Ant Communities of Southeastern Longleaf Pine Plantations[1]

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ABSTRACT

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The ant community in a recent replant longleaf pine plantation on the Savannah River Plant, S.C. had the greatest species diversity and richness when compared to mature, thinned and burned pine plantations. Four species of ants dominated all pine plantations: *Crematogaster lineolata* (Say), *Aphaenogaster traetae* Forel, *Aphaenogaster fulva* Roger and *Conomyrma insana* Roger. There is an apparent relationship between the channelization of stumps, snags and dead logs by termites and densities of *Crematogaster* spp. Recent burning of pine straw had no measurable effect on the dominant tree bole/stump nesting species.

Introduction

A number of recent studies have considered the structure of ant communities (Chew 1977, Culver 1972, Whitford 1978, Bernstein and Gobbel 1979, Bernstein 1979). These studies have emphasized characteristics such as nest dispersion, foraging behavior and seasonal activity. Here we analyze the effect of forest management practices on the diversity and relative abundance of ants. Since ants are numerous and diverse in most temperate environments, perturbations of those environments should affect the relative abundance and diversity of the ant fauna. In addition there should be faunal shifts during succession.

In recent years there has been an increase in the establishment of pine plantations on the southeastern U.S. coastal plain. These plantations are essentially monospecific stands of longleaf pine, *Pinus palustris* Mill and loblolly pine *Pinus taeda* L. Management consists of thinning for pulp harvest and periodic burning to reduce the danger of wildfire and to release nutrients tied up in dead needles. We hypothesized that these management practices would have a marked effect on the ant community.

Methods

Our studies compared ant communities in four *Pinus plaustris* plantations which differed in age and which had been subjected to various management practices. We compared a 20± year old unmanaged stand (unmanaged), a 20± year old stand which had been burned 12 months prior to our sampling (1 year burn), a 23 year old thinned stand which had not been burned in several years (managed) and a recent pine replant with trees 3–4m high (replant). The 20± year old stands had little undergrowth and essentially closed canopy. The replant stand had grass cover, blackberry stands and numerous small shrubs between the rows of pine and between the small trees. There were numberous snags, stumps and fallen logs in the mature stands.

Ants in the various habitats were sampled between April 15 and May 2, 1979. Ants were sampled using bait stations and 0.25m² quadrats. Bait stations were constructed of ½ of a plastic gallon (3.8 liter) milk carton with peanut butter smeared inside. In earlier work, Gentry (unpublished data) found that peanut butter was readily accepted by most ants in the area. Bait stations were set on a 16 station 4 × 4 grid with 10m spacing. Ants on a bait were quickly dumped into a stainless steel pan and then aspirated into vials of 70% alcohol. Baits were checked 4 times during the day: early morning, mid-day and late afternoon and once after sunset. Ants not attracted to baits were sampled by collecting all the ants in leaf litter enclosed in a 0.25m² frame. The litter within the frame was placed in metal pans and vigorously shaken to force the ants to the pan surface. The litter was then carefully removed in small increments and examined for ants. Sixteen frames were examined in each habitat. The ants were returned to the laboratory, counted and identified to species using a reference collection at the SREL provided by A. Van Pelt.

The data were reduced to frequency of a species at the bait stations summing across all 5 sample times per site. Species diversity was estimated by H′ the diversity index calculated by $H' = -\sum_{i=1}^{s} (pi \cdot lnpi)$ where pi is the proportion of species i based on numbers. The eveness of the proportions was calculated as $J = H'/lns$ where s is the number of species. The ant communities were also compared by Horn's overlap index which provides an index of similarity between communities (Horn, 1966).

Results

The pine replant area had the greatest species diversity and richness (Table 1). The cumulative number of species increased with almost every sample. Four species dominated the pine plantation communities without regard to successional stage or management practice. In order of relative abundance these were: *Crematogaster lineolata* (Say), *Aphaenogaster traetae* Forel, *Aphaenogaster fulva* Roger and *Conomyrma insana* (Roger). There was no apparent diurnal pattern in visitation of baits by various species. However in the pine replant plantation, *A. treatae* was taken only at night although it was active on the baits during the day in the closed-canopy habitats. There was a correlation (r between 0.53 and 0.85 for the four sites) between relative abundance and frequency at baits and abundance and frequency in the quadrat samples (Table 1).

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Table 1.—Frequency of species at baits summing all sample times (n = 80) left of slash, frequency of species in .25m² quadrats right of slash (n = 16) and community diversity indices H′ and J calculated on the basis of average numbers per bait station.

