

Measuring Mercury in Runoff from Burned Watersheds

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Table of Contents

Acknowledgments.....3
Executive Summary.....4
Project Objectives.....5
Project Approach.....6
Project Outcomes.....8
Conclusions.....10

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Executive Summary

Wildfires affect the biogeochemistry of a watershed. This has the potential to cause negative effects on the aquatic environment of the watershed, such as eutrophication from increased nutrients released into the water environment. This study involves various analyses of water quality for creeks affected by the Camp Fire. The focus of my work in the lab was nutrient analysis using ion chromatography. Throughout the project I was able to work on the whole research process from sampling to analyzing data.

Project Objectives

This project focused on the impact of wildfires on the water quality of affected watersheds. This was accomplished by analyzing several water parameters. The larger study included measurements of metals, anions, mercury, total organic carbon and total dissolved nitrogen. I was to be involved in the processing of the samples beginning with collection of water samples from several creeks. In our lab, the testing for anions and preparation of samples for the others were performed. I would be directly using ion chromatography to measure nutrient content in the water. I was to also help in managing the data in collaboration with the other labs collecting data for the other analyses.

The project was originally set to focus on watersheds affected by the Carr Fire and Delta Fire. After the Camp Fire occurred in November 2018, the project shifted to focus on the watershed affected by this event. The same analyses will be performed on samples collected from the plots affected by the Carr and Delta Fires using the rainfall simulator at a later date. Although the location changed, I still gained experience in the analysis of natural water sources to determine the health of a watershed after a wildfire event.

Project Approach

To begin this research, water samples were collected from the creeks in the watershed. This included various sampling locations along Butte Creek, Big Chico Creek, Clear Creek and Dry Creek. Locations were chosen to represent various severities of the burnt watershed, see Figure 1. Sample collection began at the first storm after the Camp Fire occurred and continued through the raining season. The majority of the samples were taken using an ISCO autosampler which was an efficient way to collect multiple samples over a few days. Some samples were hand collected therefore I was able to gain experience in collecting water samples in the field through several trips to the sampling location. I learned proper sample collection in the open environment. This included how and where to take samples from a creek.

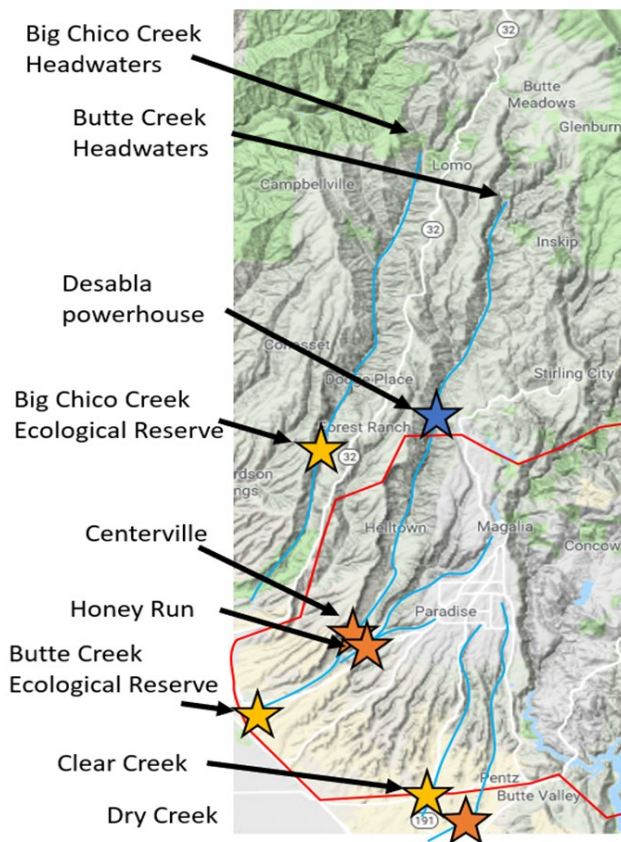


Figure 1: Location of Creeks for Sampling

While some tests were performed soon after they were collected, others were to be performed at other labs or once we had the proper instruments. Before any analysis, the water samples had to be prepared according to the type of analysis required. The samples were all tested for metals and ions. The first step was to filter the samples. This varied as samples for metals had to be filtered with a cellulose acetate filter while ion analysis required a glass fiber filter. During filtration for metals, a measurement of total suspended solids was made by measuring the volume of water filtered through pre-weighed filters and weighing after drying the used filters. Some samples required acidification for proper preparation and storage. I learned to follow proper procedures in the laboratory to carefully prepare samples. While sample preparation was occurring, some preliminary measurements of pH, electrical conductivity and turbidity were also taken for each sample.

