

Presence of Bacteria and Antibiotic Resistance in Water Sites on San Cristóbal Island



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Background

On the island of San Cristóbal, Galápagos, the study of bacteria levels in publicly accessible water sites is relevant for public health. The processing of wastewater and the prevalence of antibiotic use on the island are factors that may contribute to antibiotic resistance. Previous work suggested the presence of bacterial strains with antibiotic resistance. Our work aimed to gather data about the relative quantities of bacteria in sites throughout the island and the possible strains of antibiotic-resistant *Escherichia coli*.

Methods

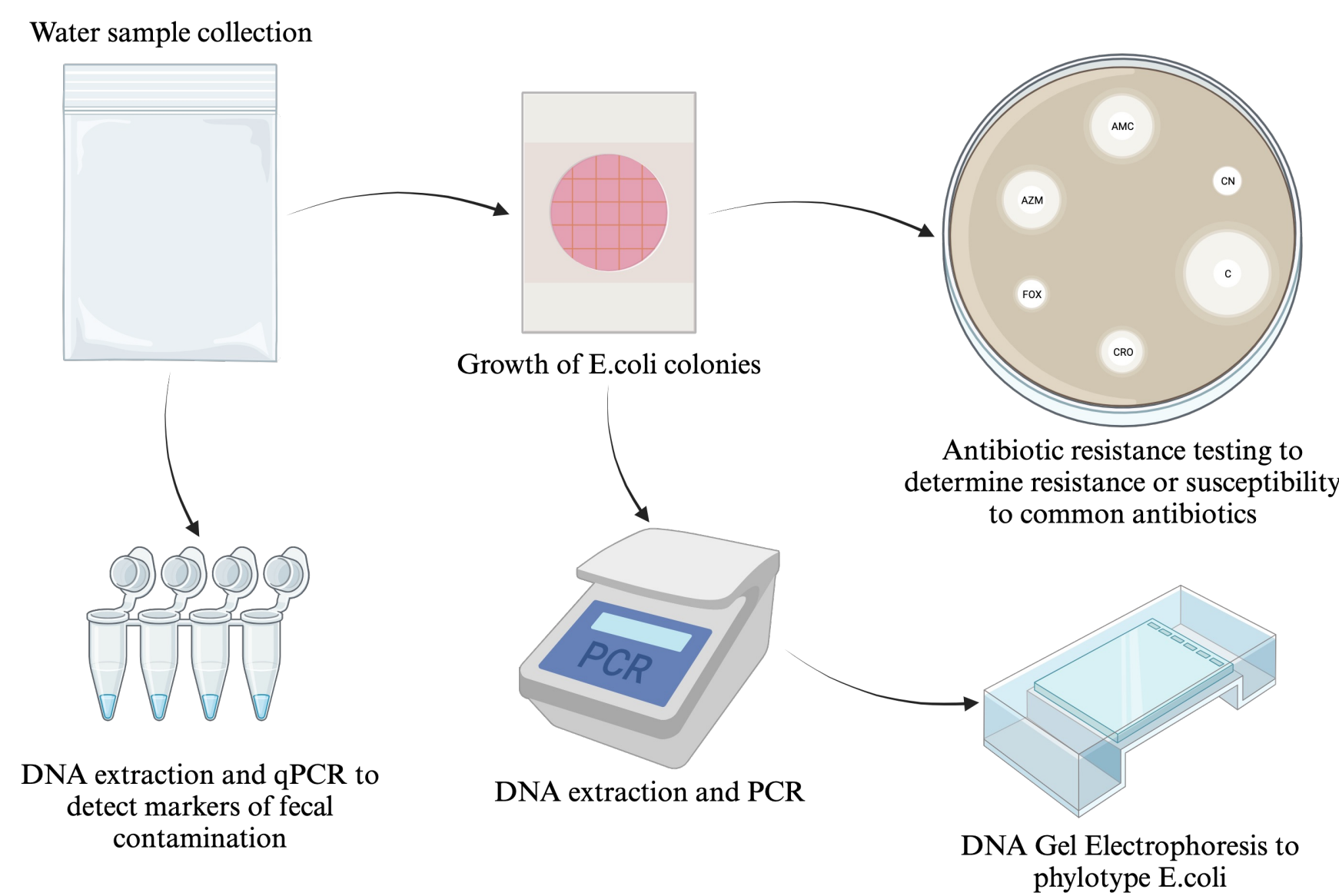


Figure 1. Procedure for Water Collection and Analysis. Water samples underwent analysis to determine the quantity of fecal-coliform bacteria, particularly *E. coli*; potential animal or human sources of bacteria; *E. coli* resistance to antibiotics; and *E. coli* phylogroups.

