

Diversity and Taxonomic Classification of Epiphytes in the Federal Capital Territory, Nigeria

ABSTRACT

Epiphytes exist in the Federal Capital Territory communities but there is little or no information on their diversity and taxonomy. However, Federal Capital Territory is a treasure house of ethnic communities and some valuable plant species. One major gap across the Federal Capital Territory, is lack of formal record on the diversity and taxonomic classification of the epiphytes. The objective of this study is to collect and identify epiphytes present in the Federal capital Territory, determine species composition and abundance, and further identify the various plants used as hosts by the epiphytes. The greatness of epiphytes has enabled them to exploit a wide range of habitats including tropical and temperate woodlands, plantations and mangroves. In tropical canopies, epiphytes are remarkably diverse and show asynchronous phonological patterns at the community level. A reconnaissance survey of the study on diversity of and taxonomic classification of epiphytes was carried out from November to December, 2021 in Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje and Kwali area councils of the Federal Capital Territory (FCT), Nigeria. Eighteen study points were randomly selected from the administrative town and two

settlements from each of the area council. The study sites were selected considering the dry riparian nature of the region, altitudinal ranges, notable presence of epiphytes diversity and recommendation from respondents. Data was collected by administering semi-structured questionnaires to 90 respondents for a single face-face interview. Epiphytic plants collected from the field were identified. Those that could not be identified were taken to the Biological Sciences Department, University of Abuja, for identification and documentation. The epiphytes were classified into eight (8) taxonomic groups namely; Polypodiophyta, Tracheophyta, Basidiomycota, Magnoliophyta, Ascomycota, Bryophyta, Marchantiophyta and Anthophyta while four (4) evolutionary taxonomic groups were identified. Based on their mode of life, some epiphytes were classified as Typical Epiphytes while others were Semi Epiphytes and Occasional Epiphytes. The study shows that different epiphytic plants occur in the Federal Capital Territory (FCT), Nigeria, and they belong to various taxonomic groups. Epiphytes in the Federal Capital Territory, and their Taxonomic Groups, indicated that *Nephrolepis bisserata* (Sw.) Schott, *Platycerium stemaria* (P.Beauv.) Desv., *Ficus benghalensis* L., *Ficus vogelii* Miq., *Elaeis guinensis* Jacq., *Ageratum conyzoides* (L.) L., *Ficus leprieurii* (Miquel), *Ficus lutea* Vahl, *Ficus thonningi* Blume, *Ficus exasperate* Vahl., *Ficus platyphylla* Delile, *Polyandra longiflora* L., *Digitaria ciliaris* (Retz.) Koeler, *Lycoperdon spadiceus* Pers., *Auricularia polytricha* (Mont.) Sacc., *Viburnum tinus* L.,

Plagiothecium undulatum (Hedw. Schimp., *Frullania dilatata* (L.) Dumort., and *Ficus aurea* Nutt. occurred in all the area councils of the FCT while *Fomitopsis* sp P.Karst., *Entodon* sp Müll. Hal. and *Funaria* sp Hedw. were seen in Abaji, Bwari, Gwagwalada, Kuje and Kwali area councils. *Nephrolepis undulata* (Afzel. Ex Sw.) J.Sm. occurred in Bwari, Kuje and Municipal area councils. *Coprinus lagopus* P.Karst., *Daldinia concentrica* (Bolton) Cesati and de Notaris, *Entodontopsis nitens* (Mitt.) W.R.Buck and Ireland, *Syntrichia laevipila* (Brid.) K.F.Schultz. occurred in Bwari, Gwagwalada, Kuje, and Municipal area councils. Having studied the diversity and classification of epiphytes of the Federal Capital Territory, it is recommended that further research analysis be carried on the phytochemical constituents of some of these epiphytes to determine their major classes of compounds.

Keywords: Distribution, abundance, diversity, ecology, phenology.

INTRODUCTION

Epiphytes refers to as living organism that grows upon other plant for support. They are usually independent of the host plant for nutrition, although they may sometimes damage the host plant, often by shading (Westwood, 2020). Epiphytes are not restricted to grow on a host plant, for instance, the holo-epiphytes such as orchids can be found growing on wires (Wester and Zotz, 2010). They complete their life

cycle without contact with the ground. A lot of orchids also constitute the nest epiphytes (Bohan and Vanbergen, 2021). They are characterized by appropriate and efficient devices for the collection of large quantities of humus and water (Petruzzelo, 2020).

Certain ferns belong to the group of proto-epiphytes (Derzhavina, 2020). They acquire nourishment from the surface of the supporting host and from atmosphere (Stanton *et al.*, 2014). *Scindapsus officinalis*, a member of the Bromeliaceae family which belongs to the group of epiphytic bromeliads exhibits xerophytism with absorbing peltate scales that act as one-way valves and tank formation by leaf bases (Govaerts *et al.*, 2013).

The hemi-epiphytes, at some stage of their development, root in ground soil; and the stranglers *Ficus* are well known representatives of this group (Ebika *et al.*, 2015). Vascular and non-vascular epiphytes biomass production in many rain forest canopies is significant, especially in cloud forests (Diana *et al.*, 2017). Among vascular plants, epiphytes comprise about 10%, distributed among 84 families with over 25,000 species and they are particularly abundant in the wet tropic (Zotz and Bader, 2011).

