Report Template

Precipitation's Effects on River's Dissolved Oxygen

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Abstract

This report examines the relationship between precipitation and dissolved oxygen (DO) levels in a river, hypothesizing that precipitation decreases DO by increasing nutrient runoff. The experiment was conducted over several weeks, measuring DO and nitrate concentrations on both dry and rainy days. Precipitation amounts were monitored alongside changes in DO, with additional focus on nitrate and nitrite levels to assess nutrient runoff.

The results showed that days with precipitation generally had lower DO levels compared to dry days. For example, on November 6th, with the highest precipitation (0.43 inches), DO levels dropped to 5 mg/L, while on drier days, DO peaked at 8 mg/L on December 6th. Nitrate concentrations were highest on November 8th (0.5 ppm) and November 26th (0.3 ppm), coinciding with rainfall, supporting the hypothesis of nutrient runoff. Nitrite levels remained at 0 ppm and had no significant impact on DO.

These findings suggest that even modest precipitation can influence DO levels by affecting nutrient runoff. The trend observed highlights the need for further research to examine the effects of larger precipitation events. This study underscores the importance of understanding how environmental factors, like rainfall, impact river ecosystems, particularly concerning water quality and aquatic life.

Introduction

How do weather and rainfall affect the dissolved oxygen of the Ottawa River? If wind and precipitation are above average, then the dissolved oxygen of the Ottawa River will decrease because rainfall can wash away important nutrients into creeks and decrease dissolved oxygen within a few days of rain.

River health is essential, more than what one would think. The river's health is critical to the community's overall well-being by affecting the water supply. When nutrients are washed away, the water quality of a river worsens and damages the surrounding environment. Understanding how weather impacts a river's health is vital to helping the environment. Dissolved oxygen levels tell us the amount of oxygen available for organisms to breathe, when essential nutrients are washed away due to rainfall, this damages dissolved oxygen levels and harms aquatic life.

Heavy precipitation is defined as excessive or unnormal amounts of rain or snow depending on location and season. According the EPA (n.d), climate change can produce more intense precipitation. Excessive precipitation increases risks of floods, erosion, and causes many issues for river health. Firstly, heavy rainfall leads to runoff, depleting the river of vital nutrients. A lack of nutrients, like nitrogen and phosphorus, leads to increased algae that eventually deplete oxygen as the algae die and decompose, blocking sunlight from reaching the river (University of Michigan, 2019). Extreme rainfall can sometimes result in the release of sewage water into rivers which damages how sanitary the water is. Especially in areas where rivers are used as water sources this can be extremely dangerous, causing

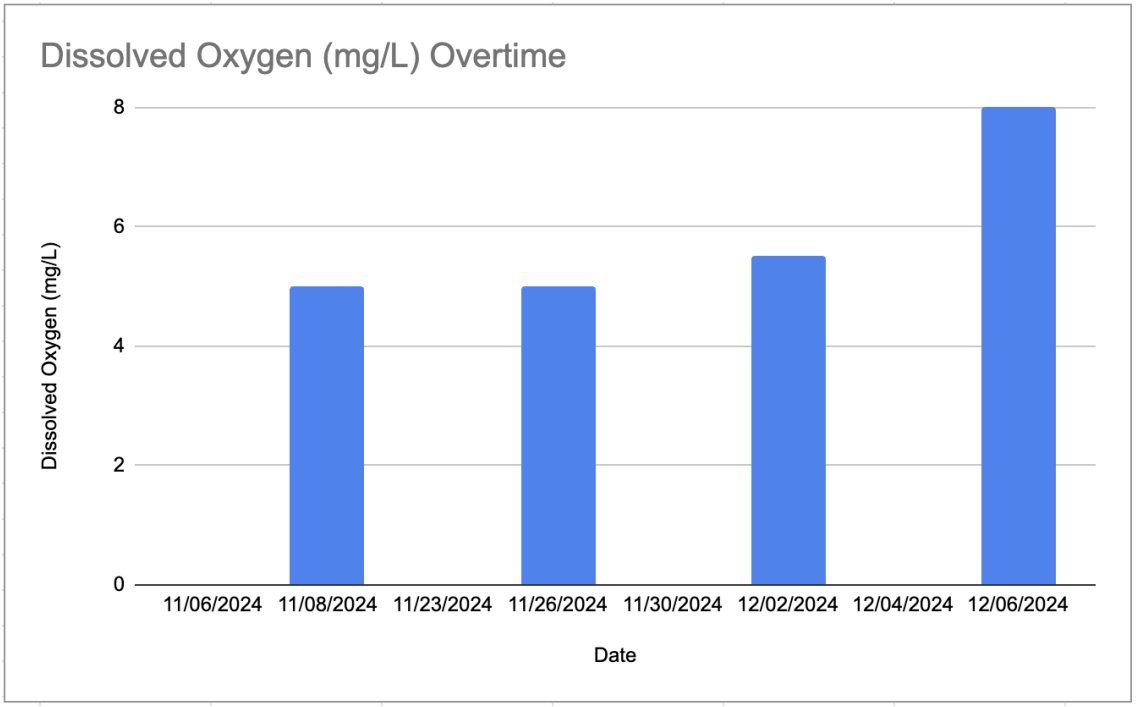
diseases or issues (Fourth National Climate Assessment, 2023). Intense rainfall stirs up sediments in the riverbed, limiting photosynthesis. Heavy precipitation disrupts the natural oxygen distribution. The heavy precipitation increases oxygen levels initially, leading to more fish activity which causes more fish kills, disrupting the river's ecosystem. (Rossana Sallenave, 2019). With oxygen levels depleting, biodiversity is impacted leading to a less diverse and fragile ecosystem (Scripps Institution of Oceanography, 2018).

