



Searching for the Source: Tracing the Footprints of Bacteria in West Augustine



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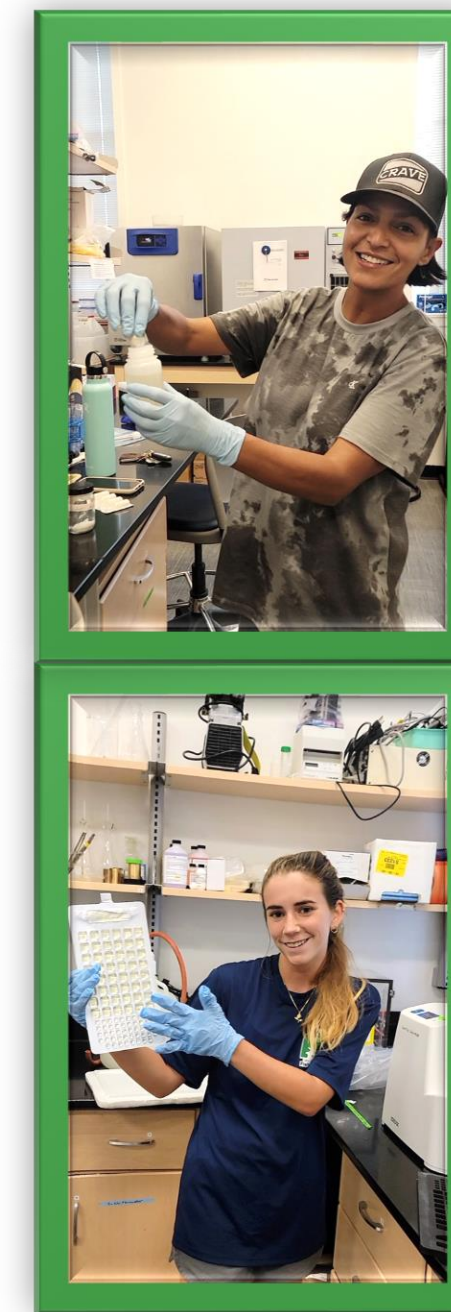
Introduction

Fecal Coliform Bacteria Trending in San Sebastian River

- The San Sebastian River, a tidal waterway west of Downtown Saint Augustine, receives substantial freshwater input from stormwater outfalls and faces a persistent water quality mystery.
- In the backdrop of its beauty, the river faces potential wastewater contamination due to the high density of Onsite Septic Tank Systems in West Augustine.
- Our journey focuses on the mystery of elevated fecal coliform levels, particularly in the northern portion of the San Sebastian River, unraveling the bacterial origins in this unique estuarine ecosystem.

Methods

Bacteria Identified in West Augustine Ditch System: High-Resolution Water Sampling (Comparative Approach)