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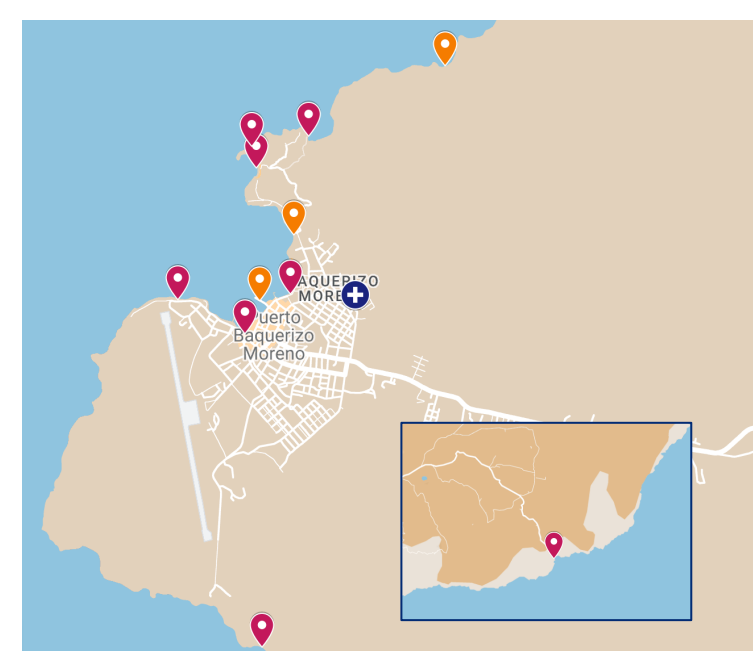


Figure 2. Map of water collection sites on San Cristóbal



Figure 3. Water collection with a local naturalist guide

Results

Figure 4. Detection of Human Fecal Contamination with Quantitative PCR.

qPCR performed on DNA extracted from water samples was used to identify a specific marker of human fecal contamination. The results show the presence of human contamination at tested sites across the collection period of May to July. Sites closest to sewage outlets—Punta Carola Pipe, Pier, Playa de Oro, and Playa de los Marineros—exhibit more frequent human fecal contamination.

