# EFFECT OF DIFFERENT WOODY SPECIES ON THE ABUNDANCE AND DIVERSITY OF MACROARTHROPOD IN AKURE FOREST RESERVE, APONMU, ONDO STATE

**BY**

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**POSTGRADUATE THESIS**

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## CERTIFICATION

This is to certify that this study was carried out by OGUNRINOLA Oluwaseun Femi (SCP12/13/H/2536) of the Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria.

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## DEDICATION

This research work is dedicated to Almighty God, the immortal, invisible, the source of my knowledge and wisdom. He is the one that knows the end of a thing from the beginning of this programme and helped me through time of difficulty.

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## ABSTRACT

The study identified the woody species, determined the abundance and diversity of selected macroarthropods (millipedes, termites, beetles and bees), the soil physico-chemical properties and examined the relationship between them in Akure forest reserve, Aponmu. This was with a view to providing information on the effect of different woody species on the abundance and diversity of selected macroarthropods.

The study was carried out in four physiognomies comprising plantations (*Tectona grandis*, *Gmelina arborea*, Taungya) and secondary regrowth forest.Four plots of 25 m x 25 m were randomly selected from a sample of 100 m x 100 m for sample collection.All woody species were enumerated and identified and composite soil samples were collected at a depth of 0-30 cm using a soil auger from five sampling points. The soil samples were bulked and analyzed for soil pH, organic matter, and total nitrogen. Pitfall traps were used for beetle collection, millipede was collected by hand picking and bee specimens were trapped using window intercept, while termite collection was done by transect method.Data collected were analyzed using descriptive statistics and analysis of variance.

The results showed that woody species diversity and abundance were fewer in planted forests relative to secondary regrowth forest. Secondary regrowth forest had 83 woody species and Shannon-Wiener Index(4.0589); *Tectona grandis* plantation had the least number of woody species (16) while Taungya plantation had the least Shannon-Wiener (2.1607) Index. Out of the twenty-seven (27) species of selected macroarthropod encountered, Taungya plantation had the highest (20 species), while the secondary regrowth forest and *Gmelina arborea* plantation had the least (14 species). Taungya plantation was richest in beetle specimens with a mean density

(8.5±1.85); *Gmelina arborea* plantationwas richest in millipede specimens (16.75±1.98), while*Tectona grandis* plantation had the richest in termite (124.75±23.63) collection. Comparative analyses showed that no significantly ($p < 0.05$) differencein the abundance of the selected macroarthropod across the plant physiognomies. The results of the soil analysis showed that Taungya plantation soil was slightly alkaline (7.32±0.31), with highest organic matter (OM) (2.14±0.16)% and total nitrogen (TON) (0.048±0.00)%, while the least OM and TON was recorded in *Tectona grandis* plantation (5.69±0.20 1.18±0.12, and 0.035±0.01%) respectively. There was a positive relationship between total organic matter (TOM) and total organic carbon (TOC) (0.999), total nitrogen and TOC (0.969), TN and TOM (0.970) in *Gmelina arborea* plantation. There wasa negative relationship between termite and woody species (-0.981) and positive significant relationship between TOM and TOC (0.999), TN and TOC (0.993), TN and TOM (0.993) in the *Tectona grandis* plantation. In the Taungya plantation positive relationship was recordedbetween millipede and pH (0.975), TN and TOC (0.985), TN and TOM (0.984), TOM and TOC (0.999). A negative significant relationship exist between termite and TOC (-0.959), Termite and TOM (-0.951) while a positive significantoccurred between TN and TOC (0.972) in secondary regrowth forest.

This study concluded that woody species affected abundance and diversity of the selected macroarthropods and soil chemical characteristics.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background Information

Forest ecosystems, in tropical as well as in temperate regions, are believed to house the major proportion of global biodiversity (Carnus *et al*., 2006). Tropical forests harbour most of world's biological diversity which play an important role in species and functional diversity of macrofauna. It was noted that tropical forests support high abundance of soil fauna and tree species diversity (Takeda, 1998). Though the exact number of species in many rainforest zone is unknown (Okojie, 1994), the diversity of tropical forest ecosystem is known to be high (FAO, 2001). In recent times, losses of biodiversity and ecosystems functioning due to forest destruction and agricultural intensification are prime concerns for science and society (Dewenter *et al.,* 2007).

Global change, extensive timber logging, and conversion of forest to arable land for food production make natural habitats decline rapidly. Land-use and land cover changes may represent a major threat to macrofauna abundance, diversity and ecosystem processes. A study conducted on diversity of soil fauna in southern Nigeria indicated a diminishing status of the species in their natural habitats (Awosika, 2009). Lasebikan (1975) observed a reduction in the number of taxa and mean densities of most taxa of soil arthropod after forest clearing. Similar observation was equally made by Eaton *et al*. (2004) in soil arthropod population which was

caused by organic matter removal and vegetation disturbance. However, there tends to exist a relationship between the flora diversity and fauna composition both at belowground and above ground through food web connection at ecosystem level.

