***Original Research Article***

**TAXONOMIC INVENTORY AND IDENTIFICATIONOF FERNS IN EKUREKU, ABI LOCAL GOVERNMENT AREA, CROSS RIVER STATE, NIGERIA**

**ABSTRACT**

Ferns are important flora of the tropical forest which provides several ecosystem functions, however, not much attention have been given to this group of plants unlike the seed bearing plants. The Taxonomic inventory and identification of ferns in Ekureku, Abi Local Government Area, Cross River State was carried out. Ten (10 m × 10 m) plots were established each for Ekureku 1 and 2. The study adopted a non-random preferential sampling method where all fern species encountered in each plot were collected, identified, and documented. Collected ferns were identified using taxonomic flora, literatures and experts in the field of Taxonomy, while conservation status of each identified fern species was assessed from recent IUCN 2023 red list website. Voucher specimens were deposited in the Herbarium of University of Cross River State (UNICROSS), Calabar.The distribution of ferns per family, genus and Species was presented using tables of numbers, percentages and charts, while diversity was determined using Shannon-Wiener index. All data were analyzed using Paleontological Statistics (PAST) software Geographical coordinates of each sampled plot were obtained using a Global Positioning System (GPS) device. A total of eighteen (18) species of ferns belonging to thirteen (13) genera were recorded with Nephrolepidiaceae and Aspleniaceae dominating the study. Similarly, the most abundant species was *Diplazium esculentum* followed by *Nephrolepsis exaltata* and *Nephrolepsis biserrata* while *Pteris vittata* was the least abundant species. Similarly, fern species was observed to be higher in Ekureku 2 compared to Ekureku 1. All the species identified were terrestrial; whereas assessment of growth form showed 56% epiphytic species, 39% non-epiphytic species and 5% species that occurred both as epiphyte and non-epiphyte. Conservation statusshowed that thirteen (13) species have Not been evaluated, while five (5) species have been considered least concern. An overall Shannon index of 2.650, Evenness of 0.786 and abundance of 0.089 were recorded for the study. Although there was a low number of species present in the sampling areas, a high Shannon Index of 2.471 was recorded for Ekureku 2, while Ekureku 1 has a high Evenness value of 0.865. This study gave information on the fern species richness and diversity in Ekureku. The study therefore showed that most of the fern species documented were epiphytes which invariably depend on different tree hosts for accommodation and protection but, there is incessant falling down of trees in the study area especially in Ekureku I, due to man-made activities such as farming, urbanization, bush burning and other anthropogenic activities. It is recommended that conservation education and awareness be expanded to this area in order to stop incessant destruction of habitats which houses Ferns, and to avoid the disappearance of this group of plants.

**Keywords**: Ecosystem, Ferns, Flora, Inventory, Taxonomy,

## 1. INTRODUCTION

Ferns are seedless vascular plants with body structures differentiated into roots, stems, fronds and pinnae. Their inability to produce flowers, seeds and fruits (Cryptogamic) makes them different from higher plants (Asikiye *et al.,* 2023; Shoyemi-Obawanle *et al.,* 2022). Some ferns are perennial, annual, terrestrials, aquatics or epiphytic. Ferns are among the most prominent and abundant group of plants which constitute an indispensable part of the natural habitats and flora of tropical forests. Their diversity, richness and distribution in tropical parts of the world including Nigeria, is attributed to factors such as seasonality, soil condition, habitat, elevation, rainfall, temperature and anthropogenic activities (Bandyopadhyay and Dey, 2022). According to Edwin-Wosu *et al.* (2022) and CBD (2001) there are 165 species of Pteridophytes endemic in Nigeria. Out of the 11,916 species globally recorded (PPGI 2016), roughly a quarter (2,865 species) is epiphytic (Bassey *et al*. 2024; Haque *et al.,* 2016). Worldwide, there exist about 11,916 taxa with 337 genera, 51 families, 14 orders and two classes of ferns, out of which about 2,865 species are epiphytic (PPG-I, 2016). The largest genera in the fern group are Asplenium, with 900 species, and Adiantum and Cyathacea with 700 species each. Family dominance has been observed for the fern families with Dryopteridaceae (1,100 species) and Thelypteridaceae (950 species) dominating (Azila *et al.*, 2021).

