UNDERSTANDING THE EFFECT ON THE POPULATION OF *E. COLI* WITH THE IMPACT OF THE ACID MINE DRAINAGE (AMD) IN ELY BROOK.

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ABSTRACT

Acid Mine Drainage (AMD) is the most persistent environmental pollution problem which affects worldwide streams. The AMD results of the natural oxidation of sulfide minerals contained in mining wastes (Sheoran et. al 2010). The AMD is recognized by the low pH that can produce. When this acidic flow enters to a stream affects many organisms because the majority of them live in neutral pHs. One of the organisms that is affected by this environmental problem in streams is the bacterium *E. coli*. This bacterium is in higher concentrations in many worldwide streams causing contamination on this water bodies, but it is affected because they can't live in a pH of 2.0 for more than 24- hours (Mehsen et. al, 2010). The method that will be used to know how the population of E. coli can be affected by the AMD is taking samples of *E. coli* in three different parts (upstream, mixed area and downstream) in Ely Brook nearly to Ely Mine. The process form of dilution with water will be 1:1 for *E. coli* samples. The materials for this research are: colilert, sealer, incubator and UV light for count the presence of *E. coli* in each quantity tray. The objective of this research is to understand how the population of *E. coli* can be affected before and after the Acid Mine Drainage impact and how the population varies in different pH.

INTRODUCTION

○ The Acid Mine Drainage (AMD) is classified as one of the main problems that affect worldwide streams and is the most persistent environmental pollution problem which occurs in coal and metal mining regions (Sheoran *et al*.,2010).

○ Acid Mine Drainage affects the streams getting acidification and occasioning death to organisms due of the low pH that this water body promote.

○ As an example, this chemical reaction represent the oxidation process of Pyrite(FeS_2). This process occurs when Pyrite contact with oxygen, water and the presence of the bacterium *Acidithiobacillus ferrooxidans* who start the acidic reaction.

$$2FeS_2(s) + 7O_2(g) + 2H_2O(l) \rightarrow 2Fe^{2+}(aq) + 4SO_4^{2-}(aq) + 4H^+(aq)$$

○ *E. coli* is a bacterium that can be present in many places, such as beaches, lakes, rivers and streams. The interest for choosing this bacterium, as a model, is because streams around northeastern U.S. have a decent concentration of them and they can be influenced, affected or impacted by the Acid Mine Drainage (AMD) because they often live in neutral pH .

OBJECTIVE

➢ Analyze how it is the relationship between pH and the concentration of the model organism (*E.coli*) before, during and after the AMD impact.

STUDY AREA

Figure 1. This GIS- map represent the location of Ely Mine and Ely Brook in Vershire, Vermont.

-The sites where samples was collected.
- Where Ely Mine is located. And where the acid drainage start.

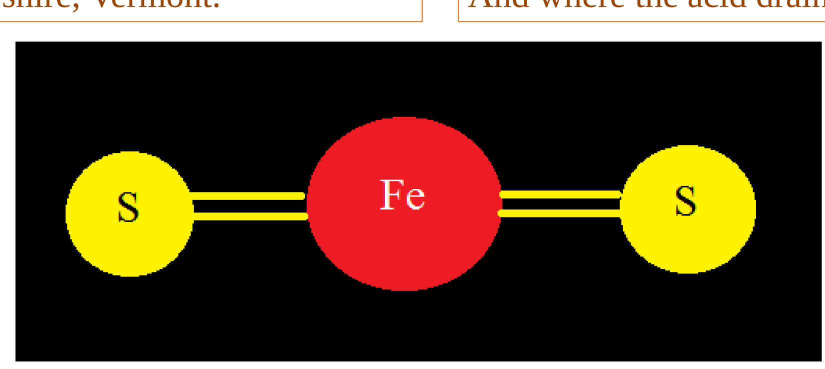
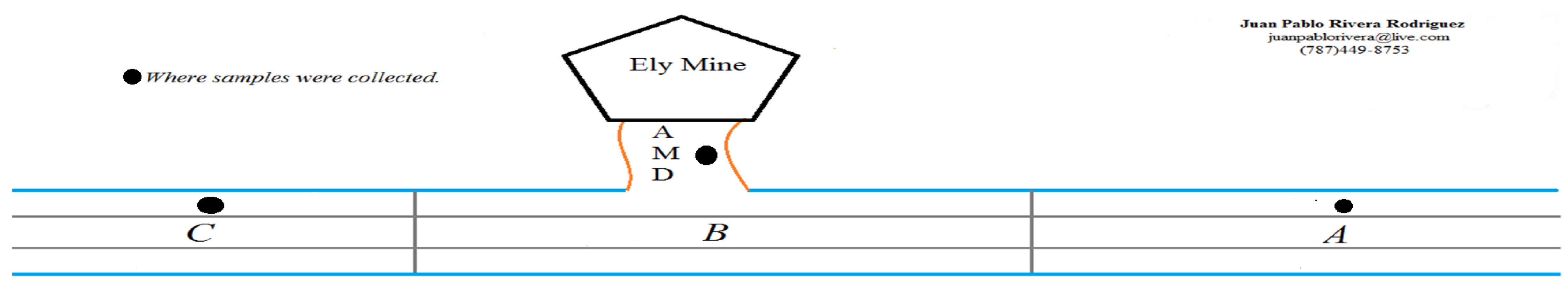


