LAND USE EFFECTS ON AERIAL INSECT COMPOSITION ON OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

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ABSTRACT

Habitat transformation plays crucial role in determining insect diversity at local and landscape scales. Various land use practices may be subjected to different levels of disturbance ranging from pristine habitats with minimal disturbance to modified habitats such as agricultural ecosystems. Little is known about the effect of these different land use types on insect diversity especially in tropical ecosystems. Effects of four land use types; oil palm plantation, cassava field, exotic flower field (University Parks and Gardens) and a natural forest on diversity of aerial insects were investigated. Seven insect orders with a total abundance of 3747 insects were collected during the entire sampling period. Order richness of insects varied significantly among the different land use types with the highest richness found in the oil palm plantation. Abundance of dipterans and coleopterans were also highest in the oil palm plantation and natural vegetation respectively. In addition to natural and semi-natural areas which serve as source habitat for insects, perennial agro-ecosystems such as oil palm plantation with relatively minimal level of disturbance may also provide support for insect diversity.

Keywords: Disturbance, Diversity, Insect orders, Oil palm, Perennials.

INTRODUCTION

Insects have increasingly been recognized as important indicators of habitat and environmental quality (Jones & Eggleton 2000; Kitching *et al.* 2000). This is largely due to their success in terms of diversity and abundance, their sensitivity to perturbations and ease of sampling (Samways 2005). The success of insects in terms of diversity, abundance and global distribution can be attributed to a wide range of factors (Samways 1994). Their reproductive capability, flight, small size, extent of habitat colonization and other factors have been identified as crucial to their survival and remarkable taxonomic and functional diversity (Tylianakis *et al.* 2010). Attempts at estimating extent of diversity (species richness) as pioneered by Erwin (1982) and later by other biologists have shown estimates of values between five to ten million species (Godfray *et al.,* 1999; Costello *et al.,* 2011). Insect diversity in the tropics have been shown to parallel the hyper diverse plant community of this region (Novotny *et al.* 2006). This is especially so for herbivorous and flower-visiting insects which make up the aerial insect fauna of most communities and interact closely with plants to achieve important functional roles as pests and pollinators (Tscharntke *et al.,* 2005).

There is universal concern for biodiversity loss (Shah, 2011). This is deepened among insect ecologists in the face of growing taxonomic challenges especially for insects and other invertebrates (Clark & May, 2002). Drivers of biodiversity loss act at local, regional and global scales (Green facts, 2006), hence the need for a holistic approach in conservation research and practice especially for highly mobile groups such as insects which move across local, regional and in some cases across national boundaries. Though insect loss is a global challenge, inventories, assessments and development of conservation strategies may be better targeted at local or regional scales. This would possibly remove the ambiguity that may result when conservation efforts are approached globally with limited consideration for local scale dynamics that shape insect diversity loss and conservation needs (Tscharntke *et al.,* 2008).

Different vegetation sites, even in close proximity, may have highly variable insect populations due to subtle differences in environmental factors or plant composition (Tscharntke & Roland, 2004) and numbers may fluctuate greatly within one site. In Nigeria, there is scanty information on insect diversity in different vegetation sites and habitats.

Mitigating insect diversity loss due to various anthropogenic threats such as intensive agriculture, land fragmentation and deforestation will require such baseline data for sustainable policies and practices that will guarantee both short-term and long-term benefits. This study therefore investigates the effect of different land use practices on the abundance and richness of aerial insects on Obafemi Awolowo University Campus.

MATERIALS AND METHODS

Study Sites

Four sites were selected for this study within Obafemi Awolowo University Campus which is about 328 m above sea level and lies on Latitude 007^0 26` and $007^0$ 32`N, Longitude 004^0 31` and $004^0$ 35`E. The selected sites were; an Oil Palm (*Elaeis guineensis*) plantation forest and a Cassava (*Manihot esculentus*) field both on Obafemi Awolowo University Teaching and Research Farm. Apart from the perennial and annual crop plants cultivated on both sites, grasses and shrubs such as *Pennisetum purpureum*, *Panicum maximum, Eleusine indica, Salacia spp., Plastostoma africana, Tectona spp.,* were also found. The other two sites were a natural vegetation forest and Obafemi Awolowo University Parks and Gardens. The natural vegetation forest is made up of indigenous plant species such as *Funtumia elastica, Azadirachta indica, Milicia excelsa, Aspilia africana* while Parks and Gardens is made up of exotic and ornamental plant species such as *Thevetia neriifolia, Nerium oleander, Achyranthex aspera, Caladium bicolor, Blepharis maderaspatensis, Fleurya aestuans, Talinum triangulare etc.*