This group of plants grows in different habitats around the world, and is abundant in tropical rainforests and subtropical ecosystems, where temperature, light and humidity are favourable. They ferns thrive best in moist, shady environments, although a few inhabit rock surfaces (Azila *et al.*, 2021). Some hardy species however, can still occur in drier areas. The greatest diversity of fern species has been found occuring in the tropics where they constitute an average of 7% of all vascular plant species of rainforests with roughly, 70% of ferns are found in tropical climates, while the remaining 30% occur in temperate climates (George, 2020). Globally fern diversity declines more strongly towards arid and cold climatic conditions than that of angiosperms.They are usually perennial plants that differ from the more primitive lycophytes in having true leaves (megaphylls), and from the more advanced seed plants (gymnosperms and angiosperms) in lacking seeds. Like all vascular plants, it has a life cycle called alternation of generations, characterized by a diploid sporophytic and a haploid gametophytic phase. Unlike the gymnosperms and angiosperms, ferns gametophyte is free–living. This group of plant first appeared in the fossil record in the early carboniferous period (Bassey *et al.*, 2023). Ferns have traditionally been grouped in the class filices, but modern classifications assign them their own division in the plant kingdom, called pteridophyta (Azila *et al*., 2021).

Ferns which make up substantial component of some tropical and sub-tropical forests of the world, have become beneficial to mankind, acting as bio-indicator of forest and environmental disturbances, and has the ability of cleaning polluted environment through a process called phyto-remediation (Asikiye *et al.,* 2023; Rahmad and Akomolafe, 2018). Until now 70% of inhabitants around the world depend on the ethno-medicinal uses of plants (Irfan *et al*., 2018c). Most of the population of poor and developing countries still relies upon traditional medicines.

Cross River State which is home to one of the 25 biodiversity hotspot in the world, lack documented evidence of this group of plants in her plants inventory. Available literatures are recent works of Bassey *et al.* (2024), Bassey *et al.* (2023) both in Osomba hill of Oban forest, and Nwaka *et al.* (2022) on epiphytic role in checking forest disturbance at the Cross River National Park (CRNP). Interestingly, values of higher plants have been investigated thoroughly, but, this group of plants has been ignored.

This study therefore, seeks to carry out a survey on the inventory and identification of ferns in Ekureku that will guide future conservation programmes/activity.

**2.0 MATERIAL AND METHODS**

The study was carried out in Ekureku I and II, Abi Local Government Area (LGA), Cross River State (CRS). Abi LGA is located in the Central Senatorial District of CRS. It is bordered to the North by Yakurr LGA, to the South by Biase LGA, to the east by Obubra LGA, and to the west by Ebonyi state. It is part of the tropical rainforest zone, with a humid climate and heavy rainfall (Akwaji *et al.,* 2022; Nwaka *et al.,* 2021). The LGA is situated between Latitude 5.76° N to 6.02° N and Longitude 7.93° E to 8.71° E with an elevation of 140mm to 400mm above sea level (Anthony *et al.,* 2015). Rainfall is usually seasonal and at times very heavy. The rainy season starts in April and ends in September, while the dry season commences in October and ends in March. The rainfall pattern is bi-modal with peaks in June and September. The annual rainfall of the area ranges from 2000mm to 2250mm (NIMET, 2024). Relative humidity in the state ranges from 80% to 90% with a humid tropical climate of about 1300 - 3000mm rain fall and 30°C mean annual. Figure 1 present study area.

