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THE EFFECTS OF GROUND FIRE ON TREE POPULATION IN A SECONDARY FOREST IN SOUTH WESTERN NIGERIA

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ABSTRACT

The changes in the tree population in a 50m x 50m rain forest plot on the campus of Obafemi Awolowo University, Ile-Ife, Nigeria, six years after it was burnt were assessed by comparing the results obtained in 1989 with those of January 1983, just before the plot was burnt and those of April 1984, ayear after the plot was burnt.

The number of tree species and the numbers of tree individuals had increased between 1984 and 1989 by 10%. *Manihot glaziovii Mill-Arg* the most abundant species in the plot in 1984 still maintain its status but its density decreased from 81% in 1984 to 61% in 1989 while *Funtumia elastica (Preuss) stapf* showed a remarkable increase from 8% in 1984 to 88% in 1989. Other species present in the plot showed a little net change in population over the same period. These observation demonstrated successional trend in gap replacement It is considered that population dynamics is better studied by monitoring plot over time as the best was of studying plant succession.

Keywords: Fire-tree population - succession - gap - dynamics

INTRODUCTION

Fire, though a rare occurrence in the rain forest zone because of its almost year-round wetness (Isichei *et al*, 1986), had now constituted a recent addition to the causes of tree mortality in the zone. Fire, which is widely used for bush clearing to prepare farmlands in this zone, destroys sprouts of plants and effect post-fire recovery because the seed bank is destroyed in some cases, while in others, the density of viable seeds in soil is drastically reduced. Fire brings about disturbance in tropical rain forest. This disturbance functions largely to interrupt and reinitiate succession as the area that was stripped of its original vegetation is colonized by a variety of species (Kershaw, 1973; Brokaw 1985 a,b). It is now widely recognised that the consequences of a single disturbance event may be observed at very different time scales and integration levels (Bongers et at, 1988). This report assesses the vegetational changes that has taken place over five-year period in a secondary forest that was burnt accidentally by a ground fire in 1983 and on which assessment was carried out in 1984 by Isichei *et al.*

MATERIALS AND METHODS

In mid-January 1983, a 50m x 50m area of forest was demarcated out of the forest adjacent to the zoological garden within the Biological Gardens of the Obafemi Awolowo University, Ile-Ife, Nigeria (7°32'N, 4°31'E). species listing and girth measurements of all woody plants over 2m high within the plot were carried out.

On 31st January, 1983, the forest patch accommodating the Biological Gardens and the demarcated plot was affected by a severe all-night fire which created openings in the community both at the ground and canopy levels.In April 1984, it was felt that the 1983 fire might have affected the species composition and the general vegetation structure of the 50m x 50m demarcated plot, hence, a re-enumeration was carried out by Isichei et al.

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In January 1989, five years after the 1984 re-enumeration, all woody plants which are 2 meters or more in height in the demarcated plot were identified, tagged with numbers and their girths at breast height (gbn) measured. The percentage contribution of each species to the total population was calculated. Basal area (A) and three indices of diversity were calculated,namely the Shannon-Wiener index (H), the Simpson index (C) and the Equitability index (E):

$$A = C^2/4\pi \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where C is the circumference or girth

$$H = - \Sigma\, pi^2 \log pi \ldots\ldots\ldots\ldots\ldots (2)$$

where pi = n/N; ni = number of individuals of species; and N = total number of individuals.

$$C = \Sigma\, pi^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3) \text{ and}$$

$$E = H/M_m \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where $H_m = 2\log s$; s = number of species. —

Results obtained from the above measurements were compared with those obtained in mid-January 1983 and those of April, 1984.

RESULTS

There was an increase in the number of individuals and the number of species occurring in the burnt plot since 1984. Whereas, there were 798 trees belonging to 40 different species in the plot in 1984, a year after the fire, the number increased to 880 trees of 49 different species in the plot in 1989 (Table 1).

