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Assessment of flora diversity and population structure in Lagos-Sagamu-Abeokuta Expressway, Southwestern Nigeria

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Abstract

The Lagos-Shagamu-Abeokuta Expressway is a globally important biodiversity hotspot and is facing rapid loss in floristic diversity and changing patterns of vegetation due to various biotic and abiotic factors. This has necessitated the qualitative and quantitative assessment of floral diversity and population structure. The vegetation survey along this route was conducted using the systematic sampling methods. Three sample plots of 50 m x 50 m were laid in alternate side at 100m interval. In each sample plot, all living trees (with GBH at 1.3 m of trees) greater than or equal to 3 m high at midpoint were measured. A total of 4212 individuals representing 134 species, 117 genera, and 48 families were recorded. Fabaceae was the dominant family in this route with 22 species, followed by Euphorbiaceae (8 species), Apocynaceae (8 species), and Poaceae (5 species). Among genera, *Senna* was followed by *Ficus, Terminalia, Cola, Clerodendrum, Albizia*, and *Alchornea*. The population structure of woody species based on diameter class distribution reflected reversed J-shape. The species diversity indexes for dominance (0.02, 0.06), Simpson index value (0.97, 0.93), Shannon–Weiner (3.91, 3.25), evenness (0.59, 0.52) and Margalef (11.22, 6.15) were recorded for arboreal and non-arboreal species respectively. Results obtained revealed high diversity of woody species in the vegetation along this route. The non-arboreal species along this route is threatened by continuous animal grazing, intensification of commercialized farming and invasive species. The information on tree species structure and function can provide baseline information for the conservation of the biodiversity of the tropical forest in this area.

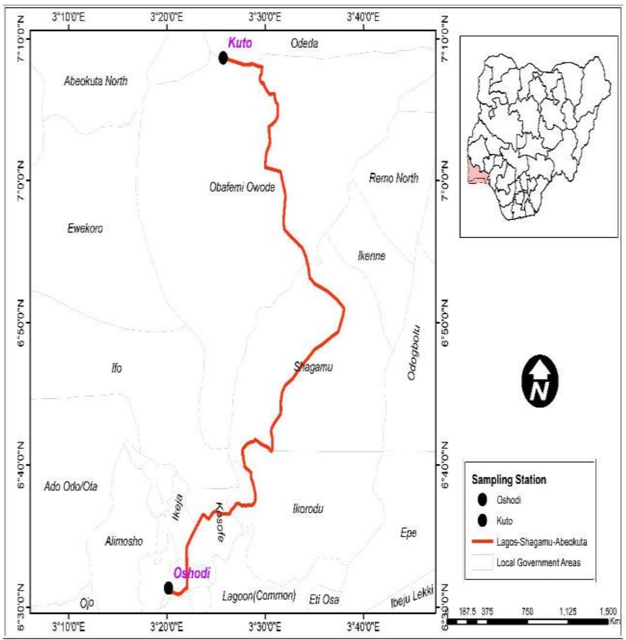
1. INTRODUCTION

Plants protect the local hydrological cycle by preventing soil erosion, lowering river tilt loads, slowing run-off, and moderating floods and other harmful fluctuations in the stream. Trees and other plants cover areas of drainage basins, regulate water run-off, may aid in the preservation of spawning habitat for fish and the sustainability of major fisheries (Salm, 1984), and provide ranches for livestock production (Poffenbarger, 2010). However, with the growing human population, habitat destruction and deforestation, overexploitation, the spread of invasive alien species, pollution, and the growing impacts of climate change, two-thirds of the world's plant species are in danger of extinction (Borokini et al., 2010). In Nigeria, the alarming destruction of natural habitats is primarily caused by unsustainable land use, settlement expansion, clearing for farming, rights of way for infrastructure development, overexploitation, and overgrazing (Benton, 2007). Also, many parts of indigenous and exotic plant species are lost due to medical purposes due to an increase in trans-medicinal practitioners who use plants as raw materials for the production of their medicine, resulting in the depletion of the country's biodiversity. According to Nigeria's first national biodiversity report, approximately 60% of 65% of tree species are now threatened with extinction, while 35% of 40% are threatened (Imeht and Adebobola, 2001). Nigeria is endowed with a diverse flora due to its geographic and climatic features. Nonetheless, plant diversity is declining at an alarming rate in Nigeria, necessitating conservation efforts. The study's goal was to create an updated baseline floral data assessment report that could be used to improve and develop management and conservation plans for protected areas. Its specific goals were to provide a taxonomic list of all recorded floral species along with their corresponding endemism, flowering period, and conservation status, and determine the level of diversity in the area using various diversity indices.