Ten (10 m × 10 m) plots each were established for sampling in Ekureku I and II. The study adopted a non-random preferential sampling method as used by Zakaria and Gbenga (2019); Akinsoji *et al.* (2016) where all fern species encountered in each plot were collected, identified, and documented where necessary. Collected ferns were identified using taxonomic flora, literatures (Reference Field Guide by Edwin-Wosu, 2019; Introductory Pteridology by Bassey, 2013; Fern and Fern-Allies of West Tropical Africa by Alston, 1959 and POWO, 2023) and experts in the field of Taxonomy, while conservation status of each identified fern species was assessed from recent IUCN 2023 red list website (www.iucnredlist.org). Voucher specimens were deposited in the Herbarium of University of Cross River State (UNICROSS), Calabar. Geographical coordinates of each sampled plot were obtained using a Global Positioning System (GPS) device. The distribution of ferns per family, genus and Species was presented using tables of numbers, percentages and charts, while diversity was determined using Shannon-Wiener index. All data were analyzed using Paleontological Statistics (PAST) software.



**Figure 1**: Map of study area

**Source**: Cross River Geographic Information System (CRS-GIS)

**3. RESULTS AND DISCUSSION**

Results of the study as presented in Table 1 showed a total of 18 species of ferns belonging to 13 genera and 10 families with 174 individuals. Polypodiaceae dominated the family distributions with 3 genera and 4 species, followed by Pteridaceae with 2 genera and 3 species. However, Nephrolepidiaceae and Aspleniaceae family with 1 genus each recorded 3 species and 2 species respectively (Table 1) dominated the study. Similarly, the most abundant species was *Diplazium esculentum* with 33 individuals followed by *Nephrolepsis exaltata* (22 individuals) and *Nephrolepsis biserrata* (17 individuals) while *Pteris vittata* was the least abundant species with 3 individuals (Table 1). Similarly, fern species was observed to be higher in Ekureku 2 with 15 out of the 18 species recorded for the study.

All the species identified were terrestrial (Table 1); whereas assessment of its growth form as presented in Figure 2 showed that 56% of the species were epiphytic, 39% were non-epiphytic while 5% exist both as epiphyte and non-epiphyte. In terms of conservation status, 13 species have the ‘Not Evaluated’ status, while five (5) species have the ‘Least concern’ status (Figure 3). An overall Shannon index of 2.650, Evenness of 0.786 and abundance of 0.089 were recorded for the study. Although there was a low number of species present in the sampling areas, a high Shannon Index Diversity (H’) of 2.471 was recorded for Ekureku 2, while Ekureku 1 has a high Evenness index of 0.865 (Table 2). However, it was also noted that no species was found dominating the study area.

 **Table 1: Species inventory and distrinution in the two sampling sites of Ekureku**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family** | **Species**  | **Habitat** | **Ekureku 1** | **Ekureku 2** |
| Aspleniaceae | *Asplenium africanum* (Willd.) Hook. | Terrestrial | X | √ |
| *Asplenium nidus* L. | Terrestrial | √ | X |
| Athyriaceae | *Diplazium esculentum (*Retz.*)* Sw. | Terrestrial | X | √ |
| Coniogrammaceae | *Coniogramme Africana* Hieron. | Terrestrial | √ | X |
| Cyatheaceae | *Alsophila camerooniana* (Baker) R.M. Tryon | Terrestrial | X | √ |
| Dennstaedtiaceae | *Pteridium aquilinum* (L.) Kuhn. | Terrestrial | √ | √ |
| Lomariopsidaceae | *Lomariopsis guineensis* (Underw.) Alston | Terrestrial | X | √ |
| Nephrolepidiaceae | *Nephrolepsis biserrata* (Sw.) Schott. | Terrestrial | √ | √ |
| *Nephrolepsis exaltata* (L.) Schott. | Terrestrial | √ | √ |
| *Nephrolepsis undulata* (Afzel.ex.Sw.) J. Sm. | Terrestrial | √ | √ |
| Polypodiaceae | *Microgramma mauritiana* (L.) Underw. | Terrestrial | X | √ |
| *Platycerium bifurcatum* (Cav.) C.Chr. | Terrestrial | √ | √ |
| *Platycerium elephantotis* (Hook.) Desv. | Terrestrial | √ | √ |
| *Phymatosorus scolopendria* (L.) Bostock & Child. | Terrestrial | X | √ |
| Pteridaceae | *Pteris linearis* (Sw.) A.R.Sm. | Terrestrial | √ | X |
| *Pteris vittata* L. | Terrestrial | X | √ |
| *Pityrogramma calomelanos* (L.) Link. | Terrestrial | √ | √ |
| Tectariaceae | *Arthropteris orientalis* (L.) J.Sm. | Terrestrial | X | √ |