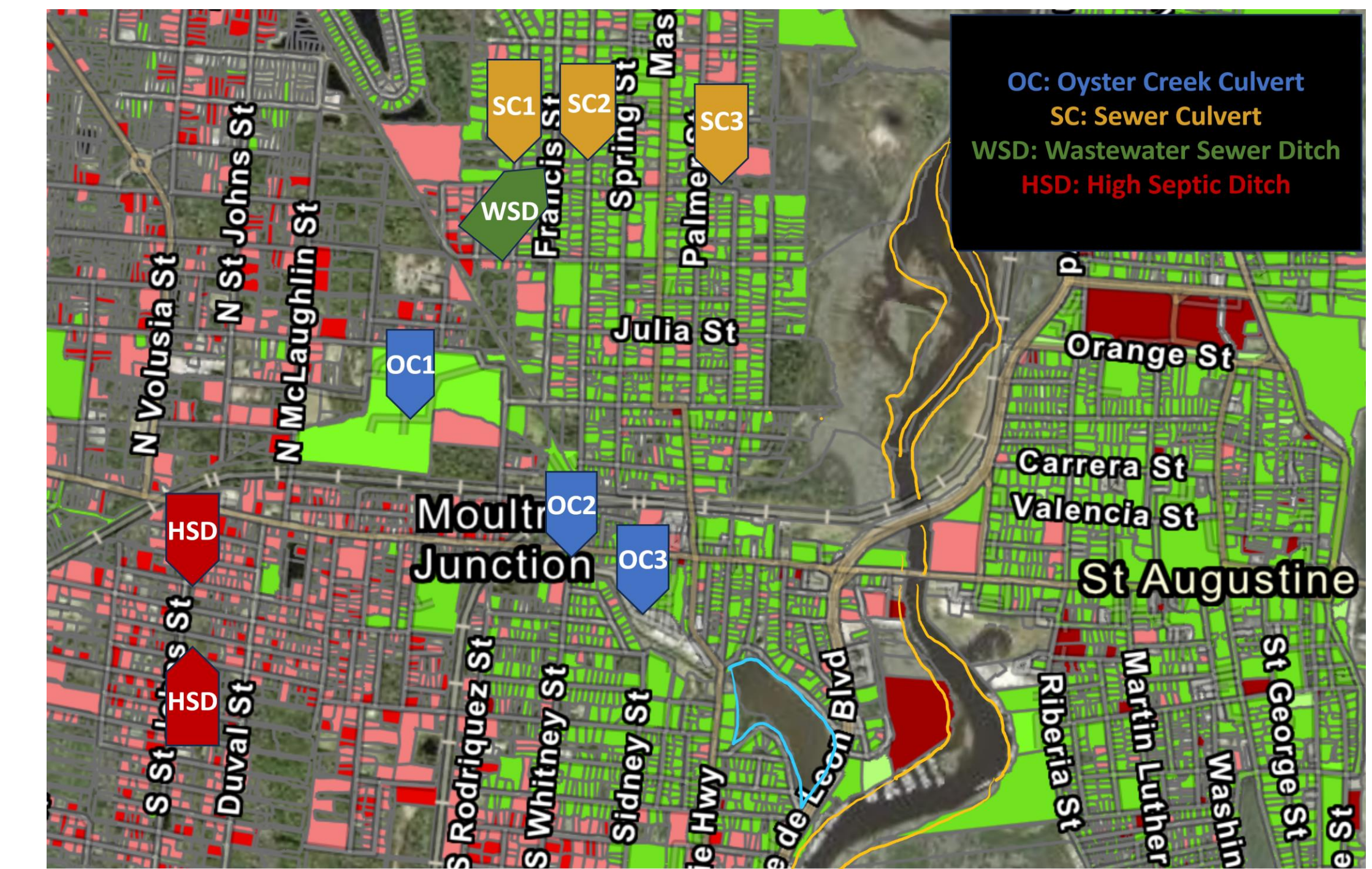


ASTM Method (#D6503-99)

Stage 1: Initial Site Selection was based on a 0.25-mile radius criterion. Early trends revealed that sites with a higher density of septic systems exhibited elevated *Enterococcus* levels.

Stage 2: In a pivotal phase of our study, high-resolution water sampling was conducted at two types of sites (parcels containing a high density of septic systems or parcels connected to wastewater sewer systems). This approach allowed us to investigate potential differences in *Enterococcus* levels between these areas, a core element of our project.

Stage 3: Ongoing Data Analysis including weekly sampling for *Enterococcus* fecal indicator bacteria began in September 2022 and continued through June 2023. Data collected during high-resolution sampling is analyzed to unveil patterns of bacterial origins.