1.1. The study area

The Lagos-Shagamu-Abeokuta Expressway is a major road in Nigeria that connects the cities of Lagos, Shagamu, and Abeokuta in Ogun State. It is located between latitude 06.514193 and 07.131501 and longitude 03.308678 and 03.334405 at an elevation of 150.2 meters. It is bordered by the states of Oyo and Osun to the north, Ondo State to the east, and the Republic of Benin to the west. The expressway has a tropical climate with distinct wet and dry seasons. The average wind speed is 10.6 kmph, the average annual rainfall is 230 mm, and temperatures range from 21 to 33 degrees Celsius. The wet season is divided into two parts: the first period is from April to July and the second period is from September to November. The main dry season is from December to March and is typically characterized by harmattan winds from the North-East Trade Winds in November. This Trunk 'A' federal road serves as a vital transportation route, enabling the movement of people, goods, and services between the cities and also playing an important role in the economic development of the region. It is largely covered by tropical rainforest and has wooded savanna in the northwest.

Figure 1: Map showing the travel routes along the Lagos



Shagamu Abeokuta Expressway

2. MATERIALS AND METHODS

The vegetation survey along this route was conducted from March to August 2021 using the systematic line transects. A 500 m line transects was located 25 m closed to the road along the forested areas. Three sample plots of 50 m x 50 m were laid in alternate side at 100 m interval. In each sample plot, all living trees with GBH at 1.3 m of trees greater than or equal to 3 m high at midpoint were measured. Four quadrats with dimensions of 1 m by 1 m were randomly used in each plot. In each plot, complete identification of all plant species of all growth forms (herbs, trees, climbers, shrubs) was done and the woody plants were completely enumerated.

Species that could not be identified were collected and preserved according to Radford et al. (1974). Two methods were used to identify the species found: (1) morphological descriptions in floras, manuals, and monographs (Keay et al., 1964); and (2) comparison of the specimens to archived dried samples in the University of Lagos Herbarium (Department of Botany), and herbarium of the Federal University of Technology, Akure, Nigeria. Identifications were limited to the genus level if morphological features were incomplete. Plant families were assigned based on the Angiosperm Phylogeny Group (APG) classification (2016), and species nomenclature and authorities were verified against the International Plant Names Index (IPNI) database (2020). All plant samples were used only for identification.

2.1. Herbarium specimens

Several samples from the species were collected, compressed, dried, and arranged in the herbarium in accordance with established protocols (Radford et al., 1974). This created a permanent record of the area's vegetation and flora, which would be useful for future research or conservation efforts. All of these specimens were kept in the University of Lagos Herbarium in Akoka, Yaba, and Lagos, Nigeria (LUH).

2.2. Vegetation diversity

In the comparative floristic analyses, descriptive statistics and diversity indices were used to assess the forest morphology of a study area. Descriptive statistics such as frequency (%), relative frequency (%), density (plants/m^2), and relative density (%) were calculated, while the diversity indices assessed included dominance, evenness, Shannon-Weiner, and Simpson's indices. The Paleontological Statistical Software (PAST v. 2.17c) was used with the probability level set at 0.05% (Hammer et al., 2001). The categorization of life forms considered was the five categories of climber, forb, grass, shrub, and tree (typical of the tropics) and was based on the classification scheme of Mueller-Dombois (1972).

2.3. Conservation Status Assessment

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2022-2) categorizes the conservation status of species into nine categories: Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable

(VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW), and Extinct (EX). These were adapted for classification of the species conservation status.

2.4. Vegetation analysis

Appropriate formulae were used in basal area computation. Biodiversity indices were adopted to determine species abundance, evenness and to compare community diversity, while species diversity indices were carried out with PAST version 4.03 with probability set at the 0.05% level of significance.

2.4.1 Basal area (BA)

The basal area of all trees in the sample plots was calculated using the formula:

$$BA = \frac{\pi D^2}{4}$$

where, BA = Basal area (m2), D = Diameter at breast height (cm) and л = pie (3.142). The total BA for each plot was obtained by adding all trees BA in the plot.

2.4.2. Relative Density (RD)

This is an index for assessing species relative distribution and was computed with:

$$RD = \frac{n_i}{N} \times 100$$

Where RD (%) is species relative density; ni is the number of individuals of species i; and N is the total number of all individual trees of all species in the entire community.

2.4.3. Relative Dominance (RDo)

Relative dominance (RDo (%)), used in assessing relative space occupancy of a tree, was estimated using:

$$RD_O = \frac{\sum Ba_i \times 100}{\sum Ba_n}$$

where Bai is basal area of all trees belonging to a particular species i and Ban is basal area of all trees in a city.

2.4.4. Family Importance Value (FIV)

This was used to estimate a family's share in the forest community. This is the sum of the relative dominance (RDo), relative density (RD) divided by 2.\

$$FVI = \frac{(\text{RD} + \text{RDo})}{2}$$

2.4.5. Importance Value Index (IVI)

The sum of the RD and RDo divided by two gave the importance value index for each species. This was used to express the share of each species in the tree community.