Epiphytes may occur from the basis of tree trunks, limbs, up to the tree crowns on trees as high as 50m or even taller and rarely on the upper leaf surface of the woody

plants-epiphylls (Petruzello, 2020). Because epiphytes are mostly found in the tree crowns, these plants are part of the canopy community where the full diversity of organisms remains to be mapped (Van Stan and Pypker, 2015). In some tropical areas, the organic matter released by epiphytes is the most important flux of nutrients reaching the forest floor (Coxosn, 2011). These plants increase the structural complexity of forests because of the frequently dependent fauna associated to these plants (Zytynska *et al.*, 2011).

Epiphytes depend totally on host plants and this entire dependency makes them to be more vulnerable to complete deforestation and fragmentation than other flora; when a tree is cut down, all the epiphytes residing on that tree die (Rasmussen and Rasmussen, 2018). They play fundamental importance to forest biodiversity and ecosystem function.

Many epiphytes have habitat preferences especially towards large trees which influence their distributions. This is due to the ability of large trees to accommodate dispersing seeds and because crowns of large trees may be cooler and more ventilated than those of smaller trees due to generally higher wind speed in the upper parts of the canopy (Getaneh and Gamo, 2016). Epiphytes are important contributor to the global plant diversity (Taylor *et al.*, 2021).

It has been estimated that 10% of all global plants are epiphytes and that in tropical countries epiphytes account for 25% of all vascular plant species (Wang *et al.*, 2016). Their great diversity and their different adaptations to life in the canopy have enabled them to exploit a wide range of habitats including tropical and temperate woodlands, plantations and mangroves (Batke, 2012). Epiphytism is not evenly distributed between plant families and epiphytic groups (Batke, 2012). **The global distribution, abundance and diversity of non-vascular groups such as bryophytes and lichens are yet to be assessed, and estimated the global total occurrence of lichens to 20000 species, while Peh *et al.*, (2018) calculated the total number of bryophytes to nearly 11000 species. Vascular as well as non-vascular epiphytes are two very diverse (Bartels, 2012). The studies on pharmaceutical ethnobotany in the region of pallars (Batke, 2012) argued that in any given sample plot, non-vascular epiphytes would contribute substantially to the epiphytic diversity, and in some instances exceeded the vascular epiphyte diversity and abundance (Batke, 2012). Baldwin and Bradfield (2011) reported that “rare” bryophytes species on forest story leaves are actually very abundant in the outer branches of canopy trees. The shift in habitat could be explained by high tree mortality, the opening up of the canopy and the resulting increase in solar radiation (Pfeifer *et al.*, 2018).**

The numerous types of epiphytic adaptations and the variation in growing locations highlighted the importance epiphytes play in forest dynamic processes such as

nutrient cycling (Bianchi and Rodrigo de Andrade, 2014). Epiphytes are important contributor to the global plant diversity (Taylor *et al.*, 2021) and they provide a wide variety of habitats and food sources for other organisms (Adhikari *et al.*, 2016).

The ecology of epiphytes is highly complex and in order to achieve a more comprehensive knowledge, other ecological disciplines must be incorporated (Batke, 2012). For example, Parrot (2010) argued that most ecophysiological studies focused mainly on abiotic factors, whereas biotic interactions such as herbivory, pathogens and competition received only little attention.

Plants in temperate forests (Tooke and Battey, 2010) and seasonally dry tropical forests (Mohandass *et al.*, 2016) tend to have a single, synchronous reproductive cycle each year due to seasonal constraints of temperature and moisture (Boyle and Bronstein, 2012). In wet tropical environments, where annual temperature shows little fluctuation and dry periods are less pronounced, plant phenology may respond to subtle environmental cues, such as small shifts in light, nutrients or precipitation (Lima *et al.*, 2021).

Phenological studies in tropical regions have typically examined flowering and fruiting in trees or understory shrubs (Mohandass *et al.*, 2018). Far less is known about patterns of epiphyte phenology in the canopy (Sheldon and Nadkarni, 2015), Epiphytes in tropical canopies are remarkably diverse and likely show asynchronous

phonological patterns at the community level. Because epiphytes are key players in primary productivity, carbon sequestration, water and nutrient cycling, and mutualistic interactions with pollinating and seed-dispersing animals (Larrain and Armesto, 2010), studies on epiphytes are important addition to our understanding of tropical processes. Production of flowers and fruits when appropriate pollinators and seed dispersers are present can increase reproductive success and plant fitness (Ingo *et al.*, 2018).

MATERIALS AND METHODS

The Federal Capital Territory (FCT) falls within the Guinean forest – savanna mosaic zone of the West African sub – region (Dinerstein *et al.*, 2017). It is bounded by Kaduna state (to the North), Kogi state (to the South), Niger state (to the West) and to the East is Nasarawa state.

The Federal Capital Territory lies between the latitude of 8° 25' and 9° 25'N and longitude 6° 45' and 45' E of the Greenwich Meridian; an area covering about 8000km² (Department of Planning and Survey, F.C.D.A, Abuja, 2012). The FCT has six area councils namely: Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje and Kwali area councils (Figure 1).

