

Waterborne pathogens and *E. coli* contaminants

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March 28, 2007

Presentation overview

- Fecal pollution challenge
- *E. coli* and pathogen contaminants in Lake Ontario
- Lake Ontario beach studies
 - *E. coli* source tracking
 - Waterborne pathogen occurrence
 - *E. coli* pathotypes
 - *Campylobacter* species
- Conclusions

Fecal Pollution Challenge

- 100+ waterborne pathogens and antibiotic resistant bacteria in fecal pollution
- Potential for disease outbreaks, boil water advisories, beach closures, and contaminated irrigation waters
- Need to prevent pathogen pollution from:
 - Municipal wastewater sources (e.g. CSO outfalls)
 - Agricultural sources (e.g. livestock and poultry wastes)
 - Wildlife sources (e.g. gull and geese droppings)



Lake Ontario - Waterborne Disease

- Waterborne disease incidents not commonly reported, though notoriously under-reported
- Recent waterborne disease outbreaks in areas surrounding Lake Ontario
 - Walkerton (2000) - 7 deaths; 2300 illnesses
 - Montreal (2001) - 4 children hospitalized
 - Seneca Lake N.Y. (2005) - > 3800 illnesses
 - Toronto (2005) - 23 deaths; 112 illnesses

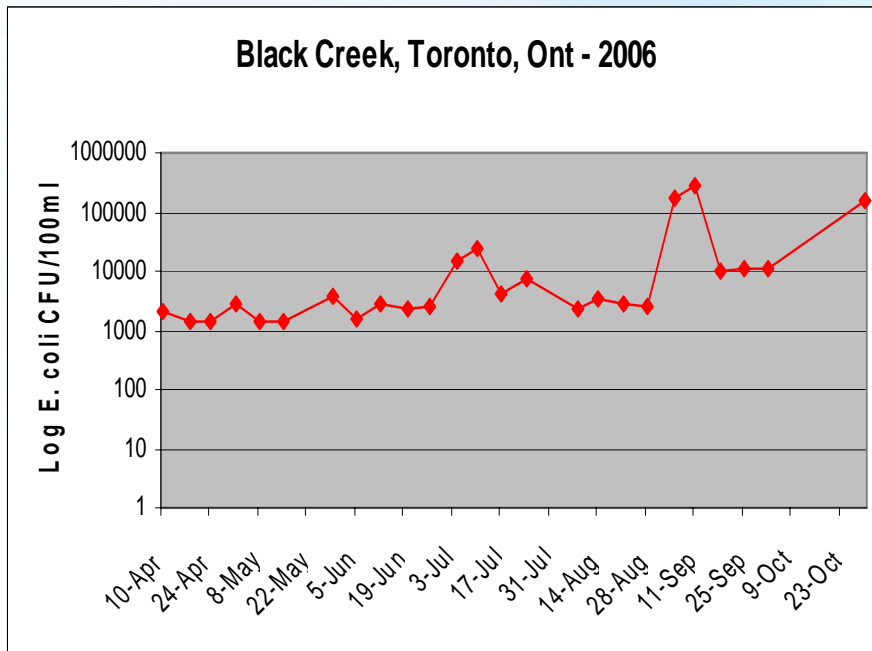


Lake Ontario – Waterborne Pathogens

- Little knowledge about the occurrence of waterborne pathogens in Lake Ontario source waters used for drinking and recreation
- High numbers of *E. coli* in some Lake Ontario tributaries and nearshore waters indicating potential occurrence of waterborne pathogens

