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Composition and Abundance of Vascular Epiphytic Flora in Contrasting Forest Environments in the Eastern Amazon

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Abstract

We analyzed the composition and abundance of the vascular epiphytic flora in non-flooded and flooded (várzea) forest in the Parque Estadual do Utinga Camillo Vianna (PEUT) in the Eastern Amazon. We sampled epiphytes from 10 canopy trees with DBH = 25-35 cm in each type of vegetation. We recorded 743 individuals from 10 families, 26 genera, and 41 species, with greater specific richness and abundance in non-flooded forest (443 individuals from 33 species and 22 genera) than in flooded forest (300 individuals from 26 species and 18 genera). Eighteen species were common to both types of vegetation. Araceae stood out with the highest species richness and Bromeliaceae with the greatest abundance. We recorded *Pleopeltis* and five Angiosperm species, including the aroid *Heteropsis spruceana* (endemic to the Brazilian Amazon), for the first time in PEUT. We also recorded *Heteropsis flexuosa*, a threatened with extinction species in Brazil.

Keywords: Epiphytes, conservation, endemism, flooded forest, non-flooded forest.

1. INTRODUCTION

Vascular epiphytes, hemiepiphytes, and nomadic climbers (vascular epiphytic flora) are plants that use other plants - typically shrubs and trees (phorophytes) - for mechanical support (Zotz et al., 2021a). They occupy different vegetation strata, and are classified and differentiated based on their climbing habit, recruitment substrate, and habitat (Clemente-Arenas et al., 2023) and they complete their entire life cycle (holoepiphytes) or part of it (hemiepiphytes and nomadic climbers) on phorophytes (Zotz et al., 2021a). The epiphytic flora is a fundamental component of forest ecosystems, providing habitat, food resources, and reproductive sites for a wide range of animal species (Soto-Medina et al., 2023). Additionally, they contribute to moisture regulation and nutrient concentration in the environment and can also serve as bioindicators (Clemente-Arenas et al., 2023).

The Amazon is the largest phytogeographic domain in Brazil, covering approximately 40% of the national territory and comprising the largest expanse of tropical humid forests in the world (Castuera-Oliveira et al., 2020). Its continental-scale vegetation supports high levels of primary productivity and considerable spatial variation in climatic and edaphic conditions (Quaresma et al., 2022). Despite the ecological importance of the epiphytic flora, the floristic composition, ecological patterns, and spatial of this synusia in the Amazon remain little studied, especially in comparison to other forest components (Irume et al., 2013; Luz et al., 2023). Huge areas of the Amazon forest remain poorly explored due to financial and logistical limitations, and in the specific case of the epiphytic flora, the difficulty of accessing the canopy imposes additional barriers (Luz et al., 2023).

This knowledge gap extends to comparative studies of the groups across different Amazonian forest types. The Amazonian vegetation encompasses several forest types, including campinarana, restinga (coastal forest), savanna formations (open vegetation), non-flooded forests (not subject to seasonal flooding), and floodplain forests known as várzea and igapó (both seasonally flooded) (Quaresma et al., 2022). Non-flooded forests, which cover about 70% of the Amazonian vegetation (Artaxo et al., 2014), represent the dominant forest type, followed by várzea forests. These two forest types differ markedly in seasonal flooding regimes, temperature, humidity, light availability, and edaphic characteristics (Bredin et al., 2020). Abiotic variations among different forest formations can directly influence the composition of the epiphytic flora (Quinteros-Gómez et al., 2024). These environmental differences result in significantly distinct floristic patterns, suggesting that epiphytic species may exhibit variation in their functional traits across environmental gradients (Taylor et al., 2022). Thus, the study of these groups in different vegetation types contributes to the identification of specific floristic patterns that characterize epiphytic synusiae (Quinteros-Gómez et al., 2024).

