



A SYSTEMATIC COMPILATION OF ENDEMIC FLORA IN NIGERIA FOR CONSERVATION MANAGEMENT

T.I. Borokini^{1,2}

ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

OPEN ACCESS

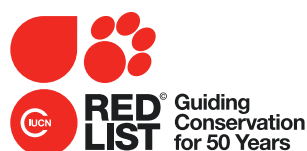
¹ Plant Genetic Resources Unit, National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan, Nigeria

² Ecology, Evolution and Conservation Biology Unit, Department of Biology, University of Nevada, Reno NV 89557-0314, USA
tbisrael@gmail.com

Abstract: Endemic species with limited geographical ranges are more susceptible to extinction than widely ranging species, and effective conservation management of endemic species requires detailed knowledge of their status and distribution. This study was conducted to assemble a comprehensive list of flora endemic to Nigeria. While earlier reports listed as many as 205 endemic plant species, only 91 species belonging to 44 families were found in this study, with Rubiaceae accounting for the highest number of species. The list contains 23 trees, 26 herbs, 22 shrubs, 14 epiphytic orchids and bryophytes, three vines and three ferns. The Oban Division of the Cross River National Park houses 41 endemic plants, while other notable locations for endemic flora include Eket, Naraguta, Degema, Idanre hills, Ukpon River Forest Reserve, Calabar and Anara Forest Reserve. Only 15 of the endemic plants are listed in the IUCN Red List of Threatened Species version 2013.2, ranging from Vulnerable to Critically Endangered.

Keywords: Biodiversity, biogeography, conservation, distribution range, endangered species, endemic flora, Nigeria, Rubiaceae, Transboundary Protected Areas.

French Abstract: Les espèces endémiques avec les zones géographiques limitées sont plus sensibles à l'extinction que largement allant espèces et efficace gestion de la conservation des espèces endémiques exige une connaissance détaillée de leur statut et de la distribution. Cette étude a été menée à dresser une liste complète de la flore endémique au Nigeria. Alors que les rapports précédents énumérés jusqu'à 205 espèces de plantes endémiques, seulement 91 appartenant à 44 familles ont été trouvés dans cette étude, avec Rubiaceae représente le plus grand nombre d'espèces. La liste contient 23 arbres, 26 herbes, 22 arbustes, 14 orchidées épiphytes et bryophytes, trois vignes et trois fougères. La Division Oban du Parc National de Cross River abrite 41 Plantes endémiques, tandis que d'autres endroits remarquables de la flore endémique comprennent Eket, Naraguta, Degema, collines Idanre, réserve forestière Ukpon River, Calabar et la réserve forestière de Anara. Seuls 15 des plantes endémiques sont répertoriés dans la Liste rouge de l'UICN 2013,2 Version espèces, allant de Vulnérable à En danger critique.



DOI: <http://dx.doi.org/10.11609/JoTT.o4010.6406-26>

Editor: Merlin Franco, Curtin University, Malaysia.

Date of publication: 26 October 2014 (online & print)

Manuscript details: Ms # o4010 | Received 30 April 2014 | Final received 19 September 2014 | Finally accepted 30 September 2014

Citation: Borokini, T.I. (2014). A systematic compilation of endemic flora in Nigeria for conservation management. *Journal of Threatened Taxa* 6(11): 6406–6426; <http://dx.doi.org/10.11609/JoTT.o4010.6406-26>

Copyright: © Borokini 2014. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use of this article in any medium, reproduction and distribution by providing adequate credit to the authors and the source of publication.

Funding: The studies was carried out entirely by the author, without any external financial support.

Competing Interest: The authors declare no competing interests.

Author Details: The author is a Senior Scientific Officer at National Center for Genetic Resources and Biotechnology, with research interests in Tropical Plant distributions and Macroecology, and Molecular Ecology. He is currently doing his PhD research at University of Nevada Reno.

Acknowledgements: The author wishes to express appreciation to the staff of @One lab, Mathewson-IGT Knowledge Center, University of Nevada Reno for assistance with map designs. The brilliant suggestions and modifications of this manuscript by the reviewers and editors is also appreciated. Assistance from the staff of Herbarium unit, Forestry Research Institute of Nigeria, Ibadan, Nigeria is also appreciated.

INTRODUCTION

Naturalists and botanists have recognised the existence of rare and endemic species for centuries. The origin of the word “endemic” as it applied to the distribution of organisms is ascribed to De Candolle (1855). An endemic species is one that is restricted to a particular geographic area; the geographical area can be defined by political boundaries, such as country or department endemics, or by ecological boundaries (Gaston 1991; Beck et al. 2007; Young 2007). The degree of endemism for an area is often cited as a measure of the uniqueness of the flora, and consequently is important for prioritizing sites for conservation (Myers et al. 2000; Brooks et al. 2002; Knapp 2002; Young et al. 2002). It should be noted that the confinement of endemic species to a single habitat renders them extremely vulnerable to environmental change. More than half of the endemic cichlid fishes in Lake Victoria have disappeared since the introduction of Nile perch, a voracious predator, as a game fish by Ugandan officials in the 1920s (Wilson 2010).

Endemism has attracted the attention of biologists and biogeographers since the 19th century (López-Pujol, et al. 2011). Plant and animal endemism is the principal criterion for determination of hotspot status because endemic species are entirely dependent on a single area for their survival, and by virtue of their more restricted ranges, are often the most vulnerable (Myers et al. 2000). These species, confined to highly threatened ecosystems, will almost certainly be the first to be hit by extinction processes, and hence need rapid and effective conservation action (Heywood & Watson 1995). The 25 hotspots cover only 1.4% of the Earth’s land surface, and account for 1,33,149 plant species (44% of all plant species worldwide) and 9,645 vertebrate species (35%) (Myers et al. 2000). More than ever before, conservationists have begun using data on the geography of biodiversity to set priorities for locating protected areas (Brooks et al. 2006).

Many of the world’s hotspots for biodiversity are found in nations with tropical moist forests, but these nations also face profound socio-economic difficulties that cause widespread habitat loss and degradation. Given that endemism and extinction risk are closely coupled (IUCN 2001), actions to minimize global extinction need to focus on patterns in endemism and range-restricted species (Pimm et al. 1995; Myers et al. 2000; Pimm & Brooks 2000). The major issue with endemism is that most species are not scientifically described, and consequently little if anything is known

about their ecology or geographical distributions (Pimm & Brooks 2000). Stuart et al. (2010) noted that only 3.9% of 2,82,000 known species have been studied and evaluated for their conservation status (Stuart et al. 2010).

Rarity is central to tropical forest conservation (Kenfack et al. 2006). The African mainland has between 40,000 and 60,000 plant species (Beentje et al. 1994; Beentje 1996), of which approximately 35,000 are endemic. At least a sixth of the world’s estimated 2,70,000 plant species (Groombridge & Jenkins 2002) are endemic to Africa, while five of the 20 global centres of plant diversity are located in Africa (Barthlott et al. 2005). Yet for most African nations the number of endemic plant species is unknown or poorly estimated, and there is little research or conservation activities concerning them.

Brenan’s 1978 report of plant diversity in Nigeria was based on his analysis of the geographical distribution of all species reported in previous publications (Hepper 1965; Morton 1972; Clayton & Hepper 1974) and the revised editions of Flora of West Tropical Africa (FWTA) (Hutchinson & Dalziel 1958, 1963, 1972). This figure of endemic species was further emphasized in the FEPA (1992) Nigerian biodiversity report. However, since many more species have been discovered after the last edition of the FWTA in 1972, some of the plants that were thought to be endemic to one country have been subsequently recorded from others. This study was carried out to review the current list of endemic species in Nigeria and compile an updated comprehensive list in order to highlight conservation priorities.

METHODS

Brenan’s (1978) account of endemism was based on analysis of Flora in Africa and other related studies. In this study identification of Nigerian endemic flora was done primarily via comprehensive secondary data mining of plant records in books, reliable internet resources and herbarium collections, performed between September 2012 and April 2014. The books used were Trees of Nigeria (Keay 1989); Nigerian Trees, volumes 1 and 2 (Keay & Onochie 1964a,b); second and revised edition of Flora of West Tropical Africa (FWTA), volume 1 (parts 1 and 2) (Hutchinson & Dalziel 1958), volume 2 (Hutchinson & Dalziel 1963), and volume 3 (parts 1 and 2) (Hutchinson & Dalziel 1972), and The Useful Plants of West Tropical Africa volumes 1–5 (Burkill 1985, 1994, 1995, 1997, 2000). There exists no nationwide plant

survey in Nigeria, thus biogeographical knowledge comes primarily from existing editions of Flora of West Tropical Africa (FWTA). Additional information on the natural distribution of taxa was obtained from the Herbarium (FHI) in Forestry Research Institute of Nigeria (FRIN), Ibadan. References were also made to other publications on checklists of orchids (Segerback 1983), pteridophytes (Alston 1959; Kornas 1983; Nwosu 2002) and bryophytes (O'Shea 2006) in Nigeria. Other vital publications consulted included Keay (1953), Hepper (1965), Bridson (1978), Morton (1972), Clayton & Hepper (1974). Furthermore, reference was also made to the list of Nigerian plants with new names and taxonomic adjustments published by Lowe & Soladoye (1990).

Having compiled the list of endemic plant species in Nigeria, it was screened on updated online Plant Systematics databases such as African Plant Database (2012), IUCN Red list of Threatened Species (IUCN 2013), Rhind (2013), Glenn (2006), Govaerts et al. (2011), IPNI

(2012), Angiosperm Phylogeny Group (2009), JSTOR (2013), GBIF (2010), the Plant List (2013) and Tropicos (2014). The plant names, family, growth habit and habitat of the identified endemic plant taxa were noted.

RESULTS

Figure 1 shows a map of Nigeria illustrating the geographical locations of endemic plants listed in Table 1. A total of 91 plant species were identified spread across 44 families, including 23 trees, 22 shrubs, 26 herbs, 14 epiphytes (orchids and bryophytes), three vines and three ferns (Fig. 2). Rubiaceae has the highest number of species (11), followed by Orchidaceae (8), Acanthaceae (7), Papilionaceae and Caesalpiaceae (5 each), Annonaceae and Malvaceae (4 each; Fig. 3). The endemic flora of Nigeria is spread across 17 states in 55 locations, of which 32 (58.2%) are forest and the rest

