

Pedology of Ant Colonized Soils in Doolittle Prairie State Preserve, Iowa, USA

Mary L Tiedeman and C Lee Burras, Iowa State University, Ames, IA



Introduction

Ants are prolific soil-dwelling organisms in terms of their overall biomass, global distribution, and species diversity. Although the breadth of ant activity within soils is tremendous, little work has been done to quantify their impact on pedology- especially in Iowa.

Objective

Quantify the impact of ant activities on pedology at Doolittle Prairie State Preserve, Iowa.

Doolittle Prairie State Preserve



- 10.5 ha prairie remnant
- Location- Central Iowa (42.15° N. Lat. 93.59° W. Long.)

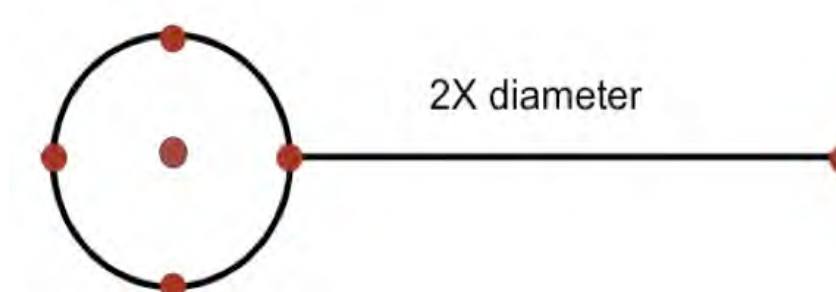
- Formed in Lacustrine Sediments over glacial till. ~7,000 years old

SMU	Series	Soil Taxonomy
288	Ottosen	Aquic Hapludoll
388	Kossuth	Typic Endoaquoll
▲	Okoboji	Cumulic Endoaquoll
▲	Harps	Typic Calciaquoll

Methods

- Doolittle Prairie was reconnoitered to identify mound number, distribution and external morphology.
- A subset of 11 mounds were selected for detailed examination.

- Cores were taken as follows:



- Profiles were described and analyzed per horizon for selected chemical and physical properties.

Hypotheses

- Ho- Pedological properties on and off mounds (after bulk density corrections) are identical
- Ha1- Many pedological properties vary on and off of mounds, but properties are identical around the radius of the mounds
- Ha2- Differences in pedological properties can be observed on and off of the mounds, as well as along the radius of the mounds

Formica Montana Wheeler at Doolittle Prairie



	Ant Mound Data		
	Min	Max	Average
Diameter (m)	0.4	2.0	0.9 +/- 0.5
BT Depth (m)	-	1.8	0.9 +/- 0.3
Area (m ²)	0.1	3.2	0.6
Vol. (m ³)	-	5.7	0.5



- ~100 mounds/ha
- Surface area of mounds range 600-3,000 m² of 10.5 ha
- 0.6-2.8% of surface of prairie covered by mounds.
- Total prairie turnover by ants est. 1,000 years.

Taxonomy

Adjacent soil classifications:

- Cumulic Endoaquoll
- Aquic Hapludoll
- Typic Hapludoll

Center soil classifications:

- Typic Vermudoll
- Haplic Vermudoll
- **Typic Endoaquoll**

Periphery soil classifications:

