The Effect of Rainfall on Fecal Coliform in the Lake Waco Wetlands

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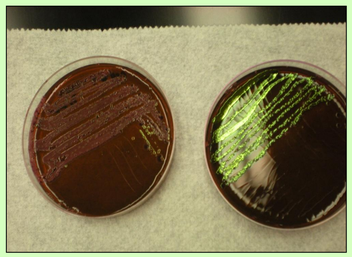
Abstract:

The primary objective of this project was to determine if Lake Waco Wetlands was reducing the amount of fecal coliform as water passed through the cells. The hypothesis stated that the amount of fecal coliform would decrease as the water flowed through the various cells of the wetlands. Water samples were collected from four cells in the wetlands. The Standard Qualitative Analysis of Water was utilized to detect fecal contamination. A series of tests which included the presumptive test, the confirmed test, and the completed test were utilized to determine whether fecal coliform was within the water samples. If fecal coliform was present, a Gram stain identified if the bacteria was *E. coli*. The results showed the MPN (most probable number of coliform)/ 100 mL declined as the amount of coliform flowed through the wetlands. It was concluded that the natural purification system was doing an adequate job of reducing fecal coliform as water flowed through the wetlands.

Introduction:

Fecal coliform is a bacterium that is found in the waste products of animal intestines. In small amounts, this pathogen is not harmful. However, in large amounts they can indicate the presence of harmful bacteria such as *Vibrio cholerae*, and *S. typhimurium*. Fecal coliform presence in the Waco's wetland water can denote the water quality available to the residents. In addition, average rainfall amounts may be associated with a significant increase in the fecal coliform numbers (Hill et al 2006). This work demonstrates the effectiveness of a filtration system to eradicate fecal coliform bacteria as water flows through the cells of the wetlands, and how rainfall affects fecal coliform numbers. Harmful products in drinking water raise daily concerns about human health. If water is not treated properly, it can easily hurt a large population in a short period of time. Numerous waterborne pathogenic diseases can be eliminated with proper monitoring of water quality (Carey 2007). Measuring the amount of pathogens in each stage of the purification process will show whether the purification system is effectively removing the pathogens before it becomes drinking water.



Materials and Methods:

Materials:

EMB plate, incubator plate, test tubes and lactose broth, petri dish, filter paper, indole reagent, crystal violet, iodine, acetone alcohol, Safrinin, microscope

Method:

Collecting Data: Samples were collected with sterile cups. Cell one sample was collected near the water pipe which brings in water from the Bosque River. Samples from cell two and cell three were collected near the beginning of the cell. Cell four sample was collected at the end of the cell. Each location was relatively close to the shore and was in a low-movement area.

A. Presumptive Test

- Obtain three sets of three test tubes. Label each set as A, B, or C.
- Fill each set with a different lactose strength level (3-ds, 6-ss, or 0)
- Add each set with a different amount of water (10 ml, 1 ml, .1 ml)
- Incubate all tubes for 24-48 hours at 37^{O}C
- If there is gas and acid presence, move onto the Confirmed test. If there was no reaction, the test indicates no signs of pathogens.

B. Confirmed Test

- Put a streak of the water sample on the EMB plate ; incubate plate
- If no green colonies develop, the water is drinkable. If green colonies develop, move on to Completed test.

C. Completed Test

- Inoculate 1 lactose broth and 1 nutrient agar slant from the same EMB plate. Do this for each sample that tested positive for the Confirmed test. Incubate plates.
- If there is evidence of fermentation (acid and gas), then this indicates the presence of pathogens within the sample.

