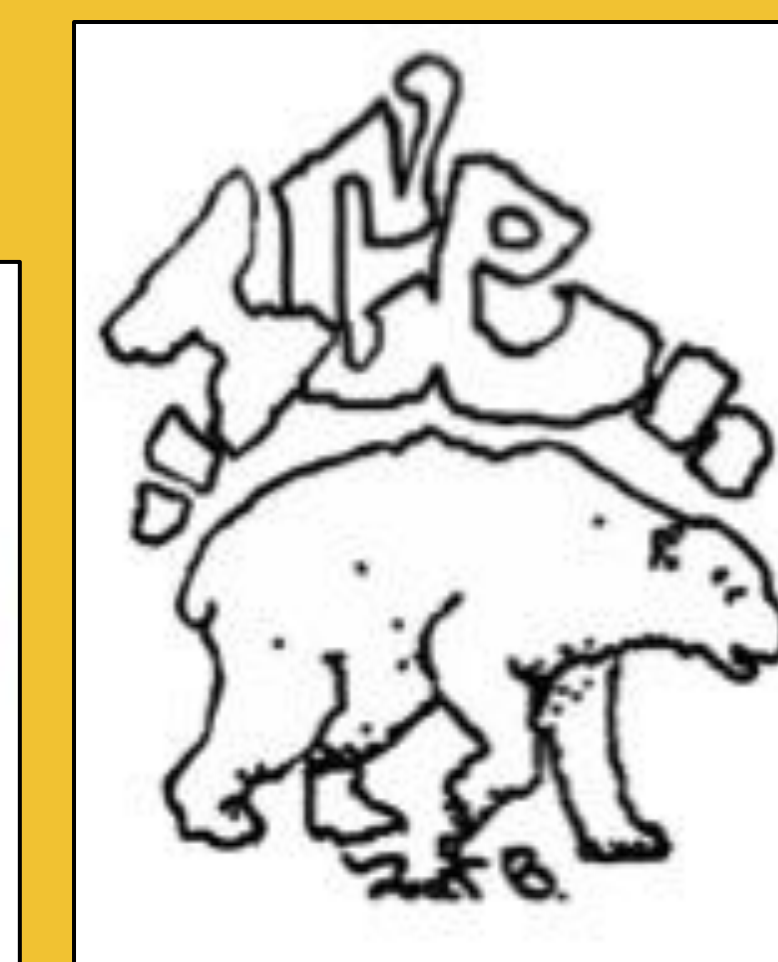


# Utilizing Earthworm Abundance and Species Diversity as Indicators of Soil Health in Greenpoint, Brooklyn.

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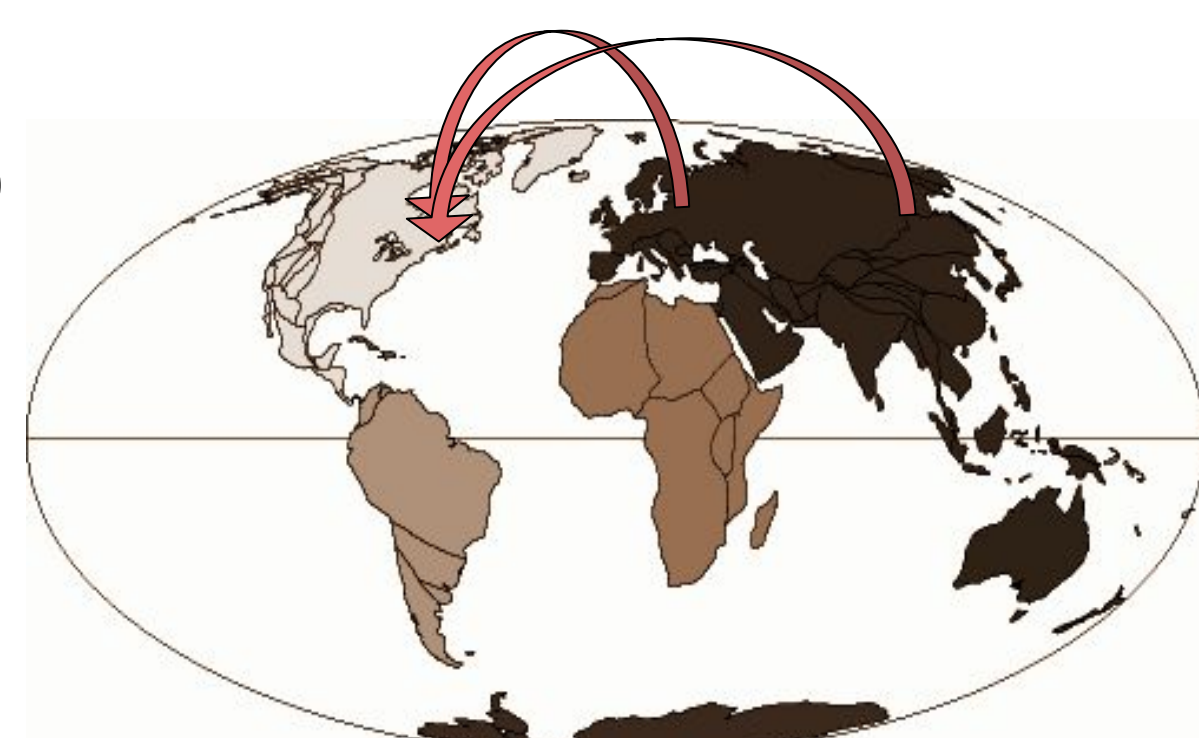
## SUMMARY:

