Journal of Forestry Research and Management. Vol. 16(3).116-125; 2019, ISSN 0189-8418

www.jfrm.org.ng

SOIL SEED BANK DYNAMICS AND REGENERATION POTENTIAL OF OLOKEMEJI FOREST RESERVE OGUN STATE, NIGERIA

*Taiwo D. M., Olaoti-laaro, S. O. and Igho-Osagie, U. P.

Forest Conservation and Protection
Forestry Research Institute of Nigeria.
+2348167754312. taidamar20@gmail.com

ABSTRACT

Forest degradation and deforestation disrupts the structure and functions of the ecosystem with negative impacts on biodiversity and natural regeneration of the forests. In Nigeria, forests are lost through burning, shifting cultivation and logging of trees, thus reducing the potential of the forest to naturally regenerate and perform ecosystem functions as expected in a forest reserve. These describe the state of degradation in Olokemeji forest reserve. Hence, a need to evaluate the regeneration potential of Olokemeji forest reserve through the understanding of it's seed bank dynamics. Six study plots of 15 m^2 each were randomly selected and designated as Frequently Burnt Plot 1, Frequently burnt plot 2, Harvested plot, Unharvested plot, Arable plot 1 and Arable plot 2. Five quadrants were systematically located on each of the study plots. Soil samples were collected from five quadrats on each of the six study plots of 15 m^2.at two soil depths: 0-15 cm and 15-30 cm from each sample plots. They were monitored in perforated plates for six months in a screen house. PAST and TWINSPAN were used for analysis of diversity indices and two way indicator species analysis. *Oldelandiacorymbosa* had the highest measure of spread within 21-50% cover in the Unharvested plot at 0-15cm depth.*Leptochloacaerulescens* had the highest relative importance value (RIV) of 8.66 which occurred in the Frequently burnt plot at 0-15 cm soil depth. The two ways indicator species analysis revealed that 13 species emerged from the 30 quadrats.The Unharvested plot had the highest number of species (43) among the sample plots. The highest evenness index of 0.98 was found in the Frequently burnt plot 2 at 15-30cm soil depth. Species diversity was low across the sample plot for both soil depths. The low species diversity depicted the low regeneration potential of Olokemeji Forest reserve.

Keywords: flora, diversity, forest, herbaceous

Introduction

Forests are reservoirs of species, habitat and genetic diversity (Marco and Stefano, 2018) and activities on forest lands will have a significant impact on local, regional and global diversity, the health and function of natural ecosystems including the regulation of climate, biodiversity sustainability, food provision, fuel, habitat function, aesthetic and educational roles. Forest plays significant roles in climate change mitigation.

Soil seed bank is the aggregation of viable seeds in the superficial soil. It represents a living record of the recent vegetation and potential seedlings emergence pattern of an area in the ground-work for the recruitment, regeneration and persistence of a population (Lu *et al.,* 2010).Soil seed bank can also be defined as the sum of all surviving seeds in the litter and soil (Newsmaster *et al.,* 2011).

The soil seed bank is constituted by viable seeds present on or in the soil and the associated humus/ litter layer (Gonzalez*et al*., 2009). The presence of buried viable seeds in the soil is commonly associated with a phenomenon calledseed dormancy, which prevent the seeds from germinating even under favourable environmental

conditions. According to Bakker *et al.*, 1996, this reservoir corresponds to the seeds not germinated butthey are potentially capable of replacing the plants which has disappeared by natural death or other causes and plants that are susceptible to diseases, disturbances and animal consumption, including man. A soil seed bank is understood to be an integral component of plant communities (Oke and Odebiyi, 2007) and can be used to predict secondary succession (Oberhauser, 1997). Olokemeji forest reserve is currently degraded due to human impacts such as logging and farming activities. Therefore, the objective of this research is to determine the vertical distribution and diversity of flora at two soil depths in the study plots of Olokemeji Forest Reserve, Ogun State, Nigeria.