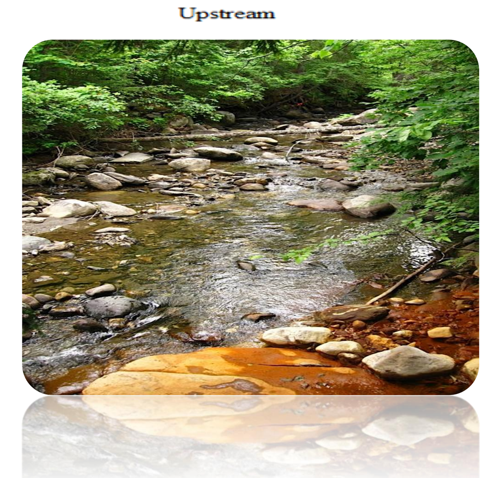
Figure 2. This is the molecular form for Pyrite (FeS_2) . Pyrite is a mineral that is made of Iron and two atoms of Sulfur.

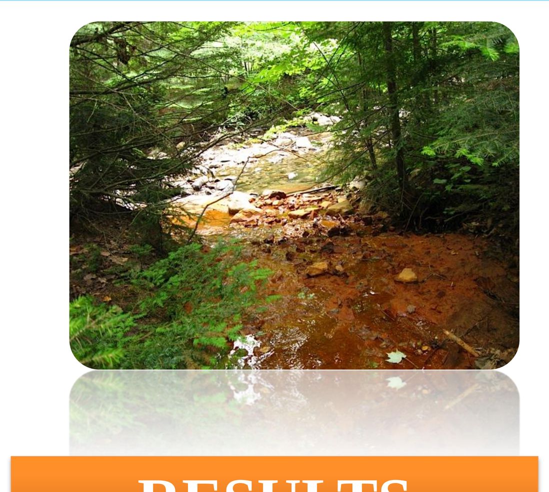
METHODOLOGY

Take *E. Coli* samples (100 ml) from Ely brook → Dilution 1:1 with water. → Quantity Trays and colilert → Sealer → Incubator- For samples 24 hours → UV Light → Reading samples



