

# The Potential Role of Freshwater Mussels as Indicators of Bacterial Levels in their Environment

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## Abstract

Water is an important public resource threatened by pollution such as wastewater contamination, agricultural runoff, and chemical waste. Bioindicators, organisms used to assess the quality of an environment and its changes over time, are an important method of measuring and monitoring water quality. Because they are directly affected by environmental pollution, bioindicators can sometimes serve as a more sensitive means of assessing water quality than chemical or physical tests. Due to their ability to filter large quantities of water, bivalves, such as mussels, are potential candidates for bioindicators. Bivalves may also provide a means of continuous water monitoring because they are sessile organisms and have the potential to filter and retain particles for long periods of time. The use of bivalves as bioindicators of the bacteria *Escherichia coli* would help with efforts to monitor water quality for public health. *E. coli* is found in the lower intestines of warm-blooded organisms and in fecal matter. It is transferred to water bodies via agricultural runoff, waste from sewage overflows and polluted stormwater runoff. *E. coli* can cause urinary tract infections, respiratory illnesses including pneumonia, and bacterial gastroenteritis. This review suggests bivalves may be a useful tool for assessing bacteria levels and that *Elliptio complanata*, the Eastern Elliptio mussel, may be an effective bioindicator of potential sources of *E. coli* contamination in the Conococheague Creek within the Chesapeake Bay Watershed.

## Hypothesis

Freshwater mussels can help to assess bacteria levels in bodies of water, making them an effective bioindicator of contaminants such as *E. coli* abundance.

## Background

- Only 3 percent of Earth's water is freshwater. Of that 3 percent about 1.2 percent can be used for drinking.<sup>10</sup>
- Poor water quality with an abundance of *E. coli* can result in illness and disease transmission.

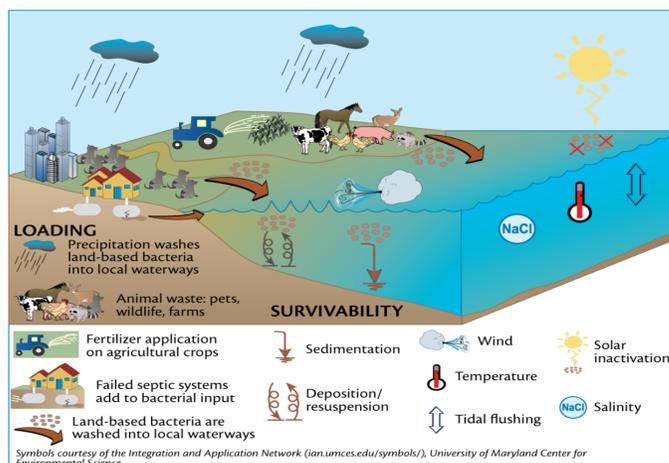


Figure 1. Types of Pollution<sup>1</sup>

## Background Cont.

- A bioindicator is any organism whose physical or biological processes are affected or altered by environmental conditions and can be used to identify and quantify the effects of pollutants in the environment.<sup>4</sup>
- Freshwater mussels can be used as a safe & effective way to manage poor water quality due to their ability to filter and retain excess nutrients and bacteria.<sup>11</sup>
- Agricultural productivity in the Chambersburg area – could lead to agricultural runoff into the Conococheague Creek
- Looking specifically into *E. coli* abundance in the Conococheague creek caused by fecal contamination
- Research is beneficial to assess how well mussels filter and retain bacteria versus traditional methods of testing water quality.

### *Eastern Elliptio (Elliptio complanata)*

- Freshwater mussels thrive in nutrient rich waters<sup>8</sup>
- Have a greater environmental tolerance than most species; can tolerate harsher environments<sup>6</sup>
- Live in fine sand, silt, and muddy substrates<sup>8</sup>
- Filter 16 to 20 gallons of water per day<sup>8</sup>
- Are sessile organisms and can live between 60 to 70 years

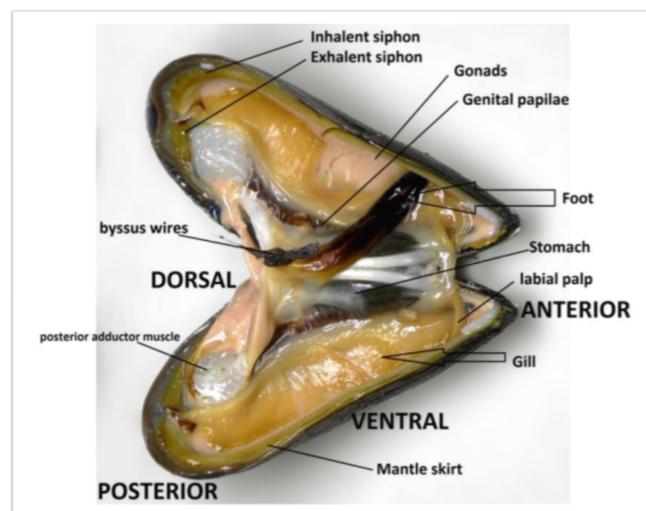


Figure 2. Freshwater Mussel Diagram<sup>2</sup>

### Basic Filtration System

- Draw's water down through inhalant siphon & passes the water over specialized gills.
- Particles get trapped on the sieve-like gills
- These particles are then taken to the labial palps before they enter the mouth.
- The filtered water is then expelled by the exhalant siphon back into the water column.