Earthworms species diversity indicates pollution levels and abundance indicates disruption of soil structure. Earthworms were utilized as bioindicators in public and private locations in Greenpoint, Brooklyn to observe the functionality of the soil and need for bioremediation. It was hypothesized that public locations would have fewer earthworms and private locations would lower diversity on the SDI due Greenpoint pollution. Earthworms were collected using mustard extraction from 12 sites, identified taxonomically, and identified on DNASubway. The abundance data demonstrates no significant difference between public and private, yet 16/30 public samples had 0 earthworms while 22/30 of private samples had at least one earthworm ( $p=0.07$ ). Based on DNA sequencing, the SDI indicates the diversity of private locations is 0.775 making it higher than public locations at 0.6 and refuting taxonomic results at with 2/36 correct species identifications.

## BACKGROUND:

### Fig 1: Invasive Earthworms

- From Asia/Europe (Raver) they alter forest ecosystems (Bohlen, Bainbridge).
- Earthworms in urban soil are understudied, they provide bioremediation and benefit soil structure (Gift).

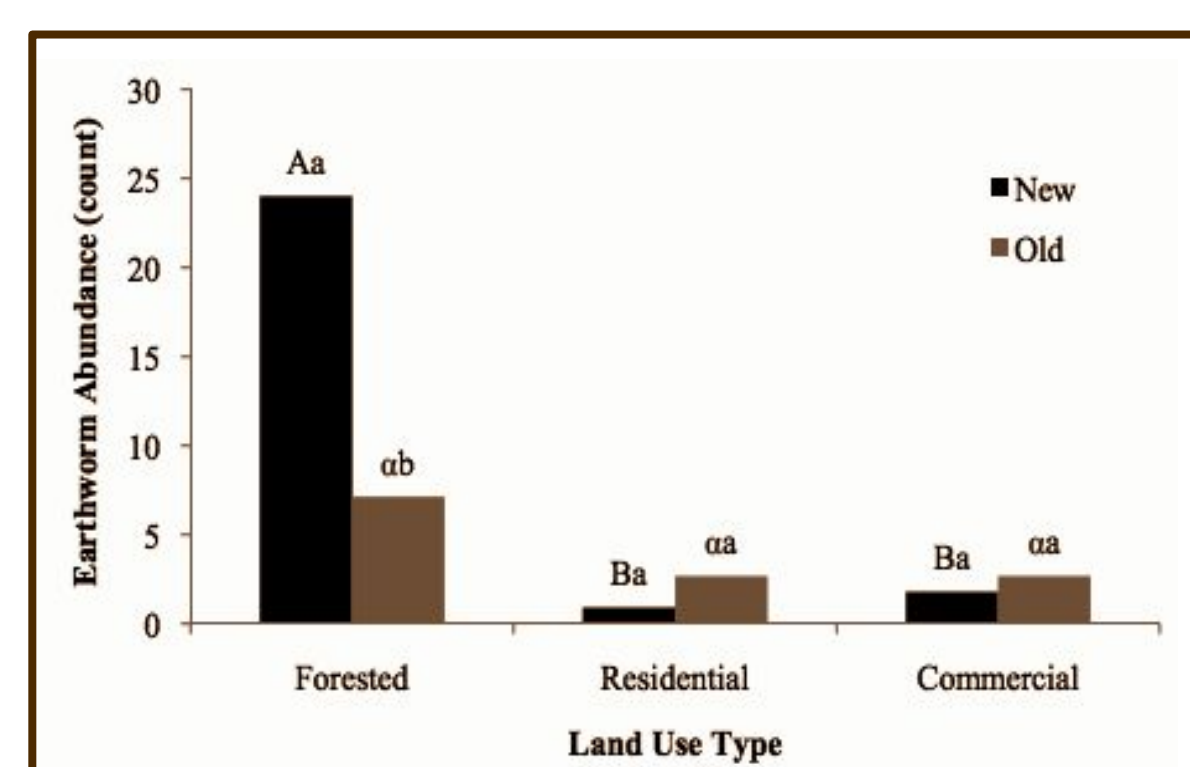


### Fig 2: An earthworm (lumbricidae).

- Low population diversity → high pollution levels (Pères, 2011).
- Low abundance → soil compaction due to human disruption (Bainbridge, 1999).
- Earthworms are a method of soil decontamination (Gift, 2009).

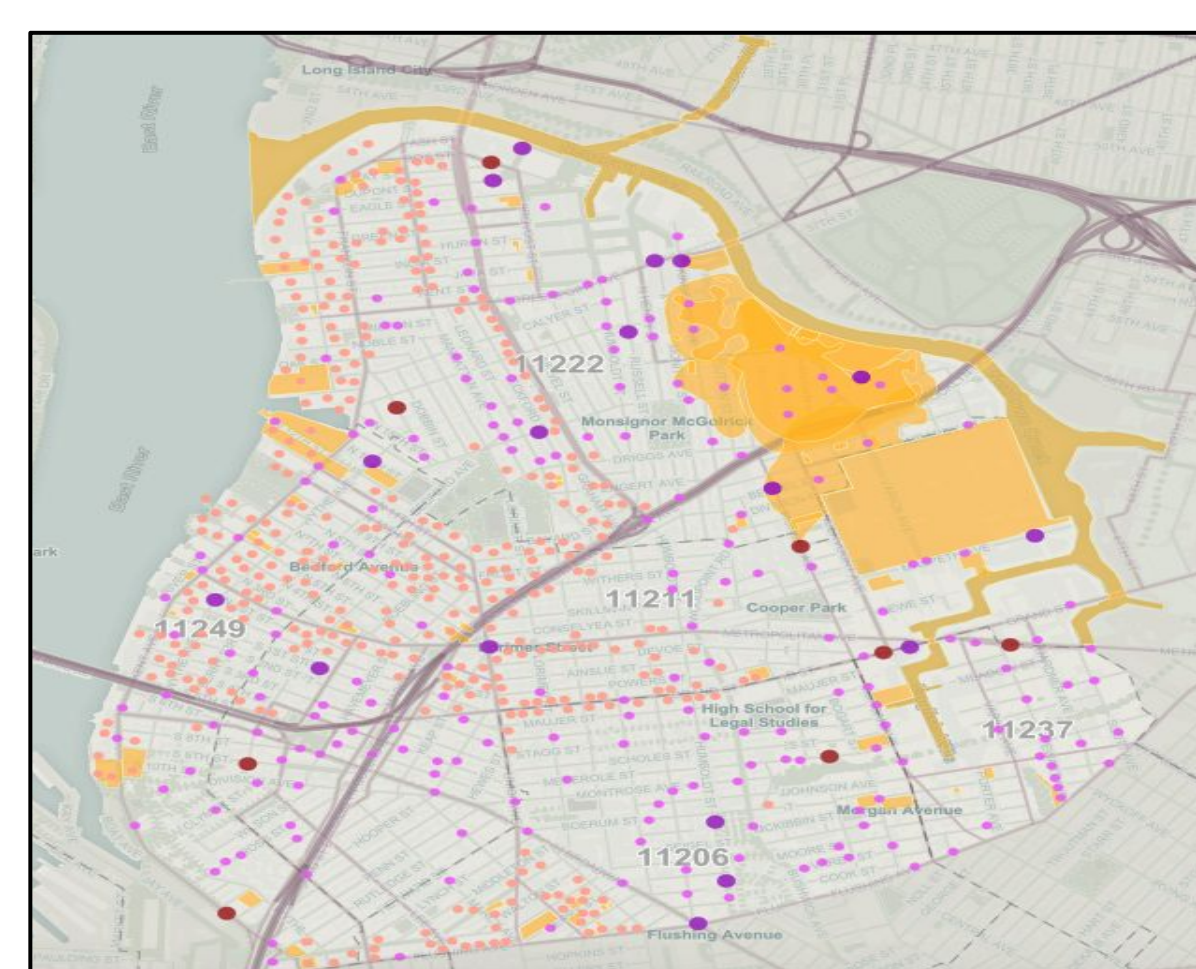
### Fig 3: Adult Earthworm Abundance Observed Across Three Land Use Types (Gift, 2009)