D. Gram Stain (Bauman, Talaro)

- To determine the type of pathogen, conduct a gram stain.
- Results:
  - Gram +: bacteria with thicker-wall of peptidoglycan
  - Gram –: bacteria with thinner-wall of peptidoglycan

Results:

In the first trial, Cell 1 had 39MPN/100mL, Cell 2 had 21MPN/100mL, Cell 3 had 93MPN/100mL, and Cell 4 had 43MPN/100mL (Figure 1). The peak of this trial occurred in Cell 3 and then gradually declined in Cell 4. Furthermore, in the first trial, Cell 1, Cell 3 and Cell 4 indicated presence of *E. coli*, and there were no specific detections of any pathogens in Cell 2 (Table 1). In the second trial, Cell 1 had 43MPN/100mL, Cell 2 had 23MPN/100mL, Cell 3 had 23MPN/100mL, and Cell 4 had 23MPN/100mL (Figure 1). The results indicated that the amount of coliform decreased from Cell 1 to Cell 2 and then remained constant. In the second trial, Cell 1, Cell 3, and Cell 4 indicated presence of *E. coli*, and there were no specific detections of any pathogens in Cell 2 (Table 1).

Literature Cited:

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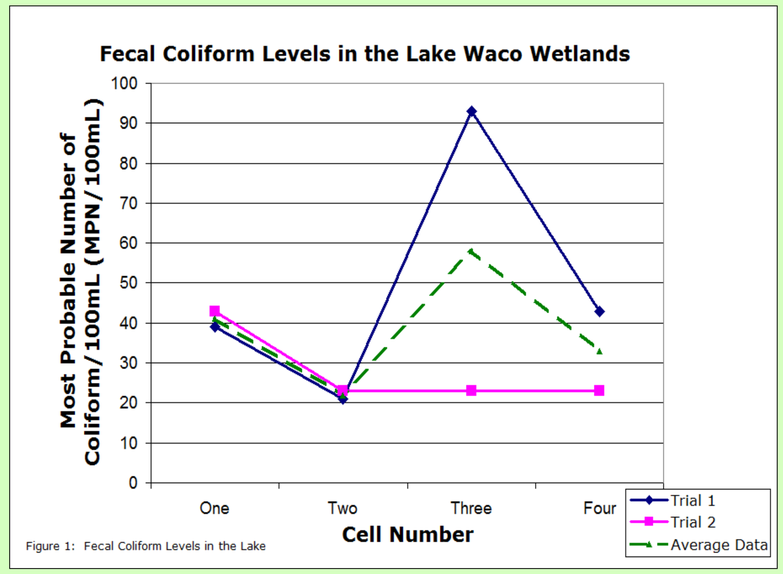

Figure 1: Fecal Coliform Levels in the Lake

Table 1: Presence of Bacilli or E. coli in Each Cell in Lake Waco Wetlands

	Cell 1	Cell 2	Cell 3	Cell 4
Trial 1	E. coli	Not detected	E. coli	E. coli
Trial 2	E. coli	Not detected	E. coli	E. coli

Discussion:

The water in the first cell contains the most bacteria due to the fact that the water supply stems directly from the North Bosque River. The wetland water system may naturally filter the water through sediment, leaving pathogenic microorganisms behind, therefore less bacteria is present when the water enters subsequent cells. Though the amount of fecal coliform is not entirely depleted, it can be implied from the data that the wetlands lessen the amount of harmful bacteria. However, the process of water filtration is not instantaneous. Water is filtered slowly, so extra water introduced to the system by way of precipitation can quickly throw the filtration system off track. Large amounts of rainwater combined with the natural flow of the wetland water system can lead to copious amounts of bacteria being washed into the later cells. Before the first sample was collected, two storms produced 1.22 cm of rain. This may have caused a peak in the amount of fecal coliform pumped into the wetlands indicating the third cell held the most bacteria as opposed to the expected outcome of the first cell being the most abundant. Nonetheless, the subsequent samples were in concurrence with the hypothesis. Apart from the adverse affects of the occasional rainstorm, the wetlands does its part in the decontamination of harmful bacteria and pathogens in water.

Conclusion:

By examining Waco's wetlands water supply, it is appropriate to conclude that the natural filtration system of the wetlands is eradicating fecal coliform bacteria as it flows through the marshes. The wetlands are a natural purification system in which plants and soils in the wetlands play a significant role (Oram 2009). It is crucial for one to understand the value of wetlands in the United States and all around the world. Therefore, the significance behind this project was to reveal the role of wetlands in purifying water and the effects of rainfall on fecal coliform.

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