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Floristic composition of Ayikunnugba waterfall Oke-Ila Orangun Southwestern Nigeria for Conservation Planning

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The floristic composition of Ayikunnugba waterfall forest was examined in this research study. The study area was divided into two compartments upper and lower compartments. The study areas were visited three times during the study periods. In this study, a total of 30 study plots of about 25 m x 25 m quadrats (500 sq m) size were established. About 15 plots were placed at the elevation 10 m a.s. at the lowest point of the waterfall and 15 study plots at the hilltop of 580m above the sea level.. Data were gathered from each quadrate. All the trees in the plot with the diameter at breast height (DBH) >lcm were enumerated, measured and identified. Also recorded were species name family which they belong and mean height. Important quantitative analysis such as density, important values and frequency of tree species were calculated. A total of 73 species belonging to thirty three families were recorded in the study area. The highest occurring tree species is *Funtumia elastica* with 32 individual's sampled. The highest DBH of 297cm was recorded in Milicia excelsa while the lowest DBH of 11cm was recorded in Khaya ivorensis Also the highest mean height of 35m was recorded in *Ceiba pentandra* and the lowest mean height of 5m was recorded from *Xylopia aethiopica.* Thirty-three families were recorded within the two blocks, Euphobiaceae has the highest number of tree species (7). The species density and species importance result indicate that *Funtumia elastica* has a density of (318) and the plant species with the lowest density was *Khaya ivorensis* which has 18. *Funtumia elastic* also has an important value of 2.133. The Shannon_H diversity index indicates that the lower block was higher (3.984) than the upper block (2.973).

Keywords : Ayinkunugba waterfall Nigeria, Floristic composition, Diversity, Pristine forest, Conservation value.

INTRODUCTION

The tropical rainforest ecosystem is known to be among the *most* diverse and complex species-rich ecosystems on the planet (henyen, *et al,* 2010). How*ever,* the expansion of anthropogenic disturbances in primary forest areas is increasingly devastating most tropical rainforests. Activities such as selective logging, agricultural intensification and establishment of palm oil and cocoa plantations have continued to place immense pressure on species diversity in such forests. These activities result in considerable loss of biodiv*er*sity, degradation of timber and non-timber resources as well as disruption of the ecological and biological complexities in the forests. Consequently, plant species composition and abundance in disturbed and fragmented tropical forests have increasingly become important economically, socially as well as for biodiversity conservation, especially with the alarming rate at which original primary forests are disappearing *(*Onyekwelu, 2002).

The ability of such tropical forest ecosystems to recover is limited as high and excessive logging has adverse effects on the availability of quality seed germplasm for natural regeneration (Husch, *et al,* 2003). Therefore, information on floristic composition and diversity as well as tree volume are essential for understanding disturbed tropical forest ecosystem dynamics *(*Addo-Fordjour *et al.* 2009). Tree diversity is particularly fundamental to total tropical rainforest biodiversity, as trees provide habitat structure and resources for other flora and fauna species. It is estimated that about 70-90% of living flora and fauna in rainforest ecosystems depend on trees for survival (Tilman, 2008).

In Nigeria, selective logging and clear felling are the predominant methods of timber extraction from government owned forest reserves. Forest compartments are allocated to concessionaires who identify mature economic tree species, fell and extract them. These forest reserves were established with the aim of protecting samples of natural ecosystems, conservation of biodiversity, preservation of ecological processes, for scientific research and education,

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Floristic composition of Ayikunnugba waterfall Oke-Ila Orangun Southwestern Nigeria for Conservation Planning environmental monitoring, and maintenance of genetic hilly forests spread across the entire area. However, resources. The management of such goverment reserves average altitude for the forest is only about 177m. The 15 governed by policies, rules and regulations enforced by Brea has *mean* annual temperature is between 250C - State Departments of Forestry (Adekunle and Olagoke 2010) 2600 while generally the minimum temperature is 1900 However, a major limitation is the paucity of

