Grailville Wetlands Project

Svetlana Belkin

Abstract

One of the most important ecosystems, on this planet, are the wetlands because of their powerful functions in the environment. Data collection and experiments, on the two ponds (one big and one small), were done with on the lands of a non-profit called the Grailville, owned by the non-profit called the Grail. All of the work is available on the public domain and upholds the values of Open Science. The focus of the project is to determine if the ponds are stable and how to maintain them organically. This mean using no harsh chemicals but natural means of floating wetlands and biodegradable nibblers filled with barely. Point data in terms of pH levels and ammonia levels were the two main factors looked at. The data collection occurred in early spring and lasted to late-fall for three years for the big pond and five years for the small pond. After the data collection and the experiments over the five years, both of the ponds show stability with normal fluctuations of pH. The ammonia, on the other hand, showed some spikes that are possibility tied to temperature inversion of the pond waters. The floating wetlands experiments failed due to various reasons ranging from the mats being too close to the edge of the pond to plants getting out competed by native plants. In terms of Open Science, I learned many lessons including how to structure a repository and format .csv files.

Introduction

Wetlands

Wetlands are important to the environment because they allow water purification, flood control, carbon sink and shoreline stability. It is distinct ecosystem since aquatic plants that adapted to the unique hydric soil. In the Midwest of the United States of America, wetlands tend

to be rivers, ponds, and seasonally flooded areas. In terms of plant life it can range from surface covering plants, such as duckweed (*Wolffia globosa*) and cattails (*Typha* genus). Wildlife can range from Canadian geese (*Branta canadensis*) to snapping turtles (*Chelydra serpentina*).

The pond testing happened on the Grailville southside located in the Greater Cincinnati area and the land is owned by The Grail, an international women's movement started in 1921 in Holland. The land for Grailville was bought in 1944 and serves as a center of education and a sacred space.

Based on the National Wetlands Inventory (NWI), the both ponds are classified as a PUBgh and is a freshwater pond but the little is 1.33 acres and the big is 1.53 acres. There is also a freshwater emergent wetland that is a PEM1Ch, 0.90 acre wetland. PUBgh stands for Palustrine, Unconsolidated Bottom, Intermittently Exposed, Diked/Impounded. Unconsolidated bottom means that the pond has "at least 25% cover of particles smaller than stones (less than 6-7 cm), and a vegetative cover less than 30%" (NWI). For the freshwater emergent wetland, PEM1Ch stands for Palustrine, Emergent, Persistent, and Seasonally Flooded. This small wetland was never included in the testing.

The small pond was a part of the Wetlands Project, an initiative designed to naturally help it to come back to life. The main method used is floating wetlands. Floating wetlands use rubber mats with pot-sized holes filled with plants like yarrow and comfrey. The plant's roots act as biological filters that filter metals and other contaminants out of the water.

Nibblers are also used and they are degradable spheres with barley. Barley normally is used in straw or extract form for algae control by raising the pH in the pond. But in this case, it's used to clean the bottom of the small pond of muck.

Open Science/Citizen Science

Open science allows one to make their research more accessible by everyone, mainly the public domain. There are six principles of open science: open data, open source, open methodology, open peer review, open access, and open educational resources. Open Science is linked to citizen science because it is the practice of science outside academic and research institutions. I practice both a Open and citizen science because of the values of Open Science and I am not associated with academic or research institutions.

Materials

An API Pond Care Pond Master Test Kit was used as the kit to test ponds. It includes test tubes and chemicals used to test for pH, ammonia, nitrate, and phosphate. In order to revive a sample from a pond, a metal stick with a cup in a cup holder on one end is used. The data is then added into a .csv file and LibreOffice Calc is used for data analysis.

Methods

Data Collection

The data collection season went from the last week of March (week 13) to the last week of October (week 43). Once a week, one sample per pond (big and small) were collected and analyzed for pH, ammonia, nitrate, and phosphate. The data is added to a .csv file, one for each pond and a separate file was used as a timeline for notes, such as “it rained during the data collection” or when a nibbler was placed in the small pond.