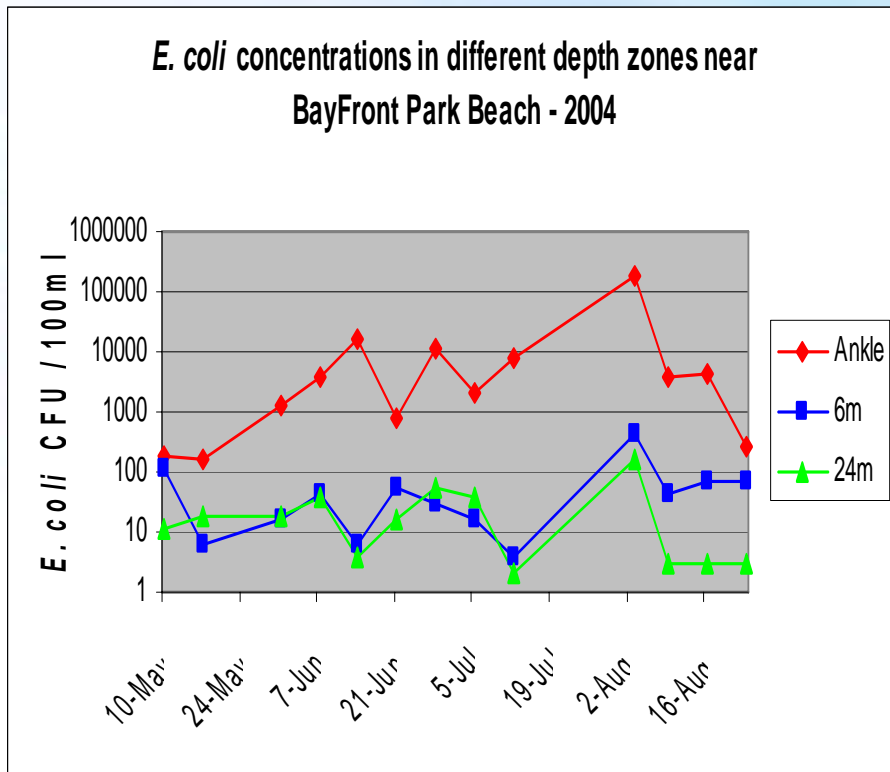


Lake Ontario Tributaries/Outfalls *E. coli* Contamination



Lake Ontario Nearshore - Beaches

E. coli contamination



Bayfront Park Beach

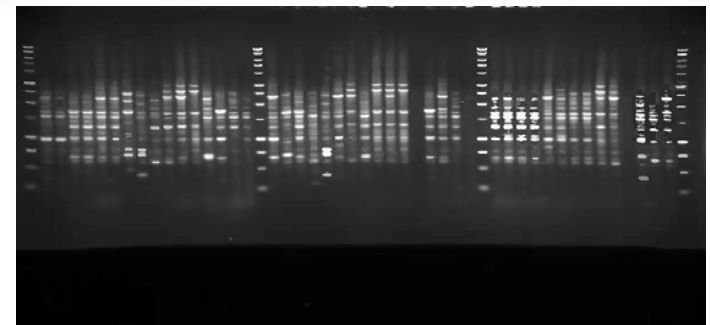
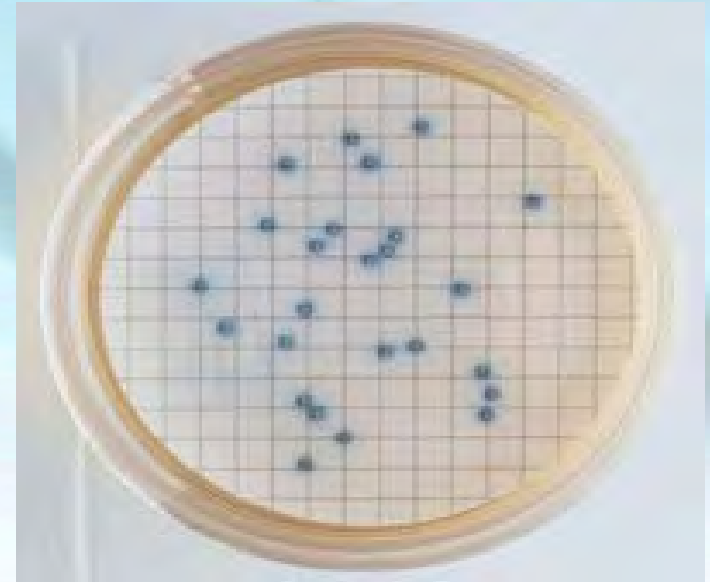
E. coli and waterborne pathogen contaminants

- Microbial source tracking of fecal pollution sources
 - *E. coli*
- Detection of waterborne pathogens
 - *E. coli* pathotypes
 - *Campylobacter* sp.