Materials and Methods

Olokemeji forest reserve, situated in the lowland rain forest of south-western Nigeria occupies a total land area of 58.88 km^2. This research was carried out within November, 2016 and April, 2017. Six sample plots of 15 m^2 each were randomly selected from the study site and they were designated as Frequently Burnt plot 1, Frequently burnt plot 2, Harvested plot, Unharvested plot, Arable plot 1 and Arable plot 2. 2.5 kg Soil samples were collected from five points on each of the six sample plots at two soil depths: 0-15 cm and 15-30 cm from each sample plot, the soil samples collected were bulked and replicated three times. Each replicated soil samples were spread in perforated seedling trays having 10 cm wide and 4 cm deep and the seedling trays were arranged in a completely randomized design and they were monitored in the Screen house for six months for seedling emergence at Department of Crop Protection and Environmental Biology, University of Ibadan (Akinyemi and Oke, 2013). Floral species identification was carried out with the use of Akobondu (Akobondu, 2016) and authenticated at Forest Herbarium Ibadan (FHI). Relative importance value (RIV) was calculated through the use of Microsoft Excel from information on relative density and relative frequency. Species indices was evaluated with the use ofPAST (Paleontological Statistics) (Hammer and Harper, 2006). Two way indicator species (TWINSPAN) was used to enumerate the measure of spread of the seedling emergence in each quadrats. These data analysis were carried out with respect to the objective of this study.

Result

Floristic Composition and Relative Importance Value of herbaceous Flora of sample plots

The herbaceous flora of the soil seed bank in the study plots enumerated at Olokomeji Forest Reserve showed twelve species (12) belonging to seven families. *Leptochloa caerulescens* had the highest relative importance value (RIV) of 8.66 which occurred in the Frequently burnt plot at 0-15 cm soil depth, 7.57 in Frequently burnt plot 2, very low relative importance values were recorded for the other plots, while zero RIV was recorded for other plots. *Vernonia galamensis* had the least recorded relative importance value (RIV) of 1.09 and was only present in Arable plot 2 (Table 1)

Journal of Forestry Research and Management. Vol. 16(3).116-125; 2019, ISSN 0189-8418

www.jfrm.org.ng

Table 1: Relative Importance Values Of seedling emergence in sample plots of Olokemeji Forest Reserve, Ogun State, Nigeria, 2017

Species	Family	HP1(0-15cm) RIV	HP(15-30cm) RIV	UP(0-15cm) RIV	UP(15-30cm) RIV	FT1(0-15cm) RIV	FT1(15-30cm) RIV	FT2(0-15cm) RIV	FT2(15-30cm) RIV	AP1(0-15cm) RIV	AP1(15-30cm) RIV	AP2(0-15cm) RIV	AP2(15-30cm) RIV
*Leptochloacaerulescens*Steud.	Poaceae	0.54	0	1.08	0.54	8.66	0	7.57	1.62	0.54	0	0	0
Talinumfruticosome(L.) Juss	Portulaceae	2.21	2.95	0	0	2.21	0.74	0	0	6.64	2.21	2.21	0.74
*Phyllantusamarus*Schumach. &Thonn.	Phyllanthaceae	4.73	0	1.58	0.78	2.37	2.37	0	1.57	0	0	0.78	0
*Oldelandiacorymbosa*L.	Rubiaceae	0	0	12.29	0.77	0.38	0	0	0	0	0	0	0
*Mariscusalternifolius*Vahl.	Cyperaceae	1.98	0	1.32	6.61	0	0	0	1.98	0.66	0	0	0
Desmodiumscorpiurus(Sw.) Desv	Fabaceae	1.74	0	0.87	0	0	1.74	0	0	0	0	0	0
*Euphorbia heterophylla*L.	Euphorbiaceae	0	0	1.41	0.7	0	0	0	0	2.11	0	0	0
*Chromolaenaodorata (*L) R.M.King& H. Rob	Asteraceae	0	0	1.09	0	0	0	0	1.09	1.09	0	0	0
Cynodondactylon(L.)Pers	Poaceae	0	0	0	0	1.09	1.09	0	0	0	1.09	0	0
Brachiaradeflexa(Schumach.)CE Hubbard	Poaceae	0	0	1.09	0	0	0	0	0	2.19	0	0	0
*Ageratum conyzoides*Linn	Asteraceae	0	0	0	0	0	0	0	0	2.17	0	0	0
*Tridaxprocumbens*L.	Asteraceae	0	0	0	0	0	0	0	0	1.09	0	0	0
Vernoniagalamensis(Cass.) Less.	Asteraceae	0	0	0	0	0	0	0	0	0	0	1.09	0