The floristic knowledge derived from the majority of studies conducted in the Brazilian Amazon domain remains predominantly concentrated in non-flooded forests (Irume et al., 2013). The epiphytic flora is particularly under-sampled in other vegetation types such as floodplain forests (Quinteros-Gómez et al., 2024). Even within Amazonian conservation units, only a handful of studies have inventoried the floristic composition of epiphytes to date (Ferreira et al., 2022; Miranda et al., 2025). Most floristic surveys in these areas have been directed to plant groups such as ferns (Costa et al., 2006), herbs, lianas, shrubs (Furtado et al., 2024), and palms (Ferreira et al., 2023). There is thus a need for more comprehensive studies on the richness and abundance of the epiphytic flora within conservation units to evaluate biodiversity trends and support effective conservation actions targeting these synusiae (Luz et al., 2023).

The floristic knowledge of epiphytic synusiae provides essential insights not only for the characterization of different forest typologies but also for the identification of endemic and threatened species - often poorly documented in protected environments. Given this scenario, the present study aimed to carry out a floristic inventory and analyze the composition and abundance of vascular epiphyte, hemiepiphyte, and nomadic climber communities in non-flooded and várzea areas within a strictly protected conservation unit in the eastern Amazon.

2. MATERIAL AND METHODS

2.1. Study area

The study was conducted in Parque Estadual do Utinga Camillo Vianna (PEUT; 1°23’58”-1°26’25” S; 48°25’19”-48°25’16” W) in the Metropolitan Region of Belém, state of Pará, Brazil (Figure 1). The average temperature in this conservation unit is about 26 °C, with average maximum temperature of 31 °C and average minimum temperature of 23 °C. The annual precipitation is about 3,000 mm, with a rainy season from January to May (> 200 mm) (Mendonça et al., 2025), and the climate is humid equatorial. The area is recognized for its remarkable plant richness (Furtado et al., 2024), but it is also one of the most threatened in the Amazon region, mainly due to the expansion and consolidation of urbanization in its surroundings (Ferreira et al., 2023).

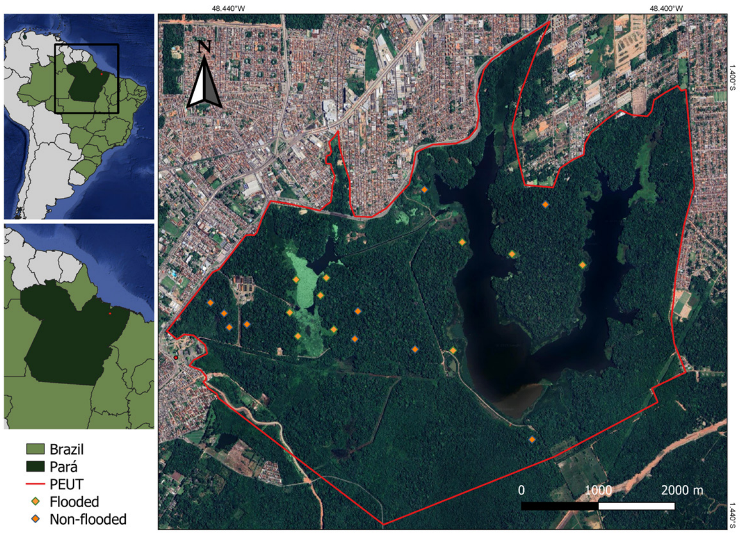

Figure 1. Location of Parque Estadual do Utinga Camillo Vianna in the Metropolitan Region of Belém, state of Pará, Brazil.

The area comprises a mosaic of vegetation types, the native vegetation is mainly composed of non-flooded and várzea forests, although there are also fragments of campinarana and igapó forests. The várzea forest (hereinafter, flooded forest) (Figures 2a-b) is influenced by seasonal flooding caused by tidal dynamics and river level fluctuations, featuring more fertile soils. In contrast, the non-flooded forest (Figures 2c-d) is characterized by higher elevation areas, drier and nutrient-poorer soils, and no seasonal flooding (Ferreira et al., 2022).

Figure 2. Natural environments of flooded forest (a-b) and non-flooded forest (c-d) in Parque Estadual do Utinga Camillo Vianna, state of Pará, Brazil.