## Background Cont.

- The particles trapped on the gills may include bacteria.

### *Escherichia coli*

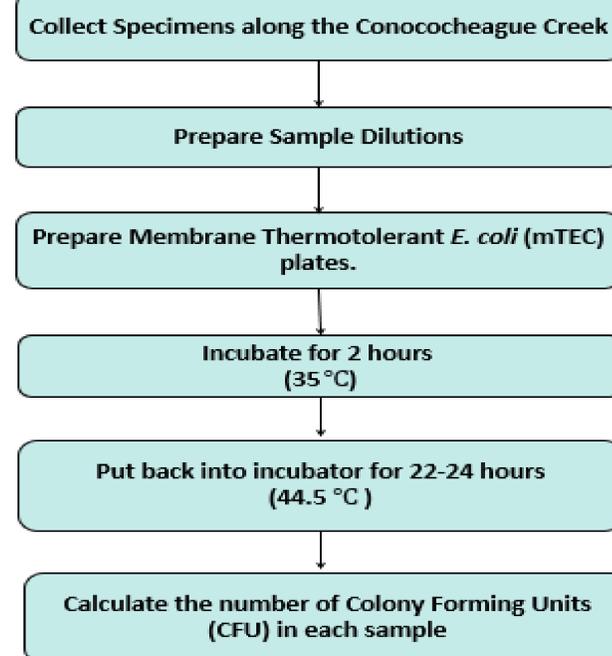
- *E. coli* is a species of bacteria found in the environment, food, and intestines of animals and humans.
- Can be an indication of fecal contamination<sup>7</sup>
- Some types of *E. coli* are pathogenic & can cause diarrhea, respiratory illnesses, UTI's and gastrointestinal illnesses
- Root causes of *E. coli* contamination are overflow of sewage, agricultural runoff, as well as nonpoint sources of human waste and water.

### Other Studies

- Invasive bivalves have been used successfully in bioremediation studies.<sup>4a</sup>
- They have also been successfully used in assessing heavy metal concentrations to provide a view of the health status of coastal environments.<sup>9</sup>
- Other studies have also looked at bacterial concentration in bivalves by assessing the gastrointestinal tract, gills, and hemolymph.<sup>5</sup>

## Methods

### Flowchart of Experimental Design



## Methods Cont.

- Membrane filtration; used for dilute samples
  - Traps microorganisms larger than the filter pore size

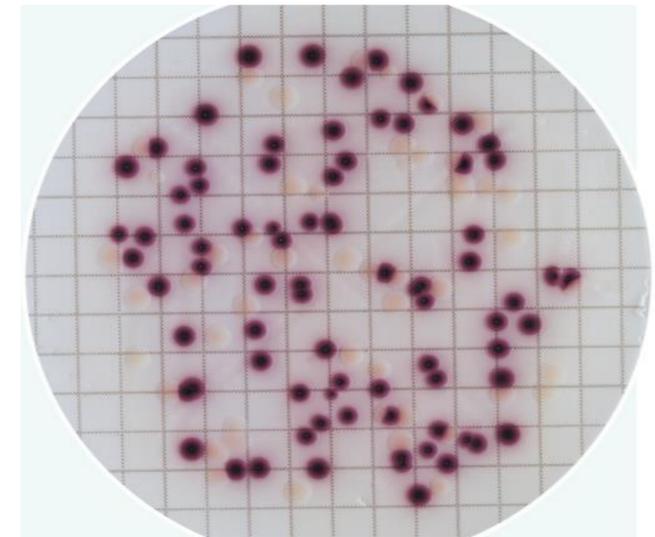


Figure 4. mTEC Agar<sup>3</sup>

- Using modified mTEC (Membrane Thermotolerant *E. coli*) Agar<sup>7</sup>
- Used for *E. coli* detection in water using membrane filtration<sup>7</sup>
- Produce magenta colonies = represent *E. coli*<sup>7</sup>

## Anticipated Results

- The distribution of *E. coli* found in the gut microbiome and water samples will not differ between the agricultural and non-Agricultural sites.
- Similar distributions of bacteria in the gut microbiome of the mussel vs. the water sample would suggest that bivalves could serve as effective bioindicators.
- Bivalves could serve as a low cost indicator organism of pollution.

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