A Comparison of Ant Faunae on Unreclaimed Stripmines in Indiana

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Introduction

Previously, ants have not been considered indicator species characterizing successional stages. However, the collection of invertebrates on revegetating stripmines indicates that ants occur in abundance(3), exist in a large assortment of species, and the assortment changes between extremes, from barren ground to undisturbed forest(5).

If the ant composition of various stripmine sites are compared, differences will be readily noted (See Tables 1 and 2). Species changes as to kinds and numbers due to changes in vegetation, for example, become more apparent when the same sites are compared after a long time lapse as is done in this study.

Methods

Following cessation of mining in 1950, we examined an unreclaimed mining site fourteen and thirty-one years later. The research site consists of coal spoilbanks west of Clinton and south of Centenary, Vermillion County, Indiana. The rugged ridges were formed in 1949 and 1950 and left unreclaimed. The area was purchased by the Clinton Chapter of the Izaak Walton League, from which permission to do this study was obtained. The League has protected the area from further human activities.

In 1964, while most of the area was still in a bare ground and grass stage, nineteen sets of paired pitfall traps were established on the spoilbanks. These sampled ant populations in each of 19 stands selected on the basis of variations in slope and vegetation. Two additional pairs of traps sampled ants in an adjacent abandoned orchard and undisturbed forest. The pitfall traps were operated weekly through the summer. Accompanying weather data, soil analyses and vegetation tallies were made as described by Munsee(5).

In 1981, the same locations were sampled during the same calendar days, providing a direct measurement of changes at each site. The ants were sorted and identified for both years. The variation in ant populations among sites at varying stages of succession are given in Table 1 and 2. Prominence values, based on Beals' study of forest bird communities(1), were derived by multiplying the density of a species by the square root of its frequency. Density was determined by dividing the total number of individuals of a species collected at a site by the total number of sample periods. Frequency was determined by dividing the number of sample periods in which a species was trapped by the total number of sample periods.

The sites in 1964 were compared by calculating a similarity matrix based on the presence and absence of ant species. A similar matrix was calculated for the 1981 sites and dendrograms were drawn for each year, clustering the sites with the most similar ant samples.

Results

Prominence values of ants from the 1964 and 1981 studies are given in Tables

TABLE 1. *Average prominence values for ants in 1964.*

	W	A	B	C	D	E	F	G	H	I	J	K	L-O	M	N	P	Q	R	S	T
Aphaenogaster rudis rudis (Emery)	37.7	16.0	0.1	28.7	– –	70.7	0.3	0.3	55.2	– –	268.0	99.3	2.8	– –	0.2	– –	– –	0.1	0.1	41.7
Camponotus castaneus (Latreille)	5.7	4.4	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Crematogaster lineolata (Say)	2.5	57.6	27.0	33.6	8.1	125.7	39.7	28.6	172.3	3.6	186.6	99.0	16.2	2.4	28.3	11.7	4.4	0.4	23.3	15.3
Formica fusca Linnaeus	0.5	0.5	2.6	5.4	208.3	50.2	4.6	234.3	46.7	7.6	25.0	14.0	101.4	74.7	19.5	92.0	26.3	80.7	50.9	4.2
Iridomyrmex pruinosus analis (Andre)	– –	0.1	489.9	133.8	20.4	93.9	321.7	187.2	335.4	228.0	83.0	– –	42.4	257.0	323.6	352.1	330.8	132.3	622.1	101.8
Lasius neoniger Emery	3.0	4.2	11.4	64.3	0.3	– –	0.1	– –	5.3	0.4	0.1	0.1	17.5	0.7	0.5	– –	0.1	– –	– –	9.0
Leptothorax curvispinosus Mayr	4.8	1.5	– –	– –	– –	0.1	– –	– –	0.2	– –	18.1	29.0	0.3	0.1	– –	– –	– –	– –	– –	– –
Monomorium minimum (Buckley)	– –	– –	0.1	0.1	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	0.1	– –	– –
Paratrechina melanderi arenivaga (Wheeler)	0.1	40.0	0.7	– –	– –	1.8	1.2	0.1	25.9	– –	– –	– –	– –	– –	7.2	– –	– –	– –	– –	– –
Pheidole bicarinata bicarinata Mayr	– –	– –	185.6	0.8	22.7	163.1	– –	104.8	220.6	244.3	– –	– –	2.8	344.4	175.1	61.0	4.1	78.3	66.8	122.2
Ponera pennsylvanica Buckley	1.1	2.0	– –	0.5	0.1	0.5	– –	0.2	0.1	– –	11.3	18.5	0.5	0.1	0.1	– –	– –	– –	0.3	4.0
Smithistruma filitalpa Brown	– –	– –	0.1	– –	0.1	0.3	– –	1.0	– –	0.1	0.6	0.1	0.3	– –	0.7	– –	– –	0.4	– –	0.1
Solenopsis molesta (Say)	– –	50.6	5.3	227.9	0.7	18.6	515.7	29.4	18.3	1.4	130.0	102.2	502.9	38.5	82.5	14.5	36.8	25.9	12.1	22.7
Tapinoma sessile (Say)	1.1	12.6	0.7	55.5	– –	9.4	– –	0.2	– –	– –	– –	0.3	0.2	– –	– –	– –	– –	– –	– –	0.2

