



FOREST ECOSYSTEM POTENTIALS IN NIGERIA: OPPORTUNITIES FOR GREEN ECONOMY IN THE 21ST CENTURY



EDITORS

**B.O. AGBEJA, A. C. ADETOGUN, O.V. OYERINDE, J.A. OLUSOLA
& O.S. OLANIRAN**

**Proceedings of The 3rd Commonwealth Forestry
Association (CFA) Conference, Nigeria Chapter
Federal University of Technology Akure, Ondo
State, Nigeria
2-3 December, 2020**



Proudly Supported by the Federal University of Technology, Akure

Copyright © 2020 *Forest Ecosystem Potentials in Nigeria: Opportunities for Green Economy in the 21st Century*

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, magnetic tape, mechanical, photocopying, recording or otherwise without permission from the President, Commonwealth Forestry Association, Nigeria Chapter.

e-version ISSN:2550-7524

Production of Proceedings

Commonwealth Forestry Association, Nigeria Chapter
C/o Department of Social and Environmental Forestry,
Faculty of Renewable Natural Resources,
University of Ibadan, Ibadan, Nigeria

Correct Citation of this Publication

Yusuff, A. Q., Adedeji, M. S., Adams, O. T., Odewale, M. O., Aderemi, F. T. and Aluko, A. K., (2020): *Gardenia jasminoides* and *Galphimia gracilis*: The Growth and the Bloom. (Eds., B. O. Agbeja, A. C. Adetogun, O. V. Oyerinde, J. A. Olusola & O. S. Olaniran) *Proceedings of the 3rd Annual Conference of the Commonwealth Forestry Association, Nigeria Chapter*, Federal university of Technology, Akure, Nigeria 2 – 3 December, 2020, Pp. 36-41.

Preface

The 3rd Commonwealth Forestry Association (CFA) Conference, 2020, Nigeria Chapter is a follow-up to the fifth CFA Workshop held in July, 2019 at Federal University of Technology Akure (FUTA), Akure, Ondo State, Nigeria. CFA, Nigeria Chapter is a non-profit association under the supervision of the CFA Headquarters, United Kingdom. Though, some Nigerians have been members since 1970s, the Nigerian Chapter of the Association was formally inaugurated on the 08 September, 2011 at the Federal University of Technology Akure, Ondo State, Nigeria. This is a research oriented conference that seeks to bring together forestry and allied natural resource scientists, graduates, development experts and policy makers from higher institutions and research institutes to proffer future solutions to the dwindling Nigerian Forest Estate. By standard, Nigeria is expected to have 25% of forest estate with gazette notice. However, Nigeria has less than 10% forest estate.

CFA CHARTER AND BYE-LAWS

The Royal charter of 1 November 1921, as amended by Supplemental Charter of 28 November, 1962, provides that the name of the Association shall be the Commonwealth Forestry Association. The Charter and Bye-Laws which follow incorporate amendments agreed at the Annual General Meeting on 5 May, 1981 and which submitted to the Privy Council for the granting of a further Supplemental Charter.

CHARTER

The objects and powers of the Association were prescribed as follows:

- i. To promote for the public benefit the practice of Forestry both in the United Kingdom and throughout the world;*
- ii. To advance education in the value of trees and forests for the conservation of wildlife, soil and water resources, amenity and recreation;*
- iii. To promote research for efficient and sustained production of timber resources and into the inter-relationship between trees and site fertility both for Forestry and Agriculture, publishing the useful results of such research;*
- iv. To encourage the establishment and management of trees and forests as part of the overall wise and sensible use of land; and*
- v. To be a centre for the exchange and dissemination of information on all aspects of forestry and forest products or provide or promote or assist in the provision or promotion of other centres similarly engaged.*

The theme of 3rd Commonwealth Forestry Association Conference 2020 is **‘Forest Ecosystem Potentials in Nigeria: Opportunities for Green Economy in the 21st Century’**.

Papers presented in the proceedings, which were peer reviewed, included lead papers and voluntary papers. They were classified under the following sub-themes:

1. Status and Extent of Nigeria’s Forest Ecosystem in Different Ecological Zones
2. New Technologies and Approaches to Sustainable Forest Management in Nigeria
3. Forest Ecosystem and Climate Change Adaptation and Mitigation
4. Impact of Insurgency and Human/Wildlife Conflicts on Forest Ecosystem in Nigeria
5. Gender Perspectives on Forest Ecosystem in Nigeria
6. Forest Ecosystem Services for Mankind in Nigeria
7. Sustainable Development of Value-Addition of Wood Products in Nigeria
8. Sustainable Production, Harvest and Replenishment of NonTimber Forest Products (NTFPs) in Nigeria
9. Indigenous knowledge of Plants for Repertoire of Medicine
10. Forest Governance and Institutions in Nigeria.

The Commonwealth Forestry Association Nigeria Chapter appreciates the moral support of Professor Joseph Adeola Fuwape, the Vice-Chancellor, Federal University of Technology Akure, Nigeria for hosting the 3rd CFA Conference Nigeria Chapter. The efforts of members of Local Organizing Committee (LOC) namely: Dr. (Mrs). O. V. Oyerinde (Chairman), Dr. Johnson A. Olusola, Dr. Samuel Oluyinka Olaniran, Dr. Oluwatobi Emmanuel Olaniyi, Dr. (Mrs) Oluwayinka S. Oke, Dr. (Mrs) Olaide O. Oyeleke, Mrs. Oluwayemi Johnson, Dr. Opeyemi Boboye, Mr. O. I. Adetula, Mr. A.O. Agbo-Adediran are highly appreciated. I appreciate the immense contributions of all Executive Officers of CFA Nigeria Chapter for the success of this conference. They are Professor A. C. Adetogun (Vice-President), Dr. O. R. Adejoba (Secretary), Mr. A. O. Agbo-Adediran (Assistant Secretary), Professor A. O. Omole (Public Relations Officer), Dr. O. V. Oyerinde (Finance Secretary), Dr. I. O. Osunsina (Social Secretary), Professor S. A. Oluwalana (Ex-officio) and Professor S. O. Akindele (Ex-officio).

Professor B. O. Agbeja

President, Commonwealth Forestry Association Nigeria Chapter

TABLE OF CONTENTS

Preface- Professor B. O. Agbeja , President, <i>Commonwealth Forestry Association, Nigeria Chapter</i>	3
Table of Contents	4-9
THEME: FOREST ECOSYSTEM POTENTIALS IN NIGERIA: OPPORTUNITIES FOR GREEN ECONOMY IN THE 21ST CENTURY	10
SPEECH BY PRESIDENT OF NIGERIA CFA CHAPTER - Prof. B. O. Agbeja	11-15
KEYNOTE ADDRESS I: Forest Ecosystem Potentials in Nigeria: Opportunities for Green Economy in the 21 st Century..... <i>Prof. J. A. Akande</i>	16-29
KEYNOTE ADDRESS II: Adaptation Strategies Associated with Agriculture and Tree Products in the Gambia: Panacea for Green Economy..... <i>Prof. S. Yaffa</i>	30-34
KEYNOTE ADDRESS III: The Limitless Opportunities in Nigerian Forest Ecosystem for Green Economy in the Twenty First Century <i>Prof. S. A. Oluwalana</i>	35-39
KEYNOTE ADDRESS IV: Climate Change Battle Ranges: Any Hope for Humans? <i>Prof. P. G. Oguntunde</i>	40-51
SUB-THEME 1: Status and Extent of Nigeria’s Forest Ecosystem in Different Ecological Zones	52
<i>i. Gardenia jasminoides and Galphimia gracilis: The Growth And The BloomYusuff, A. Q; Adedeji, M. S; Adams, O. T; Odewale, M. O; Aderemi, F. T. and Aluko, A. K.</i>	53-58
<i>ii. The Potential of Agroforestry in Biodiversity Conservation in the Tropics.....Agbeja, A. O; Olaitan A. O. and Akindolu, D. R.</i>	59-65
<i>iii. Contemporary Status of some Selected Forests in Ondo State, Nigeria.....Obadun, F. M., Adekunle V. A. J. and Lawal, A.</i>	66-80
<i>iv. Phytoecological Studies of a Protected Area in Lowland Humid Forest, Ondo State, Nigeria..... Adeyekun, O. J., Akinbowale, A. S., Arinzechi, C. I. and Adekunle, V. A. J.</i>	81-92
<i>v. The Genus Sterculia Linn. in Nigeria: Taxonomic Significance of Morphological and Foliar Epidermal Characters.....Onefeli, A. O. and Oladele-Akin, O. M.</i>	93-103
<i>vi. Structural Diversity of tree Stems of Elephant Camp Natural Forest in Omo Forest Reserve..... Falade O. F. and Iheke, J. U.</i>	104-111
SUB-THEME 2: New Technologies and Approaches to Sustainable Forest Management in Nigeria	112
<i>i. Dead Organic Matter and Carbon Assessment in Okomu National Park, Edo State, Nigeria.....Oke, O. S., Akindele, S. O. and Onyekwelu, J. C.</i>	113-121
<i>ii. Efficacy of Three Different Species of Saw Dust as Growth Media for Cashew (Anacardium occidentale L.).....Aruwajoye, D. A. and Olufemi, A. D.</i>	122-126
<i>iii. Diameter Distribution for Tectona grandis Linn. F. Stands in Ado-Ekiti, Nigeria.....Adesuyi, F. E., Adebisi, E. I., Olugbadieye, O. G and Adekunle, V. A. J.</i>	127-134
<i>iv. Modelling the Growing Space of Parkia biglobosa Benth for Agroforestry Project.....Ogana, F. N., Wakawa, L. D., Ogana, T. E. and Japheth, H. D.</i>	135-140

