INFLUENCE OF DECOMPOSING PIG CARCASSES ON SOIL MICROBIAL METABOLIC ACTIVITY IN A CANADIAN TEMPERATE CLIMATE

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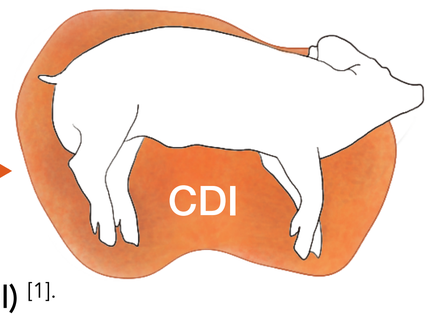
INTRODUCTION

DECOMPOSITION

- A decomposing body is capable of generating and purging large amounts of fluids, biological by-products, nutrients and carcass-derived bacteria into the surrounding environment [1,2].
- The affected area is the **Cadaver Decomposition Island (CDI)** [1].



BACTERIA

- Soil and groundwater bacterial community function is influenced by the input and availability of chemical and biological compounds [2].
- The ability for bacteria to metabolise and transform these compounds is dependent on concentration, type and quality (lability) [3].
- Chemical and biological changes in the environment can be reflected by changes in **bacterial metabolic activity and capacity** [4].

CONTEXT

- Outdoor human decomposition facilities regularly deposit the bodies of donors in order to study decomposition for forensic purposes.
- The establishment of new facilities often requires approbations from government regulatory bodies to ensure there are minimal risks to the environment and public health.

PROBLEM

- The potential environmental impacts of body decomposition are unknown, especially on soil and groundwater in Canadian temperate regions.

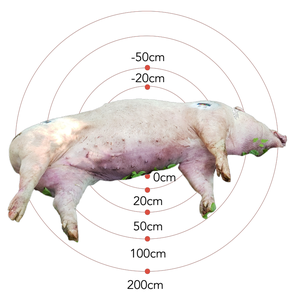
OBJECTIVES

- Evaluate the potential spatial effects that the decomposition of human analogs (domesticated pigs) have on:
  - Soil **dissolved organic carbon (DOC)** levels & quality;
  - Soil pore-water **bacterial metabolic activity & capacity**.

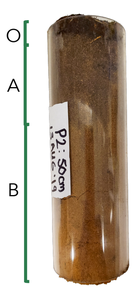
METHODOLOGY

- Surface deposited pig carcasses (n=2) on June 18, 2019.
  - *Location*: Mixed wooded area on the campus of the Université du Québec à Trois-Rivières, Trois-Rivières, Qc;
  - *Sampling method*: Soil cores (2" X 6") at distance intervals from the pig carcass.
  - *Core collection*: Day 56 of decomposition (active/advanced decay).

SAMPLE COLLECTION & PREPARATION



1 - Soil cores at distances of **0cm, 20cm, 50cm, 100cm and 200cm.**



2 – Separate soil core into A- and B-horizons.

3 – Air-dry soil for 1-week and sieve out debris.

4 – Dissolve soil in Milli-Q H_2O, centrifuge, collect supernatant.

5 – Filter using GF/F (DOC analysis) or GF/D (bacterial analysis) glass microfibers filters.

SAMPLE ANALYSIS

Method of Analysis	Measures & Indices	Purpose
GE TIC-TOC M9 analyzer	DOC concentration (ppm)	DOC levels
Excitation-Emission Fluorescence Spectroscopy	**PARAFAC modelling:** DOC source **$SUVA_{254}$:** DOC aromaticity **Fluorescence index (FI):** DOC source **Humification index (HIX):** Degree of DOC humification **Biological Index (BIX):** Autotrophic activity, freshness **Spectral Slope Ratio (Sr):** DOC molecular weight [5]	DOC, source, type and quality
Optically isolated O_2 sensors (PSt5)	Bacterial respiration (BR) rates ($\mu g\text{-}C \cdot L^{-1} \cdot hr^{-1}$)	Bacterial metabolic activity
BIOLOG EcoPlates & well absorbance (590nm)	Degradation rates of 31 carbon substrates (AWCD: Average well color development)	Bacterial metabolic capacity