TABLE 2. *Average prominence values for ants in 1981.*

	W	A	B	C	D	E	F	G	H	I	J	K	L-O	M	N	P	Q	R	S	T
Aphaenogaster rudis rudis (Emery)	2.2	0.6	1.2	1.6	– –	0.5	1.8	2.2	2.4	6.3	0.7	1.1	1.7	1.2	0.8	2.1	8.1	2.7	1.6	0.3
Camponotus castaneus (Latreille)	0.4	0.5	0.1	0.1	0.1	– –	0.1	0.1	0.1	0.1	0.2	0.1	– –	– –	– –	0.1	0.1	0.1	0.1	0.1
Crematogaster lineolata (Say)	0.1	0.1	6.2	7.9	0.8	1.9	9.6	2.7	3.1	1.9	4.7	2.0	1.3	0.5	1.8	2.0	9.1	0.2	1.9	0.5
Formica fusca Linnaeus	0.2	0.1	0.4	0.1	14.1	0.5	3.3	0.5	0.4	0.5	2.2	0.1	0.1	0.3	1.3	0.1	17.0	0.4	3.1	0.3
Iridomyrmex pruinosus analis (Andre)	– –	– –	– –	– –	16.4	– –	– –	– –	– –	0.1	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Lasius neoniger Emery	0.1	– –	0.9	5.0	0.5	0.6	0.6	1.1	0.2	0.3	10.5	1.2	1.3	1.2	2.3	0.1	0.2	0.6	1.7	0.8
Leptothorax curvispinosus Mayr	0.1	0.1	– –	0.1	– –	0.3	0.3	0.4	0.4	0.1	0.1	0.3	0.1	0.6	0.1	0.3	0.6	0.2	0.1	0.1
Monomorium minimum Buckley	– –	– –	0.1	0.1	– –	– –	9.3	0.1	– –	– –	– –	– –	– –	– –	0.9	– –	– –	– –	– –	– –
Myrmecina americana Emery	– –	– –	0.1	1.0	– –	0.1	0.1	0.4	0.2	0.1	0.2	0.6	0.2	0.1	0.2	0.1	0.5	0.4	– –	0.1
Myrmica pinetorum Wheeler	0.1	0.2	0.2	0.2	– –	0.1	1.4	5.1	1.0	0.8	1.6	0.2	0.6	1.0	0.8	0.2	1.9	0.2	0.5	0.1
Myrmica spatulata Smith	10.2	6.1	2.3	9.9	0.4	0.5	0.1	7.7	2.3	2.9	6.6	6.7	12.4	7.5	5.9	5.3	6.3	8.0	12.0	12.5
Paratrechina melanderi arenivaga Wheeler	– –	– –	0.1	0.1	1.2	1.0	4.8	6.5	1.3	2.4	– –	– –	– –	1.3	1.4	0.8	0.1	0.1	– –	– –
Pheidole bicarinata bicarinata Mayr	– –	– –	0.1	– –	7.5	– –	– –	– –	– –	– –	0.1	– –	– –	– –	– –	– –	– –	– –	– –	– –
Ponera pennsylvanica Buckley	– –	– –	0.1	1.0	– –	0.2	0.3	– –	0.1	0.1	0.7	0.1	1.0	0.1	0.3	0.1	0.2	0.1	0.3	0.1
Smithistruma filitalpa Brown	– –	– –	– –	– –	– –	– –	– –	– –	0.1	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
Solenopsis molesta (Say)	– –	– –	1.1	– –	0.2	20.6	9.9	0.4	9.7	2.3	0.2	– –	0.1	0.6	3.6	4.8	3.5	0.2	3.1	0.2
Tapinoma sessile (Say)	– –	0.3	0.7	– –	0.1	0.9	1.8	4.0	1.2	1.9	0.3	0.5	0.3	2.8	0.4	0.8	1.3	0.1	1.8	0.2

1 and 2. Stand D remained essentially barren in both 1964 and 1981. Sites W and A are undisturbed forest and abandoned orchard, respectively. The other sites are intermediate successional stages of the stripmine spoilbanks. Some ant species were not collected on the barren sites while others were not found in the forest site. Ants such as *Crematogaster lineolata*, *Formica fusca* and *Aphaenogaster r. rudis* are fairly ubiquitous in 1964 and 1981. *Iridomyrmex pruinosus analis*, *Smithistruma filitalpa*, *Pheidole b. bicarinata* and *Solenopsis molesta* are greatly reduced or absent in 1981. New ants, ants with greatly increased numbers, and ants found in many new sites in 1981 include *Camponotus castaneus*, *Myrmica spatulata*, *Myrmica pinetorum*, *Myrmecina americana* and *Leptothorax curvispinosus*. However, many ants such as *Monomorium minimum*, *Paratrechina melanderi arenivaga*, *Ponera pennsylvanicus*, *Tapinoma sessile* and *Lasius neoniger* varied by sites in 1964 and shifted to other developing sites in 1981.

