

Article

Floristic Composition and Mutualistic Interactions in Ant Gardens of a Tropical Rocky Outcrop Forest in Peru

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Abstract

Tropical rocky outcrops are considered biological islands with high endemism and challenging environmental conditions. Ant gardens (AGs) represent a sophisticated ant–plant mutualism that may facilitate plant establishment in these restrictive habitats. This study conducted a comprehensive floristic inventory of Morro de Calzada (MdC), a tropical rocky outcrop in the Peruvian Andean–Amazonian piedmont, and evaluated the relationship between plant composition and the presence of AGs across six sampling units (912–1413 m a.s.l.). A total of 310 vascular plant species (77 families, 180 genera) were recorded. Melastomataceae (37 spp.), Moraceae (18 spp.), and Rubiaceae (18 spp.) were the most diverse families. Species richness decreased with elevation, with sampling unit 2 (951–1050 m a.s.l.) showing the highest richness (170 spp.) and sampling unit 6 the lowest (52 spp.). AGs were concentrated in the sampling unit SU4, which hosted the highest phorophyte richness (12 spp.) and number of gardens (22); this diversity was possibly driven by canopy and host-tree structure. The ant *Azteca trailii* tococae was the primary builder, showing strong associations with *Meriania* aff. *microflora* and *Ficus citrifolia*. Epiphyte composition was dominated by *Anthurium gracile*, with *Epiphyllum phyllanthus* as a notable xerophytic element. AG dimensions correlated positively with host-tree DBH and height. High floristic turnover among sampling units (Jaccard dissimilarity 0.78–0.94) contrasted with structural homogeneity of gardens, indicating ecological plasticity of *Azteca trailii*. The study highlights the role of AGs as ecosystem engineers in rocky outcrops and emphasizes the conservation value of MdC, which harbors endemic and threatened species. Sampling unit SU4 emerges as a functional hotspot for ant–plant mutualisms.



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1. Introduction

Rocky outcrops are geological formations characterized by the exposure of bedrock that rises above the surrounding surface, resulting from differential erosion processes that occur over geological time scales [1,2]. These formations are distributed across a wide range of latitudes and climatic zones, where they act as “biological islands” within the landscape, especially in mountainous regions. Due to their high level of endemism and their crucial role as refuges for threatened species, they are considered critical habitats for conservation [3–5].

Ecologically, these systems represent environments subject to intense selective pressure, characterized by shallow substrates, limited nutrient availability, and severe water constraints [6,7]. However, such conditions make rocky outcrops ideal settings for studying adaptive mechanisms and evolutionary processes [8,9]. In this context, the establishment and persistence of plants often depend on complex biotic interactions capable of mitigating the physical and chemical limitations of the habitat [10].

In particular, symbiotic interactions play a decisive role in the organization and stability of plant communities on rocky outcrops, where severe environmental filtering limits the establishment of many species [2,11]. Cooperation between organisms not only reduces the impact of abiotic stress but also increases the capture, retention, and redistribution of resources at the microscale through nutrient recycling processes [12–15]. Within this context, plant–microorganism associations, such as mycorrhizae, optimize nutrient uptake from nutrient-poor substrates and maximize drought tolerance [16,17], while plant–animal interactions influence key processes such as seed dispersal, germination, and establishment in highly restrictive microhabitats [18–20]. These relationships not only create more favorable microenvironments but also modulate community structure and dynamics, contributing to ecological stability and resilience under extreme conditions [21,22].

Among the most characteristic mutualistic interactions in tropical ecosystems are ant gardens (AGs), complex three-dimensional structures built and maintained by tree-dwelling ants [23]. These structures result from mutualistic associations in which the nest architecture is formed through the accumulation of organic matter, mineral particles, and roots of epiphytic plants, primarily from the genera *Epidendrum*, *Philodendron*, *Codonanthopsis*, *Peperomia*, and *Anthurium*, among others [24–29]. The most frequently reported builder species belong to the genera *Azteca*, *Camponotus*, and *Crematogaster* [30–34]. In this plant–ant mutualistic relationship, plants provide structural support and root anchorage, while ants disperse seeds, regulate substrate pH, and enrich the matrix with nutrients derived from organic waste, thereby promoting plant growth in limiting environments [24,35,36].

Over the past years, research on ant gardens has seen a significant increase due to their recognized importance in the dynamics and functionality of tropical ecosystems [29,32,37–40]. These structures frequently develop in environments subject to anthropogenic disturbances, such as deforestation, habitat fragmentation, and canopy opening [29,30,41,42]. Due to their sensitivity to variations in resource availability and forest structure, ant gardens have been proposed as functional indicators of ecological disturbance [26,28,37].

In the San Martín region of Peru, el Morro de Calzada (MdC) is a unique tropical rock outcrop system located in the Andean–Amazonian Piedmont. Its geomorphological configuration generates a marked environmental gradient characterized by shallow soil depth, low water retention, high exposure to solar radiation, and limited nutrient availabil-

ity, factors that act as ecological filters on the composition and structure of the vegetation. However, despite its ecological and biogeographic importance, knowledge regarding the system's floristic diversity, and particularly regarding the specificity and functioning of mutualistic interactions associated with ant gardens, remains limited.

This study aimed to conduct a comprehensive floristic survey of Morro de Calzada, evaluating the relationship between plant composition and the presence of ant gardens, with the goal of providing empirical evidence to help understand the role of these interactions in the ecological organization and functioning of this unique tropical rock outcrop.

2. Materials and Methods

2.1. Study Area

El Morro de Calzada (MdC) is located in the Alto Mayo Valley, Moyobamba Province, San Martín Region, Perú ($6^{\circ}1'32.02''$ S, $77^{\circ}2'35.55''$ W) (Figure 1). This system consists of a rocky outcrop of tropical origin embedded within the valley's landscape, covering an area of approximately 1247.6 ha, where a mosaic of primary and secondary forests in various stages of succession coexists [43]. Due to its geomorphological prominence and ecological significance, it is locally recognized as the “guardian of the Alto Mayo” (Figure 2).

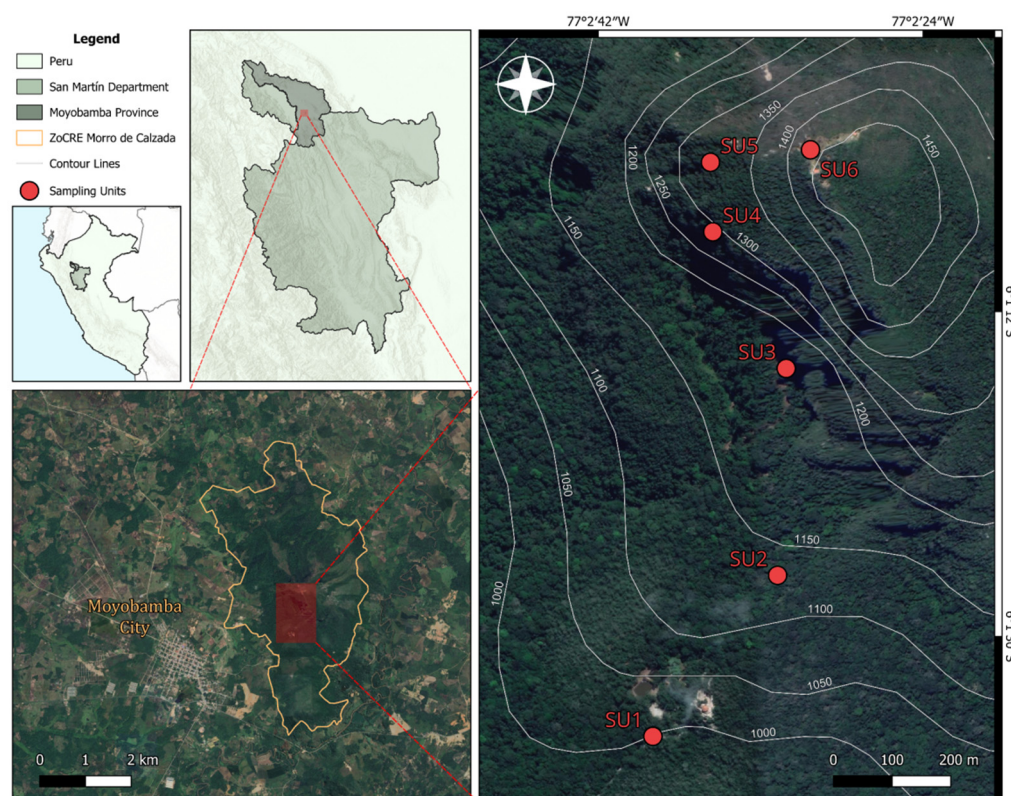


Figure 1. Location of Morro de Calzada in the San Martín Department and the location of the plots along the altitudinal gradient.

The geomorphological configuration of the system creates a marked altitudinal gradient ranging from 912 m above sea level to 1413 m above sea level, resulting in high environmental and microclimatic heterogeneity. In this context, factors such as shallow soil depth, limited water-holding capacity, high exposure to solar radiation, and reduced nutrient availability act as ecological filters that shape the structure and composition of the vegetation [44,45].

The forest's physiognomy is characterized by trees reaching up to 20 m in height that form a partially open canopy, a condition that favors the presence of ant gardens.

This configuration reflects a set of functional adaptations to the restrictive environmental conditions typical of this tropical system.

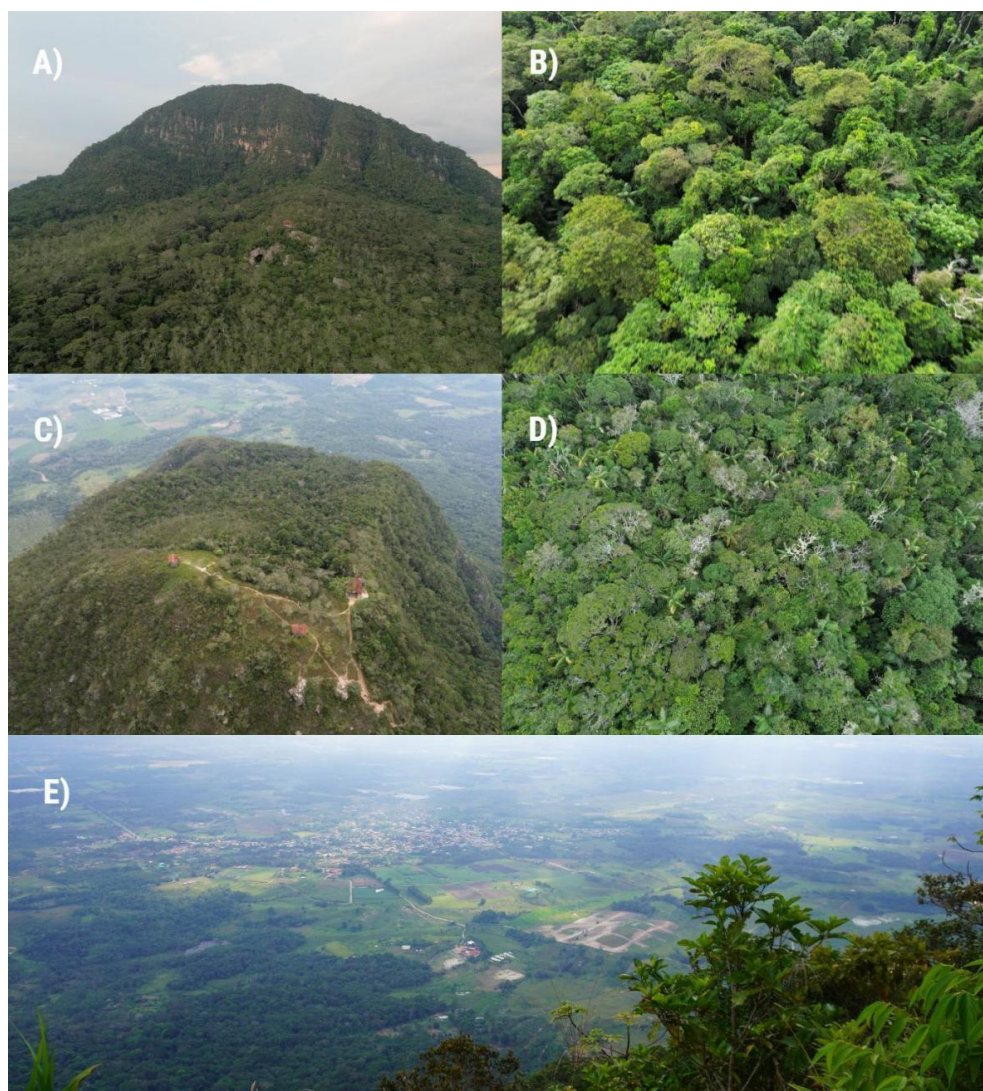


Figure 2. (A) View of Morro de Calzada, “Guardian of Alto Mayo,” from the basal area. (B) Vegetation corresponding to the lower sampling unit (SU1). (C) View of the summit of Morro de Calzada (SU6). (D) Intermediate sampling unit (SU4) with an emergent canopy dominated by palm trees. (E) Panoramic view of the Calzada district from the top of the hill. All images were obtained through manual flights using a DJI Mavic 3 drone.

