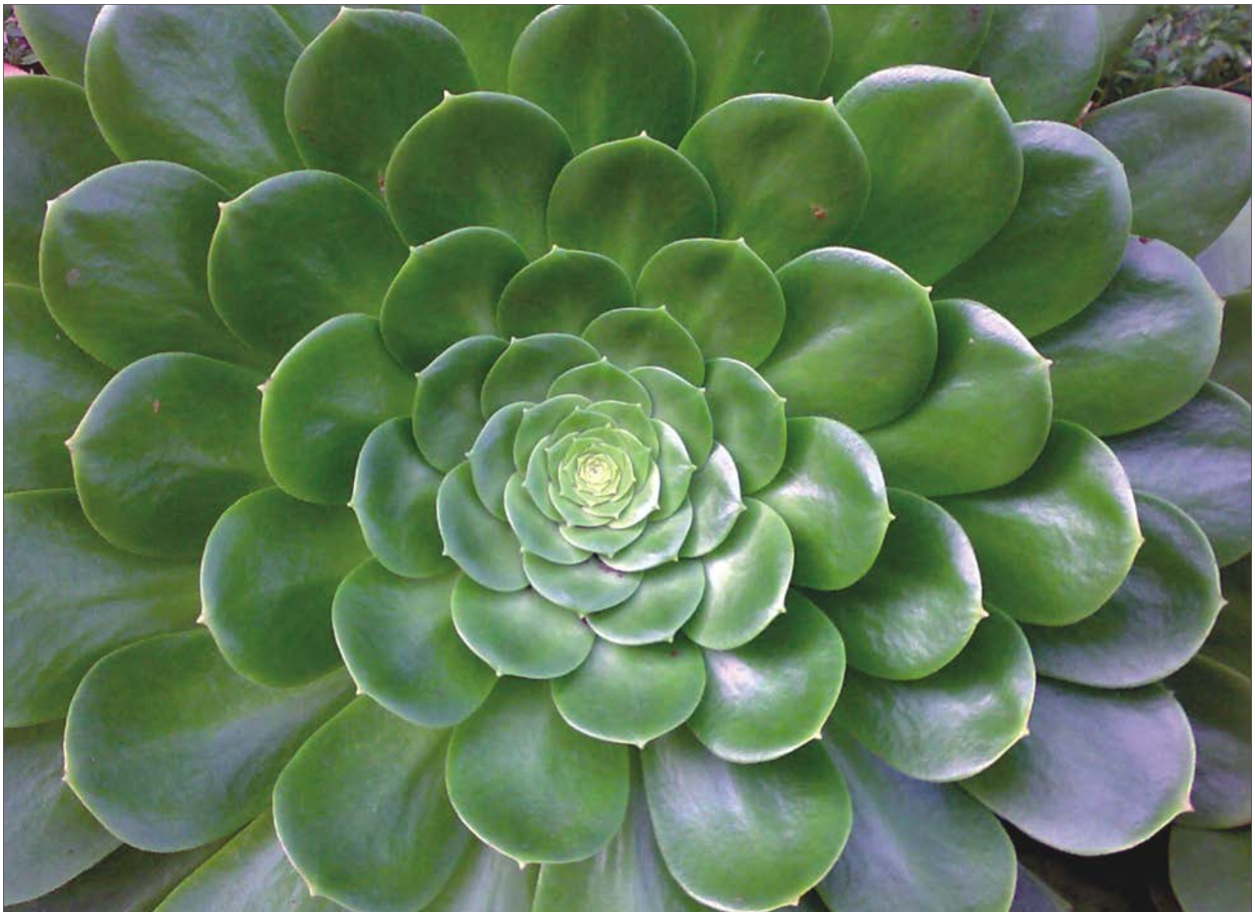

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Research Article
Vascular Epiphyte Diversity Along an Altitudinal Gradient in the Mount Oku Forest, North-West Cameroon

[1]Junior Baudoin Wouokoue Taffo, [2]Grace Mendi Anjah, [2]Delphine Ghenkela and [1]Elodie Mafouo Tchinda

[1]Department of Biological Sciences, Faculty of Science, University of Maroua, P.O. Box 814, Maroua, Cameroon
[2]Department of Plant Biology, Faculty of Science, University of Dschang, P.O. Box 67, Dschang, Cameroon

