Water Quality Analysis in Bluefields Bay, Jamaica during March 2022

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Abstract

WATER QUALITY ANALYSIS IN BLUEFIELDS BAY, JAMAICA MARCH 2022. Hannah Lowery, Biology. Allison Gargus, Geography. Faculty Advisor: Dr. Robert Pavlowsky. Bluefields Bay, Jamaica uses local stream and spring systems for secondary drinking water sources, clothes washing, bathing, and recreation. Water quality in this area is vulnerable due to poor economic development, pollution from human activities, and karst geology where groundwater can be affected by surface pollution. The objectives of this study were to assess water temperature, salinity, specific conductance, and bacteria at 12 sites along four stream and spring systems, including outflow from a Mangrove forest. Using prevailing water conditions and observed land-use characteristics, sampling sites were evaluated for water pollution risk. Good water quality conditions were found in more secluded areas away from the public, where streams flow through healthy wetlands, and at spring heads where ground water is discharged below mountain bluffs. Poor water quality conditions were found at sites near populated areas with greater densities of crude septic systems used for domestic waste treatment. The qualitative colorimetric bacteria test used in Jamaica was calibrated with a standard method (IDEXX) using samples from five Springfield, Missouri sites. Future work to improve water quality in Bluefields Bay includes informing the community about water resources management practices and developing a system for community program for water quality monitoring.

Methods

Sampling Site		
#	Water way	Location
5	Sawmill	Water intake
6	Sawmill	Pimenta Factory
7	Sawmill	Main road (ds)*
8	Water Wheel	Near spring head
8.1	Water Wheel	Main road (ds)
12	Bluefields River	Below spring head
11	Bluefields River	Water intake
10	Bluefields River	River Top bridge (us)
9	Bluefields River	Main road (us)
15	Big Dismel	Spring
13	Blue-Hole	Spring
14	Creek	Main road (us)

* upstream of road at trib confluence on first sampling run

The sites were selected based on usage by the community of Bluefields Bay. Temperature (℃) , specific conductivity (ms/cm), and salinity (ppt) were measured by use of a YSI Pro 30 conductivity/salinity water quality instrument.

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EZ Coliform Cult-MUG containers were used to test if bacteria was found in the water. These samples were placed in a dark area for two days in order for the solute to react to the potential bacteria that was in the water sample.

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The bacteria color scale ranged from clear (no bacteria detected) to dark blue (bacteria detected). The intensity was measured by visual judgement on scale from 0 to 2.5; with 0 being no color change, 0.5 being little color change, 1 being noticeable color change, 1.5 being mediocre color change, 2.0 being highly noticeable color change, and 2.5 being vivid color change.

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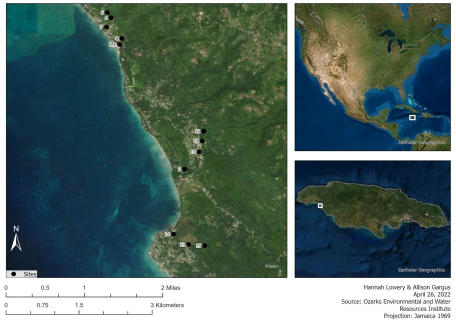
Five IDEXX water samples were conducted in Springfield, MO to ensure consistency throughout the study by comparing data to that taken in Bluefields Bay, Jamaica.

Conclusion

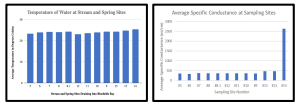
The main factors affecting water quality in Bluefields Bay are due to communal bathing and washing of household items and clothing. Pollution in the waterways also comes from plumbing leakage and water collection for drinking. In some cases, animal feces and other contaminants from wildlife (like pesticides) can contribute to poor water quality. This is in part due to the thin soil layers on top of the white limestone that does not offer much protection against surface pollution (Karanjac 2005). We can address this problem by gathering water for drinking upstream and bathing/washing more downstream, as well as not collecting water for drinking during the busy weekends when an increased number of the community is out bathing. Fences also help to protect the spring heads, as noted at Site 5 with a fence when compared to Site 12 without a fence at the spring head. A better way to address this water quality predicament is by having sufficient plumbing and showers for everybody in the community so that the water is safe to drink everywhere along the waterways during all periods of the week. The bottle method that we used to gather our bacteria data from the streams and springs is also accurate enough for screening of the water quality by local groups in Jamaica based on the comparison of the total coliform and test color observed.

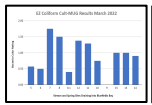
Study Area

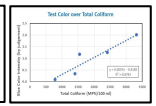
Water Quality Sites in Bluefields Bay, Jamaica



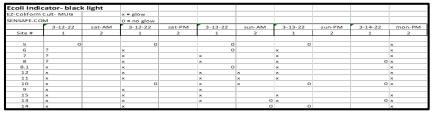
Results







Note: The main issues affecting this water quality are saline water intrusion, especially along coastal aquifers as a result of prolonged withdrawal of water and nitrate contamination in populated areas (Mandal 2011). This is experienced the most at the site 14 creek mangroves where the salinity is >2000 ppm unlike the rest of the sites where it is <2000 ppm.

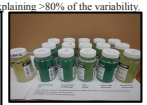


Discussion

The community of Bluefields used the water sites for multiple purposes including drinking water, bathing, and washing. These factors contributed to the abnormal growth of bacteria during the days when human activity was more common in the water (the weekends when they would wash their clothes and bathe). Conductivity measures the ability of water to pass through an electrical current (EPA 2021). If dissolved salts and inorganic chemicals are present in the water, conductivity will increase with salinity. The warmer the temperature of water, the higher the conductivity. This indicates that pollution has entered the waterway. Human disturbance increases conductivity. Several investigations exist which use planktonic communities as indicators of water quality in Jamaica and Caribbean Bays (Webber 2005). This is similar to the idea that we used when testing the water quality by using the EZ Coliform Cult-MUG to detect the organic presence in the water. If the solution changed colors and glowed under a blacklight, this indicated the presence of E. coli. If the solution changed colors but did not glow, there were other organic materials present. According to USEPA, drinking water should have zero coliform. Thus, if we get any reaction or color change in the water sample, the site should not be used for consumption. We also compared the bottle method to IDEXX samples taken in Springfield, Missouri and the Coliform counts are positively related to the color values with a linear relationship explaining >80% of the variability.

Bacteria Trends in Springfield Springs and Streams				
Site	Total Coliform	Ecoli	Color	Blacklight Intensity
1	3100	290	2.0	XXX
2	2420	23	1.3	XX
3	1414	63	0.3	0
4	1553	20	1.2	X
5	791	26	0.1	0

Black light glow may indicate >60-100 MPN/100 ml
Mix limits between 125 or 300 MPN/100 ml (check)

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