v.	Agroforestry as a Land Use Option for Sustainable Forest Management in Sokoto State, Nigeria..... <i>Samaila, U., Abdulkareem A. and Mustapha, S. W.</i>	141-146
vi.	Effects of Rock Dusts on the Early Growth of Cocoa (<i>Theobroma cacao</i>) L..... <i>Smart, M. O. Akintola, O. O. Adesida, O. A. and Adeoye, A. S.</i>	147-152
vii.	New Technologies and Approaches to Sustainable Forest Management in Nigeria <i>Ete, J. A, George-Onaho, J. A., and Agboola I. S.</i>	153-158
viii.	Assessment of Agroforestry Practices as Land Use System in Wukari Local Government Area, Taraba State, Nigeria..... <i>Sobola, O. O., Maiguru, A. A., Zaku, S. S., Idiege, D. A., Akintan C. I. and Douglas, A.</i>	159-165
ix.	Organic Liquid Fertilizer: Evaluation of Effect on Growth and Yield of <i>Abelmoschus esculentus</i> L. <i>Moench</i> <i>Yusuf, A. Q., Aluko, A. K., Aderemi, F. T. Adams, O. T., Adedeji, M. S. and Odewale, M. O.</i>	166-169
x.	Evaluation of Growing Media on Growth and Yield of Fluted Pumpkin..... <i>Yusuf, A. Q., Adams, O. T., Adedeji, M. S. and Odewale, M. O. and Usman, S.</i>	170-173
xi.	Nitrogen Utilization for Improved Maize Leave Production and Cob Yield <i>Oyebamiji, N. A., Aduradola, M. A., and Babalola, O. A.</i>	174-180
xii.	Soil Hydrothermal Properties and Yield of <i>Lycopersicon esculentum</i> Mill as Influenced by Leaf litter Mulch of Urban Agroforestry Trees..... <i>Oroka, F. O., Ureigho, N. U. and Uwuigbe, E. O.</i>	181-185
xiii.	The quantification and Drivers of Mountainscape Transformation Using Remotely Sensed Data: A Aase of Ado-Awaye Mountain, Southwest Nigeria <i>Olaniyi, O. E., Okerinu, P. and Akinsorotan, O. A.</i>	186-193
xiv.	Role of Sustainable Forest Management in Rural Livelihoods in Nigeria <i>Yekinni, T., Ishola, O., Omoniyi, L., Ogunyinka, A., and Adeeko, A.</i>	194-197
xv.	Factors Influencing Spatio-Temporal Variation of Urban Green Space In Ado-Ekiti Metropolis..... <i>Alegbeleye, O. M. and Alo, A. A.</i>	198-206
xvi.	Influence of Plant and Animal Based Fertilizer on Growth and Yield of Okra <i>Abelmoschus esculentus</i> L..... <i>Yusuf, A. Q., Odewale, M. O., Oni, O. A., Adesida, O. A., Adams, O.T., and Adedeji, M. S.</i>	207-211
xvii.	Assessment of Stakeholders Participation in the Management of Odoba Forest Reserve, Ogbadibo Local Government Area, Benue State, Nigeria <i>Onuche, P., Shomkegh, S. A. and Ancha, P. U.</i>	212-219
xviii.	Mapping and Assessment of Some Settlements in Oluwa Forest Reserve Using Geographical Information System <i>Adetula, O. I. and Adetula, A. I.</i>	220-228
xix.	Volume Equations for Selected Privately-Grown Teak Stand in Ekiti State, Nigeria..... <i>Oluwafemi, D. F., Akinbowale, A. S., Tolorunju, M. S. and Adekunle, V. A. J.</i>	229-234
xx.	Evaluation of Leaf Litter Decomposition as Process of Nutrient Return in Forest Plantations <i>Aborele, G. O, Oladoye S., Aduradola, M. and Adejuyigbe, C.</i>	235-247

SUB-THEME 3: Forest Ecosystem and Climate Change Adaptation and Mitigation	248
i. Emerging Potentials of Hydroponic Farming in Nigeria: An Alternative Farming Practice in the Face of Climate Change <i>Oloriegbe, W. A., Adeeko, A., Nwagbara, S. I., Akinleye, O. E. and Kolapo, O. A.</i>	249-254
ii. <i>Faidherbia albidia</i> (Del.) A. Chev: An Ideal Agroforestry Tree Species for Small Holder Farmers in the Midst of Climate Change Impacts in Nigeria <i>Amaogu, D. C., Ikechukwu, L. O. and Chilaka, V.</i>	255-260
iii. Assessing the Impact of Climate Change on Agricultural Production in Edo State, Nigeria <i>Mangodo, C., Isese, M. O. O., Oripelaye, O. S. and Osazuwa, D. K.</i>	261-265
iv. Application of Heat Shock Protein Genes: An Innovative Approach to Mitigating Abiotic Stresses to Plant Development..... <i>Nwogwugwu, J. O., Batcho, A. A., Osunlaja, O. A. and Oladipo, A. D.</i>	266-270
v. Assessment of Awareness Level of the Effects of Climate Change on Forest Dependents in Onigambari and Olokemeji Forest Reserves in Oyo State, Nigeria <i>Kolade, R. I., Adejumo, A. A., Akanni, O. F., Obafunsho, O. E., Oke, D. O. and Ogunsola, A. J.</i>	271-276
vi. Potentials of Species Distribution Modelling in Response to Climate Change Impacts on Biodiversity in Nigeria..... <i>Adaja, A. A. and Olajuyigbe, S. O.</i>	277-282
SUB-THEME 4: Impact of Insurgency and Human/Wildlife Conflicts on Forest Ecosystem in Nigeria	283
i. Characterisation of Feral Helmeted Guinea fowl in Captivity by Smallholder Farmers in Precinct of National Parks <i>Yusuf, A. A., Jayeola, O. A., Osunsina, I. O. O., Dedeke, G. A. and Mukhtar, R. B.</i>	284-289
ii. Human - Wildlife Conflict in Communities Surrounding Falgore Game Reserve, Kano State. Nigeria. <i>Fingesi, U. I., Ibrahim, A. O. and Abubakar, S. A.</i>	290-296
iii. Diversity of Birds and Tree Species diversity of Osun-Osogbo Sacred Grove World Heritage site Osun State South West Nigeria <i>Okosodo, E. F. and Tinuoye, O. I.</i>	297-310
iv. Assessment of Indigenous knowledge in Protected Area Management: Case of Old Oyo National Park..... <i>Oyeleke, O. O. and Olawale, S.</i>	311-316
v. Comparison of Avifauna Composition of Artificial and Natural Water Bodies: A case study of Elemi River and Ureje Dam, Ekiti State..... <i>Orimaye, J. O., Ogunyemi, O. O. and Onemayin, C. O.</i>	317-326
SUB-THEME 5: Gender Perspectives on Forest Ecosystem in Nigeria	327
i. Role of Women in Sustainable Forest Management..... <i>Ureigho, U.N.</i>	328-331
ii. Socio-Economic Importance of Biodiversity to Rural Livelihoods in Odeda (LGA), Ogun State, Nigeria..... <i>Oyewumi, O. R. and Aro, O. S.</i>	332-339
SUB-THEME 6: Forest Ecosystem Services for Mankind In Nigeria	340
i. Phytochemical Screening of <i>Tetracarpidium conophorum</i> (African Walnut) Seeds <i>Olusola, J. A., Owokotomo, O. O. and Olusola, T. T.</i>	341-346
ii. Contribution of <i>Adansonia digitata</i> (Boabab) to the Socio-Economic Development of Community in Wurno, Sokoto, Nigeria..... <i>Mustapha, W. S., Abdulkarim, A. and Samaila, U.</i>	347-353

