

# A COMPARISON OF CULTURE, RAPID DETECTION, AND MODELING TECHNIQUES FOR DETERMINING *E. COLI* CONCENTRATIONS AT ST. LAWRENCE RIVER BEACHES

HALEY, J.<sup>1</sup>, BRAMBURGER A.J.<sup>1</sup>, BROWN, R.S.<sup>2</sup>, & RIDAL, J.J.<sup>1</sup>

1. St. Lawrence River Institute of Environmental Sciences. Cornwall, ON. K0C1P0, Canada.
2. Dept. of Chemistry/Sch. of Environmental Studies. Queen's University, Kingston, ON. K7L 3N6



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# St. Lawrence River Institute

- Research centre located in Cornwall, Ontario, Canada
- Mandate is **research, education and community action** relating to large river systems, with a focus on the St. Lawrence River ecosystem
- A non-governmental organization, work with a wide variety of individuals, groups, agencies and communities to fulfill its environmental mission



# Swim advisory postings in Ontario

- St. Lawrence River near Cornwall has been classified as an area of concern
  - Remedial Action Plan delisting criteria relating to the beach closings and water contact sports Beneficial Use Impairment
    - 1) At public beaches, no more than 20% of weekly five sample *E. coli* geometric means exceed the Provincial Water Quality Objective during an annual swimming season.
- Provincial Water Quality Objective is set at 100 cfu/100 mL for a geometric mean in 5 samples

# Some of the Challenges

- In the Cornwall area, public beach areas are monitored by the Eastern Ontario Health Unit
- No further investigations are made to determine the sources or mitigation measures for these bacterial appearances
  - *E. coli* results it can be up to 48 hr from sample collection to beach posting
  - *E. coli* levels can vary substantially from day to day and studies have found little or no correlation between fecal indicator bacteria levels from one day to the next

# Beach Health Project

- The St. Lawrence River Institute of Environmental Sciences has partnered with
  - Eastern Ontario Health Unit (EOHU),
  - Raison Region Conservation Authority
  - St. Lawrence Parks Commission
  - Ontario Public Health Lab
- to study 4 candidate beaches along the St. Lawrence River



# Objectives of the Beach Health Project

- Characterize 4 local candidate beaches
- Identify possible sources of microbial contamination
- Identify best management practices
- Improve efficiency in evaluating and reporting beach conditions

