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A SURVEY OF LITTER AND SOIL INSECTS IN DIFFERENT SITES IN EKPOMA

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ABSTRACT

The numbers of litter and soil-inhabiting insects were assessed during the 1990 planting season (February to April) in five site types, namely, rain forests, newly cut and burnt areas of abandoned cultivated grounds and three types of abandoned cultivation grounds. The families Entomobryidae, Isotomidae, Poduridae, Sminthuridae, Caraidae, Cerambycidae, Forficulidae, Formicidae, Termitidae, and Gryllidae were found common to the five site types but Ptinidae, Elateridae and Scarabaeidae were obtained mainly in the forests. There were significant differences in mean numbers among the sits types for Formicidae, Termitidae, Carabidae, Isotomidae, Entomobryidae, Poduridae, Forficulidae and Cerambycidae. Carabidae dominated the populations and its numbers showed significant differences among the site types. The highest and lowest number of insects were obtained in the forests and the newly cut and burnt areas respectively. These results demonstrate the need to discourage the indiscriminate cutting and burning of vegetation before the cultivation of crops and intensify the conservation and management of forests in order to preserve litter/soil insects in the Nigerian ecosystems.

INTRODUCTION

The insects which form part of the microfauna that live in litter and soil are important especially in the conversion of fallen leaves, buds, twigs, flowers and dead roots that constitute litter into humus which is very useful in farming. The type and rate of decomposition of litter which may be related to the abundance of microarthropods could affect the process of mobilisation of nutrients and the formation of humus. Interestingly, the positive association of microarthropods with wood decomposition has been demonstrated (Lasebikan, 1977).

Farmland is a renewable natural resource provided that its necessary biologically important nutrients are maintained (Stark, 1978) by the activities of a number of litter and soil macroarthropods of which the insects constitute a large proportion. However, among other factors, agricultural practices such as bush clearing and burning, use of pesticides and various processes that are involved in the cultivation of crops, could adversely affect the abundance of soil invertebrate populations in the temperates (Edwards 1984; Tucker, 1989) and tropics

(Huhta *et al.* 1967; Oliver & Ryke, 1969; Edwards & Lofty, 1969; Lasebikan, 1975, 1977, 1979; Sheals, 1955). Vertebrates have also been affected by modern agricultural practices (Norris, 1963; Potts, 1980; Taper & Barnes, 1986).

The present study was carried out to assess the abundance of litter and soil-inhabiting insects in different site types in Ekpoma:- (i) abandoned cultivated grounds prepared by cutting and burning of vegetation for crop cultivation, (ii) abandoned cultivated grounds which have been left to fallow and (iii) relatively undisturbed rain forests. It is hoped that information gained in the study would contribute to the knowledge which is currently available on the extent to which farming practices affect the abundance of litter and soil insects in Nigeria.

MATERIALS AND METHODS

The Study Area

This study was carried out in Ekpoma which is a lowland mixed farming area in northern Edo State, Southern Nigeria . Ekpoma has the following features: altitude (100m); longitude (6° 15' N); wet season (April to October); dry season (November to March); planting season (usually February to April) especially for rice (*Oryza spp.*), maize (*Zea mays*) and yams (*Dioscorea* spp.). The climate is hot and humid and the vegetation is tropical rain forest, predominantly mixed with grasses and the weed *Chromolaena odorata* (formerly *Eupatorium odoratum*) due to disturbance. The soil is mainly loamy and dark-brownish, with pH 5.6 to 6.7. During the planting season, the vegetation in areas to be farmed (usually previously cultivated grounds) is cut and burnt by individual farmers, followed by ploughing (mainly by hoeing) and mound making for yam cultivation. Maize and rice are usually planted without ploughing. Previously cultivated grounds may be left to fallow for a few years before they are recultivated.

Detailed information about farming and other activities in the sites sampled were obtained from various farmers in the study area and considered in the interpretation of results. These include, previous crops grown in the fallowing grounds, pesticide and fertilizer application, time of abandoned cultivated grounds and incidence of bush fires.