The 1964 dendrogram (Figure 1) demonstrates that, based on ant species, the stripmine sites are more similar to each other and to the barren site D, than they are to the two control sites. From Figure 2 it appears that by 1981 the

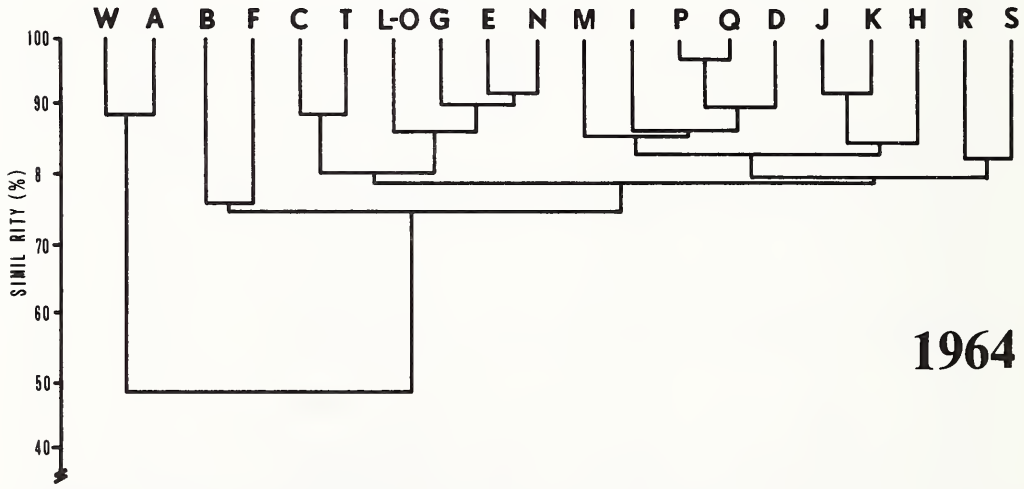

FIGURE 1. Dendrogram of study sites clustered on presence and absence of ants in 1964.

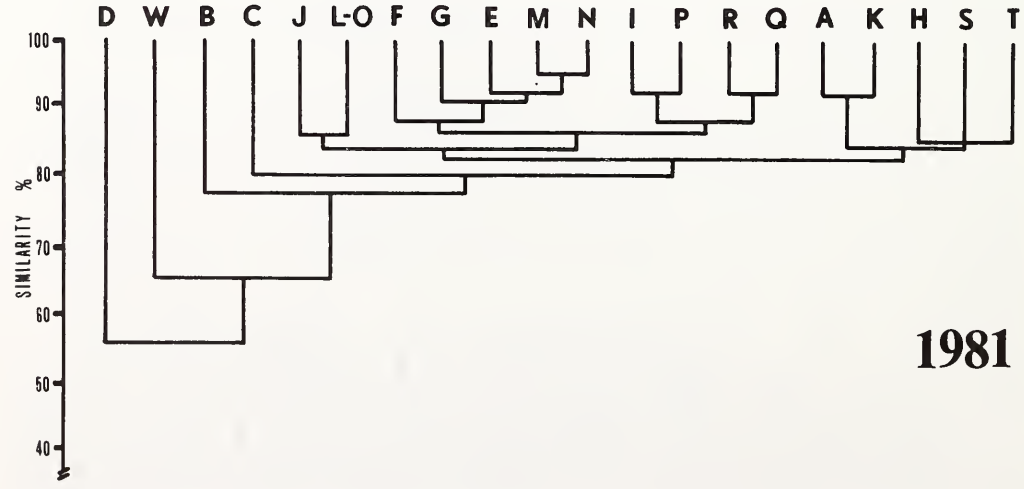

FIGURE 2. Dendrogram of study sites clustered on presence and absence of ants in 1981.

stripmined sites, except for D, are now more closely associated with the unreclaimed orchard (site A) and the forest (site W), and are not dissimilar to D.

Discussion

Although Munsee(5) found no correlation between plants and the ant fauna in 1964, a dendrogram clustering similar sites on the basis of ants alone indicated the mined sites were in an early stage of succession closer to the barren site D than to the adjacent unmined sites. Since the 1981 dendrogram based on ants shows the revegetating sites to be more similar to each other and to the unmined sites, than to the barren site D, ants alone are sufficient to indicate a general successional change.

Also, ants may not be mere passive indicators of site conditions since recent research shows several ant species are important in spreading plant seeds(2) and plant seeds buried by ants may have much better chances of survival than seeds dispersed on the surface of the stripmine spoilbanks(4). If this is the case here, some of these ant species may have a direct role in stripmine succession.

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