used in this study are aerobic by nature so they do require adequate dissolved oxygen concentrations to achieve their full water quality improvement potential.

## MATERIALS AND METHODS:

- 144 gallons Pondzilla Pro (36 gallons of Pondzilla Pro per season)
- 240 pounds Natures Blend Dry Bacteria Blend (60 pounds of Natures Blend applied per season)
- Secchi Disk
- Commercial Spray Vessel with Custom Spray Setup
- Peristaltic Pump with Product Feed Line
- Preserved and Non-Preserved Sampling Bottles

To begin the study a series of ponds were reviewed as potential candidates for the study based on prior water sample data and seasonal growth observations. Criteria for each category were needed to be met in order to qualify for the study in which one pond was selected based on the following criteria. The first of the criteria was that the pond must exhibit total phosphorus levels above $0.03 \mathrm{mg} / \mathrm{L}$ which indicates a Eutrophic (nutrient rich and aged) pond. The initial phosphorus sample for the study pond was found to be $53.8 \mathrm{mg} / \mathrm{L}$. The second criteria used was that the pond must have a maximum of 1-2 feet of clarity to show clarity improvements. The initial secchi disk recording was 1.5 feet. Our last criteria for this study was the pond must be controlled as far as water volume input. This pond was built in 2010 with a synthetic liner with the only water input sources being rainfall and a well. The well was not used frequently to date to keep the pond full.


FIG 1. AERIAL IMAGERY OF STUDY POND

The pond selected for the study has a surface acreage of 0.83 acres, an average depth of six (6) feet, and a total volume of 4.98 acre feet. Products were applied to the pond a monthly schedule from April through September each year from 2019 until recently in 2022. Each application was completed using a twelve (12) foot Carolina Skiff with custom spray setup utilizing a twelve foot boom with spray nozzles. During each in water application the entire surface footprint was applied to. During these in-water applications our staff applied one (1) gallon of PondZilla Pro and ten (10) pounds of Nature's Blend Dry Bacteria formulation. The product rates were 25.7 ounces/acre-foot of water of PondZilla Pro and approximately two (2) pounds of Nature's Blend Dry Bacteria formulation. In addition to the in water applications two peristaltic pumps were set to dispense two and a half (2.5) gallons of Pondzilla Pro into the pond per month equating to a total of five (5) gallons per month. To achieve five (5) gallons metered total per month the pumps were set to dispense six (6) ounces of product twice per day.


FIG 2. SHORELINE IMAGE OF POND AT START OF STUDY

During each field visit, our staff completed these applications and then proceeded to test the water for a multitude of parameters including; turbidity, conductivity, free reactive phosphorus, dissolved oxygen, chlorophyll a, total phosphorus, alkalinity, total hardness, total nitrate, total nitrate, total Kjeldahl nitrogen, total nitrogen and pH .

The other test performed each visit was a Secchi Disk recording of water clarity. After eachmonth's samples were received, they were logged into a Microsoft Excel spreadsheet for future review of trends in the data.


FIG 3. PICTURE OF APPLICATION UNIT


FIG 4. PERISTATIC METERING PUMP


FIG 5. BOOM APPLICATION IN PROCESS

## RESULTS AND DISCUSSION:

Samples were taken during each visit where in water applications were performed between the months of April through September each year from 2019 through 2022.

The following averages were obtained using data from the analytical reports from Northern Lake Service, Inc and Sepro Corporation.

Water Sample Parameter Averages 2019-2022

|  | 2019 | 2020 | 2021 | 2022 |
| :--- | ---: | ---: | ---: | ---: |
| Turbidity (NTU) | 3.25 | 4.233 | 2.4 | 2.33 |
| Conductivity (uS/cm) | 204.19 | 184.25 | 194.52 | 193.067 |
| Free Reactive Phosphorus (ug/L) | 5.1667 | 5 | 9.4 | 5.5 |
| Dissolved Oxygen (mg/L) | 8.2667 | 8.85 | 9.34 | 9.483 |
| Chlorophyll a (ug/L) | 20.533 | 12.3167 | 10.84 | 10 |
| Total Phosphorus (ug/L) | 35.3667 | 24.45 | 29.66 | 14.67 |
| Alkalinity (mg/L as CaCO3) | 98.33 | 61.2167 | 98.76 | 94.67 |
| Total Hardness (mg/L as CaCO3) | 84.1667 | 37.167 | 88.16 | 88.55 |
| Total Nitrate/Nitrite (mg/L) | 0.02 | 0.033 | 0.036 | 0.02 |
| Total Kjeldahl Nitrogen (mg/L) | 0.8 | 2.2 | 0.6 | 0.65 |
| Total Nitrogen (mg/L) | 0.8 | 2.2 | 0.6 | 0.65 |
| pH | 7.1 | 8.2 | 8.44 | 8.33 |
| Secchi Disk Depth (ft) | 1.791667 | 2.638 | 4.65 | 7.4167 |

The following graphs show the trending lines for phosphorus, nitrogen, and water clarity (secchi disk and turbidity tests). Below are the graphs for these four (4) tests as well as our comments on the outliers that can be seen in a few of the graphs.