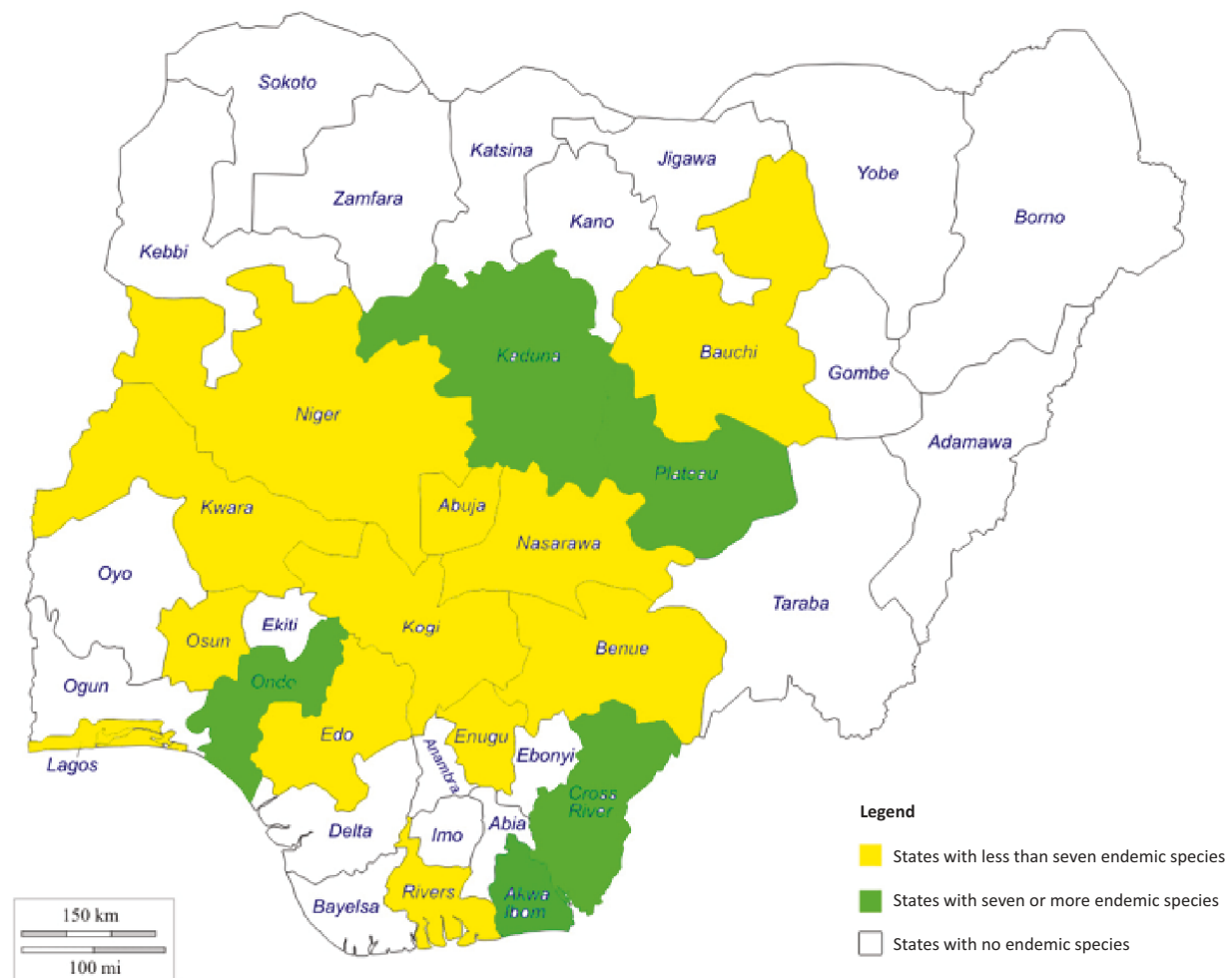


Figure 1. Tally of endemic flora of Nigeria

Table 1. List of endemic plant species in Nigeria

	Plant name	Family	Life form	Natural Distribution	Remarks
1	<i>Aeschynomene neglecta</i> Hepper	Papilionaceae	Herb	Abinsi (Benue State); Naraguta, Jos (Plateau State); Bauchi Plateau (Bauchi State)	Syn: <i>Bakerophyton neglectum</i> (Hepper) Maheshw.
2	<i>Alectra virgata</i> Hemsl.	Orobanchaceae	Herb	Lagos area	
3	<i>Allophylus nigericus</i> Bak. f.	Sapindaceae	Shrub	Calabar, Ukpon FR, Oban Division, Cross River National Park (Cross River State)	
4	<i>Anemia nigerica</i> Alston.	Schizaeaceae	Fern	Idanre hills (Ondo State)	
5	<i>Athyrium glabratum</i> (Mett. ex Kuhn.) Alston.	Woodsiaceae	Fern	River Ata, below Mt. Koloishe (Cross River State)	Some publications call it <i>Doroathyrium boryanum</i> Wild Ching
6	<i>Begonia salisburyana</i> Irmsh.	Begoniaceae	Herb	Okomu National Park (Edo State), Oban Division, Cross River National Park (Cross River State)	
7	<i>Beilschmiedia foliosa</i> (S. Moore) Robyns & Wilczek l	Lauraceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Syn: <i>Tylostemon foliosus</i> S. Moore
8	<i>Berlinia hollandii</i> Hutch. & Dalz.	Caesalpiniaceae	Tree	Itu (Akwa Ibom State); Oban Division, Cross River National Park (Cross River State).	Endangered on the IUCN Red List of Threatened Species
9	<i>Caesaria stipitata</i> Mast.	Samydaceae	Tree	Aboh (Kogi State)	Collected on Aboh on the River Niger over 100 years ago and not recorded ever since
10	<i>Cassipourea eketensis</i> Bak. f.	Rhizophoraceae	Tree	Oban Division, Cross River National Park (Cross River State), Eket (Akwa Ibom State)	Critically Endangered on the IUCN Red List of Threatened Species
11	<i>Chlorophytum caulescens</i> (Baker) Marais & Reilly	Asparagaceae	Herb	Ilorin (Kwara State) to Jebba (Niger State)	Syn: <i>Anthericum caulescens</i> Bak.
12	<i>Chlorophytum dalzielii</i> (Hutch ex Hepper) l. Nordal	Asparagaceae	Herb	Bukuru, Jos (Plateau State)	Syn: <i>Anthericum dalzielii</i> Hutchinson ex Hepper
13	<i>Clerodendrum tomentellum</i> Hutch. & Dalz.	Verbenaceae	Tree	Vom, Jos, Naraguta FR (Plateau State)	
14	<i>Cola gigas</i> Bak. f.	Sterculiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Vulnerable on the IUCN Red List of Threatened Species
15	<i>Cola glabra</i> Brenan & Keay	Sterculiaceae	Tree	Akure FR, Owena FR (Ondo State)	Vulnerable on the IUCN Red List of Threatened Species
16	<i>Cola philippi-jonesii</i> Brenan & Keay	Sterculiaceae	Shrub	Boje, Afi Mountain Wildlife Sanctuary (Cross River State)	
17	<i>Costus talbotii</i> Ridl.	Costaceae	Herb	Oban Division, Cross River National Park (Cross River State)	
18	<i>Cryptosepalum diphyllum</i> Duvign	Caesalpiniaceae	Tree	Ukpon River FR, Ekan river, Obubra (Cross River State)	Endangered on the IUCN Red List of Threatened Species
19	<i>Dactyladenia dichotoma</i> (De Wild) Prance and F. White	Chrysobalanaceae	Tree	Eket (Akwa Ibom State)	Syn: <i>Acioa dichotoma</i> De Wild. Critically Endangered on the IUCN Red List of Threatened Species
20	<i>Dalbergia albiflora</i> subsp. <i>echinocarpa</i> Hepper	Papilionaceae	Tree	Enugu extension FR, Ekulu, Milliken hill (Enugu State)	
21	<i>Diaphananche dorotheae</i> (Rendle) Summerh.	Orchidaceae	Epiphyte	Oban Division, Cross River National Park (Cross River State)	
22	<i>Dichapetalum obanense</i> (Bak. f.) Hutch. & Dalz.	Dichapetalaceae	Tree	Oban Division, Cross River National Park (Cross River State)	This species is also called <i>D. thomsonii</i> var. <i>obanense</i> by some taxonomists
23	<i>Dichapetalum thomsonii</i> (Oliv.) Engl.	Dichapetalaceae	Tree	Calabar (Cross River State)	Syn: <i>Dichapetalum obanense</i> (Baker f.) Baker f. ex Hutch. & Dalziel
24	<i>Dischistocalyx obanensis</i> S. Moore	Acanthaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
25	<i>Dissotis grammicola</i> (Hutch.)	Melastomataceae	Herb	Jemaa (Nasarawa State), Naraguta (Plateau State)	
26	<i>Dissotis idanreensis</i> Brenan	Melastomataceae	Shrub	Idanre hills (Ondo State), Osun river (Osun State)	
27	<i>Dracaena talbotii</i> Rendle	Agavaceae	Herb	Oban Division, Cross River National Park (Cross River State)	
28	<i>Drypetes talbotii</i> S. Moore	Euphorbiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
29	<i>Eriocaulum pungens</i> var. <i>inermis</i> Keay	Sapindaceae	Tree	Eket (Akwa Ibom State), Degema (Rivers State)	

	Plant name	Family	Life form	Natural Distribution	Remarks
30	<i>Fissidens nigerianus</i> Bizot ex Brugg. & Nann.	Fissidentaceae	Epiphyte	Garki Kurmi, Abuja	This taxon is a moss
31	<i>Genyorchis apertiflora</i> Summerh.	Orchidaceae	Epiphyte	Mountain Orosun, Idanre hills (Ondo State)	
32	<i>Habenaria linguiformis</i> Summerh.	Orchidaceae	Epiphyte	Zongon Katab, Zaria; Bukuru, Kuru (Plateau State)	
33	<i>Habenaria nigerica</i> Summerh.	Orchidaceae	Epiphyte	Mando FR, Mongu FR (Plateau State); Zongon Katab, Zaria (Kaduna State)	
34	<i>Habenaria phylacocheira</i> Summerh.	Orchidaceae	Epiphyte	Vom, Ropp (Plateau State)	
35	<i>Habenaria prionocraspedon</i> Summerh.	Orchidaceae	Epiphyte	Boshi (Cross River State)	
36	<i>Hibiscus grewioides</i> Bak. f.	Malvaceae	Tree	Oban Division, Cross River National Park (Cross River State)	
37	<i>Hibiscus sineaculeatus</i> F.D Wilson	Malvaceae	Herb	Anara FR (Kaduna State)	Some taxonomic notes consider it a synonym to <i>H. scotellii</i> Baker f.
38	<i>Huernia nigeriana</i> Lavranos	Asclepiadaceae	Herb	Mongu FR (Plateau State)	
39	<i>Hypoestes talbotii</i> S. Moore	Acanthaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Syn: <i>Hypoestes rosea</i> P. Beauv.
40	<i>Indigofera hutchinsoniana</i> J.B. Gillet	Papilionaceae	Herb	Jebba, River Niger, Lokoja (Kogi State)	Syn: <i>Microcharis tenella</i> Benth.
41	<i>Indigofera latisejala</i> Gillett	Papilionaceae	Herb	River Niger (Kogi State)	
42	<i>Indigofera wituensis</i> var. <i>occidentalis</i> Gillet	Papilionaceae	Herb	Bauchi Plateau (Bauchi State)	
43	<i>Ixora nigerica</i> subsp. <i>nigerica</i> Keay	Rubiaceae	Shrub	Ndealichi FR, Ukpon River FR, (Cross River state)	It is listed as vulnerable in IUCN redlist
44	<i>Justicia nigerica</i> S. Moore	Acanthaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
45	<i>Justicia tenuipes</i> S. Moore	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State)	
46	<i>Leptotrichella ligulifolia</i> (Müll. Hal.) Ochyra	Dicranaceae	Epiphyte	Unknown	This taxon is a moss
47	<i>Leptotrichella moenkemeyeri</i> (Müll. Hal.) Ochyra	Dicranaceae	Epiphyte	Unknown	Syn: <i>Seligeria moenkemeyeri</i> Müll. Hal. This taxon is a moss
48	<i>Lomariopsis decrescens</i> (Bak.) Kuhn.	Lomariopsidaeae	Fern	Unknown	The taxonomy is unresolved. Some taxonomists consider it the same as <i>Stenochlaena decrescens</i> Underw. of family Blechnaceae
49	<i>Macrobium talbotii</i> Hutch. & J.M Dalz.	Caesalpiniaceae	Tree	Oban Division, Cross River National Park (Cross River State)	
50	<i>Monodora unwinii</i> Hutch. & Dalz.	Annonaceae	Tree	Unwin (Edo State)	Vulnerable on the IUCN Red List of Threatened Species
51	<i>Mussaenda afzelioides</i> Wernham	Rubiaceae	Vine	Oban Division, Cross River National Park (Cross River State)	
52	<i>Napoleonaea lutea</i> Bak. f. ex Hutch. & Dalz.	Lecythidaceae	Tree	Eket (Akwa Ibom State)	Critically Endangered on the IUCN Red List of Threatened Species
53	<i>Napoleonaea reptans</i> Bak. f. ex Hutch. & Dalz.	Lecythidaceae	Shrub	Eket (Akwa Ibom State)	Critically Endangered on the IUCN Red List of Threatened Species
54	<i>Oiospermum nigritianum</i> Benth.	Asteraceae	Herb	Quorra (River Niger)	Formerly known as <i>Kinghamia nigritana</i> (Benth.) C. Jeffrey
55	<i>Oldenlandia rhabdina</i> Bremek	Rubiaceae	Herb	Bangwele (Bauchi State)	
56	<i>Oxymitra rosea</i> Sprague & Hutch.	Annonaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Syn: <i>Friesodielsia rosea</i> (Sprague & Hutch.) Steenis
57	<i>Oxystigma</i> sp. Harms	Caesalpiniaceae	Tree	Omo FR, Etemi FR (Ogun State); Afi Mountain Wildlife Sanctuary, Oban Division, Cross River National Park (Cross River State)	
58	<i>Papillaria moenkemeyeri</i> (Müll. Hal.) Paris	Meteoriaceae	Epiphyte	Unknown	Syn: <i>Pilotrichella moenkemeyeri</i> (Müll. Hal.) Kindb. The taxon is a moss
59	<i>Pararistolochia tenuicaula</i> (S. Moore) Keay	Aristolochiaceae	Vine	Oban Division, Cross River National Park (Cross River State)	

	Plant name	Family	Life form	Natural Distribution	Remarks
60	<i>Pavetta obanica</i> Bremek.	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
61	<i>Pavetta talbotii</i> Wernham	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
62	<i>Physacanthus talbotii</i> S. Moore	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State); Eket (Akwa Ibom State)	
63	<i>Piptostigma giganteum</i> Hutch. & Dalz.	Annonaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Vulnerable on the IUCN Red List of Threatened Species
64	<i>Rhipidoglossum longicalcar</i> Summerh.	Orchidaceae	Epiphyte	Ife FR (Osun State), Obutong beach, Oban Division, Cross River National Park (Cross River State)	It is synonymous to <i>Diaphanthe longicalcar</i> (Summerh.) Summerh.
65	<i>Riccia nigerica</i> E.W. Jones	Ricciaceae	Epiphyte	Southwest Nigeria	This taxon is a liverwort
66	<i>Rinorea pilosa</i> Chipp.	Violaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
67	<i>Rotala</i> sp. nr <i>dinteri</i> Koehne ex Schinz.	Lythraceae	Herb	Anara FR (Kaduna State)	
68	<i>Rungia dimorpha</i> S. Moore	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State)	
69	<i>Rytigynia argentea</i> (Wernham) Robyns	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
70	<i>Sabicea lanuginosa</i> Wernham	Rubiaceae	Shrub	Apapa, Lagos, Ikoyi plains, mangrove swamp (Lagos State)	
71	<i>Sabicea neglecta</i> Hepper	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
72	<i>Sabicea talbotii</i> Wernham	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
73	<i>Scaphopetalum parvifolium</i> Bak. f.	Malvaceae	Tree	Obutong road, Oban Division, Cross River National Park (Cross River State)	Vulnerable on the IUCN Red List of Threatened Species
74	<i>Scaphopetalum talbotii</i> Bak. f.	Malvaceae	Tree	Cross River National Park (Oban Division), Cross River State	
75	<i>Scyphosyce pandurata</i> Hutch.	Moraceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
76	<i>Sematophyllum trachaelocarpum</i> (Kindb.) Broth.	Sematophyllaceae	Epiphyte	Calabar (Cross River State)	Syn: <i>Hypnum trachaelocarpum</i> Mull. Hal (Hypnaceae)
77	<i>Stachys pyramidalis</i> J.K Morton	Lamiaceae (Labiatae)	Herb	Lokoja (Kogi State)	
78	<i>Staurogyne kamerunensis</i> subsp. <i>calabarensis</i> (Engl.) Benoist	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State)	
79	<i>Striga dalzielii</i> Hutch.	Scrophulariaceae	Herb	Zungeru (Niger State)	
80	<i>Synsepalum glycydora</i> Wernham	Sapotaceae	Tree	Oban Division, Cross River National Park (Cross River State); Degema (Rivers State)	Vulnerable on the IUCN Red List of Threatened Species
81	<i>Talbotiella eketensis</i> Bak. f.	Caesalpiniaceae	Tree	Eket (Akwa Ibom State), Degema (Rivers State)	Endangered on the IUCN Red List of Threatened Species
82	<i>Tiliacora nigerica</i> Troupin	Menispermaceae	Vine	Akure FR, Aponmu FR (Ondo State)	
83	<i>Tricalysia obanensis</i> subsp. <i>obanensis</i> Keay	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
84	<i>Tricalysia wernhamiana</i> (Hutch. & Dalz.)	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
85	<i>Tridactyle muricata</i> (Rendle) Schltr.	Orchidaceae	Epiphyte	Oban Division, Cross River National Park (Cross River State)	
86	<i>Urelytrum auriculatum</i> C.E Hubbard	Poaceae	Herb	Vodni, Pankshin (Plateau State)	
87	<i>Urelytrum gracilis</i> C.E Hubbard	Poaceae	Herb	Shika, Zaria (Kaduna State)	
88	<i>Urobotrya nigerica</i> Baker f.	Opiliaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	
89	<i>Vellozia schnitzleinia</i> var <i>occidentalis</i> Milne-Redh.	Velloziaceae	Herb	Anara FR, Zaria (Kaduna State); Gawu Hills, (Niger state)	
90	<i>Vernonia bauchiensis</i> Hutch. & Dalz.	Asteraceae	Herb	Jos Plateau (Plateau State)	
91	<i>Xylopia talbotii</i> Exell.	Annonaceae	Tree	Oban Division, Cross River National Park (Cross River State); Eket (Akwa Ibom State).	Vulnerable on the IUCN Red List of Threatened Species

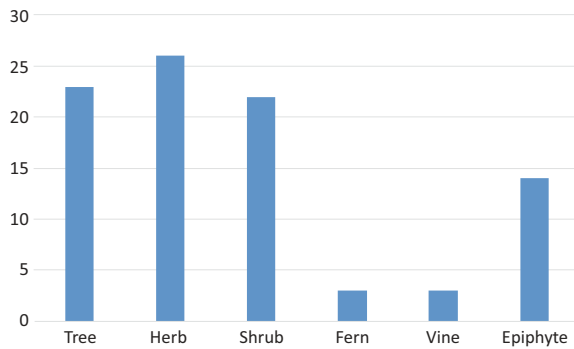


Figure 2. Habit of endemic taxa in Nigeria

savannah.

