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EFFECT OF BUSH BURNING ON HERBACEOUS PLANT DIVERSITY IN LAGOS STATE POLYTECHNIC, IKORODU CAMPUS, LAGOS - NIGERIA.

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ABSTRACT
Bush burning has been practiced in many parts of the world, and has been accepted as an integral part of the traditional agriculture. This study was conducted to assess the effect of bush burning on plant species diversity. Three frequently burnt sites denoted 1, 2, 3 as well as a Control site denoted as 4, were selected in Lagos State Polytechnic, Ikorodu Campus, based on last burning time lapse being 5 months, 10 months, 3 years and no recent history of burning (control) respectively. Samples were taken using the systematic sampling procedure on three transects laid across 40m^2 area of each site. Plant samples were taken on each transect using a 0.25m^2 quadrat. Samples were collected at 10m interval. Data obtained for plants were compared using % frequency, % stand and Simpson and Shannon diversity indices. Highest plant diversity was observed in the control site being 81% and 95% for Simpson and Shannon indices respectively whereas, values ranged between 31 and 35% and 47 and 50% for the Simpson and Shannon indices respectively in study sites. Total species encountered were highest in the control site and least in sites 1 and 2. Dominance of single species were observed in all except control site with *Chromolaena odorata* 79.5% stand in site1 and *Panicum maximum* 82.5% and 79% in sites 2 and 3 respectively.

KEYWORDS: Bush Burning, Plant Diversity, *Chromolaena Odorata, Panicum Maximum*

INTRODUCTION
Bush burning has been practiced in many parts of the world and has been accepted as an integral part of the traditional farming system (Hough, 1993).It is a commonly applied management tool in forest ecosystems worldwide (Turner et al., 1994). Fire is used for hunting, clearing of land for agriculture, maintaining grass lands, controlling pests and removing dry vegetation and crop residues to promote agricultural productivity (Hough, 1993). Bush fire is a part of the natural ecology in a number of countries (Liu et al., 2001).

In managing grasslands, farmers often introduce burning to remove moribund and unpalatable grasses from previous growing season, to stimulate the re-growth of fresh herbage with higher nutrient content (Tainton and Mentis, 1984; Snyman, 2003). Burning is also believed to rid the grassland of parasitic insects and to prevent the encroachment of undesirable invasive species (Auid and Denham, 2006).

However, Frequent and uncontrolled bush burning has become a major problem in most parts of the world today especially in the forest zones of developing countries (Hough 1993). Bush burning has contributed to deforestation with its attendant problems. Frequent bush burning is generally considered to have negative effects on biodiversity (Tramor and Woinarski, 1994, Bradstock et al. 1997 and Egunjobi 1971).

Fire has been listed as a major threatening process for biodiversity (Robinson et al 2003). Frequent burning of bush has generally considered having negative effects on biodiversity (Trainor and Woinarski, 1994; Bradstock et al., 1997). Pyke et al. (2010) reported that fire can change plant communities by reducing dominance of some plants while enhancing the dominance of others. According to report by Paltridge and Latz (2009), as fire sensitive species are killed by fire, they are replaced by a more fire tolerant plants. A fire incident followed by a heavy rains six weeks later in Australia, was reported to have resulted in a mass of flowering annuals and seedlings shortly afterwards, and nearly a year later, 63 species were recorded in the burnt area, of which 53 were new to the site, whereas the unburnt area showed no such effects (Gill, 1996). Study on the effect of Fire on weed species in Kebbi state, Nigeria showed the disappearance of some species such as Panicum laetum, Cyperus rotundus, Ipomea cylindrica and Tridax procumbens, with an increase in population density of broad leaf species that were erect with woody stems, Whereas C. rotundus and Imperata cylindrica recorded the highest density in unburnt plots (Birnin –Yauri and Aliero, 2008). Akinsoji (2013), in comparing burnt and unburnt plots at Olokemeji Forest Reserve, reported lowest diversity index, changes in vegetation types as well as dominance of some trees in burnt plots, whereas the unburnt plots had highest diversity index and presence of more fire sensitive species. Gandiwa (2011), following a similar study in Bulawiyo, Zimbabwe reported that there were significant differences in plant density, number of species per plot and number per plant in woody plant between burnt and unburnt sites.

