Ants of Forest and Fallow Plots in Nigeria*

Sylvanus C. Ewuim
Department of Applied Biology, Nnamdi Azikwe University, Awka, Nigeria
and
M. Adetola Badejo* and Olawale O. Ajayi
Department of Zoology, Obafemi Awolowo University, Ile-Ife, Nigeria

ABSTRACT
Pitfall traps were used to monitor the activity of ants in a forest floor and a one-year-old fallow plot in Ile-Ife, Nigeria, at monthly intervals between November 1980 and October 1981. Similar studies were carried out between October 1987 and June 1988. Of all the 10 species of ants recorded, Pheidole crassinoda was the most abundant in the forest and fallow plots both in 1980–81 and 1987–88. P. crassinoda accounted for 52 percent and 88 percent of the ant populations collected manually from the forest and fallow plots respectively between December 1987 and June 1988. This species was also significantly higher in the pitfall catches of the fallow than the forest plots. Pitfall traps were not effective in sampling the populations of the belligerent Dorylus nigricans. The data are consistent with the widely accepted notion that forested areas support less ants than unforested areas. Differences in physical habitat characteristics, food availability, nesting habits, predation and microenvironmental factors were considered responsible for the differences in activities and abundance of ants in the forest and fallow plots.

Key words: abundance; activity; ants; fallow; fluctuations; food availability; forest; litter cover; nesting sites; pitfall traps.

ECOLOGICAL STUDIES ON THE ARTHROPOD fauna inhabiting the litter of forest and agroecosystems in Nigeria are very scanty. Apart from the works of Lasebikan (1974), Lasebikan et al. (1985) and Badejo and Van Straalen (1993) on various aspects of the ecology of the collembolan fauna of forests and cassava plots in Ile-Ife, no other intensive study has been carried out on litter arthropod species in Nigeria. Other studies on litter arthropod fauna by Lasebikan (1977, 1985) focused on Acarina and Collembola more than any other group of litter arthropods.

Ants are a diverse group of animals with a community structure which tends to reflect the nature of the environment in which they occur (Burbidge 1992). They constitute a very interesting group of litter arthropods for intensive ecological studies because of their relatively high abundance and high degree of foraging success (Carroll & Janzen 1973), population stability, resource partitioning and coexistence (Torres 1984a), and effectiveness of pitfall traps in sampling their populations (Adis 1979). These characteristics are unique to ants, hence their response to perturbations in terrestrial ecosystems are bound to be different from the response of other groups of litter arthropods.

Previous studies on the response of ants to agricultural activities have revealed that ploughing has a minimal effect on species number and it does not affect the organization of their communities (Torres 1984b). So also recovery of ants after disturbance is very fast because they do not build elaborate nests (Wheeler 1910) and they can endure long periods of starvation (Brown 1973, Carroll & Janzen 1973).

Many species of ants nest and forage on the tropical rain forest floor (Wilson 1959) but information on them is scanty (Franks & Bossert 1983). Hitherto, investigations on ants in tropical ecosystems have been restricted to arboreal ants (Way 1954, Leston 1973, Taylor 1977, Taylor & Adeoyin 1978). In this paper, we attempt to investigate the species composition and relative abundance of ants that forage on the floor of forest and fallow plots in a tropical rain forest zone in Africa. We expect that this study will add to the existing information on ant communities in the tropics.

STUDY SITE
This study was carried out in a forest and the Commercial Farm of the Obafemi Awolowo University, Ile-Ife, Nigeria (7°29′N, 4°34′E), between Novem-

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* Corresponding author.
ber 1980 and October 1981 and also between Oc-
tober 1987 and June 1988. The study area has a
bimodal rainfall pattern with an annual mean of 844.8 mm and a mean annual temperature of
25.4°C. There are usually two seasons. The dry
season is from November to February while the wet
season is from March to October (Badejo 1990).

The forest is part of the lowland rain forest of
southern Nigeria. It is a secondary regrowth situ-
ated about 800 m to the northwest of Faculty of
Agriculture buildings. From oral evidence, farming
activities stopped in this forest around 1930. Typ-
ically, its vegetation is composed of herbs which
make up the understory, timbers and trees of var-
ious girths and heights. The canopy is not entirely
closed, so sunlight rays locally penetrate the forest.

The tree species in the sampled area included
*Funtumia elastica* (Apocynaceae), (all plant names
after Hutchinson & Dalziel, 1954–72) *Cola milleni*
(Sterculiaceae), *Antiaris africana* (Moraceae), *Elaeis
guineensis* (Palmae), *Celtis zinca*i (Ulmaceae), *Al-
bizia xygia* (Mimosaceae), *Morus mezozygia* (Mora-
ceae) and *Lecaniodiscus cuspinoides* (Sapindaceae).
Detailed account of the physiognomic features and
floristic composition of the forest was given by Las-
ebikan (1974). These features had not changed
radically during this study probably because the
vegetation had reached climax equilibrium. Litter
fall occurs throughout the year in this forest al-
though the majority of it falls during the dry season
(Lasebikan 1985).

