



# Characterization of E.coli in Recreational Waters of Sayulita, Mexico and Possible Implications for Human and Marine Ecosystem Health



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## Abstract

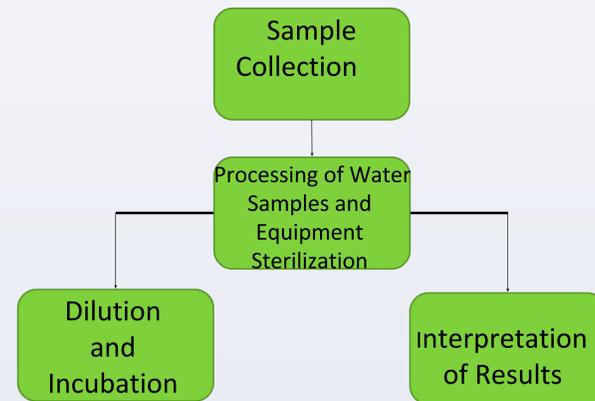
The principal objective of this research was to test for the presence of Escherichia coli (E. coli) in recreational waters of Sayulita, Nayarit, Mexico over a period of seven weeks in 2014 and again in 2015. Four interns in The Science Exchange Program collected water samples from seven different areas in the drainages and ocean. They utilized the IDEXX Colilert-18 predispensed MPN procedure to quantify the levels of E.Coli, and determine if samples exceeded the Mexican government's recommended limit for Enterococcus, a similar indicator, in recreational waters (>200 MPN/100mL). Of the 28 ocean samples taken, 32% exceeded the government limit with an average of 280MPN/100mL. Likely sources of pollution are from two drainages with illegal storm water and sewer connections. From the 42 drainage samples we found 69% exceeded the government limit with a mean of 6,021 MPN/100mL. Through health interviews and surveys I implemented at local clinics in 2015, there were 30 cases of gastrointestinal or other illnesses, and although 52% of patients reported recent swimming in the ocean, it is not possible to rule out other factors. Lower water temperatures were significantly correlated to higher E. Coli MPN levels (n=62, Spearman's R=-0.56; p<0.001), a trend that could help future sampling strategies. More water quality sampling and a beach posting program needs to be implemented at this internationally popular surfing, fishing, and swimming spot. Low cost citizen science methods such as those used in this study could be replicated by locals.

## Introduction

Purpose: Detection of E. coli in recreational waters of Nayarit Mexico.-Samples taken from 7 different areas in Nayarit, Mexico



## Materials and Methods



In 2015, dilutions were made at 1:100, 1:1000, 1:10,000 5 samples of each dilution were pipetted into tubes with Collilert-18 and incubated at 35°C for 18 hours. After incubation tubes were checked for color and fluorescence. Sample Interpretation:

### Colorless-

Sample is negative for total coliforms/ E. coli.

### Yellow Color

Sample is positive for total coliform

### Yellow and fluoresces under UV light

Sample is positive for E.Coli.

## Results



Fig. 1 Positive E. coli samples fluorescing (left) and Clear(-)&Yellow(+) for coliform. (right)

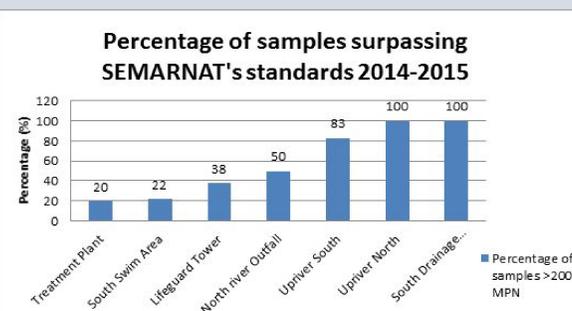


Figure 1 Samples exceeding SEMARNAT's standards

## Results

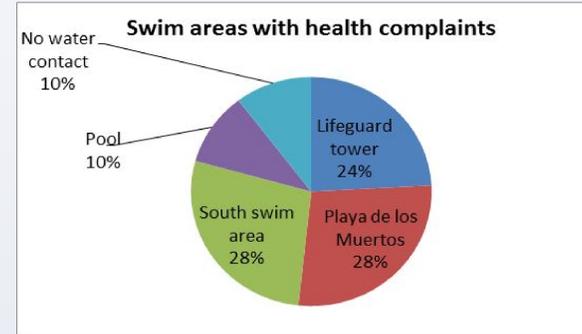


Fig. 2 Locations with incidence of gastrointestinal diseases and other symptoms from the 2015 surveys

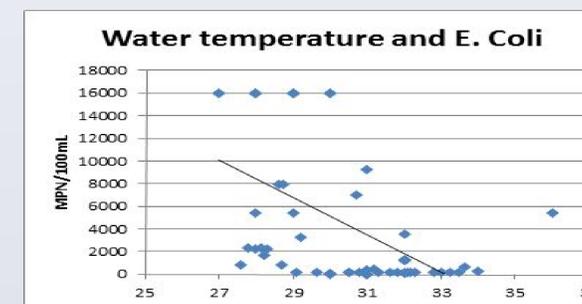


Figure 4. MPN levels significantly related to water temperature (r = -.56; p<0.001)

Of the 28 ocean samples taken, 32% exceeded the recommended limit. From the 42 drainage samples we found 69% exceeded the recommended limit. For comparison, the County of San Diego issued advisories for only 3-5% of their routine samples from 2000-2006 (DEH 2006). Likely sources of pollution are from two drainages with illegal storm water and sewer connections. This leads us to speculate that there's a filtration or dilution process that decreases the E.coli that reaches the ocean.



## Conclusions

During the study period, a total of 30 cases were reported with a water-related illness within 72 hours after swimming. Although 80% of the patients had swum in the ocean and 52% of the swimmers were in our sampling areas; it is difficult to try to pinpoint a single cause for their illnesses. Locals tend to swim very regularly, but other sources of bacterial or pathogens could be improperly handled food. The air temperature in Sayulita during the study period was in the low to mid 30's (C), and bacteria can thrive in this temperature on any surface. Interestingly, we also found that low water temperature was significantly correlated (p<.001) with higher E.coli MPN/100mL. High temperatures may have created conditions where bacteria do not survive. Another possible explanation is that low water temperatures are associated with inflows of water which could have increased turbidity or another factor that we did not study. Nevertheless, our results show that tracking water temperatures may be a good way to alert authorities to a possible high risk E. Coli condition, and trigger a water quality sampling event.

Future Research: For effective results, consistent sampling at various ocean sites is needed as well as an increase in the study period to try to obtain representative samples of the area.

## References

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