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Methods to sample *E. coli* in foreshore sand and pore water

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· A very strong significant

correlation was observed

between the saturated

sand and the pore water

Introduction

- E. coli is often orders of magnitude higher in sand/pore water near the shoreline than shallow lake waters [1].
- This bacteria reservoir can act as a non-point source for contaminating lake waters [2]. Health units do not sample this reservoir [3].
- Study objectives were to (i) compare different methods used to quantify E. coli in the reservoir and (ii) compare the abundance of Figure 1: Reservoir Components E. coli in different components of the reservoir.

Methods

- Samples were collected at 6 beaches in Southern Ontario (Figure 2). 4-5 transects were sampled on 3-4 occasions at each beach using methods shown in Figure 3.
- Data was log transformed and analyzed using ANOVA, and if significant, further analyzed using Tukey's pot hoc test.





Shovel Method







Figure 3: Sampling Methods

Results

Comparing methods for pore water

- PW-Shovel method resulted in statistically higher concentrations in the pore water than the PW-Drivepoint method (p=0.025), PW-Careful resulted in concentrations in between the two (Table 1).
- Although the methods did not result in statistically different variances (p = 0.354), the PW-Shovel method had a lower variance than the PW-Careful and the PW-Drivepoint method.

Table 1: Summary of results for different sampling methods

Pore Water					
	N	Mean	Standard Deviation	Grouping	
		(log CFU/100mL)	(log CFU/100mL) or		
		or (log CFU/g)	(log CFU/g)		
PW-Shovel	78	3.47	1.11	Α	
PW-Careful	78	3.33	1.30	A,B	
PW-Drive Point	75	2.95	1.27	В	
Saturated Sand					
Sat-Shovel	75	1.31	1.05	Α	
Sat-Careful	75	1.40	1.36	Α	
Sat-Core	76	1.70	1.35	Α	
Unsaturated Sand	i				
Unsat-1cm	78	2.23	1.30	A	
Unsat-5cm	17	1.63	0.84	В	

Comparing methods for unsaturated sand

Unsat-1cm had statistically higher and statistically more variable concentrations than Unsat-5cm (Table 1).

Comparing methods for saturated sand

- There was no statistical difference between the saturated sand collection methods (Table 1). This may be due to the large variations in each sampling method.
- Saturated sand collected using the Sat-Shovel method resulted in significantly lower variability in *E. coli* concentrations than collecting sand using the other methods (p=0.047).

Comparing methods for all components



between saturated sand and pore water

- Figure 4: E. coli distribution on volumetric basis
- · Statistically (p<0.001), the shovel method had the highest percentage of E. coli in the pore water as well as the lowest percentage of *E. coli* attached to the sand, followed by the careful excavation method, which was followed by the drive point/core method (Figure 4).
 - Disturbance caused by digging with a shovel may cause E. coli to detach from the sand resulting in higher pore water concentrations and lower sand concentrations.

Results continued

Comparing the different components of the reservoir

Table 2: Correlations between reservoir components

	Pore Water	Saturated Sand	Unsaturated Sand	Ankle-Depth Water	
Pore Water	1	0.953 (<0.001)	0.682 (<0.001)	0.262 (0.027)	
aturated Sand	1	1	0.695 (<0.001)	0.300 (0.011)	
Unsaturated Sand	1	1	1	0.579 (<0.001)	•
Ankle-Depth Water	1	1	1	1	

The component that was most representative of the ankle-depth water was the unsaturated sand (Table 2).

(Table 2).

- *Results are shown as r (p) where: r = regression value and p = significance (p<0.05 is significant)
- After an ANOVA was shown to be significant (p<0.001). Tukey's post-hoc test showed that when converted into volumetric units, the unsaturated sand statistically had the highest E. coli concentrations, followed by the saturated sand, which was followed by the pore water.
- Pore water was statistically less variable than unsaturated and saturated sand

Conclusions and Future Work

- Sampling pore water using a shovel results in the highest observed E. coli concentrations and lowest observed variability.
- Sampling the top 1 cm of unsaturated sand results in higher and more variable concentrations than sampling the top 5 cm of sand.
- There was no observed difference in E. coli concentrations when using different methods to sample saturated sand.
- The sampling method used affects the distribution of E. coli between the pore water and saturated sand.
- The unsaturated sand has the highest amount of *E. coli* in the foreshore reservoir. while the pore water has the lowest amount of E. coli and is the least variable.
- Future work is required to determine if these results apply for other types of beaches.

References

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Acknowledgements







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