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# Determining Environmental Changes Using Time Lapse Photography

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**Abstract:**

This paper aims to use photographs throughout several years to observe, examine, and make conclusions on changes occurring at different areas of the Bath Nature Preserve. Throughout the years 2013-2021, photographs have been captured at roughly the same angle at multiple locations in the preserve. These photographs focus on the observation dock in the Bath Pond and have been placed into a time lapse video and examined to physically see how the environment is changing. Changes to the environment could be natural or as a result of outside factors. By examining these changes, it can be determined if alterations need to be made to help the environment thrive. Two specific spots are looked at in the preserve. Elements like water level and appearance, plant life and quantity, and animal life can be observed throughout time with these photographs. Through these photographs, it can be seen that the water level of the pond has been steadily increasing over the past few years. The pole was 29 inches above the dock in 2013 and is currently only around 3 inches are able to be seen. Changes need to be made in order to keep the dock accessible. By acknowledging the water level change occurring, it can be determined if any threats pose danger to the area and then can be brought to the appropriate attention so changes can be made.

**Introduction:**

Water levels are increasing globally (Ramsayer, 2020). Factors such as glacier melting, climate increases, and loss of ice sheets contribute to the sea level increases. As more greenhouse gases are released into the atmosphere, they trap heat. This causes high volumes of water to absorb that heat, resulting in an expansion of bodies of water. Smaller areas of water may be less

susceptible to these particular factors, but they are still experiencing water level increase (unless in the instance of extreme droughts).

Throughout this research, the Bath Pond in the Bath Nature Preserve will be examined. How different parts of the environment are changing over time will be looked at, particularly water level change. Water level is important as the pond only houses a small area. Extra water collection could lead to an increase in water area, affecting the surrounding organisms. The observation dock on site is also heavily used by researchers and visitors, the dock can only move with so much water, and could be soon overflowed. Previous observation has proven that beavers have moved into the area and inhabited it. Beavers can strongly impact the environment by creating dams which collect or migrate water (Helsinki, 2018). This can increase water levels in the area and can cause a shift in the carbon levels. With more water, the soil, housing a lot of the carbon, surrounds the pond and can become displaced. Carbon is stored in soil and if the water is increasing, it is moving around the soil or eroding away. This results in more carbon released into the water. Carbon reacts in the water to make carbonic acid which can alter the pH level of the pond.

Using photographs throughout the years, it will be determined if the water level in Bath Pond is rising, if this could have affected species in the area, whether the surrounding plants and soil are being impacted, and what can be changed.

## Materials and Methods:

### *Study Sites*

There are many frequently visited parts of the Bath Nature Preserve (BNP, Summit County, Ohio). This preserve is visited by locals, tourists, students, faculty, and researchers. The

research performed will focus on the Bath Pond. This location includes a land area  that leads into a pond, with an observation dock as shown in figure 1. It is at BNP that several photographs have been taken of different sites. This research will focus on the Bath Pond, while future research can expand on this and use other sites as a focus. The pond is the starting point as the water level will be examined.

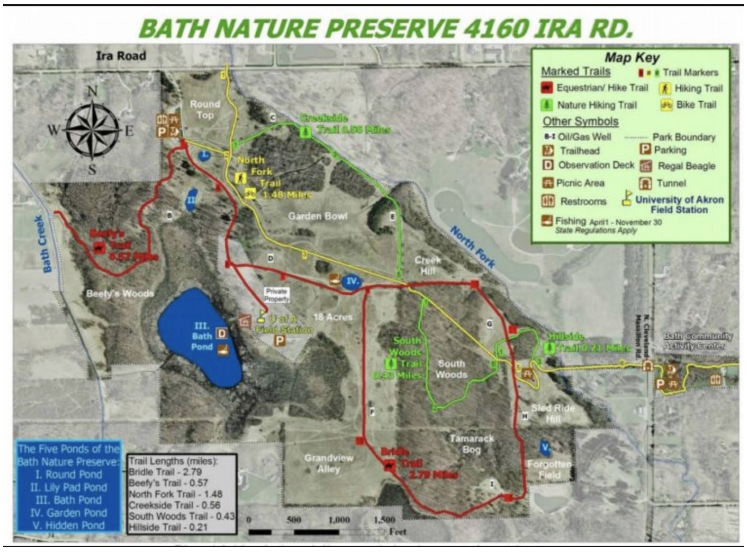
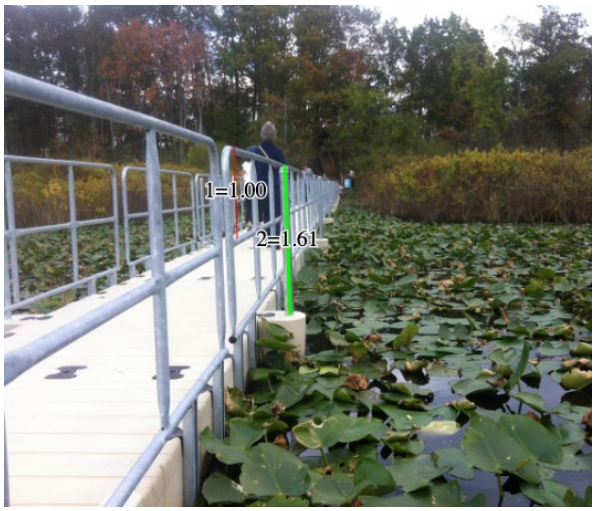