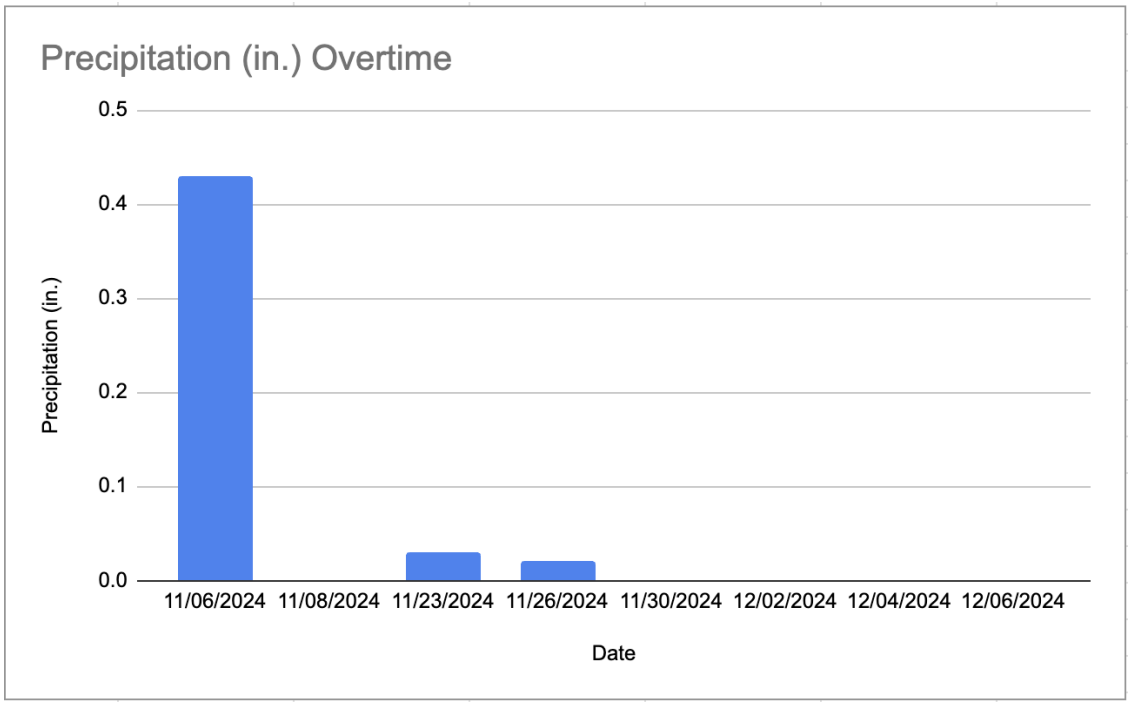
Heavy precipitation can have detrimental affects on the health of rivers by exausting dissolved oxygen levels, which are vital for the survival of organisms. Runoff carrying sewage pollutants, nutrients, and organic matter contributes to oxygen depletion, harming biodiversity and disrupt ecosystems. By addressing these challenges, solutions can be made in order to replenish the health of freshwater resources.

