TEMPORAL PATTERN OF TREE COMMUNITY DYNAMICS IN A SECONDARY FOREST IN SOUTHWESTERN NIGERIA, 29 YEARS AFTER A GROUND FIRE.

BY

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CERTIFICATION

We certify that this work was done by Miss Ademoh Ozavize Fatimoh, in the Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria.

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DEDICATION

This work is dedicated to the Almighty God, my lovely siblings for their support during the course of my education.

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ABSTRACT

The study determined successional replacement model among the functional groups in the forest, the changes in floristic composition and community structure and tree mortality and recruitment rates in a secondary forest at Ile-Ife, 29 years after fire. It also determined if change in basal area of the tree community within time period results from recruitment and mortality of all tree species and assessed whether changes in rainfall and temperature were the major drivers of change in the forest. This was with a view to determining the stand temporal pattern of tree community dynamics in a moist forest regenerating after fire disturbance.

Two sample plots, 0.25 ha each, were established in burnt and unburnt parts of the secondary forest. In each plot, woody plant species ≥ 1 cm in girth and 1m and above in height were completely enumerated, identified to species level, labelled with a permanent tag and girth size measured at breast height (gbh). The number of species, genera and families were established for each plot. The data collected were used to calculate species diversity indices, basal area, species evenness, density, similarity and dissimilarity indices for the plots. Tree mortality and recruitment rates were calculated using data from this study and previous studies in the burnt plot in 1983, 1984, 1997 and 2008. Correlation and regression analyses were used to assess whether decadal changes in rainfall and temperature were major drivers of changes in the forest after calculating decadal temperature and rainfalldata for 29 years collected from various Meteorological Stations on the campus.

The results showed that a total of 380 trees were present in the 0.25 ha of the burnt plot, representing 63 species, 46 genera and 22 families. Stem density decreased from 4332 stem ha^{-1} to ha^{-1}, 29 years after the fire. The species diversity (H^{1}) which decreased to 2.50 in 2008 has

increased to 3.50 in 2012. The species evenness which peaked (0.80) in 1997 decreased to 0.48 in 2012. The basal area which increased to 20.18 m^2 h^{-1}in 1997 and dropped to 14.62 m^2h^{-1}in 2008 has increased to 21.34 m^2 h^{-1}in 2012. The tree annual mortality rates which continued todecrease one year after the fire (-2.02% y^{-1}in 1984-1997, -5.16 % y^{-1} in 1997 -2008) had increased to 25.7% y^{-1} in2008-2012.The annual recruitment rates continued to decrease since the fire, decreasing to the lowest rate of-25.7 % y^{-1}in 2008 -2012. There was a non-significant positive correlation between basal area and mortality ratesbut a non-significant negative correlation between basal area and recruitment rates.There was a non-significant positive correlation between decadal mean minimum temperature, decadal mean maximum temperature, decadal mean annual rainfall and density but a non-significant negative correlation between these climatic data and basal area, species richness and species diversity. The changes in community parameters in the forest as it recovers from the fire disturbance followed the tolerance model of succession.

The study concluded that changes in the floristic, structural character, mortality and recruitment rates were still going on in the forest, 29 years after the fire disturbance. Changes in decadal rainfall and temperature since the fire seemed to be part of the drivers of the changes in the forest.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Disturbance of forest

Disturbance is defined as any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment (Pickett and White, 1985). Disturbances play important role in determining the structure and functioning of ecosystems (Oliver, 1981; Paine and Levin, 1981; Pickett and White, 1985). They directly affect community and population dynamics by altering resource availability (Denslow *et al.,* 1998) causing mortality and providing opportunities for recruitment (Canham and Marks, 1985) and by influencing the relative competitive status of individuals (Sousa, 1984). Disturbances may also be important in maintaining species diversity, particularly in species-rich ecosystems such as tropical forests (Connell, 1978; Huston, 1979; Glitzenstein *et al.,* 1986), by providing occasional periods favourable to recruitment for long-lived organisms such as certain tree species (Warner and Chesson, 1985). Disturbance may be large scale or small scale. Large scale disturbance is caused by landslides and erosion, small scale disturbance is caused by tree fall (Richards, 1996; Whitmore, 1989, 1991). A forest community may be disturbed by fire, disease, flood or human activities such as timber harvesting and farming.

