Using Water Quality Data and Particulate Matter Chemistry to Investigate Low Dissolved Oxygen Concentrations In The Forest River Watershed, Salem MA

Lucas Connatser, Douglas Allen
Department of Geological Sciences, Salem State University, Salem, MA

INTRODUCTION

A study done last year, found that the Forest River Watershed had areas with low levels of dissolved oxygen in the Forest River itself (Reid 2020). During the study, there was a drought and since then, the river has been recharged. Knowing all of this two hypotheses have been made.

- In the forest river park watershed, the low dissolved oxygen environment seen in the study last year (Reid 2020) will still exist after the recharge from the rain this area got over the summer.
- In the low dissolved oxygen environment, microorganisms are acting as oxygen reducers and are playing a part in creating this kind of environment.

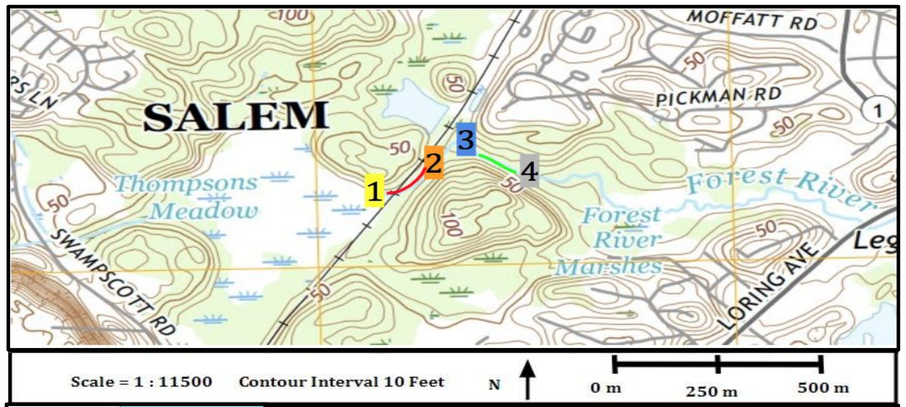

Figure 1. Map of the water testing and sampling area on the Forest River in Salem Massachusetts. Areas of concern are highlighted on the map.

METHODS

- A multiparameter YSI Sonde 6600 was used to measure the dissolved oxygen content of the Forest River.
- One liter Nalgene water bottles were used to take samples of the water at each of the four locations.
- The water samples were filtered and prepped in capsules to run through the Elemental Analyzer and Isotope-Ratio Mass Spectrometer.
- Samples were run through the Elemental Analyzer and Isotope-Ratio Mass Spectrometer to find ratios with Carbon, Nitrogen, and Sulfur to be able to use in a Meyers style plot.