Figure 1 displays a map of BNP
https://birding-in-ohio.com/summit-county/bath-nature-preserve-bridle-trail-loop/

*Images*

Throughout the years 2013-2021, Dr. Randall Mitchell has photographed locations throughout the Bath Nature Preserve. Over 500  images were collected throughout the last eight years of the Bath Pond. Around 200 images are relevant to this research, since they include images of the dock that allow evaluation of the water level. The observation dock is set on poles that are underwater and in the ground. made of plastic and has been anchored to the ground along poles. These poles have been positioned in the ground underwater. They then connect to the dock at several points on each side. The dock is able to move vertically along the poles in order to correspond to the water level.


Figures 3 and 4 show how the measurements were collected electronically on photographs from the left and ride side of the dock on 10/12/2013



Figures 5 and 6 show how the measurements were collected electronically on photographs from the left and ride side of the dock on 10/19/2019 in comparison to the numbers obtained in figures 3 and 4.

These can be seen attached to the dock via plastic pieces located along the edge of the dock. The plastic collars have a hole in the middle, allowing room for the poles stated above. The dock floats up and down these poles depending on the water level. The more of the pole that is

visible correlates to a lower water level and *vice versa*. The dock consists of guardrails on either side which stay consistent with the boardwalk, as they are there for guidance for visitors.. Using an online photo measurer (https://eleif.net/photo_measure.html), the guard rail height will be measured to represent the constant. This being a unit of one, the pole height is then measured using the guardrail's unit height. This has been repeated for the left side pole and the right side pole and an average was calculated (figures 2-6). The process was repeated for every photo throughout the eight years. Using the calculations found, using the guardrail's real height of 18 inches or 45.72 centimeters, the height of the pole above the walkway on each day has been calculated.

*Time Lapse Video*

Using all of the photographs without the measurements, videos are be composed of both sides. All of the photographs have been placed in chronological order and displayed for a short time in order to represent a time lapse. These videos are each about one minute in length and composed of around 80 photographs each. These photos were obtained randomly and do not reflect evenly throughout time. Differences throughout time and from season to season are able to be physically seen. More snow can be seen in the years 2013-2016 versus 2017-2021. It is also notable that the pole is more visible in the earlier years and almost unable to be seen in 2021. This displays an increase in water level over the years, almost steadily.

*Data Analysis*

All of the measurements collected throughout each photograph have been be placed in an excel sheet and converted to centimeters. This tells how much of the pole is visible at any given time. Once converted and arranged chronologically, the data table was then converted into a

scatter plot to better visualize the water level over time. Plots made and shown above look at each season throughout the eight years.

**Results:**

Overall, 192 data points were collected. This includes 96 measurements from the left side and 96 measurements from the right side of the dock. The number of photos from each year are ten from 2013, 40 from 2014, 44 from 2015, 30 from 2016, 22 from 2017, 20 from 2018, ten from 2019, 18 from 2020, and two from 2021. Broken down into seasons, 52 photographs were from winter, along with 52 from spring, 30 from summer, and 59 from autumn. There was not an even distribution of photographs obtained.

From the years 2013-2017, the pole can be seen through the dock at a much higher height then it can be after 2018 (figure 7). Presently, in 2021, the pole is only centimeters above the plastic collars and is almost completely obscured from view, although it was over 2' above the collar in 2013. More snow can be seen in the years 2013-2016 versus 2017-2021. Looking at the time lapse videos, it can be seen that 22 photographs from 2013-2016 show snow/ice while 2017-2021 only show 8. From 2013-2016 there are 124 photographs while 2017-2021 only has 72. Statistically, this implies that around 18% of the photographs show snow/ice in 2013-2016 while only 11% is seen in the later years. It is also notable that the pole is more visible in the earlier years and almost unable to be seen in 2021. This displays an increase in water level over the years, almost steadily.