iii. Impact of Degradation of Mangrove Forest to Human Well-Being in the Ondo Coastal Zone, Nigeria..... <i>Olajide, A. and Popoola, O. O.</i>	354-361
iv. Urban Forests and Pollution Mitigation: An Insight into Urban Forest Ecosystem Services in Nigeria..... <i>Obia, C. I.</i>	362-367
v. Strategies to Enhance Forest Ecosystem Services for improved Rural Livelihood in Nigeria..... <i>Adedayo, A. G.</i>	368-374
vi. Water Ecosystem and Food Security Around Ona River, Oyo State - A review..... <i>Agbeja A. O. and Okewumi, M. S.</i>	375-378
vii. Mitigating Environmental Hazards through Urban Forestry in Nigeria..... <i>Kolade, R. I., Kolade, O. B., Adejumo, A. A., Oke, D. O. and Akanni, O. F.</i>	379-384
viii. Phytochemical Analysis and Antioxidant Activity of <i>Gacinia kola</i> Seeds..... <i>Oyerinde, O. V. Ogunlade, B. T., Oyerinde, A. S. and Onishile, B. O.</i>	385-391
ix. Influence of Forestry on Sustainable Environmental Management <i>Olaitan, A. O., Agbeja, A. O., Asabia, L. O. and Olaifa, K. A.</i>	392-397
x. Farmer's Perception and Socio-economic Importance of <i>Adansonia digitata</i> in Savanna Ecological Zones of Nigeria..... <i>Oyerinde, O. V. and Boboye, O. M.</i>	398-412
xi. Utilization Pattern and the Export Potential of Bamboo in Nigeria..... <i>Osazuwa D. K, Yusuf A. S, Adeyemi T. O. A, Shasanya, O. S, Oripelaye O. S, Akemien, N. N.,</i>	413-417
SUB-THEME 7: Sustainable Development of Value-Addition of Wood Products in Nigeria	418
i. Fibre Characteristics of <i>Manihot esculenta</i> (TMS 1202 and TME 419 Varieties) and <i>Manihot utilissima</i> (T-MU Variety) for Pulp and Paper Production in Makurdi, Nigeria..... <i>Tembe, E. T., Ekhuemelo, D. O. and Akogwu, M. O.</i>	419-427
ii. Evaluation of Fibre Morphological of Rice (<i>Oryza sativa</i>) Varieties Grown in Makurdi, Benue State, for their suitability in Pulp and Paper Production <i>Tembe, E. T., Ekhuemelo, D. O. and Joseph, E. O.</i>	428-436
iii. Sustainable Development of Value Addition of Wood Products in Nigeria..... <i>Ete, J. A. George-Onaho, J. A. and Agboola, I. S.</i>	437-441
iv. Analysis of Crude Fibre and Mineral Element Concentrations in <i>Typha latifolia</i> L. and <i>Typha</i> <i>domingensis</i> Pers. as a Measure of their Pulp and Paper Potentials..... <i>Sotannde, O. A., Idoghor, S. M. and Abare, A. Y.</i>	442-449
v. Lignin from Lignocellulosic Biomass: A Sustainable Source of Bio-renewable Fuel and Chemical..... <i>Olayiwola, Y. B., Oluyeye, A. O. and Ajayi, B.</i>	450-456
vi. Effects of Thermal Modification on the Physical and Mechanical Properties of <i>Leucaena leucocephala</i> Wood..... <i>Ogunjobi, K. M., Agboola, O. Q., Olufemi, O. O., Gakenou, O. F. and Adetogun, A. C.</i>	457-462
vii. Effects of Weathering on Mechanical Properties of Wood Plastic Composites..... <i>Aina, K. S. Oluyeye, A. O. and Fuwape, J. A.</i>	463-471
viii. Investigation of the Anatomy and Fibre Characteristics of Selected Tropical Timber Species.....	472-479

<i>Adu, O. M., Olaniran, O. S. and Oluyeye, O. A.</i>	
ix. Susceptibility of wood cement composites to microbial attack..... <i>Oladipo, O. E., Oladele, O. O., Edema, M., Fabiyi, J. S., Oluyeye, A. O. and Fuwape, J. A.</i>	480-485
x. Bamboo Resources: Uses and Development in Nigeria..... <i>Adejoba, O. R. and Olanrewaju, C. M.</i>	
xi. Adhesive Penetration and Adhesive Bonding Strength in Wood Composite Application: A review..... <i>Olayiwola, Y. B. Adeniyi I. A. and Aina, K. S.</i>	486-490
xii. Layered Structure and Properties of Wood-Cement Composites Produced from Flakes and Sawdust of <i>Gmelina arborea</i> <i>Oluyeye, A. O., Fuwape J. A. and Adeduntan, S. A.</i>	491-498
xiii. Characterization of Lignins Isolated from Bamboo (<i>Bambusa vulgaris</i>) Organosolv and Kraft Black Liqour..... <i>Sadiku, N. A. and Yusuf, A. F.</i>	499-509
xiv. Comparative Analysis of the Physical Properties of Wood Plastic Composites (WPC) Produced from Sawdust of <i>Ceiba pentandra</i> and <i>Cola gigantea</i> Wood..... <i>Akinfiresoye, W. A. Olukunle, O. J. and Oluyeye, A. O.</i>	510-519 520-525
xv. Evaluation of Banana Stalk and Oil Palm Empty Fruit Bunch Fibers for Paper Production..... <i>Orimisan, G., Oyeleye I. O. and Ajayi, B.</i>	526-531
i. Volumetric Shrinkage and Moisture Content Relations of <i>Pterocarpus santalinoides</i> ' Wood in parts of Rivers State..... <i>David-Sarogoro, N. and Emerhi, E. A</i>	532-537
SUB-THEME 8: Sustainable Production, Harvest and Replenishment of Non-Timber Forest Products (NTFPs) in Nigeria	538
i. Emerging Potentials of Mushroom as a Non-Timber Forest Product in Nigeria - A Review..... <i>Oluwole, O. R., Efunwoye O. O. and Adeeko, A.</i>	539-545
ii. Decomposition Rate of <i>Albizia zygia</i> (DC.) J. F. Macbr and <i>Albizia adanthifolia</i> Leaves (Schum.) W. Wight on Soil Properties..... <i>Oshakuade-Dayo, A. A. and Oke, D. O.</i>	546-551
iii. Households' Cooking Energy Use and Incidence of Common Ailments: Secondary Data Analysis of 2018/19 Nigerian General Household Survey..... <i>Ibrahim, F. M.</i>	552-559
iv. Evaluation of Honey Bee (<i>Apis mellifera</i>) Pollen: Implications for Honey Production Sustainability..... <i>Arowosoge O. G. E. and Adegoke, A. F.</i>	560-566
v. Effects of Periods of Organo-Priming and Hydro-Priming on the Germination of <i>Vitex doniana</i> and <i>Canarium schweinfurthii</i> Seeds..... <i>Adelani, D. O., Emeghara, U. U., Oladele N. A., and Ogunsanwo, J. A.</i>	567-572
vi. Early Growth Performance of <i>Pentaclethra macrophylla</i> (Benth) as influenced by Pretreatments..... <i>Ojo, M. O. and Oyedeji, O. F.</i>	573-577
vii. Effect of Watering Regimes on the Early Growth of <i>Milicia excelsa</i> (Welw. C.C. Berg) Seedlings..... <i>Aduradola, A. M., Ojekunle, O. O. and Akinsola, B. I.</i>	578-583
viii. Germination Studies in Seeds of Selected Semi-Arid Agroforestry Trees in Nigeria <i>Zubairu, S. U.</i>	584-587
ix. Non-silk Benefits from Sericulture – A Review..... <i>Ayandokun, A. E., Ete, J. A. and Agboola, I. S.</i>	588-591 592-597

x. Seedlings Growth Performance of <i>Terminalia ivorensis</i> (A. Chev) as Influenced by Different Organic Fertilizers..... <i>Hammed, R. A., Rafiu B. O. and Oyelowo, O. J.</i>	598-602
<i>xī. Sustainable Management of Non-Timber Forest Products and their Potentials on Livelihood in Nigeria..... Asinwa, I. O., Kazeem, I. F., Agbeja, A. O. Fawole, A. O. and Olaiifa, K.A.</i>	
SUB-THEME 9: Indigenous knowledge of Plants for Repertoire of Medicine	603
<i>i. Efficacy of Medicinal Plants for the Treatment of Asthma.....Faleyimu, O. I. and Osalope, K.B.</i>	604-612
<i>ii. Indigenous Knowledge of Selected Fruit Tree Species in Oba Hill Forest Reserve, Osun State, Nigeria.....Orowale O. O. and Oyerinde, O. V.</i>	613-621
SUB-THEME 10: Forest Governance and Institutions in Nigeria	622
<i>i. Participation of the Local Community on Watershed Management at Wurno Local Governement Area Sokoto, Nigeria..... Abdulkarim, A., Samaila, U. and Mustapha, W. S.</i>	623-628
<i>ii. Forest Governance and Institutions in Nigeria Ete, J. A.</i>	629-636



Birds and Tree Species Diversity of Osun-Osogbo Sacred Grove World Heritage Site Osun State Southwestern, Nigeria



Okosodo, E. F. and Tinuoye, O. I.