$$IVI = \frac{(\text{RD } x \text{ RDo})}{2}$$

3. RESULT AND DISCUSSION

There were 4212 individuals per ha of plant species in Lagos Shagamu Abeokuta Expressway (LSAE), distributed into 117 genera, 48 families, and 134 species (Table 1 and 2). Trees made up 42.53% of the total area, while shrubs, herbs, climbers, grasses, and sedges made up 20.28%, 20.89%, 11.19%, 3.73%, and 0.74% respectively (Table 3). Families with the highest representation of individuals include Poaceae (5 genera and 5 species), Fabaceae (18 genera and 22 species), Euphorbiaceae (7 genera and 8 species), Vitaceae (1 genus and 2 species), Asteraceae (5 genera and 5 species), Malvaceae (4 genera and 6 species), Verbenaceae (4 genera and 5 species), Apocynaceae (8 genera and 8 species), and Lamiaceae (2 genera and 2 species) as shown in Table 1 and 2. *Bambusa vulgaris* Schrad. ex Wendel. (352, 14.47), *Cissus aralioides* (Baker) Planch. (293, 12.05), *Zea mays* L. (cult.) (287, 11.08), and *Tridax procumbens* L. (89, 3.6) had the most individuals with the highest relative densities. *Senna siamea* (Lam.) H.S. Irwin & Barneby (75.03, 16.38), *Gmelina arborea* Roxb. (20.02, 7.77), *Tectona grandis* L. f. (12.07, 5.76), *Margaitaria discoidea* (Baill.) G.L. (43.19, 10.82), *Pleioceras barteri* Baill. (9.92, 0.11), *Khaya grandifolia* C. DC. (8.36, 0.03), and *Albizia zygia* (DC.) J. F. Macbr. (8.02, 5.06) were the arboreal plant species with the highest importance value index (Figure 2).

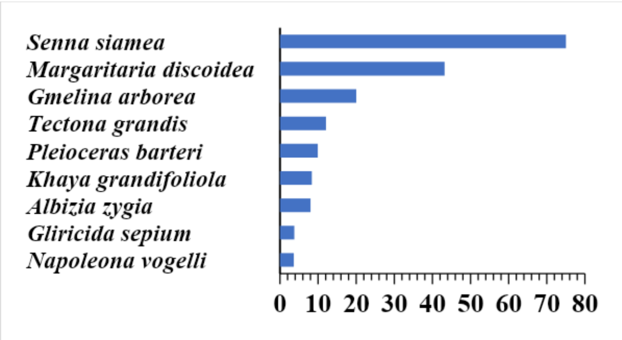


Figure 2: Species of importance values of woody species

The family Poaceae accounted for the highest number of individual species recorded (Figure 5). There was a high proportion of woody species in lower frequency classes and a low proportion of woody species in higher frequency classes, indicating that the species compositions at the study sites were generally diverse (Figure 3). Species diversity is a useful parameter for the comparison of communities under the influence of biotic disturbances or to determine the state of succession and stability in the community. The species diversity indices for dominance, Simpson index value, Shannon–Weiner, evenness, and Margalef recorded are 0.02, 0.06; 0.97, 0.93; 3.91, 3.25; 0.59, 0.52; and 11.22, 6.15; for arboreal and non-arboreal species respectively.

The analysis of the tree flora of the study area showed that members of the family Fabaceae (35.08%) are the most represented, followed by the Euphorbiaceae (17.67 %), Verbenaceae (14.9), Apocynaceae (4.12%), and Anacardiaceae (3.18%) as shown in Figure 4. This corresponds with the findings of Atsbha et al., (2019), Aynekulu (2011) and Anteneh et al. (2011) who reported that Fabaceae family dominated their study sites. However, the abundance of the Fabaceae is proof of the old age or maturity of the inventoried forest (Cusset, 1989). The majority of the taxa found in the studied area are important for conservation. They are found primarily in the intricate mosaic of lowland and ridge forest formations, and the ecological fragility and anthropogenic pressure on the forest indicate that these ecotypes have significant conservation value. The number of plants per quadrat area is expressed as density, and it is a critical measure for long-term forest management. The most abundant woody species are listed in order of density as Manihot esculenta Crantz., Senna siamea (Lam.) H.S. Irwin & Barneby, Sesbania sesban (L.) Merrill, Senna occidentalis (L.) Link, Margaritaria discoidea (Baill.) G.L., and Holarrhena floribunda (G. Don) Dur. & Schinz. Their dominance could be associated with enormous tolerance to anthropogenic disturbances.

Seven out of the 134 species were listed as vulnerable; these includeTectona grandis L. f., Cola millenii K Schum, Triplochiton scleroxylon K. Schum., Khaya grandifolia C. DC., Anthocleista djalonensis a. Chev., Pterocarpus osun Craib, and Dalbergia latifolia Roxb. Their vulnerability (IUCN, 2022), is probably due to their declining population and risk of being overexploited for their valuable wood, which is used for building, carpentry, furniture, and source of energy. This suggests that the species are facing a high risk of extinction in the wild, due to habitat destruction as a result of deforestation, logging, climate change, pests, diseases, clearance for agriculture and energy. Similarly, indications in the tropical rainforest are that there is high pressure in the use of wood as sources of energy compared to other sources. These species have been reported as species with excellent heating characteristics (Okpiliya, 2004). Therefore, the establishment of protected areas, sustainable logging practices, and community education on the importance of preserving the species is vital. The presence of these species in the study sites could be attributed to the area's status as a biodiversity and endemism hotspot in Nigeria, indicating that it is qualitatively diverse. Furthermore, the presence of these species in the study area could be due to the unintentional nature of the terrain, which limited human activities, particularly agriculture, to areas that were relatively accessible, leaving the inaccessible areas relatively undisturbed.