Abstract
Background and Objective: Vascular epiphytes are important components of biological diversity in tropical forests. The survival of the important elements of global vegetation is recognized to be increasingly threatened. This study was conducted in the Mount Oku forest from May-August, 2014. It aimed to assess the diversity and distribution of vascular epiphytes at two altitudinal zones (2200-2500 and 2500-2800 m) in the Mount Oku forest, North-West, Cameroon. **Materials and Methods:** The floristic data were collected on three phorophytes: *Schefflera abyssinica*, *Nuxia congesta* and *Rapanea melanophloeos* using Johansson's method. A total of 180 host trees (e.g., in each altitudinal range, 30 individuals of each host tree) were sampled. **Results:** A total of 69 and 55 species of vascular epiphytes were recorded respectively at altitudinal zones 2200-2500 and 2500-2800 m. The richest epiphyte families at both ranges of altitudes were the Aspleniaceae and Orchidaceae with 12 species each. Host trees *Schefflera abyssinica* and *Nuxia congesta* support most epiphytes. Epiphytic groups, Pteridophyta with 28 species found in 10 families, Dicotyledonae with 29 species found in 16 families and Monocotyledonae with 13 species found in 2 families. **Conclusion:** The altitudinal gradient was found to differ in the composition, diversity and structure of the epiphytic groups, which must be considered for the elaboration of conservation action plans for this ecosystem and their vascular epiphytes.

Key words: Altitudinal gradient, floristic diversity, Mount Oku, phorophyte, tropical forest, vascular epiphyte

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Corresp onding Author: Junior Baudoin Wouokoue Taffo, Department of Biological Sciences, Faculty of Science, University of Maroua, P.O. Box 814, Maroua, Cameroon Tel: +237670041177

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

INTRODUCTION

Epiphytes are essential components of biological diversity that germinate and grow upon host plants (typically woody perennials)[1-3]. Epiphytes are extremely important elements of the flora and they represent about 10% of all plant species globally[4]. Vascular epiphytes are plants that live on other plants (phorophytes) using them only for support without necessarily being parasites i.e they do not obtain any nutritive substance from the phorophyte for their metabolism[2]. Vascular epiphytes are particularly abundant in the wet tropics and obtain water and nutrients from fog, dew and from the rains[2]. The roots of epiphytic plants have evolved to accommodate support and assimilation of water and nutrients from surfaces other than the ground. Among vascular plants, vascular epiphytes represent approximately 29000 species[5]. The majority of vascular epiphytes are ferns and monocots especially orchids, bromeliads and aroids, relatively few are dicots such as ericads.

Epiphytes are important because they promote the alpha diversity of tropical forests[6]. This increases the resources of the canopy to provide shelter, food, breeding sites for vertebrates and invertebrates thus they contribute to biodiversity and the protection of the environment. They could be used as indicators of other anthropogenic changes in ecosystems[7]. By absorbing nutrients from mist or suspended particulate matter, epiphytes are capable of rapidly reintegrating energy and ions into an ecosystem[8]. Since the survival of epiphytes directly depends on trees, an initiative taken for their protection leads to the protection of trees and the forests. This protection has vital importance to the planet as the forest plays an important role in carbon sequestration, oxygen production, biodiversity conservation and the protection of the environment[9]. The altitudinal gradient corresponds principally to a gradient of temperature and is well known to be one of the factors that fashion the model of species diversity[10,11].

Biogeographical and ecological studies on epiphytes in the tropics shows that two environmental variables these species respond to are the position within the host tree and the altitude[12]. The epiphytic flora changes both in diversity and composition along an altitudinal gradient and epiphytes richest areas tend to be located at middle elevations from 1500 m-2500 m[3]. Epiphytes represent a vulnerable group since they depend directly on higher plants thus deforestation directly leads to their destruction, affecting other taxons which depend on the resources provided by epiphytes[13]. Many biotic and abiotic factors determine the abundance and diversity of epiphytes, such as climate, water availability, edaphic factors, host tree size, species identity, bark features and tree architecture[7]. Momo[14] quantified changes in the land cover of Mount Oku for the last 4 decades using satellite images and realized that Mount Oku forests lost 62.1% of their area between 1978 and 2001, corresponding to a mean deforestation rate of 579 ha year^{-1}. Massive deforestation leads to the extinction of 26% of vascular plants and 62% of epiphytes[15]. Obtaining accurate measurements of the diversity of vascular epiphytes is essential for the conservation of biodiversity. Despite the large contribution of epiphytes to biodiversity, information on their composition and diversity is partially known in tropical regions. Vascular epiphytes are an understudied and particularly important component of tropical ecosystems. However, owing to the difficulties of access, little is known about the diversity of epiphytes-host trees and the factors structuring them, especially in Cameroon.