Department of Leisure and Tourism, Federal Polytechnic Ilaro, Ogun State

*Correspondence: francis.okosodo@federalpolyilaro.edu.ng

Abstract

*Birds and tree species diversity was studied in Osun- Oshogbo Sacred Groove World Heritage site in South West Nigeria. A total of 20 transect lines of 500m were randomly laid out and the minimum distance between two transect lines was 200m. The number of transect lines was determined by the site size. Data were collected for six months (Dry and Wet seasons) in 20019. The ecological survey for the floristic study was conducted in March 2019. In all, a total of 125 bird species belonging to 49 families and 18 orders were recorded in the three study sites, The Order Passeriformes had the highest frequency (51 %) of the entire number of birds recorded, while the dominant families were Estrildidae and Pycnonotidae, comprising (74 %) of the total species One endemic and one rare weaver bird species were recorded. A total of 741 individual tree species in 174 tree species and 49 families were enumerated. The highest occurring tree species are *Brachystegia eurycoma* and *Brachystegia nigerica* with 36 and 19 tree species respectively. DBH of 466cm was recorded in *Brachystegia eurycoma*, followed *Brachystegia nigerica* 456 cm in the study area. Also the highest mean height of 41m was recorded in *Millicia excelsa* and the highest occurrence of tree species was recorded in *Brachystegia eurycoma* 39. Shannon diversity was 4.849 in the study area.*

Key words: Birds, tree species, ecological survey, habitat fragmentation, conservation

INTRODUCTION

Birds are among the best monitors of environmental changes and have been used to evaluate the environment throughout history as bio-monitors and the changes in their population, behavior patterns, and reproductive ability have most often been used to examine the long term effects of habitat fragmentation. Hence they are the good indicators of the ecological status of any given ecosystem (Castelletta *et al.*, 2000). Forests attract much avifauna because of the habitat suitability for most of them. This especially includes the birds that are associated with the vegetation, and for most, the existence of trees is vital to their life cycle. Birds show different levels of interest to various stands depending on the age of the stands. Deforestation in the tropics is one of the major threats to global biodiversity (Dobson *et al.*, 1997). In Nigeria at present, the destruction of natural habitats continues rapidly, resulting in the depletion of the country's biodiversity). However, South Western Nigeria is the region of high population densities and intense agricultural land -use area (Agbelusi, 1994). For this reason, perhaps biodiversity depletion may be occurring at much higher rate than elsewhere in Nigeria. NEA,(2002) reported that increased export demands for primates and birds for research and trade in timber and non-timber species are indirect causes of biodiversity loss in various parts of the country. Agricultural intensification, logging, and poaching within and around most forest reserve in south west Nigeria have resulted in sharp decline of bird species in recent times, avian species are becoming intolerant of pressures on their habitats (Manu, 2000). An assessment of the abundance and diversity of bird species in Oshogbo Groove therefore, serve as a good indication of the health of the environment.

MATERIALS AND METHODS

Study Area

Osun-Osogbo Sacred Grove is located along the bank of Osun River in Osogbo Local Government Area of Osun State, Southwestern Nigeria (Oseghale, *et al*, 2014)Its geographical coordinates are 7 02 and

08 E. The sacred grove is situated on the margin of the southern forests of Nigeria on a raised parcel which is about 350 meters above sea level. The grove is bounded in the North by Laro and Timehin Grammar Schools, the South by entrance of Ladoke Akintola University of Technology (LAUTECH) which runs parallel to form a western boundary. In the east, it is bounded by Osun State Agricultural Farm Settlements (NEA, 2010) Annual rainfall varies between 1600 and 2000 ml, mean annual temperature is 30 °C and the relative humidity is not below 40 % during dry season and 100 % during the wet season (Mengistu, and Salami, 2007). The study site experiences a bimodal annual rainfall pattern, between April and July and from September to October, separated by dry season (Isichei, 1995). Vegetation is predominantly rainforest, including wetlands along the rivers and *Panicum maximum* dominated open land. Among the common trees are *Celtis zenkerii*, *Triplochiton scleroxylon*, *Antiaris africana*, *Pycnanthus angolensis* and *Antiaris africana*, *Pycnanthus angolensis* and *Alstonia boonei* (Keay 1989)

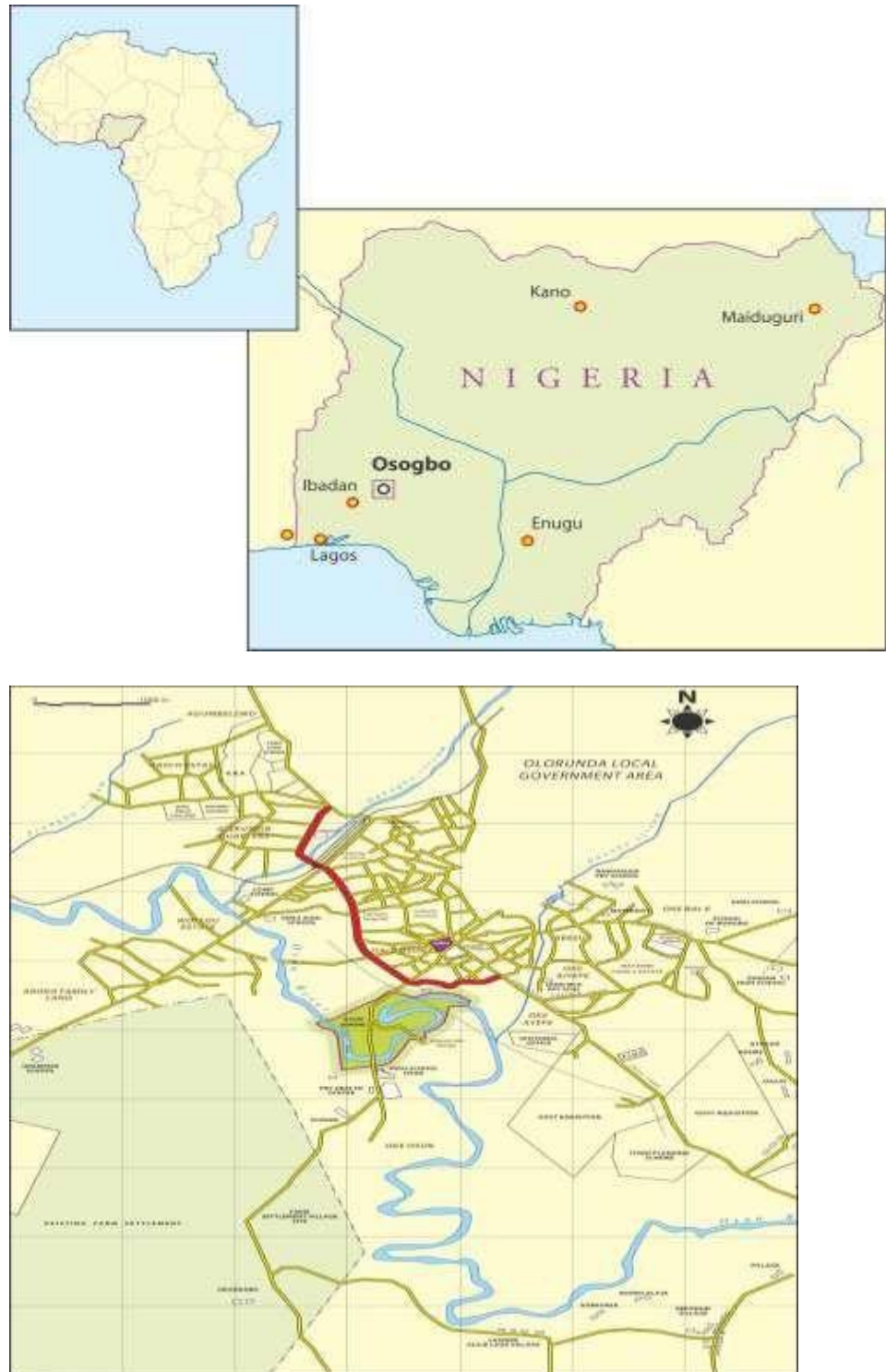


Figure 1 Map of the Study Area Source: (African World Heritage Sites)

Data Collection

Line transects method according to (Sutherland, 2009) was used to collect data on bird species diversity, and abundance in the study area. In all of 20 transect lines were randomly placed measuring 500 m each transect was divided into 200 m sections randomly placed. The programme GPS 2011 Utility (GPSU, 2012) was used to locate the starting and ending points of transects. Transect lines were walked three times a week for three months in both seasons (May, July and September for wet season and November, January, and March for dry season) of the year. Survey was conducted between 0.600hours and 10.00hours and 1600 hours to 1800 hours, the survey was not conducted beyond 10.00hours in the morning in other to reduce day light effect. Transects were walked at an average speed of 1.5 kilometer per hour, depending on the terrain and the number of bird species recorded. All birds viewed on the ground or in the vegetation, as well as birds that are flying ahead, were identified and the number in the group recorded. Birds of the same species within 10m of each other were

counted in the same group. A pair of binoculars with a magnification 7x 50 was used in the identification of bird species.

Distance estimates were obtained by using a digital range finder. Physical features of birds sighted but could not be identified immediately were taken and field guide book of West African birds (Burrow and Demey, 2011) was used to identify the bird species and bird calls were used to confirm the presence of nocturnal bird species within the study sites

From the data collected, avian species diversity was calculated using;

Shannon diversity index, (Usher, 1991) which is given as:

$$H^i = - \sum P_i \ln P_i$$

Where: H^i = diversity index

P_i = is the proportion of the i th species in the sample

$\ln P_i$ = is the natural logarithm of the species proportion.