According to Preece (1989) the effect of a particular fire on an individual species depends on the intensity and duration of fire, the pre- fire condition of the biota, the period since the last fire occur and the pre- and post-weather especially rainfall which influences soil moisture. Morrison et al. (1995) further reported that the effect of fire frequency on plant communities depends on three variables namely the length of interfere interval, the variability of interfere interval and the time since the most recent fire. Robinson et al (2003), in their report stated that fire sensitive species are destroyed by fire and can become locally extinct if fire is too

frequent or too intense. However, Trollope and Tainton (1986) reported that fire intensity had no significant effect on grass sward.

Griffth and Friedel (1981) stated that the recovery of a plant community is related to the ability of all plants in the community to regrow to maturity and produce seeds. Williams et al. (2002) further reported that if interfere interval is too short for species to reach maturity and seed production stage, seed banks may be depleted and species eliminated from the area. Robinson et al (2003) reported that many fire tolerant plant species possess adaptive features that enable them survive as some even require fire to complete their life cycle. Grasses usually survive fire mostly by hanging their buds at or below the soil surface (Lunt and Morgan, 2002).
The aim of this study is to carry out a comparative study of the effect of bush burning on plant diversity in selected sites with varying periods of burning in a rainforest ecosystem.

MATERIALS AND METHODS
STUDY SITES
Three different plots, each representing a different stage of re-growth after burning were used for this study. A control plot with no recent history of burning was selected as a control. All plots were located within the Campus of Lagos State Polytechnic, Ikorodu, Lagos State. Most bushes within the campus are kept low ether by cutting with cutlass or by burning with fire. Cutting is generally done during the rainy seasons whereas burning is utilized during the dry season when the bushes are very dry. Prior to this study, each of the three plots under study has undergone at least three successive burnings that has occurred yearly.

PLOT 1: located on latitude 6.64731 and 3.552181 NE is the most recently burnt. Burning took place on this plot around April, 2012. There were still traces of burnt vegetation as the soil appeared black with ash. It was also characterized by very scanty vegetation (Figure 1).

PLOT 2: located on latitude 6.64423 and longitude3.52466 NE. The plot was burnt in December 2011, and it has a lot of fire resistant species such as Panicum maximum (Figure 2).

PLOT 3: located on latitude 6.64281 and longitude 3.52486 SE. Plot 3 is located opposite popular commercial centre and the place was burnt December 2009, 3 years prior to the study period and is covered with thick vegetation (Figure 3)

PLOT 4: located on latitude 6.64867 and longitude 3.52125NE. Plot 4 is situated at the back of Department of Mass Communication, Lagos State Polytechnic, Ikorodu Campus. Burning has not occurred on this plot in recent time prior to the study period in 2012 (Figure 4).

SAMPLING PROCEDURE FOR PLANT DIVERSITY
Samples were taken using the systematic sampling procedure on three transects laid across 40m2 area in each plot. Plant samples were taken using a 0.5x 0.5 (0.25m2) quadrat. Samples were collected at 10m interval. Three quadrat samples were collected along 2 transects and 4 on one transect (the centre transect) in all plots, making a total of 10 quadrats per 40m2 plot.

ANALYSIS OF DATA
Data collected for the plant samples were subjected to the diversity tests listed below:

1. **Percentage frequency:** This was obtained by assessing the presence or otherwise of particular species in sample quadrats taken. It was obtained for each plot using the formular:

$$\% F = \frac{\text{No of quadrats with presence of a particular species}}{\text{Total No. of quadrats taken}}$$

2. **Percent of stand**: This was derived according to Odum (1979). It refers to the number of stand of a plant species in relation to total number of species encountered. Percentage of the total number of all plant species present is calculated as follows:

$$\% \text{ stand} = \frac{\text{Total No. of individuals of a species counted in a plot}}{\text{Total No. of all species counted in that plot}}$$

3. **Simpson and Shannon diversity index** (Odum, 1979).Sampson diversity index was estimated as follows:

Sampson diversity index = 1 - D

$$\text{Where } D = \sum (pi)^2$$
$$Pi = n/N$$

Shannon diversity index = $H/\log_e S$

$$\text{Where } H = -\sum pi \log_{e\, pi}$$
$$Pi = n/N$$
S= Number of species.