This study revealed the presence of biodiversity variability in the study area. A forest community is said to be rich if it has a Shannon Diversity value of 3.5 (Kent and Coker, 1992). The Shannon Wiener Diversity and evenness indices for the tree species were greater than 3.5 and 0.59, indicating that the forest was highly diverse with few species dominating in the studied route, and this supports the previous work of Haastrup et al. (2009). The diversity of non-woody species, such as herbs, grasses, and climbers, was relatively low. The high diversity of the arboreal species demonstrates that the vegetation in the study area was relatively unaffected by anthropogenic factors such as illegal tree felling. However, the relatively low diversity of non-arboreal plants observed indicates that bush clearing and burning have been practiced. Soil type, rainfall trends, anthropogenic action, and land use change are some of the other factors that could explain differences in biodiversity across the study area. The Shannon diversity index values obtained in this study are higher than those obtained in previous studies conducted both in Nigeria and in other tropical countries (Adekunle et al., 2013; Osabiya et al., 2022; Omomoh et al., 2019; Fonge et al., 2013). It is recommended to conduct regular monitoring in order to understand the dynamics of habitats and communities and plan for their management accordingly.

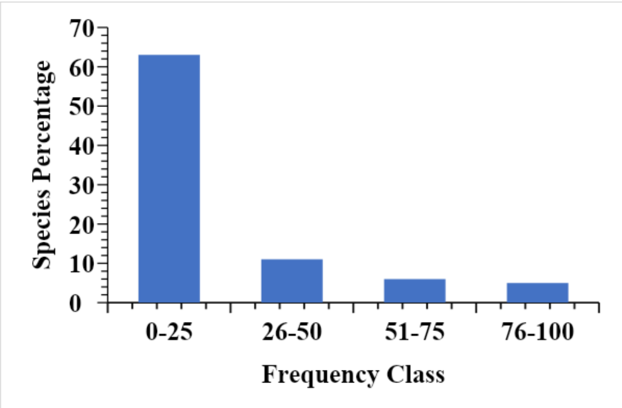


Figure 3: Woody species frequency class distribution

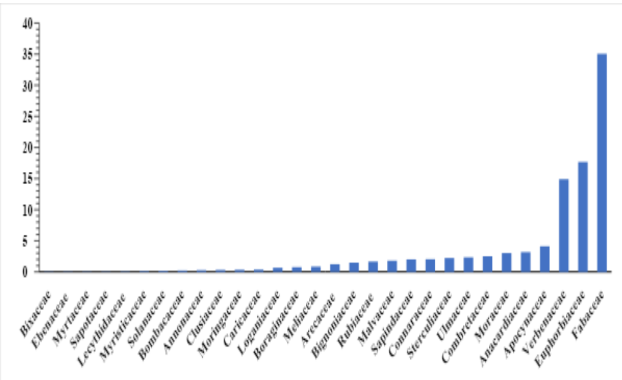


Figure 4: Family Importance values of woody species

Table 1: Structural analysis of non-woody species along Lagos-Shagamu-Abeokuta Expressway