Species Relative Population Density

The relative population density of bird species at various sites and seasons were determined as outlined by Bibby (*et al*, 1992) as follows:

$$D = \frac{n_1 + n_2}{\pi r^2 m} \text{Log}_e \left[\frac{n_1 + n_2}{n_2} \right]$$

where: D = density

r = radius of the first zone

n_1 = number of birds counted within zone

n_2 = number of birds counted beyond zone and m = number of replicate count in such area.

Habitat Survey

The ecological survey for the floristic study was conducted in March 2019 (Ogunjemite, *et al* 2005). . In this study, a total of 20 study plots of about 25 m × 25m Quadrats (500 sq m) size were established. All woody plants with stems rooted independently within a plot and with a DBH (measured at 1.3 m above ground for all lifeforms) equal to or greater than 2.5 cm were measured, inventoried and identified to species level. Multiple stems were measured separately, but all stems rooting in the same place were counted as one individual. Specimens were collected in April and May 2019. All specimens were sorted to species level and identified by matching them with vouchers identified by specialists or professional botanists. DBH measurement was taken with the simple tape measure while the height of trees was taken using Haga Altimetre.

Data Analysis

Species diversity, floristic composition and similarity were measured with quantitative and qualitative indices. The frequency of a species for each habitat type is defined as the number of (25x25m) plots in which it is present, and the sum of all frequencies as the total number of plots per site. Species diversity values were expressed in terms of species richness for each habitat type. To quantify and compare floristic composition between habitats, the Past Model version 3 was used analyzed the diversity.

RESULTS

From the result obtained from the research study it indicates that the study area supports the diversity of bird life and plant species. A total of 125 bird species belonging to 49 families and 18 orders enumerated in the study areas. The result of the family composition indicates that *Estrildidae* and *Pycnonotidae* had the highest number of bird species of 12 each. One endemic bird species *Malimbus ibadanensis* and one species of weaver *Ploceus tricolor* were encountered during the survey. The understory stratum has the highest number of bird species in the study area, these bird species that belong to these families are *Sylviidae*, *Cisticolidae*, *Cuculidae*, *Estrildidae*, and *Pycnonotidae*. The results of the Shannon_H diversity shown that it was highest during the dry season (4.659) than the wet season (4.297). A total of 741 individual tree species in 174 tree species and 49 families were enumerated. The highest occurring tree species are *Brachystegia eurycoma* and *Brachystegia nigerica* with 36 and 19 tree species respectively. DBH of 466cm was recorded in *Brachystegia eurycoma*, followed by *Brachystegia nigerica* 456 cm in the study area. Also the highest mean height of 41m was recorded in *Millicia excelsa* and the highest occurrence of tree species was recorded in *Brachystegia eurycoma* 39. Shannon_H diversity was 4.849 in the study area. The result of the family composition indicates that *Sterculiaceae* has the highest tree species 14 followed by *Euphorbaceae* 13 tree species.

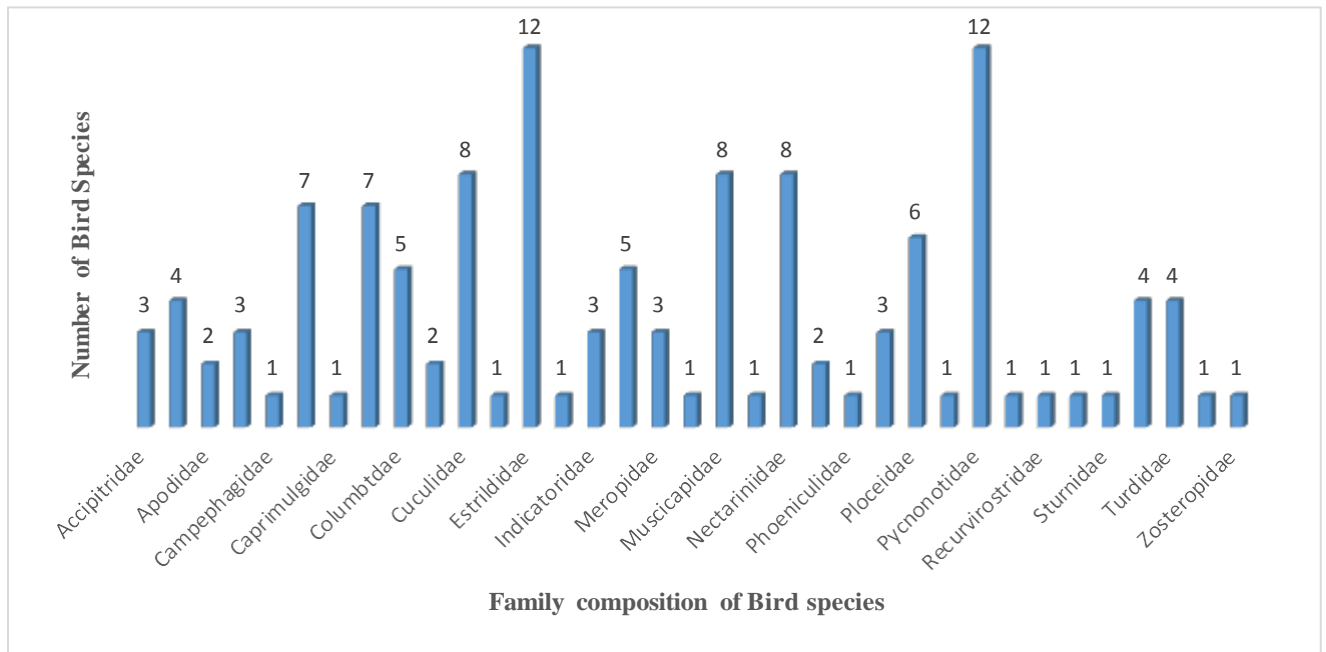


Figure 2: Bird species family composition in the study area

Table 1, Bird species diversity index in the study sites

Diversity Index	Dry season	Wet season
Taxa_S	125	100
Individuals	210	175
Dominance_D	0.01229	0.02315
Shannon_H	4.659	4.297
Evenness_e^H/S	0.8439	0.735
Margalef	23.19	19.17
Equitability_J	0.9649	0.9331

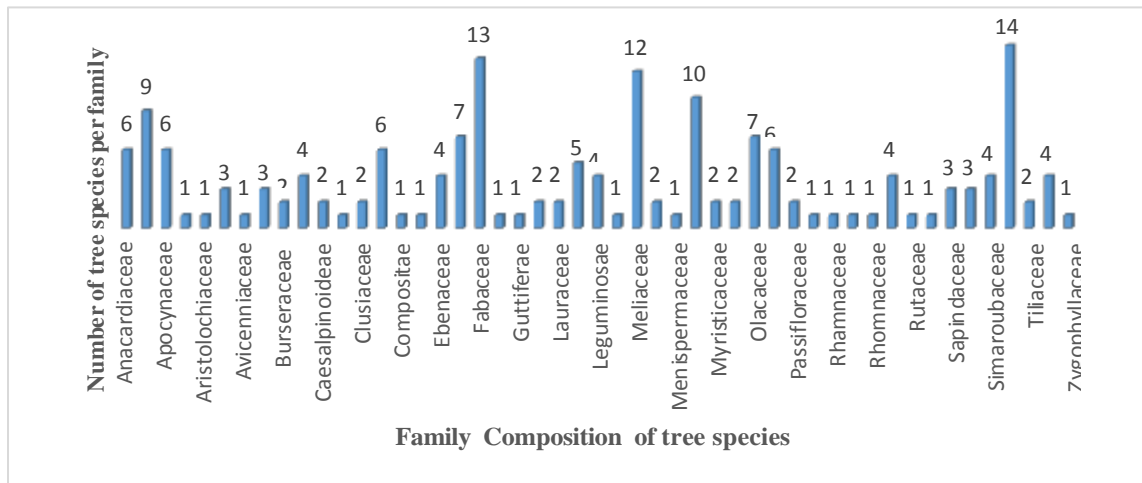


Figure 3: Tree species family composition in the study area

Table 2: Pyto-sociological parameters of tree species in the study area

Habitat Type	Number of Tree Species	Number of Individual Tree Species	Highest DBH (cm)	Highest MH (m)	Highest Occurrence	Shannon-Wiener H'
Rain Forest	174	1047	466 <i>Brachystegia nigerica</i>	41 <i>Milicia excelsa</i>	39 <i>Brachystegia nigerica</i>	4.849

DISCUSSION

The majority of bird species encountered during this study were resident bird species and few migratory bird species. The 98% of the bird species encountered in the study area were forest species which in agreement with (Elgood et al, 1977) who carried out a bird species survey in Southwestern Nigeria. The study area is located in the low land rain forest which offered even distribution pattern of birds showed highest species richness and Shannon diversity in in both seasons of the year which comprises mixed moist deciduous canopy, that could be due to the presence of the majority of evergreen trees, which provided the sufficient food in the form of flowers and insects (Thiollay, 1998). The result showed that 125 bird species utilized the study area throughout the period of the research study. This result is consistent with the work of Matlock Jr, *et al*, (2003) who reported that forest patches and protected area in Sao Tome have high a retention of bird species than agricultural landscapes. This is also supported by previous research studies that suggested multi-strata agroforestry systems are being able to accommodate high levels of species richness and abundance for several tropical groups, especially when compared with alternative land use. The comparison of species diversity between dry and the wet season, the result indicates diversity was higher in the dry season than wet season in the study area. This is consistent with MacArthur and MacArthur (2001) who reported that diversity increases with the number of layers in the vegetation. Pearson (2001) reported that tropical wet evergreen forest support more rare bird species than other habitats. Manu (2007) reported that birds select vegetation variables according to the manner by which an individual habitat affects access to food, mates or its vulnerability to predators.