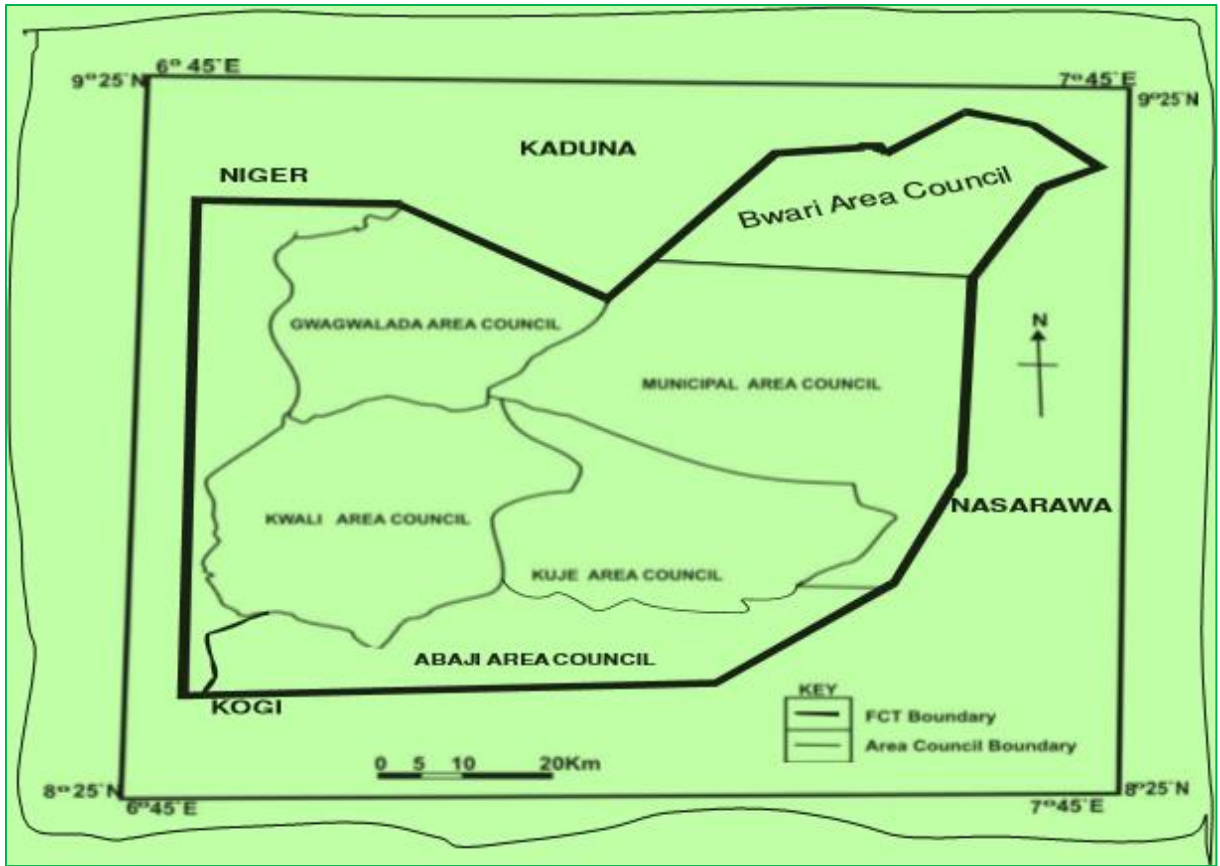


Figure 1: Map of the Federal Capital Territory Showing the Six Area Councils

Source: Department of Planning and Survey, F.C.D.A, Abuja, 2002

A reconnaissance survey of the study area was carried out from November to December, 2021 in the six area councils of the FCT namely; Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje and Kwali (Department of Planning and Survey, F.C.D.A, Abuja, 2002).

The study was survey research in which a total of 90 respondents were randomly drawn from the six area councils that make up FCT. Species recommendation during

preparatory field observations were done. All epiphytes were collated and analyzed using information on diversity and taxonomic classification. Data was collected using field surveys on diversity of epiphytes as described by Igbarese and Ogbole (2018). Field survey was carried out in the company of a Field Assistant who identified the plant in local languages. The plants that could not be identified in the field were taken to the Biological sciences Department, University of Abuja, for proper identification of their vernacular names, scientific equivalent, and documentation. Lichens samples were identified by applying direct microscopic observation and thin layer chromatography (TCL).

Identification of plants was done with the aid of a Handbook of African Medicinal Plants (Iwu, 2014). The inventory of available epiphytes were recorded, and literature on epiphytes searched to back up the claims by the respondents. Data was collected by administering semi-structured questionnaires to 90 respondents for a single purpose face-to-face interview.

Data was analyzed using standard diversity analytical tools such as determination of respondent's consensus factor, sincerity level, ranking and scoring.

Prior written informed consent as advised by Bradai *et al* (2015) was taken from the respondents. All the epiphytes were collated and analyzed using diversity and taxonomic information. Pearson correlation analysis was used to determine the

relationship between diversity and scientific classification in order to assess variable pronounced with the most impact. Species diversity was calculated according to Shannon – Wiener diversity index (1949) in each station. The Shannon – Wiener’s index (H') of species diversity was given as:

$H' = - \sum P_i \ln P_i \dots \dots \dots$ (Shannon and Wiener, 1963); where P_i was the proportion of the total number of individuals occurring in species i .