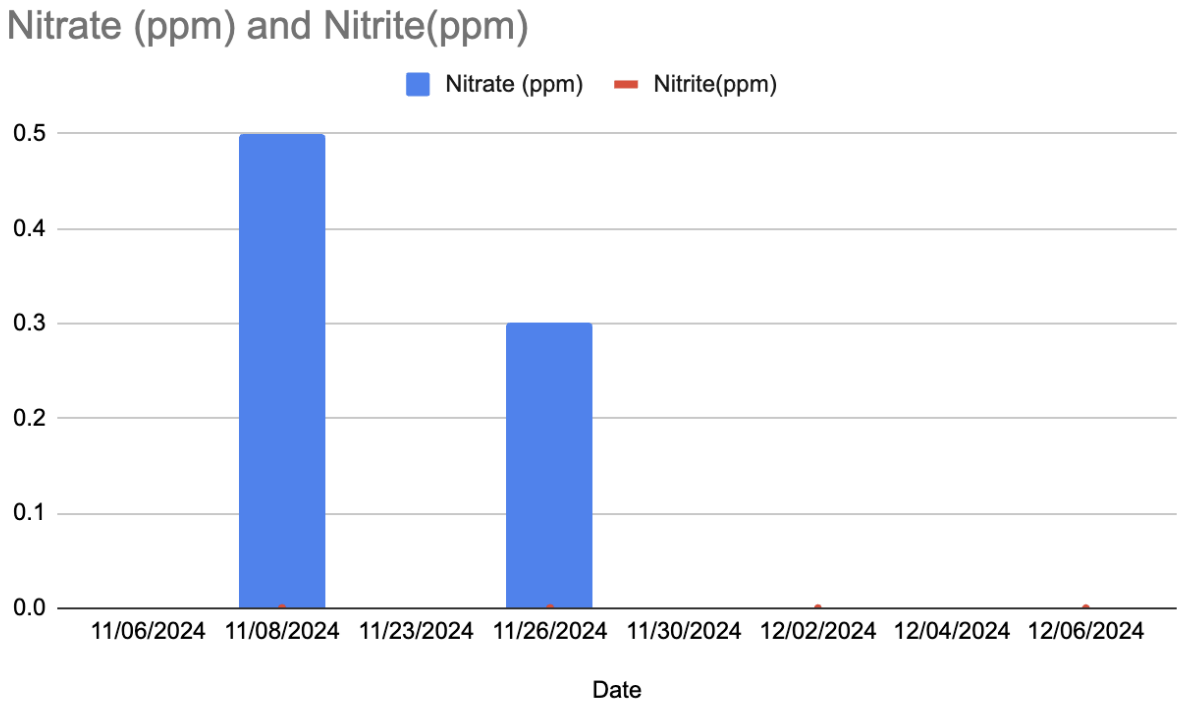
Methods and Materials

First, I recorded the date and recorded the water temperature that I received from Dr. KG. Then, I gathered all of my materials I would use which involved a WaterWorks nitrite and nitrate test strip kit which required me to dip it into the river water for a second then I let it sit for 30 seconds. Then I compared the color to the colors on the test strip container to determine the level the nitrates and nitrites are at. Next, I recorded the dissolved oxygen levels through the CHEMets Kit. It required me to grab a 25mL sample of the river water, place an ampoule tip into the water and break off the tip and allow the river water to fill. Then I inverted the stick several times. After it completely filled, I dried the stick and let it sit for two minutes. Then I color matched to the kit's dissolved oxygen levels to determine the level. The hydrosphre GLOBE dissolved oxygen, nitrate/nitrite, and water temp protocols were used. To gather weathering factors, I used the website Weather Underground to find the weathering history of my area during the days tested.