Stand evolution trajectories are often altered dramatically by disturbances (Johnstone *et al.*, 2010) but natural disturbances rarely eliminate all structural elements from the affected stand (Franklin *et al.*, 2002). Disturbances can create vastly contrasting quantities and types of living and dead structures that contribute to the ecological legacies associated with structurally diverse starting points for stand structural development (Johnstone *et al*., 2010). Such disturbance effects can propagate through the forest for decades at least (Gough *et al*., 2007) creating lags in heterotrophic respiration caused by delayed mortality or delayed decomposition (Harmon *et al*., 2011).

The world's tropical rain forests are undergoing major transformations due to deforestation, fragmentation, land use changes and climate change. Throughout wet and dry tropical regions, secondary-regrowth forests are increasing in extent, economic importance, and conservation value (Brown and Lugo, 1990; Corlett, 1995; de Jong *et al.,* 2001). Due to the transition from dominance by light-demanding pioneer tree species toward dominance by shade-tolerant species (Finegan, 1996), secondary-regrowth forests are expected to exhibit more rapid changes in tree species composition than mature forests. These successional dynamics will be important in determining how tropical forests respond to global climate change and land use/land cover changes. Demographic studies have documented effects of climatic variation on growth and mortality of tree species in moist and wet tropical old-growth forests (Condit *et al*., 1995; Clark *et al.,* 2002; Potts, 2003), and these effects can directly impact on species composition (Slik, 2004).

Impact of disturbance on the forest

Disturbances are part of the dynamic fabric of ecosystems with strong spatial and temporal variability, creating a spectrum of legacies in forest structure, successional stages, and carbon cycle trajectory environment. Disturbances affect tree species composition by changing the species of hard wood to species with softer wood when the forest is repeatedly disturbed (terSteege, 2003). Disturbance might kill trees, resulting in direct and immediate carbon transfer to the atmosphere (in the case of fire) and a shift in structural elements from live to dead pools (e.g., leaves to litter, trees to logs, live roots to coarse woody debris, etc.).

Fire is one of the most important agents of ecosystem disturbance. Many existing forest communities are at developmental stages of natural succession, which eventually result in the restoration of the forest that were destroyed by lighting or man-caused fire (Taylor, 1973). Fire is a pervasive natural disturbance that controls many structural and functional properties of plant communities and it is a major agent initiating and terminating succession (Foster, 1985). Fire disturbance has other nearinstantaneous effects, in particular the combustion of biomass; the loss of carbon to the atmosphere which exerts a significant radiative force (Randerson *et al*., 2006). Disturbance caused by human interference varies widely in scale, type and intensity. Such disturbance can range from gap formation caused by reduced impact logging to large-scale and repetitive slash- and- burn activities. Because type and intensity of disturbance varies, an array of degraded vegetation types follows, varying in structure and species diversity (Finegan, 1996). Dry forest fire combusts forest floors and litter often smolders rather than burn openly. Small plants including juvenile trees suffer greatest mortality and large ones suffer bole damage and may die within 2 to 4 years after the fire (Isichei *et al.,* 1995).

In recent years, fire incidence has increased in the tropical rainforest zones of the world, especially in deciduous forest where the dry season exceeds 3- 4 months (Isichei *et al*., 1986; Leighton and Wirawan, 1986; Kinnard and O'Brien, 1998). Fire affects forest regeneration directly through the burning of seed, seedling and trees and indirectly through its action on the soil (UNESCO, 1978). Many seeds and most seedlings are killed and trees are damaged by fire, but organ located a few centimetres under the soil may not be affected. Fire could stimulate seed germination of certain herbaceous and perennial shrubs, especially plants in the family