information on and the maximum temperature is 330C Annual precipitation plant species diversity in most Nigenan *in-situ* conservation is between 1200mm - 2200mm. The typical vegetation of the areas particularly forest reserves. Also, continuousover- area is mixed deciduous forest (Isichei, 1995, *M*engistu exploitation results in fluctuation of the status of plant diversity and Salami, 2007). The forests falls within the Nigerian from time to time and this threaten the livelihoods of current lowland forest ecoregion that extends from the eastern users (Addo- Fordjour *et al. 2*009). The local disturbances margin of the Dahomey Gap in Benin to the Niger River in alter the successional pattern and subsequent composition, the west (
Were 2001) and situated within the Congolian diversity, and canopy structure of these forests *(*Addo-Fordiour subdivision of the Guinea - Congolian belt (Oates et a*l* 2008 et al 2009), Waterfalls, most of which are formed from stream Mengistu, and Salami 007). or river which cascade from a high elevationover a cliff or rock, had very little attention from researchers the world over. Data Collection : The field survey for the floristic study was In Africa, the reason being that, waterfalls were named after conducted in March 2018 *(*Ogunjemite 2005). The study areas deities and were used as places of traditional andAncestral were visited three times during the study periods. In this study, worships. In other places, the intensity of waterfalls and a total of 15 study plots of about 25 m * 25 m quadrats (500 pressure generated from itdue to gravity has given the sq m) size were **established. About 15 plots were placed at** impression of a lifeless zone *(*Chowdhury*, et al.* 2000). the elevation 10 m a.s. at lowest point of the waterfall and 15 Knowledgeof waterfalls systems in Africa are therefore limited study plots at the hill top of 580m above the seal level.. Data to hydrology and geological features (Jamir and Pandey. were gathered from each quadrate. All the trees in the plot 2003), as natural monuments for revenue generation, with diameter at breast height (DBH) >1cm wereenumerated, because of their ecotourism potentials and as source for measured and identified. Other parameters recorded were drinking, irrigation and other domesticpurposes. Studies on species name and mean height (MHT). In this study, the the fauna and flora potentials, biodiversity conservation specimens, both forest tree species and shrubs, were andaquatic ecology of waterfalls is scarce due to traditional identified and recorded those plants species that could not and ancestral worship of neighboringcommunities that had be identified were collected in plastic bags and taken to earlier prevented all forms of activities in the study area. ProfBabafemiOgunjemite of the Federal University of Technology for proper identification. MATERIALS & METHODS

Quantitative analysis : Important quantitative analysis such as density and frequency of tree species were calculated **Study Area** : Oke-Ila Orangun is an ancient city in Osun based on the method that was used by (Ogunjemite, *et al,* State, southwestern Nigeria

and is currently headquarters
2005) of Ifedayo Local Government Area of Osun State. It is located at 7°57'18"N, and 4°59'9.6"E at an elevation of 568
Density: Density is an expression of the numerical strength m on one of the several mountains djoining the eastern
of a species where the total number of individuals of each Flanks of the Oke-lla Ridge. It is about 190 kilometers
species in all quadrats is divided by the total number of directly west of the confluence of the rivers Niger and
quadrats studied. Benue at Lokoja and about 45 km northeast of Osogbo the
Density = Total number of individuals of a species in all capital of Osun State. Okè-llá Oràngůnhas population
quadrats estimated to be 35,000. The people of Oke-llá Òràngún
Total number of quadrats studied kingdom speak distinctive dialect of the Yoruba language called Igbomina (or Ogbonna). The people are mostly
Frequency (%): This refers to the degree of dispersion of
Frequency *(%)* : This refers to the de agrarian but have a significant number of artisans, traders,
individual species in an area and expressed in terms of hunters, school teachers and other. Okè-llá Orangún is
percentage occurrence Frequency (%) = Number of quadrats notable for the adventurous and breathtaking. Ayikunugba
in which the species occurred x 100 *Wat*erfalls (also spelt Ayikunnugba Waterfalls) situated in a
Total number of quadrats studied cliffed gorge, and its associated caves with "mythical"
underground passages. The Ayikunnugba Waterfalls is
Important Value Index: This index is used to determine the located southwest of after the turn of the millennium, the
overall importance of each species in the community structure. current Orangun of Oke-la Orangun in Ifedayo Local
This was calculated using the percentage values of the relative Government area of Osun State, Oba AdedokunAbolarin
frequency, relative density and relative dominance are was installed on December 8, 2006. Oba AdedokunAbolarin
summed up together and designated as Important Value is from the Obasolo Ruling House, one of the three ruling
Index (IVI) of the species houses among which the title rotates in Oke-lla Orangun The forests in and around the waterfall is typical Of rainforest

Data for computing species richness, evenness, at altitudes ranging mostly between 10-400 metres above
diversity indices, linear regression correlation and diversity sea level. Within the *Wa*terfall there are Inselbergs and
analyzed using Past Model