RESULTS
The results on Tables 1, 2 and 3 as well as Figures 1, 2 and 3 represent burnt vegetation at 6 months, 10 months and 3 years respectively while Table 4 and Figure 4 (control site) shows the results from an unburnt plot. Results obtained from the study showed that the burnt plots (1,2 and3) had less plant species in terms of different plant species present (plant diversity) and total number of plant species counted compared to the control plot(4). Plots1 and 2 had only 4 plant species each (tables 1 and 2). Plot 3 had 5 plant species (Table 3). Total number of Plants counted for plots 1, 2 and 3 were 39, 40 and 62 respectively. These values were found to be higher in the unburnt (control) Plot where 9 different plant species were recorded with a total of 162 plants counted (Table 4).

In terms of percent stand of species in the sampled plot, it was observed that there were dominance of a single plant species in Plots 1, 2 and 3 where *Chromolaena odorata*, an invasive species, was found to be 79.5%, in Plot 1 and *Panicum maximum,* a fire tolerant and invasive plant had 82.5%, and 75% respectively for Plots 2 and 3. On the other hand there was no dominance of single species in Plot 4. The dominance of this single species is further proved by percentage frequency of occurrence where *Chromonina odorata* was found 100% of the total quadrat sampled for plot 1 *Panicum maximum* occurred in 90% and 100% of the time in Plots 2 and 3 respectively.

SIMPSON AND SHANNON INDICES

Table 5 shows the results for the Simpsons and Shannon diversity index for sampled Plots. In both indices, it was found that Plots 1, 2 and 3 (burnt plots), had less plant diversity (35%, 31% and 36% respectively) for Simpson and 50%, 46% and 48% for Shannon's, whereas in the control Plot, high plant diversity was observed for both (81% and 91% respectively for Simpson and Shannon's indices.

TABLE 1: Distribution of standing plants species in Plot 1(in 10 quadrat samples)

Plant species	Total No of plants	% Frequency	% of stand
Chromolaena odorata	31	100	79.5
Azadiractha indica wildings	2	20	5.1
Mallotus oppositifolus	5	40	12.8
Anthonotha macrophyla	1	10	2.6
Total	39		100.0

Table 2: Distribution of standing plants species in plot 2(in 10 quadrat samples) .

Plant species	Total No of plants	% Frequency	% of stand
Panicum maximum	33	90	82.5
Azadiractha indica wildings	3	30	7.5
Chromolaena odorata	1	10	2.5
Senna occidentalis	3	30	7.5
Total	40		100.0

Table3: Distribution of standing plants species in plot 3(in 10 quadrat samples)

Plant species	Total No of plants	% Frequency	% of stand
Panicum maximum	49	100	79.0
Andropogon tectorum	3	30	4.8
Mallotutus oppositifolius	7	50	11.3
Azadirachtha indica wildings	2	20	3.2
Hewittia sublobata	1	10	1.6
Total	62		100.0

Figure 1: Plot 1 recently burnt Plot
5 months prior to the sample collection

Figure 2: Plot 2 last burnt in 10 months
prior to the sample collection

Figure 3: Plot 3 last burnt in 3 years
prior to the sample collection

Figure 4: Sample plot not burnt
in recent years

Table 4: Distribution of standing plants species in Plot 4(in 10 quadrat samples) .

Plant species	Total No of Species	% Frequency	% of stand
Synedrella nodiflora	59	60	36.4
Alchornea laxiflora	21	50	13.0
Mallotus oppsoitifolius	18	70	11.1
Panicum maximum	18	60	11.1
Phyllanthus sp	14	60	8.6
Icacina trichantha	10	60	6.2
Oplismenus burmannii	10	40	6.2
Croton lobatus	8	30	4.9
Azadirachtha indica wildings	4	20	2.5
Total	162		100.0

Table 5: Simpson and Shannon diversity index for the different study sites

Plots	Simpson	Shannon
1	0.3537 (35%)	0.4960 (50%)
2	0.3076 (31%)	0.460 (46%)
3	0.3593 (36%)	0.467 (47%)
4	0.8082 (81%)	0.947 (95%)

DISCUSSION

Results from this study showed that burning affects species diversity and number of specimen per plot. The results obtained from this study agrees largely with similar works which revealed a reduction in plant species diversity both in the number per species and in the total number of species sampled per plot in response to the time of burning of each plot. This agrees with the work earlier carried out by BirninYauri and Aliero, (2008) Gandiwa, (2011). Low diversity index in burnt plots with high diversity index in unburnt plot was also reported by Akinsoji (2013) since four plant species were recorded for plots 1 and 2 being the most recently burnt plots, 5 species for plots 3 and 9 for the control plots.