Experiments

Nibblers

Nibblers were placed in the small pond once every month after Mother's Day in May starting in May and ending in October.

Floating Wetlands

For last half of the 2016 and the 2017 data collection season, the plants are prepared in the spring, a week after Mother's Day, and placed in the pots with organic coconut coir. After that the pots are placed in the holes of the mat. A rope with a brick tied to one end and the other end was tied to the mat. This brick acts as a weight. Finally the mats are kayaked out in the middle of the small pond. They remained in the pond until the last week of October. The plants are then wintered for next session.

In 2018, a different experiment was conducted. Instead of using wintered plants, the pots were filled with just coconut coir after they were scrubbed clean with organic soap. The protocol for this experiment can be found in the supplements.

Off Season

The data was analyzed with LibreOffice Calc for trends in pH over time, if there are any pH value outliers, the average pH and ammonia per data collection season, how many ammonia spikes occurred and how many of them were when it rained- either the day off or from two days before data was collected.

For the number of pH outliers, the COUNTIF function was used for each possible value on the pH scale, which ranges from 6 to 8 with .5 increments, For the number of spikes for

ammonia values, the COUNTIFS function was used to count the number of spikes that occurred during rain and the COUNTIF for total number of spikes.

Results

The pH was the main factor that was looked at with ammonia being second. Figures 1 and 2 show the trends of pH over time for the data collection seasons. For both ponds, the pH mostly fluctuated between 6.5 to 7.5, with a few outliers of 6s and 8s.

The ammonia, on the other hand, were constantly between 0.25 to 1 parts per million during weeks 21 to 34 for both ponds. After that the ammonia levels mostly stayed at zero parts per million with a less than fifteen total outliers per data collection season.

Discussion

Wetlands Work

Since the data was taken as point data roughly at the same time and the same day, it only creates a snapshot of the pond's health. There are two ways to correct this. One way is to collect data on the same day but twice or even three times instead of once. The other solution is use sensors to have close to 24/7 monitoring.

During weeks 34 of 2015 to week 32 of 2016 for the small pond [Figure 4] and weeks 22 to 31 of 2016 for the big pond [Figure 3], there was a constant reading of ammonia that never reached over one parts per million. This is most likely from the chemicals not working correctly in the ammonia testing kit. Looking at the data after week 34, the ammonia levels dropped and only rose a few times per data collection season. Only a small percentage of the spikes in the data collection seasons of 2016 and 2017 were from the rain unlike 2018's season for both ponds. This

could be from temperature differences of the water and possible temperature inversion of the pond waters. Once again, if I had means of monitoring the ponds 24/7, I would also add temperature sensing.

All of the floating wetlands experiments did not work the way that was predicted. In the 2016 data collection season, the rafts were too close to the edge of the pond. This caused the plants to only to have leaves instead of leaves and flowers.

For the 2017 data session, the plants that were potted got out competed by native aquatic plants. This may be from the pots and the mats not getting cleaned well. This allowed seeds that survived from the last season or even two seasons ago to germinate. Because of this, the experiment for the 2018 data season was created and conducted in order to see if these native plants can grow and help the pond maintain itself- which ever happened.

While the experiment was thought out and conducted well, nothing grew. Some of the possibilities are: the raft was too close to the edge, the plants did not like the coconut coir, and there was only one small raft in the pond.

The nibblers on the other hand did their job and also the duckweed that dominated the ponds possibly helped with the maintenance of the ponds.

Open Science/Citizen Science

The reason why chose to do this project is I have the permission to upload the data and my work to the public domain. In return, I learned how to structure the repository on GitHub and on my site, Sense of Openness, how format a .csv file, and what organizations are doing wetlands work in the realm of Open Science.