The Commercial Farm is situated about two km
to the west of the forest and was a regrowth forest
before it was cleared for cultivation in 1976. In
November 1980, a plot 20 m × 20 m was marked
on a one-year-old fallow for field work. The plot
was swampy and dominated by *Axonopus compress-
sus*, a grass species. There were patches of two other
weed species (*Sporobolus pyramidalis* and *Alchornea
cordifolia*). In October 1987, another 20 m × 20
m plot was marked out of another one-year-old
fallow for field work. The plot was dominated by
*Chromoleana odorata* and *Andropogon sectum* with
patches of *Aspilia africana*. Details of the cropping
history of the forest and fallow plots as well as
other site characteristics are presented in Table 1.

**METHODS**

On 27 November 1980, eight plastic dishes of 10.5
cm in diameter were sunk at random into the soil
in each of the forest and fallow plots in such a way
that their rims were flush with the ground level.
Formalin (4%) was poured into each dish up to a
level of few centimeters and the traps were left in place for 24 h. This procedure was carried out monthly between 0900 and 1000 hr until 27 October 1981.

The second part of pitfall trapping took place between 8 October 1987 and 6 June 1988 also at monthly intervals. In addition, an aspirator was used to collect ants from the litter and soil surface for 30 min on each site, on each day of sampling between December 1987 and June 1988.

In the laboratory, the ants were separated and identified to the generic or specific levels. Ants collected with the aspirator were also identified and counted according to the key of Bolton (1973) and by comparing with specimens in the collections of the Department of Plant Science Insectarium, the Natural History Museum, Obafemi Awolowo University, as well as the Cocoa Research Institute of Nigeria in Ibadan.

Pitfall trapping data were transformed to log (x + 1) before testing for site differences using Student's t-test.

RESULTS

The total number of ants caught per trap in the forest and fallow plots are presented in Table 2. In 1980–81, the highest number of ants was caught from the fallow plot in December while the lowest number was caught from the forest in May 1981. The least number of ants caught from the fallow plot was more than the number caught from each sampling occasion in the forest excepting October 1981. More ants were generally caught from the study sites in 1987–88 than in 1980–81. With the exception of January and March 1987, many more ants were caught from the fallow plot than the forest in 1987–88.

The monthly fluctuations in ant numbers caught from the forest and fallow plots are presented in Figure 1. This figure reveals that there are slight variations in the numbers of ants caught per trap in the different months in the forest and fallow plots during the two sampling periods.

Ten species of ants were caught with pitfall traps in the forest and fallow plots. Out of these 10, the numbers of only three species were large enough to permit statistical comparison. These species are Pheidole crassinoda, Camponotus maculatus and Odontomachus troglodytes. The numbers of all other species were pooled together before statistical analyses. As shown in Figure 2, more Pheidole crassinoa was caught in the fallow plot than in the forest in 1980–81 and in 1987–88 (P < 0.05). Statistical analyses reveal further that other species of ants whose numbers were pooled together were significantly higher in the fallow than the forest in 1980–81 (P < 0.05). These species include Pheidole sp., Dorylus nigricans, Oecophylla longinoda, Paltothyreus tarsatus, Crematogaster sp., Quadrirtrum sp. and Oligomyrmex sp. In 1987–88 however, there was no significant difference in the number of this group of ants caught from the forest and fallow plots.

The numbers of ants collected per man-hour per sampling occasion from the forest and fallow plots between December 1987 and June 1988 are presented in Table 3. Pheidole crassinoda was the most abundant ant species in the forest and fallow plots during this period. It can be deduced from Table 3 that Pheidole crassinoda accounts for 52 percent and 88 percent of the ants collected from the forest and fallow plots respectively during this period. Dorylus nigricans was next in abundance to Pheidole crassinoa in these two plots. Six ant species were collected manually from the forest while only three species were collected from the fallow plot. The three species that were not collected manually from the fallow plot are Odontomachus troglodytes, Oecophylla longinoda and Paltothyreus tarsatus.

DISCUSSION

In a similar study of litter Collembola, Badejo and Van Straalen (1993) observed that springtail pop-
FIGURE 1. Fluctuations in number of ants trapped in the forest and fallow plots.