Advances in Plant Sciences)
June- December 2020
168

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Okosodo and Mohapatra

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Figure 1 Map of the Study Area

diversity. The family Euphobiaceae has the highest diversity of eighteen species in this study carried out in Ayikunnugba waterfall. These findings is consistent with several authors A total of 73 species belonging to thirty three families who carried out similar studies in the rain forest zone in were recorded in the study area. The highest occurring tree Nigeria. Omorogbe (2004) reported fourteen species from species is *Funtumia elastica* with 32 individual's sampled. this same family also with the highest species diversity in The highest DBH of 297cm was recorded in *Milicia excelsa* Sakponba Forest Reserve, Edo State. Apocynaceae, while the lowest DBH of 11cm was recorded in Khaya Sterculiaceae, Euphorbiaceae, Ebenaceae, Olacaceae and ivorensis. The lowest point compartment has trees with higher Rubiaceae were reported by Ojo (2004) as forming 86% of DBH. Also the highest mean height of 35m was recorded in

the stand in Abeku sector of Omo Forest Reserve.. Ogunleye *Ceiba pentandraand* the lowest mean height of 5m was in *et al.* (2004) reported the dominance of Euphorbiaceae and recorded *Xylopia aethiopica* (Table 1). Thirty three families Meliaceae in Olokemeji Forest Reserve because of easy wind *were* recorded within the two blocks, Euphobiaceae has the dispersal which'enhanced their spread in the study location. highest number of tree species *(*7) (Figure 2). The species Soladoye *et al. (*2005) also observed that the dispersal density and species importance result indicates that Funtumia mechanism plays a strong role in addition to climatic condition elastica has densityof (318) and the plant species with the and soil type in the preponderance of species of Fabaceae, lowest density was *Khaya ivorensis w*hich has 18. The Euphorbiaceae and Rubiaceae on the Olabisi Onabanjo species importance Value SIV of tree species in the area is University permanent site. 2.333 Table, 2. The Shannon diversity index was higher in the Lower block 3.984 than the upper block 2.973 Table 3. SHE The study area is very rich with tree species diversity, analysis was used to explain the species richness and from the result obtained the study area was very rich of evenness in the study area Figure 3. The result indicates that indigenous tree species of conservation value. This findings there was a negative relationship between two blocks Figure is supported by Nwoboshi, (1982) reported that the number of tree species ha -1 could be as high as 400 in very rich rainforests. The density of trees per hectare was lower in area

DISCUSSION

upper point of the waterfall area than the lower point of the waterfall. This is findings is consistent with Thorington *et al.* Studies on floristic compositions is instrumental in (1982) who obtained 152/171 trees per hectare reported for the sustainability of forests since it play a major role in the

tropical Barro Island in Panama respectively as well as the conservation of plant species, and the management of forest
104 trees per hectare for tropical Jengka Reserve, Malaysia ecosystems (Tilman, 2008, Ssegawa and Nkuutu, 2006).
(Ho *et al.* 1987) but lower than the 323 and 306 trees per From the result obtained from the research study it indicates
hectare reported for Afi River and Oban Forest Reserves in
Nigeria (Aigbe *et al.,* 2014; Aigbe and Omokhua, 2015). Other that the study area is rich in tree species richness and
4.

Floristic composition of Ayikunnugba waterfall Oke-Ila Orangun Southwestern Nigeria for Conservation Planning Table 1 : Phyto-sociological Par**ameters of Tree Species in Study Area Location**
Taxa
DBH cm
MHT (m)
Species Density Ayikunnugba Waterfall
297 M*ilicia excelsa Ceiba pentandra Funtumia elastica*

SIV

73
35
318
2.333

mahn

Numberse
Anacardiace ae
Annonaceae
Apocyna ae
*A*recaceae
Big nodaceae
Bombacaceae
Cae salpinioideae
Cannabaceae
Chloridoideae
Clusiaceae
Combretaceae
Ebenaceae
Euphobiaceae
Fabaceae
Flacourtiacae
Irvingaceae
Lauraceae
Lecythidaceae
Leguminosae
Loganiacaea
Malvaceae
Meliac ae
Mim osoidae
Moraceae
Myristicaceae
Olacaceae
Pandao ae
Papilionoicae

Rubiaceae
sapindaceae
Sterculiaceae
Ulmaceae
Violaceae

Family

40

43

Figure 1, Family composition of Tree Species in the Study Area

Table 2: Species density and Tree SpeciesImportance ValueSIV in the Study Area

Name of Tree Species
Family
Density
SIV *Garcinia afzelii*
Clusiaceae
0.133 *Albizia ferruginea*
Mimosoidae
65
0.266 *Albizialebeck*
Mimosoidae
100
0.266 *Alchomea cordifolia*
Euphobiaceae
112
0.466 *Alstonia boonei*
Apocynaceae

0.4 *Anthocleistanobilis*
Loganiacaea
76
0.266 *Anthocleistavogelis*
Loganiaceae
32
0.2 *Bligiasapida*
sapindaceae
43
0.2