The abundance of tree species in various girth-size classes prior to, one year and six years after the ground fire were shown in Figure 1. New trees were added to the 21-40m girth-size decreased from 681 and 1984 to 588 in 1989. The higher girth-size classes were less dramatically affected but the distribution of individuals among the various girth-sizes over the 5 year period (1984-1989) is significantly different ($P \leq 0.01$ Kolmorogov - Smirnov goodness of fit test). *Manihot glaziovii* which was the most abundant species in the plot in 1984 still remained the most abundant species. But while this tree constituted 81% of the total number of species in 1984, it was 61% in 1989. Similarly, there was a reduction in its basal area from $33m^2\ ha^{-1}$ in 1984 to $23m^2\ ha^{-1}$ in 1989 (Table 1). Also, the reduction in the number of *Manihot* individuals (Table 2), most especially in the 0-20cm girth-size class in 1989 (Fig. 2) indicated that there was a reduction in the development of this tree in the plot.

There was an increase in the number of *Funtumia elastica* individuals occurring in the plot (Table 2) and most of these individuals were found in the 0-20cm girth-size class (Fig. 3). This, while the density of *Manihot* tended to fall after 1984, that of *Funtumia* tended to rise (Fig. 4). Table 2 revealed how the numbers of the ten most abundant tree species in the plot altered following the 1983 fire. Presently, over 60% of the individuals in the plot are found in the 0-20cm girth-size class (Table 3). The index of dominance decreased from 0.662 to 0.382 over the 5 year period (Table 1), while the species diversity increased from 1.091 to 1.822 over the same period.

DISCUSSION

The increase observed in the number of individuals and the number of species occurring in the plot indicates that the burnt forest is still in colonization phase. The fire had created openings at both the canopy and ground levels. Many rain forest species require such openings to *rejuvenate* (Denslow, 1980; Long & Knight, 1983; Whitmore, 1984). The colonization phase is characterised by intense competition for lights and nutrient (Brokaw, 1985 b). thus the pioneers are shaded out and many of them die off thereby creating gaps which are gradually filled by the slower-growing trees that dominate the next phase of succession. Results obtained in this study tend to suggest that *Funtumia* is likely to be adapted to the disturbance mediated micro environment which exists in this plot.

It would be concluded from the data that fire had some stimulating effect on tree flush and that the dynamics of tree population in tropical rain forest may be better studied by monitoring plots through time as suggested by Whitmore (1983). Denslow (1980) has also suggested the need for critical investigations into the adaptive strategies of species involved in tree regeneration. All these will lead to better forest

TABLE 1: DEMOGRAPHIC CHANGES IN THE TREE VEGETABLE IN REGROWTH FOREST PLOT IN SOUTHWESTERN NIGERIA FOLLOWING A GROUND FIRE

	BeforeFire 1983	1 yr. After fire 1984	6yr. After fire 1986
Total number of tree ≥ 2m high	378	798	880
Total number species	**37**	**40**	**49**
Most abundant species	*Funtumia elastica*	*Manihot glazoiovi*	
gaziovii			
And % of that species	25.4%	81.1%	60.5%
Plot's total basal	21.40	32.16	22.74
Species contributing Most			
To basal area	*Elaeis guineensis*	*Manihot glaziovii*	
glaziovii			
and % contributed	23%	44%	36%
Simpson Index (C)	0.093	0.662	0.382
Shannon Weiner diversity			
Index (A)	2.996	1.091	1.822
Equitability index (E)	0.58	0.21	0.48

* Figure in bracket are the % to the total

TABLE 2: Changes in number of the ten most abundant tree species (in terms of Basal Area) In a growth forest plot in Southwestern Nigeria following a ground fire

S/N	Manihot SPECIES	1993	1994	1989
1	Glaziovii Mill. Arg	34(23)	646(641)	532(321)
2	Funrimi Elastica (Preuss) stapf	96(38)	38(8)	100(88)
3	Pycnanthus anglensis (Welw.) Wart	30(18)	7(1)	8(7)
4	Bligha unijugata Bak	16(14)	2(0)	2(6)
5	Ficus mucoso Welw. Ex Ficalho	16(4)	5(2)	7(2)
6	Albizia zygia DC J..F Macbr	11(3)	10(1)	22(19)
7	Newbonldia leavis P. Beauv	10(2)	4(0)	12(8)
8	Elaeis quineenis jacq	8(0)	2(0)	5(0)
9	Alstonia boonei De Wild	6(0)	7(0)	6(0)
10	Bonguia anglolensis Ficalho	5(0)	3(0)	7(5)

* Figures in bracket indicate number of trees in the 0.20cm girth-size class.

