Tetrahymena as a Bioindicator of Water Quality in the East River

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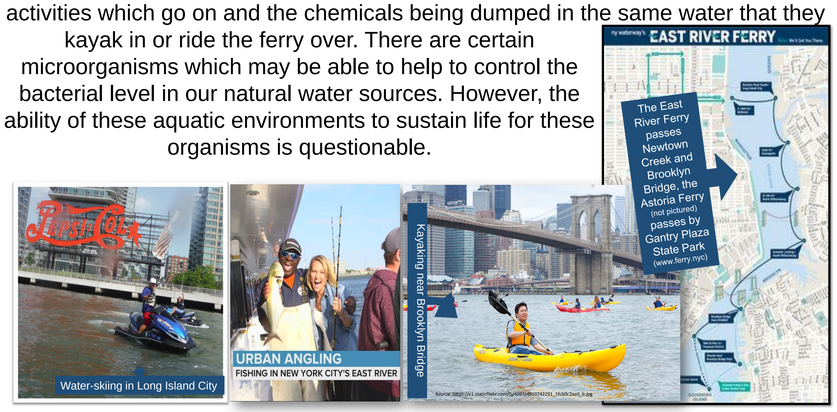
Introduction

The East River in New York City is a popular and active waterway. Often used for travel, transport and pleasure, this waterway is one which the humans of New York come in direct and indirect contact with in various ways. However, the quality of the water is in question. It is crucial for the people of New York to be aware of the activities which go on and the chemicals being dumped in the same water that they kayak in or ride the ferry over. There are certain microorganisms which may be able to help to control the bacterial level in our natural water sources. However, the ability of these aquatic environments to sustain life for these organisms is questionable.



Question

Is the chemical composition of our East River water samples one which can support life of Tetrahymena cells? If not, how might this impact the quality of the East River water? What does this microorganism offer to the ecosystem?

Hypothesis

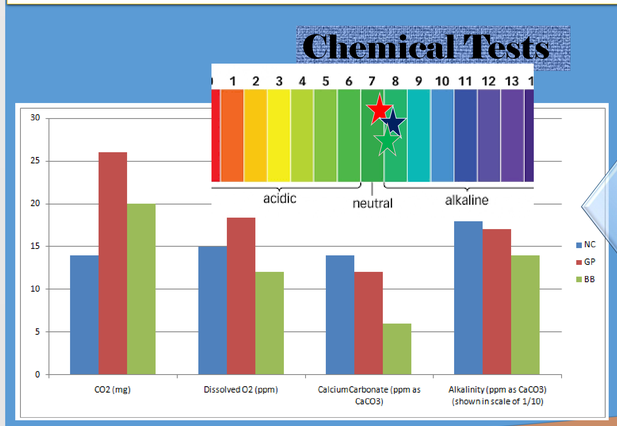
If the Tetrahymena are placed in the water samples from the East River, and they are unable to perform phagocytosis to form food vacuoles, then the water quality of the East River is low for these organisms.

Methods

We sampled three locations along the East River: Gantry Plaza State Park (Blue Star), Newtown Creek (Red Star), and Brooklyn Bridge Park (Green Star). Then, we performed tests (Dissolved O2, CO2, Alkalinity, Calcium Carbonate, and pH) to get an idea of the chemical composition of the water. Finally, we observed the ability of Tetrahymena to survive and thrive in these environments. We observed the rate of phagocytosis and morphology of these cells the East River water samples.

Results & Observations

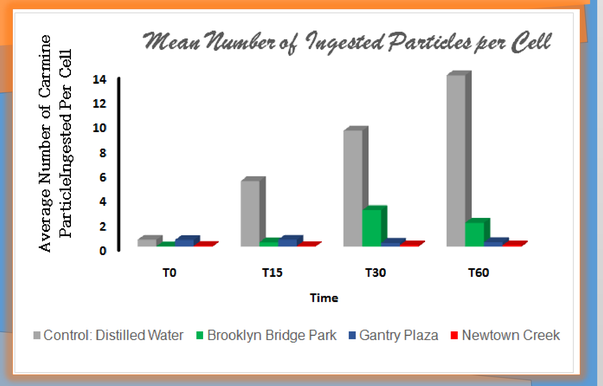
Chemical Tests

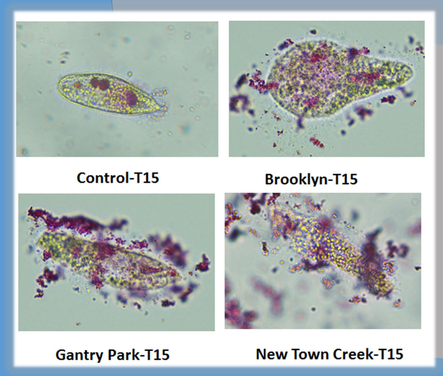


- The pH values of all three samples were found to be slightly basic, ranging from 7.9 – 8.4.
-Alkalinity and Calcium Carbonate tests were between 140-180 ppm and 6-14 ppm, respectively.
-Brooklyn Bridge Park scored lowest for Alkalinity, Calcium Carbonate, and Dissolved Oxygen tests of all three samples but the highest for CO2.

Rate of Phagocytosis

-The best surviving experimental group, Brooklyn Bridge Park, had an average rate of phagocytosis which was only 21% of that experienced in the control group (5.31/20.31).
- The highest rate of phagocytosis, 14.05, was seen in distilled water at T60. The highest rate of phagocytosis seen amongst the control groups was 3.25 at Brooklyn Bridge Park at T30 during Trial 1.
- After an average rate of 2.75 at T30 (Trial 1 & 2 combined), there was a decline observed in the Brooklyn Bridge sample. At T60 the average rate was 1.95.
-About 82% of all cells observed from East River water samples at T60 were altered and completely hindered from performing phagocytosis.





Cell Morphology

-100% of cells in the control group maintained their natural, pear cell shape.
-58% (24/40) of Brooklyn Bridge group cells suffered altered morphology at T60. This is compared to 83% (33/40) in Gantry Plaza group and 92.5% (37/40) in Newtown Creek group.

Discussion

- All three East River samples proved to be unsupportive of life for the Tetrahymena cells. The majority of the cells observed were altered from their original morphology.
- The high alkalinity level may provide stressors in the East River which alter the morphology of the Tetrahymena cells.
- The “structures [of Tetrahymena cells] reflect the physiological state of the cell” (Sauvant 1636). Thus, alterations of the structure of Tetrahymena cells affect the functional abilities of that cell and its metabolic processes.
-Studies have shown “bacterial-protozoan association may increase opportunities for transmission of… bacterial pathogens to mammalian hosts” (Smith 1).
- Further, there are certain protozoan which are able to consume and kill bacteria, thus preventing their potential effects (Smith 1).

Conclusion & Future Work

-Because most of the Tetrahymena cells were not able to survive in the East River, their ability to perform phagocytosis was severely hindered.
-The abnormally high levels of calcium carbonate and alkalinity may have an influence on the altered morphology of Tetrahymena. Thus, NYC residents should understand and limit their contribution of salt to the East River.
-We should aim to understand which protozoan organisms are able to sustain life in the East River and then understand their unique relationship(s) with bacterial bodies.
- Water quality reports found from the EPA covered bodies of water which supply drinking water to NYC, but non were located which reports specifically on the East River.
- Future work should include an analysis of the protozoan and bacterial populations in the East River. Further, the relationship between these should be studied to better understand how the quality of water may be effecting humans.

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