2.2. Data collection and analysis

For the preliminary survey of information on epiphytic species occurring in PEUT, including flowering and fruiting periods, we carried out in-person consultations at the EAO, HF, HFC, IAN, MFS, and MG herbaria (acronyms according to Thiers, 2025) as well as online searches on the Global Biodiversity Information Facility (https://www.gbif.org) and speciesLink (https://specieslink.net) platforms. Data on endemism and conservation status of the species were obtained from Flora e Funga do Brasil (https://floradobrasil.jbrj.gov.br) and Ministério do Meio Ambiente (2022). We analyzed the lists of species presented by Costa et al. (2006), Ferreira et al. (2022) and Miranda et al. (2025) to highlight the first records of vascular epiphytic flora taxa in PEUT.

Field collections were carried out from October 2024 to March 2025. The collected specimens were identified through consultation of specialized literature, particularly Koch et al. (2013), Brito et al. (2019), and Flora and Funga of Brazil (2025), and with the assistance of taxonomic specialists. Phorophytes were considered the sampling units in the survey of the epiphytic flora (Marcusso et al., 2019). In each type of vegetation, we sampled the epiphytic flora (individuals > 5 cm) of 10 adult phorophytes, which consisted of individuals with crowns reaching the forest canopy, with a diameter at breast height (DBH) of 25-35 cm (OrtegaSolís et al., 2020). The minimum distance between sampling units was at least 100 meters (Pos & Sleegers, 2010). A fertile specimen or part of it were collected from each epiphytic species on each selected phorophyte using pole pruners (Costa et al., 2011) and single-rope climbing techniques (Adhikari et al., 2021). Specimens were processed according to taxonomic protocols (Peixoto & Maia, 2013) and deposited into the MG herbarium. Specimens without flowers were cultivated in a greenhouse for identification and subsequent deposition into the MG. Structurally dependent species were classified according to life form into: epiphyte, hemiepiphyte and nomadic climber (Zotz et al. 2021b). Data regarding the number of species, genera, families, and life form of the vascular epiphytic flora were organized into tables to facilitate data synthesis and interpretation. A botanical plate of representative species of the area was produced using GIMP software (version 3.0.4).

3. RESULTS

A total of 743 individuals belonging to 41 species distributed in 26 genera and 10 families were recorded. In non-flooded forest, 443 individuals of 33 species, 22 genera, and nine families were recorded, whereas in flooded forest, 300 individuals of 26 species, 19 genera, and nine families were recorded. Eighteen (43,9%) species were common to both types of vegetation, 15 were exclusive to non-flooded forest, and eight were exclusive to flooded forest (Table 1). Regarding life form, vascular epiphytes predominated (25 species), followed by hemiepiphytes (13) and nomadic climbers (3). Araceae exhibited the highest species richness (13), followed by Orchidaceae (10), Bromeliaceae (7), Aspleniaceae, Cyclanthaceae, Gesneriaceae, and Polypodiaceae (2 species each), Clusiaceae, Dryopteridaceae and Vittariaceae (1 species each) (Figure 3).

We recorded *Pleopeltis* Humb. (Polypodiaceae), *Asplundia guianensis* Harling (Cyclanthaceae), *Heteropsis spruceana* Schott (Araceae), *Philodendron deflexum* Poepp. (Araceae), *Polystachya stenophylla* Schltr. (Orchidaceae) and *Wallisia anceps* (G.Lodd.) Barfuss & W.Till (Bromeliaceae) for the first time in PEUT. *Heteropsis spruceana*, *P. deflexum* and *P. stenophylla* were each one represented by a single individual. In contrast, some species, such as *Evodianthus funifer* (Poit.) Lindm (Cyclanthaceae), *Guzmania lingulata* (L.) Mez, *W. anceps*, *Rhodospatha latifolia* Poepp. and *Rhodospatha oblongata* Poepp. (Araceae) were recorded with high abundance in the conservation unit (Figure 4).