Upstream





Downstream

RESULTS

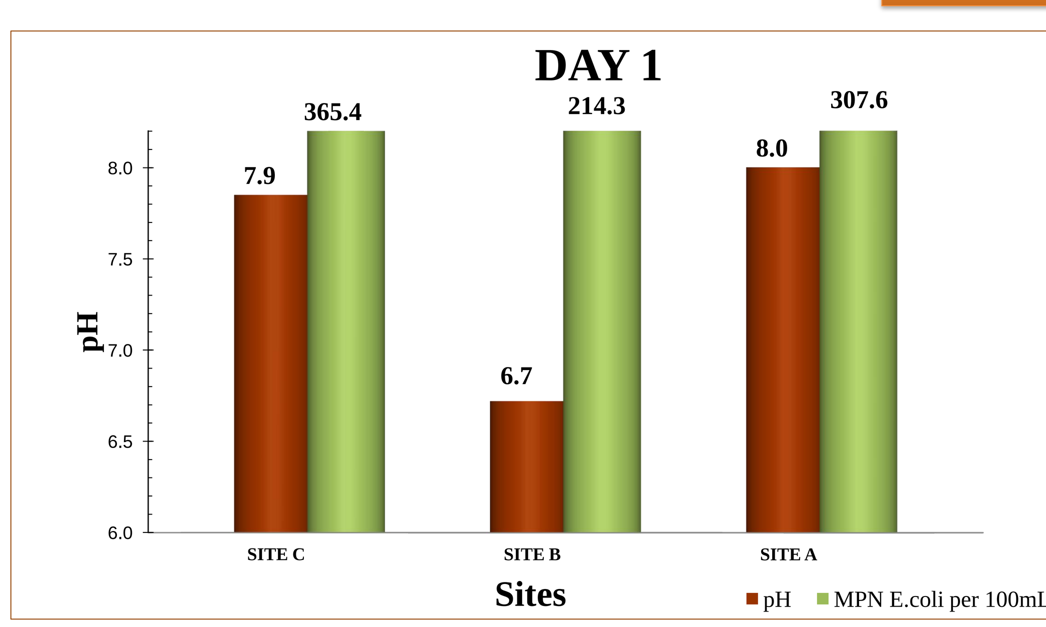


Figure 3a. This graph represent the relationship between the concentration of *E. coli* and pH in each site for DAY 1.
In DAY 1, the results of pH and *E.coli* became more higher because was a raining day and the water flow increases making more basic the water body in site B.

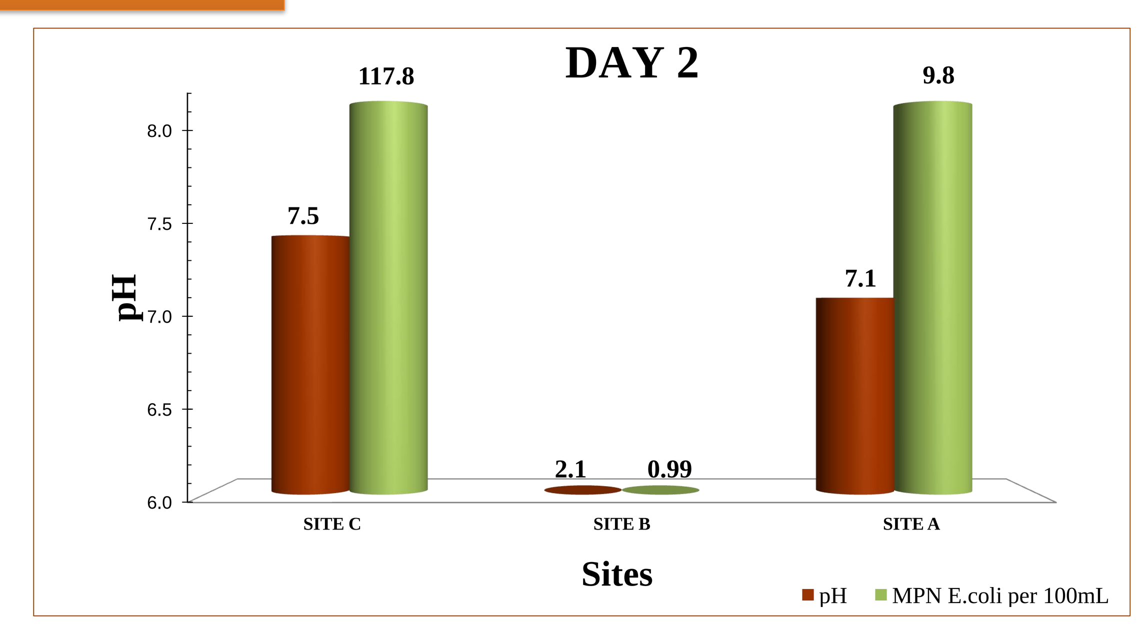


Figure 3b. This graph represent the relationship between the concentration of *E. coli* and pH in each site for DAY 2.
In DAY 2, the results decreases because was sunny, day and there was a low water flow in the stream.

