Ecologia

ISSN 1996-4021

Academic
Journals Inc.

www.academicjournals.com

OPEN ACCESS Ecologia

ISSN 1996-4021
DOI: 10.3923/ecologia.2023.1.8

Research Article
Floristic Survey of the Adjoining Areas of a Sacred Grove: A Case Study of the Okhemu Shrine, Nigeria

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Abstract

Background and Objective: The spiritual and cultural inclination of sacred groves has endowed them with the potential to protect biodiversity and sustain the ecological processes within. Hence, sacred groves could be highly valuable in preventing various threats that put plant communities at risk of being phased out. To assess the protective influence of the sacred grove towards its adjoining areas, the present study reports the floristic composition and the plant diversities along the northern end of Okhemu Shrine in Ekhor-Nogoghuan, Uhunwhode, Edo State, Nigeria. **Materials and Methods:** Floral composition of the vegetation was investigated using a nested quadrat sampling strategy. Floristic data were obtained from visual inspection and documented following herbarium-assisted identification. The phytogeographic profile of the plants was determined using Internet-based data, while the conservation status was determined based on the IUCN Red List of threatened species records. **Results:** A total of 90 plant species belonging to 82 genera and distributed among 41 families were enumerated. Among the most prevalent plant families were Euphorbiaceae, Asteraceae, Fabaceae, Malvaceae and Poaceae. The growth forms of the plants were distributed as follows: Trees (28.9%), herbs (25.6%), shrubs (20.0%), vines (8.9%) and lianas (5.6%), respectively. The systematic groups were distributed as grasses (6.7%), sedges 2.2%, ferns (1.1%) and moss (1.1%), respectively. Native plants were most prevalent with (78.9%), while exotics, cosmopolitan and pantropical plants accounted for (17.8, 2.2 and 1.1%), respectively. According to the IUCN Red List record, 91.1% of the species are yet to be evaluated for a threat status with few species such as *Brillantaisia lamium*, *Brillantaisia owariensis*, *Commelina africana*, *Vitex doniana* and *Urena lobata* indicating least concern. **Conclusion:** This study suggested that adjoining areas of sacred groves could be a refuge for native plant species of uncertain conservation status.

Key words: Biodiversity, conservation, ethnobotany, Okhemu Shrine, scared grove, phytogeography

Citation: Immanuel, O.I., E.I. Aigbokhan and O. Imarhiagbe, 2023. Floristic survey of the adjoining areas of a sacred grove: A case study of the Okhemu Shrine, Nigeria. Ecologia, 13: 1-8.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Sacred groves are biodiversity-rich forest patches manifested by a range of indigenous peoples' or communities' traditions and cultural values that conserve the groves in the belief of nature worship inherited from their ancestors[1-4]. Scared groves range from 0.001 to 26.326 ha[5,6]. The significance of sacred groves as a strategy for biodiversity conservation is based on their extensive distribution and critical roles as repositories of vulnerable species' local biodiversity[7]. Although, sacred groves were initially constructed for spiritual, cultural and religious objectives, they have significantly contributed to biodiversity protection. Many sacred groves are considered a refuge for endangered species Liles *et al.*[8]. The complex social-spiritual and religious connections of scared groves with native deities and ancestral spirits continue to implicate them in the protection of biodiversity and ecosystems[9]. In most cases, adjoining areas also share the protection influence, thereby extending the potential site for biodiversity protection, particularly in locations where traditions are sacred, like Tropical Africa and parts of Asia[9]. The Nigerian forest is renowned for the diversity and heterogeneity of plant species that make up the country's flora. Despite its relatively small size, these qualities have enabled the forest to provide huge bioresources for the financial incentive, provide habitats for threatened animal species, mitigate climate change, serve as a repository for medicine, sustain festivals and cultural activities, etc. There has been increased anthropogenic pressure on the Nigerian forest in recent times, leading to the loss of rare and threatened plant species. The intervention of mitigating measures like creating protected areas, like national parks and forest reserves, is yet to avert the situation. However, many indigenous tribes in Nigeria had long-standing traditional systems (scared groves) for protecting plant and animal species before introducing conventional biodiversity conservation approaches[1]. Species protection is typically accomplished through taboos, religious beliefs or the dedication of the species to one or more deities. This way, patches of pristine forests remain sustained through time. This strategy, if properly harnessed, could reduce the wanton spate of forest degradation in Nigeria.