The climate of the area has an average annual temperature of 22.8 °C, with lows of 10.1 °C and highs approaching 30 °C. Average annual precipitation is approximately 1512 mm, with monthly rainfall below 100 mm between May and August [46]. The rainfall pattern is highly seasonal, with a rainy season that begins in October and lasts through March, reaching its peak between February and March.

2.2. Sampling Method

Fieldwork was carried out between August 2025 and March 2026, a period selected with the aim of maximizing the recording of plant species in their reproductive stages (flowering and fruiting). To assess variation in plant diversity along the elevational gradient, six altitudinal sampling bands were established between 912 and 1413 m a.s.l. These bands are treated throughout as sampling units distributed along a continuous, multifactorial

gradient (elevation, slope aspect, and canopy structure) rather than as discrete ecological entities; plots within each band were not all located on the same slope aspect (Figure 1).

In each sampling unit, four 10×50 m (500 m²) plots were delineated, distributed strategically based on accessibility and slope conditions. A total of 24 plots were evaluated, covering a cumulative area of 1.2 ha. Sampling followed the method proposed by Gentry [47], incorporating subsequent modifications tailored to heterogeneous tropical ecosystems [48,49].

All trees, shrubs, and palms with a diameter at breast height (DBH) of ≥ 1 cm and a height greater than 1 m were recorded along the plots. In addition, systematic surveys and continuous observations were conducted outside the sampling units to record herbaceous species and lianas, thereby expanding the coverage of the floristic inventory of Morro de Calzada throughout the study period.

For phorophytes that hosted ant gardens (AGs), a standardized protocol based on Quinteros et al. [29] was applied. This protocol included photographing the phorophyte and associated epiphytes, as well as measuring the host's dasometric variables. Additionally, the dimensions of the AGs were quantified, considering length, width, and height above the ground. Finally, samples of the associated ants were collected for subsequent taxonomic identification. Botanical nomenclature was standardized using the W3-Tropicos platform.

The conservation status of the recorded species was determined in accordance with the Red List criteria and the official classification of Peru's threatened flora (Supreme Decree No. 043–2006–AG).

The ants associated with the AGs were identified at the Department of Entomology of the Natural History Museum at National University of San Marcos, using specialized taxonomic keys. Finally, the specimens were deposited at the Laboratory of Tropical Ecology and Data Analysis at National University of San Marcos.

2.3. Data Analysis

Statistical analyses and visualizations were performed in RStudio using R version 4.3.0 [50]. The methods employed comprised three levels of complexity. At the descriptive statistics level, absolute and relative frequencies (abundance, richness, and dominance), as well as measures of central tendency and dispersion, were evaluated. These results were represented using bar charts, boxplots, and lollipop plots. Ecological diversity indices, including Shannon (H') and Simpson ($1 - D$), were calculated through vectorized operations in R. In addition, the Jaccard dissimilarity index ($1 - J$) was applied for pairwise comparisons of floristic composition based on presence/absence matrices. Association analyses were conducted using Spearman's rank correlation to evaluate relationships between continuous structural variables (DBH, host height, and ant-garden dimensions), as well as to test the covariation of mutualism density against structural arboreal metrics (absolute tree abundance and Shannon diversity) across sampling units, evaluated with the `cor.test()` function. Hierarchical clustering using the UPGMA method (Unweighted Pair Group Method with Arithmetic Mean) [51] was implemented on Jaccard dissimilarity matrices to identify similarity patterns among sampling units. Tripartite mutualistic interaction frequencies (ant–phorophyte–epiphyte) were quantified and modeled as alluvial flow diagrams. The main R packages used were `vegan` version 2.6-4 [52] for dissimilarity indices and community matrices; `ggplot2` v3.4.4 [53] for core visualizations; `pheatmap` v1.0.12 [54] for heatmaps; `dendextend` v1.17.1 [55] for dendrogram extraction and structural integration with distance matrices; `dplyr` v1.1.4 [56] for data manipulation and taxonomic standardization; `readxl` v1.4.3 for data ingestion [57]; `ggcorrplot` v0.1.4 [58] for correlation matrices; `ggalluvial` v0.12.5 [59] for tripartite network visualization; and `patchwork` v1.2.0 [60] for multi-panel figure assembly.

3. Results

3.1. Floristic Inventory

A total of 310 species were recorded, comprising 33 orders, 77 families, and 180 genera. Dicotyledons accounted for 86.6% of the taxa, with 269 species grouped into 64 families and 151 genera; monocotyledons accounted for 11.9%, with 37 species distributed across 9 families and 25 genera; and the remaining 1.3% corresponded to pteridophytes (Pteridophyta), with 4 species, 4 families, and 4 genera.

Melastomataceae was the most diverse family, with 37 recorded species. It was followed by Moraceae and Rubiaceae, both with 18 species. Fabaceae recorded 15 species, followed by Asteraceae with 14, Clusiaceae with 12, and finally Lauraceae and Euphorbiaceae, with 10 species each, making them some of the most representative families (Appendix A). Figures 3 and 4 illustrate some of the species recorded in the study area.

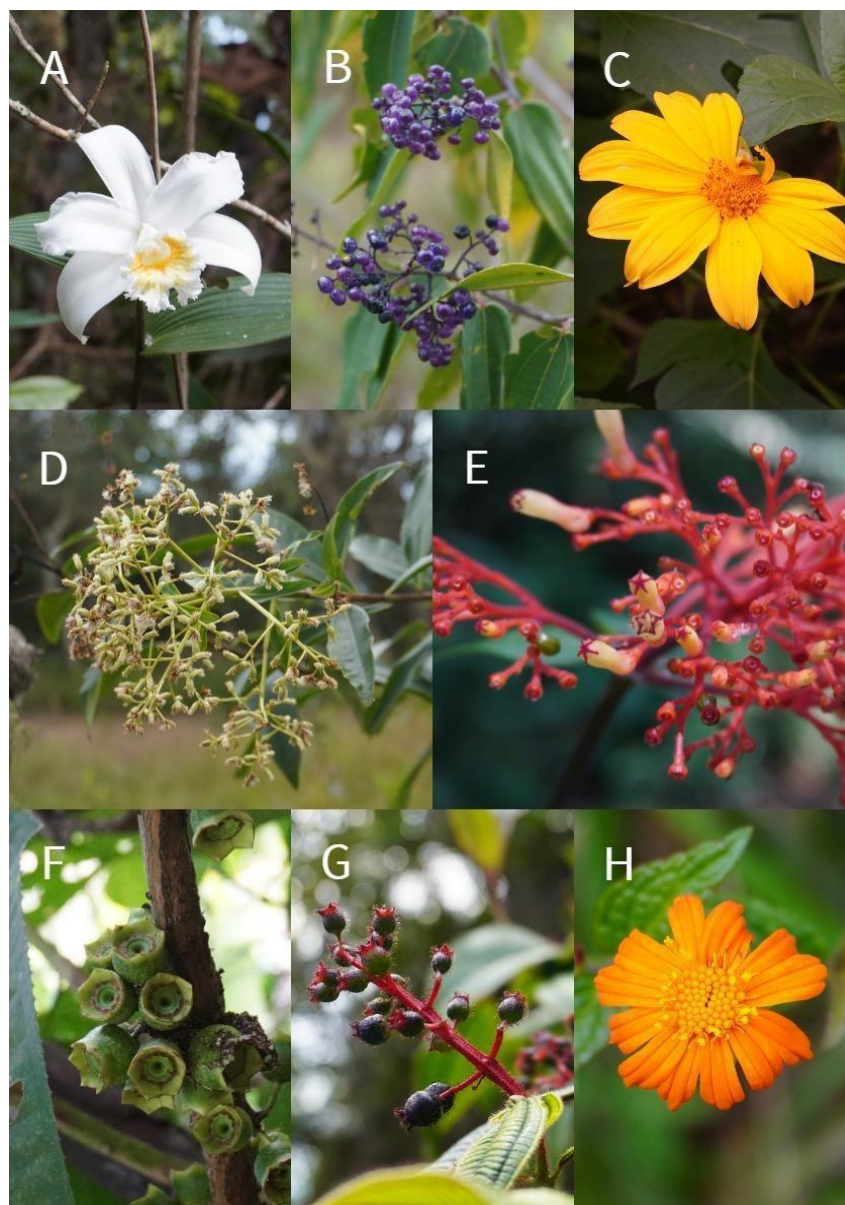


Figure 3. Selected species from Morro de Calzada. (A). *Sobralia violacea* Linden ex Lindl. (B). *Miconia prasina* (Sw.) DC; (C). *Lycoseris trinervis* (D. Don) S.F. Blake; (D). *Hebeclinium macrophyllum* (L.) DC.; (E). *Palicourea guianensis* Aubl.; (F). *Bellucia pentamera* Naudin; (G). *Miconia tocoa* Michelang.; (H). *Tithonia rotundifolia* (Mill.) S.F. Blake.



Figure 4. Selected species from Morro de Calzada. (A). *Pitcairnia paniculata* (Ruiz & Pav.) Ruiz & Pav. (B). *Byrsonima spicata* (Cav.) DC.; (C). *Desmoscelis villosa* (Aubl.) Naudin; (D). *Passiflora vitifolia* Kunth; (E). *Caryocar glabrum* (Aubl.) Pers.; (F). *Costus guanaiensis* Rusby; (G). *Sabicea cana* Hook. f.; (H). *Palicourea tomentosa* (Aubl.) Borhidi.

At the genus level, *Miconia* stood out as the most diverse genus, with 28 species, followed by *Ficus* and *Clusia*, both with eight species.

Regarding growth form, 49.52% of the species corresponded to trees, 21.86% to shrubs, and 18.33% to herbs, of which 6.75% were epiphytes. Vines represented 6.43%, whereas palms accounted for 0.64% of the total.

Thirteen families were present across all evaluated sampling unit: Araceae, Arecaceae, Asteraceae, Cactaceae, Clusiaceae, Cyatheaceae, Cyperaceae, Fabaceae, Gesneriaceae, Melastomataceae, Orchidaceae, Rubiaceae, and Urticaceae. Similarly, the genera *Anthurium*, *Clusia*, *Codonanthopsis*, *Cyperus*, *Desmoscelis*, *Epidendrum*, *Epiphyllum*, *Graffenrieda*, *Miconia*, and *Wettinia* were recorded across all sampling units.

