One Watershed, One Health: A Social-Ecological Systems Approach to Understanding Wastewater Contamination

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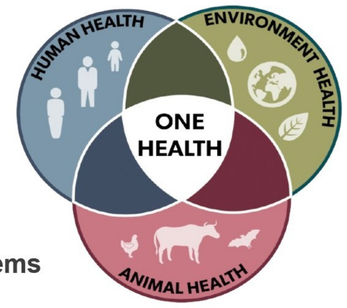
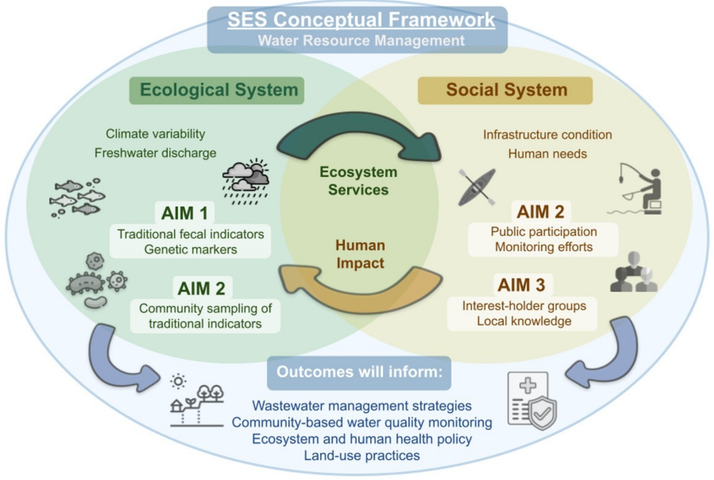
Background

- Water resource management is a major challenge for coastal communities globally
- Freshwater discharge can worsen water quality by conveying **fecal contamination** from **human sewage, agricultural runoff,** and **domestic** and **wild animals**
- Fecal contamination has serious consequences for **ecosystem and human health**
- Distinguishing among pollution sources is critical for effective management
- **Social-Ecological Systems (SES)** frameworks link ecological science to social dimensions of sustainable resource use and management



One Health Concept, Purdue University

- Data to **define fecal contamination sources**, **empower community monitoring**, and **assess interest-holder perceptions** will enable application of the SES framework for water quality improvement



Objectives & Methods

AIM 1

Determine **where**, **when**, and from which **sources** fecal contamination is occurring

Microbial Source Tracking (MST)

Collect water sample from designated sample sites

Extract DNA from sample

Quantitative Polymerase Chain Reaction (qPCR)

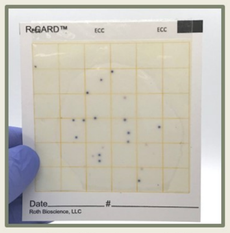
Use genetic markers to determine fecal source

AIM 2

Evaluate **R-CARD® technology** for community monitoring

Many communities want to know about and engage in water quality monitoring, but they **lack defensible data**. User-friendly R-CARD® kits can detect contamination in real time but require local validation.

1. **Validate R-CARD® results** against laboratory-based quantification of fecal coliforms and *E.coli*
2. **Test the reliability** of R-CARD® data under different environmental conditions



Roth Biosciences, LLC

AIM 3

Assess interest-holder **knowledge**, **perceptions**, and **responses** to contamination risk

Survey Three Interest-holder Groups:

Community **residents**

Members of the **biomedical community**

Local watershed **researchers**

Public perceptions are often overlooked in water quality research. Surveys may identify **perceived contamination concerns** or **locations** that can guide research, monitoring, and outreach.

Study System

The Three Mile Creek watershed in Mobile, Alabama extends through **residential, commercial, biomedical,** and **industrial** areas before outflowing into the Mobile River and ultimately Mobile Bay, **one of the largest freshwater receiving systems** among watersheds in the U.S.

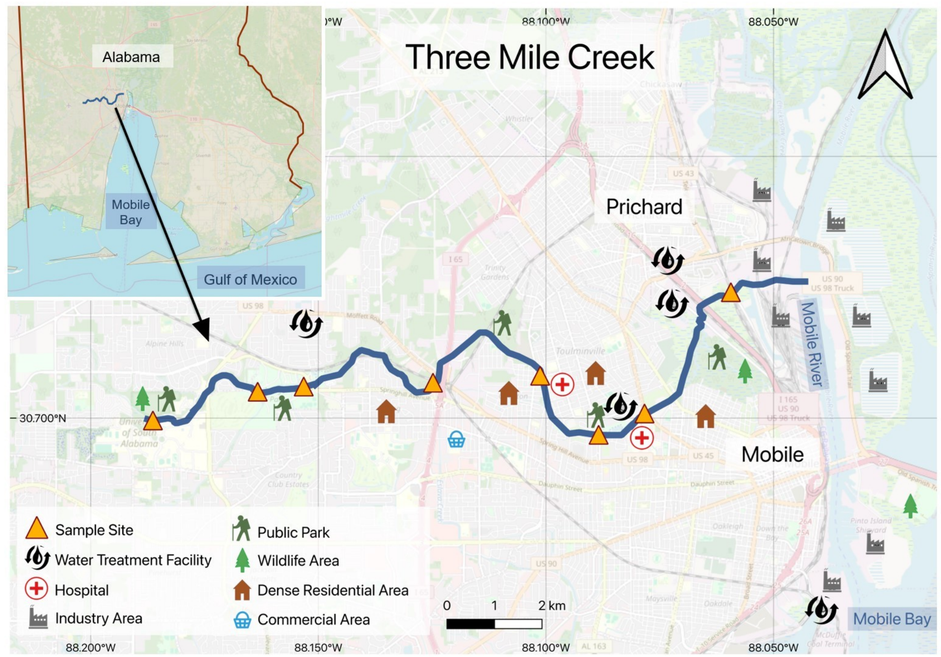
As an urban coastal watershed, Three Mile Creek potentially receives **fecal contamination input from a variety of different sources** across a land-use mosaic from industry and biomedical to dense residential and suburban areas with community parks and wooded areas.

Residential

Commercial

Biomedical

Industrial



Hypotheses

1 Fecal bioindicator concentrations (fecal coliforms, *E.coli*) will **increase following high freshwater discharge**. The magnitude and duration of increases will be location-specific depending on sources.

2 Community monitoring (R-CARD®) data will be **positively correlated** with laboratory-based measurements, with variation due to environmental conditions, particularly turbidity and salinity.

3 Interest-holder groups will **differ in their knowledge and perceptions** of contamination risk, reflecting the differences in their interaction with Three Mile Creek, education, professional expertise, and economic status.

Significance

- **SES frameworks have not been widely considered** within interdisciplinary water management approaches. This project advances SES framework application.
- R-CARD® technology may provide communities with a low-barrier way to **identify future contamination events**
- **Strengthen community participation** in science and natural resource conservation
- Outcomes will inform targeted interventions to **protect public** and **ecosystem health**

Three Mile Creek at Lewis Landing Park

Acknowledgements

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