Scared groves protect the species within the grove and create a habitable environment for species found in the adjoining areas of the grove[2]. Hence, an increase in the size and number of sacred groves will increase the number of protected species. Although a relatively high number of sacred groves exist across Nigeria, very few of these, have been reported. More obscured is the vegetative composition of these sacred groves to ascertain their potential to harbour rare and endangered plant species. The reverence for these holy sites could be one of the reasons why the flora of these sites is underexplored. Notwithstanding, there have been reports about some sacred groves in Nigeria, some of which include Emohua Sacred Grove, Rivers State. Igbo-Olua Sacred Grove, Ondo State, Osogbo Sacred Grove, Osun State Asanting Ibiono Sacred Forests Akwa-Ibom, Etche Sacred Grove Rivers, Ohe Sacred Grove, Enugu State, Ohia Sacred Grove Udowerre, Anambra and Sukur landscape, Adamawa[10-13]. This study aims to assess the potential of adjoining areas of a sacred grove to protect floristic biodiversity by using the Okhemu Shrine in Ekhor-Noguokhan, an underexplored sacred grove, as a case study.

MATERIALS AND METHODS

Study area: The study was carried out from May, 2019 to May, 2021. The Okhemu Shrine is situated within the Ekhor-Noguokhan Forest in the Uhunmwonde Local Government Area of Edo State. It is located between Latitude 06°18902'N and 06°17"145'N and Longitude 005°98"590'E and 005°49315'E. The site is about 20 km from Benin City, the Edo State Capital. The area's climate is characterized by two distinct seasons, the rainy and dry seasons. The rainy season starts between April and October, with a 2 week break in August. The study area experiences a dry season from November to March, with a cold, humid and dusty harmattan period between December and January. The average temperature in the wet season is 25 and 28°C in the dry season. The topography is a low-lying area, characterized by a sandy plain.

Sampling design: The floral composition of vegetation was investigated using the nested quadrat method described by Cox *et al.*[14]. Trees were measured using a 10 by 10 m quadrant, shrubs 5 by 5 m and herbs 2 by 2 m, respectively.

Determination of species composition: The sacred grove adjoining the north end of the Okhemu Shrine was surveyed for 2 years (May, 2019 and May, 2021) by weekly visual reconnaissance surveillance of the area. Plants found within the study site were identified, classified and catalogued according to their taxonomic (species and family) names, growth form, conservation status and biogeography (native and exotic).

Floristic data identification: After collection, the specimens were processed, preserved and mounted on herbarium sheets following the standard herbarium techniques[15]. The herbarium specimens were properly identified at the Department of Plant Biology and Herbarium, University of Benin, Benin City.

Phytogeography: Phytogeographic profile of each of the plants observed was determined using the following Internet-based data: The plant List, Global Biodiversity Information Facility (GNIF), The South African National Biodiversity Institute (SANBI), Annotated checklist of vascular plants of Southern Nigeria[16].

Determination of life forms: Plant species encountered were classified into life-form categories based on procedures developed by Raunkiaer[17].

Determination of conservation status: The conservation status of plant species encountered in the survey areas was determined based on the International Union for Conservation of Nature (IUCN) Red List of threatened species records (accessed from https://www.iucnredlist.org/search.

RESULTS

Plants found in the adjoining area of the north end of the Okhemu Shrine comprise 90 plant species belonging to 82 genera under 41 families were enumerated. Of the 41 plant families, 19 were represented by more than one species and they include Euphorbiaceae, Asteraceae, Fabaceae, Malvaceae, Poaceae, Menispermaceae, Apocynaceae, Acanthaceae, Lamiaceae, Moraceae, Combretaceae, Commelinaceae, Arecaceae, Anacardiaceae, Araceae, Cyperaceae, Dioscoreaceae, Piperaceae and Gentianaceae (Table 1). The plants were categorized into groups, with dicots accounting for 65.9%, monocots accounting for 29.3% and pteridophytes constituting only 4.9% of the total number.