Forty-one endemic species are located in the Oban division of Cross River National Park, while other notable locations include Eket (8 species), Naraguta (4 species), Degema, Idanre Hills, Ukpou River FR, Calabar and Anara FR (3 species each) (Table 1). Nine locations accounting for 57 endemic species are in montane regions, including Idanre Hills, Cross River National Park (Oban division), Bauchi Plateau, Jos Plateau, Gawu hills and Afi Mountain Wildlife Sanctuary. Eight locations accounting for 12 species are located in riparian areas, especially around river Niger. While classifying locations by State boundaries it was noted that Cross River state housed 57 endemic species, followed by Akwa Ibom State (9), Kaduna State (10), Plateau State (8), Ondo State (7), Niger and Kogi States (5 each) and Lagos State (4), while 19 states of the federation had no endemic plant species recorded.

Screening the list of endemic flora in Nigeria in the 2013.2 version of IUCN Red List of Threatened Species revealed that only 15 have been assessed by IUCN, of which eight were classified as "Vulnerable", three as "Endangered" and the remaining four were "Critically Endangered" (Table 1).

Table 2 shows the list of 153 plants that were once thought to be endemic to Nigeria but have since been found in other African countries, including Cameroon, Gabon, Equatorial Guinea and Democratic Republic of Congo.

DISCUSSION

Changes in plant species endemism in Nigeria

Brenan (1978) gave a detailed account of endemism in tropical Africa. This included 205 endemic species and five endemic genera in Nigeria, 26 in Senegal, 1 in Gambia, 88 in Guinea, 11 in Mali, 74 in Sierra Leone, 59

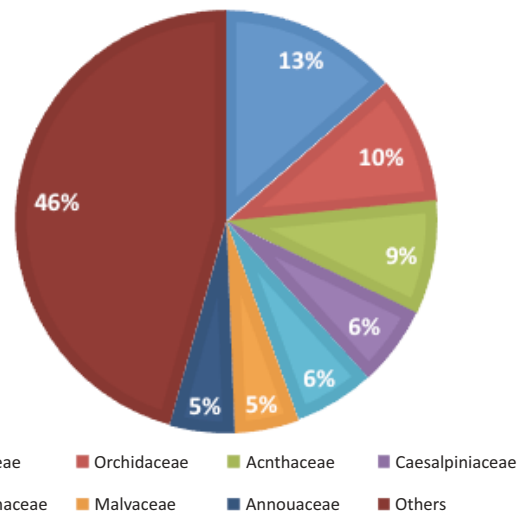


Figure 3. Endemic species representatives of the plant families

in Liberia, 41 in Côte d'Ivoire, 43 in Ghana, 20 in Togo, 11 in Benin Republic and 156 in Cameroon. These are in addition to 108 in Sao Tome and Principe, 259 in Somalia Republic, 553 in Ethiopia (and Eritrea), 449 in Tanzania, 378 in Angola and 106 in Kenya among others (Brenan 1978). The West African (Guinean) Forests, of which Nigerian tropical rainforests is part of, is one of the 25 biodiversity hotspots of global significance for conservation priorities (Myers et al. 2000). In addition, the Nigerian rainforest was identified as one of the centres of diversity in Africa (Davis et al. 1994; Beentje et al. 1994; Beentje 1996).

Nigeria was reported to harbour 7,895 plant species from 338 families and 2,215 genera, in addition to 1,489 identified species of microorganisms (Brenan 1978). It was further reported that Nigerian biodiversity comprises 4,903 species of angiosperms, 32 species of gymnosperms, 155 pteridophyte species, 80 bryophyte species, 134 plankton species, 55 bacteria species, 784 algae species, 3,423 fungi species and more than 500 species of viruses (FEPA 1992). Brenan (1978) further stated that 20 plant species had become extinct since 1950, about 431 species were endangered, 45 species were classified as rare, and 20 species were vulnerable. 205 species were endemic, the ninth highest number of endemic species among 42 African countries (Brenan 1978). Out of these 205 endemic species the northern region, with Sudanian affinities, has 39 endemic species, western and central regions have 38, and the eastern region is a host to 128 endemic species (Brenan 1978). In addition, eight moss (bryophytes) species were reported to be endemic to Nigeria (O'Shea 1997). Furthermore, Nigeria is said to rank 11th in Africa in terms of plant

Table 2. List of previously thought endemic species in Nigeria

	Plant name	Family	Habit	Distribution in Nigeria	New locations
1	<i>Acalypha nigritiana</i> Müell Arg [Syn: <i>Acalypha ornata</i> Hochst. ex A. Rich]	Euphorbiaceae	Shrub	Yoruba forests, Lagos	Burkina Faso, Central African Republic, Cameroon, Eritrea, Democratic Republic of Congo, Equatorial Guinea, Guinea, Rwanda, Congo Rep., Sudan, Ethiopia, Malawi, Kenya, Tanzania, Uganda, Zimbabwe, Botswana, Mozambique, Swaziland, Angola, Tuvalu
2	<i>Acioa talbotii</i> Bak. f. [Syn: <i>Dactyladenia staudtii</i> (Engl.) Prance & F.White]	Chrysobalanaceae	Tree	Oban	Nigeria, Cameroon, Gabon
3	<i>Actiniopteris australis</i> (Linn.f.) Link	Adiantaceae	Herb	Kabwir, Pankshin District	Brazil, Kenya, Tanzania, Uganda, Burundi, Comoros, Democratic Republic of Congo, Ethiopia, Madagascar, Malawi, Mozambique, Réunion, Somalia, Sudan, Zambia, Zimbabwe
4	<i>Aframomum stanfieldii</i> Hepper	Zingiberaceae	Herb	Owo, Onigambari Forest Reserve (FR)	Ghana, Côte d'Ivoire, Cameroon
5	<i>Agelaea pilosa</i> G. Schellenb [Syn: <i>Agelaea pentagyna</i> (Lam.) Baill.]	Connaraceae	Shrub	Usonigbe FR, Sapoba FR (Edo State); Degema (Rivers State); Ikom (Akwa Ibom state)	Guinea Republic, Guinea Bissau, Côte d'Ivoire, Ghana, Togo, Benin Republic, Liberia, Sierra Leone, Equatorial Guinea, Cameroon, Central African Republic, Angola, Gabon, Congo Republic, Kenya, Tanzania, Mozambique, Madagascar Republic, Zambia
6	<i>Allaxis obanensis</i> (Bak. f.)	Violaceae	Tree	Oban	Cameroon
7	<i>Anchomanes nigritianus</i> Rendle	Acanthaceae	Herb	Etara, Oban	Cameroon, Gabon
8	<i>Ancistrocladus guineensis</i> Oliv.	Ancistrocladaceae	Liana	Etemi FR, Omo FR, Sapoba FR	Cameroon, Gabon
9	<i>Ancistrocladus uncinatus</i> Hutch. & Dalz. [Syn: <i>Ancistrocladus guineensis</i> Oliv.]	Ancistrocladaceae	Shrub	Eket (Akwa Ibom State)	Cameroon, Gabon and Congo Republic
10	<i>Angraecum angustum</i> (Rolfe) Summerh.	Orchidaceae	Herb	Itu	Cameroon
11	<i>Annona barteri</i> Benth. [Syn: <i>Duguetia barteri</i> (Benth.) Chatrou and <i>Pachypodanthium barteri</i> (Benth.) Hutch. & Dalz.]	Annonaceae	Tree	Koton Karifi Swamp FR, Ibaji Ojoku, Kabba	Gabon and Cameroon
12	<i>Anthericum nigericum</i> Hepper	Asparagaceae	Herb	Anara FR, Zaria, Jos Plateau	Democratic Republic of Congo, Kenya, Tanzania
13	<i>Anthocleista obanensis</i> Wernham	Loganiaceae	Liana	Sapoba FR (Edo State); Eket (Akwa Ibom State); Oban Division, Cross River National Park (Cross River State)	Cameroon and Gabon
14	<i>Anthothona obanensis</i> (Bak. f.) J. Leonard [Syn: <i>Isomacrolobium obanense</i> (Baker f.) Aubrév. & Pellegr.]	Caesalpiaceae	Tree	Idanre hills (Ondo State); Degema (Rivers State), Obudu, Oban Division, Cross River National Park (Cross River State)	Liberia, Sierra Leone, Côte d'Ivoire, Cameroon, Gabon, Angola, Democratic Republic of Congo. Vulnerable on the IUCN Red List of Threatened Species
15	<i>Aporrhiza talbotii</i> Baker f.	Sapindaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Gabon
16	<i>Artabotrys coccineus</i> Keay	Annonaceae	Liana	Ibadan South FR (Oyo State)	Benin Republic
17	<i>Asplenium cornutum</i> Alston	Aspleniaceae	Herb	Mambilla Plateau	Cameroon, Equatorial Guinea
18	<i>Baijsea subsessilis</i> (Benth.) Stapf ex Hutch [Syn: <i>Baijsea campanulata</i> (K.Schum.) de Kruif]	Apocynaceae	Shrub	Ishagama, Osun FR, Onigambari FR to Ibadan	Ghana, Côte d'Ivoire, Cameroon, Equatorial Guinea, Gabon, Democratic Republic of Congo, Congo Republic, Angola, Central African Republic.
19	<i>Batesanthus talbotii</i> S. Moore [Syn: <i>Batesanthus purpureus</i> N.E. Br.]	Asclepiadaceae	Herb	Oban Division, Cross River National Park (Cross River State)	Angola, Sierra Leone, Guinea, Cameroon, Gabon, Central African Republic and Democratic Republic of Congo
20	<i>Begonia cilio-bracteata</i> Warb.	Begoniaceae	Herb	Awi FR	Cameroon, Ghana, Democratic Republic of Congo

	Plant name	Family	Habit	Distribution in Nigeria	New locations
21	<i>Beilschmiedia myrciifolia</i> (S. Moore) Robyns & R. Wilczek	Lauraceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
22	<i>Belonophora talbotii</i> (Wernham) Keay	Rubiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Gabon. Vulnerable on the IUCN Red List of Threatened Species
23	<i>Brachystegia nigerica</i> Hoyle & A. Jones	Caesalpiniaceae	Tree	Onigambari FR, Oluwa FR, Sapoba FR, Urhonigbe FR, Onitsha, Unwin, Awka	Cameroon
24	<i>Bulbophyllum calvum</i> Summerh.	Orchidaceae	Herb	Maisamari, Mambilla Plateau	Cameroon
25	<i>Butumia marginalis</i> G. Taylor [Syn: <i>Saxicolella marginalis</i> (G.Taylor) C.Cusset ex Cheek]	Podostemataceae	Herb	Oban Division, Cross River National Park (Cross River State).	Cameroon, unconfirmed records from Ghana and Niger Rep.
26	<i>Campylospermum oliveri</i> (Van. Teigh.) Farron	Ochnaceae	Tree	Calabar, Cross River State.	Cameroon, Gabon and Côte d'Ivoire
27	<i>Canthium inaequilaterum</i> Hutch. & Dalz. [Syn: <i>Keetia inaequilatera</i> (Hutch. & Dalziel) Bridson	Rubiaceae	Shrub	Oban	Congo Republic
28	<i>Carpodinus talbotii</i> Wernham [Syn: <i>Landolphia stenogyne</i> Pichon]	Apocynaceae	Shrub	Oban Division, Cross River National Park (Cross River State).	Gabon and Cameroon
29	<i>Cephalonema polyandrum</i> K. Schum [Syn: <i>Clappertonia polyandra</i> (K. Schum. ex Sprague) Bech.]	Tiliaceae	Herb	Oruikim and Oroku, Uyo (Akwa Ibom State)	Democratic Republic of Congo, Congo Republic, Cameroon and Gabon
30	<i>Chamaengis lanceolata</i> Summerh.	Orchidaceae	Herb	Sapoba FR, Oban	Cameroon
31	<i>Chassalia cupularis</i> Hutch & Dalz	Rubiaceae	Shrub	Oban, Afi River FR	Cameroon
32	<i>Chassalia subnuda</i> (Hiern) Hepper	Rubiaceae	Shrub	Calabar	Congo Republic
33	<i>Chytranthus ellipticus</i> Hutch. & Dalz.	Sapindaceae	Tree	Sapoba FR, Okomu National Park (Edo State); Oban Division, Cross River National Park (Cross River State); Eket (Akwa Ibom State)	Unconfirmed reports from Liberia
34	<i>Cleistanthus libericus</i> N.E Br.	Euphorbiaceae	Tree	Shasha FR, Okomu National Park	Ghana, Côte d'Ivoire, Liberia, Sierra Leone, Congo Rep, Gabon, Guinea, Democratic Republic of Congo
35	<i>Cleistanthus ripicola</i> Leonard	Euphorbiaceae	Tree	Koton Karifi Swamp FR, Osse River, Lower Enyong FR	Ghana, Côte d'Ivoire, Central African Republic, Congo Rep, Democratic Republic of Congo
36	<i>Cleistopholis staudtii</i> Engl. & Diels	Annonaceae	Tree	Shasha FR	Cameroon, Central African Republic, Gabon
37	<i>Clematopsis scabiosifolia</i> (DC.) Hutch. Subsp. <i>oliveri</i> (Hutch.) Brumm.	Ranunculaceae	Herb	Bauchi Plateau (Bauchi State)	Cameroon
38	<i>Clerodendrum talbotii</i> Wernham [Syn: <i>Clerodendrum capitatum</i> (Willd.) Schumach.]	Verbenaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Senegal, Mali, Guinea, Côte d'Ivoire, Ghana, Togo, Benin Republic, Somalia Republic, Cameroon, Gabon, Democratic Republic of Congo, Zambia, Uganda
39	<i>Cnestis mannii</i> (Bak.) Schellend.	Connaraceae	Shrub	Shasha FR (Ogun State); Oban Division, Cross River National Park (Cross River State).	Angola, Gabon, Congo Rep, Cameroon, Madagascar
40	<i>Cola nigerica</i> Brenan & Keay	Sterculiaceae	Tree	Shasha FR, Oban, Etemi FR	Cameroon (IUCN reports it might be extinct there) and Gabon
41	<i>Combretum excelsum</i> Keay [Syn: <i>Combretum pecoense</i> Exell]	Combretaceae	Liana	Cross River North FR (Cross River State)	Gabon, Angola and Democratic Republic of Congo
42	<i>Cordyla</i> sp. a null	Caesalpiniaceae	Tree	Ilorin, New Bussa, Yakumase	Togo