Very few studies have focused on the floristic diversity of vascular epiphytes in Cameroon[4]. No study on vertical stratification and diversity has been documented at the altitudes of Kilum, Mount Oku forest considered as an important endemic zone. This study aimed to access the diversity of vascular epiphytes in tropical forests and how their diversity changes along the altitudinal gradient in Mount Oku forest.

MATERIALS AND METHODS

Study site: The Kilum-Ijim forest commonly called Mount Oku is located in the North-West region of Cameroon. Mount Oku is made up of Mount Kilum (3011 m) is situated between (6°07-6°17 N and 10°20-10°35 E). The climate of Mount Oku presents the particularities of mountain equatorial Cameroon climate. This climate is characterized by a long rainy season (from March-November) and a short dry season (from November-March). The mean annual rainfall varies from 1800 mm in the plains and reaches 3000 mm in altitude. The mean maximum annual temperature varies from 22°C at 1800 m to 16°C at the summit (3011 m), while the mean minimum annual temperature varies from 13°C at 1800 m to 9°C at the summit. The precipitation in the form of mist, dew and fog are common. This study was concentrated on the vegetation in the upper montane, above the 2000 m contour. The soil of Mount Oku has been classified in the category of humid ferrallitic soils, may contain appreciable quantities of a lateritic-bauxitic nature and may occur at the surface, or in the profile, especially on steeply sloping land.

Data collection: This study was carried out between May-August, 2014. Six plots of 100$\times$100 m were randomly located within the two altitudinal zones 2200-2500 m and 2500-2800 m. We divided the 6 (100$\times$100 m) plots into

180 subplots of 25 m^2. Selection of phorophyte (*Schefflera abyssinica*, *Nuxia congesta* and *Rapanea melanophloeos*) was based on three criteria: Diameter at breast height of phorophyte between 30-150 cm, presence of the phorophyte at both altitudinal ranges and abundance of epiphyte on the phorophyte. A distance of at least 20 m was observed between the phorophytes. A total of 180 (30 from each phorophyte and altitudinal gradient) phorophytes were sampled within subplots of 25 m^2 to survey for epiphytes.

Each phorophyte was divided into five zones (Fig. 1), basal area (zone I), trunk zone (zone II), Inner crown zone (zone III), middle crown zone (zone IV) and outer crown zone (zone V). Data on epiphytes in zone I and II were observed and collected directly on phorophytes using secateurs. At zone III, IV and V, a binocular was used to observe distant species of epiphytes and collection was done using a long solid stick with a hook attached at the end. The trunk zone refers to the host trunk areas below the first branch the inner crown zone covers the area from the first branch to the second branch, the middle crown zone covers the area from the second branch to the third branch and the outer crown zone refers to the remaining areas above the third branch[12]. Most vascular epiphyte species were identified directly by using monographs. Voucher specimens were collected and compared to those available in the National Herbarium of Cameroon.

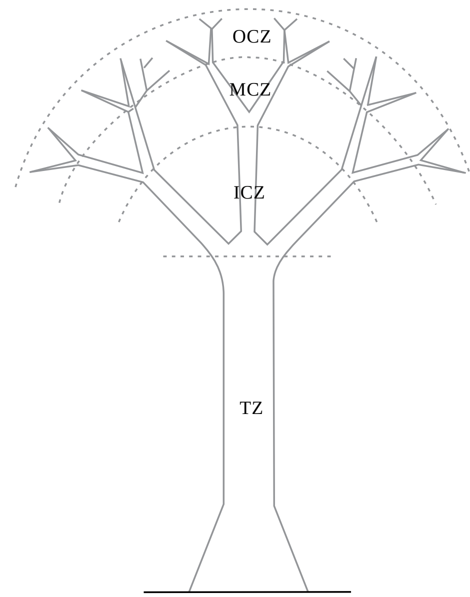

Fig. 1: Diagram of the vertical zones of host trees where epiphyte is distributed
TZ, ICZ, MCZ and OCZ indicated trunk zones, inner crown zones, middle crown zones and outer crown zones of host trees, respectively. This diagram is redrawn from Johansson (1974)