Results

Unraveling the Origins of Fecal Indicator Bacteria in West Saint Augustine: Onsite Septic Tank vs. Sewer System Water Quality Comparison

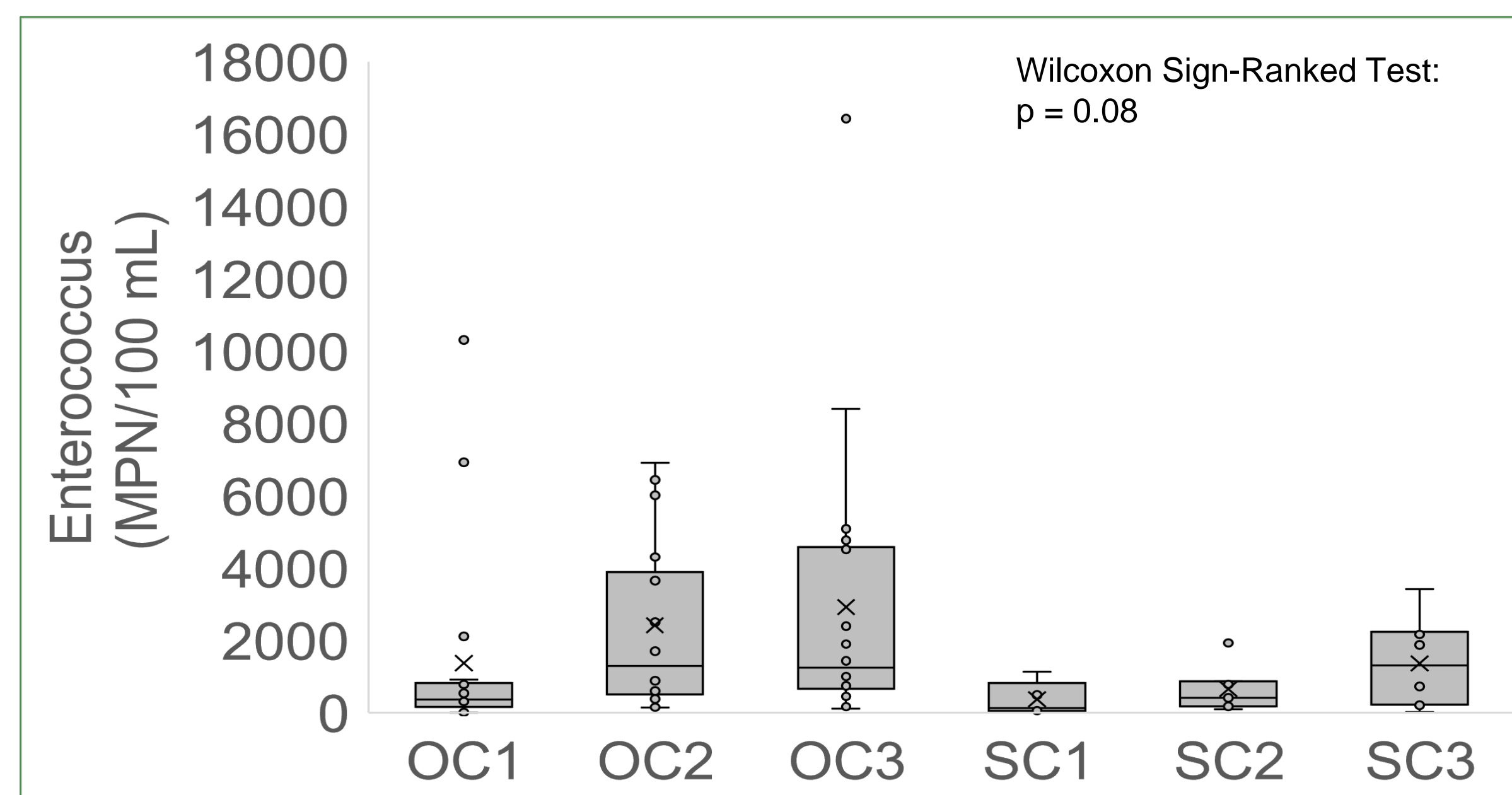


Figure 1: *Enterococcus* Bacteria Comparison: Revealing Differences in Ditch and Culvert Systems Between High Septic System Density [OC1-3] and Sewer-Connected [SC1-3] Neighborhoods.