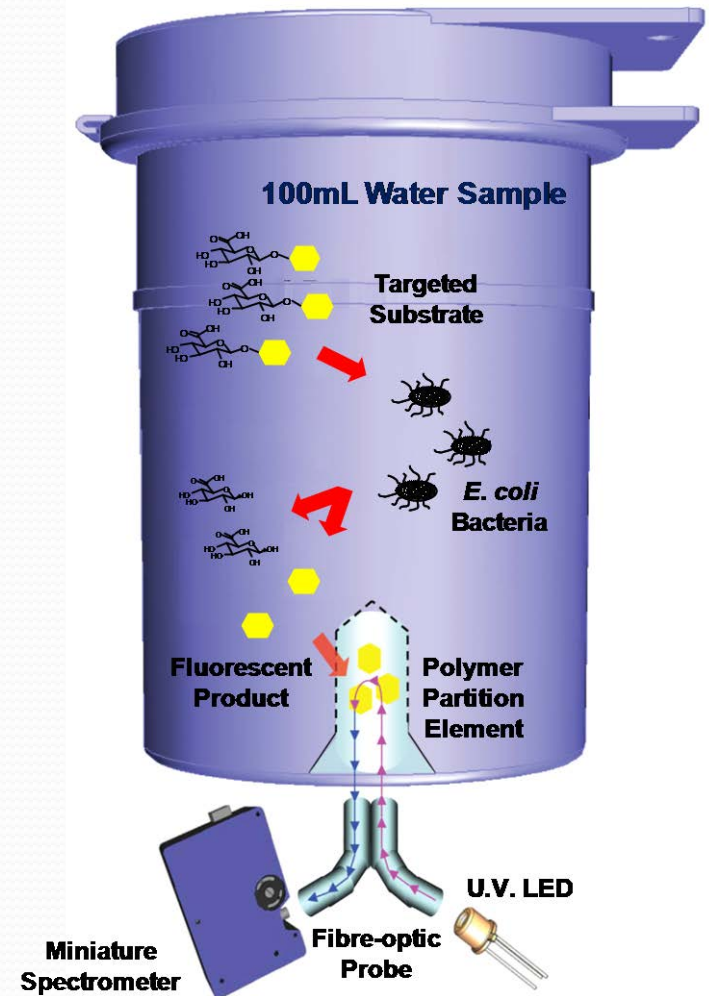


# Method Comparison Study

- In partnership with Pathogen Detection Systems Inc. the SLRIES undertook a small scale method comparison study
- Comparing
  - A New Rapid Method – ENDETEC TECTA-B16
  - Membrane filtration using DCM & BCIG agar plates
  - 3M™ Petrifilms™

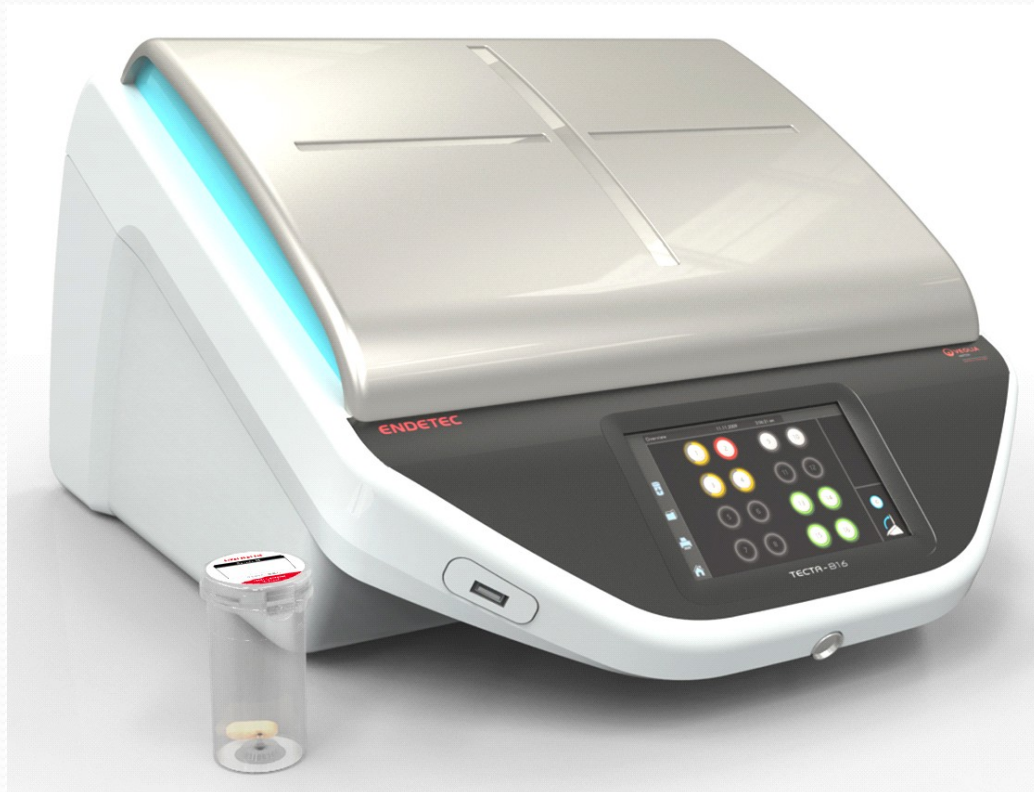
# ENDETEC TECTA B16

- Automated bacteria detection in broth culture
- Single-use test cartridge - optical fibre coupled to detector
- Enzyme converts water-soluble substrate to hydrophobic product
- Polymer extracts product and isolates it from solution
- Fluorescence detected through optical fibre, *light never passes through the sample*
- No interference from colour or turbidity