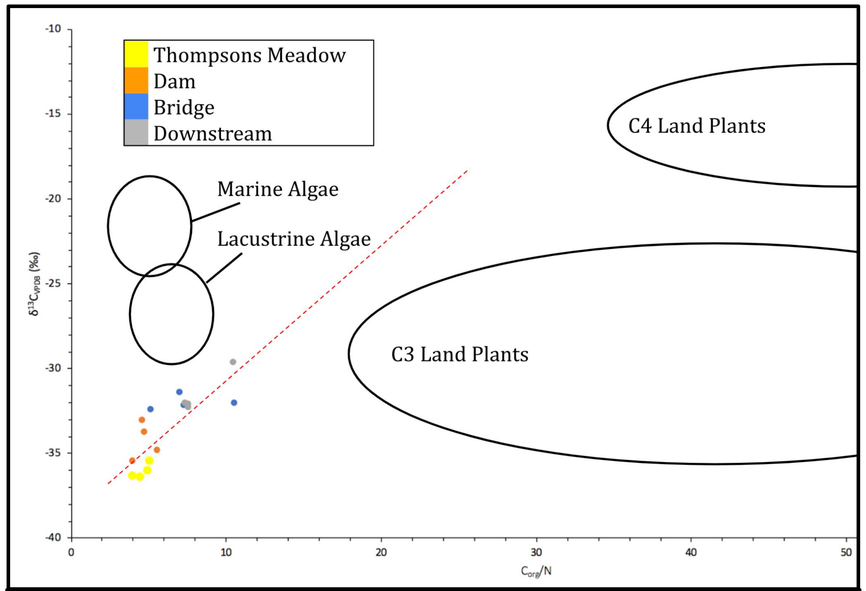

Figure 2. This is a Meyers style plot (1994) which shows δ13C vs C/N of particulate matter in the middle of the water column. Data was expected to be inside of the lacustrine algae zone. The data shown is thought to exist because of the nearly anoxic environment or because of the possible existence of man-made chemicals in the water. The red line shows the possible mixing between the algae found in the testing area and C4 Land Plants. The data shown shows a downstream progression of a higher percentage of C4 Land Plants to Algae.

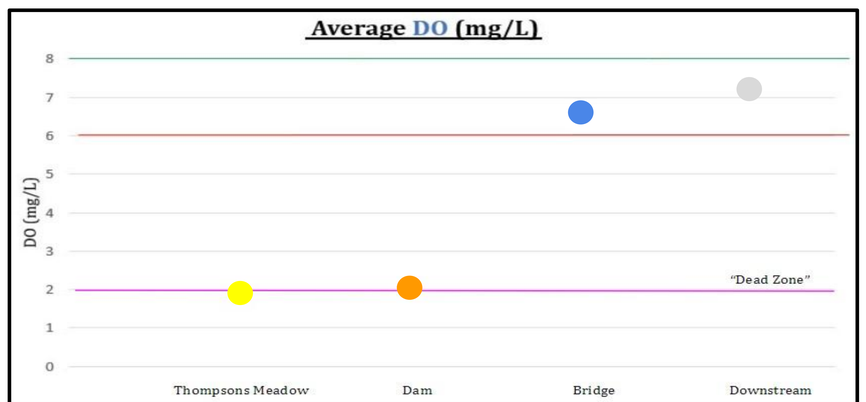

Figure 3. This is a graph showing the average Dissolved Oxygen (mg/L) in Forest River, Salem Massachusetts at each of the 4 testing locations. Below the red line is water that does not have enough DO for most fish to live. Between the red and green line contains enough DO for some fish to live, breeding is possible but not very successful. Above the green line contains enough DO for most fish to live and breeding is successful. Below the pink line is known as the Dead Zone where many organisms are killed.

DISCUSSION

As seen in figure 1, the DO content has changed from last years study (Reid, 2020). The testing done with the YSI Sonde 6600 has shown that the low DO environment has changed from being in the Dam and Bridge region to Thompsons Meadow which is the source of the Forest River and the Dam region, which can all be seen in Figure 1. This data supports the first hypothesis. The data shown in figure 2 was hoped to show the existence of microorganisms that could be contributing to the low DO environment. This was not the case. The main idea to the reason behind the data being skewed as of now is this existence of the low oxygen environment seen in Thompsons Meadow and the Dam. It has been seen before that in areas with low oxygen, organisms that are decomposing get biologically reworked. As this happens Carbon 13 rich amino acids and sugars get removed and what is left behind is very light lipids. This could explain why the delta C13 values seen in figure 13 are so low.

Location #	1	2	3	4
Location Name	Thompsons Meadow	Dam	Bridge	Downstream
DO (mg/L)	1.79	1.97	6.66	7.31
Standard Deviation	0.44	0.49	0.41	0.35
DO (mg/L) from last year (Reid 2020)	6.63	3.13	1.88	10.15

Figure 4. This is a table showing a comparison between the data that was collected this year and the data collected last year (Reid 2020).

CONCLUSION

The results show that an environment with concerningly low amounts of dissolved oxygen still exists in the Forest River. However, the data collected is not conclusive enough to say what is causing the existence of the low DO environment. A few theories now exist so we can to attempt to explain the phenomenon seen in figure 2, however I believe more research will need to be done in the future to have a definitive answer to what is causing this environment to low dissolved oxygen.

References

Meyers Philip. A., 1994, Preservation of elemental and isotopic source identification of sedimentary organic matter: Chemical Geology, v. 114, p. 289-302, doi:10.1016/0009-2541(94)90059-0. Reid, B., Allen, D., Hanson L. (2020). The Evolution of the Forest River Water Quality Due to Anthropogenic Impacts. 1-7.