Footnote: Frequently burnt Plot = FT; Harvested Plot = HP; Unharvestedunburnt Plot = UP; Arable Plot = AP

Numerical classification of soil seed bank/seedling emergence

The hierarchical division showed that the 30 quadrats which had 10 divisions of seedling emergence were divided into 27 and 3 quadrats of negative and positive groups with 11 negative preferential and 2 positive preferential. The two ways indicator species analysis (TWINSPAN) result showed that 13 species were present in 30 quadrats, which emerged from the soil seed bank flora. *Oldelandia corymbosa* had the highest measure of spread within 21-50% cover in the Unharvested plot at 0-15cm depth, it also had 2-5% cover at 15-30 cm soil depth in the Unharvested plot and 1-2% cover in the Frequently burnt plot at 0-15 cm soil depth. *O. corymbosa* had a negative preference for Frequently burnt plot and Unharvested plot.(Table 2).

Table 2: Two Ways Indicator Species Analysis (TWINSPAN) revealing The percentage cover of the Soil Seed Bank Flora in the Study Plots of Olokemeji Forest Reserve, Ogun state, Nigeria. April 2017

```
1   12 1122111 12 2  3122  1
                 613848210149523568450067797

    2 Lept o ca  ----22-122333121-----------  000
    3 Mari  alt  -----1---1221231-----------  000
    4 Tridaxp  ---------------1-----------  000
    9 Brachiar  -----1---------2-----------  000
    7 Phylama  1222221---1--121-----------  001
   11 Oldecor  -----52-----1--------------  001
    1 Tali  tri  ---1--------122222111-22---  010
   12 Cynodac  1-----------1-------1------  010
   13 Vern  gal  --------------------1------  010
    6 Euph  het  -----2---------------12----  011
    8 Ager  con  ----------------------11---  011
    5 Desmodiu  -------------2--1-------112  1
   10 C. o dora  ----------------------1-1-1  1

                 00000000000000000000000000111
                 00000000000000000011111111
                 00000001111111100000111
                 00000110000011100111
01111  000001
                        00011
```

Scale
- Represent species absent; 1 represents 1-2% cover; 2 represents 2-5% cover

3 represents 6-10% cover; 4 represents 11-20% cover; 5 represents 21-50% cover

6 represents 51-100% cover

Diversity indices of Seedling Emergence

The species diversity of the seedling emergence depicted distinct values for the entire sample plots and the number of individual species (abundance) were eleven. One hundred and fifty seven (157) individual plant species were enumerated out of which 129 individual plants were found at 0-15cm soil depth and 28 individual plants were found at the15-30cm soil depth. At 0-15 cm, the Unharvested plot had the highest number (43) of individual species, close to it was the Frequently burnt plot 1 where 34 abundance was recorded. The Harvested plot at 0-15 cm had the least abundance (14), this can be attributed to the high level of disturbance. Meanwhile at 15-30 cm soil depth, the Frequently burnt plot 1 recorded the highest abundance of 8. Dominance indices at 0-15cm soil depth ranged from very low to moderately high. It was observed that dominance indices for the different sample plots at 15-30cm also ranges from low to moderately high with the Harvested plot having 0.68 and Frequently burnt plot 2 having 0.52 dominance indices which is moderately high, while the Arable plot has0.25 dominance indices which is the lowest.

Species richness across the two soil depths varied, ranging from extremely low to very high at the vertical distribution. At 0-15 cm soil depth, the seedling emergence exhibited very high species richness in the Arable plot 1 at 0.77 and Frequently burnt plot 2 had the lowest species richness at 0.29 respectively. While at 15-30 cm depth the species richness was highest in Frequently burnt plot 1 at 0.75 and lowest in Harvested plot at 0.35. The evenness index was high across each sample plots (Table 3) (Plate 1).