The two main mistakes that I made. The first was when I first formatted my .csv file which is I made the data as three comma separated entries instead of mm-dd-yy as one entry. The way I fixed it was by using LibreOffice Calc to convert the date into week number based on the year and concatenating the year to 20yy, as I only had it in the two digit format. Function that was used `=WEEKNUM(DATE(CONCATENATE(20,D2),A2,B2))`. The second is that I should of preregistered this project on the Center for Open Science Framework. This would of allowed me to plan out the experiments and the data analysis and forced me to follow my plan.

Conclusion

Even though the floating wetlands experiments did not go as they intended, the ponds were stable.

Figures

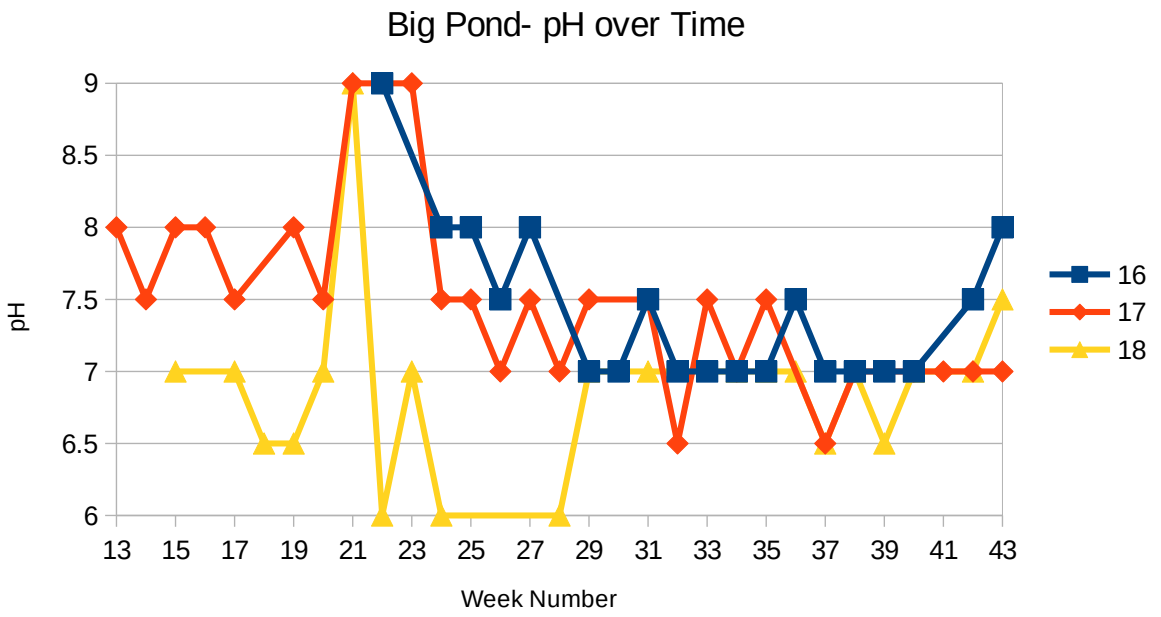

Figure 1- This graph shows the trend of the big pond's pH over time where time is for the data collection seasons 2016, 2017, and 2018. The week numbers are from week 13 (first week of March) to week 43 (last week of October).