Species richness was determined using the Margalef’s Index (D) for species richness: $D = (S - 1) / \ln N \dots \dots \dots$ (Margalef, 1968).

Where S = number of species and N = number of individuals.

The structure and composition of epiphyte communities (biological parameters) were analyzed through descriptive statistical tools on SPSS. This permitted the determination of the percentage composition, relative abundance of the species and species identified for each sample.

After identification, identified species were deposited at the University of Abuja herbarium.

RESULTS

A total number of thirty (30) epiphytic species which cut across various taxonomic groups were collected from three points selected randomly from each of

the area councils: administrative town and two settlements. The scientific classification of the epiphytes based on their taxonomic groups and area councils where they were present in the Federal Capital Territory is represented in table 1 and plates from 1 – 29 below.

Table 1: Epiphytes in the Federal Capital Territory, and their Taxonomic Groups

Divison	Order	Family	Genus	Species	Area Council
Polypodiophyta	Polypodiales	Nephrolepidaceae	<i>Nephrolepis</i>	<i>biserrata</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Polypodiophyta	Polypodiales	Polypodiaceae	<i>Platynerium</i>	<i>stemaria</i>	BWR, ABJ, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>benghalensis</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>vogelii</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Arecales	Arecaceae	<i>Elaeis</i>	<i>guineensis</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Asterales	Asteraceae	<i>Ageratum</i>	<i>conyzoides</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>leprieurii</i>	ABJ, BWR, GWA, MUN, KUJ, KWL

Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>lutea</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>thonningii</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>exasperata</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Rosales	Moraceae	<i>Ficus</i>	<i>platyphylla</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Polypodiales	Lomariopsidaceae	<i>Nephrolepis</i>	<i>undulata</i>	BWR, KUJE, MUN
Tracheophyta	Fabales	Fabaceae	<i>Polyandra</i>	<i>longiflora</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Tracheophyta	Poales	Poaceae	<i>Digitaria</i>	<i>ciliaris</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Basidiomycota	Polyporales	Fomitopsidaceae	<i>Fomitopsis</i>	<i>sp</i>	ABJ, BWR, GWA, KUJ, KWL
Basidiomycota	Agaicales	Agaricaceae	<i>Lycoperdon</i>	<i>spadiceus</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Basidiomycota	Agaicales	Psathyrellaceae	<i>Coprinus</i>	<i>lagopus</i>	GWA, KUJ
Basidiomycota	Auriculariales	Auriculariaceae	<i>Auricularia</i>	<i>polytricha</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Magnoliophyta	Dipsacales	Adoxaceae	<i>Viburnum</i>	<i>tinus</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Ascomycota	Xylariales	Hypoxylaceae	<i>Daldinia</i>	<i>concentrica</i>	GWA, KUJ

Bryophyta	Hypnales	Stereophyllaceae	<i>Entodontopsis</i>	<i>nitens</i>	GWA, MUN
Bryophyta	Hypnales	Plagiotheciaceae	<i>Plagiothecium</i>	<i>undulatum</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Bryophyta	Hypnales	Entodontaceae	<i>Entodon</i>	<i>sp</i>	ABJ, BWR, GWA, KUJ, KWL
Bryophyta	Pottiales	Pottiaceae	<i>Syntrichia</i>	<i>laevipila</i>	BWR, GWA
Bryophyta	Funariales	Funariaceae	<i>Funaria</i>	<i>sp</i>	ABJ, BWR, GWA, KUJ, KWL
Marchantiophyta	Porellales	Frullaniaceae	<i>Frullania</i>	<i>dilatata</i>	ABJ, BWR, GWA, MUN, KUJ, KWL
Anthophyta	Urticales	Moraceae	<i>Ficus</i>	<i>aurea</i>	ABJ, BWR, GWA, MUN, KUJ, KWL

KEY

GWA - Gwagwalada

ABJ - Abaji

BWR - Bwari

KUJ - Kuje

MUN - Municipal

KWL - Kwali

Plates 1 – 29: Photos of Identified Host and Epiphytes Plants in the Federal Capital Territory



Ficus thonningi



Elaeis guinensis persistent old frond



Daldinia concentrica



Auricularia polytricha



Ficus lepori



Caprinus lagopides



Funeria sp



Nephrolepis sp



Platycerium stemaria



Sporophyte phenological phase of *Platycerium stemaria*



Syntrichia laevipila



Frullania dilatata



Formitopsis sp



Ficus vogelli



Lycopodium spadiceum



Ficus platyphylla



Lycoperdon spadiceus and *Daldina cocentrica*



Ficus sp



Plagiothecium undulatum



Digitaria sp



Nephrolepis undulata and *Ageratum conyzoides*



Ficus sp., *Calyptrichium emarginatum* and *Cyrtorchis sedeni*



Entodon sp



Ageratum conyzoides, Nephrolepis exaspirata, Ficus sp



Viburnum tinus



Ficus aurea



Ficus platyphylla



Peperomia pelucida



Epiphytes roots

UNDER PEER REVIEW

The epiphytes were classified based on their mode of life as shown in Table 2 below. Some epiphytes were Typical Epiphytes while others were Semi Epiphytes and Occasional Epiphytes.