Table 1. Species and abundance of vascular epiphyte (EP), hemiepiphyte (HM), and nomadic climber (NC) in non-flooded (NF) and flooded (FL) forests in Parque Estadual do Utinga Camillo Vianna, state of Pará, Brazil. First record in PEUT (*), endemic to the Brazilian Amazon (#), and vulnerable (+). LF = Life form.

Family/Species	FL	NF	LF	Voucher
Araceae				
Anthurium gracile (Rudge) Lindl.	-	1	EP	*Araújo, J. F. 24* (MG)
Anthurium sinuatum Benth. ex Schott	-	1	EP	*Araújo, J. F. 4* (MG)
Heteropsis flexuosa (Kunth) G.S. Bunting+	16	7	HM	*Araújo, J. F. 1* (MG)
Heteropsis spruceana Schott*, #	-	1	HM	*Araújo, J. F. 25* (MG)
Monstera adansonii Schott	4	5	NC	*Araújo, J. F. 2* (MG)
Philodendron deflexum Poepp*	-	1	HM	*Araújo, J. F. 34* (MG)
Philodendron ecordatum Schott	6	1	HM	*Araújo, J. F. 16* (MG)
Philodendron fragrantissimum (Hook.) G. Don	-	2	HM	*Araújo, J. F. 9* (MG)
Philodendron linnaei Kunth	6	14	HM	*Araújo, J. F. 33* (MG)
Philodendron pedatum (Hook.) Kunth	31	12	HM	*Araújo, J. F. 43* (MG)
Philodendron sp.	-	1	HM	*Araújo, J. F. 44* (MG)
Rhodospatha latifolia Poepp.	47	40	HM	*Araújo, J. F. 14* (MG)
Rhodospatha oblongata Poepp.	54	62	HM	*Araújo, J. F. 8* (MG)
Aspleniaceae				
Asplenium serratum L.	-	6	EP	*Araújo, J. F. 36* (MG)
Asplenium sp.	-	1	EP	*Araújo, J. F. 37* (MG)
Bromeliaceae				
Aechmea bromeliifolia (Rudge) Baker	-	1	EP	*Araújo, J. F. 10* (MG)
Aechmea mertensii (G. Mey.) Schult. & Schult.f.	1	-	EP	*Araújo, J. F. 6* (MG)
Aechmea setigera Mart. ex Schult. & Schult.f.	2	1	EP	*Araújo, J. F. 7* (MG)
Aechmea tocantina Baker	-	1	EP	*Araújo, J. F. 47* (MG)
Guzmania lingulata (L.) Mez	42	81	EP	*Araújo, J. F. 12* (MG)
Tillandsia sp.	-	1	EP	*Araújo, J. F. 48* (MG)
Wallisia anceps (G.Lodd.) Barfuss & W.Till*	26	128	EP	*Araújo, J. F. 35* (MG)
Clusiaceae				
Clusia grandiflora Splitg.	2	2	NC	*Araújo, J. F. 23* (MG)

Family/Species	FL	NF	LF	Voucher
Cyclanthaceae				
Asplundia guianensis Harling*	4	9	HM	*Araújo, J. F. 17* (MG)
Evodianthus funifer (Poit.) Lindm	31	43	HM	*Araújo, J. F. 3* (MG)
Dryopteridaceae				
Elaphoglossum luridum (Fée) H. Christ	4	1	EP	*Araújo, J. F. 39* (MG)
Gesneriaceae				
Codonanthopsis crassifolia (H. Focke) Chautems & Mat. Perret	6	4	EP	*Araújo, J. F. 26* (MG)
Drymonia coccinea (Aubl.) Wiehler	1	1	HM	*Araújo, J. F. 16* (MG)
Orchidaceae				
Epidendrum carpophorum Barb. Rodr.	1	-	EP	*Araújo, J. F. 32* (MG)
Epidendrum nocturnum Jacq.	1	-	EP	*Araújo, J. F. 42* (MG)
Gongora sp.	-	1	EP	*Araújo, J. F. 49* (MG)
Octomeria sp.	-	1	EP	*Araújo, J. F. 51* (MG)
Polystachya foliosa (Hook.) Rchb.f.	1	-	EP	*Araújo, J. F. 29* (MG)
Polystachya stenophylla Schltr.*	1	-	EP	*Araújo, J. F. 41* (MG)
Polystachya sp.	1	-	EP	*Araújo, J. F. 46* (MG)
Scaphyglottis prolifera (Sw.) Cogn.	2	-	EP	*Araújo, J. F. 50* (MG)
Vanilla odorata C.Presl	1	1	NC	*Araújo, J. F. 22* (MG)
Zygosepalum labiosum (Rich.) Garay	-	10	EP	*Araújo, J. F. 31* (MG)
Polypodiaceae				
Microgramma lycopodioides (L.) Copel.	7	1	EP	*Araújo, J. F. 45* (MG)
Pleopeltis sp.*	-	1	EP	*Araújo, J. F. 40* (MG)
Vittariaceae				
Vittaria lineata (L.) Sm.	2	-	EP	*Araújo, J. F. 38* (MG)
Total	300	443		