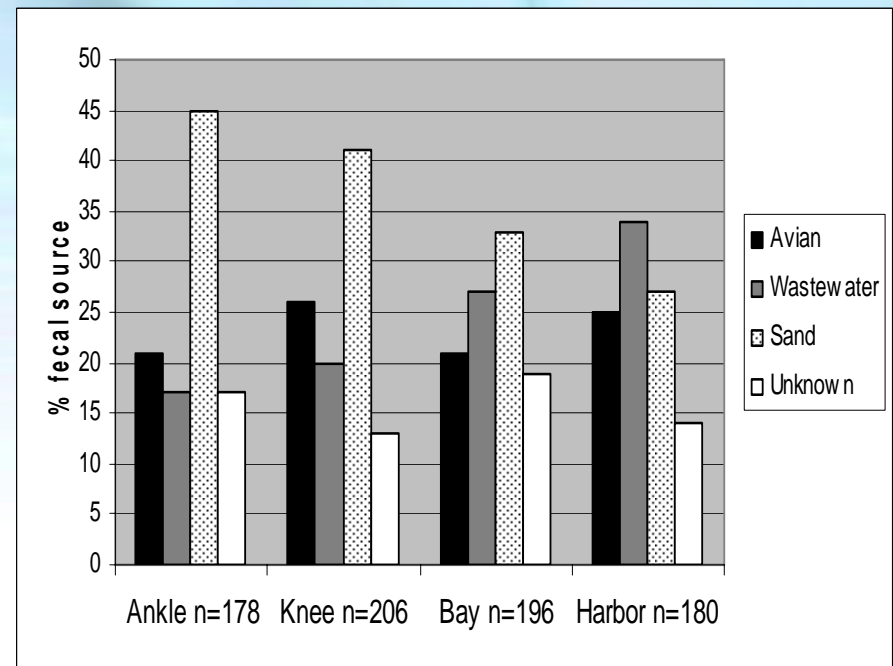
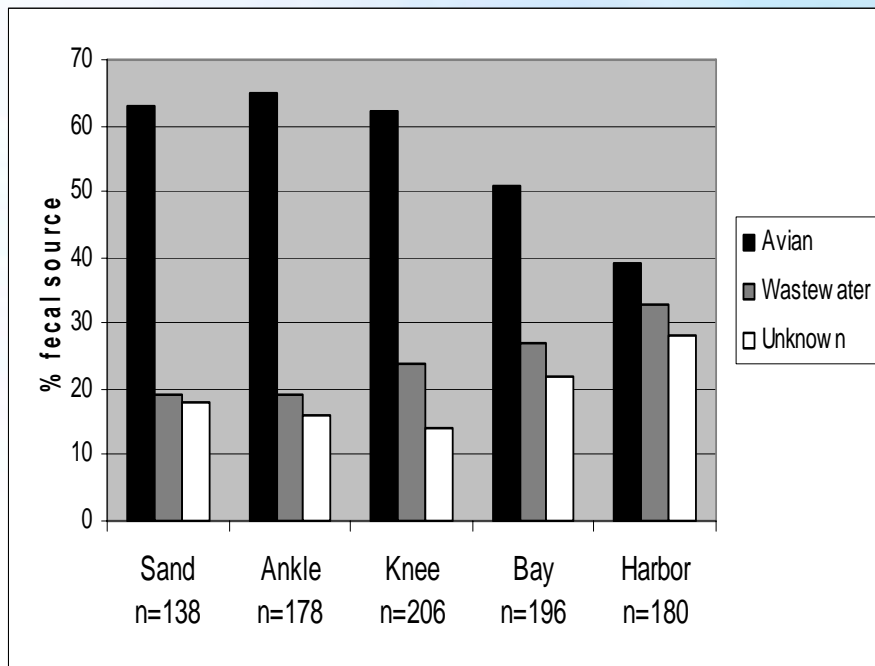
Microbial source tracking