Journal of Forestry Research and Management. Vol. 16(3).116-125; 2019, ISSN 0189-8418
www.jfrm.org.ng

Table 3: Herbaceous species diversity across soil depths in study plots of Olokemeji Forest Reserve, Ogun State, Nigeria

Diversity induces	HP1 (0-15 cm)	HP2 (15-30 cm)	UP1 (0-15 cm)	UP2 (15-30 cm)	FT1 (0-15 cm)	FT1 (15-30cm)	FT2 (0-15 cm)	FT2 (15-30 cm)	AP1 (0-15 cm)	AP2 (15-30 cm
Taxa	5	2	8	4	6	5	2	2	9	3
Individuals	14	5	43	5	34	8	17	5	21	5
Dominance	0.28	0.68	0.56	0.28	0.33	0.25	0.71	0.52	0.23	0.44
species richness	0.72	0.32	0.44	0.72	0.67	0.75	0.29	0.48	0.77	0.56
Species Diversity	1.44	0.5	1.05	1.33	1.35	1.49	0.47	0.67	1.81	0.95
Evenness	0.84	0.82	0.36	0.95	0.64	0.89	0.79	0.98	0.68	0.86

Footnote: Frequently burnt plot = FT; Harvested plot = HP; Unharvested plot = UP; Arable plot = AP

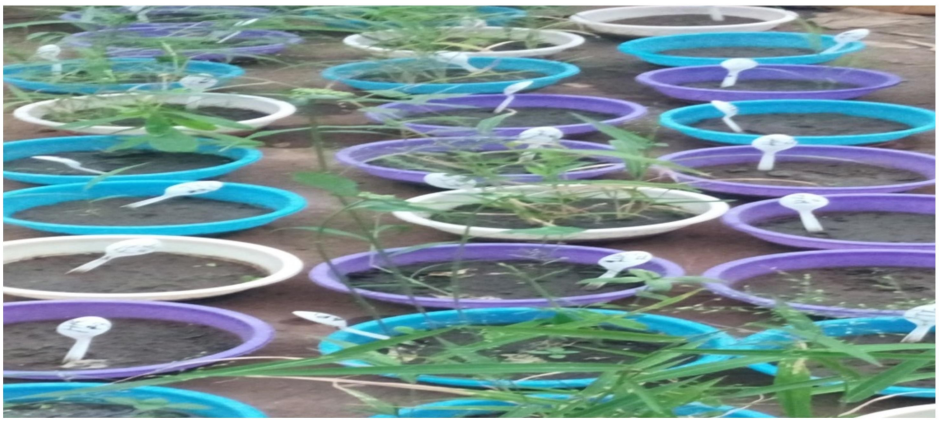

Plate 1: Seedling emergence in 11TH week soil in soils of study plots of Olokemeji Forest Reserve, arranged in a Completely Randomized Design, January 2017

Discussion

Out of the twelve species recorded from the seedling emergence, ten species were found at 0-15 cm depth while seven species were recorded for 15- 30 cm soil depth. This infers that the soil seed bank is species richer at 0-15 cm than at 15-30 cm depth. At 0-15 cm depth, the Unharvested plot had the highest record of species abundance. While at 15-30 cm, the Frequently burnt plot 1 had the highest species abundance, this can be traced to frequent burning on the plantation forest. Soil seedling emergence had low diversity indices across all the study plots, this can be attributed to the anthropogenic activities taking place in the forest reserve. The Arable plot 1 had the highest species richness at 0-15 cm soil depth, while the Frequently burnt plot 1 had the highest species richness at 15-30 cm soil depth, this can also beattributed to continuous ploughing of the Arable plot and frequent burning at Frequently burnt plot 1. The Unharvested plot had a moderately high species richness which could be attributed to shortage of light reaching the underground herbaceous vegetation (Olajuyigbe and Adaja, 2014).

The plantation forest by virtue of its degradation has further become a repository for notorious herbaceous invasive plants such as *Chromolaena odorata*, *Alternantherabrasiliana*, *Andropogon gayanus* and *Tridax procumbens.* Some of which were recorded in the soil bank study. In Olokemeji forest reserve, a major environmental change had been created by indiscriminate logging, which resulted in fragmentation, gap formation as well as negative impacts on plant species composition and richness ((Adetula, 2001). This excessive opening of canopy gaps usually stimulates growth of dense, herbaceous and woody lianas which in turn suppress tree regeneration ((Omeja *et al*., 2004). Seven tropical tree species were identified in the study plots where this study was carried out revealing low tree species diversity and the species richness recorded in this study was lower than the species richness observed in similar ecosystems in southern Nigeria (Adekunle, 2006). Nevertheless, the floristic composition compared favourably with many other lowland rainforests in Africa.