A gradual decrease in species number was observed with increasing elevation in Morro de Calzada (Figure 5). Sampling unit 1 (<950 m a.s.l.) recorded 42 species, whereas Sampling unit 2 (951–1050 m a.s.l.) showed the highest richness, with 52 species. Subsequently, Sampling units 3 and 4 recorded 27 and 30 species, respectively, while richness declined to 23 and 21 species in Sampling units 5 and 6.

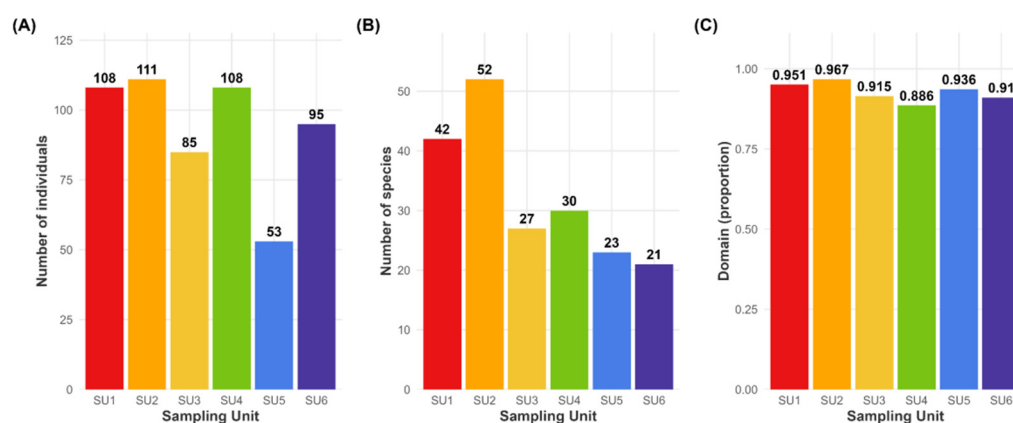


Figure 5. (A) Species abundance by sampling unit. (B) Species richness by sampling unit. (C) Species domain by sampling unit.

3.2. Variation in Vegetation Structure Among Sampling Bands

Three ecological indicators were compared across six sampling units (SU1–SU6): abundance, richness, and dominance. Sampling unit SU2 showed the highest abundance and species richness, suggesting high diversity and a large number of individuals. In contrast, SU5 and SU6 showed low richness values, indicating a lower variety of species (Figure 5). Regarding dominance, SU4 and SU3 exhibited the highest values, indicating that a few species accounted for a large proportion of individuals within these sampling units. Conversely, SU2 showed the lowest dominance, reflecting greater evenness in species distribution. Overall, the results indicate that plant abundance, richness, and dominance vary considerably among sampling bands. Because these bands combine differences in elevation, slope aspect, and canopy openness (Figure 1), this variation should be interpreted as heterogeneity along the sampled gradient rather than as evidence of discrete, internally homogeneous ecological units; ordination-based confirmation was beyond the scope of the present dataset and is identified as a priority for future analyses.

Figure 6 displays the ecological diversity indices across the gradient. The Shannon (H') and Simpson ($1 - D$) indices showed the highest values in SU2, reflecting greater diversity and evenness in the distribution of individuals. In contrast, SU4 and SU6 showed the lowest values, indicating less diverse communities subjected to greater dominance by select species. Overall, these results suggest that ecological diversity varies markedly among sampling units, partitioning the environment into balanced zones and restricted floristic assemblages.

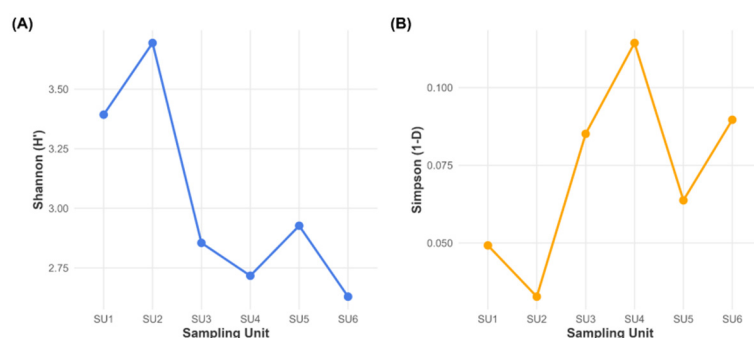


Figure 6. Diversity indices across the six study sampling units: (A) Shannon (H') and (B) Simpson ($1 - D$).

The heat map (Figure 7) shows how species richness varies among botanical families across the six sampling units. The marginal classification trees display hierarchical clustering, grouping sampling units based on their shared floristic profiles and aggregating botanical families that exhibit similar distribution patterns across the sampling units. Families such as Melastomataceae, Moraceae, Lauraceae, and Clusiaceae showed the highest richness values, represented by more intense shades, indicating their dominant role in the floristic composition. In contrast, families such as Cannabaceae, Caryocaraceae, and Clethraceae showed low values, represented by lighter shades, indicating lower representation. The distribution was not homogeneous: some sampling units concentrated greater diversity within certain families, whereas others showed reduced or no presence. Overall, the heat map makes it possible to identify patterns of richness, concentration and dispersion, highlighting which families were more diverse and in which sampling unit they were most strongly represented. This provides key information for understanding the structure and heterogeneity of the plant community.

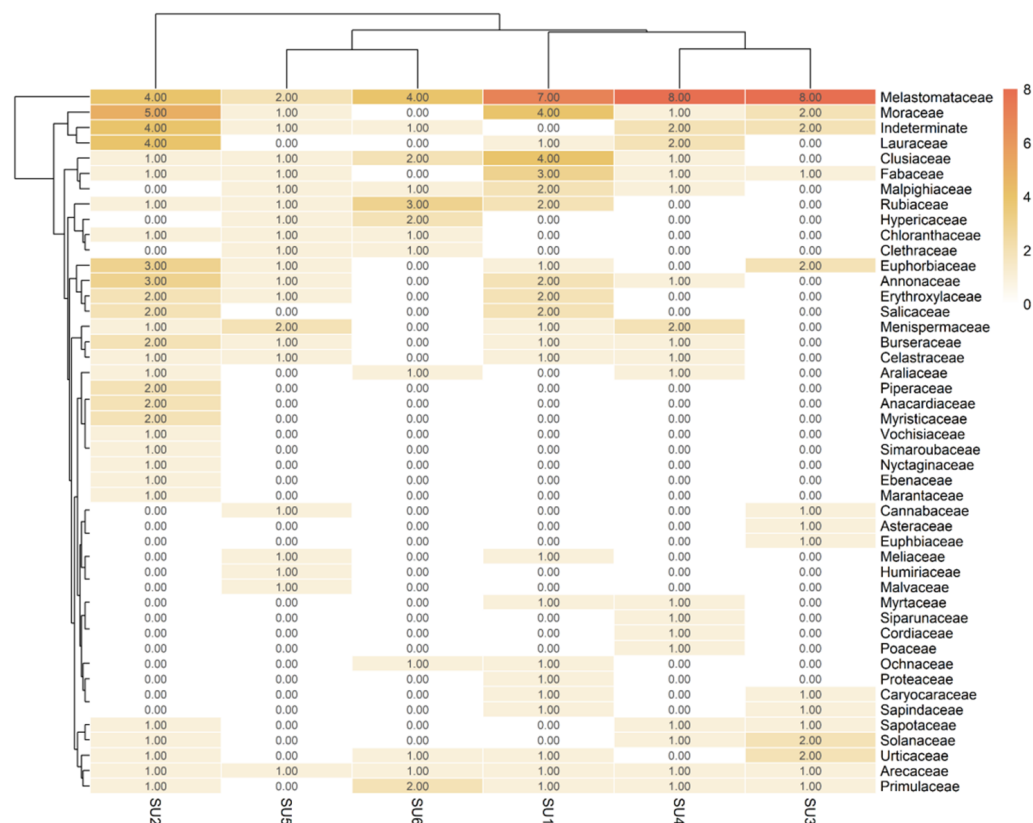


Figure 7. Number of recorded species distribution by botanical families across the six sampling units.

Jaccard dissimilarity analysis evaluated the degree of difference in species composition among the six sampling units (SU1–SU6) (Figure 8). Pairwise values were uniformly high, ranging from 0.78 to 0.94, indicating that the sampling unit shared few species and exhibited markedly differentiated floristic communities. The highest dissimilarity was observed between SU2 and SU4/SU6 (0.94), whereas the lowest values were recorded between SU5 and SU6 (0.78), indicating a closer floristic affinity at higher elevations. The UPGMA hierarchical clustering (Figure 8B) structurally confirms these relationships, segregating the sampling unit into distinct compositional clades where SU5 and SU6 form a terminal node, while SU2 remains highly divergent. Overall, the matrix and resulting dendrogram reflect pronounced spatial turnover and structural diversity within the system.

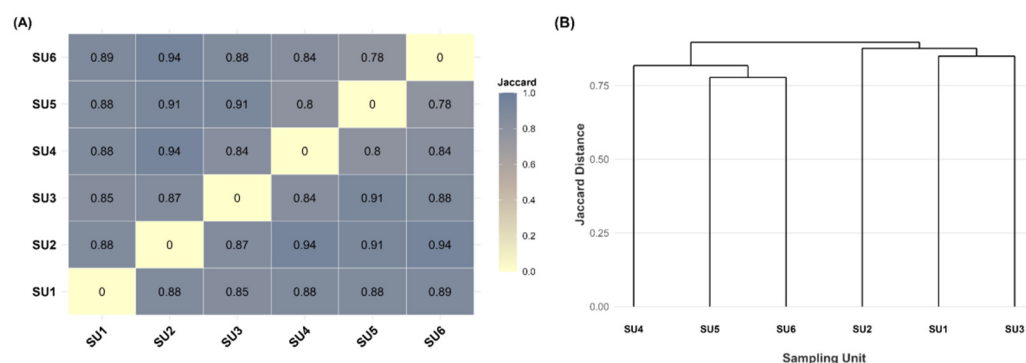


Figure 8. Floristic turnover among sampling units. (A) Pairwise Jaccard dissimilarity matrix. (B) UPGMA hierarchical clustering dendrogram illustrating structural similarities in species composition.

3.3. Threatened Flora and Conservation Status

Of the 310 taxa recorded in the study area, the vast majority corresponded to species confirmed as native (307), whereas three taxa were of non-native origin. Regarding conservation status according to the IUCN Red List and the Peruvian Supreme Decree (DS), 198 taxa were categorized globally as Least Concern (LC), indicating a flora that is predominantly stable in terms of international threat status. However, 104 taxa lacked assessment in at least one of the two reference systems consulted, representing a significant knowledge gap regarding the conservation status of the local flora. One taxon, *Monstera dubia* (Araceae), was classified as Data Deficient (DD) by the IUCN, highlighting the need for additional population studies for this group.

A relevant subset of the inventory included taxa with some recognized level of threat at the global or national scale. According to the IUCN, *Myrcia egensis* (Myrtaceae) is listed as Endangered (EN), whereas *Myrcia bracteata* (Myrtaceae) and *Justicia comata* (Acanthaceae) are categorized as Vulnerable (VU). Under the Peruvian DS framework, additional taxa were also classified as VU: *Cosmibuena grandiflora* (Rubiaceae), *Couratari guianensis* (Lecythidaceae), *Desmodium subsericeum* (Fabaceae), and *Epiphyllum phyllanthus* (Cactaceae). The Near Threatened (NT) category included *Wettinia maynensis* (Arecaceae), *Xylopia nitida* (Annonaceae), and *Baccharis genistelloides* (Asteraceae), the latter recorded exclusively under the DS system. Additionally, three taxa were confirmed as endemic to Peru: *Miconia manserichensis* (Melastomataceae), *Myrsine youngii* (Primulaceae), and *Sterculia peruviana* (Malvaceae). This highlights the biogeographic value of the study area and the importance of its conservation in the face of anthropogenic pressures.