## TOTAL \& FREE REACTIVE PHOSPHORUS

When we initially tested the study pond the total phosphorus level was $53.8 \mathrm{ug} / \mathrm{L}$.
Throughout the first year we were able to reach an average level of $35.37 \mathrm{ug} / \mathrm{L}$. The goal for most ponds we actively manage for water quality is to maintain a maximum of $30 \mathrm{ug} / \mathrm{L}$ with lower concentrations preferred. As the study progressed the total phosphorus dropped substantially in 2020, but an extremely wet spring filled with large runoff events in 2021 brought on an increase of total phosphorus. The spike can be observed in the graph below following these runoff events. However, even with this increase we were able to keep levels under $30 \mathrm{ug} / \mathrm{L}$ on average. Moving into the final year of study we continued the ongoing phosphorus reduction trend and the final average of the study was at $14.67 \mathrm{ug} / \mathrm{L}$ with the final sample having a record of $9 \mathrm{ug} / \mathrm{L}$.

Though we saw substantial decreases in the total phosphorus, free reactive phosphorus had a minimal decrease. This could be attributed to consistently binding of the
phosphorus within the glycocalyx of the bacteria strains as well as monthly maintenance of any growth that was observed. As with total phosphorus we did observe a spike in the spring of 2021, but this was quickly remedied following our bacteria and enzyme application to the pond as well as ongoing injection of proactive enzymes.


FIG 3. TOTAL PHOSPHORUS AND FREE REACTIVE PHOSPHORUS CONCENTRATIONS OVER TIME

## TOTAL NITROGEN

Given that Nitrogen can also be a limiting nutrient for growth we wanted to look at how Nitrogen was affected by the nitrogen fixing strains of bacteria. Overall, we saw a gradual drop with levels maintaining themselves below the $1 \mathrm{mg} / \mathrm{L}$ concentration. When monitoring a pond for Nitrogen, concentrations above $1 \mathrm{mg} / \mathrm{L}$ as that can pose potential harm for aquatic life. We noted two different sampling events that did go above $1 \mathrm{mg} / \mathrm{L}$ and raised some red flags as an aquatic manager. Both of these sets of data were collected early on in the study. Though a specific reason can not be pointed out for the large increase in the spring of 2020, we have some theories for the potential causes. The water sample was collected soon after ice out so the sample could have been skewed due to an over winter fish kill, an initial fluctuation due to the aeration system being started up, or possibly a runoff event from snow melt that may have polluted the pond with nearby agriculture runoff.

Even with this large influx, the pond recovered quickly the following visit in May after having the initial bacteria and enzyme application completed in April. As the study progressed, we observed an ongoing decrease of total nitrogen, but did see a slight bump of concentration after the spring rains of 2021. Throughout 2022 Nitrogen levels stabilized with very slight decreases in concentration. We anticipate a similar pattern as we continue to manage this pond with bacteria and enzymes.

## Total Nitrogen (mg/L)



FIG 4. TOTAL NITROGEN CONCENTRATION OVER TIME

## SECCHI DISK DEPTH AND TURBIDITY

For the last two parameters we have grouped them together as both the secchi disk depth and turbidity allow us to measure water clarity and how turbid a pond is. Throughout the entirety of the study, we observed consistent improvement with both of these parameters. Given that the beneficial bacteria and enzymes targeted suspended organic solids, we anticipated a significant change could occur. The trend line is statistically significant based on the data with an R2 value of 0.9065. At the beginning of the study we had a secchi disk reading of only one and half ( $1 \boxtimes$ ) feet and by the end of the study we reached a secchi disk reading of eight (8) feet. There was one period of the study where we observed a spike in the NTUs for Turbidity.

Looking through our onsite observations and notes from that visit the spike of turbidity appeared to be due to a columnized algal bloom that was taking place. An algaecide application and bacteria/enzyme application were performed when this was observation was made. The water clarity rapidly returned to normal levels that we had been observing after this application was completed.

## Secchi Disk Depth (ft)



Date of Collection
FIG 3. SECCHI DISK DEPTHS FROM 5/5/2020 THROUGH THE END OF THE STUDY ON 9/5/2022. SECCHI DEISKS WERE NOT COLLECTED DURING THE FIRST YEAR OF STUDY


FIG 5. TURBIDITY LEVEL OVER TIME OF THE STUDY


BEFORE PHOTOS - 2019


MID-STUDY - SEPTEMBER 2020


STUDY CONCLUSION - SEPTEMBER 2022

## CONCLUSION:

In the conclusion of this four (4) year study, continued metering of Pondzilla Pro along with monthly applications of Pondzilla Pro and Nature's Blend Dry Bacteria formulation has significant impact on water clarity and available phosphorus. To help aid in further nitrogen reduction a bacteria formulation emphasizing nitrogen fixation may be required. A study targeting a pond with higher concentrations of Nitrogen may show more impact utilizing similar techniques and methods found in this study. Future studies on ponds that do not have aeration could also shed light on how much dissolved oxygen is truly required to allow the aerobic bacteria to provide positive results and at what level(s). From this study we obtained positive results and have shown that the microbial bacteria indeed are helping prolong the life of the pond and slow down the eutrophication process. Wisconsin Lake and Pond Resource, LLC as well as Naturalake Biosciences will keep pushing further to help pond owners manage their ponds and improve ecosystems throughout the state. The goal of the study was to show that monthly maintenance with proactive products does truly provide benefits to pond owners, and this study shows just that.

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