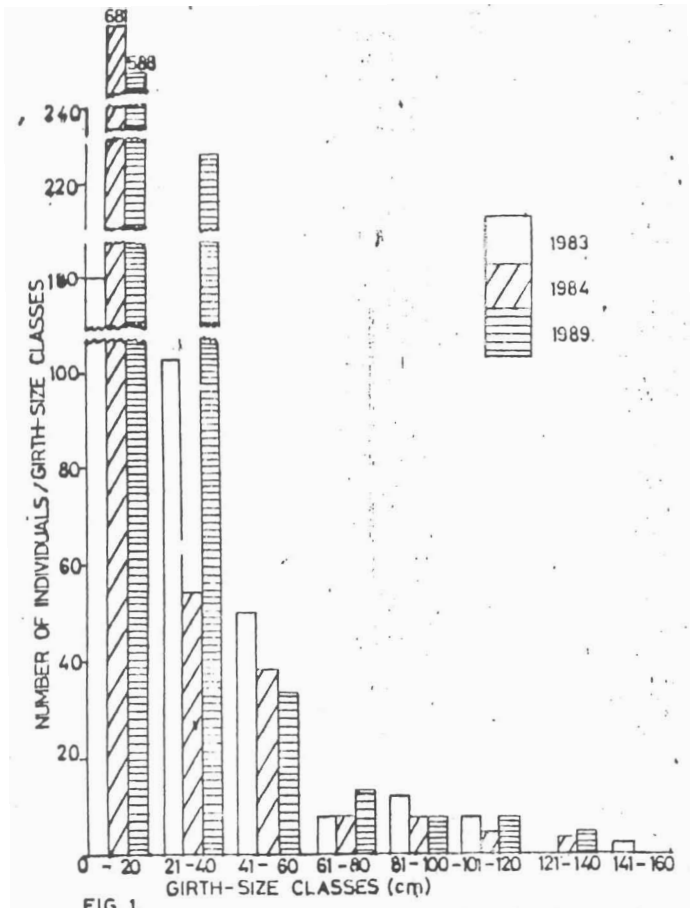

FIG 1.
Abundance of Tree species in various girth-size classes prior to one year after and six years after a ground-fire in a secondary regrowth forest plot in Southwestern Nigeria.

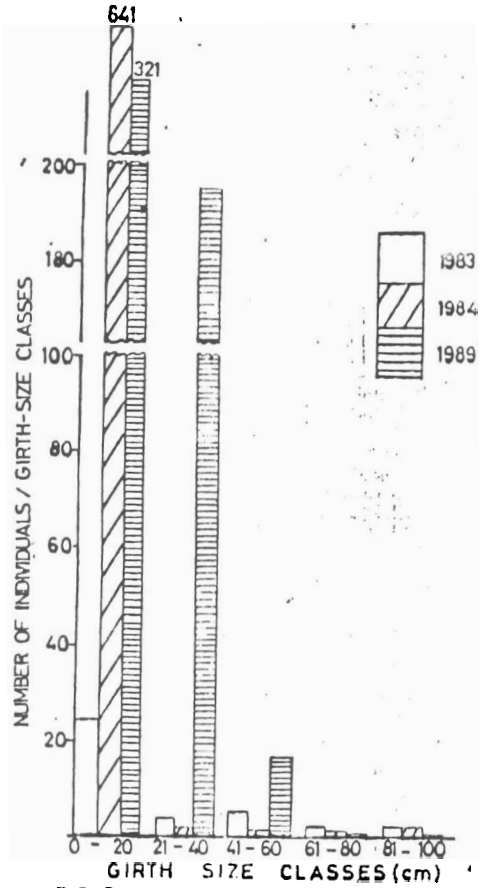

FIG 2
Abundance of Manihot glaziovii in various girth - size classes prior to one years after and six years after a ground fire in a secondary regrowth forest plot in Southwestern Nigeria