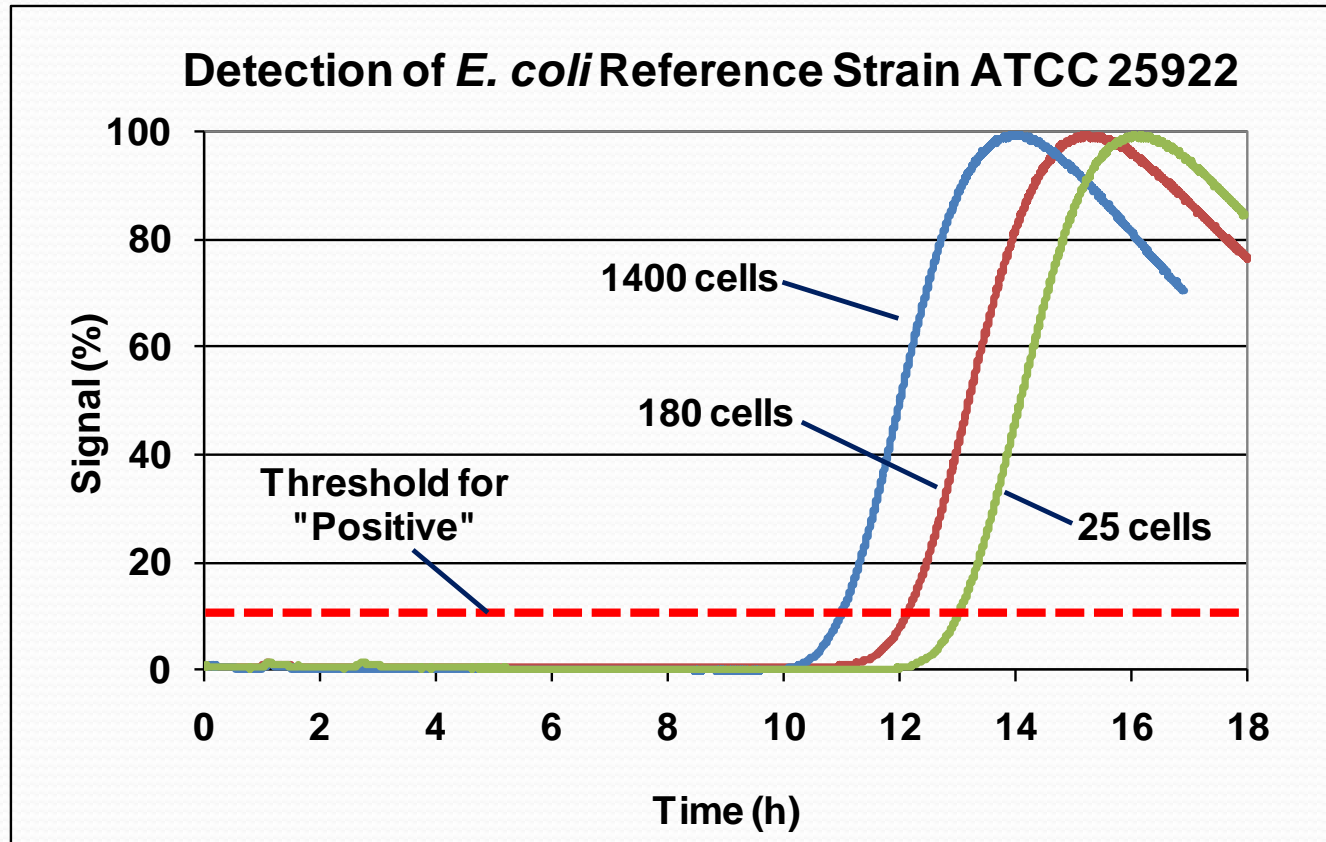
# ENDETEC TECTA B16

[www.endetec.com](http://www.endetec.com)



- **Complete method for fresh water:**
  - **sample directly into cartridge, swirl to dissolve reagents (<2 min)**
  - **touch screen to set up test, insert sample, close lid**  
**(no dilutions, no filtering, no visual observation)**