RESULTS

Fig 1. Lateral & Vertical Extent of DOC Concentration

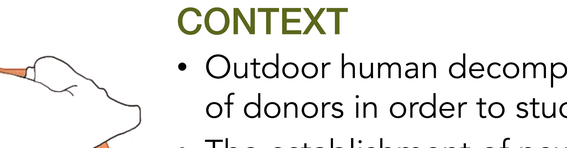


Fig 2. Lateral & Vertical Extent of Microbial Carbon Respiration

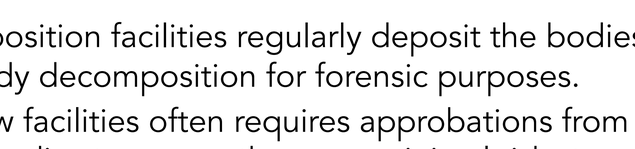


Fig 1. and *Fig 2.* respectively demonstrate the extent of lateral (distance) and vertical (soil horizons) distribution of soil DOC and soil-pore water microbial carbon respiration. Both measurements show distinctive A-horizon peaks within 20cm from the pig's center. The measures remain relatively unchanged between horizons at distances >20cm.

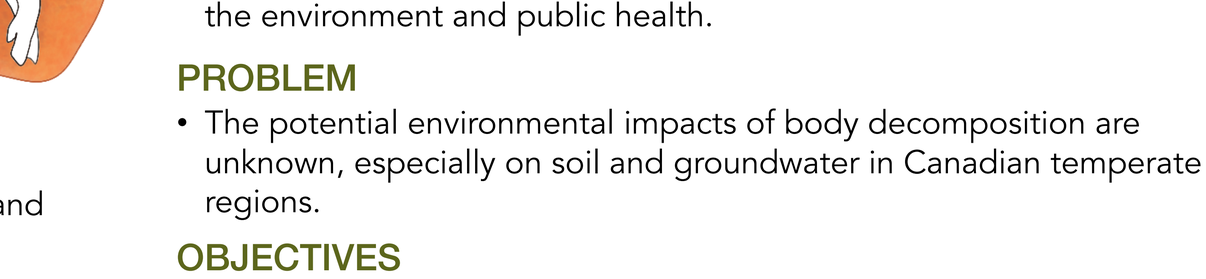


Fig 3. PARAFAC components demonstrating DOC sources. Peaks A, C, M indicate humic terrestrial sources. Peaks T, B indicate proteinic sources. C5 has an unidentifiable peak, which was found in high abundance close to the carcass.

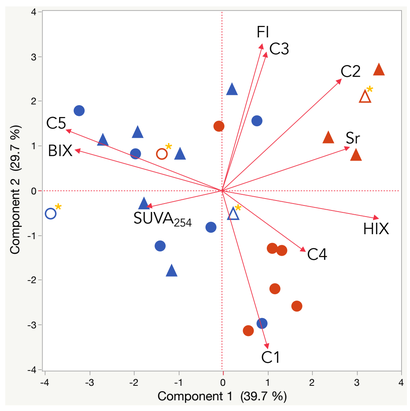


Fig 4. PCA of PARAFC components (C1-C5) and DOC fluorescence indices at varying distances from the carcass. There is a noticeable shift, driven by C5 & BIX, in DOC composition directly beneath the pig (0cm) in the A-horizon.

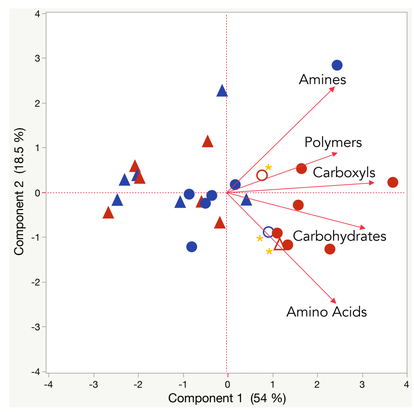


Fig 5. PCA of bacterial metabolic capacity to oxidize major substrate classes at varying distances from the carcass. There is a noticeable shift in metabolic capacity directly beneath the pig (0cm) in both horizons.

P1 (A-horizon) P1 (B-horizon) P2 (A-horizon) P2 (B-Horizon) 0cm

CONCLUSION

* **DOC levels and bacterial metabolic activity increased with decomposition.**

The effect was contained within the A-horizon and ≤ 20cm from the carcass.

* A **unique PARAFAC peak** may be attributed to decomposition material, which could be used to map CDI in soils and in the aquatic environment. * Observed a strong **shift in DOC composition and metabolic capacity** beneath the carcass, thus suggesting a constrained input of organic material and utilization by microbes.

Future directions: Analyze deeper groundwater (piezometers), deposit human donors, and examine the PARAFAC peaks of decomposition fluid to validate the results.

ACKNOWLEDGEMENTS

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