	Plant name	Family	Habit	Distribution in Nigeria	New locations
43	<i>Crateranthus talbotii</i> Baker f.	Lecythidaceae	Tree	Oban, Calabar	Gabon
44	<i>Crossandra obanensis</i> Heine	Acanthaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
45	<i>Crossandra talbotii</i> S. Moore [Syn: <i>Stenandrium talbotii</i> (S. Moore) Vollesen]	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State); Okomu National Park, Benin City (Edo State)	Cameroon, Gabon and Ghana
46	<i>Crossonephelis africanus</i> (Radlk.) Leenh. [Syn: <i>Glennia africana</i> (Radlk.) Leenh.]	Sapindaceae	Shrub	Ilaro FR (Ogun State)	Tanzania, Mozambique, Togo, Zimbabwe, Ghana, Benin Republic and Kenya
47	<i>Croton membranaceus</i> Müll. Arg	Euphorbiaceae	Shrub	Lokoja, Onitsha	Côte d'Ivoire
48	<i>Cuviera trilocularis</i> Hiern	Rubiaceae	Shrub	Oban, Calabar	Cameroon
49	<i>Cuviera truncata</i> Hutch. & Dalz.	Rubiaceae	Shrub	Sanga river FR, Onitsha, Degema, Oban, Vogel Peak, Gangumi	Cameroon
50	<i>Cyanotis hepperi</i> Brenan	Commelinaceae	Herb	Vogel Peak (Adamawa State)	Unconfirmed reports of sightings in Cameroon
51	<i>Dactyladenia eketensis</i> (DeWild) Prance and F. White [Syn: <i>Acioa eketensis</i> DeWild.]	Chrysobalanaceae	Tree	Eket (Akwa Ibom State)	Gabon. Critically Endangered on the IUCN Red List of Threatened Species
52	<i>Dissotis elliptica</i> Gilg var <i>setosior</i> Gilg.	Melastomataceae	Herb	Balleghete, Obudu, Koloishe mountains, Ikwette	Cameroon, Guinea, Liberia
53	<i>Dissotis fruticosa</i> (Brenan) Brenan & Keay [Syn: <i>D. rotundifolia</i> var. <i>fruticosa</i>]	Melastomataceae	Herb	Idanre hills (Ondo State)	Equatorial Guinea
54	<i>Dalichos brevicaulis</i> Bak. [Syn: <i>Macrotyloma brevicaula</i> (Baker) Verdc.]	Papilionaceae	Herb	Jebba (Kogi State); Yola (Adamawa State); Bauchi Plateau (Bauchi State)	Cameroon and Ghana
55	<i>Dorstenia obanensis</i> Hutch. & Dalziel [Syn: <i>D. buesgenii</i> Engl. or <i>D. turbinata</i> Engl.]	Moraceae	Tree	Oban Division, Cross River National Park (Cross River State)	Guinea, Côte d'Ivoire, Ghana, Cameroon, Gabon, Equatorial Guinea, Congo Republic, Democratic Republic of Congo
56	<i>Dracaena goldieana</i> Bull.	Agavaceae	Herb	Uwet, Calabar.	Cameroon, Gabon
57	<i>Drypetes obanensis</i> S. Moore	Euphorbiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Côte d'Ivoire, Cameroon, Gabon. Vulnerable on the IUCN Red List of Threatened Species
58	<i>Enneastemon foliosus</i> (Engl. & Diels.) Robyns & Ghesq. [Syn: <i>Popowia foliosa</i> Engl. & Diels.]	Annonaceae	Shrub	Okomu National Park	Cameroon
59	<i>Eriocaulon intrusum</i> Meikle [Syn: <i>Eriocaulon teusczii</i> Engl. & Ruhland]	Eriocaulaceae	Herb	Naraguta, Plateau state	Democratic Republic of Congo, Tanzania, Angola, Malawi, Mozambique, Zambia
60	<i>Eriocoelum oblongum</i> Keay	Sapindaceae	Tree	Eket, Afi River FR, Aboabam-Arrimakpan path	Gabon. Data Deficient on the IUCN Red List of Threatened Species
61	<i>Eriosema bauchiense</i> Hutch. & Dalz.	Papilionaceae	Herb	Vom (Plateau State)	Cameroon, Tanzania, Democratic Republic of Congo, Malawi
62	<i>Eugenia obanensis</i> Baker f.	Myrtaceae	Shrub	Onitsha	Ghana, Côte d'Ivoire, Cameroon, Congo Rep, Gabon, Angola, Guinea
63	<i>Eugenia talbotii</i> Keay	Myrtaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
64	<i>Fagara buesgenii</i> Engl. [Syn: <i>Zanthoxylum buesgenii</i> (Engl.) P. G. Waterman]	Rutaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon and Gabon
65	<i>Fagara melanorhachis</i> Hoyle [Syn: <i>Zanthoxylum gillettii</i> (DeWild.) P.G. Waterman]	Rutaceae	Tree	Sapoba FR (Edo State), Enugu (Enugu State)	Cameroon, Ghana, Guinea, Gabon, Sierra Leone, Liberia, Côte d'Ivoire, Togo, Benin Republic, Equatorial Guinea, Democratic Republic of Congo, Congo Republic, Zambia, Zimbabwe, Ethiopia, Kenya, Tanzania, Mozambique
66	<i>Fimbristylis nigritana</i> C.B Cl	Orchidaceae	Herb	Nupe	Togo

	Plant name	Family	Habit	Distribution in Nigeria	New locations
67	<i>Friesodielsia soyauxii</i> (Sprague & Hutch.) Steenis [Syn: <i>Friesodielsia montana</i> (Engl. & Diels.) Steenis]	Annonaceae	Shrub	Ibadan South FR (Oyo State)	Gabon, Congo Rep, Democratic Republic of Congo and Central African Republic
68	<i>Garcinia obanensis</i> Baker f. [Syn: <i>Garcinia mannii</i> Oliv.]	Clusiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Cameroon, Gabon and Equatorial Guinea
69	<i>Garcinia ovalifolia</i> var ?	Guttiferae	Tree	Recorded from forests of Benin only	Guinea, Mali, Ethiopia, Uganda, Angola
70	<i>Gladiolus melleri</i> Bak. f	Iridaceae	Herb	Jos Plateau, Naranda mountain	Burundi, Democratic Republic of Congo, Tanzania, Angola, Malawi, Mozambique, Zambia. Nigeria is the only place it was reported in West Africa
71	<i>Globulostylis minor</i> Wernham	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon.
72	<i>Globulostylis talbotii</i> Wernham [Syn: <i>Cuviera talbotii</i> (Wernham) Verdc.]	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon. <i>Globulostylis</i> has only two species, and both species are thought to be endemic to Nigeria
73	<i>Guaduella humilis</i> Clayton	Poaceae	Herb	Oban Division, Cross River National Park (Cross River State)	Cameroon
74	<i>Habenaria keayi</i> Summerh.	Orchidaceae	Herb	Kaduna, Dogon Kurmi, Sara mountains, Bauchi, Naraguta FR, Ibadan	Togo, Cameroon, Ethiopia, Arabian Peninsular
75	<i>Hugonia talbotii</i> De Wild.	Linaceae	Herb	Sapoba FR (Edo State), Oron, Eket (Akwa Ibom State)	Democratic Republic of Congo
76	<i>Hunteria eburnea</i> Pichon [Syn: <i>Hunteria umbellata</i> (K.Schum.) Hallier f.]	Apocynaceae	Tree	Afi River FR	Benin Rep., Ghana, Guinea Bissau, Guinea, Côte d'Ivoire, Liberia, Senegal, Sierra Leone, Central African Republic, Gabon, Democratic Republic of Congo
77	<i>Hymenostegia talbotii</i> Baker f.	Caesalpiniaceae	Tree	Eket (Akwa Ibom State)	Gabon and Cameroon. Critically Endangered on the IUCN Red List of Threatened Species
78	<i>Inversodicraea tenuifolia</i> G. Taylor [Syn: <i>Ledermannia tenuifolia</i> (G. Taylor) C. Cusset]	Podostemaceae	Herb	Boje-Aboabam road, Afi River Wildlife Sanctuary (Cross River State)	Gabon
79	<i>Ixora bauchiensis</i> Hutch. & Dalz.	Rubiaceae	Shrub	Naraguta, Jos, Kemdere	Central African Republic, Cameroon, Congo Republic
80	<i>Ixora degemensis</i> Hutch. & Dalz. [Syn: <i>Ixora euosmia</i> K. Schum.]	Rubiaceae	Tree	Degema (Rivers State)	Cameroon. Endangered on the IUCN Red List of Threatened Species
81	<i>Jatropha neriifolia</i> Müll. Arg.	Euphorbiaceae	Shrub	Nupe, Abinsi	Benin Republic
82	<i>Justicia talbotii</i> S. Moore	Acanthaceae	Shrub	Eket (Akwa Ibom State)	Liberia, Sierra Leone, Côte d'Ivoire, Ghana, Gabon, Democratic Republic of Congo, Congo Republic.
83	<i>Lefebvrea nigeriae</i> Wolff [Syn: <i>Lefebvrea grantii</i> (Hiern) S. Droop.]	Umbelliferae (Apiaceae)	Herb	Vom, Naraguta (Plateau State); Bauchi Plateau (Bauchi State)	Widely distributed throughout Southern, Eastern, Central Africa and parts of West Africa
84	<i>Leucas oligocephala</i> subsp. <i>tenuifolia</i> J.K. Morton	Lamiaceae	Herb	Jos Plateau	Guinea, Burundi, Central African Republic, Rwanda, Cameroon, Kenya, Tanzania, Uganda, Malawi
85	<i>Lobelia lelyana</i> E. Wimm [Syn: <i>Lobelia sapinii</i> DeWild.]	Lobeliaceae	Herb	Jos Plateau	Ghana, Côte d'Ivoire, Senegal, Togo, Sierra Leone, Cameroon, Central African Republic, Democratic Republic of Congo, Tanzania, Malawi, Mozambique
86	<i>Markhamia lutea</i> (Benth.) K. Schum.	Bignoniaceae	Tree	Abeokuta	Ghana, Côte d'Ivoire, Togo, Burundi, Sierra Leone, Cameroon, Congo Republic, Gabon, Guinea, Rwanda, Central African Republic, Democratic Republic of Congo, Tanzania, Malawi, Mozambique, Sudan, Kenya, Uganda
87	<i>Memecylon fosteri</i> Hutch. & Dalz. [Syn: <i>Warneckea fosteri</i> (Hutch. & Dalziel) Jacq.-Fél.]	Melastomataceae	Shrub	Idanre hills (Ondo State)	Cameroon, Sao Tome and Principe

	Plant name	Family	Habit	Distribution in Nigeria	New locations
88	<i>Memecylon meikleii</i> Keay [Syn: <i>Warneckea guineensis</i> (Keay) Jacq.-Fél.]	Melastomataceae	Shrub	Ibadan (Oyo State)	Côte d'Ivoire, Liberia and Ghana
89	<i>Memecylon obanense</i> Bak. f. [Syn: <i>Memecylon englerianum</i> Cogn. var. <i>englerianum</i>]	Melastomataceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Guinea, Liberia, Côte d'Ivoire, Cameroon, Congo Republic
90	<i>Mendoncia iodoides</i> (S. Moore) Heine [Syn: <i>Afromendoncia iodoides</i> S. Moore]	Acanthaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Equatorial Guinea, Gabon and Congo Republic
91	<i>Millettia pilosa</i> Hutch. & Dalz.	Papilionaceae	Shrub	Oban Division, Cross River National Park (Cross River State); Umuahia (Abia State)	Cameroon
92	<i>Napoleona parviflora</i> Bak. f.	Lecythidaceae	Tree	Oban	Côte d'Ivoire, Liberia, Sierra Leone, Guinea
93	<i>Neobaumannia hedyotoidea</i> var. <i>longipila</i> Brenan [Syn: <i>Knoxia hedyotoidea</i> (K. Schum.) Puff. & Robbr.]	Rubiaceae	Shrub	Idanre hills, Akure FR, Aponmu FR	Ghana, Togo, Cameroon
94	<i>Oxymitra glaucifolia</i> Hutch. & Dalz. [Syn: <i>Friesodielsia glaucifolia</i> (Hutch. & Dalziel) Steenis]	Annonaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
95	<i>Oxymitra obanensis</i> Sprague & Hutch. [Syn: <i>Unona obanensis</i> Baker f. or <i>Friesodielsia enghiana</i> (Diels.) Verdc.]	Annonaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Liberia, Sierra Leone, Côte d'Ivoire, Ghana, Central African Republic, Democratic Republic of Congo, Cameroon, Gabon, Congo Rep., Uganda, Equatorial Guinea
96	<i>Pancovia sessiliflora</i> Hutch. & Dalz.	Sapindaceae	Shrub	Etemi FR, Olokemeji FR, Omo FR, Okeigbo, Ikoyi plains, Agege	Ghana
97	<i>Pararistolochia ju-ju</i> (S. Moore) Hutch & Dalz. [Syn: <i>Pararistolochia mannii</i> (Hook. f.) Keay]	Aristolochiaceae	Liana	Degema (Rivers State)	Côte d'Ivoire, Benin Republic, Gabon, Ghana, Togo, Congo Republic.
98	<i>Pararistolochia talbotii</i> (S. Moore) Keay [Syn: <i>Pararistolochia promissa</i> (Mast.) Keay or <i>Aristolochia talbotii</i> S. Moore.]	Aristolochiaceae	Herb	Oban Division, Cross River National Park (Cross River State)	Côte d'Ivoire, Ghana, Central African Republic, Cameroon, Democratic Republic of Congo, Gabon.
99	<i>Pararistolochia tribrachiata</i> (S. Moore) Hutch & Dalz. [Syn: <i>Pararistolochia macrocarpa</i> (Duch.) Poncey]	Aristolochiaceae	Liana	Oban Division, Cross River National Park (Cross River State)	Liberia, Côte d'Ivoire, Ghana, Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Congo Rep, Equatorial Guinea
100	<i>Pauridiantha insculpta</i> (Hutch. & Dalz.) [Syn: <i>Empogona talbotii</i> (Wernham) Tosh & Robbr.]	Rubiaceae	Shrub	Oban	Congo Republic, Cameroon
101	<i>Pausinystalia talbotii</i> Wernham	Rubiaceae	Tree	Oni river, Omo FR, Oban, Calabar	Cameroon
102	<i>Paxia liberosepala</i> (Bak. f.) Schellenb ex Hutch. & Dalz. [Syn: <i>Rourea myriantha</i> Baill.]	Connaraceae	Liana	Oban Division, Cross River National Park (Cross River State)	Cameroon, Gabon, Democratic Republic of Congo, Congo Republic, Equatorial Guinea, Madagascar
103	<i>Pennisetum dalzielii</i> Stapf & C.E. Hubbard [Syn: <i>Pennisetum sieberianum</i> (Schltdl.) Stapf & C.E. Hubb.]	Poaceae	Shrub	Sokoto	Eritrea, Angola, Gambia, Senegal, Togo, Cameroon, Chad, Ethiopia, Sudan
104	<i>Phaulopsis talbotii</i> S. Moore	Acanthaceae	Herb	Oban Division, Cross River National Park (Cross River State)	Sierra Leone, Liberia and Cameroon
105	<i>Phragmanthera talbotiorum</i> (Sprague) Balle [Syn: <i>Phragmanthera talbotiora</i> (Sprengel) S. Balle or <i>Loranthus talbotiorum</i> Sprague]	Loranthaceae	Shrub	Eket (Akwa Ibom State); Oban Division, Cross River National Park (Cross River State)	Cameroon and Gabon
106	<i>Pohliella flabellata</i> G. Tayl. [Syn: <i>Saxicolella flabellata</i> (G.Taylor) C. Cusset]	Podostemataceae	Herb	Afi River FR on Aboabam-Boje path	Cameroon, Ghana, Niger