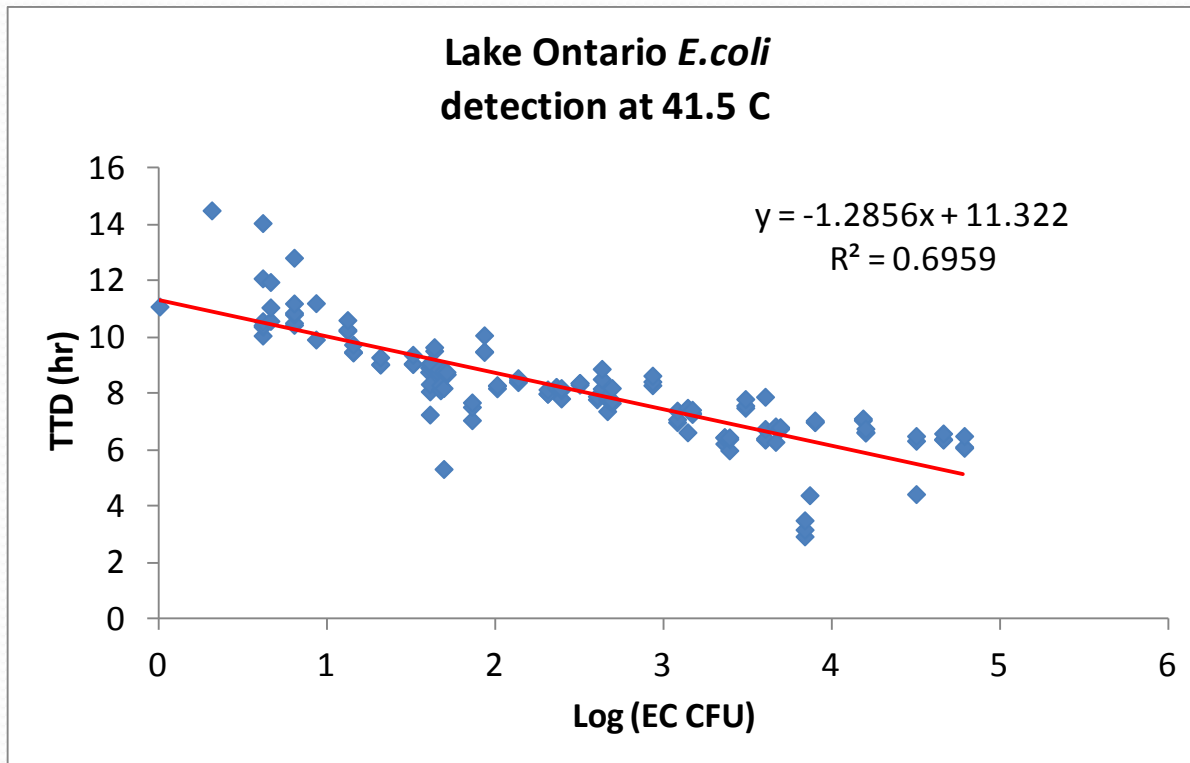
# ENDETEC TECTA B16



- Detect signal departing from baseline
  - sample positive for indicator enzyme
- Time to detection (TTD) related to contamination level

# ENDETEC TECTA B16

- Calibration using Lake Ontario samples (near Kingston, ON)
- Time to detection (TTD) related to contamination level (reference test was Idexx Colilert 18)



EC (CFU)	Est. TTD (hr)
1	11.3
10	10.0
100	8.8
1000	7.5
10000	6.2
100000	4.9
1000000	3.6