The analysis of the growth forms of plants in the study area revealed that herbs accounted for the majority of growth forms recorded with 33 species representing 36.8%. This is followed by trees with 30 species representing 33.3%, shrubs with 13 species representing 14.4%, vine with 9 species representing 10.0% and lianas with 5 species representing 5.6% of the overall species composition of the study area (Fig. 1). The categorization of plant species on the adjoining sites of the grove based on Raunkiaer life forms classification system reveals that the majority of plants on the sites are phanerophytes with 48 species, accounting for 53.3%. This was followed by chamaephytes with 28 species, accounting for 31.1%, hemicryptophytes were represented by 9 species with 10.0%, epiphytes were 4 species with 4.4% and only cryptophytes with one species accounting for only 1.1% of the total (Fig. 2).

The phytogeographical profile of the plants found in the study area revealed that native plants were the most represented, with 71 species accounting for 78.9%, while exotic plants amounted to 16 species, representing 17.8% of the total, plants with cosmopolitan distribution patterns were 2 species, accounting for 2.2%, while those with a Pantropical distribution recorded one species, accounting for 1.1% (Fig. 3). The conservation status of the plant species based on the IUCN Red List suggests that the majority of plants were of the not evaluated (NE) category accounting for 82 species (91.1%), while those in the least concern (LC) category was represented by 7 species (7.8%) and data deficient category recorded one specie (1.1%) (Fig. 4).