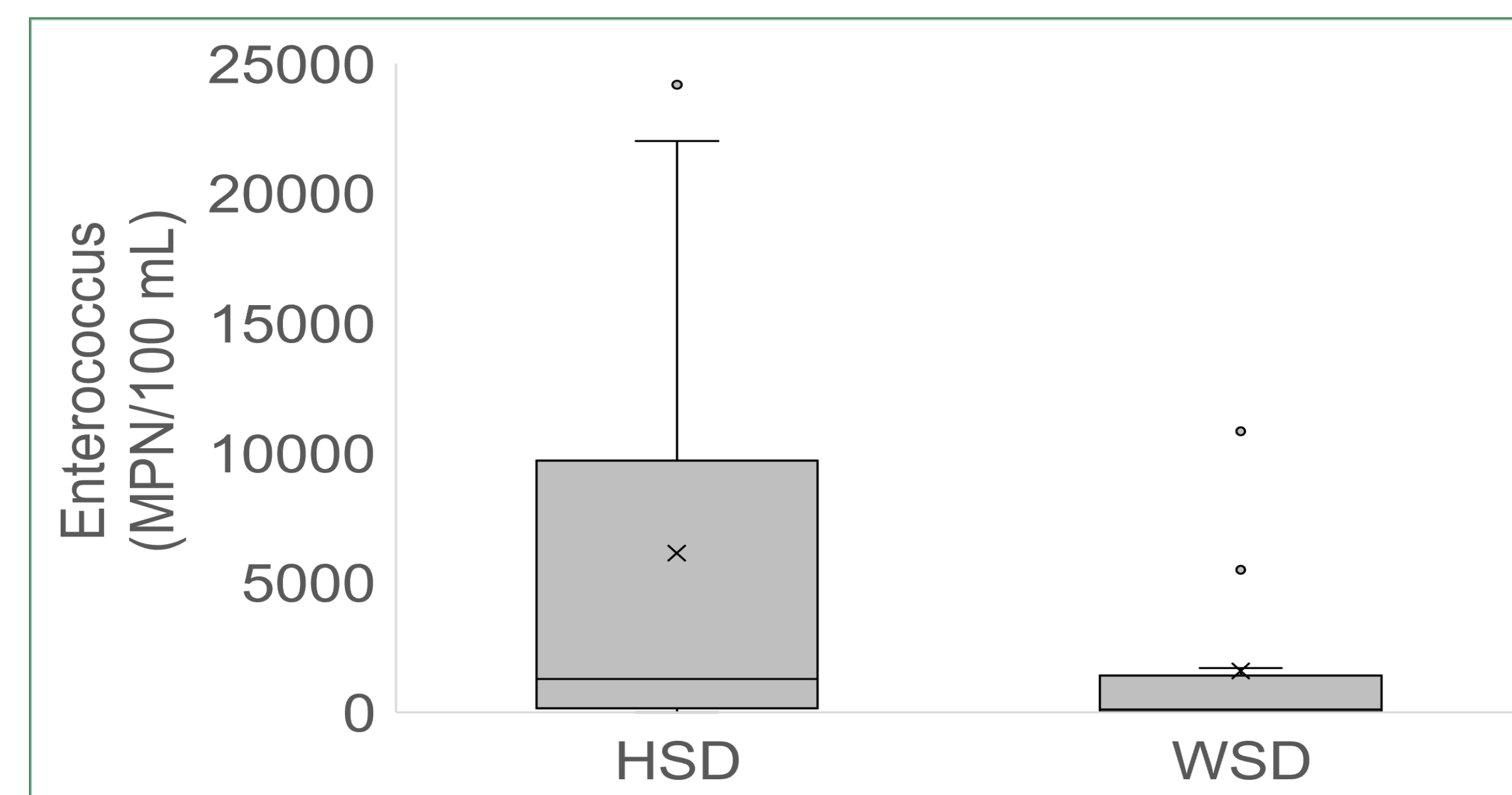


Figure 2: High-Resolution Sampling Reveals Variances in *Enterococcus* Levels: High Septic System Density [HSD] vs. Wastewater Sewer Systems [WSD].