Table 2: Epiphytic Classification Based on Mode of Life

Epiphytes	Family	Taxonomic Group	Epiphytic Classification
<i>Nephrolepis biserrata</i>	Dennstaediaceae	Pteridophyte	Typical Epiphyte
<i>Platynerium stemara</i>	Polypodiaceae	Pteridophyte	Typical Epiphyte
<i>Ficus benghalensis</i>	Moraceae	Angiosperm	Semi Epiphyte
<i>Ficus vogelii</i>	Moraceae	Angiosperm	Semi Epiphyte
<i>Ficus platyphylla</i>	Moraceae	Angiosperm	Semi Epiphyte
<i>Ficus aurea</i>	Moraceae	Angiosperm	Semi Epiphyte

<i>Ficus thonningi</i>	Moraceae	Tracheophyta	Typical Epiphyte
<i>Ficus exasperata</i>	Moraceae	Tracheophyte	Typical Epiphyte
<i>Ageratum conyzoides</i>	Asteraceae	Angiosperm	Occasional Epiphyte
<i>Elaeis guineensis</i>	Araceae	Angiosperm	Occasional Epiphyte
<i>Lycoperdon spadiceum</i>	Agaricaceae	Fungi/Thallophyte	Typical Epiphyte
<i>Coprinus lagopus</i>	Psathyrellaceae	Fungi/Thallophyte	Typical Epiphyte
<i>Auricularia polytricha</i>	Agaricaceae	Fungi/Thallophyte	Typical Epiphyte
<i>Daldinia concentrica</i>	Hypoxylaceae	Fungi/Thallophyte	Typical Epiphyte
<i>Ficus lepriurii</i>	Moraceae	Angiosperm	Semi/ Epiphyte
<i>Frullania dilatata</i>	Frullanaceae	Bryophyte	Typical Epiphyte
<i>Plagiothecium undulatum</i>	Plagiotheciaceae	Bryophyte	Typical Epiphyte
<i>Entodon nitens</i>	Entodontaceae	Bryophyte	Typical Epiphyte
<i>Syntrichia laevipila</i>	Pottiaceae	Bryophyte	Typical Epiphyte
<i>Digiteria ciliaris</i>	Poaceae	Tracheophyta	Typical Epiphyte
<i>Viburnum tinus</i>	Adoxaceae	Tracheophyte	Typical Epiphyte

<i>Ficus lutea</i>	Moraceae	Tracheophyte	Typical Epiphyte
<i>Nephrolepis undulata</i>	Oleandraceae	Pteridophyte	Occasional Epiphyte
<i>Ficus thonningi</i>	Moraceae	Tracheophyte	Typical Epiphyte
<i>Ficus exasperata</i>	Moraceae	Tracheophyte	Typical Epiphyte
<i>Funeria sp.</i>	Funariaceae	Bryophyte	Typical Epiphyte
<i>Fomitopsis sp.</i>	Formitopsidaceae	Polyporales	Occasional Epiphyte

DISCUSSION

The study shows that different epiphytic plants occur in the Federal Capital Territory (FCT), Nigeria, and they belong to various taxonomic groups. Table 1: Epiphytes in the Federal Capital Territory, and their Taxonomic Groups, indicated that *Nephrolepis bisserata* (Sw.) Schott, *Platynerium stemaria* (P.Beauv.) Desv., *Ficus benghalensis* L., *Ficus vogelii* Miq., *Elaeis guinensis* Jacq., *Ageratum conyzoides* (L.) L., *Ficus leprieurii* (Miquel), *Ficus lutea* Vahl, *Ficus thonningi* Blume, *Ficus exasperate* Vahl., *Ficus platyphylla* Delile, *Polyandra longiflora* L., *Digitaria ciliaris* (Retz.) Koeler, *Lycoperdon spadiceus* Pers., *Auricularia polytricha* (Mont.) Sacc., *Viburnum tinus* L., *Plagiothecium undulatum* (Hedw. Schimp., *Frullania dilatata* (L.) Dumort., and *Ficus aurea* Nutt. were found to be present in all the area councils of the FCT while *Fomitopsis sp* P.Karst., *Entodon sp* Müll. Hal. and *Funaria sp* Hedw. were seen in Abaji, Bwari, Gwagwalada, Kuje and Kwali area councils. *Nephrolepis undulata* (Afzel. Ex Sw.) J.Sm.

occurred in Bwari, Kuje and Municipal area councils. Other epiphytes that were present included *Coprinus lagopus* P.Karst., *Daldinia concentrica* (Bolton) Cesati and de Notaris, *Entodontopsis nitens* (Mitt.) W.R.Buck and Ireland, *Syntrichia laevipila* (Brid.) K.F.Schultz. They occurred in Bwari, Gwagwalada, Kuje, and Municipal area councils.