3.4. Phorophyte and Ant Gardens

The results showed marked heterogeneity among the six sampling units. The sampling unit designated SU4 concentrated the highest richness of phorophyte species (12) and the highest number of ant gardens (22) (Figure 9). A positive association between phorophyte

richness and ant-garden number is suggested by this plot-level pattern and is examined quantitatively below; we note that SU4 plots also correspond to a distinct slope aspect and denser canopy relative to other sampling units, which may co-vary with this result. In contrast, SU3 showed minimum values for both variables, reflecting low diversity and limited construction activity. Sampling units SU1, SU2, SU5, and SU6 exhibited intermediate values, with some correspondence between phorophyte richness and the number of ant gardens. Overall, the data indicate a close spatial association between phorophyte richness and the proliferation of ant gardens, highlighting sampling unit SU4 as a sector with high mutualistic activity within the studied gradient. Figure 10 illustrates some ant gardens recorded in the study area.

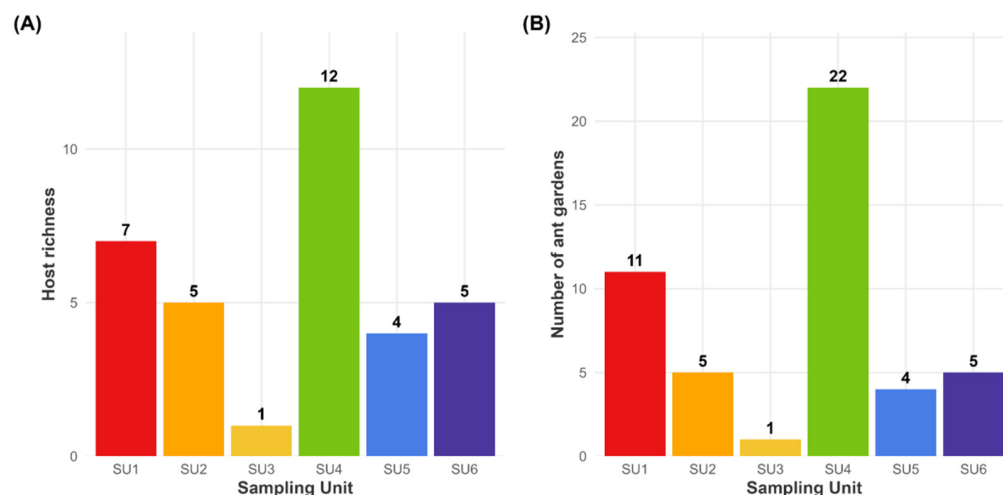


Figure 9. (A) Host plant richness and (B) distribution of ant gardens across ecological sampling units.



Figure 10. (A–C) Typical ant gardens found in Morro de Calzada.

To quantitatively assess the drivers of mutualism density at the sampling unit level, ant garden frequency was tested against structural arboreal metrics (Figure 11). Spearman correlation analysis revealed a positive, albeit statistically non-significant, trend between total arboreal abundance and the number of ant gardens ($\rho = 0.676$, $p = 0.14$). Conversely,

overall arboreal diversity (Shannon H') showed a complete lack of correlation with nest density ($\rho = -0.058$, $p = 0.913$).

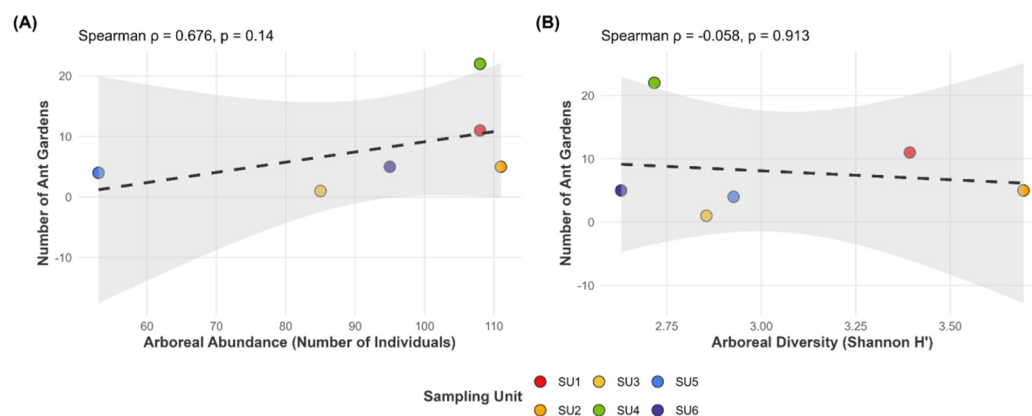


Figure 11. Covariation between structural arboreal metrics and mutualism density across sampling units. (A) Arboreal abundance (total individuals) vs. number of ant gardens. (B) Arboreal diversity (Shannon H') vs. number of ant gardens.

Most ant gardens were associated with *Azteca trailii tocoae*, particularly on host plants such as *Meriania* aff. *microflora* (8 ant gardens) and *Ficus citrifolia* (5 ant gardens). In contrast, *Camponotus cuneidorsus* was recorded in only one ant garden associated with *Aspidosperma excelsum*, reflecting a much more restricted distribution. Sampling unit SU4 recorded the highest epiphyte richness (16 species), followed by SU1 with 7 species and sampling unit SU5 and SU6 with 6 species each, respectively (Figure 12A). SU3 showed the lowest diversity, with only 2 species. This pattern reveals marked vertical heterogeneity in the distribution of epiphytes. In addition, some species, such as *Anthurium gracile*, reached 9 records, indicating their dominant role in ant gardens. Others, such as *Epiphyllum phyllanthus* and *Epidendrum* sp., occurred with intermediate frequencies, whereas most species were recorded only once (Figure 12B).

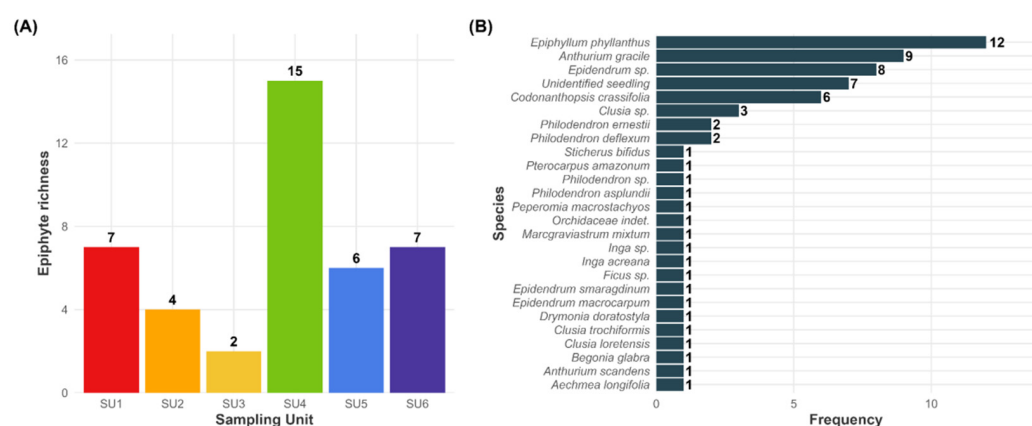


Figure 12. (A) Epiphyte richness and (B) frequency across ecological sampling unit.

Figure 13 shows marked variability in the dimensions of ant gardens and in the characteristics of phorophytes across the six sampling units. The length and width of ant gardens showed notable differences, with some sampling units displaying extreme values and greater dispersion. Similarly, diameter at breast height (DBH) and host plant height reflected structural contrasts, highlighting sampling units with more robust trees compared with others characterized by smaller individuals. The presence of outliers indicates heterogeneity in local conditions.

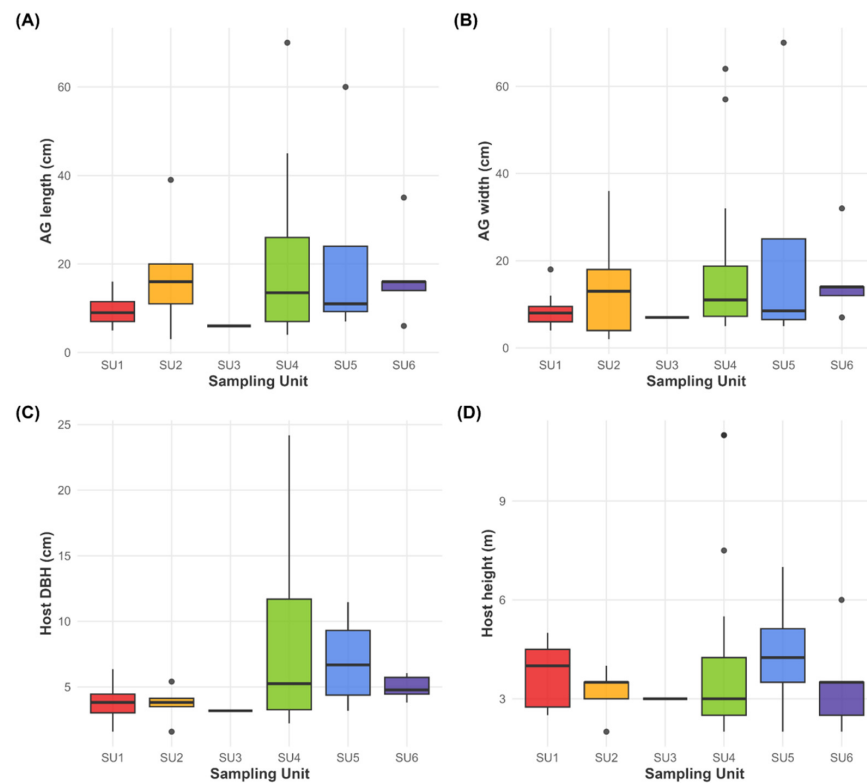


Figure 13. Structural variation of ant gardens and host trees across ecological sampling units: (A) Ant garden length (cm); (B) Ant garden width (cm); (C) Host tree diameter at breast height (DBH, cm); (D) Host tree height (m).

Linear regression models (Figure 14) evaluated the allometric structural variation of ant gardens and host trees across ecological sampling units: (A) Ant garden length (cm); (B) Ant garden width (cm); (C) Host tree diameter at breast height (DBH, cm); (D) Host tree height (m). Allometric scaling between ant garden dimensions and the structural traits of phorophytes. The models revealed a direct positive fit between ant garden width and length, indicating proportional structural growth. Furthermore, predictive modeling confirmed positive trends between mutualistic nest development and host architecture. Specifically, ant garden length scaled positively with phorophyte DBH, while the insertion height of the ant gardens scaled with total phorophyte height. The corresponding coefficients of determination (R^2) confirm that more robust host metrics act as reliable predictors for the developmental capacity and vertical placement of mature ant gardens.

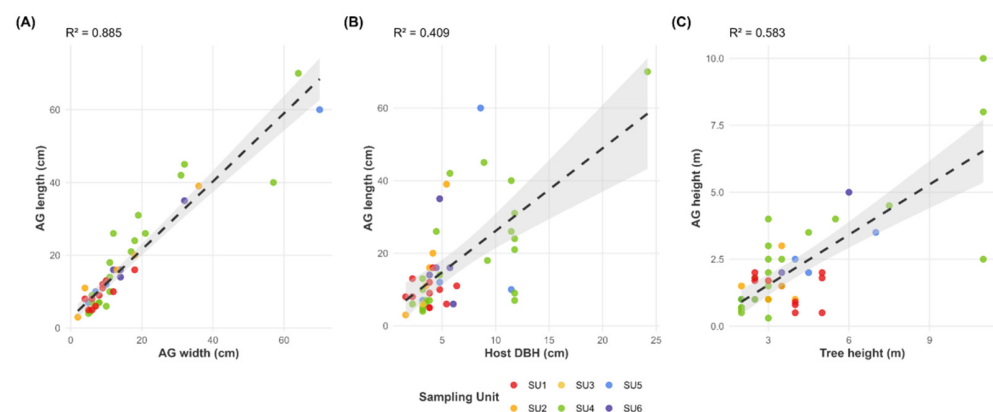


Figure 14. Scaling relationships between ant garden and host-tree dimensions, displaying linear fits and coefficient of determination (R^2) values: (A) Ant garden width vs. length; (B) Host DBH vs. Ant garden length; (C) Tree height vs. Ant garden height.