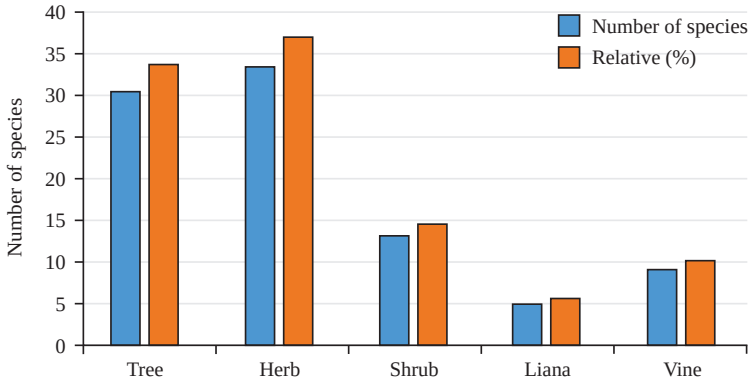

Fig. 1: Distribution of plant species based on growth habit

Table 1: Checklist of plant species adjoining the North end of Okhemu Shrine

Family (%)	Scientific name	Local name	Growth form	Life form	Common use (s)	IUCN Red List status
Acanthaceae (3.3%)	*Asystasia gangetica* (L.) T. Anderson	Ebe oghoghiro (Edo)	Herb	He	Fo and M	N.E
	Brillantaisia lamium (Nees) Benth.	Ebohohede, (Edo)	Herb	Ch	M	L.C
	Brillantaisia owariensis P. Beauv.	Ebohodede, (Edo)	Herb	Ch	Orn and M	L.C
Anacardiaceae	*Mangifera indica* L.	Ogwi (Edo)	Tree	Ph	Dy, Tan and M	D.D
	Spondias mombin L.	Okighan (Edo)	Tree	Ph	Dy, Tan and M	N.E
Apocynaceae (5.6%)	*Baissea axillaris* (Benth.) Hua	Nil	Liana	Ph	Fo and M	N.E
	Landolphia dulcis (Sabine ex G. Don) Pichon	Ubo-nakhe (Edo)	Shrub	Ph	Fr, O and M	N.E
	Rauwolfia vomitoria Afzel.	Akata (Edo)	Shrub	Ph	Tim, Dy and M	N.E
	Voacanga africana Stapf	Ako dodo (Yor)	Tree	Ph	Oil, Fi and M	N.E
	Alstonia boonei De Wild.	Ogiegbukhu (Edo)	Tree	Ph	M and Tim	N.E
Araceae (2.2%)	*Caladium bicolor* (Aiton) Vent.	Ede-ohia (Igbo)	Herb	Ch	M	N.E
	Colocasia esculenta (L.) Schott	Iyokho-oto (Edo)	Herb	Ch	V and M	N.E
Arecaceae (2.2%)	*Elaeis guineensis* Jacq.	Udin, (Edo)	Tree	Ph	Fo and M	N.E
	Raphia vinifera P. Beauv.	Oha, (Edo)	Tree	Ph	Tim and M	N.E
Asteraceae (6.6)	*Acanthospermum hispidum* D.C.	Dangunro (Yor)	Herb	Ch	M and Sp.	N.E
	Aspilia africana (Pers.) C.D Adams	Ogbia (Edo)	Herb	Ch	M and Fo	N.E
	Chromolaena odorata (L.) R. King and H. Robinson	Ebe-awolowo (Edo)	Shrub	Ph	M and O	N.E
	Gymnanthemum amygdalinum (Delile) Sch. Bip. ex Walp.	Oriwo (Edo)	Shrub	Ph	M Fo and Sp	N.E
	Melanthera scandens (Shumach and Thonn.) Roberty	Azuzo (Igbo)	Herb	Ch	M Fi and V	N.E
	Sclerocarpus africanus Jacq. ex. Murr	Nli atolo (Igbo)	Herb	Ch	M	N.E
Bignoniaceae (1.1%)	*Newbouldia laevis* Seem. ex. Bureau	Ikhimi (Edo)	Tree	Ph	Tim, Fu and M.	N.E
Bromeliaceae (1.1%)	*Ananas comosus* (L.) Merr.	Edin-ebo (Edo)	Herb	Ch	V, Fi and M	N.E