This study shows that lowland forest in the study areas are best habitats for the birds as far as the numbers and diversity is concerned. This is in agreement with (Prمود *et al.*, (1997) who reported that serious loss of the biodiversity value occurs in the transformation of original landscapes to croplands due to human interference. Karr and Roth, (1971) reported that the more complex the structure or composition of the vegetation, the more likely that habitat will contain more bird species. In this study, tree density, high DBH, presence of tall emergent tree, trees occurrence and understory density were important vegetation characteristics responsible for the high bird species richness recorded in the study area. Bird species behavioral pattern was found to play a big role in bird diversity in the conserved area, for example, (Pied Flycatcher, Black shouldered Puffback, Lagden's Bush-Shrike and Blue Shouldered Robin Chat, Ibadan malimbe, Yellow Mantled weaver Pipping hornbill and Black cuckoo were more or less resident in the study area throughout the

period of this study and forest edges despite the availability of food resources in the surrounding farmlands (Cody, 1985).

CONCLUSION AND RECOMMENDATION

The presence of some endangered and threatened bird species in the study area is a sign of hope. However, their conservation must be guaranteed and that will only be achieved by the conservation of extensive areas of natural vegetation. Houses are springing up in the buffer zone in the study area it means high population and farming intensification is ongoing in the area, the study host high population of rare bird species of ecotourism value such as *Malinbus ibadanensis*, *Coracias cyanogaster*, *Spizaetus africanus*, *Ceratogymna fistulator*, *Cuculus clamosus* and Yellow Mantled Weaver. The management of these areas should design programmes to discourage bush burning, deforestation and poaching by the local people. The conservation strategy must integrate the physical, economic, social and cultural condition of the farmers and Local people so as to come up with innovations and technologies that conserve and sustain biodiversity.

ACKNOWLEDGEMENTS

The authors are grateful to the Staff and management of Osun-osogbo World Heritage site for their support during the period of the study.

REFERENCES

- Agbelusi, E. A. (1994). Wildlife Conservation in Ondo State Nigeria. *Nigeria Field*, 59, 73-83.
- Boo, E. (1990): Ecotourism: Potentials and pitfalls, World Wild Fund for Nature (WWF) Washington, D. C.
- Borrow, Nik and Demey Ron. (2012). "A guide to the birds of western Africa". Princeton University Press
- Cody, M. L., (1985) An introduction in habitat selection in birds. *In* Habitat selection in birds (Cody ed.) Academic Press Inc. London pp 191-248.
- Castelletta, M., N. S. Sodhi, and R. Subaraj. 2000. Heavy extinctions of forest avifauna in Singapore: lessons for biodiversity conservation in South-East Asia. *Conservation Biology* 14:1870–1880.
- Dobson, A. P. Bradshaw, A. D. and Baker. A. J. M (1997). Hopes for the future: restoration ecology and conservation biology. *Nature* 277:515–521.
- Elgood, J. H. (1977). Forest birds of south-western Nigeria. *Ibis* 119 462-480
- GPSU . 1998-2005. GPS Utility Version 4.20.0
- Karr J. R. and Roth R. R. (1971) Vegetation structure and avian diversity in several new world areas. *American Naturalist* 105: 423-435.
- Ikemeh (2009) Status Survey of the Idanre Forest Reserve: A February 2009 Survey. Report to the A.G. Leventis Foundation, Liechtenstein, the Nigerian Conservation Foundation, Lagos, and the Ondo State Government, Nigeria.
- Isichei, T. M. (1995). Omo Biosphere Reserve, Current Status, Utilization of Biological Resources and Sustainable Management (Nigeria). Working Papers of the South-South Cooperation Programme on Environmentally Sound Socio-Economic Development in the Humid Tropics. UNESCO, Paris
- Keay. R. W. J., (1989), Trees of Nigeria. A review version of Nigerian trees (1960, 1964) by R. W. J Keay, C. F. A Onochie and D. P Strandfield. Claridon Press Oxford University press: Pp 476 pp.
- MacArthur, J. W. and Preer, J. (2001). On bird species diversity: II. Prediction of bird census from habitat measurements. *American Naturalist* 96, 167-174.
- Manu, S., Peach, W. & Cresswell, W. (2007). The effects of edge, fragments West Africa. *Ibis* 149:287-297
- Manu, S. A. (2000) Effects of habitat fragmentation on the distribution of forest birds in South western Nigeria with particular reference to the Ibadan Malimbés and other Malimbés, PhD thesis. University of Oxford.
- Matlock Jr., E. B., Rogers, D., Edwards, P. J. and Martin, S. G. (2002) Avian communities in forest fragments and reforestation areas associated with banana plantations in Costa Rica. *Agriculture, Ecosystems and Environment* 91: 199-215
- Mengistu, O. A. and Salami, J. E, (2007). Application of remote sensing and GIS inland use/land cover mapping and change detection in a part of south western Nigeria. *African Journal of Environmental Science and Technology* Vol. 1 (5), pp. 099 -109.
- National Commission for Museums and Monuments (2010): Osun Osogbo sacred grove, UNESCO world heritage site 2010- 2014, conservation management plan.
- Nigerian Environmental Analysis. (2002). Biodiversity and Sustainable Forestry (BIOFOR) Indefinite Quantity Contract (IQC). (USAID BIOFOR, London and Abuja
- Sutherland, J. W. (2009) Ecological census Techniques: A handbook. 4th Edition. Cambridge University Press. U.K. 1 – 336.
- Ogunjemite, B. G., Afolayan T. A. and Agbelusi E. A. (2005) Habitat Structure of Chimpanzee Community in Ise Forest Reserve, Ekiti State, South-western Nigeria. *African Journal of Ecology*, 43, 396 -399
- Oseghale, G. E., Omisore, E. Ogbadegesin, J. Taiwo, (2014) Exploratory Survey On The Maintenance Of Osun-Osogbo Sacred Grove, Nigeria. *African Journal of Hospitality, Tourism and Leisure* Vol. 3 (2)

- Pearson D. (2001) Pantropical comparison of bird community: structure of six lowland forest sites, *Condor* 79: 232- 244.
- Pramod, P., R.J.R. Daniels, N.V. Joshi and M. Gadgil. 1997. Evaluating bird communities of Western Ghats to plan for a biodiversity friendly development. *Current Science*, **78**:156-162.
- Thiollay, J. M. (1998). Long-term dynamics of a tropical savanna bird community. *Biodiversity and Conservation* 7, 1291-1312.
- Thies, C. (2005) Landscape perspectives on agricultural intensification and biodiversity ecosystem service management. *Ecology Letters* 8: 857-874.
- UNESCO. 2018. Operational guidelines for the implementation of the World Heritage Convention, Paris: UNESCO.

Appendix 1: Checklist of bird species in the study area

Family	Scientific Name	Common Name
Accipitridae	<i>Spizaetus africanus</i>	Cassin's hawk Eagle
	<i>Kaupifalcomono grammicus</i>	Lizard Buzzard
	<i>Polyboroidestypus</i>	African Harrier Hawk
Alcedinidae	<i>Ispidinalecontei</i>	African Dwarf Kingfisher
	<i>Halcyon badia</i>	Chocolate Backed Kingfisher
	<i>Halcyon malimbica</i>	Blue Bresated Kingfisher
	<i>Halcyon senegalensis</i>	Woodland Kingfisher
Apodidae	<i>Cypsiurusparvus</i>	African Palm Swift
	<i>Apus affinis</i>	Little Swift
Bucerotidae	<i>Tockusfaciatus</i>	African Pied Hornbill
	<i>Tockusnasutus</i>	African Grey Hornbill
	<i>Ceratogymnafistulator</i>	Pipping Hornbill
Campephagidae	<i>Coracinaazurea</i>	Blue Cuckoo Shrike
Capitonidae	<i>Tricholaemahirsuta</i>	Hairy Barbet
	<i>Pogoniulus atroflavus</i>	Red RumpedTinkeredbird
	<i>Gymnobuccocalvus</i>	Naked Faced Barbet
	<i>Pogoniulusscolopaceus</i>	Speckled Tinkerbird
	<i>Pogoniuluschrysoconus</i>	Yellow Fronted Tinkerbird
	<i>Gymnobuccopeli</i>	Bristled Nosed Barbet
	<i>Pogoniulussubsulphureus</i>	Yellow Throated Tinkerbird
Caprimulgidae	<i>Macrodipteryxlongipennis</i>	Standard Nightjar
	<i>Caprimulgusnigriscapularis</i>	Black-Shouldered Nightjar
Cisticolidae	<i>Bathmoercuscerviniventis</i>	Black Head Rufous Wabblers
	<i>Cisticolaerythroptis</i>	Red Faced Cisticola
	<i>Camaropterachloronota</i>	Olive Green Camaroptera
	<i>Priniaabairdii</i>	Banded Prinia
	<i>Camaropterabrachyura</i>	Grey Backed Camaroptera
	<i>Priniasubflava</i>	Tawny- Flanked Prinia
	<i>Apalisjacksoni</i>	Black Throated Apalis
Columbidae	<i>Treron calva</i>	African Green Pigeon