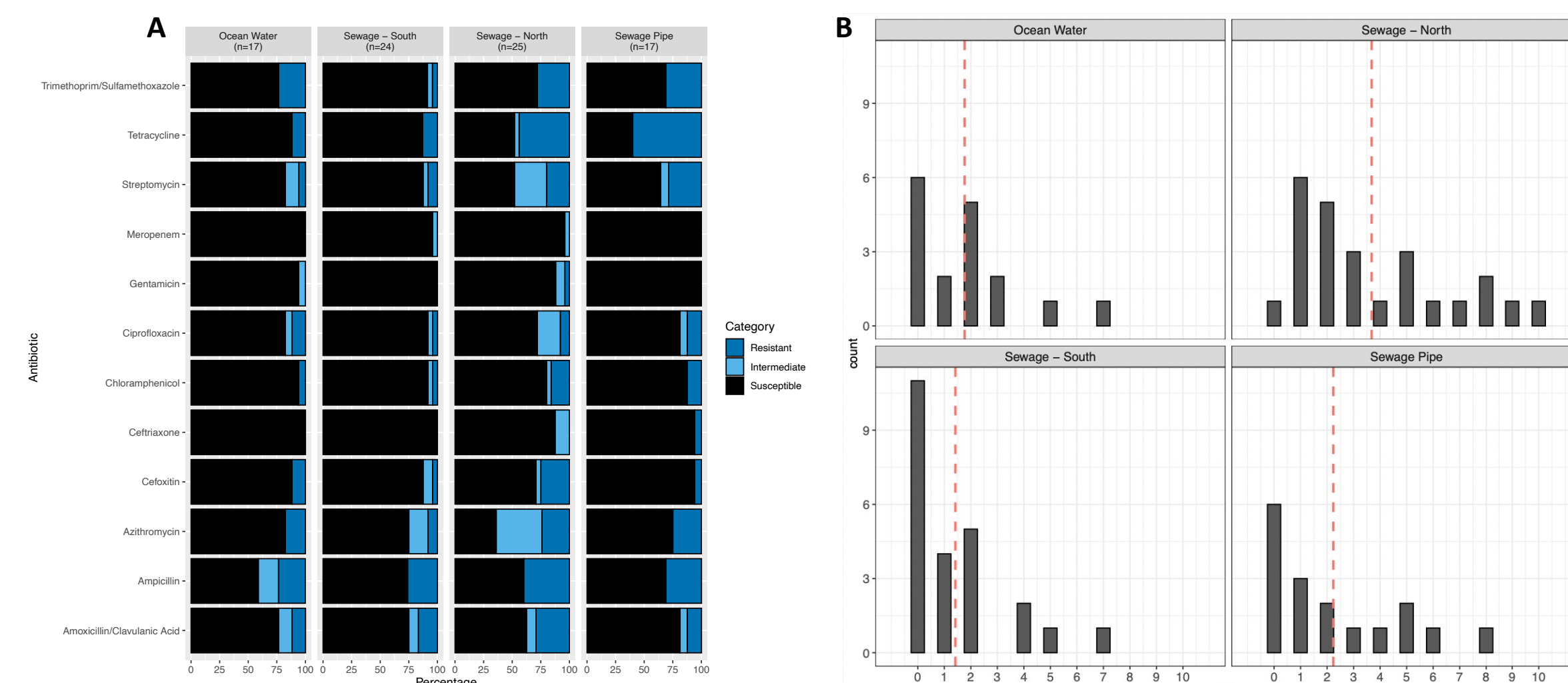
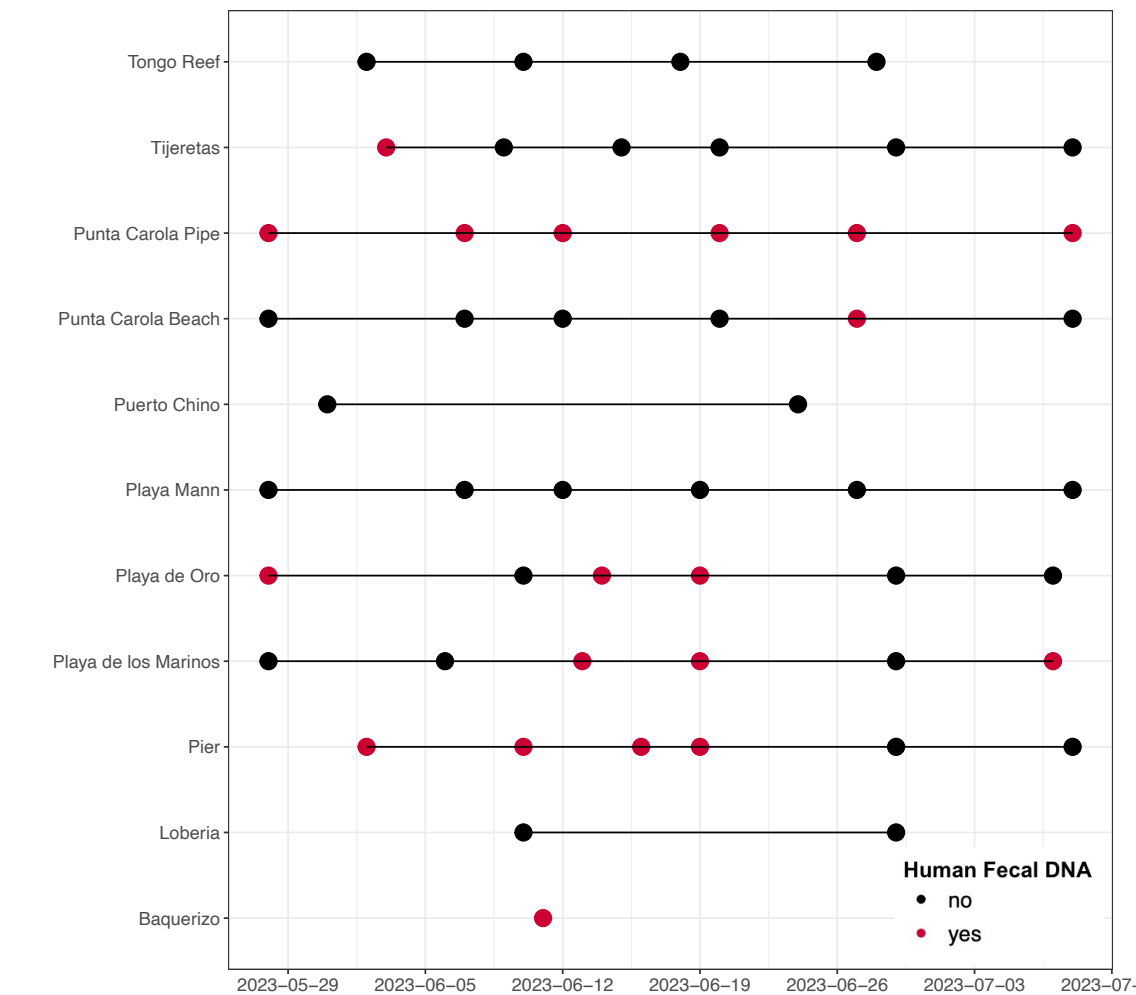