FIGURE 2. Relative abundance of ants in the forest and fallow plots. Species lumped together as ‘others’ include Pheidole sp., Dorylus nigricans, Oecophylla longinoda, Pulothyreus tarsatus, Cremahtaraster sp., Quadrisrums sp. and Oligomyrmex sp.
In this study, the population of ants appears to oscillate around an equilibrium in the forest and fallow plots. This is an indication of population stability which has been reported to be an attribute of ant populations (Wilson 1971, Brown 1973, Carroll & Janzen 1973, Torres 1984a). Ants, being able to withstand longer periods of starvation and dessication than springtails (Majer et al. 1984, Torres 1984a), are probably not influenced to an appreciable extent by fluctuations in environmental factors. The stability of ant populations has also been attributed to their longevity (Wheeler 1910) and very few natural enemies (Wilson 1971).

Ants have been described as "trap-loving" litter arthropods (Adis 1979) but Southwood (1966) had reported earlier that pitfall trap catches are not a faithful representation of their abundance. In this study, pitfall traps have failed to provide an adequate estimate of the activity and relative abundance of the belligerent *Dorylus nigricans* whose colonies were often seen in long files on the floor of the forest and fallow plots. Pitfall trapings may therefore not be used to estimate the relative abundance or activity of this species. Most of the other species whose numbers were relatively low in the pitfall trapings are not true litter dwellers. For example, the tailor ant *Oecophylla longinoda* and *Crematogaster* sp. are arboreal (Majer 1972, Bolton 1973) while *Palothyreus tarsatus*, the common stink ant, is a ground-nesting species which usually forages solitarily.

It is not surprising that activity of ants are lower in the forest than fallow plots on almost all sampling occasions (see Fig. 1 and Table 2). Torres (1984b) has already reported that non-forested areas support more numbers of ant species than forested areas. Moreover, ants in agricultural and grassland communities forage mainly on the ground (Torres 1984b) unlike in forests where many species forage on trees even when their nests are on the ground (Hölldobler & Wilson 1990, Majer & Cameron-Pesci 1991). The differences in abundance and species composition of ants of the forest and fallow plots investigated in this study may therefore be due to the differences in habitat characteristics of the two environments.

*Pheidole crassinoda* is the most common species trapped and collected manually from the forest and fallow plots investigated in this study (see Fig. 2; Table 3). Similar results have been reported by Byrne (1994). The relatively lower activity and abundance of *P. crassinoda* in the forest when compared with the fallow plots could be due to the fact that this species feeds largely on grass seeds which were more in the fallow than in the forest. So also, the heavy litter cover of the forest is capable of creating shady ground conditions which could make nesting more difficult for this species in the forest (Majer et al. 1984).

The numbers of the two most dominant ant species *Pheidole crassinoda* and *Camponotus maculatus* trapped from the forest and fallow plots in 1987–88 were significantly higher than the numbers trapped in 1980–81 (Fig. 2). While the differences in the forest could be due to possible fluctuating conditions at climax equilibrium, the differences in the fallow plots could be due to the differences in cropping history and floristic composition of the sampled plots as well as the swampy nature of the plot sampled in 1980–81.

In a study of the ant communities in a forest, a grassland and an agricultural land in Puerto Rico, Torres (1984a, b) reported that species composition of these three ecosystems were different from one another. Differences were attributed to microclimatic factors, as well as tolerance to high temperatures and food supply. The larger number of species in the non-forested ecosystems were also explained on the basis of larger food overlaps, tighter guilds, more variable microclimate and higher levels of aggressiveness. There are indications that the floristic composition, litter cover and degree of disturbance of the forest and fallow plots investigated in this study are likely to play important roles in determining the species composition and abundance of the ant species. Several others (e.g., Majer & Koch 1982, Greenslade & Thompson 1981, Rossbach & Majer 1983) have already reported that differences in humidity and temperature conditions affect the distribution and activity of ants. The results presented in this study are of a preliminary nature. It would be interesting to know the exact influence of microclimatic and biotic factors.

<table>
<thead>
<tr>
<th>Ant species</th>
<th>Forest</th>
<th>Fallow</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pheidole crassinoda</em></td>
<td>26</td>
<td>42</td>
</tr>
<tr>
<td><em>Camponotus maculatus</em></td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><em>Odonomachus troglodytes</em></td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><em>Dorylus nigricans</em></td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><em>Oecophylla longinoda</em></td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td><em>Palothyreus tarsatus</em></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>48</td>
</tr>
</tbody>
</table>

Table 3. The numbers of ants collected per man-hour per sampling occasion on the floor of the forest and fallow plots between December 1987 and June 1988.
operating within forests and agroecosystems on the distribution, abundance, foraging and nesting activities of the ant communities.

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LITERATURE CITED