Data analysis: The diversity of vascular epiphytes in the two altitudinal gradients was calculated using Shannon-Weaver diversity and Pielou evenness indices. Floristic similarities of both epiphyte species and host plant species in the two altitudinal gradients were calculated using the floristic similarity coefficient of Sorensen and Jaccard.

RESULTS

Vascular epiphytes diversity: A total of 3015 vascular epiphytes individuals belonging to 69 species (69 from 2200-2500 m and 55 from 2500-2800 m), 46 genera and 28 families were recorded. The number of vascular epiphytes recorded from a single phorophyte sampled in the study varied from 6-49. The richest phorophyte was *Schefflera abyssinica* (49 species) followed by *Rapanea melanophloeos* (30 species) and *Nuxia congesta* (23 species). In the altitudinal zone of 2200-2500 m, 1406 individuals of vascular epiphytes were recorded belonging to 69 species, 46 genera and 28 families while in the altitudinal zone of 2500-2800 m, 1609 individuals were recorded belonging to 55 species, 38 genera and 26 families. At altitude 2200-2500 m, the most abundant species were *Loxogramme lanceolata*, *Pleopeltis excavata* and *Cyrtorchis ringens* while at altitude 2500-2800 m, the most abundant species were *Peperomia vulcanica*, *Pleopeltis excavata*, *Loxogramme lanceolata* and *Asplenium aethiopicum*.

Table 1: Diversity and evenness indices of vascular epiphytes in the two altitudinal gradients

	2200-2500 m	2500-2800 m
Maximum diversity	6.11	5.78
Shannon-Weaver diversity (H)	5.24	4.75
Pielou evenness (E)	0.86	0.82

Shannon-Weaver diversity and Pielou evenness indices respectively 5.24 and 0.86 were higher in 2200-2500 m than 2500-2800 m (Table 1).

Vertical distribution of epiphytes on the phorophytes: Vascular epiphytes of the studied altitudinal zones were found to be distributed in the different zones of the host plants. A total of 45, 43 and 40 epiphyte species of altitude 2200-2500 m inhabited base, trunk and canopy regions, respectively, while 43, 42 and 41 epiphytes species were recorded from the three regions in the given order in 2500-2800 m (Appendix 1). As the distributional pattern revealed, vascular epiphyte species *Asplenium aethiopicum*, *Loxogramme lanceolata*, *Peperomia vulcanica* and *Pleopeltis excavata* grow in all five regions of phorophytes at both zones. *Alchemilla fischeri*, *Cardamine africana*, *Cyperus* sp.,