No.	Name	Family	Habitat	F	RD	FP	IUCN
1.	*Alternanthera sessilis* (L.) R. Br. Ex DC.	Amaranthaceae	Herb	69	2.837	December-March	LC
2.	*Landolphia owariensis* P. Beauv.	Apocynaceae	Climber	1	0.041	July-August	LC
3.	*Anchomanes difformis* (BL.) Engl.	Araceae	Herb	39	1.604	September -December	LC
4.	*Periploca nigrescens* (Afzel.)	Asclepiadaceae	Climber	23	0.946	May-July	LC
5.	*Calotropis procera* (Ait.) Ait.f.	Asclepiadaceae	Climber	15	0.617	October-March	LC
6.	*Pergularia daemia* Forssk. Chiov.	Asclepiadaceae	Herb	29	1.192	August-February	LC
7.	*Secamone afzelii* (Schult.) K.	Asclepiadaceae	Climber	15	0.617	April-July	LC
8.	*Aspilia africana* (Pers.) C. D. Adams	Asteraceae	Herb	34	1.398	September-February	LC
9.	*Chromolaena odorata* (L.) R. M. King & H. Rob.	Asteraceae	Herb	68	2.796	December-March	LC
10.	*Synedrella nodiflora* Gaertn.	Asteraceae	Herb	34	1.398	December-April	LC
11.	*Tithonia diversifolia* A. Gray	Asteraceae	Herb	68	2.796	October- December	LC
12.	*Tridax procumbens* L.	Asteraceae	Herb	89	3.66	January – December	LC
13.	*Gloriosa superba* L.	Colchicaceae	Herb	54	2.22	July-October	LC
14.	*Ipomoea asarifolia* (Desr.) Roem. & Schult.	Convolvulaceae	Herb	12	0.493	March-October	LC
15.	*Ipomoea involucrata* P. Beauv.	Convolvulaceae	Climber	15	0.617	December-September	LC
16.	*Costus afar* Ker Gawl.	Costaceae	Herb	18	0.74	July-August	LC
17.	*Luffa cylindrica* M. J. Roem.	Cucurbitaceae	Climber	6	0.247	August-October	LC
18.	*Kyllinga erecta* Schumach.	Cyperaceae	Sedge	6	0.247	May-October	LC
19.	*Dioscorea alata* L.	Dioscoreaceae	Climber	11	0.452	July-October	LC
20.	*Dracaena manni* (L.) Ker Gawl.	Dracaenaceae	Herb	4	0.164	September-October	LC
21.	*Euphorbia hirta* L.	Euphorbiaceae	Herb	44	1.809	January-December	LC
22.	*Calopogonium mucunoides* Desv.	Fabaceae	Climber	52	2.138	December-March	LC
23.	*Centrosema pubescens* Benth.	Fabaceae	Climber	36	1.48	September-February	LC
24.	*Caesalpinia bonduc* Roxb.	Fabaceae	Herb	65	2.673	February-April	LC
25.	*Chamaecrista mimosoides* L.	Fabaceae	Herb	18	0.74	November-April	LC
26.	*Mezoneuron benthamianum* Baill.	Fabaceae	Climber	4	0.164	May-August	LC
27.	*Mucuna pruriens* (Linn.) DC. var. pruriens	Fabaceae	Climber	25	1.028	August-December	LC
28.	*Hoslundia opposita* Vahl	Lamiaceae	Herb	23	0.946	October-February	LC
29.	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Herb	81	3.331	September-April	NE
30.	*Spigelia anthelmia* L.	Loganiaceae	Herb	18	0.74	December-January	LC
31.	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	Herb	4	0.164	October-April	LC
32.	*Sida acuta* Burm. f.	Malvaceae	Herb	112	4.605	November-April	LC
33.	*Sida corymbosa* R. E. Fries	Malvaceae	Herb	23	0.946	February-April	LC
34.	*Sida urens* L.	Malvaceae	Herb	17	0.699	March-August	LC
35.	*Mimosa pudica* L.	Mimosaceae	Herb	16	0.658	November-March	LC
36.	*Boerhavia diffusa* L.	Nyctaginaceae	Herb	23	0.946	April-June	LC
37.	*Phyllanthus muellerianus* (Kuntze) Exell	Phyllanthaceae	Herb	8	0.329	September-May	LC
38.	*Phyllanthus amarus* Schum. & Thonn.	Phyllanthaceae	Herb	66	2.714	September-May	LC
39.	*Bambusa vulgaris* Schrad. ex Wendel.	Poaceae	Grass	352	14.47	-----------	LC
40.	*Eleusine indica* (L.) Gaertn.	Poaceae	Grass	4	0.164	January-December	LC
41.	*Panicum maximum* Jacq.	Poaceae	Grass	97	3.988	January-December	LC
42.	*Pennisetum purpureum* Schumach.	Poaceae	Grass	33	1.357	January-December	LC
43.	*Zea mays* L. (cult.)	Poaceae	Grass	287	11.8	June-August	LC
44.	*Antigonon leptopus* Hook. & Arn.	Polygonaceae	Climber	24	0.987	January-December	LC
45.	*Paullinia pinnata* L.	Sapindaceae	Climber	28	1.151	December-January	LC
46.	*Physalis angulata* L.	Solanaceae	Herb	18	0.74	August-October	LC
47.	*Starchytarphetta cayennensis* (L.C. Rich) Vahl.	Verbenaceae	Herb	23	0.946	September-May	LC
48.	*Cissus aralioides* (Baker) Planch.	Vitaceae	Climber	293	12.05	September-November	LC
49.	*Cissus arguta* Hook.f.	Vitaceae	Climber	28	1.151	April-May	LC

*LC: Least Concern; NE: Not Evaluated; F: Frequency; RD: Relative Density; FP: Flowering Period.

Table 2: Structural analysis of woody species along Lagos-Shagamu-Abeokuta Expressway