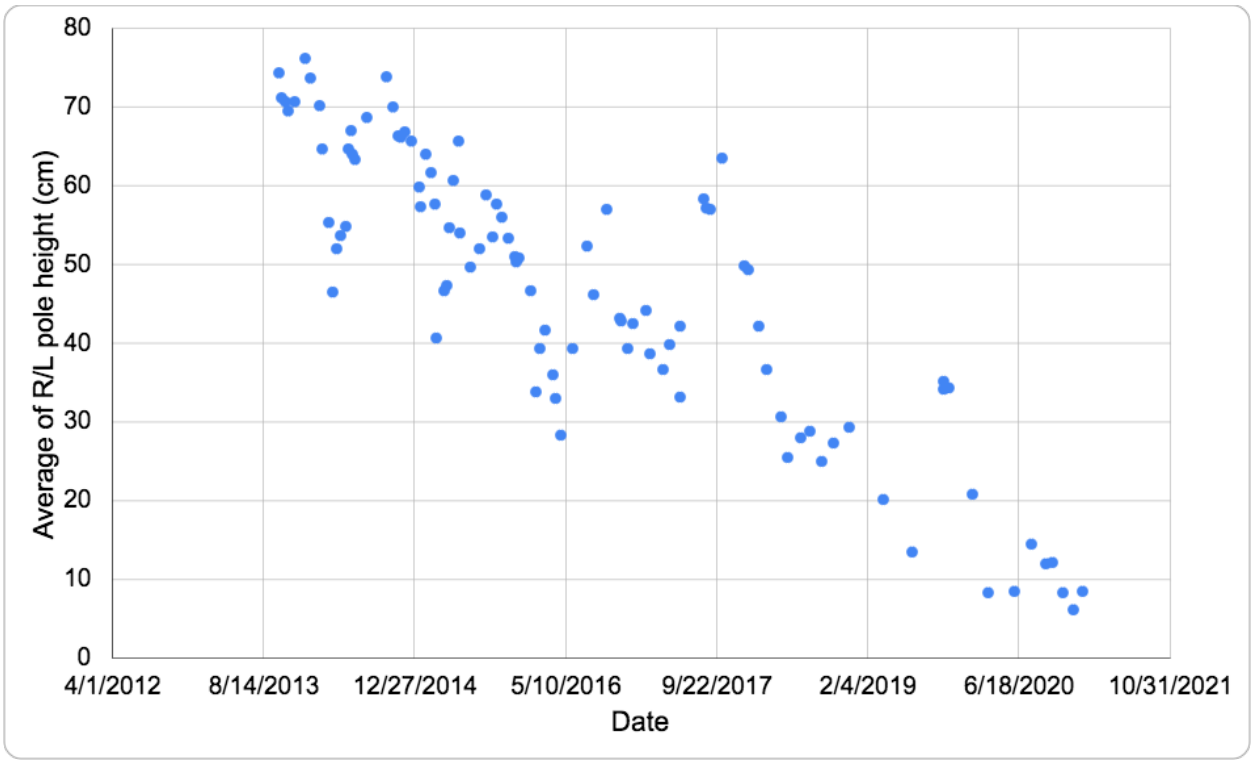
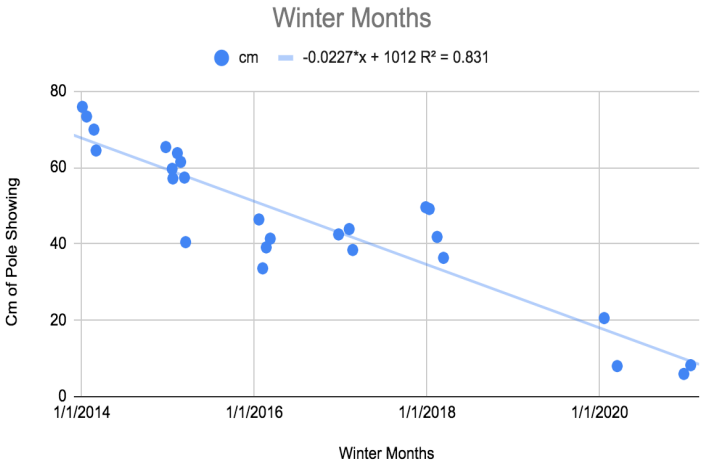
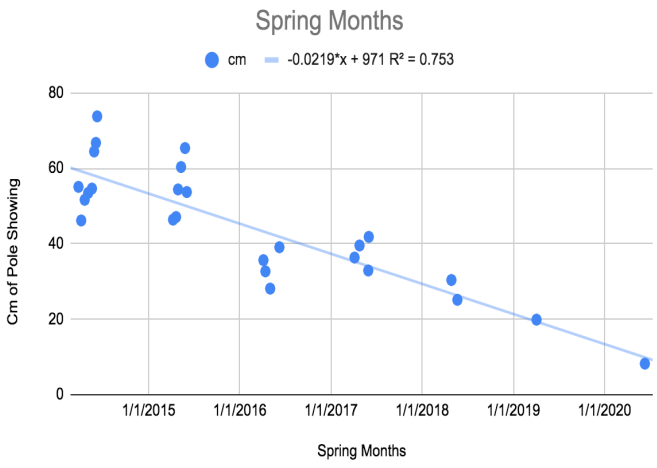
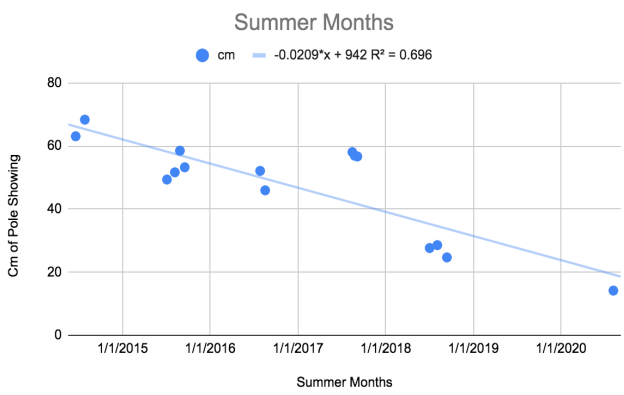
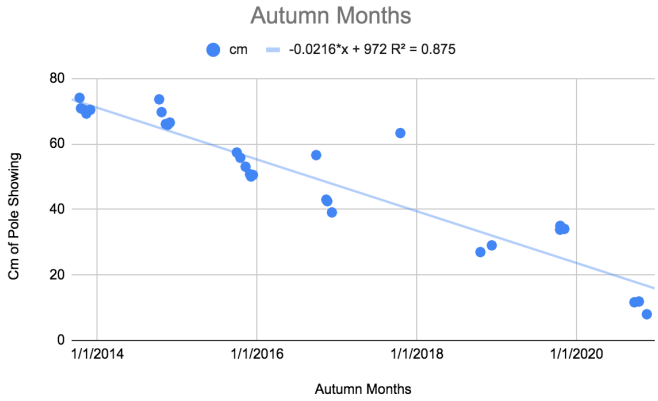