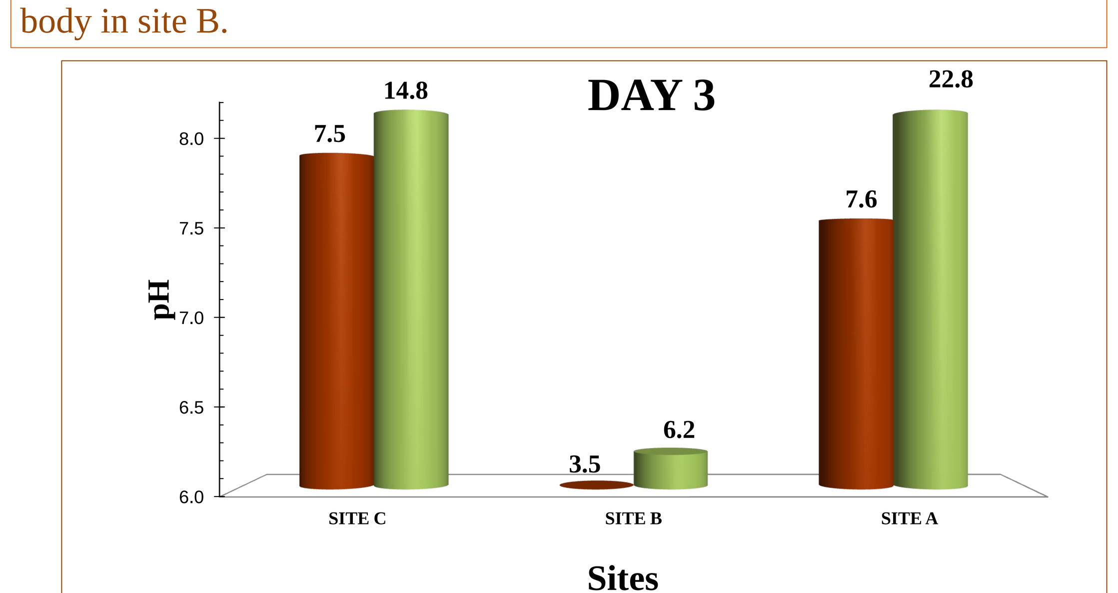


Figure 3c. This graph represent the relationship between the concentration of *E. coli* and pH in each site for DAY 3.
In DAY 3, the results was intermediate ones because was a cloudy day and the water flow was moderate.

Figure 4a. The buffering process is caused by the neutralization that occurs when water and acid get mixed. This reaction promote the white color in rocks.

Figure 4b. Site B, is the most important site because is where acid enters to the stream affecting the model organism.

DISCUSSION

➢ The results suggest that *E. coli* can be affected by the Acid Mine Drainage.

➢Through the path of *E. coli* in Ely Brook (site A) a population of *E .coli* survived the impact of the AMD, but they depend of the environmental conditions such as climate and water flow.

➢The buffering process occurs when the acid from the mine and the stream basic water are mixed. Then is develop an adaptation process due to the buffering area that allows the survival of *E. coli* after the AMD impact.

➢According to the *E .coli* analysis there was a pH of 3.5 in site B (middlestream) which means in results that some types of *E. coli* can live at that pH.

➢The AMD is a source of contamination in streams and decreases the concentration of *E.coli* in Ely Brook.

➢The y axis for the concentration of E. coli do not appear because the graphs are for visualization issues.

FUTURE WORKS

➢What type of *E. coli* can survive after the impact of the Acid Mine Drainage?

➢ What type of *E .coli* can survive in a pH of 3.5?

➢ Make a relationship between the measures of water flow of Ely Brook and Ely Mine.

LITERATURE CITED

➢Alan T. Herlihy, Mark E. Mitch, Philip R. (1989) Kaufmann *Water, Air, and Soil Pollution* 50: 91-107.

➢A.S. Sheoran*, V. S. (2010). Geochemistry of Acid Mine Drainage: A Review. *Envorimental Research Journal* , Vol.4 Issue3/4.

➢Gary K. Bissonnette and Mark L. Double. Enumeration of coliforms from streams containing acid mine water. *Water Pollution Control Federation* , Vol.52, No.7.

➢Department of Microbiology and Immunology, U. o. (2004). Detection of *Acidithiobacillus ferrooxidans* in acid mine drainage environments using fluorescent in situ hybridization (FISH) .

➢Ely Mine: EPA'S Proposed Cleanup Fact Sheet, March 2002

➢Jennings, S.R., Neuman, D.R. and Blicker, P.S. (2008). "Acid Mine Drainage and Effects on Fish Health and Ecology: A Review". Reclamation Research Group Publication, Bozeman, MT.

➢H.Al-Zoubi, A. R. (2010). Nanofiltration of acid mine drainage. *Desalination Publication* , 148-161

➢McGuinness, S. (1999.). Treatment of Acid Mine Drainage. *Science and Environment Section.House of Commons Library.* , Research Paper 99/10.

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