- More human disturbance → less abundance.
- Supported by research of Bainbridge, 1999.



### Fig 4: The Greenpoint-Brooklyn ToxiCity Map created by Neighbors Allied for Good Growth (NAGG)

- Demonstrates potential & confirmed polluted locations.
- Yellow = areas undergoing remediation.
- Pink dots = chemical spills.



## METHODS:

### Preparation

- 12 locations selected in Greenpoint → 6 Private/6 Public. 6 "commercial"/6 "residential".
- 5 locations randomly selected at each site → pinned on Google Map.
- Private yards required owner permission and public locations required Park's Department Research Permit.

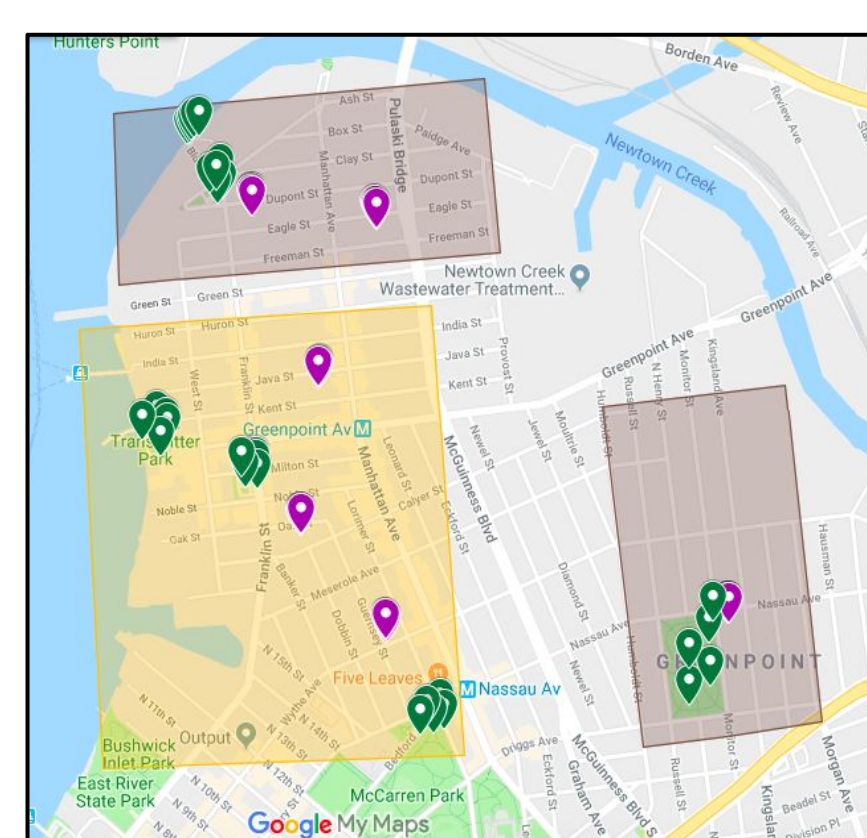


Fig 5: Google Map of Testing Locations. Key: green (public), pink (private) yellow square (commercial), brown square (residential).