	Plant name	Family	Habit	Distribution in Nigeria	New locations
107	<i>Polystachya camaridioides</i> Summerh	Orchidaceae	Herb	Calabar	Cameron, Guinea
108	<i>Polystachya odorata</i> var <i>trilepidis</i> Summerh	Orchidaceae	Herb	Mountain Orosun, Idanre	Cameroon
109	<i>Protea argyrophaea</i> Hutch [Syn: <i>Protea madiensis</i> Oliv. subsp. <i>madiensis</i>]	Protaceae	Shrub	Bauchi Plateau (Bauchi State)	Found throughout West, Central and East Africa
110	<i>Psammetes nigerica</i> Hepper [Syn: <i>Psammetes madagascariensis</i> (Bonati) Eb. Fisch. & Hepper]	Scrophulariaceae	Herb	Badagry (Lagos State)	Madagascar. Brenan (1978) reported that this genera is endemic to this region of Nigeria.
111	<i>Pseudospondias microcarpa</i> var <i>hirsuta</i> Brenan	Anacardiaceae	Tree	Eleyele, Ibadan (Oyo State), Omo FR, Etemi FR (Ogun State)	Zimbabwe. Vulnerable on the IUCN Red List of Threatened Species and present only in Nigeria. Hyde et al. (2014) listed it in Zimbabwe and Mozambique.
112	<i>Pseudospondias microcarpa</i> var <i>longifolia</i> (Engl.) Keay	Anacardiaceae	Tree	Benin (Edo State)	Cameroon
113	<i>Psophocarpus longepedunculatus</i> Hassk. var. <i>barteri</i> Baker	Papilionaceae	Tree	Unspecified	Throughout Central and parts of West and East Africa, and Madagascar.
114	<i>Psychotria arborea</i> Hiern	Rubiaceae	Tree	Calabar (Cross River State)	Cameroon
115	<i>Psychotria dalzielii</i> Hutch. [Syn: <i>Psychotria eminiana</i> var. <i>eminiana</i>]	Rubiaceae	Shrub	Mando FR, Zaria	Burundi, Central African Republic, Cameroon, DR Congo, Chad, Sudan, Tanzania, Angola, Malawi, Mozambique, Zambia
116	<i>Psychotria potanthera</i> Wernham	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
117	<i>Psychotria rowlandii</i> Hutch. & Dalz. [Syn: <i>Psychotria gabonica</i> Hiern.]	Rubiaceae	Shrub	Lagos, Omo FR	Côte d'Ivoire, Liberia, Sierra Leone, Central African Republic, Congo Republic, Gabon
118	<i>Psychotria talbotii</i> Wernham	Rubiaceae	Shrub	Idanre, Oban, Kwa Falls, Akampa Estate, Calabar	Cameroon
119	<i>Psychotria viticoides</i> Wernham	Rubiaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon and Gabon
120	<i>Pterocarpus osun</i> Craib.	Papilionaceae	Tree	Ibadan Forest Reserve (IITA) (Oyo State); Unwin, Benin City (Edo State); Ikom (Akwa Ibom State); Obubra (Cross River State)	Cameroon and Gabon. Recent descriptions of the plant distribution range do not include other African countries, as earlier noted in FWTA, Part 1 Volume 2.
121	<i>Pycnanthus microcephalus</i> (Benth.) Warb.	Annonaceae	Tree	Oban, Ikom	Cameroon, Equatorial Guinea
122	<i>Radlkofera calodendron</i> Gilg.	Santaniaceae		Okomu National Park	Cameroon, Democratic Republic of Congo
123	<i>Rangaeris longicaudata</i> (Rolfe) Summerh.	Orchidaceae	Herb	Lagos, Cross River North FR	Cameroon, Gabon, Côte d'Ivoire
124	<i>Rinorea ardisiiflora</i> (Welw. Ex. Oliv.) O. Ktze.	Violaceae	Tree	Iyamoyong FR	Democratic Republic of Congo
125	<i>Rinorea crassifolia</i> (Bak. f.) DeWild [Syn: <i>Alsodeia crassifolia</i> Bak. f.]	Violaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon
126	<i>Ritchiea obanensis</i> Hutch. & Dalziel	Capparidaceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Equatorial Guinea, Gabon, Cameroon and Congo Rep. Some taxonomic publications consider it synonym to <i>R. polypetala</i> Hook f.
127	<i>Ritchiea pentaphylla</i> Gilg & Benedict [Syn: <i>Ritchiea erecta</i> Hook. f.]	Capparidaceae	Shrub	Lagos State, Ilaro, Abeokuta (Ogun State)	Equatorial Guinea, Gabon, Cameroon and Congo Rep.
128	<i>Rubus apetalus</i> var (?) Poir [Syn: <i>Rubus apetalus</i> Poir]	Rosaceae	Shrub	Bauchi Plateau (Bauchi State)	Southern Africa
129	<i>Rubus rosifolius</i> Sm.	Rosaceae	Liane	Gembu, Mambilla Plateau	More abundant in East Africa (Malawi, Zambia, Zimbabwe) and Cameroon, introduced to East Asia

	Plant name	Family	Habit	Distribution in Nigeria	New locations
130	<i>Rutidea pavettoides</i> Wernham [Syn: <i>Rutidea hispida</i> Hiern]	Rubiaceae	Liana	Ilaro FR, Lagos, Etemi FR, Oban	Côte d'Ivoire, Senegal, Central African Republic, Cameroon, Gabon, Democratic Republic of Congo
131	<i>Rutidea nigerica</i> Bridson	Rubiaceae	Shrub	Etemi FR	Benin Rep., Cameroon, Central African Republic
132	<i>Salacia hispida</i> Blakelock	Celastraceae	Tree	Okomu National Park	Democratic Republic of Congo
133	<i>Salacia talbotii</i> Baker f.	Celastraceae	Shrub	Oban Division, Cross River National Park (Cross River State)	Cameroon and Gabon
134	<i>Salix nigerica</i> Skan. [Syn: <i>Salix mucronata</i> Thunb. subsp. <i>mucronata</i>]	Salicaceae	Annual	Katagum, Lake Chad (Borno State)	Egypt, Libya, Sudan and parts of Southern Africa
135	<i>Scaphopetalum letestui</i> Pellegr.	Sterculiaceae	Shrub	Oban	Gabon, Congo Republic
136	<i>Sherbournia amaraliocarpa</i> (Wernham) Hepper	Rubiaceae	Shrub	Oron to Eket	Equatorial Guinea, Gabon, Democratic Republic of Congo
137	<i>Solanum clerodendroides</i> Hutch & Dalz [Syn: <i>Solanum madagascariense</i> Dunal]	Solanaceae	Shrub	Eket (Akwa Ibom State)	Madagascar.
138	<i>Solenostemon minor</i> J.K Morton [Syn: <i>Plectranthus decumbens</i> Hook.f.]	Lamiaceae	Herb	Kagoro hills, Jos, Mount Koloishe, Obudu	Cameroon, Guinea
139	<i>Soyauxia talbotii</i> Baker f.	Medusandraceae	Tree	Eket (Akwa Ibom State)	Cameroon. Endangered on the IUCN Red List of Threatened Species
140	<i>Strombosia pustulata</i> Oliv.	Olaceae	Tree	Gashaka-Gumti National Park, Gangumi, Onigambari FR, Owo FR, Aponmu FR, Afi River FR, Ohosu FR, Okomu National Park, Awka, Ikom	Sierra Leone, Cameroon
141	<i>Tacazzea barteri</i> Baill. [<i>Tacazzea apiculata</i> Oliv.]	Asclepiadaceae	Liana	Kogi State	Scattered throughout West, Central and Southern Africa
142	<i>Tarenna baconioides</i> Wernham	Rubiaceae	Shrub	Oban	Cameroon
143	<i>Tarenna eketensis</i> Wernham [Syn: <i>Rutidea degemensis</i> and <i>Rutidea talbotiorum</i>]	Rubiaceae	Shrub	Sapoba FR	Benin Republic, Ghana, Côte d'Ivoire, Liberia, Central African Republic, Cameroon, Democratic Republic of Congo, Congo Republic, Gabon, Guinea, Equatorial Guinea, Zambia
144	<i>Tricalysia pleiomera</i> Hutch. [Syn: <i>Tricalysia bifida</i> DeWild.]	Rubiaceae	Tree	Oban	Cameroon, Congo Republic, Democratic Republic of Congo
145	<i>Trichoscypha longipetala</i> Bak. f. [Syn: <i>Trichoscypha mannii</i> Hook. f.]	Anacardiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Sierra Leone, Liberia, Cameroon, Gabon, Congo Rep, Equatorial Guinea, Ghana and Côte d'Ivoire
146	<i>Trichoscypha talbotii</i> Bak. f. [Syn: <i>Trichoscypha laxiflora</i> Engl.]	Anacardiaceae	Tree	Oban Division, Cross River National Park (Cross River State)	Cameroon, Gabon, Congo Rep., Democratic Republic of Congo, Equatorial Guinea
147	<i>Tridactyle lagosensis</i> (Rolfe) Schltr.	Orchidaceae	Herb	Lagos, Eket	Cameroon, Equatorial Guinea, Gabon
148	<i>Trochomeria dalzielii</i> Bak. f. ex Hutch. [Syn: <i>Trochomeria macrocarpa</i> (Sond.) Hook. f. subsp. <i>macrocarpa</i>]	Cucurbitaceae	Liana	Kotangora, Katagum, Abinsi, Jira, Mada hills (Plateau State)	East, South and parts of West and Central Africa
149	<i>Tylostemon confertus</i> S. Moore [Syn: <i>Beilschmiedia conferta</i> (S. Moore) Robyns & Wilczek and <i>Beilschmiedia gaboensis</i> (Meisn.) Benth. & Hook. f.]	Lauraceae	Tree	Eket (Akwa Ibom State)	Congo Rep, Democratic Republic of Congo, Cameroon, Gabon and Equatorial Guinea
150	<i>Uebelinia nigerica</i> Turill [Syn: <i>Lychnis abyssinica</i> (Hochst.) Lidén]	Caryophyllaceae	Herb	Obudu Cattle Ranch (Cross River State)	Eritrea, Ethiopia, Cameroon, Kenya and Tanzania
151	<i>Urera talbotii</i> Rendle	Urticaceae	Liana	Oban Division, Cross River National Park (Cross River State)	Gabon
152	<i>Warneckea guineensis</i> (Keay) Jacq-Fel.	Melastomataceae	Shrub	Near Eleyele hill, Ibadan (Oyo State)	Côte d'Ivoire, Liberia and Ghana
153	<i>Zenkerella citrina</i> Taub.	Caesalpiniaceae	Tree	Oban	Cameroon

diversity (Brenan 1978).

As much as it is important to conserve endemic flora, it is equally important to accurately identify them in order to accord them conservation priorities. However, this study scrutinized the endemic flora in Nigeria and found only 91 to be true endemics in Nigeria, in contrast to 205 earlier reported by Brenan (1978). Likewise, *Globulostylis* and *Psammetes*, which were among the reported five endemic genera in Nigeria, have lost their endemic status. A total of 153 species thought to be endemic to Nigeria have been found in other countries (Table 2). Similar findings were reported in India, where 62 earlier reported endemic genera of angiosperms have been found in other countries, while some taxonomic changes to some genera have affected their status (Irwin & Narasimhan 2011). Furthermore, of the 147 earlier reported endemic genera in India (Nayar 1996), Irwin & Narasimhan (2011) concluded that only 49 genera are actually endemic.

This reduction in the number of endemic species in Nigeria may be due to the fact that recent taxonomic and herbarium records show that many have been found in other countries, especially neighbouring Cameroon. Brenan (1978) gave examples of such endemics such as *Pennisetum dalzielii*, *Psychotria dalzielii*, *Allexis obanensis*, *Globulostylis talbotii*, *G. minor* and *Pohliella flabellata* among others, which have been discovered in other countries, thus losing their endemic status in Nigeria (Table 2). In addition, changes in plant adaptability and physiology, gradual spread and increased dispersal capacity, human disturbance, new pests and diseases and new consumers could make some plants cross their natural distribution range to other political boundaries and thus lose their natural endemic status in Nigeria.

As taxonomic records are being improved, some of the endemic species “imperfectly known” in the Flora of West Tropical Africa (FWTA) are being properly described, given binomial names and their geographical distribution determined. For example, *Coccinia* sp. C of FWTA has been properly named as *C. adoensis*, *Cordyla* sp. B. as *C. pinnata* (Lepr. ex A. Rich) Milne-Redhead, *Crotalaria* sp. A as *C. cuspidata* Taub, *Croton* sp. A and sp. B as *Croton sylvatica*, *Diospyros* sp. 1 as *D. obliquifolia* (Hiern ex. Gurke) F. White, *Diospyros* sp. B as Nigerian Trees (Keay 1989) as *D. platanoides* Letouzey & F. White, *Salacia* sp. D as *S. cameroonensis* Loes, *Salacia* sp. E as *S. lateritia* Halle, *Salacia* sp. J as *S. pynaertii* De Wild, *Placodiscus* sp. A as *P. opacus* Radlk. among many others listed in Lowe & Soladoye (1990). Some of the imperfectly known endemic species in FWTA are in

genera such as *Psychotria*, *Ouratea* and *Eugenia*. With the continuous incidence of discovery of new plants globally and as more scientific information is available and shared among countries, updating of documented records of flora is inevitable.

Indeed, there are still many plants yet to be identified in some areas of the country. For instance, it was reported by Chapman & Chapman (2001) that plant species of the mountainous landscape of Mambilla Plateau in Taraba State of Nigeria are endemic and yet to be properly identified. Similarly, it was reported in a short article on Cross River National Park by the Nigerian Park Service that four plant species new to science have been discovered in the Park, which include *Tridactyle* sp. nov. (Orchidaceae), *Uapaca* sp. nov. (Euphorbiaceae), *Habenaria* sp. nov. (Orchidaceae) and *Afrocalathea flavida* sp. nov. (Marantaceae) (<http://crnp.nigeriaparkservice.org/>). To confirm this knowledge gap, WWF and IUCN (1994) noted that floral inventory of the Cross River National Park is yet to be completed.