Azteca trailii tococae (Figure 15) showed strong associations with the genera *Miconia* (9) and *Meriania* (8), as well as moderate associations with *Ficus* and *Desmoscelis*. In contrast, *Camponotus cuneidorsus* showed few or no associations, being limited to very one occasional record.

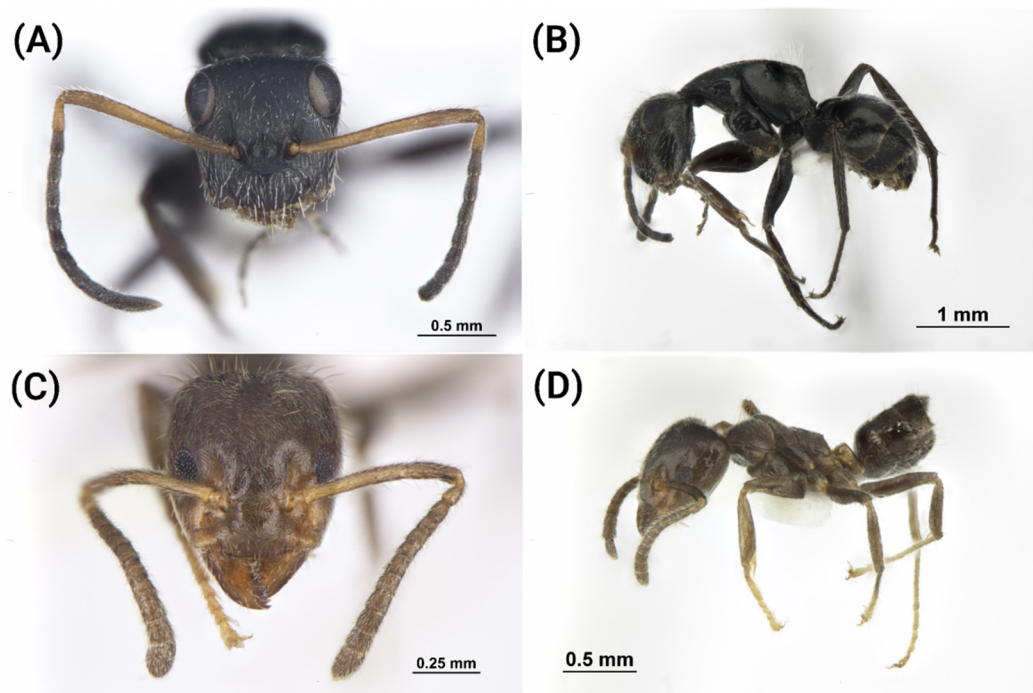


Figure 15. Ants species: (A,B) *Camponotus cuneidorsus* Emery, 1920 and (C,D) *Azteca trailii tococae* Forel, 1904.

Jaccard dissimilarity analysis for phorophytes (Figure 16) showed high pairwise values among most sampling units, ranging from 0.80 to 1.00, indicating marked spatial turnover in host species composition. Sampling unit SU4 showed moderate dissimilarity with SU2 and SU5, with values of 0.87 and 0.86, respectively. In contrast, SU1, SU3, and SU6 exhibited values approximating 1.00 when compared with other sampling units, reflecting highly differentiated species compositions. The parallel UPGMA clustering (Figure 15B) hierarchically structures these dissimilarities, visually segregating the host communities and confirming the high turnover rate across the gradient. Overall, these results indicate that host distribution varied significantly among sampling units, reinforcing ecological heterogeneity and highlighting the importance of considering spatial stratification in the analysis of ant garden diversity.

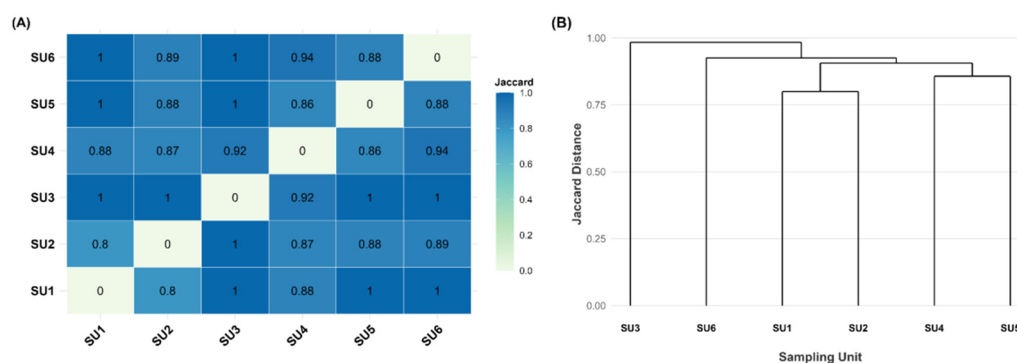


Figure 16. Host species turnover across ecological sampling units. (A) Pairwise Jaccard dissimilarity matrix. (B) UPGMA hierarchical clustering dendrogram of host species composition.

The tripartite network analysis illustrated the structural assembly of the mutualistic associations among ant species, phorophyte hosts, and epiphytes (Figure 17). *Azteca trailii tococae* operated as the dominant central node, forming associations with multiple host trees, most frequently *Meriania* aff. *microflora*, *Ficus citrifolia*, and species within the genus *Miconia*. These primary phorophytes subsequently hosted diverse epiphytic assemblages. Within the epiphyte level, *Anthurium gracile* and *Epiphyllum phyllanthus* registered the highest interaction frequencies across the network, connecting with multiple host species. In contrast, the network flow for *Camponotus cuneidorsus* was highly restricted.

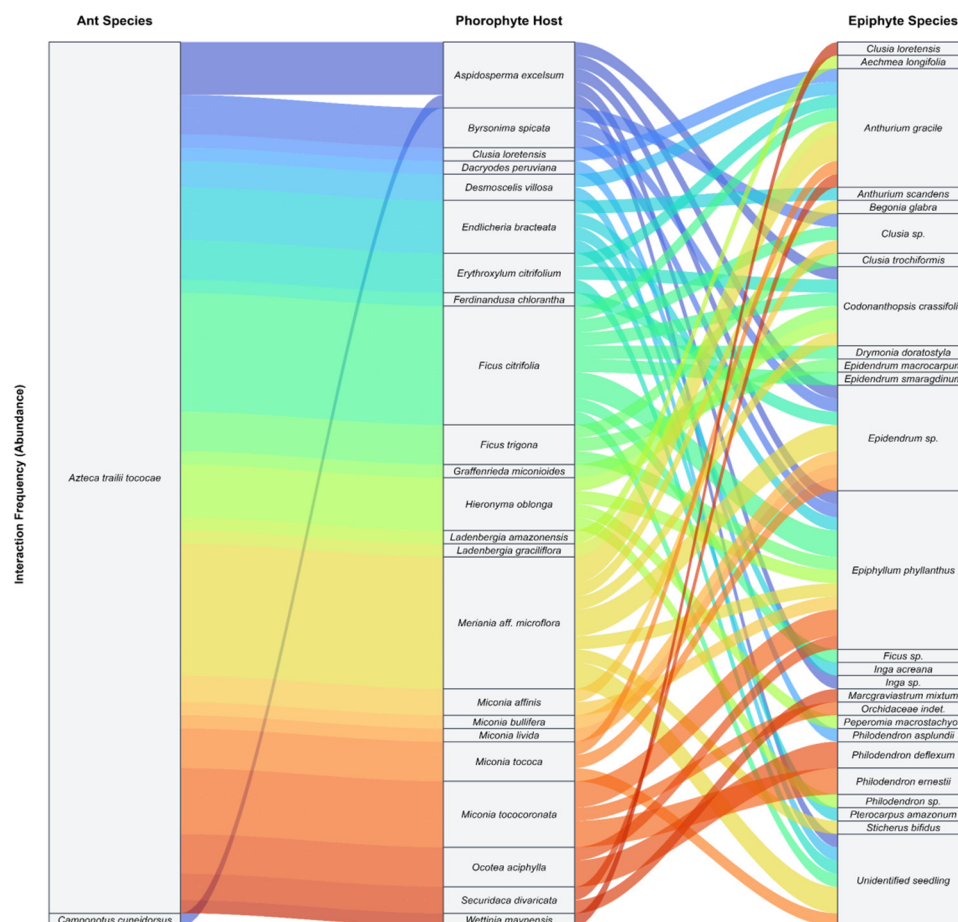


Figure 17. Tripartite mutualistic network showing interactions among ant species, phorophyte hosts, and epiphytes.

4. Discussion

4.1. Floristic Composition and Elevational Gradients

Species richness did not decline monotonically along the elevational gradient: it peaked at 170 species in the SU2 before declining to 52 species in SU6. This non-monotonic pattern is broadly consistent with elevational environmental filtering documented in other tropical gradients, although in the present dataset elevation co-varies with slope aspect and canopy openness across sampling units, so the relative contribution of each factor cannot be isolated with the current design. These filters include progressive temperature reductions, heightened wind exposure, and severe edaphic constraints characteristic of higher elevations [44,45,61]. The reduced taxonomic richness observed in the SU1 sampling unit relative to SU2 may reflect localized anthropogenic edge effects and habitat fragmentation reported elsewhere for similar systems [41], although this study did not directly quantify disturbance history or fragmentation at SU1, and this explanation should be treated as a hypothesis rather than an established cause. Despite these altitudinal and anthropogenic

pressures, the persistence of a resilient, generalist floristic backbone, principally comprising Araceae, Orchidaceae, and robust Melastomataceae, acts as a stabilizing matrix across the entire gradient, exhibiting the high environmental tolerance necessary to persist across fluctuating abiotic zones [6].

The atypical dominance of Asteraceae within this system diverges sharply from standard closed-canopy tropical forest models, reflecting the specific geomorphological constraints of the rocky outcrop. This dominance is facilitated by high incident irradiance, extreme canopy openness, and characteristically shallow substrates [62]. Within this extreme abiotic context, the localized presence of *Baccharis genistelloides* in the sampling unit (SU5, SU6) represents the establishment of an extra-local high-Andean element substantially outside its standard altitudinal and latitudinal range [63,64]. The severe environmental filters at the summit generate functionally analogous ecotones that mimic higher-elevation puna transitions. This environmental severity effectively suppresses the establishment of typical lowland mesophytic competitors, thereby enabling stress-tolerant taxa, which are otherwise competitively excluded in dense, closed-canopy forests, to successfully colonize the outcrop [9,44].

Operating under these distinct geomorphological and climatic dynamics, the Morro de Calzada system functions as a critical biological refuge. It harbors highly restricted endemic flora, including *Miconia manserichensis*, *Myrsine youngii*, and *Sterculia peruviana*, alongside multiple globally threatened taxa [2]. However, the high proportion of Data Deficient (DD) and unassessed taxa cataloged in the inventory underscores significant, ongoing knowledge gaps regarding the conservation viability of this isolated flora. Ultimately, this pronounced floristic heterogeneity and the resulting structural complexity establish the foundational environmental matrix. Ultimately, this pronounced floristic heterogeneity and the resulting structural complexity establish the environmental matrix that determines the spatial availability of suitable habitats, defines the structural constraints, and governs the distribution of specialized mutualistic niches among sampling units, thereby conditioning the establishment of ant-garden symbioses [26,30].