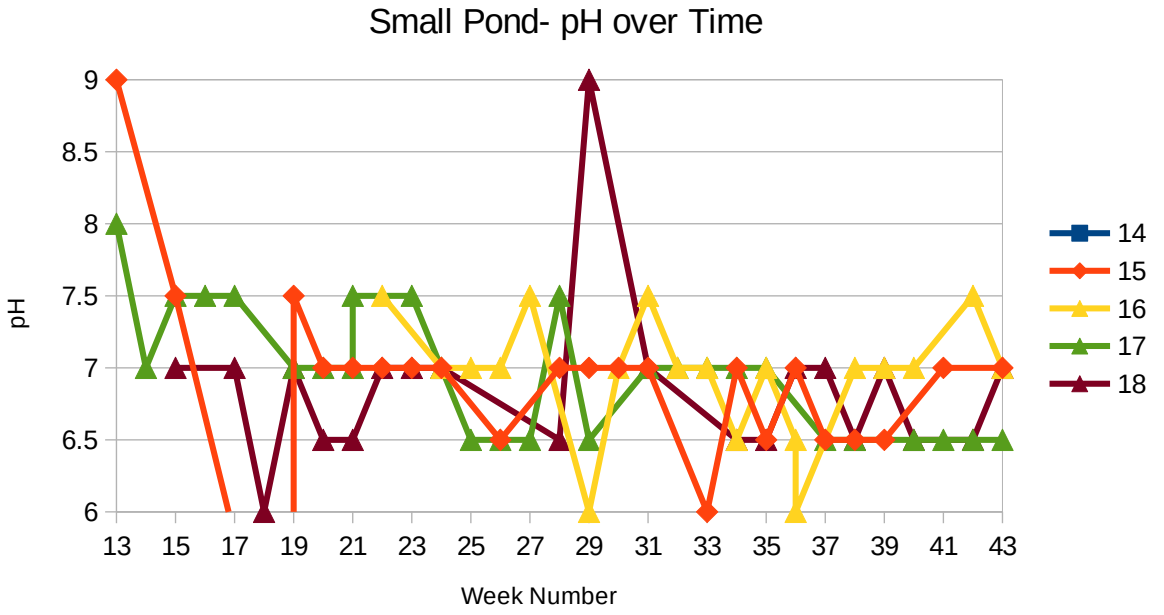

Figure 2- This graph shows the trend of the small pond's pH over time where time is for the data collection seasons 2014, 2015, 2016, 2017, and 2018. The week numbers are from week 13 (first week of March) to week 43 (last week of October).

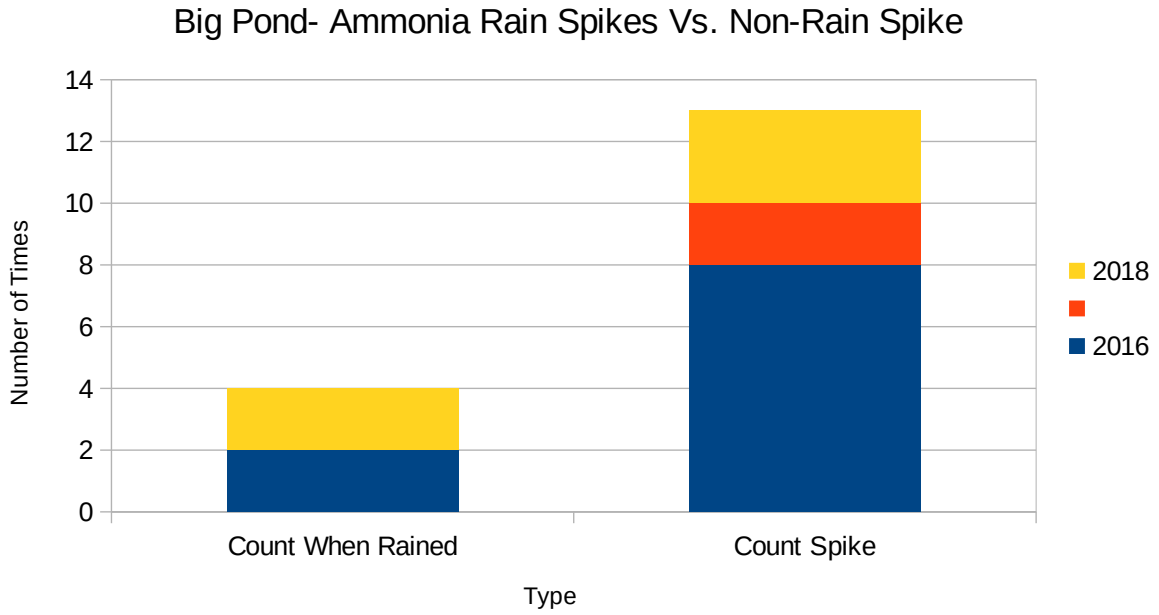

Figure 3- Ammonia data for the big pond showing the number of when a spike occurred from rain or from other means. The orange dot is 2017.