No	Name	Family	Habitat	F	DBH	BaHa1	RD	RDo	IVI	FIV	FP	IUCN
1.	*Anacardium occidentale* L.	Anacardiaceae	Tree	6	172.8	2.34	0.34	0.19	0.03	0.27	Oct-Nov.	LC
2.	*Mangifera indica* L.	Anacardiaceae	Tree	15	432.7	14.71	0.84	1.23	0.52	1.03	Nov-Mar	LC
3.	*Spondias mombin* L.	Anacardiaceae	Tree	43	451.5	16.01	2.41	1.34	1.61	1.88	Apr-June	LC
4.	*Cleistopholis patens* (Benth.) Engl. & Diels	Annonaceae	Tree	7	148.4	1.73	0.39	0.14	0.03	0.27	Apr-May	LC
5.	*Alstonia boonei* De Wild.	Apocynaceae	Tree	16	414.4	13.49	0.89	1.13	0.51	1.01	Nov-Jan.	LC
6.	*Funtumia elastica* (Preuss) Stapf	Apocynaceae	Tree	2	51.8	0.21	0.11	0.02	0.00	0.06	Jan-Dec..	LC
7.	*Holarrhena floribunda* (G. Don) Dur. & Schinz	Apocynaceae	Shrub	67	194.4	2.97	3.76	0.25	0.47	2.00	Sept-Dec.	LC
8.	*Pleioceras barteri* Baill.	Apocynaceae	Shrub	4	11.6	0.01	0.22	0.00	9.92	0.11	Jan-Dec.	LC
9.	*Rauvolfia vomitoria* Afzel.	Apocynaceae	Shrub	6	16.8	0.02	0.34	0.00	0.00	0.17	Dec-Jan.	LC
10.	*Thevetia nereifolia* Juss.	Apocynaceae	Shrub	12	34.8	0.09	0.67	0.00	0.00	0.34	Jan-Dec.	LC
11.	*Voacanga africana* Stapf	Apocynaceae	Shrub	15	43.5	0.14	0.84	0.01	0.00	0.43	Feb-Apr.	LC
12.	*Borassus aethiopum* Mart.	Arecaceae	Tree	6	89.4	0.63	0.34	0.05	0.00	0.19	Aug-Oct.	LC
13.	*Elaeis guineensis* Jacq.	Arecaceae	Tree	33	293.7	6.77	1.85	0.56	0.52	1.21	Jan-Dec	LC
14.	*Raphia hookeri* G. Mann & H. Wendi.	Arecaceae	Tree	1	23.6	0.04	0.06	0.00	0.00	0.03	May- July	LC
15.	*Newbouldia laevis* (P. Beauv.) Seemann. ex bureau	Bignoniaceae	Tree	28	459.2	16.56	1.57	1.38	1.09	1.48	Nov-Jan.	LC
16.	*Bixa orellana* L.	Bixaceae	Tree	2	37.9	0.11	0.11	0.00	0.00	0.06	Jan-Dec.	LC
17.	*Bombax buenopozense* P. Beauv.	Bombacaceae	Tree	2	43.6	0.15	0.11	0.01	0.00	0.06	Dec-Mar.	LC
18.	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae	Tree	3	154.5	1.87	0.17	0.16	0.01	0.16	Dec-Feb.	LC
19.	*Cordia milleni* Baker	Boraginaceae	Tree	18	279.1	6.12	1.01	0.51	0.26	0.76	Mar-June	LC
20.	*Carica papaya* L.	Caricaceae	Tree	12	102	0.82	0.67	0.07	0.02	0.37	Jan-Dec.	LC
21.	*Harungana madagascariensis* Lam. Ex Poir.	Clusiaceae	Shrub	11	31.9	0.08	0.62	0.01	0.00	0.31	Jan-April	LC
22.	*Combretum platyterum* (Welw.) Hutch. & Dalziel	Combretaceae	Tree	12	283.2	6.29	0.67	0.52	0.18	0.60	Sept-Nov	LC
23.	*Terminalia catappa* L.	Combretaceae	Tree	18	226.8	4.04	1.01	0.34	0.17	0.67	Mar-June	LC
24.	*Terminalia mantaly* Perr.	Combretaceae	Tree	24	403.2	12.77	1.35	1.07	0.72	1.21	Mar-June	LC
25.	*Terminalia superba* Engl. & Diels	Combretaceae	Tree	1	56.9	0.25	0.06	0.02	0.00	0.04	Nov-Feb.	LC
26.	*Byrsocarpus coccineus* Schum. & Thonn.	Connaraceae	Shrub	42	121.8	1.16	2.36	0.09	0.11	1.23	Sept-Nov	LC