The taxonomic classification of the epiphytes further indicated that *Nephrolepsis bisserata* (Sw.) Schott, and *Platyserium stemaria* (P.Beauv.) Desv., belong to the Division Polypodiophyta (Holtum and Klaus, 1999). According to Heatwole *et al.*, 2015, *Ficus benghalensis* L., *Ficus vogelii* Miq., *Ageratum conyzoides* (L.) L., *Ficus lepriori* (Miquel), *Ficus lutea* Vahl, *Ficus thonningi* Blume, *Ficus exasperate* Vahl., *Ficus platyphylla* Delile, *Polyandra longiflora* L., *Digitaria ciliaris* (Retz.) Koeler, belong to Tracheophyta while *Fomitopsis sp* P.Karst., *Lycoperdon spadiceus* Pers., *Caprinus lagopides* P.Karst. and *Auricularia polytricha* (Mont.) Sacc., are Basidiomycota (Davis *et al.*, 2012). According to Hartley, 2020, *Viburnum tinus* L., is of the Division Magnoliophyta with *Daldinia concentrica* (Bolton) Cesati and de Notaris, belonging to Ascomycota (Kirk, *et al.*, 2008). *Entodontopsis nitens* (Mitt.) W.R.Buck and Ireland, *Syntrichia laevipila* (Brid.) K.F.Schultz., *Plagiothecium undulatum* (Hedw.) Schimp., and *Frullania dilatata* (L.) Dumort., belong to Marchitophyta (Felipe *et al.*, 2020) while *Ficus aurea* Nutt. is a member of Anthophyta (Shi *et al.*, 2021). *Entodon sp* Müll. Hal. and *Funaria sp* Hedw.

represent the Division Bryophyta (Danyan *et al.*, 2021). Table 2: Epiphytic Classification Based on Mode of Life indicated that *Nephrolepis bisserata*, *Platyterium stemaria*, *Ficus thonningi*, *Ficus exasperata*, *Lycoperdon clavatum*, *Caprinus lagopides*, *Auricularia polytricha*, *Daldinia concentrica*, *Frullania dilatata*, *Plagiothecium*, *Entodon nitens*, *Syntichia laevipila*, *Digitaria ciliaris*, *Viburnum tinus*, *Ficus lutea*, *Ficus thonningi*, *Ficus* are typical epiphytes (Zotz *et al.*, 2023) while *Ficus benghalensis*, *Ficus vogelii*, *Ficus lepriori*, *Ficus plathphylla*, *Ficus aurea*, *Ficus exasperata* and *Funaria sp* are semi epiphytes (Zotz *et al.*, 2021) *Ageratum conyzoides*, *Elaeis guineensis*, *Nephrolepis undulata* and *Fomitopsis sp* are occasional epiphytes (Einzmann *et al.*, 2024).

CONCLUSION

The research shows that different types of epiphytes exist in the Federal Capital Territory, and they belong to various taxonomic groups. They live as typical, semi or occasional epiphytes. The outcome of this research will obtain documentary information on the Diversity and Taxonomic Classification of Epiphytes in the Federal Capital Territory (FCT).

Consent

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

- 1.
- 2.
- 3.

REFERENCES

- Adhikari, Y., Fischer, A. and Fischer, H.S. (2016). Epiphytic orchids and their ecological niche under anthropogenic influence in central Himalayas, Nepal. In: *Journal of Mountain Science*. Vol. 13, Issue 5.-pp.774-784. DOI: <https://doi.org/10.1007/s11629-015-3751-2>
- Baldwin, L. and Bradfield, G.E. (2011). Bryophyte community difference between edge and interior environments in temperate rainforest fragments of coastal British Columbia. *Canadian Journal of Forest Research* 35(3):580-592.
- Bartels, S.F. (2012). Mechanisms Regulating Epiphytic Plant Diversity. *Critical Reviews in Plant Sciences* 31 (5): 391 – 400. DOI: 10.1080/07352689.680349
- Batke, S. (2012). 'Epiphytes: a study of the history of forest canopy research', *The Plymouth Student Scientist*, 5(1):253 -268.
- Batke, S. (2012). 'Epiphytes: a study of the history of forest canopy research', *The Plymouth Student Scientist*, 5(1), p.253-268. <http://hdl.handle.net/10026.1/13973>

- Bianchi, J.S. and Rodrigo de Andrade, K. (2014). Edge effect on vascular epiphytes in a tropical Atlantic Forest. *Acta Bot. Brass.*28(1).
<https://doi.org/10.1590/S0102-33062000>
- Bohan, D.A. and Vanbrgen, A.J. (2021). The Future of Agricultural Landscapes, Part 11 Volume 64, Pages 2-368.
- Boyle, W.A. and Bronstein, J.L. (2012). Phenology of tropical understory trees: patterns and correlates. *Revista de Biologia Tropical*. Online version. *Rev. biol.trop* vol.60 n.4 san Jose.
- Bradai, L., Neffar, S., Amrani, k., Bissati, S. and Chenchouni, H. (2015). Ethnomycological survey of traditional usage and indigenous knowledge on desert truffles among the native Sahara Desert people of Algeria. *J Ethnopharmacol.*Mar 13; 162():31-8.
- Coxosn, D. (2011). Nutrient release from epiphytic bryophytes in tropical montane forest (Guadeloupe). *Canadian Journal of Biology* 69 (10):2111-2129. DOI: 10.1139/691-266
- Danyan, S., Yang, L., Shi, X., Ma, X., Zhou, X., Hedges, S.B. and Zhong, B. (2021).