	<i>Turturbremeri</i>	Blue Headed Wood Dove
	<i>Streptopeliasenegalensis</i>	Laughtng Dove
	<i>Streptopeliasemitorquata</i>	Red Eyed Dove
	<i>Tuerturympanistria</i>	Tambourine Dove
Coraciidae	<i>Eurystomusglaucus</i>	Broad Billed Roller
	<i>Coraciascyanogaster</i>	Blue Billed Roller
<hr/>		
Cuculidae	<i>Chrysococcyxcupreus</i>	African Emerald Cuckoo
	<i>Centropusgrillii</i>	Black Coucal
	<i>Cuculusclamosus</i>	Black Cuckoo
	<i>Chrysococcyxcaprius</i>	Dideric Cuckoo
	<i>Cercococcyxmechowi</i>	Dusky Long Tailed Cuckoo
	<i>Chrysococcyxklaas</i>	Klaas Cuckoo
	<i>Centropussenegalensis</i>	Senegal Coucal
	<i>Ceuthmocharesaereus</i>	Yellowbill
Dicruridae	<i>Dicrurusadsimillis</i>	Fork Tailed Drongo
Estrildidae	<i>Spermestes bicolor</i>	Black And White Mannikin
	<i>Nigrita bicolor</i>	Chestnut Breasted Negrofinch
	<i>Nigritacanicapilla</i>	Grey Headed Negrofinch
	<i>Nigritaluteifrons</i>	Pale Fronted Negrofinch
	<i>Lagonostictasenegala</i>	Red BilliedFirefinch
	<i>Cryptospizareichenovii</i>	Red Faced Crimsonwing
	<i>Spermophagaruficapilla</i>	Red Headed Bluebill
	<i>Spermophagahaematina</i>	Western Bluebill
	<i>Nigritafusconota</i>	White Breasted Negrofinch
	<i>Parmoptilarubrifrons</i>	Red Fronted Antpecker
	<i>Parmoptilawoodhousei</i>	Woodhouse's Red Headed Antpecker
	<i>Spermestes cucullatus</i>	<i>Bronze Mannikin</i>
Hirundinidae	<i>Cecropis semirufa</i>	Rufous Chested Swallow
Indicatoridae	<i>Prodotiscus insignis</i>	Cassin's Honeyguide
	<i>Dryoscopus senegalensis</i>	Black Shouldered Puffback
	<i>Malaconotuslegdeni</i>	Lagden's Bush Shrike
Malaconotidae	<i>Dryoscopus sabini</i>	Large Billed Puffback
	<i>Dryoscopus angolensis</i>	Sabine's Puffback
Meropidae	<i>Meropsgularis</i>	Black Bee Eater
	<i>Meropspusillus</i>	Little Bee Eater
	<i>Meropsalbicollis</i>	White Throated Bee Eater
Monarchidae	<i>Elminianigromittrata</i>	Chestnut -Capped Flycatcher
Muscicapidae	<i>Fraseriaaocreata</i>	African Forest Flycatcher
	<i>Trochocercusnitens</i>	Blue Headed Crested Flycatcher

	<i>Cossyphacyanocampter</i>	Blue Shouldered Robin Chat
	<i>Stiphorniserythrothorax</i>	Forest Robin
	<i>Cercotrichasleucosticta</i>	Forest Scrub Robin
	<i>Sheppardiacyornithopsis</i>	Lowland Akalat
	<i>Ficedulahypoleuca</i>	Pied Flycatcher
	<i>Muscicapainfuscata</i>	Sooty Flycatcher
Musophagidae	<i>Tauracopersa</i>	Green Crested Turaco
Nectariniidae	<i>Fraseriaocreata</i>	Green Crested Turaco
	<i>Trochocercusnitens</i>	Buff Throated Sunbird
	<i>Cossyphacyanocampter</i>	Collard Sunbird
	<i>Stiphorniserythrothorax</i>	Green Sunbird
	<i>Cercotrichasleucosticta</i>	Reichenbach1's Sunbird
<hr/>		
	<i>Sheppardiacyornithopsis</i>	Splendid Sunbird
	<i>Ficedulahypoleuca</i>	Supberb Sunbird
	<i>Muscicapainfuscata</i>	Variable Sunbird
Oriolidae	<i>Oriolusbrachyrhynchus</i>	Western Black Headed Oriole
	<i>oriolushosii</i>	Black Winged Oriole
Phoeniculidae	<i>Phoeniculuscastaneiceps</i>	Forest Wood Hoopoe
Platysteiridae	<i>Platysteiracastanea</i>	Chestnut Wattle Eye
	<i>Megabyasflammulatus</i>	African Shrike Flycatcher
	<i>Platysteiracyanea</i>	Common Wattle Eye
Ploceidae	<i>Malimbuserythrogaster</i>	Red Headed Malimbe
	<i>Ploceusnigerrimus</i>	Velliot's Weaver
	<i>Malinbus scutatus</i>	Red-Vented Malimbe
	<i>Ploceus tricolor</i>	Yellow Mantted Weaver
	<i>Ploceus cuculators</i>	Village Weaver
	<i>Malimbus ibadanensis</i>	Ibadan Malimbe
Prionopidae	<i>Prionopscaniceps</i>	Red Billed Helmet-Strike
Pycnonotidae	<i>Andropadusansorgei</i>	AnssorgesGreenbull
	<i>Bledasyndactyla</i>	Common Bristlebill
	<i>Pycnonotus barbatus</i>	Common Bulbul
	<i>Bledaeximius</i>	Green Tailed Bristlebill
	<i>Baeopogon indicator</i>	Honeyguide Greenbull
	<i>Phyllastrephusicterinus</i>	IcterineGreenbull
	<i>Andropadusvirens</i>	Little Greenbull
	<i>Andropaduscurvirostris</i>	Plain Greenbull
	<i>Chlorocichla simplex</i>	Simple Greenbull
	<i>Chlorocichla simplex</i>	Simple Leave Love
	<i>Nicatorchloris</i>	Western Nicator
	<i>Andropaduslatirostris</i>	Yellow Whiskered Greenbull

Rallidae	<i>Sarothrurapulchra</i>	White Spotted Flutail
Recurvirostridae	<i>Himantopus himantopus</i>	Black Winged Stilt
Strigidae	<i>Strix woodfordii</i>	African Wood Owl
Sturnidae	<i>Poeyopteralugubris</i>	Narrow Tailed Starling
	<i>Lamprotornis purpureiceps</i>	Purple Headed Starling
Sylviidae	<i>Sylvietta virens</i>	Green Combec
	<i>Hylia prasina</i>	Green Hylia
	<i>Macrosphenus concolor</i>	Grey Longbill
	<i>Eremomela badiceps</i>	Rufous Crowned Eremomela
Turdidae	<i>Alethe castanea</i>	Fire Tailed Alethe
	<i>Zosterorhina princei</i>	Grey Ground Thrush
	<i>Alethe diademata</i>	White Tailed Alethe
	<i>Neocossyphus poensis</i>	White Tailed Ant Thrush
Viduidae	<i>Vidua macroura</i>	Pin Tail Whaydah
Zosteropidae	<i>Platysteira concreta</i>	Yellow White Eye

Appendix 2: Checklist of tree species in the study area

Name of Tree Species	DBH	MH	Frequency
<i>Adenostemma perrotteii</i>	35	13	7
<i>Adenia lobata</i>	43	17	6
<i>Adenostemma perrotteii</i>	40	19	2
<i>Azelia africana</i>	233	34	9
<i>Albizia coriaria</i>	188	31	1
<i>Albizia gummifera</i>	199	29	8
<i>Albizia ferruginea</i>	212	32	13
<i>Albizia zygia</i>	246	32	6
<i>Allanblackia floribunda</i>	178	35	4
<i>Alstonia boonei</i>	280	31	4
<i>Alstonia congensis</i>	145	30	6
<i>Albizia heterophylla</i>	47	17	9
<i>Amphimas pterocarpoides</i>	190	29	2
<i>Anarcadium occidentale</i>	57	17	6
<i>Angylocalyx zenkeri</i>	133	28	8
<i>Anona muricata</i>	34	14	6
<i>Anonidiummanni</i>	48	18	4
<i>Anopyxis klianeana</i>	67	21	5
<i>Anthoceleista nobilis</i>	76	24	3
<i>Anthothona macrophylla</i>	59	21	4
<i>Antiaris africana</i>	233	35	3