27.	*Cnestis ferruginea* Vahl ex DC.	Connaraceae	Shrub	28	81.2	0.52	1.57	0.04	0.03	0.81	Jan-Feb.	LC
28.	*Diospyros barteri* Hiern	Ebenaceae	Tree	2	47.2	0.175	0.11	0.01	0.00	0.06	May-June	LC
29.	*Alchornea cordifolia* (Schum. & Thonn.) Müll. Arg.	Euphorbiaceae	Shrub	62	179.8	2.54	3.48	0.21	0.37	1.85	Oct.-Dec.	LC
30.	*Alchornea laxiflora* (Benth.) Pax & K. Hoffm.	Euphorbiaceae	Shrub	23	62.1	0.30	1.29	0.02	0.02	0.66	Sept-Nov	LC
31.	*Bridelia ferruginea* Benth.	Euphorbiaceae	Shrub	2	5.4	0.00	0.11	0.00	1.07	0.06	May-Sept	LC
32.	*Mallotus oppositifolius* Mull. -Arg	Euphorbiaceae	Shrub	12	32.4	0.08	0.67	0.01	0.00	0.34	Nov-Dec.	LC
33.	*Manihot esculenta* Crantz.	Euphorbiaceae	Shrub	98	264.6	5.49	5.50	0.46	1.26	2.98	June-July Oct-Nov.	LC
34.	*Margaritaria discoidea* (Baill.) G.L.	Euphorbiaceae	Tree	94	1579.2	195.8	5.28	16.36	43.19	10.82	Oct-Feb.	LC
35.	*Securinega virosa* Roxburgh ex Wild.	Euphorbiaceae	Shrub	33	95.7	0.72	1.85	0.06	0.05	0.96	Oct-Jan.	LC
36.	*Albizia lebbeck* (L.) Benth.	Fabaceae	Tree	12	216	3.66	0.67	0.31	0.10	0.49	Feb-May	LC
37.	*Albizia zygia* (DC.) J. F. Macbr.	Fabaceae	Tree	35	1115.2	97.69	1.96	8.16	8.02	5.06	Jan-Mar, Aug-Oct.	LC
38.	*Dalbergia latifolia* Roxb.	Fabaceae	Tree	3	33.3	0.09	0.17	0.00	0.00	0.08	Sept-Oct. Jan-Feb.	VU
39.	*Daniella oliveri* Hutch. & Dalziel.	Fabaceae	Tree	2	57.5	0.26	0.11	0.02	0.00	0.06	Oct-Mar.	LC
40.	*Delonix regia* (Gul Mohr)	Fabaceae	Tree	8	238.4	4.46	0.45	0.37	0.08	0.41	Apr.-May	LC
41.	*Dialium guineense* Willd.	Fabaceae	Tree	7	102.4	0.82	0.39	0.07	0.01	0.23	Dec-Mar.	LC
42.	*Gliricidia sepium* (Jacq.) Walp.	Fabaceae	Tree	34	775.2	47.20	1.91	3.94	3.76	2.93	Nov-Mar.	LC
43.	*Leucaena leucocephala* (Lam.) de wit	Fabaceae	Tree	18	230.4	4.17	1.01	0.35	0.18	0.68	Jan-Dec.	LC
44.	*Lonchocarpus sericeus* (Poir.) H. B. & K.	Fabaceae	Tree	21	478.8	18.00	1.18	1.50	0.89	1.34	Dec-Mar.	LC
45.	*Pentaclethra macrophylla* Benth.	Fabaceae	Tree	11	155.1	1.89	0.62	0.16	0.05	0.39	Mar-Apr.	LC
46.	*Pterocarpus osun* Craib	Fabaceae	Tree	1	34.8	0.09	0.06	0.00	0.00	0.03	Aug-Nov	VU
47.	*Senna hirsuta* (Lam.) H.S. Irwin & Barneby	Fabaceae	Shrub	51	137.7	1.49	2.86	0.12	0.18	1.49	Apr-Sept.	LC
48.	*Senna obtusifolia* (L.) H.S. Irwin. & Barneby	Fabaceae	Shrub	43	116.1	1.06	2.41	0.09	0.11	1.25	Jul-Sept.	LC
49.	*Senna occidentalis* (L.) Link	Fabaceae	Shrub	67	187.6	2.76	3.76	0.23	0.43	1.99	Mar-June	LC
50.	*Senna siamea* (Lam.) H.S. Irwin & Barneby	Fabaceae	Tree	98	2038.4	326.3	5.50	27.26	75.03	16.38	Aug-May	LC
51.	*Sesbania sesban* (L.) Merrill	Fabaceae	Shrub	76	205.2	3.31	4.27	0.28	0.59	2.27	May-Sept	LC