- Typic Vermudoll
- Haplic Vermudoll
- **Typic Endoaquoll**

Taxonomic Change in Relation to Adjacent Soil

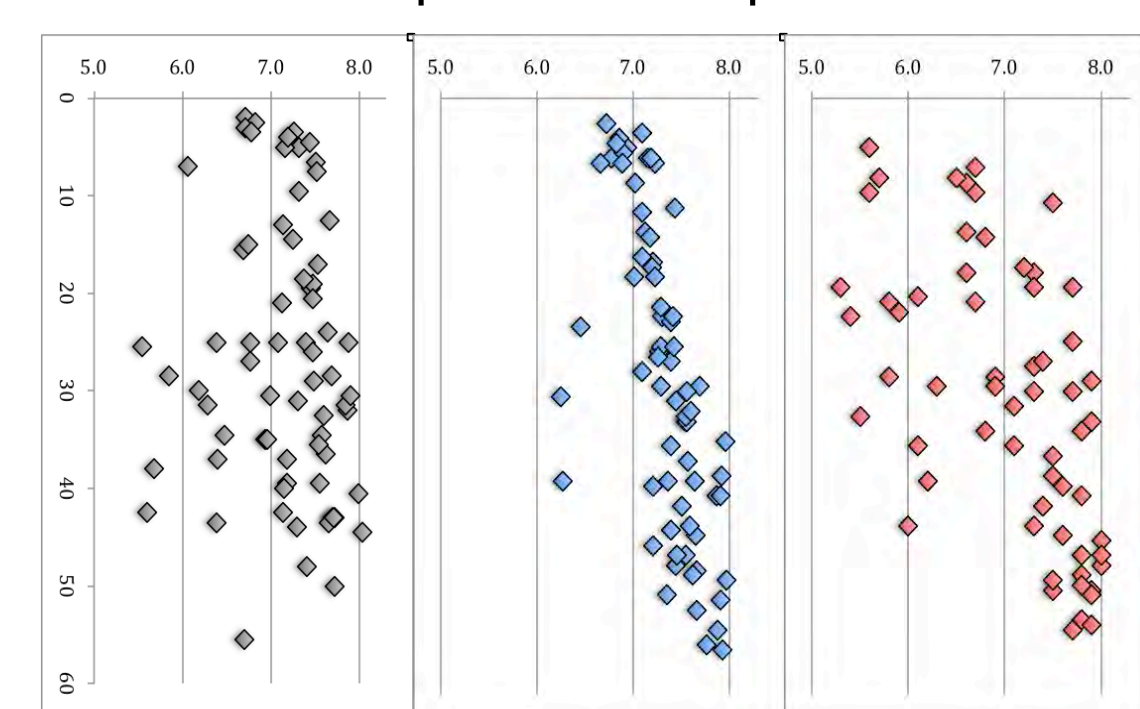
	Order	Suborder	G. Group	Subgroup	n
Center	0%	31%	88%	100%	16
Periphery	0%	12%	90%	98%	42

• Typic Endoaquoll classification due to bias of US Soil Taxonomy

- Redox materials brought upward by ants
- Otherwise are Vermudolls
- As result, the numbers above are conservative