- Water quality decisions based on enumeration of *E. coli*
- **Problem:** *E. coli* detection gives no info on the source of fecal pollution
- **Need:** Science-based tools to:
 - Mediate between stakeholders
 - Guide corrective actions
 - Assess pathogen risks
- **Microbial source tracking (MST):** techniques that compare similarity of microbes in water and fecal pollution sources to infer source of contamination



Source of *E. coli* at Bayfront Beach

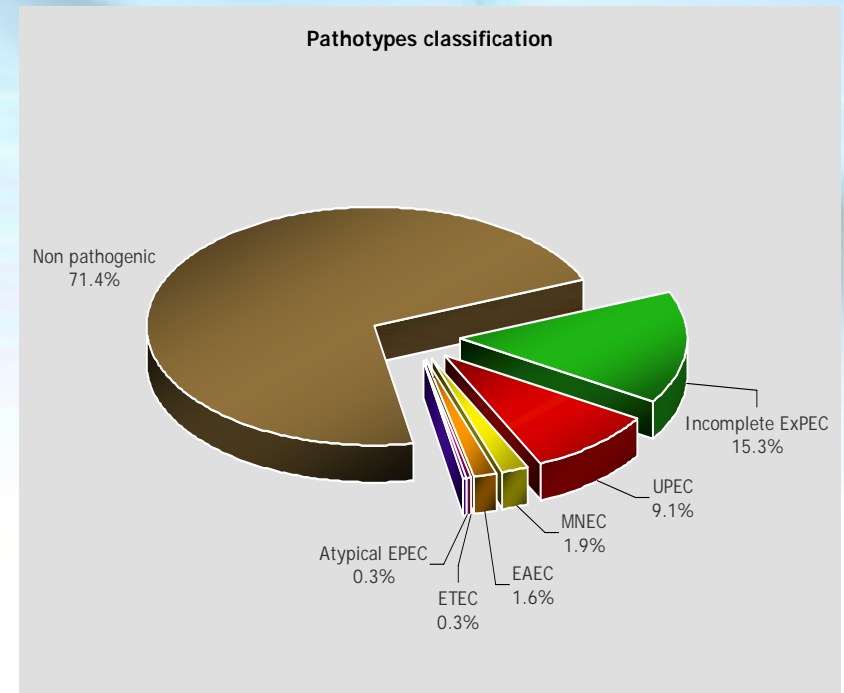