Appendix 1: List of vascular epiphytes recorded in the two altitudinal zones

		Zone of phorophyte (2200–2500 m)			Zone of phorophyte (2500–2800 m)		
Family	Species names	Base	Trunk	Canopy	Base	Trunk	Canopy
Acanthaceae	*Asystasia gangetica* (L) T. Anderson	+	+	-	+	+	+
Acanthaceae	*Mimulopsis solmsii* Schweinf	+	-	-	-	-	+
Apiaceae	*Sanicula elata* Buch-Ham	+	+	+	+	+	+
Apiaceae	*Sanicula* sp.	+	-	-	-	-	-
Araliaceae	*Schefflera abyssinica* (Hochst. ex A.Rich.) Harms	+	+	+	+	+	-
Araliaceae	*Schefflera mannii* (Hook.f.) Harms	+	+	+	+	+	-
Aspleniaceae	*Asplenium abyssinicum* Fee	+	-	-	+	+	+
Aspleniaceae	*Asplenium aethiopicum* (Burm.f.) Bech	+	+	+	+	+	+
Aspleniaceae	*Asplenium anisophyllum* Kunze	+	+	-	+	+	-
Aspleniaceae	*Asplenium biafranum* Alston and Ballard	-	-	+	+	+	+
Aspleniaceae	*Asplenium buettneri* Hieron.	+	+	+	-	+	+
Aspleniaceae	*Asplenium erectum* Bory ex Wild	+	+	-	+	+	+
Aspleniaceae	*Asplenium friesiorum* C. Chr	-	+	+	+	+	+
Aspleniaceae	*Asplenium gammascens* Alston	-	+	+	-	+	+
Aspleniaceae	*Asplenium mannii* Hook.	-	+	+	+	+	+
Aspleniaceae	*Asplenium protensum* Schrad	+	+	+	+	+	+
Aspleniaceae	*Asplenium* sp.	+	+	+	-	+	+
Aspleniaceae	*Asplenium theciferum* (Humb., Bonpl. & Kunth)	+	+	+	+	+	+
Asteraceae	*Ageratum conyzoides* subsp. *houstonianum* Mill.	+	+	-	+	+	-
Asteraceae	*Crassocephalum mannii* (DC.) S. Moore	+	+	-	+	+	-
Asteraceae	*Microglossa* sp.	+	-	-	+	-	-
Balsaminaceae	*Impatiens sakeriana* Hook.f.	+	+	-	+	+	-
Balsaminaceae	*Impatiens* sp.	+	-	-	-	-	-
Crassulaceae	*Kalanchoe crenata* (Andrews) Haw.	+	+	+	+	+	-
Crassulaceae	*Umbilicus botryoides* Hochst. ex A. Rich.	+	+	-	+	+	+
Cruciferae	*Cardamine africana* L.	+	+	+	+	+	-
Cyperaceae	*Cyperus distans* L. f. subsp. *Longibracteatus* (Cherm.) Lye	-	-	-	+	-	-
Cyperaceae	*Cyperus* sp.	+	-	-	-	-	-
Dryopteridaceae	*Lastreopsis fulensis* (Bak.) Tardiell	+	+	-	+	+	+
Geraniaceae	*Geranium arabicum* Forssk	+	-	-	+	-	-
Grammitidaceae	*Xiphopteris villosissinta* (Hook.) Alston	-	-	+	-	-	+
Hymenophyllaceae	*Microgonium ballardianum* (Alston) Pic. Serm.	+	+	+	+	+	+
Hymenophyllaceae	*Vandenboschia melanotricha* (Schltdl Pic). Serm	+	+	-	+	+	+
Hypericaceae	*Hypericum revolutum* Vahl	+	-	-	+	-	+
Isoetaceae	*Azolla africana* Derve	+	+	+	+	+	+
Isoetaceae	*Azolla* sp.	+	-	-	-	-	-
Lamiaceae	*Pycnostachys meyeri* Gürke	+	-	-	+	-	+
Lycopodiaceae	*Huperzia mildbraedii*	-	-	+	-	-	+
Lycopodiaceae	*Huperzia ophioglossoides* (Lam.) Trevis	-	-	+	-	-	+
Lycopodiaceae	*Lycopodium cernuum* L., F.W.T.A. Suppl.	-	-	+	-	-	-
Oleandraceae	*Arthropteris monocarpa* (Cordem) C. Chr.	-	-	+	-	-	-
Orchidaceae	*Aerangis biloba* (Lindl.) Schltr	-	+	-	-	-	+
Orchidaceae	*Aerangis gravenreuthii* (Kraenzl.) Schltr	-	-	+	-	-	+
Orchidaceae	*Acestrorhynchus serratus* Summerth.	-	+	-	-	-	-
Orchidaceae	*Angraecum moandense* De Wild	-	-	+	-	-	-
Orchidaceae	*Calyptrochilum christyanum* (Rchb.f.) Summerh	-	+	-	-	-	-
Orchidaceae	*Cribbia confusa* P.J. Cribb	-	-	+	-	-	-
Orchidaceae	*Cyrtorchis arcuata* (Lindl.) Schltr. Subsp. Arcuate	-	-	+	-	-	-
Orchidaceae	*Cyrtorchis ringens* (Rchb.f) Summerth.	-	+	+	-	+	+
Orchidaceae	*Diaphananthe bueae* (Schltr.) Schltr.	-	-	+	-	-	+
Orchidaceae	*Diaphananthe polyantha* (Kraenzl.) F.N.Rasm.	-	+	+	-	+	+
Orchidaceae	*Habenaria* sp.	+	+	-	-	+	+
Orchidaceae	*Polystachya cultriformis* (Thou.) Spreng.	-	-	+	+	+	+
Oxalidaceae	*Oxalis corniculata* Linn.	+	+	-	+	+	+
Piperaceae	*Peperomia vulcanica* Baker	+	+	+	+	+	+
Piperaceae	*Peperomia retusa* A. Dietr	+	+	+	+	+	+
Piperaceae	*Peperomia thomeana* C. CD	+	+	+	+	+	+
Piperaceae	*Peperomia* sp.	+	+	+	-	-	+
Polypodiaceae	*Loxogramme lanceolata* (Sw.) C. Presl., F.W.T.A. Suppl.	+	+	+	+	+	+
Polypodiaceae	*Pleopeltis excavata* (Bory ex Willd.) Ching	+	+	+	+	+	-