Burning was also observed to enhance dominance of some species at the expense of some other species. Pyke *et al.* (2010) stated that fire can change plant communities by reducing dominance of some plants and enhancing the abundance of others. In general, several reports have shown that fire kills sensitive species like the broad leafed herbaceous species thus allowing some fire resistant species to dominate the vegetation with continuous frequent burning. In this study, it was observed that there was a dominance of single species in all three burnt plots. Dominance of single species as a consequence of bush burning had been earlier reported by Tramor and Woinarski (1994) and *Bradstock et al.,* (1997), Patridge and Latz (2009) and Akinsoji (2013).

In this study, *Chromolena odorata* and *Panicum maximum* were found as dominant post fire species. *C. odorata* is a serious invasive species in Nigeria, being very resistant with high seed production (about 80,000 seeds per plant). *C. odorata* is an invasive or opportunistic species with characteristics which enables it displace other plants in the ecosystem as a result of its aggressive nature (Auid and Denham, 2006). Report by Wisumprema (2007) shows that *P. maximum* is considered an invasive weed that displaces native plants and is also a fire hazard especially during dry seasons where the dry leaves can readily catch and spread fires around. It is obvious here that burning in capable of allowing invasive alien species such as *C. odorata* to displace indigenous plants in a plant community. Erosion of native plants due to bush burning and their replacement by exotic species was earlier reported by Birnin- Yauri and Aliero (2008).

Replacement of diversity of plants by a single species in a habitat may pose a serious danger to such as ecosystem. This is because plants are the basis of any food chain in an ecosystem. Diversity of plants means diversity of animals, since an animal depends on plants directly or indirectly for food. Gradual reduction in diversity of plants which are the primary producers in any ecosystem, gradually brings about reduction in the animal species since along the chain, some animals will be starved out of that habitat or ecosystem as the case maybe (Omeigbe, 1998; Patridge and Latz, 2009).

CONCLUSION

Burning of vegetation results in decreased biodiversity population density of herbaceous species and loss of organic matter in soil, burning also has stimulatory effect sand serves as a tool to promote the growth of certain plants in directed succession. Bush appears as a central theme in this report because burning is one of the challenges in our environment as it is embedded in the cultural value and traditional farming system of the people. The effects of bush burning on rural livelihoods and on the ecosystem is becoming increasingly extensive and damaging, however it

has been difficult to reduce or completely eliminate bush fire completely. This therefore suggests that there is a need for an increased understanding of the causes and the effects of the bush fire on our ecosystem.

Policies can address the undesirable effect with respect to forestry, arable agriculture, rangeland soil conservation and wildlife. Also education and community awareness need to be focused especially on threat to the environment and property caused by inappropriate use of fire, particularly burning which is too frequent, extensive in area of excessive intensity badly tuned or carelessly implemented.

REFERENCES.

Akinsoji, A. (2013). Vegetation Dynamics of Fire Experimrntal plots at Olokemeji Forest Reserve, Nigeria. *Journal of Biology, Agriculture and Horticulture* **3(16):**128- 133.

Auld, T. D. and Denham, A. J.(2006). How much seed remains in the soil after a fire*? Plant Ecology* **187**: 15–25.

Birnin- Yauri, Y. A. and Aliero, B. C.(2008). Implication of bush burning on weedSpecies diversity, Population density and Organic Matter content of soil in BirninYauri, Kebbi State, Nigeria*. Journal of applied Science and Environmental Management.***12(1**): 53-55

Bradstock, R.A., Tozer, M.G., and Keith, D.A. (1997). Effects of high frequency fire on floristiccomposition and abundance in a fire-prone heathland near Sydney. *Australian Journal of Botany* **45**: 641-655.

Egunjobi, J.K. (1971). Savannah burning, soil fertility and herbage Productivity in the derived Savannah Zone of Nigeria, Africa. *IUCN Publication* Vol.22: pp. 52-58.

Gandiwa, E. (2011). Effects of repeated burning on woody vegetation structure and compositionin a semiarid southern African savanna. *International Journal of Environmental Sciences* **2(2)**: 468- 471.