rep-PCR DNA fingerprinting



Types of *E. coli* at Bayfront Beach

DNA microarray fingerprinting

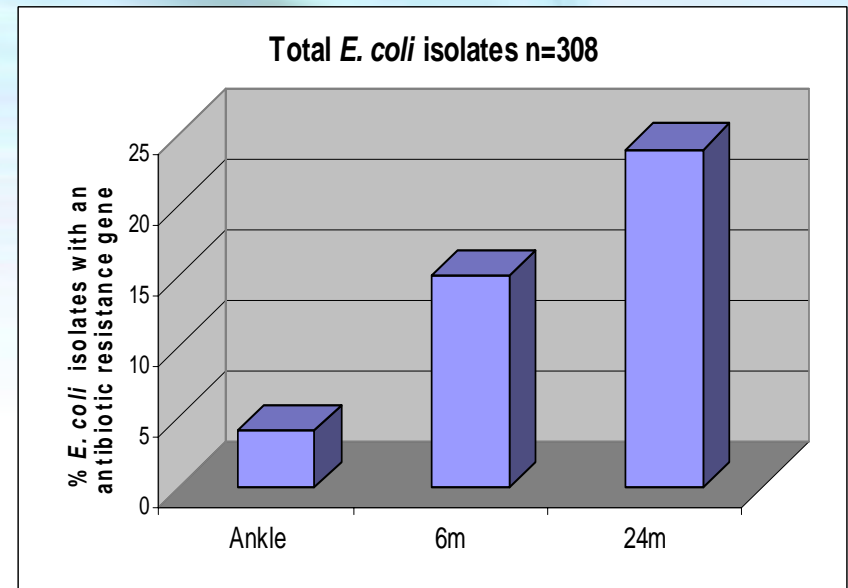
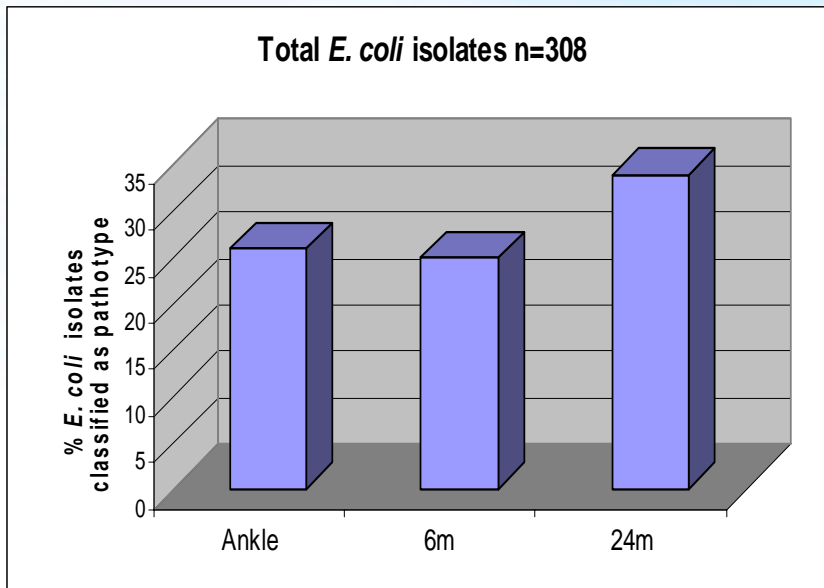
- Most *E. coli* harmless inhabitants of human/animal intestinal tracts
- 11 *E. coli* pathotypes recognized
 - Intestinal symptoms (EHEC)
 - Extra-intestinal symptoms (UPEC)
- Occurrence of *E. coli* pathotypes in aquatic ecosystems?
- 308 *E. coli* isolates from Bayfront beach studied - DNA microarray
- Almost 30% were pathotypes