Analysis for specific ions was performed once a liquid ion chromatography instrument was installed during summer. I was able to learn how to use this instrument as I analyzed the samples we had previously collected. The concentration of the anions in the sample were determined after calibration with a standard solution. Serial dilutions of the standard set the detection limits of the concentrations of ions. The standard solution allowed measurements of the following analytes: fluoride, chloride, nitrite, bromide, nitrate, phosphate and sulfate. Anions were identified based on a characteristic retention time within the column. From the graphs produced by the instrument, the anion concentrations were determined by integration of the curves and using the calibration curve.

Project Outcomes

After data collection, data analysis began with producing the calibration curves from the ion chromatography. The calibration curves for each ion were created by linear regression of the results from the standard and its dilutions as shown in Figure 2. From the equations from these graphs the concentrations for each sample could be calculated from integration of the chromatograms. The analytes found in most samples were fluoride, chloride, nitrate and sulfate. Of these, nitrate and sulfate were of greater interest due to the possibility of the source being burned material and their effects on the biogeochemistry of the watershed. It was found that greater concentrations of ions were found in the creeks which experienced a higher burn severity as shown in Figures 3 and 4. Further data analysis is required to determine trends in the results from all the types of testing performed on the samples.

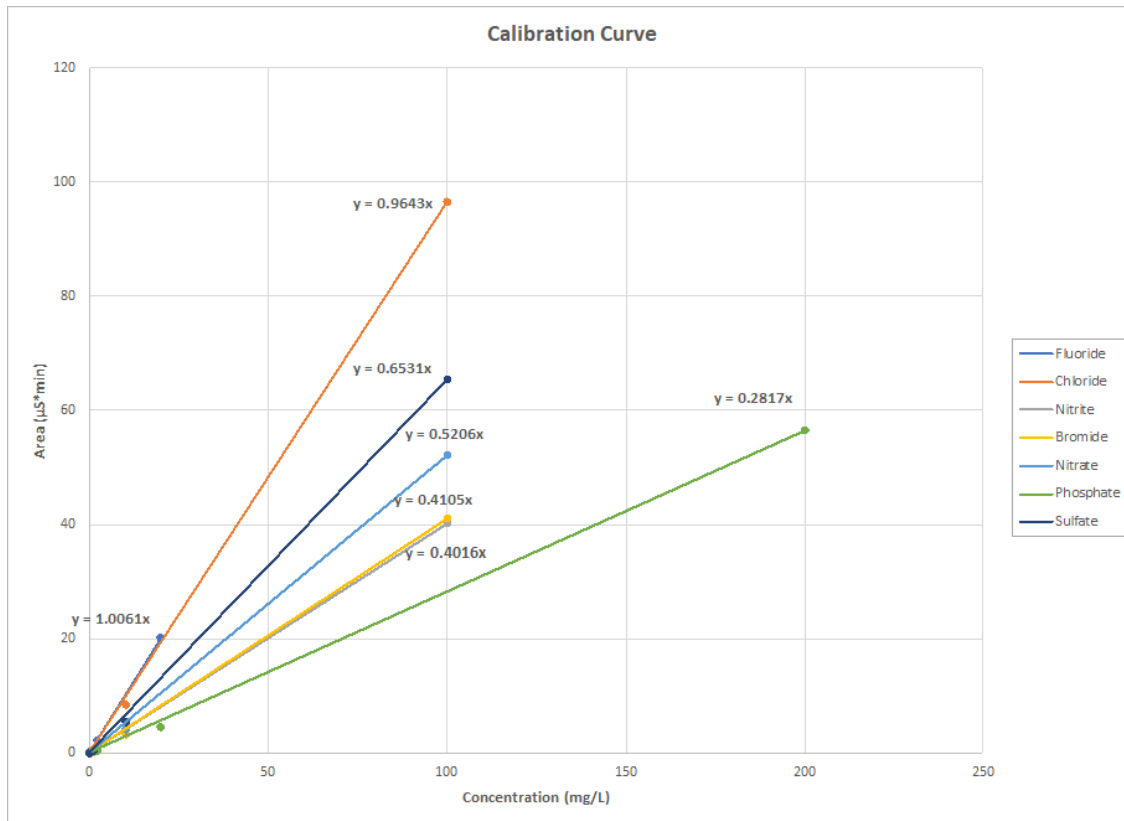


Figure 2: Calibration Curve for Anions

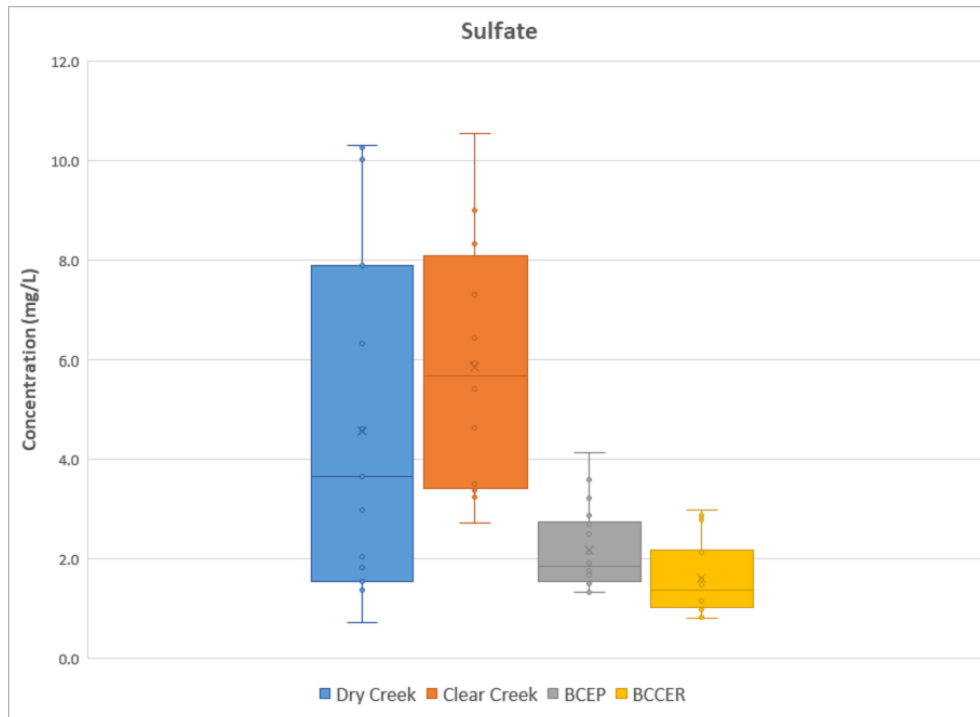


Figure 3: Sulfate Concentrations in the Creeks

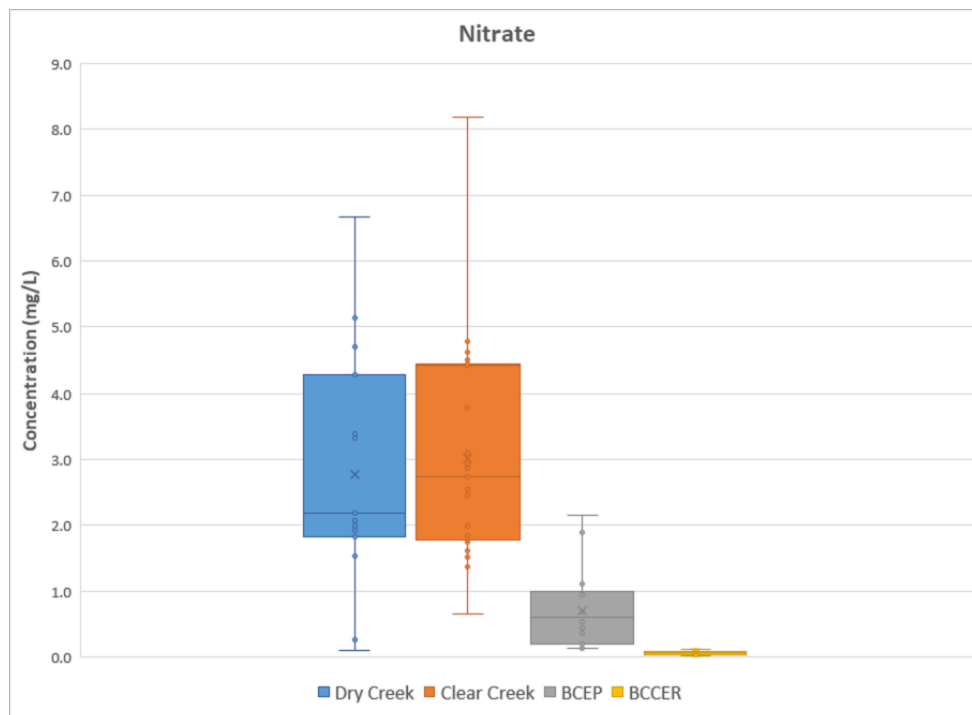


Figure 4: Nitrate Concentrations in the Creeks

Conclusions

Through this project I gained experience in following lab techniques for testing water quality. I practiced proper handling of water samples during collection and lab testing. I also gained experience with laboratory equipment used for water quality analysis. Compiling and calculating results allowed me to practice analyzing data. I learned the importance of organization in data analysis as the data was collected for samples over several months and for the variety of measurements for each sample. This internship provided valuable insight into the monitoring required in watershed management.