	Managed	Unmanaged	1 Year Burn	Replant
Aphaenogaster floridana M. R. Smith			.03/0	
Aphaenogaster fulva Roger	.40/0	.20/0	.23/.38	.06/0
Aphaenogaster texana Emery			.03/0	.01/0
Aphaenogaster treatae Forel	.17/.18	.32/.06	.13/.31	.05/.18
Brachyrmex sp. (Mayr)				.03/0
Camponotus pennsylvanicus DeGeer	.02/0	.03/0	.03/0	.03/0
Camponotus texanus Wheeler	.02/0		0/.06	
Conomyrma insana (Roger)	.08/.13	.09/0	.09/.38	.10/.13
Crematogaster clara Mayr		.02/0		
Crematogaster lineolata (Say)	.48/.38	.43/.38	.30/.38	.46/.25
Crematogaster punctulata Emery		.05/.13	.06/.06	.05/.13
Dolichoderus mariae Forel			0/.06	.01/0
Formica pallidefulva Latreille	0/.06	.01/0	.01/.06	.01/0
Iridomyrmex pruinosum Andre		0/.06		.01/0
Lasius alienus Emery				.01/0
Lasius niger Emery				.01/0
Leptothorax pergandei Emery			.03/0	.01/0
Monomorium sp. Mayr				.04/0
Pheidole dentata Mayr	.02/0	.02/0		
Pheidole texana Wheeler				.01/0
Pogonomyrmex badius (Latreille)				0/.06
Ponera pennsylvanica Buckley	0/.06	0/.19	0/.06	0/.06
Prenolepis imparis (Say)		0/.06		
Solenopsis globularia Westwood			0/.06	
Solenopsis texana Westwood		0/.06	.03/0	.06/.06
S	9	13	15	19
H′	0.415	0.880	0.368	1.186
J	0.200	0.440	0.167	0.396

In a survey of dead snags in a paraquat treated plantation (26 snags, area approximately 1 ha) the twenty percent of the snags which had not been channelized by termites had no ants present. The remaining snags had been channelized by termites and of these 33.3% had only termites, 42.8% had both ants and termites and 23.4% had ants only. The presence of ants in snags channelized by termites was higher than expected (x^2 = 13.3, $p < .01$). One *Crematogaster* colony was identified as *C. punctulata* when nests and galleries were broken into, the ants quickly began to attack the termites and carry them to their nests.

The ant communities in the intensively managed pine plantations had the highest similarity (Horn's index: 0.98 for the 1 year burn and managed plantations). The ant community in pine replant was the most dissimilar but still had overlap indices of 0.79, .80 and .84 with the ant communities in the more mature stands. The high overlap indices reflect the shared dominant species in all of the communities. Assuming that a bait station with large numbers of *Crematogaster* sp. represented ants from a single colony and if adjacent stations had few or no *Crematogaster* we concluded these represented discrete colonies and obtained the following colony densities: 8.4 colonies ha^{-1} *C. lineolata in the 3 mature pine areas and 5.6 colonies* ha^{-1} *in the replant area.*

Discussion

The data collected in this study demonstrates the value and reliability of the bait station technique for rapidly obtaining data on the structure of ant communities. Chew (1977) discussed the limitations of this technique but used no other quantitative technique by which to calibrate his bait boards. The frequencies of species taken in the quadrat samples in our study and at bait stations were similar indicating that with few exceptions, the bait stations provide a reliable estimate of diversity and abundance of the ant fauna in southern pine forest ecosystems. The increase in cumulative number of species varies as a function of colony density, colony size and foraging habit. *Crematogaster* sp. recruited rapidly to baits and were represented in all subsequent samples at a station. Other species either did not recruit rapidly to the baits or had lower colony density or colony size. The survey of tree snags provided an absolute density of *Crematogaster* sp. colonies of 13.4 · ha^{-1}. That survey was in a plantation area in which trees had recently been impregnated with paraquat and where there was an abnormally high density of dead snags.

Pine plantations are relatively sterile environments, the higher diversity of the ant community in the pine replant is apparently a function of the greater heterogeneity of that habitat. Absence of a closed canopy in the replant plantation provided habitat for open area species like *Pogonomyrmex badius* and a diversity of woody plants, grasses and vines providing a broader food base for other species of ants. Burning of the leaf litter appears to have reduced densities of some species thus resulting in reduced diversity. The dominant species in all plantations were stump or hollow bole nesting

species. The *Crematogaster* sp. appear to have a commensal to amensal type of symbiosis with the termites *Reticulotermes* sp. These termites channelize pine snags soon after the tree dies. This channelization weakens the standing snag and is the primary factor in the tree snapping at the base and falling to the ground. The channels provide nest sites for ants like *Crematogaster* sp. Once the ants breach the channels, the termites apparently abandon that section of the trunk and seal it off with carton cement. We found nests of *Solenopsis* sp. and *Apahenogaster* sp. in partially fallen logs which also contained *Reticulotermes* in other sections of the log or stump. The controlled fires used to reduce the needle litter and release nutrients apparently are not sufficiently hot to affect either the ants or termites in fallen logs or snags.

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