The diversity of trees is fundamental to total rainforest biodiversity (Cannon*et al.,* 1998), with an indication that 70-90 percent of living flora and fauna inhabiting this ecosystem depends on the forest for their survival (Tilman and Lehman, 2001). In fact, the canopy system and favourable environmental conditions of tropical rainforests enhance the increase of biodiversity. The presence of this canopy is a significant component to the belowground biodiversity, which requires proper management for sustainable land use and also for maximal environmental benefits such as macrofauna as food to man, macrofauna as indicators of habitat quality, macrofauna as a link between the aboveground biodiversity, and as soil modifiers. Furthermore, they also influence decomposition and biodegradation of organic residues, soil organic matter dynamics, humification, nutrient release and physical parameters such as bulk density, porosity and water availability (Lee and Foster, 1991; Lavelle *et al.,* 1992; Brussard *et al.,* 1993; Tinzara and Tukahirwa, 1995; Beare *et al*., 1997; Black and Okwakol, 1997).

In general, soil macrofauna breakdown and redistribute organic residues in the soil profile, which increases the surface area and availability of organic residues for microbial activity and subsequent deposition of faecal pellets has important ecological implications (Lavelle *et al.,* 1992). Certain groups of macrofauna particularly, termites and earthworms, can substantially modify soil structure through formation of macropores and aggregates (Lee and Foster, 1991). The influence of soil fauna on soil structural properties has been considered to be the best long-term indicator of soil quality (Linden *et al*., 1994). Previous studies indicate that soil fauna helps in the functioning of forest ecosystem and an important indicator that influence

decomposition and biodegradation of organic residues, as well as breaking down and redistributing organic matter in the soil profile (Lee and Foster, 1991; Lavelle *et al.,* 1992).

Studies showed that habitat destruction adversely affects survival of major soil fauna components like earthworms, ants, beetles and termites (Woodman *et al.,* 2008). Modification in the structure and composition of plant communities, growth and physical changes in the forests can decrease invertebrate diversification of macroarthropod especially termites (Lavelle *et al.*, 1997), which may be catastrophic to forest health and productivity. Advancing knowledge on the impact of change in forest tree species on the macroarthropods abundance in relation to soil nutrient dynamics will help in planning and implementation of sustainable forest management.

Soil fauna is vital in forest productivity. The soil biota constitutes a major fraction of global terrestrial biodiversity in which they played an important role in terrestrial food webs maintenance. Soil organisms involved in litter comminution are important components of the ecosystem because of their active participation in carbon dynamics. Soil biotas such as collembola, mites, millipedes, beetles, termites and earthworms have been considered important in maintenance of forest productivity through litter decomposition. These groups have been ascribed different roles in decomposition process (Decaens *et al*., 2006).

Soil invertebrates perform important functions related to the growth conditions of plants. For example, ecosystem engineers such as termites and earthworms increase soil porosity and average pore size by tunneling through the soil (Edwards and Shipitalo, 1998). These invertebrates ingest considerable amounts of soil and dead plant material, thereby contributing to the mixing of organic matter and mineral soil. This improves aggregate stability and increases the surface of organic material so that it is more readily colonized and decomposed by soil

bacteria and fungi (Lavelle *et al.*, 1997). Soil invertebrates are the dominant animal group in many terrestrial ecosystems and may have higher biomass on an area basis than aboveground herbivorous insects or vertebrates (Odum, 1971). They are an important food source for many predacious invertebrates and vertebrates (Bilde *et al*., 2000; McNabb *et al*., 2001). Macro-arthropods have an important role in the maintenance of soil structural stability and fertility in many natural and man-made habitats.

Soil biota is at the ecological center of many tropical ecosystems (Wilson, 1992). Termites are considered important insect indicators. In many tropical forest soils, termites are the most abundant and important decomposers (Wood and Sand, 1978; Matsumoto and Abe, 1979; Collins, 1983). Termites living in the tree canopy and on epiphytes may also attain high biomass (Ellwood and Foster, 2004). Termites are vital in maintaining decomposition processes (Collins, 1989), and play a central role as mediators of nutrient and carbon fluxes (Lawton *et al*., 1996). The presence of termites increases soil permeability markedly and may improve soil structure, aeration, nutrient cycling and soil fertility. Termites fragment and comminute litter, thereby facilitating the action of microorganisms, which in turn transform litter organic compounds into mineral nutrients available to plants. Termites also influence the decomposition processes by species composition and local assemblages (Lawton *et al*., 1996).

## 1.2 Statement of Research Problem

Forest and its products are being destroyed by several anthropogenic activities in Nigeria. These activities have led to loss of biodiversity and extinction of many flora and fauna. An urgent need exists for increased efforts to examine and investigate the diversity and abundance of macro arthropods within different forest stands. Assessing the effect of different woody

species on the abundance and diversity of some selected macroarthropods in the forest is essential, hence this study.