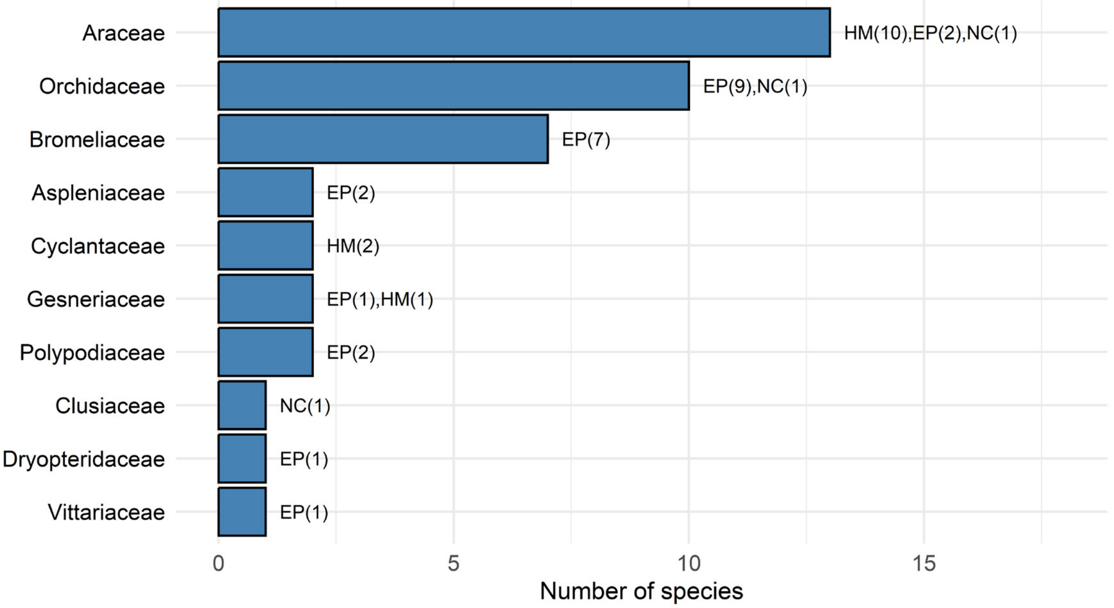

Figure 3. Species richness by life form of the main families of the vascular epiphytic flora in Parque Estadual do Utinga Camillo Vianna, state of Pará, Brazil. Epiphyte (EP), hemiepiphyte (HM), and nomadic climber (NC) species.