Insect Sampling

A 50 x 50 m plot was demarcated at the centre of each of the selected sites where insect sampling was done on a monthly basis for seven months between May and November, 2012. Insect trapping was done with twelve coloured pan traps (yellow, white & blue bowls of 2000 ml capacity each) in each of the study sites. Three pan traps comprising of the different colours were placed at the four corners of the demarcated plot on each site. The traps were half filled with water and a few drops of detergent to break surface tension and enhance insect trapping. Traps were removed after three days from each site. Collected insects were stored in 75 % ethanol and sorted into the various orders under a dissecting microscope.

Data Analyses

The samples collected from each of the traps were categorized into order richness and abundance for each of the sampling sites. One way Analysis of Variance (ANOVA) was carried out to determine if order richness and abundance varied significantly between the different sites. Tukey Honest Significant Differences (Tukey HSD) was carried out on the ANOVA results in a posthoc comparison. Variation in the abundance of each order across the different sites was also determined with one way ANOVA and Tukey HSD post hoc. Data were analysed in R (version 2.12, R development core team 2010) and SPSS for windows (version 16.0, 2007).

Results

Seven insect orders were represented in the samples collected from the four study sites. Order Diptera, Orthoptera, Lepidoptera, Coleoptera and Hemiptera were found on all the sites sampled while Order Odonata was found only on the Oil Palm plantation. The insects orders collected from each of the sites are shown in Table 1.

Table 1: Insect Orders Sampled in the Different Study Sites from May to November 2012 at Obafemi Awolowo University, Ile-Ife.

Natural forest	Cassava plantation	Oil palm plantation	Parks and Garden
Diptera	Hymenoptera	Diptera	Hymoptera
Hymenoptera	Diptera	Hymenoptera	Diptera
Orthoptera	Coleoptera	Orthoptera	Coleoptera
Lepidoptera	Orthoptera	Hemiptera	Orthoptera
Coleoptera	Hemiptera	Coleoptera	Isoptera
Hemiptera	Lepidoptera	Homoptera	Lepidoptera
	Thysanoptera	Lepidoptera	Hemiptera
	Isoptera	Odonata	Thysanoptera
		Thysanoptera	
		Isoptera	

A total of 3747 insects were collected throughout the sampling period from all the sites. The total number of insects collected from the Oil Palm plantation, Cassava field, Natural vegetation and Parks and Gardens were 1177, 1233, 656 and 681 insects respectively. The most abundant orders sampled were Hymenoptera and Diptera with a total of 1546 and 1165 individuals respectively, which makes up about 73% of the total abundance. A total of 1005 individuals were recorded for the remaining five insect orders sampled, which represented 27% of the total abundance.

Analysis of variance results showed that order richness was significantly different among the study sites (P = 0.0007, F value = 8.043) while abundance was similar ($P > 0.05$). Order richness and abundance were not significantly different between the sampling months ($P > 0.05$). Results of Tukey HSD posthoc test showed average order richness was highest in Oil palm plantation compared to the other study sites (Fig. 1).