 **Figure 2:** Fern species life form  **Figure 3:** Fern species conservation status

**Table 2: Diversity index between Ekureku 1 and 2**

|  |  |  |
| --- | --- | --- |
| **Variable/study site** | **Ekureku 1** | **Ekureku 2** |
| Abundance (Hmax) | 0.130 | 0.101 |
| Shannon\_H | 2.157 | 2.47 |
| Evenness\_e^H/S | 0.865 | 0.789 |

Overall Shannon diversity of 2.650, Evenness= 0.786, abundance=0.089

The importance of plant identification and inventory cannot be over emphasized as it makes record readily available for researchers, acting as reference materials for scientific study. On the other hand, plant identification which is a critical component of inventory has been view as a scientific way of identifying an unknown plant from a known plant having the same name in all places with the view to avoiding confusion and misinterpretation. It makes communication easier between tourists and the local people on the diversity of the area creating an opportunity for non-botanists to scientifically identify local plants (Asikiye *et al.,* 2023; Akomolafe and Rahmad, 2019).

The findings of the study which shows that the family polypodiaceae dominated the area, agrees with the report of Asikiye *et al.* (2023), which says that polypodiaceace family were the most abundant amongst other families found in the tropical zones. Although most of the ferns recorded were mostly epiphytes as they were mainly found on trees which conforms to the work done by Asikiye *et al.* (2023) and Maria *et al.* (2018), and non-epiphytes (plants that found on soil, water or rocks), *Nephrolepsis biserrata* appeared as epiphyte and Non-epiphyte. The habitat was mostly terrestrial which could be linked to the higher elevation of the study area. A study carried out by Arjun *et al.* (2021) in the central Western Ghats found an increase of terrestrial pteridophytes with increasingelevation which could be the reason for the type of habitat observed in the study. In another study Watkins *et al.* (2006) on the species richness of pteridophytes along an altitudinal gradient in Costa Rica also found out that there was a steady increase in terrestrial forms of Pteridophytes at higher altitudes.

Furthermore, the result also showed that 72.2% out of the total numbers of ferns recorded for the study were yet to be evaluated by IUCN. This situation according to Bassey *et al.* (2024) could dangerous signal that fact that any of these species maybe under threat or even lost from that environment without knowledge. This is more worrisome as Brummitt *et al.*, (2016) has reported that 16% of pteridophyte and lycophyte species are globally threatened with extinction and that 22% are of elevated conservation concern being threatened or near threatened. Accordingly, there is therefore, an urgent need for the evaluation of these plants in order to know their status and implement conservation strategies.

Finally, low number of species but with high diversity recorded in the study area could be attributed to certain factors such as the size of the area sampled, climatic conditions, soil type, and geographic location may affect fern species richness. According to Joevi-Jhun and Cristy-ann (2023), anthropogenic activities like conversions of the area into agricultural lands, construction of houses and pollution due to dumping of garbage in any part of the forest might have greatly affected the species richness of the area which could possibly be the reason for the low number of species in the study area since ferns are very sensitive to changes in the environment, especially light intensity.

**4.CONCLUSION**

This study has shown fern species richness and diversity in Ekureku, and that most of the species were members of polypodiaceace family, followed by Pteridiaceae. Also, majority of the identified species exhibited epiphytic characteristics as most of them were seen growing on trees, with only one species which exhibited both epiphytic and non-epiphtyic trait. From this research, it can be deduced that hat most of fern species documented were epiphytes which invariably depend on different tree hosts for accommodation and protection but, there is incessant falling down of trees in the study area especially in Ekureku I, due to man-made activities farming, urbanization, bush burning and other anthropogenic activities. It is therefore, recommended that conservation education and awareness be expanded to this area in order to stop incessant destruction of habitats which house Ferns, and to avoid the disappearance of this group of plants.

**Disclaimer (Artificial intelligence)**

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.

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