Appendix 1: Continuous

Family	Species names	Zone of phorophyte (2200–2500 m) Base	Trunk	Canopy	Zone of phorophyte (2500–2800 m) Base	Trunk	Canopy
Polypodiaceae	*Pleopeltis lanceolata* (L.) Kaulf., F.W.T.A. Suppl.	+	+	+	+	+	-
Polypodiaceae	*Pleopeltis preussii* (Hieron) Pic. Serm	+	+	+	+	+	-
Ranunculaceae	*Clematis simensis* Fresen	-	+	+	-	+	-
Rosaceae	*Alchemilla fischeri* Engl.	-	+	+	+	+	-
Rubiaceae	*Gallium siemens* Fresen	+	+	-	+	-	-
Rubiaceae	*Pavetta* sp.	-	+	-	+	+	+
Selaginellaceae	*Selaginella abyssinica* Spring	+	+	+	+	+	+
Urticaceae	*Laportea ovalifolia* (Schum.) Chev.	+	+	-	+	+	+
Woodsiaceae	*Athyrium glabratum* (Mett.) H. Ohba	-	-	+	-	-	-

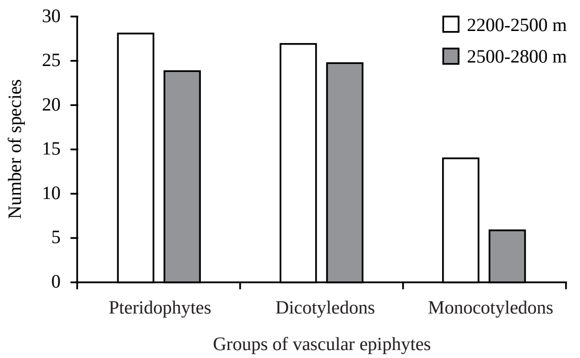

Fig. 2: Number of species and groups of vascular epiphytes in each altitudinal gradient

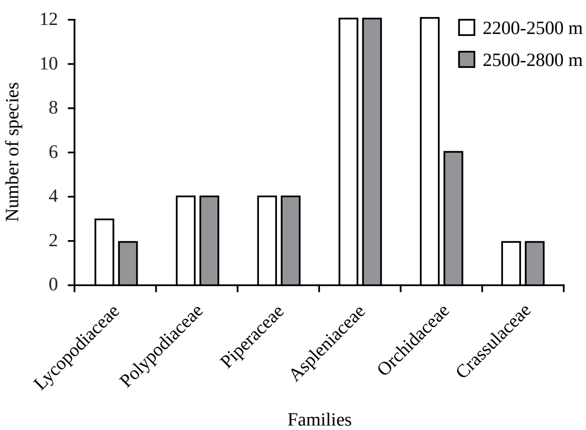

Fig. 3: Families with a high species number of vascular epiphytes at both altitudinal gradients

Geranium arabicum, *Habenaria* sp., *Impatiens sakeriana*, *Kalanchoe crenata*, Oxalis corniculata and *Umbilicus botryoides* were found on base and trunk portions of the phorophytes whereas *Cyrtorchis ringens*, *Polystachya cultriformis*, *Huperzia ophioglossoides* and *Huperzia mildbraedii* were occupied canopy portions of the phorophytes.