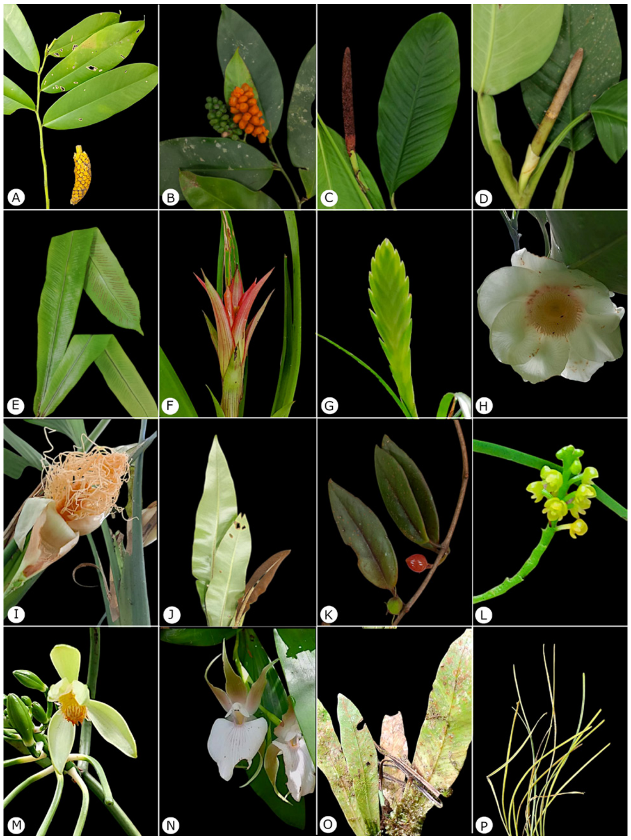

Figure 4. Vascular epiphytic flora of Parque Estadual do Utinga Camillo Vianna, state of Pará, Brazil, highlighting species recorded for the first time in the area (b, l, g), endemic to the Brazilian Amazon (b), vulnerable (a), and the most abundant species of each family (c, d, e, f, h, i, j, k, n, o, p). Araceae - a) *Heteropsis flexuosa* (Kunth) G.S. Bunting; b) *Heteropsis spruceana* Schott; c) *Rhodospatha latifolia* Poepp.; d) *Rhodospatha oblongata* Poepp.; Apleniaceae - e) *Asplenium serratum* L.; Bromeliaceae - f) *Guzmania lingulata* (L.) Mez; g) *Wallisia anceps* (G.Lodd.) Barfuss & W.Till; Clusiacae - h) *Clusia grandiflora* Splitg.; Cyclanthaceae - i) *Evodianthus funifer* (Poit.) Lindm; Dryopteridaceae - j) *Elaphoglossum luridum* (Fée) H. Christ; Gesneriaceae - k) *Codonanthopsis crassifolia* (H. Focke) Chautems & Mat. Perret; Orchidaceae - l) *Polystachya stenophylla* Schltr.; m) *Vanilla odorata* C.Presl; n) *Zygosepalum labiosum* (Rich.) Garay; Polypodiaceae - o) *Microgramma lycopodioides* (L.) Copel.; Vittariaceae - p) *Vittaria lineata* (L.) Sm.

4. DISCUSSION

The species richness recorded in this study (41 species) can be considered high since it was greater than that reported in some studies conducted in the Brazilian Amazon (Magalhães & Lopes, 2015; Miranda et al., 2025) and the Amazon-Pantanal transition zone (Olivo-Neto et al., 2023), although it was lower than the richness reported for the Colombia (Benavides et al., 2005) and Ecuadorian Amazon (Kreft et al., 2004). It is important to highlight that most surveys of the epiphytic flora employ plots with considerable variation in size and number, which can directly affect the richness values obtained (Luz et al., 2023). Although the use of phorophytes as sampling units has been recommended (Pos & Sleegers, 2010), collection methods are not standardized, hampering direct comparisons between different studies.

We found greater specific richness and abundance in non-flooded forests than in flooded forests. Differences in richness between these forest environments can be explained by their contrasting environmental conditions (Quaresma & Jardim, 2012). Non-flooded forests in the Amazon region have a more diverse tree formation than floodplain forests, resulting in greater availability and variety of arboreal substrates for epiphytes (Irume et al., 2013; Quaresma et al., 2022). Conversely, seasonal flooding during the rainy season raises soil water levels and can prevent the establishment of vascular epiphytes in the lower strata in the flooded forests in the Amazon, resulting in lower species diversity and abundance in these environments (Arévalo & Bentacur, 2006).