Cannabaceae (1.1%)	*Trema guineensis* (Schumach.) Ficalho	Ehunogo (Edo)	Tree	Ph	Dy, Tan, Fi, Fr and M	N.E
Cannaceae (1.1%)	*Canna indica* L.	Ebesalebo (Edo)	Herb	Ch	Dy, Tan, Fi, Fr and M	N.E
Clusiaceae (1.1%)	*Pentadesma butyracea* Sabine	Edu-eni (Edo)	Tree	Ph	M Fi and Fr	N.E
Combretaceae (2.2%)	*Combretum platypterum* (Welw.) Hutch. and Dalziel	Ovben-ome (Edo)	Liana	Ph	Orn and M	N.E
	Combretum racemosum P. Beauv.	Akoso (Edo)	Liana	Ph	Oil, Aux and M	N.E
Commelinaceae (2.2%)	*Commelina africana* L.	Ohiowu (Edo)	Herb	Cr	Fo and M	L.C
	Palisota hirsuta (Thunb.) K. Schum. ex. Englee	Uguela-ohuah (Edo)	Herb	Ch	M	N.E
Cannabaceae (1.1%)	*Cnestis ferruginea* Vahl ex. DC	Ukpo-ibieka (Edo)	Shrub	Ph	Dy, Tan, Fi, Fr and M	N.E
Costaceae (1.1%)	*Costus afer* Ker Gawl.	Ukweroha, (Edo)	Herb	Ch	Fi, V and M	N.E
Cucurbitaceae (1.1%)	*Momordica charantia* L.	Ebe-isiughu (Edo)	Vine	E	M	N.E
Convolvulaceae (1.1%)	*Ipomoea involucrata* P. Beauv.	Eriri-aqwo (Igbo)	Vine	Ch	V, Fo and M	N.E
Cyperaceae (2.2%)	*Mariscus alternifolius* auct, non Vahl	Nil	Herb	Ch	Fo and M	N.E
	Scleria foliosa Hochst. ex. A. Rich.	Emee (Yor)	Herb	Ch	M	N.E
Dioscoreaceae (2.2%)	*Dioscorea bulbifera* L.	Aduinu (Igbo)	Herb	E	M	N.E
	Dioscorea praehensilis Benth.	Ogigban (Edo)	Vine	E	V	N.E
Dilleniaceae (1.1%)	*Tetracera alnifolia* Willd.	Ononagba (Yor)	Vine	He	V and M	N.E
Dryopteridaceae (1.1%)	*Nephrolepis biserrata* (Sw.) Schott	Owuro (Edo)	Herb	Ch	V and M	N.E
Euphorbiaceae (8.9%)	*Jatropha curcas* L.	Oru-ebo (Edo)	Tree	Ph	Fi, O and M	N.E
	Hevea brasiliensis (A. Juss.) Mull. Arg.	Alrhaba-nofua (Edo)	Tree	Ph	O, Fr and M	N.E
	Ricinodendron heudelotii (Baill.) Pierre ex Heckel	Okhuen-nebo (Edo)	Tree	Ph	V, Fo and M	N.E
	Manihot esculenta Crantz	Ikhirikhia (Edo)	Tree	Ph	Ti and M	N.E
	Alchornea laxiflora (Benth.) Pax and K. Hoffm	Uwenuwen (Edo)	Tree	Ph	Ti and M	N.E
	Macaranga barteria Mull. -Arg.	Ohaha (Edo)	Tree	Ph	Ti and M	N.E
	Croton hirtus L'Herit	Nil	Herb	Ch	Ti and M	N.E
	Mallotus oppositifolius (Geisel.) Mull. Arg.	Ebubosa (Edo)	Shrub	Ph	Ti, Fi and M	N.E