Bombax brevicuspe
Bombacaceae
122
0.133

Bombax buonopozense
Bombacaceae
21
0.066

Brachystegiaeurycoma
Caesalpinioideae
125
0.133

Canthiumhispicum
Rubiaceae
124
0.266

Canthiumsubcordatum
Rubiaceae
0.133

Ceiba pentandra
Bombacaceae
64
0.533

Celtiszenkeri
Ulmaceae
98

0.133

densities reported for various tropical ecosystems include:
Sixty-two percent of the trees encountered were in the 1420 tree**s per hectare *for* Amazo**nia tropical rainforest diameter class of ^ 12 cm. This then meant that the majority *(*Campbell *et al.,* 1986); 391 to 617 trees per hectare for of the trees were wildlings and so were not merchantable. tropical rainforest in Costa Rica (Heaney and Proctor, 1990);
Oduwaiye *et al. (*2002) reported that all plots studied by them 1533 and 1183 trees per hectare for slope and alluvium had the largest number of trees in the smallest diameter forests, respectively in Caledonia (Jaffre and Veillon, 1990). It class of below 10 cm at the Okomu permanent sample plots. has been reported that tree density can be affected by natural They also had the smallest number of trees in the diameter calamities, anthropogenic activities and soil properties class of 25-30 cm. However, Oduwaiye and Ajibode (2005) *(*Adenkule *et al.*, 2013).
reported the highest number of trees for diameter class of
46

Upper

Lower 22

71

25

80

80

Okosodo and Mohapatra Table 3: Diversity of Tree Species in the Study Area Diversity Index Lower Area Block **Lower** Upper Taxa_s

73

73

Individuals

257

257

257

Dominance_D

0.02981

0.02412 0.04077

Shannon_H

3.984

3.827

4.02

Evenness_e^H/S

0.7364

0.6321 0.7646

Brillouin

3.584

3.443

3.62

Menhinick

4.554

4.429

4.554

Margalef

12.98

12.61
12.98

Equitability_J
0.9287
0.893
0.9373 Fisher_alpha
34
32.44
Upper Area
25

80 0.06125

2.973 0.7823

2.571 2.795 5.477 . 0.9237 12.48
0.05562

2.758 0.6718 2.395 2.46

4.792 0.8749 10.02

0.085

3.03

0.8339

2.62 2.795 5.477 0.9432 12.48

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Diversity

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264 272 280 288 296 304312 320 328

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Figure 3, SHE Analysis of Tree Species Diversity in the Study Area

11-30 cm followed by those of between 0-10 cms at in the forest area.Logging is presently going in the area by Onigambari Forest Reserve, Ibadan. Timber trees are logged thelocalpeople, these people are involved in logging, majorly at 60 to 90 cm dbh depending on the species (ITTO,2007). cutting downcommercial timber species such as *Ceiba* These trees *were Piptadeniastrumafricana* with a dbh of *pentandra, Alstoniacongensis Cola gigantea, Daniella ogea.* 136.80 cm in compartment 81, *Alstoniaboonei* with a dbh of Farmingintensification is ongoing in the area and 115.50 cm in compartment 95 and *Hannoaklaineana* with a compartments are been cleared for the cultivation of cocoa dbh of 175.00 cm in compartment 112. These three tree and plantain farms. Deforestation and settlements by the stands were located in sample plot demarcated at the centre local people should be discouraged Sustainable harvest of of the various compartments. tree species inthis area should be properly managed so that avian habitats can be supported. Land conversion for CONCLUSION AND agriculturalpurposes is very high in this region, since most of the communities are agrarian. However, this may

RECOMMENDATION

increaseextinction risk for many threatened and endangered species in the area. The community leaders of these areas Tree diversity was higher in the low point compartment should designprogrammes to discourage bush burning, than upper point compartment within the studyarea which livestock grazing, deforestation and illegal farming in the suggests that land use change between the three waterfall area. compartments was responsible for this. Land conversion for agricultural purposes is very high in this region, since most

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of the communities are agrarian. However, this may increase extinction risk for many threatened and endangered tree

The authors are very grateful to the staff and species and wildlife species in the area, such as Avian management of Osun State Ministry of Agriculture South species and primates in the area. The management of these

Western. Nigeria, the Royal Highness of Oke-Ila Orangun Oba areas should design programmes to discourage bush
for their support during the period of the research study. burning, livestock grazing, deforestation and illegal farming

Advances in Plant Sciences
June- December 2020
(71)

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Floristic composition of Ayikunnugba waterfall Oke-Ila Orangun Southwestern Nigeria for Conservation Planning

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