Araceae exhibited the highest species richness in non-flooded and flooded forests, with 17 and 7 species, respectively. A similar pattern was observed by several authors, who highlighted Araceae as one of the most relevant families in the composition of the epiphytic flora of the Amazon region (Benavides et al., 2005; Pos & Sleegers, 2010; Obermuller et al., 2014; Magalhães & Lopes, 2015; Miranda et al., 2025). The success of species of the genera *Heteropsis* Kunth, *Philodendron* Schott, and *Rhodospatha* Poepp. in colonizing various Neotropical forest areas can be attributed to the multiple adaptive strategies associated with different life forms (vascular epiphytes, hemiepiphytes, and nomadic climbers), variation in secondary growth, and high morphological plasticity of stems, petioles, and leaves in response to environmental conditions (Riordan et al., 2023).

Among Araceae species, the occurrence of *H. flexuosa*, assessed as Vulnerable in Brazil (MMA 2022), and *H. spruceana*, endemic species to the Brazilian Amazon, may be related to their reproductive and dispersal efficiency that suggest a high capacity for colonization across diverse environments, substrates, and phorophyte species (Irume et al., 2013). These two species face anthropogenic pressures, including their use as raw material for basket making, replacement of nails in house construction, fishing activities, and personal adornments (Vargas & Andel, 2005). The presence of *H. flexuosa* and *H. spruceana* in PEUT reinforces the role of protected areas as refuges for threatened and endemic taxa (Ferreira et al., 2022).

Orchidaceae stood out as the second most species-rich family in the study, result that differs from the global pattern recorded for epiphytic flora, which shows Orchidaceae as the richest family (Marcusso et al., 2022; Taylor et al., 2022).

In the Amazon, Orchidaceae was the most prevalent family in flooded forest (Quaresma et al., 2017), restinga (Quaresma & Jardim, 2014) and *campinarana* (Klein et al., 2022), but not in non-flooded forest (Irume et al., 2013). However, Orchidaceae did not present the greatest specific richness nor was it the most abundant family in any of the PEUT forest environments, which may be related to limitations in seed dispersal, the specificity of its ecological interactions (Quaresma et al., 2017), or the marked seasonality in Amazonian forest habitats (Marcusso et al., 2022).

Bromeliaceae also stood out in PEUT for its species richness, but mainly for the high abundance of certain taxa, especially *G. lingulata* and *Wallisia anceps*, the most abundant species in this study. *Aechmea* Ruiz & Pav. had the greatest richness in the family, with five species recorded in the non-flooded forest and four in the flooded forest. This pattern of high abundance of Bromeliaceae is widely reported in Amazonian tropical forests (Quaresma & Jardim, 2012), and may be related to the presence of species with distinct seed dispersal strategies (zoochory and anemochory), for example, the plumose characteristics of its seeds that favor efficient dispersal in forest environments (Bonnet & Queiroz, 2006).

Cyclanthaceae species, such as *A. guianensis* and *E. funifer*, can adapt to different Amazonian forest types (Leal et al., 2022). They exhibit different ecophysiological and morphological adaptations such as climbing roots, which are sclerified structures (ensuring mechanical protection) with ability to attach to tree substrates, and absorbing roots, which have a high potential for conducting water and nutrients resources (Wilder & Johansen, 1992), which may favor the establishment of these species in the contrasting Amazonian environments.

Gesneriaceae was represented by a few individuals of *Codonanthopsis crassifolia* and *Drymonia coccinea*, which have the potential for "resurrection", a rare mechanism in angiosperms that allows structural recovery of the individuals when the water availability becomes greater. Furthermore, they have trichomes, which help protect against light intensity because trichomes accelerate heat loss processes by reflecting light and increasing thermal conductivity at high temperatures. Thus, lower leaf temperatures minimize water loss through transpiration, constituting a strategy for optimizing water use in drier conditions (Legardón & García-Plazaola, 2023).