Figure 7-The average height of the right and left side poles shown in centimeters plotted with their corresponding date from 2013-2021






Figures 8-11 display the measurements obtained organized by season.

Looking at seasonal changes, the water level tends to be more closely related in the earlier years. Spring shows the greatest variation, as this may have to do with precipitation rates. Each season individually shows the same relationship as the overall trend, a steady decrease in pole height or a steady increase in water level.

The vegetation in the area includes some seasonal plants and some year round. Throughout the time lapse videos (linked below) it can be seen that the seasonal plants tend to come and leave around the same time each year. They appear to be around the same in amount each year, and the year round plants appear to be acting similarly from year to year as well.

**Discussion:**

Water levels are increasing globally, but small bodies of water may be influenced by factors that can be controlled. A species that has recently come to the Bath Pond is the *Castor*

*canadensis* (beaver). These species build dams that can increase water level in a specific area. It is known that the beavers are building dams in the southern outlet of the pond (figure 12-13). The dams are contributing to the ponds increase in water level. Further research is needed in order to comprise a solution for the increasing water level and to determine if the beavers location could affect the amount of water change.

Figure 12 and 13 show the south end of the Bath Pond and the beaver dams in May 2020.

Depending on beaver population numbers, there may be too many beavers and not enough predators. *Vulpes fulva* (red fox) and *Canus latrans* (coyote) are two of the beaver's predators. Their populations could be low in relation to the beavers, allowing more beavers to build more dams. This could pose the possibility of removing beavers from the area, or obtaining or producing more fox and coyotes. Another possible solution would be creating man made streams as a way for the pond to drain. This would allow the beavers to stay in the area and create more water areas as an attraction. This would need a high planning period, the land would have to be thoroughly examined to contract a design to properly execute this. The pole in the dock could also be lengthened to allow more water. This solution could result in the water taking over some the land and increasing in size, not just height.

Overall, through the use of photographs and time lapse video, it can be seen that the water in the Bath Pond is increasingly rising. If action is not taken soon, the water will push the dock to its maximum height and soon flow over the dock, making it inaccessible. Precipitation, the beavers, and draining are all factors to take into consideration.

**Acknowledgments:**

I would like to take the time to thank Dr. Randall Mitchell for finding this research opportunity for me and taking all these interesting and informative pictures. Thank you to Dr. Duff and Dr. Niewiarowski for being readers for my project and giving me feedback on my work. Finally, I would like to thank the Bath Nature Preserve for considering my research as a way to interpret changes occurring at their pond.

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