Possible evolutionary trends among endemic species

Rubiaceae was observed to have the highest number of species representatives in the endemic flora of Nigeria, as discovered in this study. Series of plant diversity studies carried out in various parts of Nigeria also show Rubiaceae to be one of the families with the highest number of species representatives (Ojo 2004; Soladoye et al. 2005; Borokini et al. 2010).

Rubiaceae was reported to be among the most diversified and largest of the families in the African rain forest (Robbercht 1996), and the family is identified as the fourth largest plant family globally, with 13,143 species, classified into 611 genera (Davis et al. 2009), more than 40 tribes, and three subfamilies (Goervarts et al. 2006). They occur on all continents (Goervarts et al. 2006), but most taxa are in tropical or subtropical areas (Bremer & Eriksson 2009). Endemism was reported to be generally high in Rubiaceae because many species have restricted distributions. Recording eight out of 11 endemic species of Rubiaceae in Cross River National Park (Oban Division) alone is of scientific interest, all of which are shrubs except for one vine. The same goes for endemic species in families such as Orchidaceae, Acanthaceae, Lecythidaceae and Annonaceae which are found in the same locations and having the same growth habit. It has been reported earlier that endemic species belonging to the same families sharing the same natural habitat must have originated from a single ancestral species (Wilson 2010). Similar situation of discovery of

over 500 endemic haplochromine cichlid fish species in Lake Victoria, originating from a single ancestral species was reported by Meyer (1993).

In the same vein, eight endemic species of Orchidaceae were identified in this study. Orchidaceae is the largest plant family on earth, having an estimated 25,000 species, grouped into 850 genera, with over 70% being epiphytes (Gravendeel et al. 2004). Segerback (1983) described 104 species of orchids for Nigeria, but Jayeola (1991) otherwise encountered over 400 species for Nigeria. The African continent harbours around 2,400 orchid species (Madison 1977). The high numbers of representative species of these two families—Rubiaceae and Orchidaceae—indicate a high diversity of these families in Nigerian flora, and therefore, there is the need for thorough studies on the phylogenetic relationship among these species.

Factors that could be responsible for their evolution include development of adaptive features to climate change that occurred thousands of years ago, changes in flowering time, dispersal capacity and some of them may be sun-loving or shade tolerant, with preference for altitudes. Furthermore, it is scientifically accepted that geographical barriers could isolate populations of a single species, leading to allopatric speciation (Templeton 1981; Slatkin 1987; Coyne 1992; Palumbi 1994). The tropical rainforests are a big candidate for any form of speciation—allopatry, parapatry, peripatry, sympatry and ecological. This is because high diversification rate and biogeographic history of tropical environments, abundance of geographical barriers (e.g., mountains, rivers, hills and deep valleys), new niche evolution, species survival in mountainous refugia during the pleistocene age, biotic interactions among species (such as predation, association and competition), spatial heterogeneity, higher metabolic rate, rapid accumulation of genetic incompatibilities and other intrinsic and extrinsic isolating mechanisms could lead to speciation that gave rise to the present species richness and endemism in the present tropical regions (Mittelbach et al. 2007; Schemske et al. 2009; April et al. 2013). Genetic bottlenecks, behavioural isolation and the effects of landscape and metapopulation processes have been demonstrated and reported for several plants and animals, including Lahontan Cutthroat Trout Fish in Nevada and California, United States of America (Neville et al. 2006; Peacock & Dochtermann 2012).

Mountain Biodiversity

The present study shows that nine of the geographical locations of these endemic flora are hills and mountains,

harbouring 57 species out of the entire 91 endemic flora, indicating that 62.6% of the endemic species are found in mountainous regions. Literatures have shown that a large fraction of the world's most precious gene pools are preserved in mountains, while nearly half of the world's biodiversity hotspots are concentrated on mountains (Spehn et al. 2010), with tropical montane forests noted for their high levels of species endemism and diversity (Gentry 1992, 1993; Kapos et al. 2000; Schmitt et al. 2010). In addition, from Ethiopia to the Cape (South Africa), mountains contain several centres of endemism for birds, mammals, and plants (Fjeldså & Lovett 1997; de Klerk et al. 2002; Goodman & Benstead 2003; Jetz et al. 2004). All these indicate that mountains are centres of biodiversity and endemism, and this should therefore encourage intensive ecological studies on the plant diversity of hills, mountains and inselbergs that spread across Nigeria, for which research information are currently lacking. In addition to this, 32 out of the entire 55 locations are within tropical rainforest ecoregions. The concentration of most of the endemic plants in tropical rainforests in Nigeria is supported by previous findings by Myers et al. (2000), McNeely et al. (1990) and Mittermeier et al. (2000) among others.

Biodiversity of the Nigerian-Cameroon forest complex

The ecological importance and the significance of the biodiversity of the Cameroon-Nigerian forest complex cannot be overemphasised. And recording 66 (72.5%) species out of 91 endemic species in southern Nigeria (Cross River, Akwa Ibom and Rivers states) is another confirmation of not only the global significance of its biodiversity, but also of the species richness of endemic flora in the region. The Korup National Park shares boundaries with Nigeria's Cross River National Park (Oban Division), while the Okwango division of the Cross River National Park borders the Takamanda Forest Reserve in Cameroon, forming an extensive trans-boundary corridor of biodiversity complex (Fig. 4). This forest ecoregion is a part of the Guineo-Congolian regional centre of endemism (White 1983). Among the taxa that exhibit particularly high levels of species richness and endemism in this trans-boundary ecoregion are primates (Eeley & Lawes 1999; Oates et al. 2004; Sarmiento & Oates 2000; Hilton-Taylor 2000), mammals (AECCG 1991; Happold 1994), amphibians (Lawson 1993; Schiøtz 1999; Kamdem-Toham et al. 2003; Conservation International 2007), birds (Collar & Stuart 1988; Stattersfield et al. 1998), butterflies (Larsen 1997), dragonflies (Vick 1999), fish (Reid 1989), mammals (Burgess et al. 2000), and vascular plants (Cable & Cheek

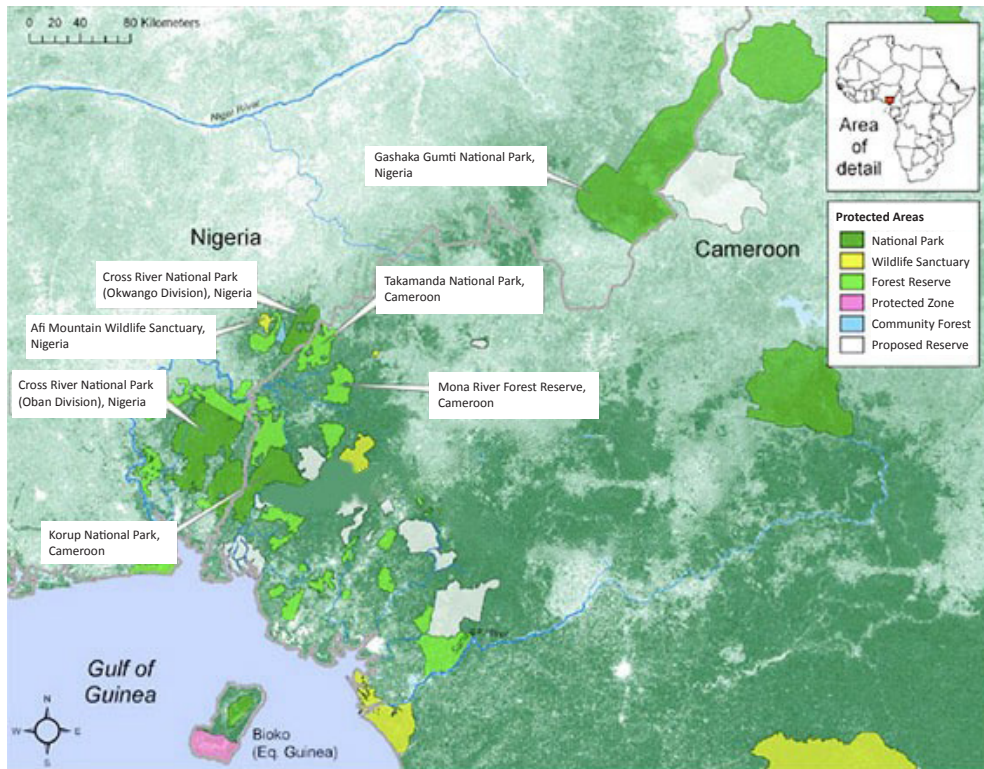


Figure 4. Locations of neighbouring protected areas in Nigeria and Cameroon.

1998). The biogeographical barriers of the Sanaga River in Cameroon and the Cross River in Nigeria define the mainland boundaries of this ecoregion. These rivers are particularly important geographical barriers for primates, Red-eared Guenon *Cercopithecus erythrotis* and amphibians, such as Dizangue Reed Frog *Hyperolius bopoleti*. However, they are significant to global conservation because they are only found within a restricted ecosystem shared between the two countries. In Cameroon's Korup National Park, 1700 species of vascular plants have been recorded, as many as 5% of which are narrow endemics (Davis et al. 1994). These support the need for a stronger framework for trans-boundary management of biodiversity.

Coexistence of endemic plants and animals

Cross River National Park is the peak of Nigeria's biodiversity, being the largest tract of the remaining and surviving primary rainforest in Nigeria. About 78% of primate diversity finds home in the protected areas; while it harbours another 30 species of non-primate mammals, including the African Forest Elephant *Loxodonta cyclotis*, Hippopotamus *Hippopotamus amphibious*, Forest Buffalo *Syncerus cafer nanu*, Giant Otter Shrew *Potomagale veloxl* (Stuart et al. 1990). Over

30% of Nigeria's 860-bird species are found in the Park, including the endangered Red-headed Rock *Picathartes oreas*, the rare Green Ibis *Bostrychia olivacea*, the Violet-backed Flycatcher *Hyloita violacea*, and the Black Guinea Gowl *Agalacea niger*, Bannerman's Weaver, White-throated Babbler, Bat Hawk, Cassin's Hawk-eagle, Grey-throated Rail, Olive Long-tailed Cuckoo, Bare-cheeked Trogon, Lyre-tailed Honeyguide, Green-backed Bulbul, Grey-throated Flycatcher and Rachel's Malimbe (Manu & Imong 2006). Eniang & Ijeomah (2011) reported 56 species of snake in the Oban division while 28 snake species were reported for the Okwango division (Eniang et al. 2002) of the Cross River National Park. Larsen (1997) estimated about 950 butterfly species in the Oban division, of which the Cross River National Park officials reported that two are endemic and another two—*Tetrahanis okwangwo* and *T. oboti*—are new to science. Furthermore, the Park officials reported that two new frog species were identified, namely *Didynamipus sjoosteati* and *Nyctibates corrugatus*, which are new records for Nigeria. The floral diversity of the National Park was reported to be 1,568 species from 523 genera in 98 families. These include 1,303 flowering plants, 141 lichens and 56 moss species.

These information strongly support high mutual

existence of endemic flora and fauna; and agrees with earlier reports of association of high floral diversity with high faunal diversity by Siemann et al. (1998), Knops et al. (1999) and Haddad et al. (2001) among others. Species endemism richness, as described by Kier et al. (2009) is the mutual coexistence of endemic flora and fauna in the same geographical area; this was observed in Hawaiian Islands where over 10,000 known endemic insects, 100 endemic birds and about 1,000 endemic flowering plants were reported (Wagner et al. 1990, 2005; Wilson 2010). Similar ecological coexistence was found in the Ash Meadows National Wildlife Refuge in Mojave Desert where about 26 endemic plants and animals (including fishes and insects) were found (U.S. Fish and Wildlife Service 1990) and the east slopes of the Andes Mountains in Peru and Bolivia (Beck et al. 2007). Consequently, areas with the highest percentage of the world's biodiversity have been proven to harbour a high density of humans with rich cultural diversity (Balmford et al. 2001; Brooks et al. 2002).

Threats to the endemic species

These results present some troubling news with respect to the reported hotspots of this Nigerian endemic flora. For instance, some endemic plants noted to be located in Lagos and Calabar have been completely overtaken by urbanization. Several forest reserves in Nigeria are being de-reserved and concessions given to timber companies for logging, and replacing them with monocultural plantations of exotic trees such as *Tectona grandis*, *Gmelina arborea* and *Eucalyptus camaldulensis*. Furthermore, the indigenous people around these forest reserves clear significant sections for farming, as well as hunting for wild animals. The presence of those endemic species in those locations and their population status should be investigated. Eket is a big town in Akwa Ibom State in the southern region of Nigeria, housing eight endemic plants in addition to high biodiversity in the region; but is plagued by problems such as oil spillage and gas flaring from commercial oil exploration and acid rain (Nduka et al. 2008; IUCN 2013). These threats have been identified as a major threat to the endemic plants, some of which are already assessed by the IUCN Red List of Threatened species (IUCN 2013).

Collins (1990) and Mittermeier et al. (2000) reported that the West African Guinean forest is the worst damaged of the 25 global hotspots which, due to logging and clearance, have destroyed at least 85% of the rainforests. All these probably support the report that 20 plants are extinct in Nigeria (FEPA 1992). Worse

still, a recent survey conducted on the plant collections of all botanic gardens in Nigeria shows that none of these endemic species is being conserved ex situ, as a back-up to these endemics in their natural habitats (see BGCI Garden Search Database for Nigerian botanic gardens <http://www.bgci.org/garden_search.php>). In addition, database search on JSTOR and ISI Web of Science produced very few published research works on any of the endemic plants, indicating a very wide research and knowledge gap on these endemic species, let alone their conservation in Nigeria. For example, in order to ensure effective conservation of threatened species, population viability analysis (PVA) should be conducted to predict their survival in the future.

Therefore, there is the need for intensive conservation of the remaining endemic flora in Nigeria. It is important to note that since timber resources in free public lands have been exhausted in Nigeria, pressure is on timber resources in protected areas, through illegal logging and indiscriminate allocation of forest concessions and de-reservation of forest reserves and other in situ conservation sites. It is safe to say that in situ conservation sites in Nigeria have been heavily disturbed, though efforts are being increased to protect the remaining tracts, especially in Southern Nigeria. Ecological restoration, through re-vegetation of disturbed areas should be done, using indigenous tree species. Community Forestry should be adopted and introduced in the forest reserves and national parks, as a way of combating illegal activities and enhancing participatory forest management. In addition, existing policies governing the management of these protected areas need to be critically reviewed so as to increase transparency in decision making and reducing corruption. Intensive taxonomic and phylogenetic studies, vegetation surveys and biogeographical research should be conducted on the Nigerian flora; in situ conservation efforts have to be supported by adequate ex situ conservation measures.