### Collection

- 12" x 12" quadrat placed on chosen location.
- Mustard powder concoction is poured over square (Lawrence, 2002).
- Worms appear from ground, retrieved with forceps.
- Placed in 70% isopropyl alcohol and stored in freezer.



Fig 6: Homemade metal quadrat was used to section off testing locations.

### Identification

- 20% of samples chosen randomly (at least 5).
- DNA extracted with Qiagen DNEasy Kit at I.C.E.
- Identified using Blue Line of DNASubway.

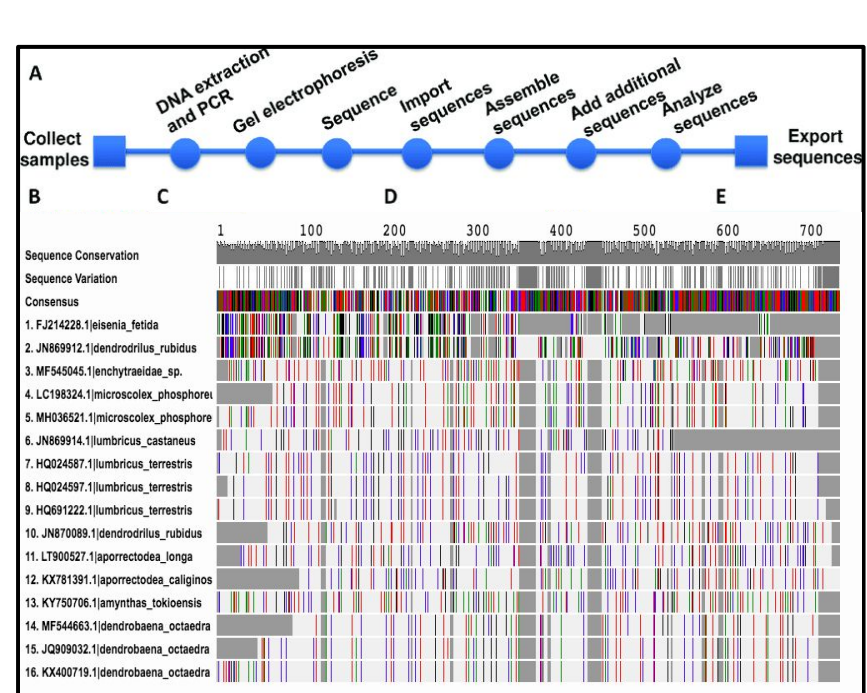


Fig 7: DNASubway (blue line) Identification of an Earthworm.

### Analysis

- Chi-squared utilized to calculate significance of earthworm abundance;
  - Public v. Private.
  - Commercial v. Residential.
  - Zero-Worm comparison.
- Biodiversity of samples using Simpson's Diversity Index.