# Methods

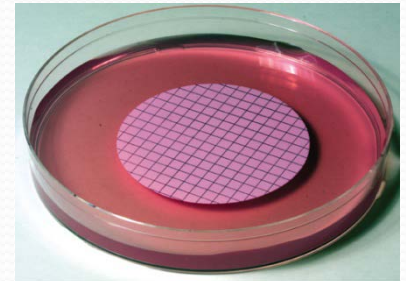
1 L  
Water  
Sample

TECTA

DCM

BCIG

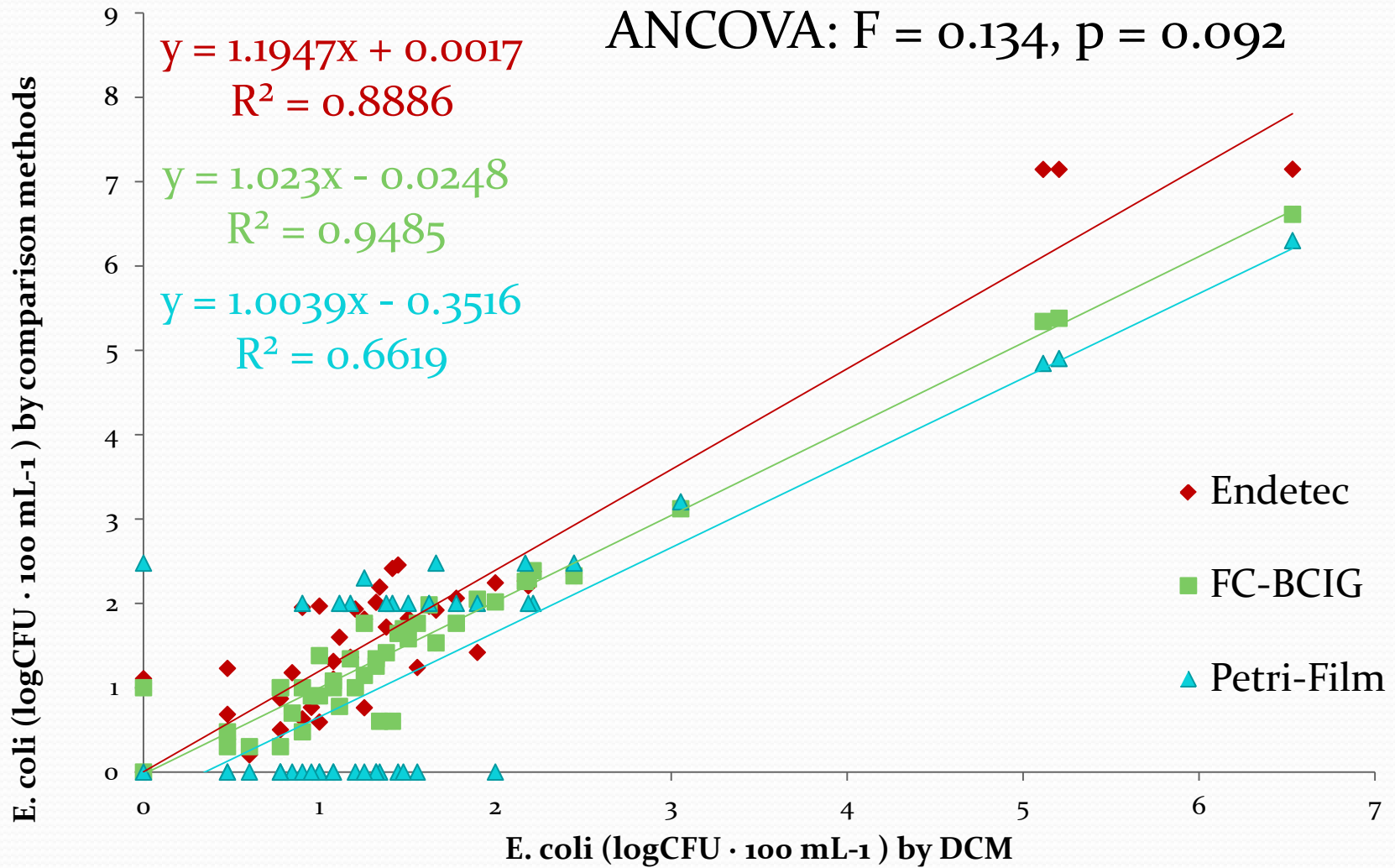
3M  
Petrifilm



# Methods

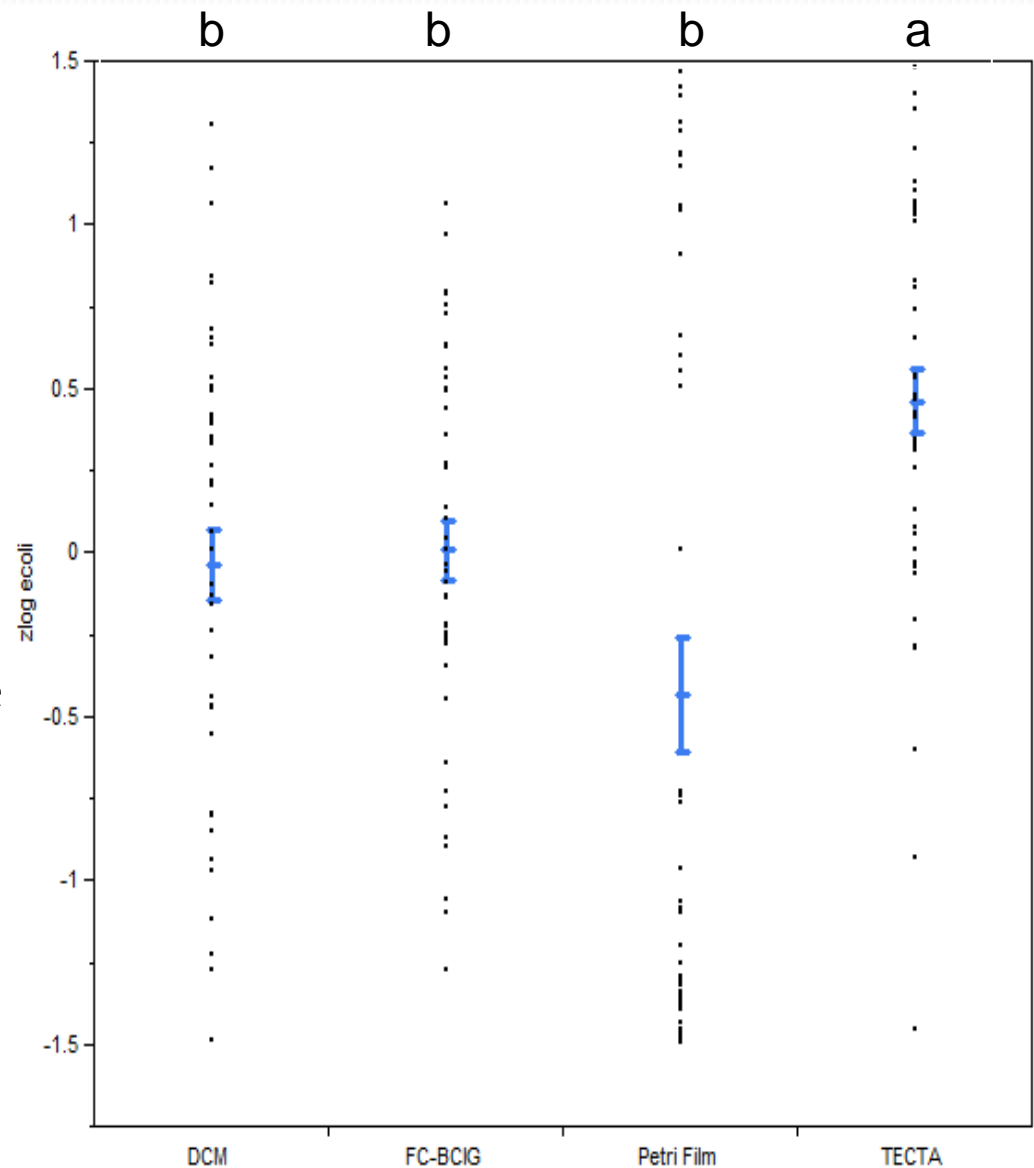
- Water samples collected at 4 candidate beaches, as well as surface waters from suspected *E. coli* point sources near Cornwall, ON.
- *E. coli* densities (CFU/100mL) determined using 4 subsamples from each field sample by DCM, BCIG, Petri-film and TECTA, respectively.
- Relationships between *E. coli* estimates generated by DCM and trial methods (BCIG, Petri-film, TECTA) evaluated with linear regression and ANCOVA.
- Log *E. coli* estimates normalized per sample and differences in mean *E. coli* among methods evaluated by ANOVA.

# Results



# Results

- One-way ANOVA shows significant differences among methods (standardized to sample means,  $F = 8.32$ ,  $p < 0.001$ ).
- Post-hoc Tukey's HSD test demonstrated that mean *E. coli* concentrations estimated by the TECTA method were significantly higher than those measured by culturing techniques ( $\alpha = 0.05$ ,  $q = 2.59$ ).



# Discussion

- Broad agreement between all methods evaluated.
  - Very close agreement between membrane filtration methods (DCM and BCIG).
- 3M™ Petrifilms™\* method unreliable at low CFU counts.
  - Ease of use and reliability at high counts suggests potential for use as a simple presence/absence indicator.
- TECTA method is very reliable within CFU range of interest (0-100 CFU / 100mL).
  - Some calibration adjustments may be necessary.
  - Good potential for rapid *E. coli* determination in recreational waters (< 10 h).

\*Schaft, H. and Watterworth L.A. 2005. Enumeration of heterotrophs, fecal coliforms and *Escherichia coli* in water: comparison of 3M™ Petrifilms™ plates with standard plating procedures. *J. Microbiol. Meth.* 60:335-342

# Thank you!

## Collaborative Partners



ST. LAWRENCE RIVER INSTITUTE



EOHU  
Eastern Ontario  
Health Unit



BSEO  
Bureau de santé  
de l'est de l'Ontario



## Research Funding



THE ONTARIO  
TRILLIUM  
FOUNDATION



LA FONDATION  
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