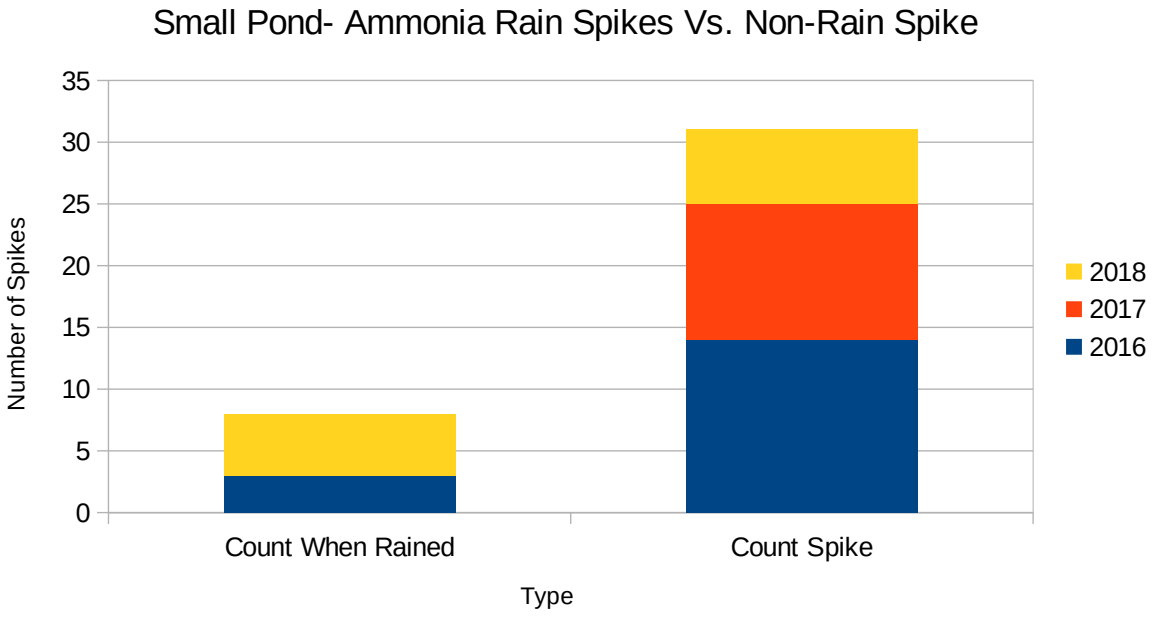

Figure 4- Ammonia data for the small pond showing the number of when a spike occurred from rain or from other means.

Supplements

2018 Data Collection Season Experiment

Materials

- One small mat

- Pots

- Organic cleaning solution, example: baking soda and vinegar, Ecover

- Organic Coconut Coir or peat moss

- Kayak

- Rope

- Brick

Method

Note: This step should be done at least two days when it's a sunny day before placing the mats with the pots in the pond as the mats and the pots need to dry in the sun.

1. Clean the mat and the pots with organic cleaning solution. Ecover was used in this experiment. This is done to make sure that there are no residual seeds that may of survived.

2. Dry the mat and pots in the sun.

Note: These steps below should be done after Mother's Day in the Midwest due to frost.

3. Both peat moss and Coconut Coir, which comes in a brick, need to be moistened. To do so, place the material in a deep bowl and place some water and mix. You will need a packing

consistency in order to pack the pots to the top. If too dry, the peat moss/coir will flow out of the pot, mainly the top. If too wet, it might not pack well.

4. Once at pond, place the pots into the holes of the mat.

5. Tie some rope to one end of the mat with a brick. This brick acts as the weight to keep the mat from drifting off.

6. Take the kayak and take the mat out into the pond.

7. Data collect like normal.

8. At the end of the data collection season (around the last week of October), use the kayak to pull in the mat.