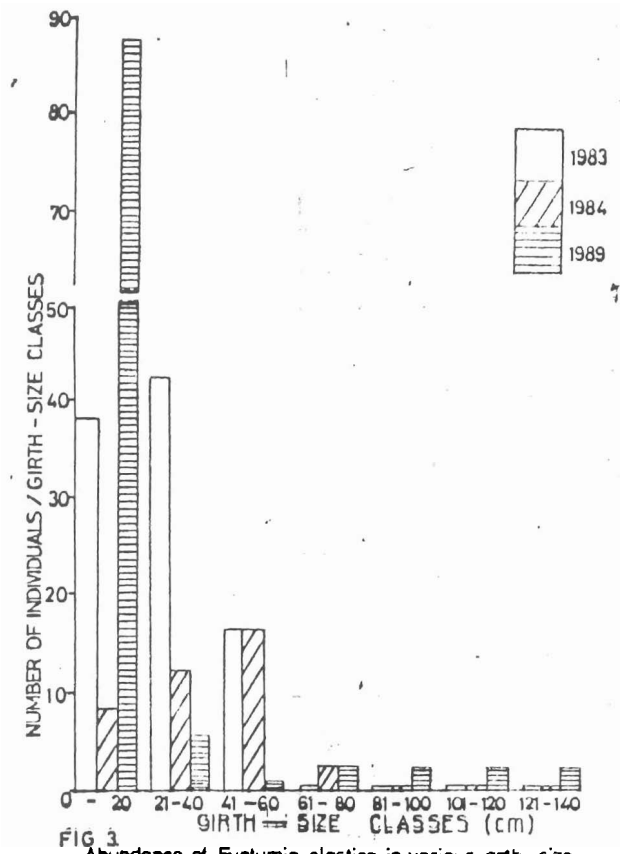

FIG 3.
Abundance of Funtumia elastica in various girth-size classes prior to, one year after and six years after a ground-fire in a secondary regrowth forest plot in Southwestern Nigeria.

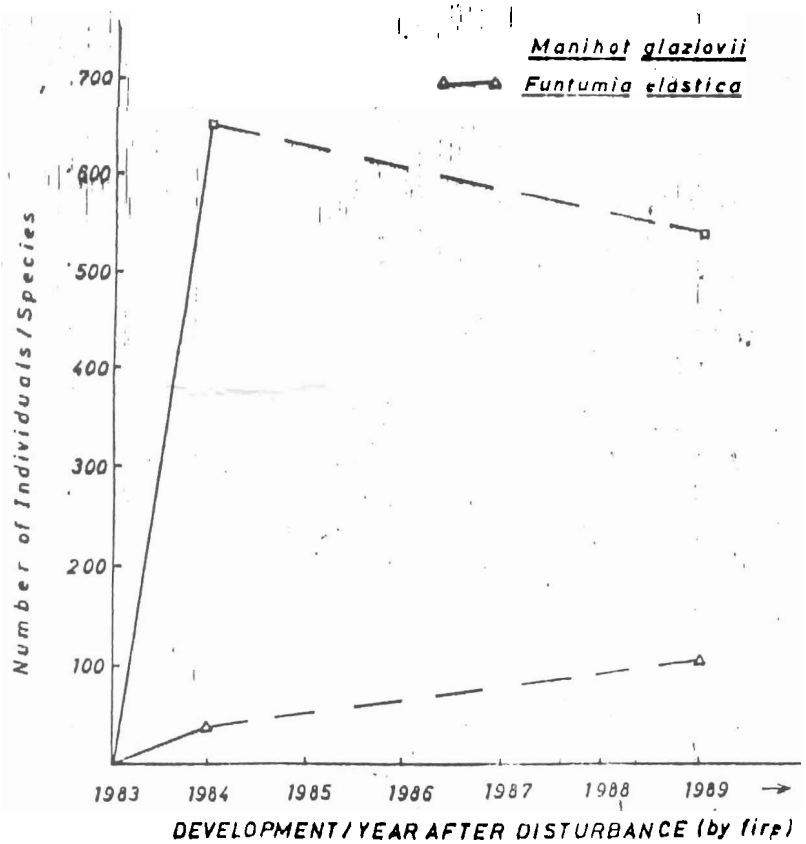

FIG 4.
Changes in number of individuals trees of Manihot glaziovii and Funtumia elastica with time following a ground-fire in a secondary regrowth forest in Sout-western Nigeria.

Table 3: **PATTERN OF DENSITY DISTRIBUTION AMONG SIZE-CLASSES IN A REGROWTH FOREST PLOT IN SOUTHWESTERN NIGERIA FOLLOWING A GROUND FIRE**

Girt-size Classes (cm)	Number of Individual lass
0-20	588(66.82)
21-40	227(25.86
41-60	33(3.75)
61-80	13(1.48)
81-100	8(0.91)
101-120	6(0.68)
111-120	4(0.45)
140-160	1(0.11)
TOTAL	880(100.00)

management.

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