Table 1: Continue

Family (%)	Scientific name	Local name	Growth form	Life form	Common use (s)	IUCN Red List status
Fabaceae (6.7%)	*Albizia zygia* (DC.) J. F. Macbr.	Ekpaghudo (Edo)	Tree	Ph	V, Fo and M	NE
	Calopogonium mucunoides Desv.	Agbara (Edo)	Vine	He	Fo and Aux	NE
	Gliricidia sepium (Jacq.) Kunth ex. Walp.	Agunmaniye (Yor)	Shrub	Ph	Fu, Fo and M	NE
	Pentaclethra macrophylla Benth.	Okpagha (Edo)	Tree	Ph	Dy, Sp, Fi and Fu	NE
	Piptadeniastrum africanum (Hook.f.) Brenan	Ekhinmi (Edo)	Tree	Ph	Fu, Fi and M	NE
	Tetrapleura tetraptera (Schumach.) Taub.	Ighirehmi (Edo)	Tree	Ph	Ti, Fr and M	NE
Gentianaceae (2.2%)	*Anthocleista djalonensis* A. Chev.	Oriweni (Edo)	Tree	Ph	Ti and M	NE
	Anthocleista vogelii Planch.	Orimi-ghughu (Edo)	Tree	Ph	Ti and M	NE
Lamiaceae (3.3%)	*Clerodendrum splendens* G. Don	Afifia omya (Igbo)	Shrub	Ph	Dy, Tan and M	NE
	Vitex doniana Sweet	Oriri (Edo)	Tree	Ph	V, Fo and Fr	LC
	Solenostemon monostachyus (P. beauv.)	Ebekpimweahianmwen (Edo)	Herb	Ch	Orn and M	NE
Malvaceae (6.6%)	*Cola heterophylla* (P. beauv.) Scott and Endl.	Ebededa (Edo)	Tree	Ph	M	NE
	Cola nitida (Vent.) Schott and Endl.	Evbe gabari (Edo)	Tree	Ph	M	NE
	Grewia mollis Juss.	Evbare (Edo)	Tree	Ph	Ti, Fr and M	NE
	Sida acuta Burm. f.	Obeche, Ubhekhe (Edo)	Shrub	Ph	M	NE
	Triplochiton scleroxylon K. schum	Oshiomabhigue (Edo)	Tree	Ph	M and Fr etc.	NE
	Urena lobata L.	Oronhon (Edo)	Shrub	Ph	V and Fo	LC
Marantaceae (1.1%)	*Trachyphrynium braunianum* (K. shum.)	Ebitoto (Edo)	Herb	Ch	Fr, Ti and V	NE
Melastomataceae (1.1%)	*Heterotis rotundifolia* (Sm.) Jacq-Fel.	Nil	Herb	He	M	NE
Menispermaceae (5.6%)	*Chasmanthera dependens* Hochst.	Ogbo (Igbo)	Vine	He	M	NE
	Triclisia coriacea Oliv.	Nil	Vine	Ch	M and Fr	NE
	Triclisia patens Oliv.	Alugbirin (Yor)	Liana	Ph	M and Fr	NE
	Triclisia subcordata Oliv.	Alugbirin (Yor)	Liana	E	M and Fr	NE
	Sphenocentrum jollyanum Pierre	Obanabe (Edo)	Shrub	Ph	M and Fr	NE
Moraceae (2.2%)	*Ficus exasperata* Vahl.	Amenmen (Edo)	Tree	Ph	Fr and M	NE
	Ficus capensis Thunb.	Uuwar, yaaraa, farin	Tree	Ph	V, D and Ta	NE
Musaceae (1.1%)	*Musa-sapientum* var. *Paradisiaca* L.	Oghede (Edo)	Herb	Ch	Fr	NE
Onagraceae (1.1%)	*Ludwigia decurrens* Walter	Nil	Herb	Ch	M	NE
Pandaceae (1.1%)	*Microdesmis puberula* Hook.f. ex. Planch	Erankpata, ubelu (Edo)	Shrub	Ph	V, Fo and Fr	NE
Piperaceae (2.2%)	*Piper guineense* Schumach and Thonn.	Ebe-ahanhi (Edo)	Vine	He	M and Sp	NE
	Peperomia pellucida (L.) Kunth	Rinrin, Erenren (Edo)	Herb	Ch	M and V	NE
Poaceae (6.7%)	*Bambusa vulgaris* Schrad. ex. J.C. Wendl	Iko (Edo)	Herb	Ch	V, Fr and Fu	NE
	Cynodon dactylon (L.) Pers.	Koko-igba (Yor)	Herb	He	M	NE
	Dactyloctenium aegyptium (L.) Wild.	Kutukku, Gudagude (Edo)	Herb	Ch	M and Fr	NE
	Oplismenus burmannii (Retz.) P. beauv.	Ita-oka (Yor)	Herb	He	M	NE
	Panicum maximum Jacq.	Ikin (Yor)	Herb	Ch	Ce and Pul	NE
	Setaria barbata (Lam.) Kunth	Ele ododo (Igbo)	Herb	Ch	M and Fo	NE
Portulacaceae (1.1%)	*Talinum triangulare* (Jacq.) Willd.	Ebe-dondon (Edo)	Herb	He	Fo, Sp and M	NE
Sapindaceae (1.1%)	*Cardiospermum halicacabum* L.	Mpikpo (Edo)	Vine	Ph	V, Fo and O	NE
Selaginellaceae (1.1%)	*Selaginella kraussiana* (Kunze) A. Braun	Ebahenegieghe (Edo)	Herb	Ch	M	NE
Urticaceae (1.1%)	*Myrianthus arboreus* P. beauv.	Ihieghe, Oseghe (Edo)	Shrub	Ph	Fr, Ti, M	NE
Violaceae (1.1%)	*Rinorea welwitschii* (Oliv.) Kuntze	Iyokhaze (Edo)	Tree	Ph	M and Ti	NE
Vitaceae (1.1%)	*Leea guineensis* G. Don	Igheghe-biaka (Edo)	Tree	Ph	Fr and M	NE