## RESULTS:

### Earthworm DNA Species Frequency in Public and Private Locations

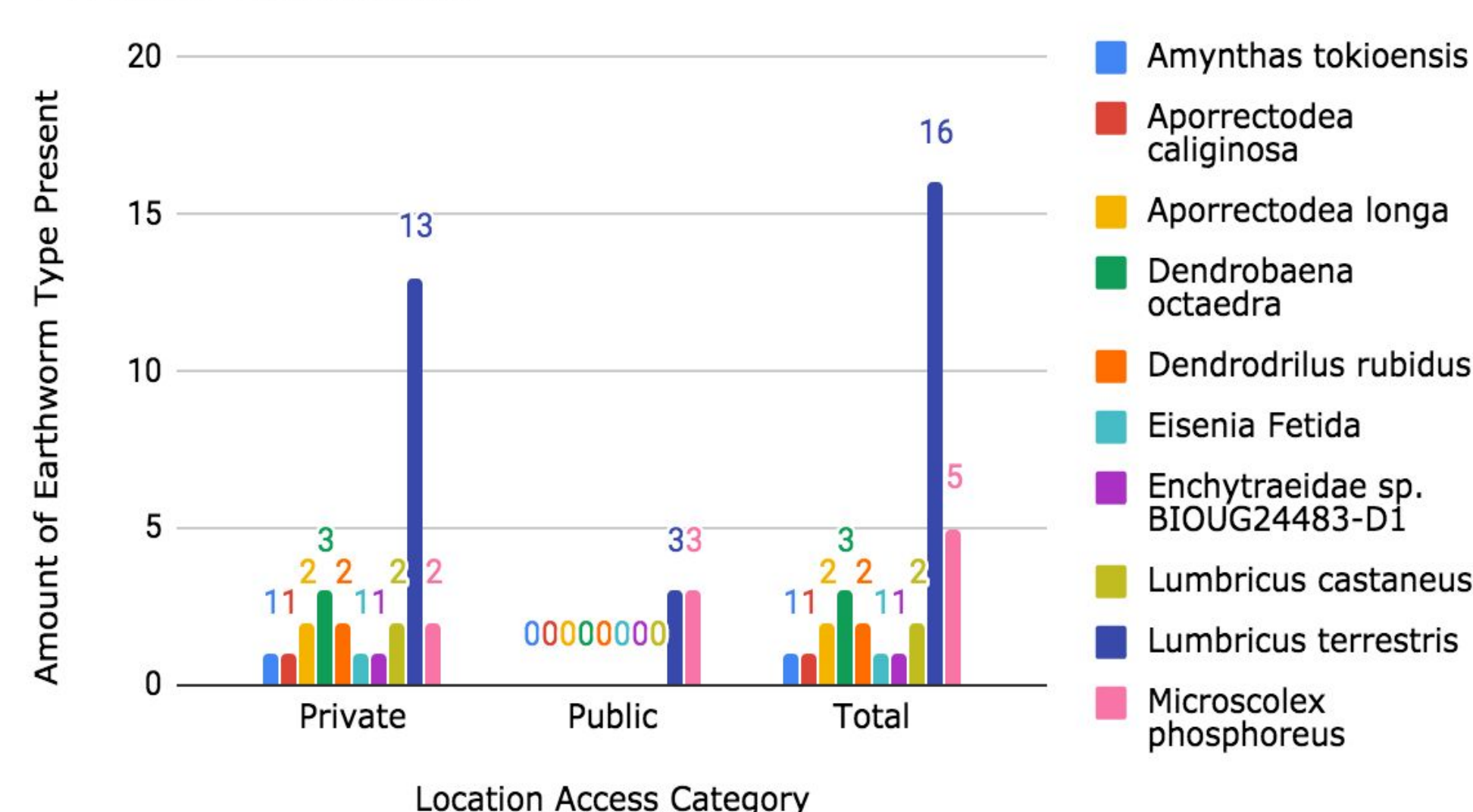


Fig 8: DNA Species Frequency in Public and Private Locations

### SDI Value for Species in Public and Private Sites



Fig 9: Simpson's Diversity Index of DNA Species in Public and Private Locations. SDI is calculated on 0-1 range of diversity. There is a noticeable drop in the diversity of species in private locations to public locations.