Gill A. M. (1996). How fire affect biodiversity. In: Biodiversity and Fire - the effect and Effectiveness of Fire Management. *Biodiversity Series* paper No 6 Pp. 47-55. Dept. Environment, Sports and Territories, Canberra.

Griffith, G. F. and Friedel, M. H. (1981). Review of Fire in Ulum National Park N T and Implications for Park Management: A Patch burn Strategy for fire Management. CSIRO Division of Land Resource Management. Alice Spring.

Hough J. (1993) Why burn the bush? Social approaches to bush fire management in West African National Parks. *Biological Conservation* **65:** 23 – 28.

Liu, D., Trager, B. and Balmes, J.R. (2001). The effect of smoke inhalation on lung function and airway responsiveness in woodland fire fighters. *American Journal of Respiratory and Critical Care Medicine **146**: 1469-73.*

Lunt, I. D. and Morgan, J. W. (2002). *The role of fire regimes in temperate grasslands of Southeastern Australia. Flammable Australia* (Bradstock, R.A., Williams, J.E. and Gill, A.M. Eds) Cambridge University Press, Melbourne: Pp177-197.

Morrison, D.A., Carry, G.J., Pengelly, S.M., Ross, D.G., Mullins, B.J.,Thomas, C.R. and Anderson, T.S., (1995). Effects of fire frequency on plants pecies composition of sandstone communities in the Sydney Region inter- fire interval and time since-fire. *Australian Journal of Ecology* **20**: 239–247.

Odum, E. P. (1979). *Ecology*. Holt Rinchart and Winston publishers. 244pp

Omeigbe, O. (1998). Bush burning and its effect in Africa. A case study of Nigeria. *Benin Journal of Environment Education* **1(1):**10 – 20.

Paltridge, R. and Latz, P. (2009). Fire Management Plan for Mann Ranges and Musgrave Ranges fire Management Region of Anangu Pitjan tjatjaraYunkuny tjatjara Land. A Report Prepared for Anangu Pitjan tjatjaraYunkuny tjatjara Desert Wildlife Service. Alice Spring, Australia. Pp 3

Preece, N., Latz, P., O'Byrne, D., Portlock, H. and Waithman, J. (1989). Fire Management forcontrol of Australia Parks and Reserves Conservation Commission of Northern Territory, Alice Spring.

Pyke, D.A., Brooks, M.L. and D'Antonio, C. (2010). Fire as a restoration tool: A decision framework for predicting the control or enhancement of plants using fire. *Restoration Ecology* **18**(**3**): 274-284.

Robinson, A.C., Copely, B.P., Canty, P.D., Baker, L.M. and Nesbitt, B.J. (2003). A Biological Survey ofAnanguPitjantjatjaraYunkunytjatjara(APY) Lands, South Australia (1991-2003). Department of Environmental Heritage. South Australia.

Snyman, H.A. (2003). Short – term response in productivity following an unplanned fire in a semi-arid rangeland of South Africa. *Journal of arid Environ*. **39:** 645-666.

Trollope, W.S.W., and Tainton, N.M. (1986). Effect of fire intensity on the grass and Bush components of the Eastern Cape thomveld. *Journal of Grassland Society of Southern Africa* **3:**37-42.

Tainton, N.M. and Mentis, M.T. (1984). Fire in grassland. In: de v. Booysem, P. andTainton, N.M. (Eds). Ecological effects of fire in South Africa Ecology Studies No. 48 springer, Berlin. P. 510.

Trainor C. R, and Woinarski, Jcz. (1994). Responses of lizards to three experimental fires in the savanna forest of kakadu national park. *Wildlife research* **21:** 131-148.

Turner, M. G.; Hargrove, W. W., Garner, R. H.and Roe, W. H. (1994). Effects of fire on landscape heterogeneity in yellow stone National park, Wyoming. *Journal of vegetation science* **5**: 731 – 742.

Williams, R.J., Griffiths, A.D. and Allan, G. (2002). Fire regimes and biodiversity in the wet-dry tropical savanna landscapes of northern Australia*. Flammable Australia: the fire regimes and biodiversity of a continent*. Bradstock, R.A., Williams, J.E. and Gill,A.M. (Eds). Cambridge University Press, Cambridge. pp. 281–304

Wisumperma, D. (2007). First known record of guinea grass cultivation in Sri Lanka. *Journal of the Royal Asiatic Society* **53**: 219-226.