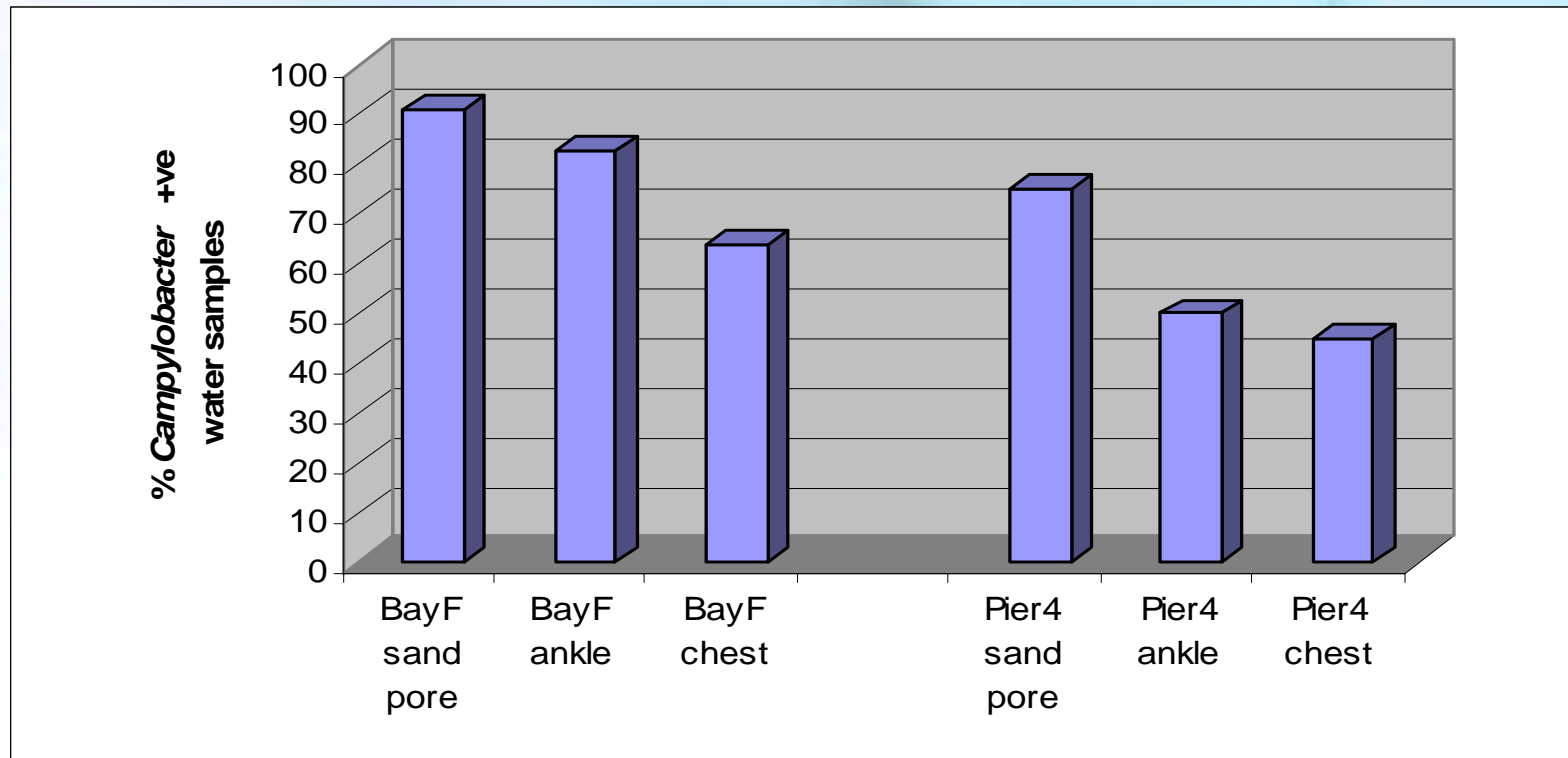
Occurrence of *E. coli* types across Bayfront Beach depth zones

virulence genes

antibiotic resistance genes



Occurrence of *Campylobacter* sp. across BayFront and Pier 4 beach depth zones



Summary

- Little known about the occurrence of waterborne pathogens in Lake Ontario source waters used for drinking and recreation
- High numbers of *E. coli* can be found in some Lake Ontario tributaries and nearshore waters
- Research needed to identify the sources of *E. coli* responsible for contaminating nearshore waters and closing beaches in Lake Ontario
- Research needed to better understand the occurrence, sources, offshore transport, and potential health risks of waterborne pathogens in Lake Ontario



Acknowledgements

- Stephen Hill, Izhar Khan, Allan Crowe, Abdel El-Shaarawi, Jeannine Guindon, Alyssa Loughborough, Jiri Marsalek, Jacqui Milne, Peter Seto, Kinga Smolen, Flora Suen, and Laura Swystun, NWRI-EC.
- Roland Brousseau, Katia Hamelin, Luke Masson, Christine Maynard, BRI-NRCC.
- Josee Harel, John Morris Fairbrother, Guillaume Bruant, U. de Montreal.
- Sadjia Bekal, Sante Publique du Quebec