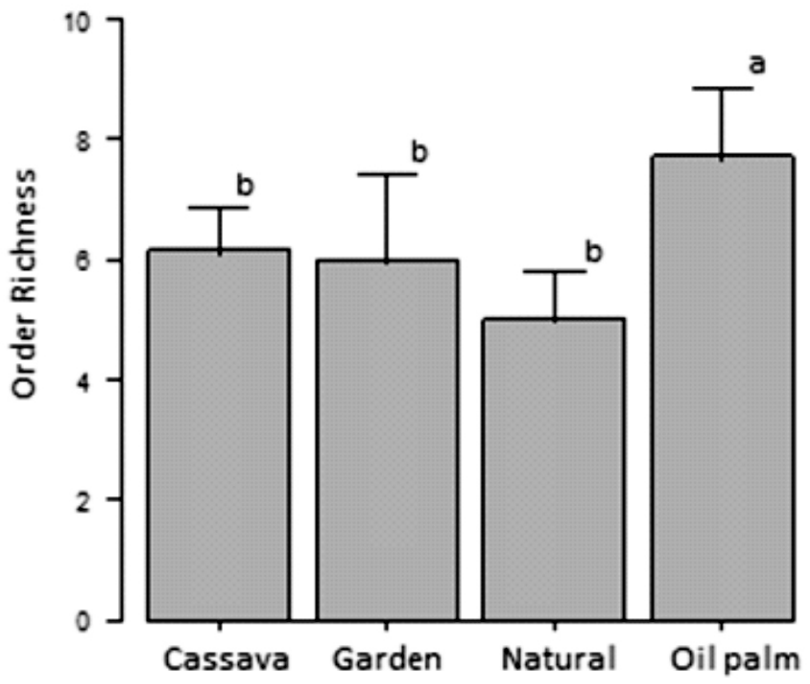

Fig. 1 Mean (± SE) order richness of insects sampled in different land use types from May to November 2012 at Obafemi Awolowo University, Ile-Ife. Letters above the bars with different codes indicate significant difference among treatments

Abundance of the order Diptera varied significantly among the study sites, with the highest mean abundance found in oil palm plantation compared to the other study sites (*P* = 0.00315, F value = 6.007, Fig. 2). A similar result was obtained for order Coleoptera which recorded highest mean abundance in the natural sites (*P* = 0.00315, F value = 6.007, Fig. 3).

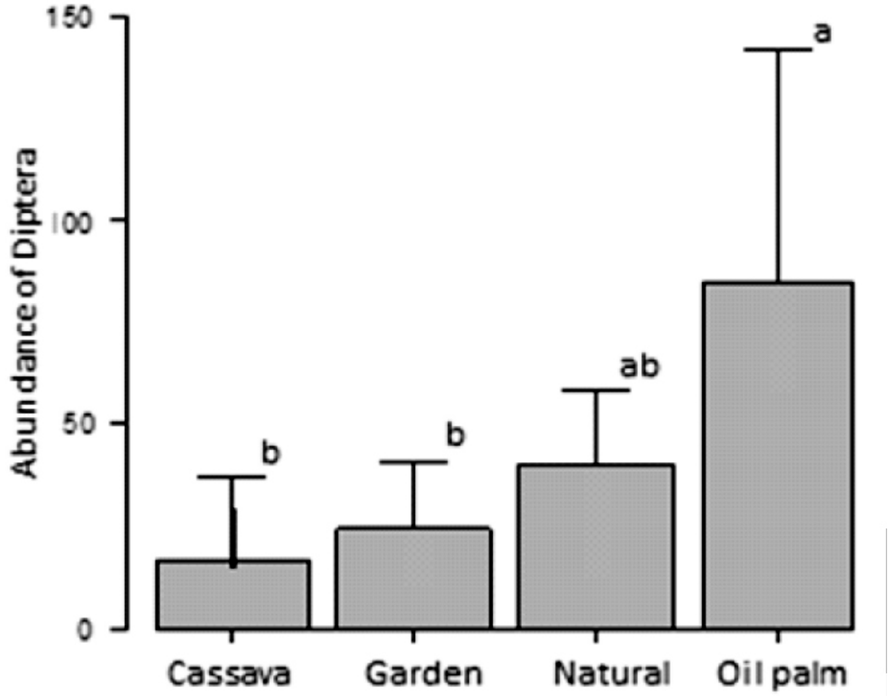

Fig. 2 Mean (± SE) abundance of dipteran insects sampled in different land use types from May to November 2012 at Obafemi Awolowo University, Ile-Ife. Letters above the bars with different codes indicate significant difference among treatments