Large-Scale Phylogenomic Analysis Reveal the Monophyly of Bryophytes and Neoproterozoic Origin of Land Plants. *Mol Bio Evol.* 38 (8): 33332 – 3344. Doi: [10.1093/molbev/msab106](https://doi.org/10.1093/molbev/msab106).

Davis, R.M., Sommer, R. and Menge, J.A. (2012). *Field Guide to Mushrooms of Western North America*. Berkley: University of California Press. P. 207

Department of Planning and Survey (2012). F.C.D.A, Abuja.

Derzhavina, N.M. (2020). Ecological Morphology of Proto-Epiphyte Fern *Lemmaphyllum microphyllum* C. Presl and Its Relation to the Adaptogenesis. *Contemporary Problems of Ecology* Issue 3.
DOI: <https://doi.org/10.1134/S19954255200>

Diana, C., Gomez, G., Quiel, C.R., Zotz, G. and Bader, M.Y. (2017). Species Richness and Biomass of Epiphytic Vegetation in a Tropical Montane Forest in Western Panama. <https://doi.org/10.1177/1940082917698468>.

Dinerstein, E., Olson, D., Joshi, A., Noss, R., Hassen, M., Locke, H., Ellis, E.C., Jones, B., Barber, C.V., Hayes, R., Kormos, C. Martin, V., Crist, E., Sechrest, W. and Saleem, M. (2017). An Ecoregion-Based Approach to Protecting half the Terrestrial Realm. *Bioscience*, 67(6), 534-545.
<https://doi.org/10.1093/biosci/bix014>

- Getaneh, Z. A. and Gamo, F.W. (2016). “Vascular Epiphytes in Doshke and Kurpaye: A Comparative Study, Gamo Gofa, Ethiopia”. *International Journal of Biodiversity*. <https://doi.org/115/9482057>
- Govaerts, R., Luther, H.E. and Grant, J. (2013). World checklist of Bromeliaceae. Kew: Royal Botanic Gardens. Available at: <http://apps.kew.org/wcsp/>
- Ebika, S.T.N., Morgan, D., Sanz, C. and Harris, D.J. (2015). Hemi-epiphytic Ficus (Moraceae) in a Congolese forest. *Plant Ecology and evolution* 148(3):377-386, <http://dx.doi.org/10.5091/plecevo.1024>
- Einzmann, H.J.R., Weichgrebe, L., Kohlstruck, J. and Zotz, G. (2024). Climbing aroids in a Panamanian lowland forest: We should consider our categories, *Journal of Vegetation Science*, 10.1111/jvs.13246, 35, 2.
- Felipe, S., Civian, P., Foster, P.G. and Cox, C.J. (2020). The Chloroplast Land Plant Phylogeny: Analysis Employing Better-Fitting Tree-and Site-Heterogenous Composition Models. *Front Plant Sci.* 11: 1062. doi: 10.3389/fpls.01062
- Hartley, C. (2020). “The secret to this fruit’s mysterious blue color”. doi:10.1126/science.abe2087
- Heartwole, H., Done, T. and Cameron, E. (2015). Ecology of Coral Cay, A Study of

- One – Tree Island, Great Barrier Reef, Australia. Series: Monographine Biological, Vol. 43, p. 102.
- Holtum, J.A.M. and Klaus, W. (1999). “Degrees of crassulacean acid metabolism in tropical epiphytic and lithophytic ferns”. *Functional Plant Biology*. 26 (8): 749 – 757 doi: 10.1071/pp99001.
- Humagain, K. and Shrestha, K.K. (2010). Medicinal Plants in Rasuwa district, central Nepal: trade and livelihood. *Botanica Orientalis: Journal of plant science*. Volume 6, Pages 39 – 46.
- Igbere and Ogbole (2018). Ethnobotanical survey of plants used in the treatment of typhoid and its complication (s) in esan north east local government area, Uromi, Edo State. *Nig. J. Pharm.* 14 (2), 175 – 188.
- Ingo, G., Bohle, V., Tschardtke, T. and Westphal, C. (2018). How plant reproductive success is determined by the interplay of antagonists and mutualists. *Ecosphere* 9(2):e02106. 101002/ecs2.2106
- Iwu, M. (2014). Handbook of African Medicinal Plants. DOI: 105860/choice.31-5446609) Chapter: 26. DOI: 10.1017/CB09780511778384.065
- Kirk, P.M., Cannon, P.F., Minter, D.W. and Stalpers, J.A. (2008). Dictionary of the Fungi (10th ed.). Wallingford: CABI. ISBN 978-0-85199-826-8.

Larrain, J. and Armesto, J.J. (2010). Epiphyte and biomass loads of canopy emergent trees in Chilean temperate rain forest: A neglected functional component. Institute of Ecology and Biodiversity IEB, Las Palmeras 3425, Nunoa, Santiago, Chile.

Lima, D.F., Mello, J.H.F., Lopes, I.T., Forzza, R.C., Goldenberg, R. and Freitas, L. (2021). Phenological responses to climate change based on a hundred years of herbarium collections of tropical Melastomataceae. *PLoS ONE* 16(5): e0251360. doi: 10.1371/journal.Pone.0251360

Map of Federal Capital Territory showing the six area councils (2002).

Department of Planning and Survey, F.C.D.A., Abuja.