Presentation of Data and Results







The days with no dissolved oxygen levels were untested dates from which I had collected data from precipitation levels. Nitrite and nitrate wasn't tested on November 6th, 23rd, 30th, or December 4th. Nitrate levels had been highest on November 8th being at 0.5 ppm, the second highest was on November 26th at 0.3ppm. The rest of the tested days it was at 0ppm while nitrite levels were 0ppm each tested day. The precipitation levels was highest on November 6th at 0.43 inches, on November 23rd it was at 0.03 inches, and on November 26th it was 0.02 inches. Other than those dates, it remained at 0 inches. Dissolved oxygen levels was at 5mg/L on November 8th and 26th. On December 2nd, it was 5.5mg/L and on December 6th it was at 8mg/L. Dissolved oxygen levels slowly increased over a period of time, precipitation was highest in early November but then usually remained at 0 inches besides November 23rd and 26th, and nitrate was highest on November 8th and had one other instance on November 26th but normally remained at 0ppm like nitrites.

Analysis and Results

This study aimed to test the hypothesis that precipitation would decrease dissolved oxygen levels in a river. The data showed that dissolved oxygen levels tended to be lower on days with measurable precipitation, supporting the hypothesis. For example, on November 6th, with the highest precipitation (0.43 inches), dissolved oxygen was recorded at 5 mg/L. In contrast, on drier days, oxygen levels were higher, reaching 8 mg/L on December 6th. Nitrate levels peaked at 0.5 ppm on November 8th and 0.3 ppm on November 26th, which corresponded with days when there was precipitation. Nitrite levels stayed at 0 ppm throughout the study.

Given the small sample size (only a few days with measurable precipitation), more robust statistical analysis, like correlation or regression, would be needed to fully assess the relationship between precipitation and dissolved oxygen.

Multiple factors could've been done to better the experiment. The small number of data points makes it difficult to draw strong conclusions. Additionally, environmental factors like temperature or biological activity, which weren't controlled for, could have affected the results. To improve the experiment, more frequent sampling and a broader range of data would help clarify the relationship between precipitation and dissolved oxygen. Controlling for other environmental factors and performing more detailed statistical analyses would reduce uncertainties and strengthen the conclusions.

Conclusion

This experiment aimed to explore the impact of precipitation on dissolved oxygen levels in a river, with the hypothesis that precipitation would decrease dissolved oxygen levels by increasing nutrient runoff. The results supported the hypothesis, as the data showed a general trend where days with precipitation had lower dissolved oxygen levels compared to days with no precipitation. On November 6th, when precipitation was highest (0.43 inches), dissolved oxygen was lower (5 mg/L), while on drier days, oxygen levels were higher, peaking at 8 mg/L on December 6th.

Nitrate concentrations were highest on November 8th (0.5 ppm) and November 26th (0.3 ppm), coinciding with days that had higher precipitation, further supporting the idea that precipitation might influence nutrient runoff and oxygen levels. Nitrite levels remained at 0 ppm throughout, which did not appear to have a direct impact on dissolved oxygen.

While the relationship between precipitation and dissolved oxygen was more apparent with small amounts of precipitation, higher levels of precipitation might show a more significant effect. These results suggest that even modest amounts of precipitation can influence dissolved oxygen levels, likely through nutrient runoff, and further studies with greater variability in precipitation could provide a clearer picture of this relationship.

.Discussion

If this project were to be repeated, improvements could include more frequent data collection, especially during higher precipitation events, to capture a wider range of conditions. This would expand the analysis to include additional water quality datasets like temperature and pH would provide a fuller picture of the factors influencing dissolved oxygen. A longer study period would also help account for seasonal variations in oxygen levels.

This research can inform water management practices and policies, particularly in urban and rural areas, by helping to understand the impact of precipitation on water quality and aquatic ecosystems. The findings could support strategies to mitigate nutrient runoff and protect aquatic life.

For further study, research could explore the effects of different types of precipitation (e.g., heavy vs. light rain) and the role of land use (urban vs. agricultural areas) on water quality. Expanding the study to multiple rivers with different environmental conditions could offer insights into regional differences.

This study aligns with existing research that shows precipitation can increase nutrient runoff, affecting dissolved oxygen levels. However, it also highlights that even small amounts of precipitation can influence oxygen levels, suggesting the need for more research to fully understand these dynamics.

Acknowledgments

Dr. Kreischer-Gajewicz

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