Sampling

Samples (soil cores) were taken between February and April 1990 from 14 sites located in different parts of the study area. In each site, ten 50mm diameter and 50mm deep soil cores were randomly obtained with a simple sharpened steel cylinder as previously used by Tucker (1989), and kept in separate polytene bags. The sites were grouped into five site types as follows: A,2 undisturbed rain forests; B,4 areas in abandoned cultivated grounds cleared of vegetation and burnt for crop cultivation in 1990; C,3 yam cultivated grounds abandoned in 1988; D,2 rice/maize cultivated grounds abandoned in 1989; E,3 yam cultivated grounds abandoned in 1989.

Extraction and data analyses

Core samples were deep-frozen until required for analyses. After thawing, extraction of the invertebrates was done by mechanical soil washing and conventional floatation technique, using a sieve (1mm mesh) of diameter 200mm which was continuously shaken from right to left under a running water tap. The invertebrates (anthropods) obtained from the debris after the washing, were extracted by floatation in concentrated $MgSO_4$ solution sorted in and a mixture of 70% ethanol and glycerine (20:1). They were finally placed into the different family groups, with the aid of standard literature, under a binocular disecting microscope. The number per soil core of each insect family group usually adults, except for Coleoptera and Forficulidae in each site type, were recorded. After adding an offset of 0.5, the data were then square root transformed and used in Analysis of Variance (ANOVA) tests, for significant difference between the site types in the number of insects.

RESULTS

The mean number of insects in each of the families for each site type are summarised (Table 1). Each mean number of insects $core^{-1}$ is a back-transformed value of the site type mean. The families Ptinidae (spider beetles), Elateridae (click beetles), Scarabaeidae (dung beetles), and millipedes and centipedes not shown in Table were also encountered but mainly in site A.

Analysis of variance tests revealed that there were significant differences in mean number of insects among the site types for Formicidae ($F_{4, 45}$ = 14.5, $P<0.001$), Isotomidae ($F_{4, 45}$ = 10, $P<0.001$), Carabidae ($F_{4, 45}$ = 11.11, $P<0.001$), Termitidae ($F_{4, 45}$ = 9.00, $P<0.001$), Entomobyidae ($F_{4, 45}$ = 7.2, $P<0.001$) Poduridae ($F_{4, 45}$ = 3.5, $P < 0.05$), Forficulidae ($F_{4, 45}$ = 3.76, $P<0.05$) and Cerambycidae ($F_{4, 45}$ 29.33, $P<0.001$). For Forfilculidae and Cerambycidae, the forests had significantly higher numbers than all other site types and no other pairwise comparisons between site types were significant (Table 1). Site B had significantly lower numbers of Isotomidae and Entomobryidae than all other site types and, no other pairwise comparisons between site types were significant (Table 1). For Formicidae, Carabidae and Termitidae, sites A and B had the highest and lowest numbers respectively, leaving the pairwise comparisons between the other site types not significant (Table 1). The family Carabidae dominated the families of insects and sites A and B consistently had the highest and lowest numbers respectively (Table 1).

DISCUSSION

The results recorded in this study may largely be attributable to the cutting and burning of vegetation before crop cultivation. It is thus likely that the cutting and burning of vegetation and crop cultivation over the years may have caused a reduction in the numbers and/or absence of spider beetles, click beetles, dung beetles, millipedes and centipedes in site B, C, D and E. For Poduridae, the inability of the SNK tests to separate sites C, D and E from each of sites A and B in the number of insects (Table 1) is probably due to the observation made in this study that more than other Collembolans encountered. Poduridae was largely collected from underground tunnels and nests of ants and termites and therefore less affected by cutting and burning in site B. The cutting of vegetation has been found to reduce the number of litter and soil insects (Huhta *et. al.*, 1967; Oliver and Ryke, 1969; Edwards and Lofty, 1969; Lasebikan, 1975, 1977, 1979) and a trend observed in this study is the relatively high and low numbers of insects in sites A and B respectively. The types of crops grown and their mode of cultivation (ploughed or unploughed) in 1988 and 1989 appeared unrelated to the subsequent numbers of insects in sites C, D and E in 1990 (Table 1). This suggests the ability of cultivated grounds (irrespective of previous crops) to build up their insect numbers after previous losses through the processes of ploughing, cutting and burning. However, the initial losses may hardly be completely regained in abandoned cultivated grounds as observed from the differences in numbers among sites A, C, D and E (Table 1), unless these grounds were left to fallow permanently.