Margalef, R. (1968). Perspectives in Ecological Theory. Chicago University press, Chicago.

Mohandass, D., Campbell, M., Xin-Sheng, C. and Qing-Jun, L. (2018). Flowering and fruiting Phenology of Woody Trees in the Tropical – Seasonal Rainforest, Southern China. *Current Science* 114(11). DOI: 19.18520/cs/v114/i11/2313-2322

Mohandass, D. Alice, C., Hughes, and Davida, P. (2016). Flowering and fruiting

patterns of woody species in the tropical montane evergreen forest of southern India. *Current Science*, 111(2), 404-416.

<http://www.jstor.org/stable/24908632>.

Parrot, L. (2010). Measuring ecological complexity. *Ecological Indicators* 10(6): 1069-1076.

Peh, K., S-H., Corlett, R.T. and Bergeron, Y. (2018). *Routledge Handbook of Forest Ecology*. (1st ed.)

Pages 640-656. <https://doi.org/10.4324/9781315818290>

Pfeifer, M., Gonsamo, A. and Woodgate, W. (2018). Tropical forest canopies and their relationships with climate and disturbance: results from a global dataset of consistent field-based measurements.

For. Ecosyst. 5,7. <https://doi.org/10.1186/s4066-017--0118-7>

Rasmussen, H.N. and Rasmussen, F.N. (2018). The epiphytic habitat on a living host: reflections on the orchid-tree relationship. *Botanical Journal of the Linnean Society*, Volume 186, Issue 4, Pages 456 – 472.

<https://doi.org/10.1093/botlinnean/box085>

Shannon, C.E. and Wiener, W. (1963). *The mathematical theory of communication*. Urbana, University of Illinois Press.

- Shannon, C.E. and Wiener, W. (1949). The mathematical theory of communication. Urbana, University of Illinois Press, 177p.
- Sheldon, K.S. and Nadkarmi, N.M. (2015). Reproductive phenology of epiphytes in Monteverde, Costa Rica. *Rev. bio, trop online*, vol. 63, n.4, pp.1119-1126.
- Shi, G., Herrera, F., Herendeen, P.S., Clark, E.G. and Crane, P.R. (2021). “Mesozoic cupules and the origin of the angiosperm second integument”. *Nature*. 594 (7862): 223 – 226. doi.10.1038/s41586-021-03598-w.
- Stanton, D.E., Chavez, J.H., Villegas, L., Villansante, F., Armesto, J., Hedin, L.O. and Horn, H. (2014). “Epiphytes improve host plant water use by microenvironment modification”. *Functional Ecology*. 28(5): 1274 – 1283. doi:10.1111/1365 – 2435.12249
- Taylor, A, Zotz, G., Weigdt, P., Cai, L., Karger, D.N., König, C. and Kreft, H. (2021). Vascular epiphytes contribute disproportionately to global centres of plant diversity. bioRxiv.05.21.44115: doi: <https://doi.org/10.1101/5.21.445115>
- Tooke, F. and Battey, N.H. (2010). *Journal of Experimental Botany*, Volume 61, pages 2853 – 2862, <https://doi.org/10.1093/jxb/erq165>
- Van Stan and Pyker (2015). A review and evaluation of forest canopy

epiphyte roles in partitioning and chemical alteration of precipitation. *Science of The Total Environment* 536. DOI:10.1016/j.scitotenv.

Wang, X., Long, W., Schamp, B.S., Yang, X., Kang, Y., Xie, Z. and Menghui, X. (2016). Vascular Epiphytes Diversity Differs with Host Crown Zone and Diameter, but Not Orientation in a Tropical Cloud Forest. *PLoS ONE* 11(7):e0158448.doi:10.1371/journal.pone.0158548

Westwood, J.H. (2020). ‘Parasitic plant’. Encyclopedia Britannica, <https://britannia.com/plant/parasitic-plant>

Wester, S. and Zotz, G. (2010). Growth and survival of *Tillandsia flexuosa* on electrical cables in Panama. *Journal of Tropical Ecology* 26(01):123-126. DOI: 10.1017/S0266477400000459

Zotz, G., Andrade, J.L. and Einzmann, H.J.R. (2023). ‘CAM plants: their importance in epiphyte communities and prospects with global change’. *Annals of Botany*. 132 (4): 685 – 698. doi: 10.1093/aob/mac158.

Zotz, G., Almeda, F., Baustista-Bello, A.P., Eskov, A., Giraldo-Cañas, D., Hammel, B., Harrison, R., Koster, N., Kromer, T., Lowry II, P.P., Moran, R.C., Plunkett, G.M. and Weichgrebe, L. (2021). Hemiepiphytes revisited. *Perspective in Plant Ecology, Evolution and Systematics*. Volume 51, 125620.

Zotz, G. and Bader, M.Y. (2011). Sampling vascular epiphyte diversity-
species richness and global effects on vascular epiphytes. *Progr Bot.*
community structure. *Ecotropica* 17: 103 – 112.

Zytynska, S.E., Fay, M.F., Penney, D. and Preziosi, R.F. (2011). Genetic
variation in a tropical tree species influences the associated epiphytic plant
and invertebrate communities in a complex forest ecosystem.
<https://doi.org/10.1098/rstb.0183>

UNDER PEER REVIEW