Conclusion

There is a high level of anthropogenic interference at Olokemeji forest reserve, and the soil seed bank dynamics reflected the nature of impact. It is therefore

adviceable that the goal of the forest reserve be aligned with anthropogenic activities allowed to take place in it. Shifting cultivation should be strictly prohibited and agroforestry should be encouraged in selected parts/zones of the forest reserve. Burning activities should be properly regulated to enhance natural regeneration of the forest reserve. Indiscriminate logging of trees for fuelwood should be severely curtailed and improvised for sustainability of the forest reserve.

Refereneces

Adekunle, V. A. J. (2006). Conservation of tree species diversity in tropical rainforest ecosystem of South-west Nigeria.*Journal of Tropical Forest Science***18**(2): 91-101.

Adetula, T. (2001).Encroachment and Its impacts on Forestry Development.A case study of Ondo State.*Journal of Tropical Forest Resources.***17** (2) 2001. pp. 12-21.

Akinyemi D. S. and Oke S. O. (2013) Soil Seedbank Dynamics And Regeneration In Three Different Physiognomies In Shasha Forest Reserve In SouthwesternNigeria.*Ife Journal Of Science* vol. **15,** no. 2.

Akobondu, I. O., Ekeleme, F., Agayakwu, C. W., Ogazie, C.A. (2016).A handbook of West Africa Weeds *International institution of Tropical Africa, Ibadan*. 381pp.

Bakker, J. P., Pschold, P., Strystra, R. J., Bekker, R. M. and Thompson, K. (1996).Seedbank and seed dispersal: important topics in restoration ecology. *Acia Botanical Neerlandica***45**: 461-490.

González Alday, J., Marrs, R.H., and Martínez Ruiz, C., (2009). Soil seed bank formation during early revegetation after hydroseeding in reclaimed coal wastes, *Ecol. Eng.,* , vol. 35, no. 7, pp. 1062–1069.

Hammer, Ø. & Harper, D.A.T. (2006). Paleontological Data analysis, Blackwell.ohammer@nhm.uio.no.

Lu, Z.J., Li, L.F., Jiang, M.X., Huang, H.D., and Bao, D.C., (2010). Can the soil seed bank contribute to re-vegetation of the drawdown zone in the Three Gorges reservoir region? *Plant Ecol.*,, vol. 209, no. 1, pp. 153–165

Marco infusion and Stefano Scalercio.(2018). The importance of beech forests as reservoirs of moth diversity in Mediterranean Basin (Lepidoptera). DOI: 10.4081/fe.2018.294. Fragmentaentomologica, 50 (2): 161-169 (2018)

Newmaster, S. G., Bell, F. W., Roosenboom, C. R., Cole, H. A. and Towill, W. D. (2011). Restoration of floral diversity through plantations on abandoned agricultural land. *Can. J. For.***36**: 1218-1235.DOI: 10.1139/x06-021

Oberhauser.U. (1997). Secondary forest regeneration beneath pine (*Pinuskesiya*) plantations in the Northern Thai highlands : a chronosequence study. *Journal Forest Ecology and Management* **256**, 114-120.

Oke, D.O. and Odebiyi, K.A. (2007).Traditional cocoa-based agroforestry and forest species conservation in Ondo State, Nigeria. Agriculture, Ecosystems and Environment **122:**305-311.

Olajuigbe, S. O and A. A. Adaja, (2014). Floristic composition, tree canopy structure and regeneration in a degraded tropical humid rainforest in southwest Nigeria.*Tanzania jounal of Forestry and Nature Conservation,* **84**(1): 5-9

Omeja Patrick, Joseph Obua and A. B. Cunningham.(2004). Regeneration, density and size class distribution of tree species used for drum making in central Uganda.*Asian Journal of*

Ecology.https://doi.org/10.1111/j.1365-2028.2004.00509.x