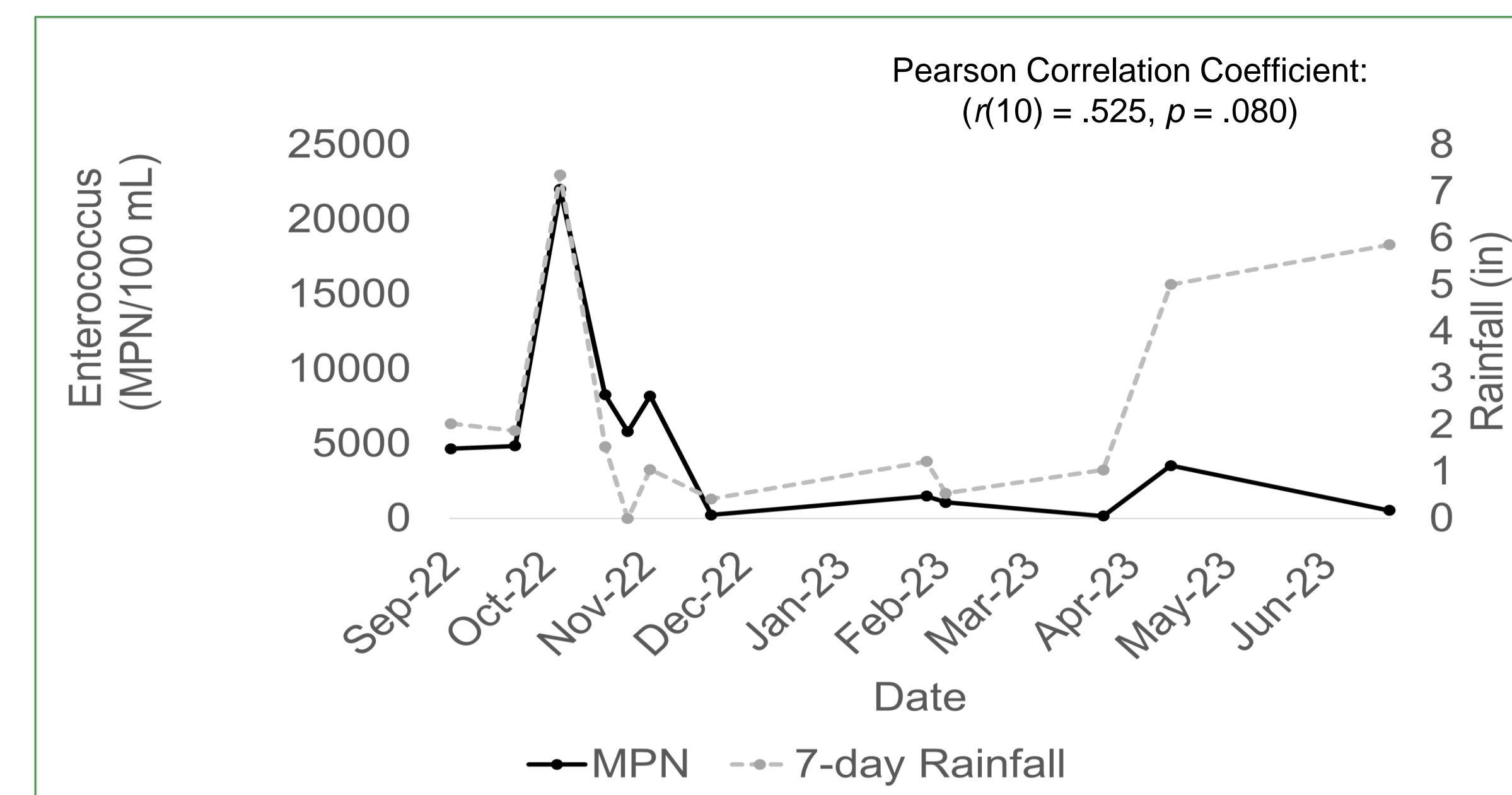


Figure 3: Moderate Correlation Between Rainfall and *Enterococcus* Levels in West Saint Augustine Ditch Systems.



