

Swims in Water & Walks on Sand

Paula Yorke, Deborah Tulloch, Michael Floy, Danson Tang, & Dr. Jessica Joyner



Abstract:

Through the year, Coney Island Beach in Brooklyn, NY receives about 12,000,000 visitors on average. Due to the heavy presence of people, the sanitation and safety of the beach has been a concern. To ensure human safety and health on Coney Island Beach, there are about two lifeguards per section, daily beach grooming, and weekly bacterial testing by the Department of Environmental Protection. Humans influence their environment as a part of daily living, even at the scale of environmental microbiomes. Such changes could impact human health if pathogens like *Escherichia coli* (E-Coli), *Enterococcus faecalis* (Enterococci), and *Staphylococcus aureus* (Staph) are found within or introduced to the soil and water. Throughout this study, bacterial concentrations increased with human presence. The presence of human borne bacterium raises concern for public health and popular recreational sites.

Introduction :

When one goes to beach their bacteria is left behind through various ways causing the amount of bacteria on the beach to fluctuate. An example of some common found bacterial species includes *Escherichia coli* (E. coli), a gram negative bacteria (thick cell wall) 1 (EXON et al.2016) bacteria that lives in the intestine of warm blooded organisms. These bacteria thrive on beaches because of the warm, moist sand that provides a breeding ground for them. This perfect environment for these bacteria is brought by wastewater, runoff and garbage. Another common bacteria found on beaches is *Enterococcus faecalis* (Enterococci). Enterococci is a bacteria that is normally found in the gastrointestinal tract of humans and animals. This bacteria is also able to thrive because of high sewage levels and the amount of garbage that is present daily. Lastly, *Staphylococcus aureus* (S.aureus) is a gram-positive bacteria (thin cell wall) and also a member of the human flora (microorganisms) on skin 2 (Exon et al., 2017).

This study focuses on the quantities of bacteria present in Coney Island beach located in Brooklyn, New York, specifically in the intertidal and supratidal (splash) zones. It is hypothesized that the largest quantities of bacteria will be found within in the supratidal zone. In this zone the sand rubs against skin which leads to a higher number of bacteria. Therefore the intertidal zone will have less bacteria than the supratidal zone.

Methods:

1. An estimate count of people was conducted in the morning and afternoon at Coney Island beach.
2. 3 samples from the water (50 mL) and sediment (~50g) from intertidal and supratidal zones were collected on Wednesdays for 3 weeks.
3. Afterwards the samples were cultured onto Mannitol Salt Agar plates and incubated at 37°C ~ 100µL water was spread plated.
~ 1g sediment was suspended in 10mL of sterile water then vortexed. 100µL of suspension was spread plated.
4. 10mL of water samples were diluted with 90mL of sterile water. Then mixed with IDEXX Entero-alert media and incubated at 41°C in Quanti-trays.
5. The next day, results were observed
~ colony forming units (CFUs) were counted and recorded on the MSA plates.
~ the number of fluorescent wells were counted and recorded for the IDEXX Quanti-trays. Then compared to the IDEXX table to determine the most probable number (MPN) of cells in the samples.
6. Gram stain procedure to observe staph cultures

Conclusion & Discussion:

This study focused on the amount of bacteria present in the three tidal zones of Coney Island Beach. It is demonstrated that:

- The presence of people affected the amount of bacteria on the beach.
- Higher quantities of people yielded to higher quantities of *Staphylococcus spp.*
- The Intertidal zone had the most bacterial colonies present due to the significant presence of people there.
- The Supratidal zone had less colony forming units (CFUs) of *Staphylococcus* due to the direct sunlight and heat, which killed the bacteria.

References:

1 Philips, M.C Solo Gabriele, H.M, Piggot, A.M, James, K.S, Zhang Y., (2011) Relationships between sand and water quality at recreational beaches. *Water Research* 45, 6703-6769
 2 Wallace, R.B, Gobler, C.J. (2014) Factors Controlling Blooms of Microalgae and Macroalgae (*Ulva Rigida*) in a Eutrophic, Urban Estuary: Jamaica Bay, NY, USA. *Estuaries and Coasts*, 38, 519-533
 3 Gerba, C.P. (2000) Assessment of Enteric Pathogen Shedding by Bathers during Recreational Activity & its Impact on Water Quality. *Quantitative Microbiology* 2, 55-68.

People Count



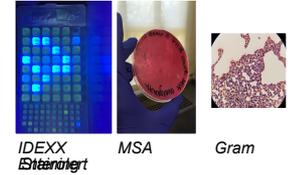
Collect Samples



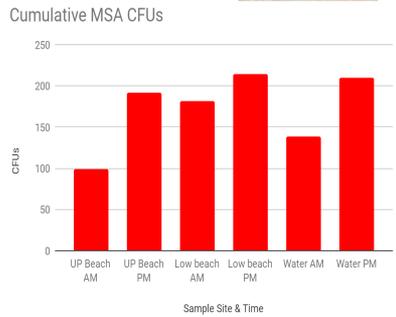
Culture & Filtering



Data Collection

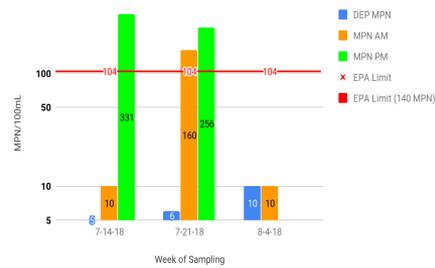


Results:



This graph of Staph shows that on average for all 3 weeks, the bacteria levels were the lowest in the morning and higher in the afternoon. Staph levels were the highest in the intertidal zone.

CI Beach MPN Measurements



The graph compares the Enterococci levels collected by the Department of Environmental Protection & this study. The bacteria collected in this study exceeds the general Environmental Protection Agency's limit of 104 MPNs.