No	Name	Family	Habitat	F	DBH	BaHa1	RD	RDo	IVI	FIV	FP	IUCN
52.	*Napoleona vogelli* Hook. & Planch	Lecythidaceae	Shrub	3	8.1	0.00	0.17	0.00	3.63	0.08	Aug-Nov.	DD
53.	*Anthocleista djalonensis* a. Chev.	Loganiaceae	Tree	17	239.7	4.51	0.95	0.38	0.18	0.66	Mar-May	VU
54.	*Urena lobata* L.	Malvaceae	Shrub	51	137.7	1.48	2.86	0.12	0.18	1.49	Apr-Sept	LC
55.	*Waltheria indica* L.	Malvaceae	Shrub	11	29.7	0.06	0.62	0.00	0.00	0.31	Nov-Apr	LC
56.	*Azadirachta indica* A. Juss.	Meliaceae	Tree	12	385.2	11.65	0.67	0.97	0.33	0.82	Mar-May Aug-Sept	LC
57.	*Khaya grandifolia* C. DC.	Meliaceae	Tree	1	21.3	0.03	0.06	0.00	8.36	0.03	July-Dec	VU
58.	*Antiaris toxicaria* var. africana Scott-Elliot ex A. Chev.	Moraceae	Tree	12	265.2	5.52	0.67	0.46	0.15	0.57	Jan -Mar.	LC
59.	*Ficus exasperata* Vahl	Moraceae	Tree	13	547.3	23.53	0.73	1.96	0.72	1.35	Feb-Apr.	LC
60.	*Ficus mucuso* Welw. Ex Ficalho	Moraceae	Tree	6	141.6	1.57	0.34	0.13	0.02	0.23	June-Sept.	DD
61.	*Ficus sur* Forssk.	Moraceae	Tree	4	168.4	2.23	0.22	0.19	0.02	0.20	Apr-Sept	LC
62.	*Morus mesozygia* Stapf.	Moraceae	Tree	1	23.6	0.04	0.06	0.00	0.00	0.03	Sept-Nov	LC
63	*Musanga cecropioides* R.Br.	Moraceae	Tree	7	294.7	6.82	0.39	0.57	0.11	0.48	Apr-June	LC
64.	*Myrianthus arboreus* P. Beauv.	Moraceae	Tree	4	128.4	1.29	0.22	0.10	0.01	0.17	Jan.-Apr.	LC
65.	*Moringa oleifera* Lam.	Moringaceae	Tree	8	188.8	2.79	0.45	0.23	0.05	0.34	Jan-Mar.	LC
66.	*Pycnanthus angolensis* (Welw.) Warb.	Myristicaceae	Tree	4	94.4	0.7	0.22	0.05	0.00	0.14	Oct-May	LC
67.	*Psidium guajava* L.	Myrtaceae	Tree	2	42.1	0.14	0.11	0.01	0.00	0.06	Dec-Mar	LC
68.	*Funtumia elastica* (Preuss) Stapf	Rubiaceae	Shrub	21	60.9	0.29	1.18	0.02	0.01	0.60	Jan-Dec..	LC
69.	*Morinda lucida* Benth.	Rubiaceae	Shrub	24	64.8	0.33	1.35	0.03	0.02	0.69	Feb-May	LC
70.	*Nauclea latifolia* Sm.	Rubiaceae	Shrub	13	35.1	0.09	0.73	0.00	0.00	0.37	Jan-Mar.	LC
71.	*Allophylus africanus* P. Beauv.	Sapindaceae	Tree	9	212.4	3.54	0.50	0.29	0.07	0.40	Dec-Mar.	LC
72.	*Blighia sapida* Koenig	Sapindaceae	Tree	1	23.6	0.04	0.06	0.00	0.00	0.03	Mar-June	LC
73.	*Deinbollia pinnata* Schum. & Thonn.	Sapindaceae	Tree	21	495.6	19.29	1.18	1.61	0.95	1.39	Dec-Mar.	LC
74.	*Lecaniodiscus cupanioides* Planch. ex Benth.	Sapindaceae	Tree	5	118	1.09	0.28	0.09	0.01	0.19	Nov-Jan.	LC
75.	*Chrysophyllum albidum* G. Don	Sapotaceae	Tree	2	46.8	0.17	0.11	0.01	0.0	0.06	Dec-Feb.	LC
76.	*Solanum torvum* Swartz	Solanaceae	Shrub	6	16.2	0.02	0.34	0.00	0.00	0.17	Aug-Nov Feb-Apr.	LC
77.	*Cola gigantea* A. Chev. var. gigantea	Sterculiaceae	Tree	16	377.6	11.2	0.89	0.93	0.42	0.92	Oct-Jan.	LC
78.	*Cola millenii* K Schum	Sterculiaceae	Tree	11	259.6	5.29	0.62	0.44	0.14	0.53	Nov-Jan.	VU
79.	*Sterculia tragacantha* Lindi.	Sterculiaceae	Tree	14	330.4	8.57	0.79	0.72	0.28	0.75	Aug-Sept.	LC
80.	*Triplochiton scleroxylon* k. Schum.	Sterculiaceae	Tree	1	23.6	0.04	0.06	0.00	0.00	0.03	Nov-Mar.	VU
81.	*Trema orientalis* (Linn.) Blume	Ulmaceae	Shrub	78	210.6	3.48	4.38	0.29	0.64	2.34	Jan-Apr. Aug-Oct.	LC
82.	*Clerodendrum polycephalum* Baker.	Verbenaceae	Shrub	16	43.2	0.15	0.89	0.01	0.00	0.45	May-Aug	LC
83.	*Clerodendrum volubile* P. Beauv.	Verbenaceae	Shrub	32	86.4	0.59	1.79	0.04	0.04	0.92	Jul-Dec.	LC
84.	*Gmelina arborea* Roxb.	Verbenaceae	Tree	58	1368.8	147.2	3.26	12.29	20.02	7.77	Feb-Apr.	LC
85.	*Tectona grandis* L. f.	Verbenaceae	Tree	49	1156.4	105.0	2.75	8.77	12.07	5.76	May-Sept	VU

*RD: Relative density; RDO: Relative dominance; FP: Flowering Period; IVI: Importance Value Index; LC: Least Concern; NE: Not Evaluated; EN:

CONCLUSION

The information gathered from this study will assist in the development of appropriate strategies and action plans for the management of such biodiversity-rich areas, as well as a better understanding of the current state of floristic diversity. Furthermore, for *in-situ* conservation of economically and ecologically important species, regular monitoring of the route and complete habitat protection are recommended. Finally, a pragmatic and beneficial conservation approach, which has previously been lacking in this section of the Expressway, must be implemented.

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