Besides the conversion of litter to humus. some members of the family groups encountered in this study, for example Formicidae and Carabidae are well known predators which can naturally contribute to the control of their prey (pests). Long-term control of a pest undisturbed by natural enemies is best achieved in an area which is relatively undisturbed by the various processes that accompany the cultivation of crops (Hassell, 1978). There is therefore the need to intensify the conservation and management of forests and discourage the indiscriminate cutting and burning of vegetation before crop cultivation. With reference to litter and soil insects, these measures are necessary to protect and preserve the benefiial insect populations, enhance the development to stability levels of any "predator-prey" relationships, increase the conversion of litter to humus and preserve other animal groups such as mammals and birds which live almost exclusively on soil/litter insects. For example, the decline of some farmland birds has been associated with the development of modern agriculture (Norris, 1963; Potts, 1980) which caused a decrease in the number of invertebrates that the birds feed upon.

Table 1: The 1990 planting season mean (back transformed numbers of litter and soil insects in five site types A-B in Ekpoma.

Insect groups	Site types				
	n=20	n=40	n=30	n=20	n=30
	2A	4B	3C	2D	3E
COLLEMBOLA					
Entomobryidae	1.21 a(0.96)	0.77 b(0.09)	1.18 a(0.89)	1.21 a(0.96)	1.16 a(0.85)
Isotomidae	1.50 a(1.75)	0.77 b(0.09)	1.42 a(1.52)	1.21 a(0.69)	1.23 a(1.01)
Poduridae	1.48 a(1.69)	0.99 b(0.48)	1.21ab(0.96)	1.25ab(1.06)	1.17ab(0.87)
Sminthuridae	0.79 a(0.12)	0.74 a(0.05)	0.76 a(0.08)	0.74 a(0.05)	0.75 a(0.06)
COLEOPTERA					
Carabidae	2.19 a(4.29)	1.26 c(1.09)	1.81 b(2.78)	1.64 b(2.19)	1.71 b(2.42)
Cerambycidae	1.44 a(1.57)	0.74 b(0.05)	0.81 b(0.16)	0.79 b(0.12)	0.76 b(0.08)
Coleoptera larvae	1.37 a(1.39)	0.87 a(0.26)	1.14 a(0.80)	1.05 a(0.60)	1.17 a(0.87)
DERMAPTERA					
Forficulidae (Adults and larvae)	1.84 a(2.09)	1.15 b(0.82)	1.18 b(0.89)	1.26 b(1.09)	1.24 b(1.04)
HYMENOPTERA					
Formicidae	1.84 a(2.89)	0.89 c(0.29)	1.30 b(1.19)	1.27 b(1.11)	1.39 b(1.43)
ISOPTERA					
Termitidae	1.59 a(2.03)	0.84 c(0.21)	1.28 b(1.14)	1.20 b(0.94)	1.19 b(0.92)
ORTHOPTERA					
Gryllidae (True crickets)	1.12 a(0.75)	0.91 a(0.33)	1.04 a(0.58)	1.01 a(0.52)	0.98 a(0.46)
Totals	16.14 (19.53)	9.93 (3.50)	13.13 (10.99)	12.63 (9.33)	12.75 (10.01)

A = Uncultivated tropical rain forests; B = Grounds cut and burnt for crop cultivation in 1990; C = Yam cultivated grounds abandoned in 1988; D = rice/maize cultivated grounds abandoned in 1989; E = Yam cultivated grounds abandoned in 1989. N is the total number of soil cores taken from each site type. Site types are preceeded by the number of each. Followed by the same letter are means not significantly different from each other at P = 0.05 in the student-Newman-Keuls (SNK) test

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