Life form according to raunkiaer[17]: Ph: Phanerophyte, Ch: Chamaephyte, Cr: Cryptophyte, H|-Hemicryptophyte and E: Epiphyte, Common Use (s): Ce: Cereal, Pul: Pulses, Co: Condiments, D: Dye, Ta: Tanning, Fo: Forages, Fr: Fruits, Fu: Fuel plant, V: Vegetables, M: Medicinal, O: Oil, Orn-Ornamentals, Ti: Timber, Sp: Spices and Aux: Auxiliary plant, Fi: Fibre, Conservation status according to IUCN: NE: Not evaluated, LC: Least concern and DD: Data deficient

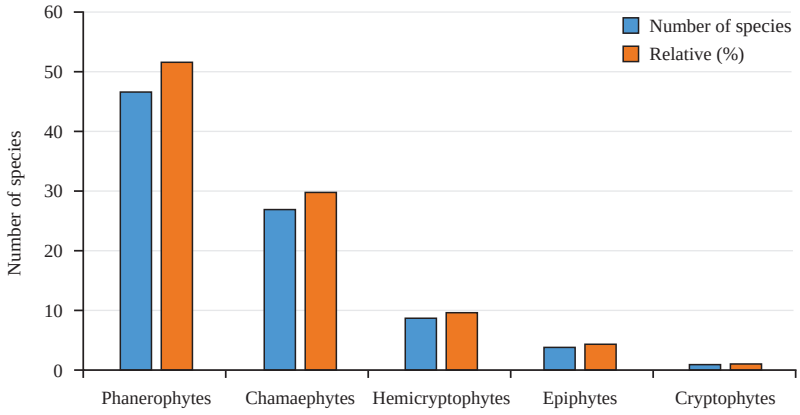

Fig. 2: Distribution of plants based on Raunkiaer's life form

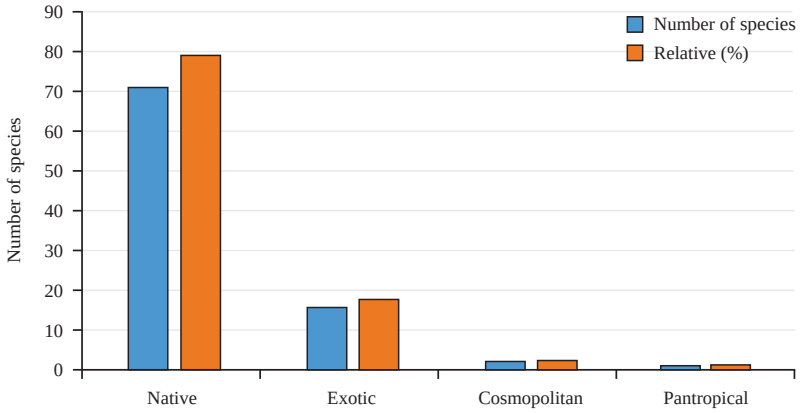

Fig. 3: Chorological profile of the plants found in the grove

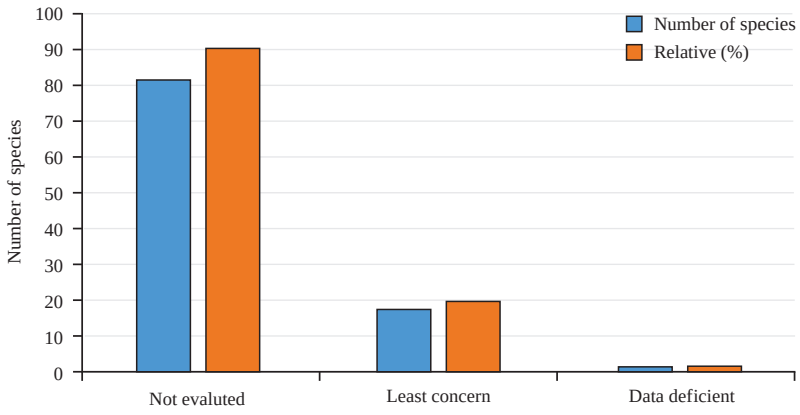

Fig. 4: Threat status of plants based on IUCN Red List categorization

DISCUSSION

The study upholds the relevance of the adjoining areas of a scared grove in contributing to the over-preservation of biodiversity, particularly in a rural setting. The study provided a floristic account of plant species found in the adjoining areas of the Okhemu Shrine, Edo State. A total of 90 plant species belonging to 41 families, were inventoried at different sections of the adjoining areas of the grove. Of these, 19 well-represented families in terms of species richness were

Euphorbiaceae, Asteraceae, Fabaceae, Malvaceae, Poaceae, Menispermaceae, Apocynaceae, Acanthaceae, Lamiaceae, Combretaceae, Commelinaceae, Arecaceae, Anacardiaceae, Araceae, Cyperaceae, Dioscoreaceae, Gentianaceae, Piperaceae and Selaginellaceae, respectively. The flora comprises an assemblage of annuals, biennials and perennials and many trees, herbs, shrubs, climbers and woody climbers or lianas. Of the families, dicots and monocots were the most dominant. This finding aligned with Dar *et al.*[18], who reported a similar diversity pattern in sacred groves in India. The presence of other plant families classified as moss and fern in these study areas indicates a mixed floristic composition with several species.

Sacred Groves act as reservoirs of the local biodiversity, preserving both the unique flora and fauna in providing a wide range of ecosystem services[2,4]. However, very little has been documented on the protective influence of the sacred grove over the neighbouring flora. Consequently, the present study has demonstrated the potential for such areas to harbour rare species which are protected by the influence of the sacred grove.