REFERENCES

- AEECCG (1991).** *The African elephant conservation review*. Unpublished Report of the African Elephant Conservation Coordinating Group, Oxford, UK 58pp.
- African Plants Database (2012).** African Plants Database (version 3.4.0). Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute, Pretoria, <<http://www.ville-ge.ch/musinfo/bd/cjb/africa/>> Assessed August 2014.
- Alston, A.H.G. (1959).** *The Ferns and Fern-allies of West Tropical Africa*. Being a supplement to the 2nd Edition of the Flora of West Tropical Africa. Crown Agents for Oversea Governments and Administration (London), 89pp.

- APG (2009). The Botanical Classification of Angiospermae. Angiospermae Phylogeny Group (APG). <http://www.f-lohmueller.de/botany/apg/apg_iii.htm> Accessed 26 August 2013.
- April, J., R.H. Hanner, R.L. Mayden & L. Bernatchez (2013). Metabolic rate and climatic fluctuations shape continental wide pattern of genetic divergence and biodiversity in fishes. *PLoS ONE* 8 (7): e70296; <http://dx.doi.org/10.1371/journal.pone.0070296>
- Balmford, A., J.L. Moore, T. Brooks, N. Burgess, L.A. Hansen, P. Williams & C. Rahbek (2001). Conservation conflicts across Africa. *Science* 291: 2616–2619; <http://dx.doi.org/10.1126/science.291.5513.2616>
- Barthlott, W., J. Mutke, M.D. Rafiqpoor, G. Kier & H. Kreft (2005). Global centres of vascular plant diversity. *Nova Acta Leopoldina* 92 (342): 61–83
- Beck, S.G., P.A. Hernandez, P.M. Jørgensen, L. Paniagua, M.E. Timaná & B.E. Young (2007). Vascular plants. Pp. 18–34. In: Young, B.E. (ed.). *Endemic Species Distributions on The East Slope of The Andes in Peru and Bolivia*. NatureServe, Arlington, Virginia, USA, 628pp.
- Beentje, H.J. (1996). Centres of plant diversity in Africa, pp. 101–109. In: van der Maesen, L.J.G., van der Burgt, X.M. & J.M. van Medenbach de Rooy (eds.). *The Biodiversity of African Plants*. Proceedings XIVth AETFAT congress, 22–27 August 1994, Wageningen, The Netherlands. Kluwer Academic Publishers, Dordrecht, XV+861pp.
- Beentje, H., B. Adams, S.D. Davis & A.C. Hamilton (1994). Regional overview: Africa, pp. 101–48. In: Davis, S.D., V.H. Heywood & A.C. Hamilton (eds.). *Centres of Plant Diversity: A Guide and Strategy for their Conservation*, Volume 1: Europe, Africa, South West Asia and the Middle East. IUCN - The World Conservation Union, Cambridge UK, 368pp.
- Borokini, T.I., A.U. Okere, A.O. Giwa, B.O. Daramola & W.T. Odofin (2010). Biodiversity and Conservation of Plant Genetic Resources in Field Genebank of the National Centre for Genetic Resources and Biotechnology, Ibadan, Nigeria. *International Journal of Biodiversity and Conservation* 2(3): 37–50.
- Bremer, B. & T. Eriksson (2009). Time tree of Rubiaceae: Phylogeny and dating the family, subfamilies and tribes. *International Journal of Plant Science* 170(6): 766–793; <http://dx.doi.org/10.1086/599077>
- Brenan J.P.M. (1978). Some Aspects of the Phytogeography of Tropical Africa. *Annals of the Missouri Botanical Garden* 65(2): 437–478; <http://dx.doi.org/10.2307/2398859>
- Bridson, D.M. (1978). A short revision of *Rutidea* (Rubiaceae). *Kew Bulletin* 33(2): 243–278; <http://dx.doi.org/10.2307/4109578>
- Brooks, T.M., R.A. Mittermeier, C.G. Mittermeier, G.A.B. Da Fonseca, A.B. Rylands, W.R. Konstant, P. Flick, J.D. Pilgrim, S. Oldfield, G. Magin & C. Hilton-Taylor (2002). Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16: 909–923; <http://dx.doi.org/10.1046/j.1523-1739.2002.00530.x>
- Brooks, T. M., R.A. Mittermeier, G.A.B. Da Fonseca, J. Gerlach, M. Hoffmann, J.F. Lamoreux, C.G. Mittermeier, J.D. Pilgrim & A.S.L. Rodrigues (2006). Global Biodiversity Conservation Priorities. *Science* 313: 58–61; <http://dx.doi.org/10.1126/science.1127609>
- Burgess, N.D., H. De Klerk, J. Fjeldsá, T. Crowe & C. Rahbek (2000). A preliminary assessment of congruence between biodiversity patterns in Afrotropical forest birds and forest mammals. *Ostrich* 71: 286–290; <http://dx.doi.org/10.1080/00306525.2000.9639929>
- Burkill, H.M. (1985). *The Useful Plants of West Tropical Africa*. 2nd Edition. Volume 1, Families A–D. Royal Botanic Gardens, Kew, United Kingdom, 960pp.
- Burkill, H.M. (1994). *The Useful Plants of West Tropical Africa*. 2nd Edition. Volume 2, Families E–I. Royal Botanic Gardens, Kew, United Kingdom, 636pp.
- Burkill, H.M. (1995). *The Useful Plants of West Tropical Africa*. 2nd Edition. Volume 3, Families J–L. Royal Botanic Gardens, Kew, United Kingdom, 857pp.
- Burkill, H.M. (1997). *The Useful Plants of West Tropical Africa*. 2nd Edition. Volume 4, Families M–R. Royal Botanic Gardens, Kew, United Kingdom, 969pp.
- Burkill, H.M. (2000). *The Useful Plants of West Tropical Africa*. 2nd Edition. Volume 5, Families S–Z, addenda. Royal Botanic Gardens, Kew, United Kingdom, 686pp.
- Cable, S. & M. Cheek (1998). *The Plants of Mount Cameroon: A Conservation Checklist*. Royal Botanic Gardens, Kew.
- Chapman, J.D. & H.M. Chapman (2001). *The Forests of Taraba and Adamawa States, Nigeria. An Ecological Account and Plant Species Checklist*. University of Canterbury, Christchurch, New Zealand.
- Clayton, W.D. & F.N. Hepper (1974). Computer-aided chronology of West African grasses. *Kew Bulletin* 29: 219–233.
- Collar, N.J. & S.N. Stuart (1988). *Key Forests for Threatened Birds in Africa*. ICBP, Cambridge.
- Collins, M. (ed.) (1990). *The Last Rain Forests. A World Conservation Atlas*. Oxford University Press, New York, 200pp.
- Conservation International (2007). "Biodiversity Hotspots: Guinean Forests of West Africa." <http://www.biodiversityhotspots.org/xp/hotspots/west_africa/Pages/biodiversity.aspx> Assessed June 12, 2008.
- Coyne, J.A. (1992). Genetics and speciation. *Nature* 355: 511–515; <http://dx.doi.org/10.1038/355511a0>
- Davis, S.D., V.H. Heywood & A.C. Hamilton (eds.) (1994). *Centres of Plant Diversity. A Guide and Strategy for their Conservation*. Volume 1. Europe, Africa, South West Asia and the Middle East. World Wildlife Fund (WWF) and the World Conservation Union (IUCN), Cambridge UK, 368pp.
- Davis, A.P., R. Govaerts, D.M. Bridson, M. Ruhsam, J. Moat & N.A. Brummitt (2009). A Global Assessment of Distribution, Diversity, Endemism, and Taxonomic Effort in the Rubiaceae. *Annals of the Missouri Botanical Garden* 96(1): 68–78; <http://dx.doi.org/10.3417/2006205>
- De Candolle, A.P. (1855). *Geographie Botanique Raisonnee: ou, Exposition des faits principaux et des lois concernant la distribution géographique des plantes de l'époque actuelle*. Vols. 1 & 2. V. Masson, Paris. 656pp.
- De Klerk, H.M., T.M. Crowe, J. Fjeldsá & N.D. Burgess (2002). Biogeographical patterns of endemic terrestrial Afrotropical birds. *Diversity Distributions* 8: 147–162; <http://dx.doi.org/10.1046/j.1472-4642.2002.00142.x>
- Eeley, H.A.C. & M.J. Lawes (1999). Large-scale patterns of species richness and species range size in anthropoid primates, pp. 191–219. In: Fleagle, J.G., C. Janson & K.E. Reed (eds.). *Primate Communities*. Cambridge University Press, Cambridge, 339pp.
- Eniang, E.A. & H.M. Ijeomah (2011). Diversity of Ophidian species in Oban Division of the Cross River National Park, Nigeria. *Production Agriculture and Technology Journal* 7(1): 188–201.
- Eniang E.A., I.J. Ekpo, G.C. Akani & L. Luiselli (2002). On the composition of the snake fauna of Uyo, a recently deforested area in Nigeria. *Herpetozoa* 14 (3/4): 143–147.
- FEPA (1992). *Biological Diversity in Nigeria: A Country Study 1991–1992*. Federal Environmental Protection Agency, Lagos, 192pp.
- Fjeldsá, J. & J.C. Lovett (1997). Geographical patterns of old and young species in African forest biota: the significance of specific montane areas as evolutionary centres. *Biodiversity Conservation* 6(3): 325–346; <http://dx.doi.org/10.1023/A:1018356506390>
- Gaston, K.J. (1991). How large is a species' geographical range? *Oikos* 61: 329–335.
- Gentry, A.H. (1992). Tropical Forest Biodiversity: distributional patterns and their conservation significance. *Journal of Oikos* 63: 19–28; <http://dx.doi.org/10.2307/3545512>
- Gentry, A.H. (1993). Patterns of diversity and floristic composition in neotropical montane forests, pp. 103–126. In: Churchill, S.P., H. Balslev, E. Forero & J.L. Luteyn (eds.). *Biodiversity and Conservation of Neotropical Montane Forests*. Proceedings of Neotropical Montane Ecosystem Symposium, New York, 432pp.
- Glenn, C.R. (2006). Earth's Endangered Creatures (online). <<http://earthsendangered.com>> Accessed 10–25 January, 2013.
- GBIF (2010). Global Biodiversity Information Facility version 1.3.1. <<http://www.gbif.org>> Accessed 26 August 2013.
- Goodman, S.M. & J.P. Benstead (eds.) (2003). *The Natural History of Madagascar*. University of Chicago Press, Chicago, 1728pp.
- Gravendeel, B., A. Smithson, F.J.W. Slik & A. Schuiteman (2004).