Figure 4: Quanti-Tray®/2000 System with Strong Fluorescence: High *Enterococcus* Levels in High Septic System Ditch [HSD] water sample.

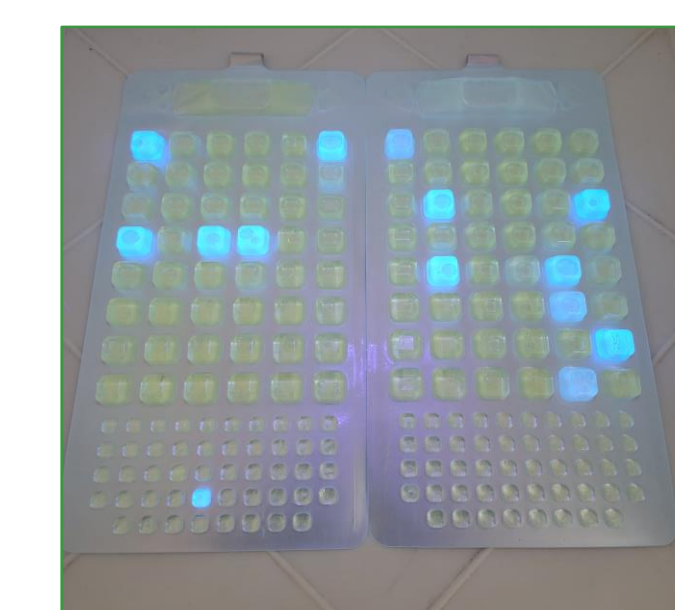


Figure 5: Quanti-Tray®/2000 System with Minimal Fluorescence: Low *Enterococcus* Levels in Wastewater Sewer-Connected [WSD] water sample.

Statistical Analysis

- ❑ No significant difference was found between Oyster Creek culvert [OC1-3] and Sewer-connected neighborhood culvert per Wilcoxon Sign-Ranked Test: $p = 0.08$
- ❑ *Enterococcus* is significantly greater in ditches at high septic tank density sites.
- ❑ There was a moderate positive correlation with rainfall and *Enterococcus* levels in all ditches per Pearson Correlation Coefficient: $(r(10) = .525, p = .080)$

Conclusion

- ❑ **Conclusion:** The study's findings align with the initial theory that areas with a higher density of septic systems may contribute to elevated *Enterococcus* levels.
- ❑ **Challenges and Limitations:** The network of rainwater drainage through each culvert system posed a significant hurdle in isolating and tracing the origins of bacteria. While this study has provided valuable insights, it's important to acknowledge that other unexamined factors may contribute to *Enterococcus* levels.

Future Direction

- ❑ **Implications for Water Quality Management:** Identifying the source of elevated *Enterococcus* levels is a crucial step in developing targeted strategies to improve water quality in the area leading to the San Sebastian River estuary.
- ❑ **Advancements for Water Quality Management:** The potential advancements for water quality management in the area, such as transitioning West Augustine to wastewater sewer-connected systems, can provide a path toward mitigating bacterial contamination.



UNDERGRADUATE RESEARCH

References: Hach Company/Hach Lange GmbH, (2007–2017). Coliforms, Fecal m-FC and m-FC/RA Broth PourRite Ampules, Method 8074 Membrane Filtration. Budnick GE, Howard RT, Mayo DR. Evaluation of Enterolert for Enumeration of Enterococci in Recreational Water. Appl Environ Microbiol. 1996;62:3881–3884.

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