### Frequency of Zero-Worms in Public & Private Samples

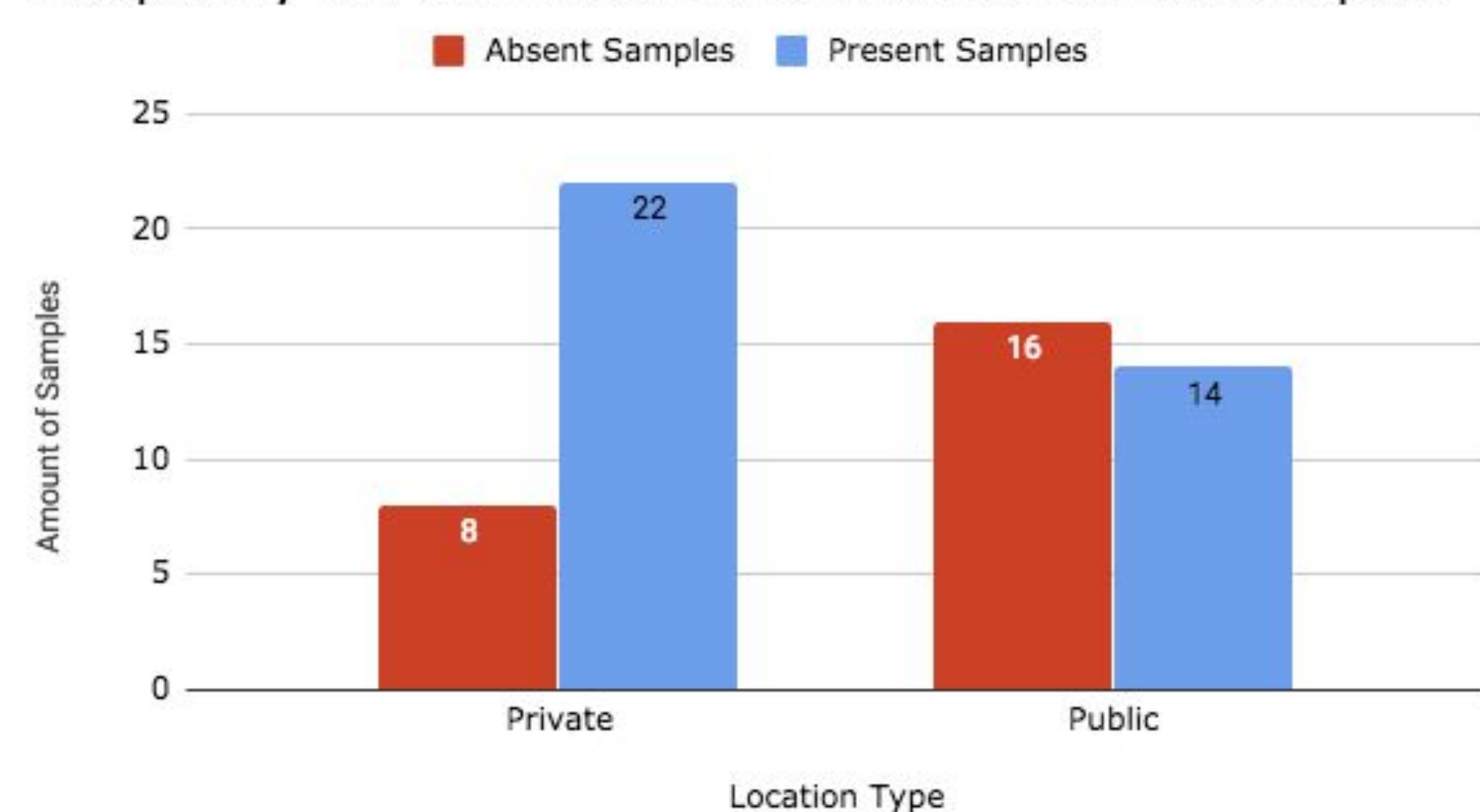


Fig 10: Frequency of Zero-Worm Presence in Public and Private Samples. A chi-square test for independence was performed and demonstrated that there was no significant differences between the abundance of earthworms in public and private locations,  $\chi^2 - (1, N = 60) = 3.4, p = 0.0652$ .

## RESULTS CONT.

- Biodiversity data reveals more information regarding local soil health: more diversity in private areas (Fig 8.) Many public samples were unsuccessful when sequenced potentially due to soil within the worm tissue.
- Through SDI analysis, comparitize to the total amount, private and public samples have little difference in diversity (Fig 9.)
- Samples completely lacking earthworms were more frequent in public sites public playgrounds (Figure 10.)

## CONCLUSIONS:

- Earthworm abundance, consistency, and flora life were very inconsistent for each sample → more inconsistent in public locations. Playground soil structure is at risk → remediate with earthworms.
- Variables: range of 45°F to 65°F between samples, different soil absorbances, fauna diversity/abundance above soil, recent gardening activity not recorded. Sequencing was unsuccessful with public location samples so there is a lack of private location identification.
- Future Directions: Control for recent garden activity and monitor human interaction, gain access to Bushwick inlet for a forested comparison, analyze soil absorbency.

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