<i>Antiaris welwitschii</i>	222	36	2
<i>Antrocaryon micraster</i>	97	28	5
<i>Aristolochina ningens</i>	111	27	4
<i>Artocarpus attilis</i>	79	27	7
<i>Aviceniagermirans</i>	87	30	5
<i>Azadirachta indica</i>	99	24	9
<i>Balanites wilsonana</i>	43	13	5
<i>Baphianitida</i>	110	28	7
<i>Bateria fistulosa</i>	57	21	4
<i>Berlinia grandiflora</i>	77	25	8
<i>Berlinia SPP</i>	65	25	3
<i>Bidens pilosa</i>	14	8	3
<i>Blighia sapida</i>	122	27	2
<i>Blighia welwithil</i>	34	12	6
<i>Bombax brevicuspe</i>	133	28	6
<i>Bosqueia angolensis</i>	112	22	6
<i>Brachystegia eurycoma</i>	456	35	36
<i>Brachystegia nigerica</i>	466	39	19
<i>Bridelia ferruginea</i>	375	21	4
<i>Bridelia micrantha</i>	57	24	6
<i>Bryophyllum pinnatum</i>	89	21	9
<i>Canarium schweinfurthii</i>	76	21	7
<i>Carpolobi alutea</i>	64	23	4

<i>Cassia alata</i>	10	8	5
<i>Cassia hrusta</i>	87	24	7
<i>Cathium hispicum</i>	66	21	9
<i>Ceiba pentandra</i>	398	35	8
<i>Celtis aldolfi-friderici</i>	98	23	4
<i>Celtis mildibraedii</i>	56	21	5
<i>Celtis mildibraedii</i>	87	23	6
<i>Celtis zenkeri</i>	111	21	5
<i>Chrysophyllum abidun</i>	231	31	4
<i>Chrysophyllum delevoyi</i>	234	30	4
<i>Chrysophyllum africana</i>	67	21	5
<i>Cissampelos mucronata</i>	41	20	2
<i>Cleistopholis patens</i>	65	21	8
<i>Cola acuminata</i>	110	25	8
<i>Cola ginganta</i>	221	31	8
<i>Cola lateritia</i>	245	31	8
<i>Cola melleni</i>	64	21	5
<i>Combretodendron macrocarpum</i>	131	24	8
<i>Cordia millenii</i>	132	25	5

<i>Crescentia cujete</i>	46	20	12
<i>Cylicodiscus gabunensis</i>	76	26	6
<i>Cymbopogon citratus</i>	99	27	12
<i>Spathodeacom panulata</i>	132	21	8
<i>Daniella ogea</i>	341	34	4
<i>Deinbollia piñata</i>	88	24	5
<i>Desplatsia subericarpa</i>	42	21	3
<i>Dialium guineense</i>	131	24	9
<i>Dlopros nigerica</i>	121	23	6
<i>Diospyrosalbo flavescens</i>	67	21	7
<i>Diospyros dendo</i>	55	20	9
<i>Diospyros mesipiliformis</i>	62	25	6
<i>Distemonanthusbenthamianus</i>	87	26	6
<i>Elaesis guineesis</i>	110	27	6
<i>Entada Africana</i>	122	28	9
<i>Entandrophragm aangolense</i>	351	34	7
<i>Entandrophragma utile</i>	366	38	9
<i>Erythrophleum suaveolens</i>	174	25	6
<i>Fagara macrophylla</i>	95	21	4
<i>Ficus sur</i>	133	27	5
<i>Ficus capensis</i>	121	23	5
<i>Ficus esasperata</i>	326	34	8
<i>Ficus glumosa</i>	98	25	0
<i>Ficus glumosa</i>	57	21	0
<i>Ficus sur</i>	43	20	3
<i>Ficus thoniigii</i>	54	21	3
<i>Funtumia Africana</i>	136	28	17
<i>Funtumia elastic</i>	90	23	3
<i>Garcinia kola</i>	122	21	3
<hr/>			
<i>Gossweilorodendron balsaminiferum</i>	34	14	1
<i>Grewiavenusta</i>	43	20	2
<i>Guareacedrata</i>	79	27	1
<i>Guibourtia sp.</i>	89	23	1
<i>Halleacilata</i>	38	12	1
<i>Hannoaklaineana</i>	76	23	1
<i>Heveabrasiliensis</i>	85	25	1
<i>Homaliumaylmeri</i>	39	11	1
<i>Hunteria umbellate</i>	63	23	2
<i>Hymenostegiaafzelii</i>	42	21	2
<i>Icacinatrchantha</i>	56	23	1
<i>Irvingiagabonensis</i>	172	28	2

<i>Irvingiagrandifolia</i>	129	30	1
<i>Khayagrandifoliola</i>	166	31	3
<i>Khayaivorensis</i>	34	12	1
<i>Kigelia Africana</i>	199	32	3
<i>Lanneawelwitschi</i>	73	23	2
<i>Lonchocarpusgriffonianus</i>	72	21	5
<i>Lophiraalata</i>	155	29	1
<i>Lovoatrichilioides</i>	111	21	1
<i>Maesobotryabateri</i>	122	24	2
<i>Maesopsiseminii</i>	26	8	7
<i>MagniferalIndical</i>	67	26	1
<i>Memocylonblakeoides</i>	210	34	8
<i>Milicia excelsa</i>	239	39	3
<i>Milleticecerriceus</i>	56	24	2
<i>monodoramyristica</i>	45	21	1
<i>Moringalucida</i>	56	20	5
<i>Musangacecropioides</i>	131	21	1
<i>Myrianthusarboreus</i>	133	23	3
<i>Napoleoneavogelii</i>	98	20	2
<i>Naucleadiderrichii</i>	67	22	3
<i>Nesogordoniapapaverifera</i>	79	20	5
<i>Newbouldialaevis</i>	73	21	5
<i>Ntrocaryonmicraster</i>	84	22	1
<i>Okoubakaaubrevillei</i>	54	21	1
<i>Olaxsubscorpioidea</i>	59	20	1
<i>Oxytenantherabyssinica</i>	78	21	2
<i>Pachyelasmattessmannii</i>	53	20	2
<i>Panda oleasa</i>	45	21	3
<i>Pausinystaliamacroceras</i>	87	24	2
<i>Pentaclethramacrophylla</i>	99	23	3
<i>Pentaclethramacrophylla</i>	87	26	3
<i>Pentaclethramacrophylla</i>	84	27	1
<i>Pentadesmabutyracea</i>	55	21	3
<i>Piptadeniastrumaffricanum</i>	145	29	1
<i>Polyalthiasuaveolens</i>	34	8	2
<hr/>			
<i>Polyceratocarpusparviflorus</i>	122	23	1
<i>Psidiumguajava</i>	13	5	1
<i>Pterocarpussoyauxii</i>	28	7	3
<i>Pterocarpusosun</i>	117	26	2
<i>Pycanthusangolensis</i>	231	39	1

<i>Rauvolfiavomitoria</i>	98	24	1
<i>Ravolfiatraphylla</i>	23	7	2
<i>Ricinodendronheudelotii</i>	32	9	3
<i>Rothmanniahispida</i>	67	24	1
<i>Saacharumofficinarum</i>	14	7	1
<i>Scottelliacoriacea</i>	54	20	3
<i>Snysepalumdulcificum</i>	13	9	1
<i>Sopondiamombin</i>	63	21	3
<i>Spathodeacampanulatu</i>	46	22	1
<i>Staudtiastipitata</i>	76	20	2
<i>Sterculiaoblonga</i>	49	21	3
<i>Sterculiatragacantha</i>	54	22	2
<i>Sterculliacoriata</i>	34	23	1
<i>Stombosiagrandifolia</i>	53	28	1
<i>Strombosia postulate</i>	63	27	3
<i>Tabernaemontanapachysiphen</i>	122	29	1
<i>Terminalia ivorensis</i>	143	29	4
<i>Terminalia superba</i>	167	30	2
<i>Tetracarpidiumconophorum</i>	112	21	1
<i>Tetrapleuratetaptera</i>	143	25	2
<i>Tetrorchidiumdidymostemon</i>	54	23	1
<i>Theobroma cacao</i>	13	7	1
<i>Tramaorientalis</i>	25	10	2
<i>Treculia Africana</i>	175	30	2
<i>Trichilialanata</i>	54	21	1
<i>Trichiliaprieuriana</i>	54	21	1
<i>Triplochiton scleroxylon</i>	257	37	4
<i>Triumfettapentandra</i>	38	21	2
<i>Uvariopsisdioica</i>	11	5	4
<i>Xylopiiathiopica</i>	29	17	1