- Epiphytism and pollinator specialization: drivers for orchid diversity? *Philosophical Transactions of the Royal Society B: Biological Sciences* 359: 1523–1535; <http://dx.doi.org/10.1098/rstb.2004.1529>
- Groombridge, B. & M.D. Jenkins (2002).** *World Atlas of Biodiversity*. Prepared by the UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, USA, 352pp.
- Govaerts, R., M. Ruhsam, L. Andersson, E. Robbrecht, D. Bridson, A. Davis, I. Schanzer & B. Sonkâ (2011).** World Checklist of Rubiaceae. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; <<http://www.kew.org/wcps/rubiaceae>> Accessed 21 February 2013.
- Haddad, N.M., D. Tilman, J. Haarstad & J.M.H. Knops (2001).** Contrasting effects of plant richness and composition on insect communities: a field experiment. *American Naturalist* 158: 17–35.
- Happold, D.C.D. (1994).** Mammals of the Guinea-Congo rain forest, pp. 243–284. In: Alexander, I.J., M.D. Swaine & R. Watling (eds.). *Essays on the ecology of the Guinea-Congo rain forest*. Proceedings of the Royal Society of Edinburgh Series B, Biological Sciences 104: f1–f6.
- Hepper, F.N. (1965).** Preliminary account of the phytogeographical affinities of the Flora of West Tropical Africa. *Webbia* 19: 593–617.
- Heywood, V.H. & R.T. Watson (1995).** *Global Biodiversity Assessment*. Cambridge University Press, New York, 1140pp.
- Hilton-Taylor, C. (2000).** 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, United Kingdom, 61pp.
- Hutchinson, J. & J. M. Dalziel (1958).** *Flora of West Tropical Africa*, (Second edition), Volume 1, Parts 1 & 2 [Keay, R.W.J. (ed.)]. Crown Agents for Oversea Governments and Administrations, London UK, 828pp.
- Hutchinson, J. & J.M. Dalziel (1963).** *Flora of West Tropical Africa*, (Second edition), Volume 2 [Hepper, F.N. (ed.)]. Crown Agents for Oversea Governments and Administrations, London UK, 544pp.
- Hutchinson, J. & J.M. Dalziel (1972).** *Flora of West Tropical Africa*, (Second edition), Volume 3, Parts 1 & 2 [Hepper, F.N. (ed.)]. Crown Agents for Oversea Governments and Administrations, London UK, 574pp.
- Hyde, M.A., B.T. Wursten, P. Ballings & M.P. Coates (2014).** Flora of Zimbabwe: Cultivated Plants: Species information: *Pseudospondias microcarpa* var. *hirsuta*. <http://www.zimbabweflora.co.zw/cult/species.php?species_id=163840> Accessed 27 August 2014
- IPNI (2012).** The International Plant Names Index. Published on the Internet <<http://www.ipni.org>> Accessed 26 August 2013; 2–22 April, 2014]
- Irwin, S.J. & D. Narasimhan (2011).** Endemic genera of Angiosperms in India: A Review. *Rheedea* 21(1): 87–105.
- IUCN (2012).** *IUCN Red List Categories and Criteria: Version 3.1*. Second edition. Gland, Switzerland and Cambridge, UK, iv+32pp.
- IUCN (2013).** IUCN Red List of Threatened Species. Versions 2012.2 and 2013.2. <www.iucnredlist.org> [Accessed 10–25 January, 2013, 4–28 April, 2014]
- Jayeola, A.A. (1991).** Computer-aided Taxonomic Study of the Angraecoid Orchids of Nigeria and Cameroon. PhD Thesis. Obafemi Awolowo University, Ile-Ife, Nigeria, 91pp.
- Jetz, W., C. Rahbek & R.K. Colwell (2004).** The coincidence of rarity and richness and the potential signature of history in centres of endemism. *Ecology Letters* 7: 1180–1191; <http://dx.doi.org/10.1111/j.1461-0248.2004.00678.x>
- JSTOR (2013).** JSTOR Global Plants Database. <<http://plants.jstor.org>> Accessed February 8, 2013; 2–22 April, 2014
- Kamdem-Toham, A., D. Olson, R. Abell, J. D'Amico, N. Burgess, M. Thieme, A. Blom, R. W. Carroll, S. Gartlan, O. Langrand, R.M. Mussavu, D. O'Hara, H. Strand & L. Trowbridge (eds.) (2003).** Biological Priorities for Conservation in the Guinean-Congolian Forest and Freshwater Region. Proceedings of Workshop held on March 30–April 2, 2000 in Libreville, Gabon.
- Kapos, V., J. Rhind, M. Edwards, C. Ravilious & M. Price (2000).** Developing a map of the World's mountain forests, pp. 4–9. In: Price, M.F. & N. Butts (eds.). *Forests in Sustainable Mountain Development: A State of Knowledge Report for 2000*. CAB International, Wallingford, UK, 590pp.
- Keay, R.W.J. (1953).** Revision of the "Flora of West Tropical Africa": IV. *Kew Bulletin* 8 (2): 287–291; <http://dx.doi.org/10.2307/4109316>
- Keay, R.W.J. & C.F.A. Onochie (1964a).** *Nigerian Trees*, Volume 1, 349pp.
- Keay, R.W.J. & C.F.A. Onochie (1964b).** *Nigerian Trees*, Volume 2, 495pp.
- Keay, R.W.J. (1989).** *Trees of Nigeria* (revised edition). Clarendon Press, Oxford, 489pp.
- Kenfack, D., D.W. Thomas, G. Chuyong & R. Condit (2006).** Rarity and abundance in a diverse African forest. *Biodiversity Conservation* 16 (7): 2045–2074; <http://dx.doi.org/10.1007/s10531-006-9065-2>
- Kier, G., H. Kreft, T.M. Lee, W. Jetz, P.L. Ibsich, C. Nowicki, J. Mutke & W. Barthlott (2009).** A global assessment of endemism and species richness across island and mainland regions. *Proceedings of the National Academy of Science of the United States of America* 106(23): 9322–9327; <http://dx.doi.org/10.1073/pnas.0810306106>
- Knapp, S. (2002).** Assessing patterns of plant endemism in Neotropical Uplands. *The Botanical Review* 68(1): 22–37; [http://dx.doi.org/10.1663/0006-8101\(2002\)068%5B0022:APOPEI%5D2.0.CO;2](http://dx.doi.org/10.1663/0006-8101(2002)068%5B0022:APOPEI%5D2.0.CO;2)
- Knops, J.M.H., D. Tilman, N.M. Haddad, S. Naeem, C.E. Mitchell, J. Haarstad, M.E. Ritchie, K.M. Howe, P.B. Reich, E. Siemann & J. Groth (1999).** Effects of plant species richness on invasion dynamics, disease outbreaks, insect abundances and diversity. *Ecology Letters* 2: 286–293; <http://dx.doi.org/10.1046/j.1461-0248.1999.00083.x>
- Kornas, J. (1983).** Pteridophyta collected in northern Nigeria and northern Cameroon. *Acta Societatis Botanicorum Poloniae* 52(3–4): 321–335; <http://dx.doi.org/10.5586/asbp.1983.036>
- Larsen, T.B. (1997).** Butterflies of the Cross River National Park - diversity writ large, pp. 229–235. Proceedings of workshop on Essential Partnership - *The Forest and the People, Cross River National Park, Calabar, Nigeria*, 451pp.
- Lawson, D.P. (1993).** The reptiles and amphibians of the Korup National Park Project, Cameroon. *Herpetological Natural History* 1: 27–90.
- López-Pujol, J., F.-M. Zhang, H.-Q. Sun, T.-S. Ying & S. Ge (2011).** Centres of plant endemism in China: places for survival or for speciation? *Journal of Biogeography* 38(7): 1267–1280; <http://dx.doi.org/10.1111/j.1365-2699.2011.02504.x>
- Lowe, J. & M.O. Soladoye (1990).** Some changes and corrections to names of Nigerian Plants since Publication of Flora of West Tropical Africa Ed. 2 and Nigerian Trees. *Nigerian Journal of Botany* 3: 1–24.
- Madison, M. (1977).** Vascular epiphytes: their systematic occurrence and salient features. *Selbyana* 2: 1–13.
- Manu, S.A. & I. Imong (2006).** *An Ornithological survey of the Cameroon Highlands in Cross River State, Nigeria: Afi Mountain Wildlife Sanctuary, Cross River National Park, Mbe Mountains and Sankwala Mountains*. NCF-WCS Biodiversity Research Programme. AP Leventis Ornithological Research Institute, Jos, Nigeria, 34pp.
- McNeely, J.A., K.R. Miller, W.V. Reid, R.A. Mittermeier & T.B. Werner (1990).** *Conserving the World's Biological Diversity*. International Union for the Conservation of Nature, The World Bank, World Resources Institute, Conservation International and World Wildlife Fund, 193pp.
- Meyer, A. (1993).** Phylogenetic relationships and evolutionary processes in East African Cichlid fishes. *Trends in Ecology and Evolution* 8(8): 279–284; [http://dx.doi.org/10.1016/0169-5347\(93\)90255-N](http://dx.doi.org/10.1016/0169-5347(93)90255-N)
- Mittelbach, G.G., D.W. Schemske, H.V. Cornell, A.P. Allen, J.M. Brown, M.B. Bush, S.P. Harrison, A.H. Hurlbert, N. Knowlton, H.A. Lessios, C.M. McCain, A.R. McCune, L.A. McDade, M.A. McPeck, T.J. Near, T.D. Price, R.E. Ricklefs, K. Roy, D.F. Sax, D. Schluter, J.M. Sobel & M. Turelli (2007).** Evolution and the latitudinal diversity gradient: speciation, extinction and biogeography. *Ecological Letters* 10:315–331; <http://dx.doi.org/10.1111/j.1461-0248.2007.01020.x>
- Mittermeier, R.A., N. Myers, P.R. Gil & C.G. Mittermeier (2000).** *Hotspots. Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. Cemex, S.A., Mexico City, Conservation International, Washington, DC, 432pp.

- Morton, J.K. (1972). Phytogeography of the West African mountains, pp. 221–236. In: Valentine D.H. (ed.). *Taxonomy, Phytogeography and Evolution*. Academic Press, London, 431pp.
- Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. De Fonseca & J. Kent (2000). Biodiversity and hotspots for conservation priorities. *Nature* 403: 853–858; <http://dx.doi.org/10.1038/35002501>
- Nayar, M.P. (1996). *Hot Spots of Endemic Plants of India, Nepal and Bhutan*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, 252pp.
- Neville, H.M., J.B. Dunham & M.M. Peacock (2006). Landscape attributes and life history variability shape genetic structure of trout populations in a stream network. *Landscape Ecology* 21: 901–916; <http://dx.doi.org/10.1007/s10980-005-5221-4>
- Nduka, J.K.C., O.E. Orisakwe, L.O. Ezenweke, T.E. Ezenwa, M.N. Chendo & N.G. Ezebasili (2008). Acid Rain Phenomenon in Niger Delta Region of Nigeria: Economic, Biodiversity, and Public Health Concern. *The Scientific World Journal* 8: 811–818; <http://dx.doi.org/10.1100/tsw.2008.47>
- Nwosu, M.O. (2002). Ethnobotanical studies on some Pteridophytes of southern Nigeria. *Economic Botany* 56: 255–259; [http://dx.doi.org/10.1663/0013-0001\(2002\)056%5B0255:ESOSPO%5D2.0.CO;2](http://dx.doi.org/10.1663/0013-0001(2002)056%5B0255:ESOSPO%5D2.0.CO;2)
- Oates, J.F., R.A. Bergl & J.M. Linder (2004). *Africa's Gulf of Guinea Forests: Biodiversity Patterns and Conservation Priorities*. *Advances in Applied Biodiversity Science*. Number 6. Conservation International, Washington D.C., 90pp.
- Ojo, L.O. (2004). The fate of a tropical rainforest in Nigeria: Abeku sector of Omo Forest Reserve. *Global Nest: The International Journal* 6(2): 116–130.
- O'Shea, B.J. (1997). The mosses of sub-Saharan Africa 2. Endemism and biodiversity. *Tropical Bryology* 13: 75–85.
- O'Shea, B.J. (2006). Checklist of the mosses of sub-Saharan Africa (version 5, 12/06). *Tropical Bryology Research Report* 6: 1–252.
- Palumbi, S.R. (1994). Genetic Divergence, Reproductive Isolation, and Marine Speciation. *Annual Review of Ecology and Systematics* 25: 547–572; <http://dx.doi.org/10.1146/annurev.ecolsys.25.1.547>
- Peacock, M.M. & N.A. Dochtermann (2012). Evolutionary potential but not extinction risk of Lahontan Cutthroat Trout (*Oncorhynchus clarkii henshawi*) is associated with stream characteristics. *Canadian Journal of Fisheries and Aquatic Sciences* 69(4): 615–626; <http://dx.doi.org/10.1139/f2012-006>
- Pimm, S.L., G.J. Russel, J.L. Gittleman & T.M. Brooks (1995). The future of biodiversity. *Science* 269: 347–350; <http://dx.doi.org/10.1126/science.269.5222.347>
- Pimm, S.L. & T.M. Brooks (2000). The sixth extinction: how large, where, and when? pp. 46–62. In Raven, P.H. & T. Williams (eds.). *Nature and Human Society: The Quest for A Sustainable World*. National Academy Press, Washington, DC, 625pp;
- Reid, J.C. (1989). Floral and faunal richness of Oban Division of Cross River National Park and list of flora and fauna of the Calabar Oban Area. Appendix 7 to Cross River National Park (Oban Division): Plan for Developing the Park and its Support Zone. Godalming, Surrey: WWF-UK.
- Rhind, P. (2013). Terrestrial Biozones: Nigerian-Cameroonian Endemic Plants. <<http://www.terrestrial-biozones.net/Paleotropical%20Ecosystems/Nigerian-Cameroonian%20Ecosystems.html>> Visited February 27, 2013.
- Robbercht, E. (1996). Geography of African Rubiaceae with reference to glacial rain forest refuges, pp. 564–581. In: van der Maesen L.J.G. (ed.). *The Biodiversity of African Plants*. Springer Netherlands, XV+861pp.
- Sarmiento, E.J. & J.F. Oates (2000). Cross River gorillas: A neglected subspecies. *American Museum Novitates* 3304, 55pp.
- Schemske, D.W., G.G. Mittelbach, H.V. Cornell, J.M. Sobel, & K. Roy (2009). Is There a Latitudinal Gradient in the Importance of Biotic Interactions? *Annual Review of Ecology, Evolution, and Systematics* 40: 245–269; <http://dx.doi.org/10.1146/annurev.ecolsys.39.110707.173430>
- Schiøtz, A. (1999). *Treefrogs of Africa*. Edition Chimaira. Hollywood Import & Export Inc, Gainesville, FL, 350pp.
- Schmitt, C.B., M. Denich, S. Demissew, I. Friis & H.J. Boehmer (2010). Floristic diversity in fragmented Afromontane rainforests: Altitudinal variation and conservation importance. *Applied Vegetation Science* 13: 291–304; <http://dx.doi.org/10.1111/j.1654-109X.2009.01067.x>
- Seegerback, L.B. (1983). *Orchids of Nigeria*. A.A. Balkema Publishers. A member of Swets and Zeitlinger Publishers. Netherlands, 111pp.
- Siemann, E., D. Tilman, J. Haarstad & M. Ritchie (1998). Experimental tests of the dependence of arthropod diversity on plant diversity. *American Naturalist* 152: 738–750; <http://dx.doi.org/10.1086/286204>
- Slatkin, M. (1987). Gene Flow and the Geographic Structure of Natural Populations. *Science* 236: 787–792; <http://dx.doi.org/10.1126/science.3576198>
- Soladoye, M.O., M.A. Sonibare, A.O. Nadi & D.A. Alabi (2005). Indigenous Angiosperm biodiversity of Olabisi Onabanjo University Permanent Site. *African Journal of Biotechnology* 4(5): 554–562.
- Spehn, E.M., K. Rudmann-Maurer, C. Korner & D. Massali (2010). Mountain Biodiversity and Global Change. GMBADIVERSITAS, Basel, 59pp.
- Stattersfield, A.J., M.J. Crosby, A.J. Long & D.C. Wege (1998). *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*. Cambridge: BirdLife International, 816pp.
- Stuart, S.N., R.J. Adams & M.D. Jenkins (1990). *Biodiversity in Sub-Saharan Africa and its Islands Conservation, Management, and Sustainable Use*. Occasional Papers of the IUCN Species Survival Commission No. 6. IUCN, Gland, Switzerland, 242pp.
- Stuart, S.N., E.O. Wilson, J.A. McNeely, R.A. Mittermeier & J.P. Rodríguez (2010). The Barometer of Life. *Science* 328: 177; <http://dx.doi.org/10.1126/science.1188606>
- Templeton, A.R. (1981). Mechanisms of speciation - a population genetic approach. *Annual Review of Ecology and Systematics* 12: 23–48; <http://dx.doi.org/10.1146/annurev.es.12.110181.000323>
- The Plant List (2013). Version 1.1. Published on the Internet; <<http://www.theplantlist.org>> Accessed 27 August 2014
- Tropicos (2014). Tropicos database. Missouri Botanical Garden. <<http://www.tropicos.org>> Accessed August 27, 2014.
- U.S. Fish and Wildlife Service (1990). *Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada*. U.S. Fish and Wildlife Service, Portland, Oregon, 123pp.
- Vick, G.S. (1999). A checklist of the Odonata of the South-west Province of Cameroon, with the description of *Phyllogomphus corbetiae* spec. nov. (Anisoptera: Gomphidae). *Odontologica* 28: 219–256.
- Wagner, W. L., D.R. Herbst & D.H. Lorence (2005). Flora of the Hawaiian Islands. <<http://ravenel.si.edu/botany/pacificislandbiodiversity/hawaiianflora/index.htm>> Accessed May 2006.
- Wagner, W.L., D.R. Herbst & S.H. Somher (1990). *Manual of the flowering plants of Hawai'i*, Volume 1. University of Hawaii Press and Bishop Museum Press, Honolulu, Hawaii, USA, 1948pp.
- White, F. (1983). *The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa* (3 Plates, Northwestern Africa, Northeastern Africa, and Southern Africa, 1:5,000,000). UNESCO, Paris, 356pp.
- Wilson, E.O. (2010). *The Diversity of Life* (Second Edition). Belknap Press of Harvard University Press, Cambridge, Massachusetts, 424pp.
- Young, K.R., C. Ulloa-Ulloa, J.L. Luteyn & S. Knapp (2002). Plant evolution and endemism in Andean South America: an introduction. *The Botanical Review* 68: 4–27; [http://dx.doi.org/10.1663/0006-8101\(2002\)068%5B0004:PEAEIA%5D2.0.CO;2](http://dx.doi.org/10.1663/0006-8101(2002)068%5B0004:PEAEIA%5D2.0.CO;2)
- Young, B.E. (2007). Introduction, pp. 5–7. In: Young, B.E. (ed.) *Endemic species distributions on the east slope of the Andes in Peru and Bolivia*. NatureServe, Arlington, Virginia, USA, 628pp.