Host specificity of vascular epiphytes: The epiphytes *Asplenium biafranum*, *Diaphananthe bueae*, *Impatiens* sp. and *Sanicula* sp., were recorded only from the phorophyte *Schefflera abyssinica* in 2200-2500 m whereas the epiphytes *Pycnostachys meyeri* was recorded from the phorophyte species *Nuxia congesta*. In 2500-2800 m, the epiphytes *Asplenium biafranum*, *Diaphananthe polyantha*, *Microglossa* sp. and *Hypericum revolutum* were recorded only from the phorophyte *Schefflera abyssinica* whereas the epiphytes *Pycnostachys meyeri* was recorded from the phorophyte species *Nuxia congesta*. The phorophyte *Rapanea melanophloeos* does not bear specific epiphytes.

Floristic similarities of epiphytes and phorophytes of the two altitudinal zones: The floristic similarity of epiphytes in the two altitudinal zones using the Jaccard index was found to be 0.80 and the Sorenson similarity index was determined to be 89%.

Diversity of vascular epiphytic groups: At the altitude 2200-2500 m, epiphytic ferns were represented by 28 species in 13 genera with the richest family Aspleniaceae 12 species in a unique genus (*Asplenium*) and epiphytic dicotyledons had 27 species in 23 genera with the richest family Piperaceae with 4 species belonging to a unique genus *Peperomia* (Fig. 2). Epiphytic monocotyledons had the richest family Orchidaceae with 12 species belonging to 9 genera. At altitude 2500-2800 m, epiphytic ferns were represented by 24 species in 13 genera. with the richest family Aspleniaceae, 12 species belonging to a unique genus (*Asplenium*) and epiphytic dicotyledons had 25 species in 21 genera. Epiphytic monocotyledons had the richest family Orchidaceae with 6 species belonging to 6 genera (Fig. 3).

DISCUSSION

The higher richness and abundance of epiphytes in the altitude 2200-2500 m (1609 individuals and 69 species) than the altitude 2500-2800 m (1406 individuals and 55 species) could be explained by altitudinal variation, annual rainfall and temperature of the study areas. Kromer *et al.*[16] explained that epiphytes become abundant when precipitation attains or exceeds 2500 mm. The same observations were done in the two zones with an annual rainfall of the altitude 2200-2500 m (high diversity) varied from 1780-2290 mm annual rainfall whereas those of the altitude 2500-2800 m was 3050 mm (low diversity). In Mount Oku, the mean maximum temperatures vary from 22°C at 1800 m to 16°C at the summit (3011 m) while the mean minimum temperatures vary from 13°C at 1800 m to 9°C at the summit (3011 m). *Schefflera abyssinica* hosts the greatest number of vascular epiphytes at all the zones of Johansson. This species is a primary hemi-epiphyte during the early years of growth which sends down its roots on the forest floor where the roots are established[17]. For this reason, most of the plants where *Schefflera* provides shade have reduced growth while *Schefflera abyssinica* persist and continues its growth. Thus, the old individuals of *Schefflera abyssinica* which persist in the forest tend to host a greater number of vascular epiphyte plants. *Schefflera abyssinica* also has a greater canopy providing many microenvironments for the establishment of vascular epiphytes. Also, the rough bark of this phorophyte enables the establishment of diaspores.

The two altitudinal zones exhibited higher Shannon-Weaver diversity and Pielou evenness indices, indicating high diversity of epiphytes in the area. The lower value of Shannon-Weaver obtained at altitude 2500-2800 m compared to the altitude 2200-2500 m conform to the results obtained in Chiapas (Mexico) that when rainfall exceeds 2500 mm annually, epiphyte diversity decreases and the microclimates of high elevations do not favour the development of epiphytes[18]. According to Quiel and Zotz[19], when temperature decreases, the diversity of species decreases. This factor (rainfall and temperature) probably influences the diversity of vascular epiphytes at the high altitudes of Mount Oku.