Figure 5. Antibiotic Resistance Assay for *E. coli* isolates. A. *E. coli* isolates were inoculated onto agar plates with antibiotic discs, and the susceptibility of the bacteria to the antibiotics was determined by measuring the zone of inhibition around the disks. Sewage samples from the Northern part of the city, close to the hospital, exhibited higher occurrences of antibiotic resistance, indicated above by blue bars. B. These results show the distribution of the number of antibiotics in the Resistant or Intermediate categories of each isolate. The red line indicates the group mean.

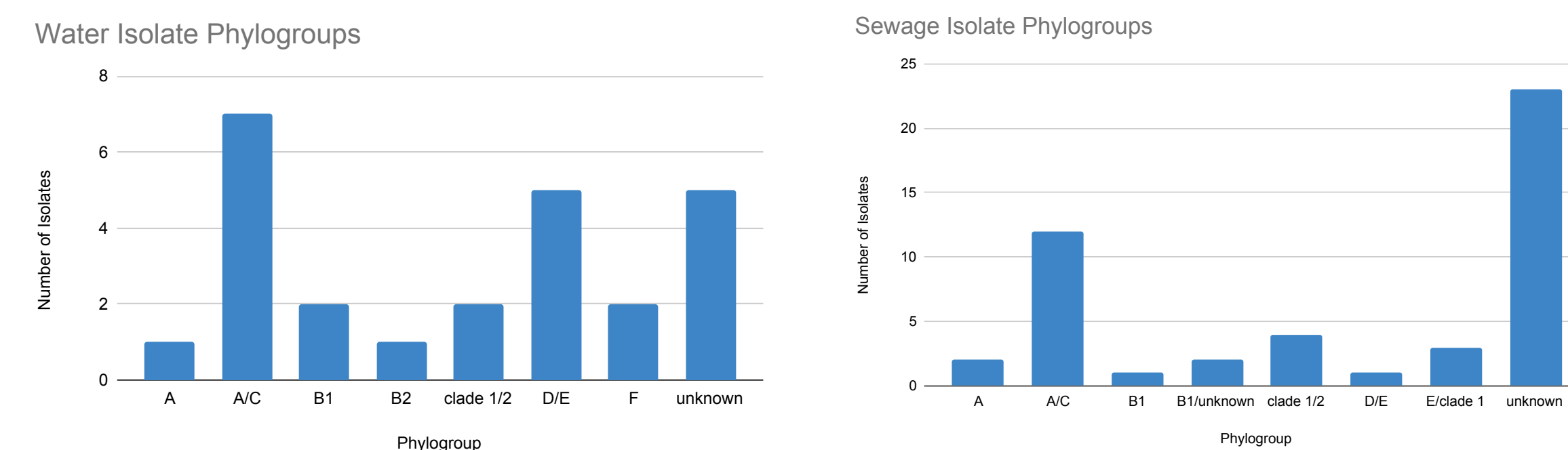


Figure 6. Identified *E. coli* Phylotypes within Samples from Ocean Water and Sewage Sites. Quadruplex PCR was used to identify the phylotypes of *E. coli* isolated from collected water and sewage samples. Both types of sites showed high quantities of the A/C *E. coli* phylotype.

Conclusions

- Animal fecal contamination was detected at every site, each time they were tested. Human fecal contamination appeared in the majority of the sites at least once.
- There was evidence of antibacterial resistance in some tested *E. coli* strains, with sites closer to known points of wastewater disposal exhibiting higher resistance to antibiotics. Furthermore, there were more instances of resistance to certain antibiotics, such as Ampicillin or Tetracycline, while no isolates were fully resistant to Meropenem.

Future Directions

- Studies conducted on other Galápagos islands could expand our understanding of how population and infrastructure affect the quantity of bacteria in the surrounding waters.
- An expanded understanding of the use of and attitude towards antibiotics among members of the local community could contribute to our understanding of the causes of resistance.

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