4.2. Spatial Stratification, Phorophyte Selection, and Allometric Scaling of Ant Gardens

The concentration of ant-plant mutualisms in the plots grouped as SU4, characterized by peak phorophyte richness (12 species) and ant-garden density (22 nests), identifies this portion of the sampled gradient as the sector with the greatest recorded ant-garden activity in the Morro de Calzada system. We refrain from labeling SU4 an ‘ecological core’ or ‘altitudinal belt’ given that its plots differ from other sampling units in slope aspect and canopy openness in addition to elevation (Figure 1); disentangling these co-varying factors will require plot-level ordination analyses. This distribution is driven by microenvironmental convergence, where stable atmospheric humidity and a partially open canopy maximize the light penetration essential for epiphyte establishment [30]. The proliferation of ant gardens relies strictly on arboreal structural heterogeneity and the availability of medium-to-large robust trees, triggering a facilitation cascade where tree diversity dictates the volumetric colonization space available for keystone ants [29,65]. Consequently, SU4 functions as a critical refuge patch within the restrictive rocky outcrop landscape, mitigating severe abiotic stress and enabling the assembly of complex symbiotic networks [6,7].

The correlation analyses suggest that forest structural attributes are more influential than taxonomic diversity in determining ant-garden occurrence. Although the positive association between arboreal abundance and ant-garden density was not statistically significant, the relatively high correlation coefficient ($\rho = 0.676$) indicates a biologically meaningful trend that may have been constrained by the low number of sampling units. By contrast,

the absence of any relationship between Shannon diversity and nest density indicates that increasing floristic diversity alone does not necessarily increase the availability of suitable nesting sites. Instead, ant-garden establishment appears to depend primarily on structural characteristics of the forest, including the abundance of mature trees capable of providing stable branch architecture and appropriate microclimatic conditions for colony persistence. This interpretation is consistent with previous studies demonstrating that arboreal ants preferentially establish gardens where host architecture and canopy structure maximize nest stability and epiphyte development, regardless of overall plant diversity [26,29,30,42]. Therefore, structural complexity, rather than species diversity per se, appears to be the principal driver of mutualistic nest distribution in the Morro de Calzada rocky outcrop.

Within this optimal sampling unit, host selection patterns show deviation from gross allometric availability. The disproportionate occurrence of ant gardens on *Meriania* aff. *microflora* and *Ficus citrifolia* relative to their floristic abundance suggests potential preferential colonization, but the mechanisms driving this pattern remain uncertain. Potential mechanisms could include microenvironmental and biochemical factors or specific functional traits in these hosts, though direct evidence of founding queen behavior or assessment processes was not collected in this study [66,67].

Among the host trees colonized by *Azteca trailii tococae*, several belonged to Melastomataceae and possessed architectural characteristics previously associated with ant gardens, including horizontal branching and the presence of foliar domatia [42,68]. Although these traits have been proposed in previous studies as potentially favoring nest establishment, the present study did not directly evaluate whether they influenced host selection by founding queens. Therefore, the observed associations should be interpreted as consistent with published ecological hypotheses rather than as evidence of an active selection mechanism. Comparative analyses between colonized and non-colonized host trees would be required to test this hypothesis. Likewise, trophobiotic interactions involving scale insects and the resulting nutrient dynamics have been documented in Azteca ant gardens [66], but these processes were not quantified in the present study and thus remain plausible explanations rather than direct inferences from our dataset.

Previous studies have described mature ant gardens as localized ecosystem engineers capable of enhancing nutrient accumulation and moisture retention [35,69]. This volumetric expansion demands strict biomechanical interdependence, necessitating proportional increases in epiphyte alpha diversity to provide complex root networks that function as biological rebar, stabilizing the masticated plant-fiber carton against precipitation [28,70]. Ant garden length was positively correlated with host diameter at breast height (DBH) (Figure 13B), indicating that larger host trees tended to support larger ant gardens. This pattern is consistent with the hypothesis that larger trees provide greater structural space for garden establishment and development [29,42]. Direct measurements of mechanical stress on garden-bearing branches, comparative analysis of branch failure rates, or experiments manipulating branch diameter would be needed to test whether ant gardens actively maximize anchorage interface. Furthermore, the vertical positioning of gardens correlates strongly with total tree height, reflecting a selective placement strategy that optimizes insolation for cultivated epiphytes while mitigating nest inundation risks [30,71]. Ant gardens exhibited an isometric relationship between nest length and width (Figure 13A), indicating proportional growth during development. This pattern is consistent with previous descriptions of ant garden architecture [26,72]. Nevertheless, because colony construction behavior and temporal nest development were not evaluated, the present data do not allow us to determine whether this proportionality results from active architectural regulation by workers or from structural constraints associated with host architecture.

The altitudinal gradient imposes severe host species turnover, evidenced by high Jaccard dissimilarity indices (0.80–1.00) for phorophyte assemblages across sampling units. Despite this continuous taxonomic turnover, *Azteca trailii tocoae* demonstrates marked ecological plasticity, maintaining a structurally conserved nest architecture across 17 distinct tree genera [26,30]. This broad niche adaptability confers a significant competitive advantage and contrasts sharply with *Camponotus cuneidorsus*, which is restricted to a single host (*Aspidosperma excelsum*). This restricted occurrence may reflect greater host specificity, competitive interactions, or other ecological factors; however, the present study does not allow these alternative explanations to be distinguished [37,73].

Finally, the statistical uniformity in the structural dimensions of established gardens across all sampling units refutes environmentally deterministic growth models. This dimensional uniformity reveals a fundamental dissociation between the environmental filters governing initial nest establishment, such as the availability of suitable phorophytes and epiphytic propagules, and the variables dictating subsequent developmental scaling [26,44]. Internal demographic and structural scaling occurs independently of external host taxonomy or sampling unit specific environmental constraints, confirming that once a colony surpasses the initial establishment threshold, volumetric development is intrinsically and resiliently regulated by the mutualistic components themselves [29].

4.3. Assembly Mechanisms of the Epiphytic Community

The absolute dominance of *Anthurium gracile* within the Morro de Calzada system establishes this species as the critical structural foundation of the epiphytic assemblage. Its complex, interlaced root networks act as indispensable biological rebar, providing the mechanical integrity required to stabilize the masticated plant-fiber carton matrix against structural degradation [26,29]. The obligate dependence of the nest architecture upon these epiphytic root structures imposes a profound evolutionary bottleneck, demanding precise, anti-gravitational seed dispersal to ensure targeted arboreal germination directly within the nutrient-enriched nest walls [36]. Previous studies have shown that seed dispersal in ant gardens can be mediated by volatile organic compounds that attract ants, based on behavioral assays and chemical analyses [24,36,74]. In the present study, we documented the composition and abundance of epiphytic species associated with ant gardens but did not evaluate the chemical cues or behavioral mechanisms involved in seed dispersal. Therefore, whether similar chemically mediated interactions occur in the Morro de Calzada system remains to be investigated.

Previous studies have suggested that variation in semiochemical signals among myrmecophytic plant species may contribute to maintaining epiphytic diversity within ant gardens by influencing ant-mediated seed selection [36,74]. Differences in the chemical composition of these volatile compounds have been proposed to elicit species-specific retrieval responses, potentially promoting the establishment of multiple epiphytic taxa rather than dominance by a single species [36,74]. Although the present study did not evaluate the chemical basis of seed selection, the diverse epiphytic assemblages observed in Morro de Calzada are consistent with this ecological framework. However, direct evaluation of chemically mediated seed selection in this system will require behavioral assays and chemical analyses. Concurrently, the regular integration of *Epidendrum* orchids into the ant garden matrix introduces a secondary assembly pathway driven by passive anemochory. Despite the stochastic nature of wind dispersal, the subsequent successful germination of these microscopic, wind-borne seeds is strongly driven by specific physiological and chemical affinities with the carton matrix, corroborating patterns of sub-dominant orchid establishment observed in other Neotropical myrmecophytic systems [25,32,75].

The relatively frequent occurrence of *Epiphyllum phyllanthus* within ant gardens is noteworthy because epiphytic Cactaceae are rarely reported in typical lowland ant gardens [26,30]. This pattern may be associated with the environmental conditions characteristic of rocky outcrops, including high irradiance and seasonal water limitation [6]. However, because microclimatic conditions and functional plant traits were not evaluated directly, the adaptive significance of this association remains speculative. The incorporation of *E. phyllanthus* suggests the extensive ecological plasticity of the mutualism, expanding the known physiological and taxonomic limits of ant gardens to encompass stress-tolerant elements capable of persisting under extreme abiotic constraints [28].

Beyond these dominant and highly adapted taxa, the epiphytic community exhibits a high proportion of singletons, indicating significant compositional heterogeneity and spatial distance-decay turnover among individual gardens [65]. Such variation could reflect several non-exclusive processes, including differences in propagule availability, local environmental heterogeneity, or stochastic dispersal events [76]. Because these processes were not evaluated directly, the present study cannot distinguish among these alternative explanations. Consequently, the overarching dynamics of the epiphytic community are simultaneously shaped by the deterministic, chemically mediated selection exerted by ants and the stochastic spatial realities of wind and vertebrate dispersal. Ultimately, the survival of the established flora, particularly the obligate mesophytic epiphytes, relies entirely on the engineered physicochemical properties of the nest. The persistence of mesophytic epiphytes within ant gardens under the relatively harsh conditions of the rocky outcrop suggests that the carton matrix may provide favorable microenvironmental conditions for plant establishment [26,77]. Although previous studies have proposed that ant garden substrates contribute to moisture retention, the present study did not quantify the physicochemical properties of the carton matrix.

4.4. Ecosystem Engineering and Conservation Implications

Ant gardens amplify their functional importance as ecosystem engineers within the edaphically impoverished and hydrologically restrictive confines of tropical rocky outcrops [6,69]. To compensate for severe abiotic constraints, establishing colonies actively execute physicochemical modifications of the local microenvironment. These structural modifications include the stabilization of substrate pH, the enhancement of critical moisture retention capacities, and the localized sequestration of limiting macronutrients, particularly nitrogen, phosphorus, and organic carbon [26,35]. In this severe geomorphological context, the engineered carton matrix functions as an indispensable physiological buffer; without this micro-engineered substrate, specialized epiphytic flora would rapidly undergo hydraulic cavitation and lethal desiccation [77].

Beyond abiotic micro-regulation, mutualism exerts definitive biotic control over the surrounding community structure. Worker ants enforce top-down regulation on local trophic webs through aggressive territorial patrolling, which significantly reduces foliar herbivory on the structural flora, thereby maximizing the photosynthetic efficiency and survival rates of the cultivated epiphytes [26,78]. Concurrently, the physical architecture of the mature nest facilitates secondary biodiversity. The complex, three-dimensional structures generate localized phytotelmata and structurally stable microhabitats that sustain distinct macroinvertebrate microcosms, inherently augmenting the overall alpha diversity of the canopy ecosystem [79].

The stringent structural and microclimatic requirements of these mutualistic networks render them acutely sensitive to anthropogenic canopy disruption, particularly within the structurally dependent and highly diverse SU4. Deforestation and encroaching habitat fragmentation disproportionately degrade the basal and intermediate elevational zones

by intensifying localized edge effects. These edge effects disrupt the stable atmospheric humidity and incident light regimes required for successful nest establishment and epiphyte germination [30,41]. Because their proliferation relies strictly on interconnected structural and environmental variables, ant garden density, spatial distribution, and localized epiphyte alpha diversity serve collectively as highly accurate functional indicators of overarching forest integrity and ecological connectivity [26,28,37].