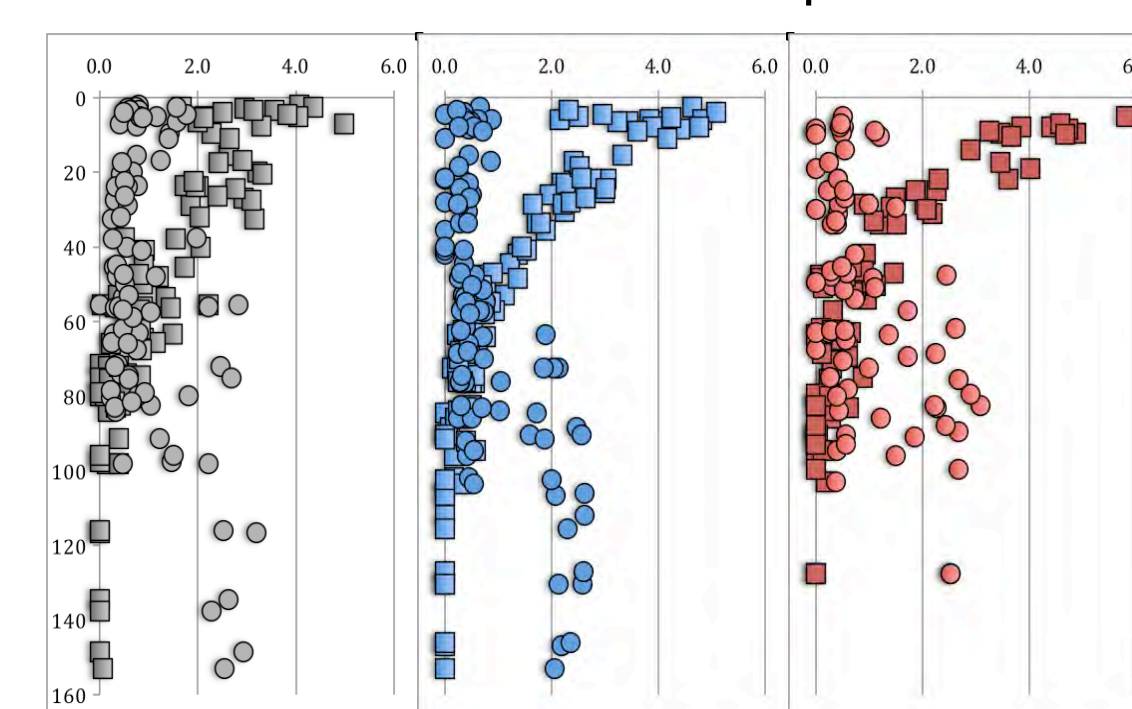
Chemical Properties

pH with Depth



pH ◆

Carbon with Depth



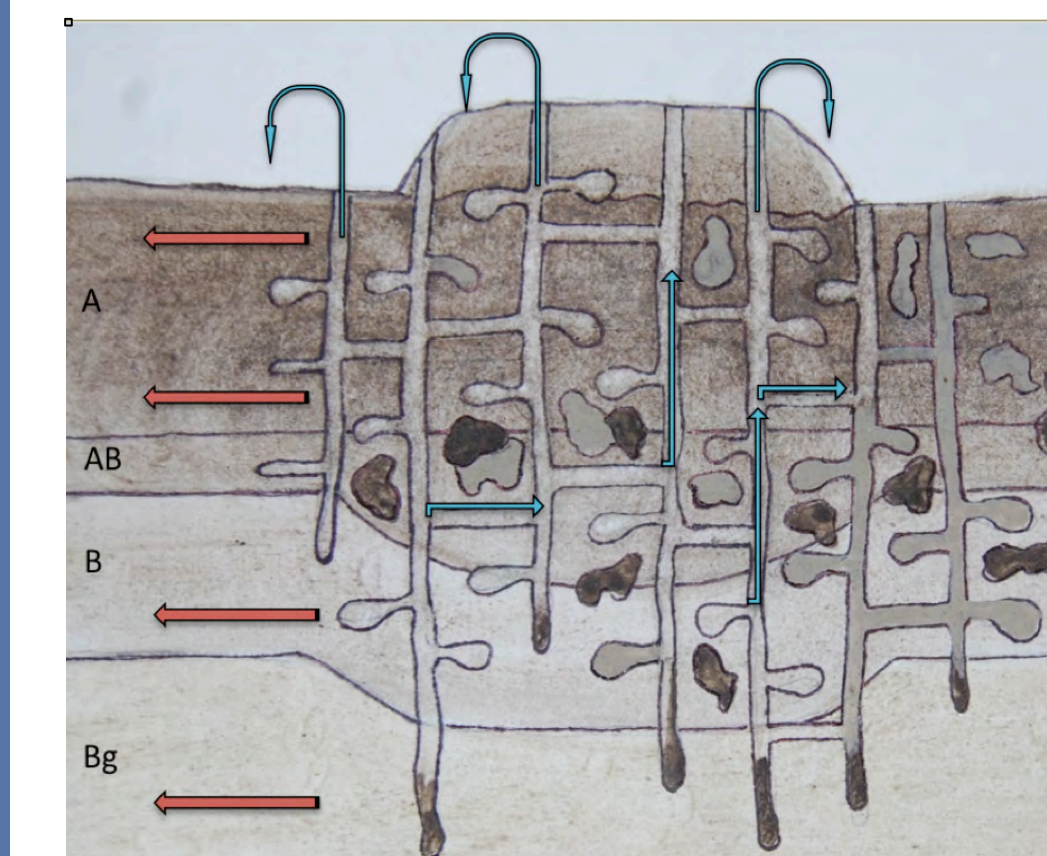
OC% ■

Inorganic C% ●

C.	pH = 0.00cm + 7.1, r ² = 0.01	OC% = 0.00cm ² - 0.06cm + 3.5, r ² = 0.79	IC% = 0.01cm + 0.47, r ² = 0.19
P.	pH = 0.02cm + 6.9, r ² = 0.42	OC% = 0.00cm ² - 0.08cm + 4.1, r ² = 0.90	IC% = 0.01cm + 0.01, r ² = 0.47
A.	pH = 0.03cm + 6.0, r ² = 0.34	OC% = 0.00cm ² - 0.11cm + 4.9, r ² = 0.89	IC% = 0.02cm + 0.12, r ² = 0.28



Model of Bioturbation



- Ants excavate/redeposit subsurface soils to surface or abandoned chambers
- Organic material falls/ is buried
- Calcareous and redox materials brought to surface
- Mound expansion extends beyond surface

Interpretations

- Ant bioturbation is a critical state factor of soil formation at Doolittle Prairie.
 - Estimated total ant turnover ~1000 years
 - Does not include other prairie organisms
- Taxonomy under ant bioturbation changes rapidly.
 - Hapludolls to Vermudolls
 - Udolls to "Aquolls"
- Recycling of bases, enrichment of carbonate minerals, cycling organic material, resetting structure, and porosity are major contributions of ants at Doolittle Prairie.
- Soils now devoid of ants (cultivated, urban) exhibit better horizonation at the expense of crucial ecosystem services.



*Above, thin sections of topsoil. From the left-Doolittle Prairie and Adjacent cultivated field

Acknowledgments

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Soils Role in Restoring Ecosystem Services

Sacramento, California
Biodiversity and Ecological Sustainability
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