Sacred groves are expected to be a rich heritage for native species. Hence the study recorded a high prevalence of native plants, compared to exotic plants, which were considerably few. Also, the scanty cosmopolitan and pantropical species found among the vegetation in the grove suggests that there are few exchanges with less biological immigration from all parts of the world or the inability of certain introduced species to propagate and thrive. The occurrence of native plants such as *Mariscus alternifolius*, *Dioscorea bulbifera*, *Elaeis guineensis*, *Cnestis ferruginea*, *Spondias mombin* and *Commelina africana* in this study which was also recorded in earlier works by Onyekwelu and Olusola[1] and Imarhiagbe[19] were suggestive of the fact that these plants enjoy a relatively wider distribution across different sacred groves of Nigeria.

The vegetative structure based on the life form of plant species encountered in the study shows that phanerophytes were the dominant, followed by chamaephytes, hemicryptophytes, epiphytes and cryptophytes cover of the overall species composition of the study area. The vegetative structural pattern suggested that phanerophytes and chamaephytes constituted a higher percentage than the typical spectrum exhibiting "thero-chamaephyte" phytoclimate. Similarly, the proportion of hemicryptophytes and cryptophytes was lower than in the typical range. The high proportion of phanerophytes and low proportion of cryptophytes indicate a high yearly biomass turnover, as most annuals finish their life cycle within a few months and decay, returning nutrients to the soil. Because most phanerophytes are exclusively seasonal, the relevance of life-form classes in terms of species composition may reflect flora's adaptability and evolutionary diversification in response to climate. The prevalence of phanerophytes and chamaephytes shows that the studied area is relatively safe from anthropogenic disturbances. This study revealed that tree and herb were the most abundant growth form, with 26 trees accounting for 28.89% and 23 herbs accounting for 25.56%, respectively, while fern and moss were the minor growth forms, with one species each representing 1.11%.

The Okhemu Shrine was established for religious and spiritual purposes, its preservation plays a vital role in *in situ* biodiversity conservation. The high concentration of locally threatened plant species present justifies the potential of the grove in protecting biodiversity. This trend agreed with findings from Bobo *et al.*[20] and Mgumia and Oba[5]. The Okhemu Shrine is secured using taboos and cultural and religious beliefs or by dedicating the forest to deities. The conservation status of the plants in the study area is yet to be fully assessed. The IUCN conservation status of the plant species found in the study area revealed that 91.1% of the species are yet to be evaluated for a threat status while the least concern accounted for 7.78% and data deficient 1.11%. From the species assessed so far, although vulnerable and threatened species were not found, this may be due to the fact that the conservation status of these species was documented based on the IUCN Red List of threatened species records. Therefore, unless a thorough assessment is carried out, a definite threat status cannot be assigned. However, the overall conservation success recorded in Ekhor Noguokhuan Grove could be attributed to the way people interact with it. People see the grove as the home of the deity (Okhemu goddess), a place of worship and a historical and cultural site, which suggests that they hold the grove in high regard and are committed to its preservation.

CONCLUSION

The value of the sacred grove in protecting biodiversity cannot be overemphasized. The Okhemu Shrine is undoubtedly rich in plant biodiversity, ranging from trees to shrubs, vines, sedges, ferns and mosses. However, most of these species are yet to be evaluated for their conservation status. From the assessment, most of these species are not yet been evaluated (NE) for a threat status but just the presence of a few evaluated as least concern. Following the effectiveness of the sacred grove in protecting biodiversity, there is a need to utilize the sacred grove strategy for biodiversity conservation in Nigeria. Also, the sacred grove,

although well protected, is facing some mild threats due to human trampling during festivals, dying of old trees, erosion of socio-religious ethics towards plants, rapid urbanization, grazing pressure and exotic weed invasion. Therefore, for effective long-term conservation and better management of the grove, the traditional heads/villagers should play active roles in the management of the groves.

SIGNIFICANCE STATEMENT

The study affirms the potential of the adjoining areas of a sacred grove to preserve species. Using a case study of the Okhemu Shrine, Nigeria, the survey revealed that 90 species among the most prevalent plant families were Euphorbiaceae, Asteraceae, Fabaceae, Malvaceae and Poaceae. The predominant growth forms of the plants were trees (28.9%), which further attests to the undisturbed nature of these areas. Furthermore, native plants were the most prevalent (78.9%). The study found that 91.1% of the species lack a threat status, according to the IUCN Red List record. Such a high percentage of not evaluated species does not suggest these species could be of a Least Concern status. But it should further spur conservation scientists to proffer a definite threat status for the species.

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