Finally, projected climate change scenarios for the tropical Andes, characterized by temperature escalations and drastically altered precipitation regimes, threaten the phenological and spatial synchrony of these intricate systems. Rapid climatic shifts risk uncoupling the altitudinal distributions of keystone ants, structurally suitable phorophytes, and chemically specialized epiphytes, leading to the potential collapse of localized mutualistic networks [28,38]. Consequently, the preservation of continuous altitudinal corridors is mandatory to maintain the contiguous environmental gradients required to sustain the mutualistic continuum against upward climatic displacement. Morro de Calzada operates as an irreplaceable biogeographic node, harboring functionally specialized symbiotic assemblages alongside globally threatened and endemic flora, thereby necessitating immediate, targeted conservation protocols to protect its structural and functional integrity from compounded anthropogenic and climatic pressures.

4.5. Methodological Limitations

Several methodological limitations must be acknowledged when interpreting the findings of this study. The establishment of sampling plots based on accessibility and slope conditions introduces an inherent non-random sampling bias. This approach may disproportionately sample specific microhabitats, potentially underrepresenting certain host-tree species or ant-garden associations located in the steeper, less accessible sectors of the rocky outcrop. Additionally, the study relies on a relatively small sample size of ant gardens, which restricts the statistical power of the analyses and increases uncertainty in generalizing the results. Consequently, the observed spatial patterns, structural covariations, and specific mutualistic associations should be interpreted cautiously as localized phenomena. While this study provides critical baseline data for the isolated Morro de Calzada system, it remains uncertain to what extent these patterns represent broader regional ant-garden dynamics across the Neotropics. Future research employing randomized, larger-scale spatial sampling designs is necessary to validate these ecological trends at a macroecological scale.

5. Conclusions

This study confirms Morro de Calzada as a biological refuge structured by altitudinal and edaphic filters. The plant community exhibits declining species richness with elevation, high spatial turnover, and atypical dominance of stress-tolerant taxa, highlighting the value of its threatened Andean–Amazonian flora.

The SU4 sampling unit functioned as the sector with the greatest recorded concentration of ant–plant mutualisms in this study, coinciding with high structural heterogeneity of host trees; whether this reflects elevation, slope aspect, canopy structure, or a combination of these factors remains to be tested with ordination methods on plot-level data.

Azteca trailii tocoae showed stronger associations with specific phorophyte genera (particularly *Meriania* aff. *microflora* and *Ficus citrifolia*) than expected from their relative floristic abundance, suggesting preferential host selection, although the mechanisms driving this pattern remain uncertain. Behavioral assays or comparative analysis of colonized versus non-colonized hosts would be required to test whether founding queens actively discriminate among host species.

Structural analysis revealed a dissociation between nest establishment and developmental scaling. While colonization is limited by altitudinal filters, mature nest dimensions show positive correlations with host DBH and total height, and exhibit isometric growth across all sampling units. These patterns suggest that once colonies surpass the initial establishment threshold, nest expansion may follow predictable scaling rules, although whether this reflects active architectural regulation by workers or passive structural constraints remains to be determined through direct observation of colony construction behavior.

The epiphytic assemblage, dominated by *Anthurium gracile* with subordinate contributions from xerophytic taxa such as *Epiphyllum phyllanthus*, shows patterns consistent with a hypothesis that the ant-constructed carton matrix provides favorable microenvironmental conditions (moisture retention, nutrient enrichment) for obligate mesophytic epiphytes. Direct measurements of carton physicochemistry and controlled comparisons of epiphyte performance inside and outside nest matrices are needed to test this inference.

Ant gardens are associated with modifications of the local microenvironment, including altered substrate pH, enhanced moisture retention, and localized nutrient sequestration. These characteristics plausibly enhance plant establishment on restrictive rocky outcrops, and the persistence of mesophytic epiphytes within ant gardens under harsh outcrop conditions suggests ecological importance. However, direct measures of ecosystem functioning including nutrient dynamics, herbivory rates, and secondary biodiversity within mature nests would be required to substantiate their role as ecosystem engineers. System resilience appears to depend on synchronized interactions between ant behaviors, host architectures, and adapted epiphytes, highlighting these mutualisms as potentially precise functional indicators of forest integrity and emphasizing the need to conserve continuous altitudinal corridors. Future research should evaluate these mechanistic hypotheses directly.

Author Contributions: Y.Q.-G., J.M.-B. and D.G.-T. conceived and designed the study. A.S.-I. and J.M.-B. coordinated the field work. Y.Q.-G., S.O.-C., J.M.-B. and A.S.-I. carried out the field work, including counting and collecting the materials. B.P.-T. and A.S.-I. carried out the georeferencing of the plots and produced the maps used in the fieldwork and in the manuscript. J.C.d.I.C., G.A.-I., E.d.P.Q.Q. and Y.Q.-G. participated in the taxonomic determination. F.C.G., Y.Q.-G., O.L.S.D. and D.G.-T. prepared the database and performed the statistical analyses. F.C.G., J.M.-B. and E.J.-P. interpreted the results and wrote the first draft of the manuscript. Y.Q.-G., O.L.S.D., B.P.-T., A.S.-I., E.J.-P. and J.M.-B. participated in writing, revising, and editing the manuscript. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data used in this study can be requested to the following authors via email: yquinterosg@unmsm.edu.pe, jehoshua.macedo@unmsm.edu.pe.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A List of Reported Species in el Morro de Calzada