Although Clusiaceae was represented solely by *Clusia grandiflora* Splitg., the family also contributed to the composition and structure of epiphytic communities in both non-flooded and flooded environments. Clusiaceae species demonstrate high tolerance to adverse conditions, such as low water resource availability (Pietroluongo et al., 2024), and *C. grandiflora* is recognized for its facultative epiphytic life form and potential to colonize phorophytes, showing remarkable ability to occupy diverse substrates in forest canopies (Lüttge, 2006).

Leaf ecophysiological characteristics are especially relevant among epiphytic ferns, as observed in Aspleniaceae (Watkins Júnior et al., 2007) and Polypodiaceae. These groups exhibit adaptations that enhance desiccation tolerance, a common condition in tropical forest canopies (Prats & Brodersen, 2021). Ferns typically have morphological specializations in their leaves, such as indumentum, scales, trichomes, and waxes, that serve to mitigate environmental stress impacts, particularly those caused by excessive solar radiation (Mendonça et al., 2025).

High richness of epiphytes in tropical forest indicates levels of conservation and ideal environmental heterogeneity because the epiphytic flora is highly sensitive to anthropogenic disturbances (deforestation and forest fires) (Sampaio et al., 2015). Floristic and ecological studies in forest fragments are essential for the maintenance and restoration of native vegetation biodiversity (Furtado et al., 2024). However, the floristic composition of epiphytic communities remains poorly understood in conservation units (Miranda et al., 2025). Most studies on plant richness and abundance in tropical forests have primarily focused on the woody component of the vegetation, but the non-woody component is an important contributor to species diversity and to various intricate ecological processes in these ecosystems (Kreft et al., 2004). The first record of one genus and several species in PEUT and the occurrence of threatened species increasingly highlight the indispensable role of protected areas in conserving biodiversity, protecting natural environments, maintaining ecosystem services and supporting scientific research (Lucas et al., 2025).

More comprehensive knowledge of the epiphytic flora has become increasingly relevant for predicting plant responses to anthropogenic impacts and for informing conservation strategies in the Amazon. Further floristic knowledge of these plant group is indispensable for understanding the mechanisms of niche occupation and adaptation within the forest canopy across contrasting forest environments and consequently for the conservation of Amazonian forest habitats amid various anthropogenic threats.

5. FINAL CONSIDERATIONS

Our findings revealed distinct patterns of species abundance and richness that are likely influenced by environmental conditions, which have the forest types as proxy to environmental differences. Araceae stood out with the highest species richness while Bromeliaceae exhibited the greatest abundance, reflecting different ecological processes related to colonization, dispersal, and adaptive strategies. The higher richness of the epiphytic flora found in the non-flooded forest can be explained by the greater environmental stability that provide a wider array of substrates and microhabitats for colonization. The more stable conditions in non-flooded forests favor the diversification and specialization of epiphytic communities. Conversely, flooded forests are mainly influenced by seasonal flooding that may have a limiting effect on the richness of hemiepiphytes and nomadic climbers because their post-germination roots depend on reaching the soil to acquire nutrients.

The results of this study demonstrated the floristic diversity of epiphytes in different Amazonian vegetation types and the importance of natural environments for species conservation, given the increasing threats to ecosystem diversity. Floristic surveys targeting this functional group in strictly protected areas are essential to monitor the ecological integrity of tropical forests. There is therefore a need for more studies and conservation policies aimed at the epiphytic flora, especially when endemic and threatened species are involved.

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Josiney Farias de Araújo: Conceptualization (Lead), Formal analysis (Lead), Investigation (Lead), Methodology (Lead), Data curation (Lead), Writing - original draft (Equal), Writing - review & editing (Equal). Felipe Fajardo Villela Antolin Barberena: Conceptualization (Supporting), Formal analysis (Supporting), Investigation (Supporting), Methodology (Supporting), Data curation (Supporting), Supervision (Lead), Writing - original draft (Equal), Writing - review & editing (Equal).

DATA AVAILABILITY

All data that support the findings of this study are included within the article.

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