A difference in the pattern of the vertical distribution of vascular epiphytes on phorophytes was observed between the two altitudinal zones. Epiphytes species richness decreased slowly in the order of zone: Canopy region, trunk zone and base region indicating that diversity of vascular epiphytes shows a decreasing trend as we move up the trunk of host trees. The trunk region represents an intermediate level of epiphyte species richness and this is a reflection of moderate microclimatic condition, proximity to the soil, exposition to wind and waterfalls in this part of the host plants[20]. This decline in the vertical distribution in epiphyte diversity may be related to the decrease in humidity and increase in light intensity along with the increasing canopy height of the phorophytes[21]. The intensity of light decreases progressively from the canopy to the forest floor, whereas humidity progressively increases. Wang *et al.*[22] said that the lower light intensity and higher humidity in the understory compared to the crown layers are more favourable for the growth of epiphytes. These results are consistent with the research by Adriano and Mário[15], in which the species richness of epiphytes on the trunk was higher than those in the outer crown zone of host trees. These results differ from those of Zhao *et al.*[23], who found that in a tropical montane forest, epiphyte diversity is the highest in the middle canopy. Therefore, the microclimatic aspects of the forests, among them humidity and light intensity, appear to be determining factors in the vertical distribution of epiphytes species.

Variation among phorophytes to the number of epiphyte species they support (despite the very little host specificity of epiphytes) appears to be a universal trend since a similar observation was made earlier by Song *et al.*[2]. Some tree species are generally better hosts than others. The same observation occurs in the studied sites. Phorophyte species such as *Rapanea melanophloeos* were containing the least vascular epiphyte species. Phorophytes tree species such as *Schefflera abyssinica* and *Nuxia congesta* of both altitudinal zones contained a large number of vascular epiphyte species. Getaneh and Gamo[20] said that this variation between vascular epiphyte species number among host tree species may be due to the characteristics of host tree species such as age, bark texture and size as well as distribution of mycorrhizal fungal symbionts and other bark characteristics.

The similarity index of Jaccard (0.8) and Sorenson (89%) showed that the two altitudinal zones belong to the same plant community. The observed similarities in both altitudes are due to the presence of Aspleniaceae, Polypodiaceae, Asteraceae, Rubiaceae, Araliaceae, Acanthaceae, Lamiaceae, Piperaceae, Cruciferae and Rosaceae which are equally represented in both areas.

Pteridophytes and Monocotyledons (orchids) account for 60.86% of all epiphytes found in this study. Pteridophytes are a major group in subtropical forests[24], while orchids are often the primary epiphytes in tropical rain forests[4,23]. These results are similar to those Noumi *et al.*[4] who found that Monocotyledonae and Pteridophyta dominate the epiphytic flora of tropical regions as found in Korup National Park Cameroon.

At the family level, Orchidaceae and Aspleniaceae is the group that most contributes to the epiphytic diversity. The species composition by family observed in this study followed a worldwide trend of many species concentrated with in Orchidaceae. For example, Noumi *et al.*[4] and Zhao *et al.*[23] identified Orchidaceae and Aspleniaceae as the dominant family in the Korup national park (Cameroon) and a tropical montane forest in SW China, respectively. The Aspleniaceae family with a single genus has obtained 12 species. *Asplenium* species have been noted for their abundance in tropical forests throughout the world[25].

The epiphytes show no special preference to phorophytes species, which is identical to other studies, may be taken as an indication of lack of co-evolutionary processes. The inclusion of local communities in forest conservation activities and management should, therefore, be considered as a realistic option to reduce the harm done to these essential ecosystems and also conserve the various vital resources (including epiphytes) that are associated with forest. An extension of this study with more hosts tree species is needed to add to our understanding of observations made and interpretation these.

CONCLUSION

In this study, a total of 69 vascular epiphyte species (69 from 2200-2500 m and 55 from 2500-2800 m) which belong to 28 families were recorded. The species diversity of vascular epiphytes in the studied forests is high. The similarity floristic indices of Johanson and Sorensen indicated that the two altitudinal zones belong to the same plant community. Species richness of epiphytes significantly decreased from the lower to upper crown zones on host trees. The difference in species composition and diversity of vascular epiphytes of the two altitudinal zones could be attributed to the altitude and the associated environmental parameters such as moisture, light and humidity.

SIGNIFICANCE STATEMENT

This study assessed biodiversity epiphytes on different host trees and the factors structuring them along an altitudinal gradient. This study will help the researcher to uncover the vascular epiphytes which are among the most threatened group of plants due to the extraction of trees (phorophytes) that many researchers were not able to explore. Thus the new knowledge this bioindicator groups along an altitudinal gradient is fundamental for monitoring biodiversity, detecting threatened species or environments and guiding preventive conservation actions.

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