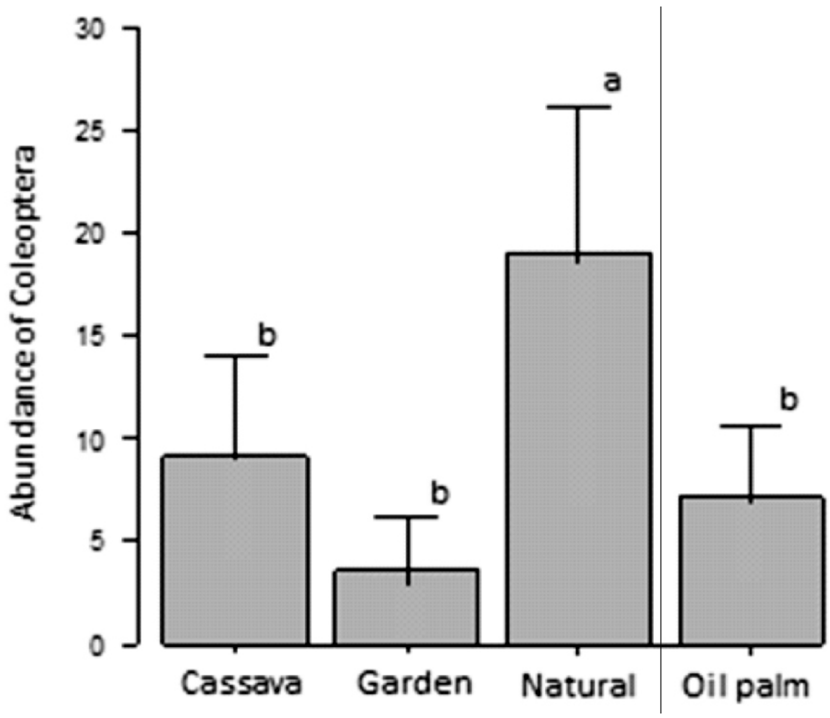

Fig. 3 Mean (± SE) abundance of coloepteran insects sampled in different land use types from May to November 2012 at Obafemi Awolowo University, Ile-Ife. Letters above the bars with different codes indicate significant difference among treatments

DISCUSSION

Highest richness of insects was encountered in the oil palm plantation compared to the other study sites. Perennial crops such as the oil palm sampled here have been reported to support greater biodiversity compared to annual crop systems (Glover & Reganold, 2010). Perennials are usually associated with less intensive practices with minimal disturbance to flora and fauna communities (Bruggisser *et al.,* 2010). This may be very important for promoting insect diversity conservation in tropical rainforest biomes which are made up of several perennial plantation forests. However, there is need for more information on the composition and distribution of insects in different perennial crop systems such as; cocoa, coffee, cola etc. In addition to local scale effects, it is also important to investigate the landscape scale effect of such habitats on insects in tropical biomes. Insect abundance was highest in the cassava field, though this was not significantly so. Annual crop areas could also provide some benefit for some group of insects because they support mass flowering of crop and non-crop vegetation which make available nectar and pollen resources on a seasonal basis. In complex agricultural landscapes with high proportion of natural or semi-natural habitats, annual crop habitats have been shown to promote diversity of various arthropod fauna (Schmidt *et al.,* 2005; Holzschuh *et al.,* 2007). Most of these studies have however been done in temperate landscapes with few reports from tropical agricultural landscapes (Munyuli, 2012).

Dipterans and Hymenopterans were the most abundant groups sampled in this study. Members of these insect orders such as bees, wasps and hoverflies have been reported to play important functional roles as pollinators (Klein *et al.,* 2007), which facilitate fruit production and parasitoids which help in biological control in these ecosystems. This is very important for plant communities in natural and agricultural habitats such as the sites sampled in this study. Dipterans and Homopterans were found to have higher abundance in oil palm plantation compared to the other sites. Ecofriendly practices that support diversity and abundance of these insect orders should be encouraged on oil palm plantations and similar perennial ecosystems (Bruggisser *et al.,* 2010). Such practices will ensure reduction in vegetation disturbance, provision of feeding and nesting sites among others. The natural site supported highest abundance of coleopterans compared to the other study sites. Natural and semi-natural areas are important as source habitats to support insect diversity especially on a landscape scale (Samways 2005). However, these pristine areas are increasingly under threat from various anthropogenic factors such as deforestation which was recently estimated to occur at the highest rate in Nigeria (FAO, 2005).

CONCLUSION

Conserving insect diversity and protecting the ecosystem services derived from insect populations requires paying attention to the effect of different land use practices on insect communities. There is a need to protect important habitat such as natural and perennial ecosystems and to promote eco-friendly management approaches in annual crop systems across our landscapes.

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