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Acanthaceae	<i>Aphelandra aurantiaca</i> Lindl.	Herb	-	Native	-
Acanthaceae	<i>Justicia comata</i> (L.) Lam.	Herb	-	Native	VU/-
Acanthaceae	<i>Justicia pectoralis</i> Jacq.	Herb	-	Native	-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Alzateaceae	<i>Alzatea verticillata</i> Ruiz & Pav.	Tree	-	Native	LC/-
Anacardiaceae	<i>Tapirira guianensis</i> Aubl.	Tree	-	Native	LC/-
Anacardiaceae	<i>Tapirira obtusa</i> (Benth.) J.D. Mitch.	Tree	-	Native	LC/-
Annonaceae	<i>Guatteria megalophylla</i> Diels	Tree	-	Native	-
Annonaceae	<i>Guatteria scytophylla</i> Diels	Tree	-	Native	-
Annonaceae	<i>Guatteria punctata</i> (Aubl.) R. A. Howard	Tree	-	Native	LC/-
Annonaceae	<i>Xylopia benthamii</i> R.E. Fr.	Tree	-	Native	LC/-
Annonaceae	<i>Xylopia nitida</i> Dunal	Tree	-	Native	NT/-
Apocynaceae	<i>Aspidosperma excelsum</i> Benth.	Tree	AG Phorophyte	Native	LC/-
Apocynaceae	<i>Mandevilla scabra</i> (Hoffm. ex Roem. & Schult.) K. Schum.	Vine	-	Native	-
Araceae	<i>Anthurium ernestii</i> Engl.	Epiphyte	-	Native	-
Araceae	<i>Anthurium gracile</i> (Rudge) Lindl.	Epiphyte	AG epiphyte	Native	-
Araceae	<i>Anthurium scandens</i> (Aubl.) Engl.	Epiphyte	AG epiphyte	Native	-
Araceae	<i>Monstera dubia</i> (Kunth) Engl. & K. Krause	Epiphyte	-	Native	DD/-
Araceae	<i>Philodendron asplundii</i> Croat & M.L. Soares	Epiphyte	AG epiphyte	Native	LC/-
Araceae	<i>Philodendron deflexum</i> Poepp. ex Schott	Epiphyte	AG epiphyte	Native	-
Araceae	<i>Philodendron ernestii</i> Engl.	Epiphyte	AG epiphyte	Native	-
Araceae	<i>Philodendron hederaceum</i> (Jacq.) Schott	Epiphyte	-	Native	-
Araceae	<i>Philodendron lechlerianum</i> Schott	Epiphyte	-	Native	-
Araceae	<i>Syngonium podophyllum</i> Schott	Vine	-	Native	LC/-
Araliaceae	<i>Didymopanax morototoni</i> (Aubl.) Decne. & Planch.	Tree	-	Native	-
Araliaceae	<i>Sciodaphyllum pentandrum</i> (Pav.) Poir.	Tree	-	Native	LC/-
Arecaceae	<i>Aiphanes deltoidea</i> Burret	Palm	-	Native	-
Arecaceae	<i>Wettinia maynensis</i>	Palm	AG Phorophyte	Native	NT/-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Asteraceae	<i>Ayapana elata</i> R.M. King & H. Rob.	Herb	-	Native	-
Asteraceae	<i>Baccharis genistelloides</i> (Lam.) Pers.	Herb	-	Native	/NT
Asteraceae	<i>Chaptalia nutans</i> (L.) Pol.	Herb	-	Native	-
Asteraceae	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Shrub	-	Native	-
Asteraceae	<i>Cyrtocymura scorpioides</i> (Lam.) H. Rob.	Herb	-	Native	-
Asteraceae	<i>Elephantopus mollis</i> Kunth	Herb	-	Native	LC/-
Asteraceae	<i>Emilia sonchifolia</i> (L.) DC.	Herb	-	Non-native	LC/-
Asteraceae	<i>Hebeclinium macrophyllum</i> (L.) DC.	Herb	-	Native	LC/-
Asteraceae	<i>Lepidaploa canescens</i> (Kunth) H. Rob.	Shrub	-	Native	-
Asteraceae	<i>Mikania psilostachya</i> DC.	Vine	-	Native	LC/-
Asteraceae	<i>Mikania banisteriae</i> DC.	Vine	-	Native	LC/-
Asteraceae	<i>Mikania cordifolia</i> (L. f.) Willd.	Vine	-	Native	LC/-
Asteraceae	<i>Mikania guaco</i> Bonpl.	Vine	-	Native	LC/-
Asteraceae	<i>Vernonanthura patens</i> (Kunth) H. Rob.	Shrub	-	Native	LC/-
Basellaceae	<i>Anredera baselloides</i> (Kunth) Baill.	Herb	-	Native	-
Begoniaceae	<i>Begonia glabra</i> Auble.	Epiphyte	AG epiphyte	Native	-
Begoniaceae	<i>Begonia humilis</i> Aiton	Herb	-	Native	-
Bignoniaceae	<i>Jacaranda copaia</i> (Aubl.) D. Don	Tree	-	Native	LC/-
Bignoniaceae	<i>Jacaranda copaia</i> subsp. <i>spectabilis</i> (Mart. ex DC.) A.H. Gentry	Tree	-	Native	-
Bignoniaceae	<i>Jacaranda glabra</i> (DC.) Bureau & K. Schum.	Tree	-	Native	-
Bromeliaceae	<i>Aechmea longifolia</i> (Rudge) L.B. Sm. & M.A. Spencer	Epiphyte	AG epiphyte	Native	-
Bromeliaceae	<i>Guzmania brasiliensis</i> Ule	Herb	-	Native	LC/-
Bromeliaceae	<i>Pitcairnia paniculata</i>	Epiphyte	-	Native	LC/-
Bromeliaceae	<i>Racinaea parviflora</i> (Ruiz & Pav.) M.A. Spencer & L.B. Sm.	Herb	-	Native	-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Burseraceae	<i>Dacryodes peruviana</i> (Loes.) <i>H.J. Lam</i>	Tree	AG Phorophyte	Native	-
Burseraceae	<i>Protium glabrescens</i> Swart	Tree	-	Native	-
Burseraceae	<i>Trattinnickia aspera</i> (Standl.) <i>Swart</i>	Tree	-	Native	LC/-
Cactaceae	<i>Epiphyllum phyllanthus</i> (L.) <i>Haw.</i>	Epiphyte	AG epiphyte	Native	-/VU
Cannabaceae	<i>Celtis iguanaea</i> (Jacq.) <i>Sarg.</i>	Tree	-	Native	LC/-
Cannabaceae	<i>Celtis schippii</i> Standl.	Tree	-	Native	LC/-
Cannabaceae	<i>Trema micranthum</i> (L.) Blume	Tree	-	Native	LC/-
Caricaceae	<i>Jacaratia digitata</i> (Poepp. & Endl.) Solms	Tree	-	Native	-
Caricaceae	<i>Jacaratia spinosa</i> (Aubl.) <i>A.DC.</i>	Tree	-	Native	LC/-
Caryocaraceae	<i>Caryocar glabrum</i> (Aubl.) <i>Pers.</i>	Tree	-	Native	LC/-
Caryophyllaceae	<i>Drymaria cordata</i> (L.) Willd. <i>ex Schult.</i>	Herb	-	Native	-
Celastraceae	<i>Cheiloclinium cognatum</i> (Miers) A.C. Sm.	Tree	-	Native	LC/-
Celastraceae	<i>Peritassa huanucana</i> (Loes.) <i>A. C. Sm.</i>	Vine	-	Native	-
Celastraceae	<i>Tontelea corymbosa</i> (Huber) <i>A.C. Sm.</i>	Vine	-	Native	LC/-
Chloranthaceae	<i>Hedyosmum racemosum</i> (Ruiz & Pav.) G. Don	Tree	-	Native	LC/-
Chrysobalanaceae	<i>Hirtella racemosa</i> Lam.	Shrub	-	Native	LC/-
Clethraceae	<i>Clethra castaneifolia</i> Meisn.	Tree	-	Native	LC/-
Clethraceae	<i>Clethra fimbriata</i> Kunth	Tree	-	Native	LC/-
Clusiaceae	<i>Arawakia weddelliana</i> (Planch. & Triana) L. Marinho	Tree	-	Native	LC/-
Clusiaceae	<i>Clusia haughtii</i> Cuatrec.	Tree	-	Native	LC/-
Clusiaceae	<i>Clusia loranthacea</i> Planch. & Triana	Tree	-	Native	LC/-
Clusiaceae	<i>Clusia minor</i> L.	Tree	-	Native	LC/-
Clusiaceae	<i>Clusia loretensis</i> Engl.	Tree	AG Phorophyte, AG epiphyte	Native	LC/-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Clusiaceae	<i>Clusia ducuoides</i> Engl.	Shrub	-	Native	LC/-
Clusiaceae	<i>Clusia hammeliana</i> Pipoly	Shrub	-	Native	-
Clusiaceae	<i>Clusia octandra</i> (Poepp.) Pipoly	Tree	-	Native	-
Clusiaceae	<i>Clusia trochiformis</i> Vesque	Tree	AG epiphyte	Native	-
Clusiaceae	<i>Garcinia gardneriana</i> (Planch. & Triana) Zappi	Tree	-	Native	LC/-
Clusiaceae	<i>Garcinia madruno</i> (Kunth) Hammel	Tree	-	Native	LC/-
Clusiaceae	<i>Symphonia globulifera</i> L. f.	Tree	-	Native	LC/-
Commelinaceae	<i>Commelina fasciculata</i> Ruiz & Pav.	Herb	-	Native	LC/-
Commelinaceae	<i>Floscopa elegans</i> Huber	Herb	-	Native	LC/-
Cordiaceae	<i>Cordia alliodora</i> (Ruiz & Pav.) Oken	Tree	-	Native	-
Cordiaceae	<i>Cordia nodosa</i> Lam.	Tree	-	Native	LC/-
Costaceae	<i>Costus guanaiensis</i> Rusby	Herb	-	Native	LC/-
Costaceae	<i>Costus lasius</i> Loes.	Herb	-	Native	LC/-
Cucurbitaceae	<i>Cayaponia glandulosa</i> (Poepp. & Endl.) Cogn.	Vine	-	Native	-
Cyatheaceae	<i>Cyathea</i> sp.	Herb	-	Native	-
Cyperaceae	<i>Cyperus laxus</i> Lam.	Herb	-	Native	LC/-
Cyperaceae	<i>Cyperus miliifolius</i> Poepp. & Kunth	Herb	-	Native	LC/-
Dryopteridaceae	<i>Polybotrya fractiserialis</i> (Baker) J. Sm.	Herb	-	Native	LC/-
Ebenaceae	<i>Diospyros capreifolia</i> Mart. ex Hiern	Tree	-	Native	-
Erythroxylaceae	<i>Erythroxylum citrifolium</i> A. St.-Hil.	Tree	AG Phorophyte	Native	LC/-
Erythroxylaceae	<i>Erythroxylum fimbriatum</i> Peyr.	Shrub	-	Native	LC/-
Erythroxylaceae	<i>Erythroxylum ulei</i> O.E. Schulz	Shrub	-	Native	LC/-
Erythroxylaceae	<i>Erythroxylum shatona</i> J.F. Macbr.	Tree	-	Native	-
Euphorbiaceae	<i>Acalypha diversifolia</i> Jacq.	Shrub	-	Native	LC/-
Euphorbiaceae	<i>Alchornea acutifolia</i> Müll. Arg.	Tree	-	Native	LC/-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Euphorbiaceae	<i>Alchornea triplinervia</i> (Spreng.) Müll. Arg.	Tree	-	Native	LC/-
Euphorbiaceae	<i>Alchornea glandulosa</i> Poepp.	Shrub	-	Native	LC/-
Euphorbiaceae	<i>Croton schiedeana</i> Schltdl.	Tree	-	Native	LC/-
Euphorbiaceae	<i>Glycydendron amazonicum</i> Ducke	Tree	-	Native	LC/-
Euphorbiaceae	<i>Maprounea guianensis</i> Aubl.	Tree	-	Native	LC/-
Euphorbiaceae	<i>Micrandra siphonioides</i> var. <i>minor</i> (Benth.) Müll. Arg.	Tree	-	Native	-
Euphorbiaceae	<i>Pseudosenefeldera inclinata</i> (Müll.Arg.) Esser	Tree	-	Native	-
Euphorbiaceae	<i>Tetrorchidium macrophyllum</i> Müll. Arg.	Tree	-	Native	LC/-
Euphorbiaceae	<i>Tetrorchidium rubrivenium</i> Poepp.	Tree	-	Native	LC/-
Fabaceae	<i>Crudia glaberrima</i> (Steud.) J.F. Macbr.	Tree	-	Native	LC/-
Fabaceae	<i>Dalbergia frutescens</i> (Vell.) Britton	Vine	-	Native	LC/-
Fabaceae	<i>Desmodium uncinatum</i> (Jacq.) DC.	Herb	-	Native	LC/-
Fabaceae	<i>Desmodium subsericeum</i> Malme	Herb	-	Native	LC/VU
Fabaceae	<i>Inga capitata</i> Desv.	Tree	-	Native	LC/-
Fabaceae	<i>Inga thibaudiana</i> DC.	Tree	-	Native	-
Fabaceae	<i>Inga acreana</i> Harms	Tree	AG epiphyte	Native	LC/-
Fabaceae	<i>Inga edulis</i> Mart.	Tree	-	Native	LC/-
Fabaceae	<i>Machaerium cuspidatum</i> Kuhl. & Hoehne	Tree	-	Native	-
Fabaceae	<i>Machaerium floribundum</i> var. <i>hypargyreum</i> (Harms) Rudd	Vine	-	Native	LC/-
Fabaceae	<i>Macrolobium ischnocalyx</i> Harms	Tree	-	Native	-
Fabaceae	<i>Pterocarpus amazonum</i> (Mart. ex Benth.) Amshoff	Tree	AG epiphyte	Native	-
Fabaceae	<i>Tachigali peruviana</i> (Dwyer) Zarucchi & Herend.	Shrub	-	Native	LC/-
Fabaceae	<i>Tachigali guianensis</i> (Benth.) Zarucchi & Herend.	Tree	-	Native	LC/-
Fabaceae	<i>Zygia latifolia</i> (L.) Fawc. & Rendle	Shrub	-	Native	LC/-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Gesneriaceae	<i>Codonanthopsis crassifolia</i> (H. Focke) C.V. Morton	Epiphyte	AG epiphyte	Native	LC/-
Gesneriaceae	<i>Drymonia doratostyla</i> (Leeuwenb.) Wiehler	Herb	AG epiphyte	Native	LC/-
Gleicheniaceae	<i>Sticherus bifidus</i> (Willd.) Ching	Herb	AG epiphyte	Native	-
Humiriaceae	<i>Humiria balsamifera</i> Aubl.	Tree	-	Native	LC/-
Humiriaceae	<i>Sacoglottis guianensis</i> Benth.	Tree	-	Native	LC/-
Hydrangeaceae	<i>Hydrangea preslii</i> Briq.Cf.	Shrub	-	Native	LC/-
Hypericaceae	<i>Vismia baccifera</i> (L.) Triana & Planch.	Tree	-	Native	LC/-
Hypericaceae	<i>Vismia macrophylla</i> Kunth	Shrub	-	Native	LC/-
Hypericaceae	<i>Vismia tomentosa</i> Ruiz & Pav.	Tree	-	Native	LC/-
Hypericaceae	<i>Vismia rusbyi</i> Ewan	Shrub	-	Native	LC/-
Hypericaceae	<i>Vismia gracilis</i> Hieron.	Shrub	-	Native	LC/-
Lauraceae	<i>Aniba muca</i> (Ruíz & Pav.) Mez	Tree	-	Native	LC/-
Lauraceae	<i>Aniba panurensis</i> (Meisn.) Mez	Tree	-	Native	LC/-
Lauraceae	<i>Endlicheria bracteata</i> Mez	Tree	AG Phorophyte	Native	-
Lauraceae	<i>Endlicheria szyszyłowiczii</i> Mez	Tree	-	Native	-
Lauraceae	<i>Licaria armeniaca</i> (Nees) Kosterm.	Tree	-	Native	-
Lauraceae	<i>Licaria triandra</i> (Sw.) Kosterm.	Tree	-	Native	LC/-
Lauraceae	<i>Nectandra brittonii</i> Mez	Tree	-	Native	-
Lauraceae	<i>Nectandra matthewsii</i> Meisn.	Tree	-	Native	-
Lauraceae	<i>Ocotea aciphylla</i> (Nees & Mart.) Mez	Tree	AG Phorophyte	Native	-
Lauraceae	<i>Ocotea bofo</i> Kunth.	Tree	-	Native	-
Lauraceae	<i>Ocotea splendens</i> (Meisn.) Baill.	Tree	-	Native	-
Lecythidaceae	<i>Couratari guianensis</i> Aubl.	Tree	-	Native	LC/VU
Lecythidaceae	<i>Eschweilera andina</i> (Rusby) J.F. Macbr.	Tree	-	Native	LC/-
Lepidobotryaceae	<i>Ruptiliocarpon caracolito</i> Hammel & N. Zamora	Tree	-	Native	-

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Malpighiaceae	<i>Byrsonima chrysophylla</i> Kunth	Tree	-	Native	-
Malpighiaceae	<i>Byrsonima spicata</i> (Cav.) DC.	Tree	AG Phorophyte	Native	LC/-
Malvaceae	<i>Mollia gracilis</i> Spruce ex Benth.	Tree	-	Native	-
Malvaceae	<i>Quararibea wittii</i> K. Schum. & Ulbr.	Tree	-	Native	-
Malvaceae	<i>Sterculia peruviana</i> (D.R. Simpson) E.L. Taylor ex Brako & Zarucchi	Tree	-	Endemic	-
Malvaceae	<i>Theobroma bicolor</i> Bonpl.	Tree	-	Native	-
Marantaceae	<i>Ischnosiphon arouma</i> (Aubl.) Körn.	Herb	-	Native	LC/-
Marcgraviaceae	<i>Marcgraviastrum mixtum</i> (Triana & Planch.) Bedell	Vine	AG epiphyte	Native	-
Melastomataceae	<i>Adelobotrys adscendens</i> (Sw.) Triana	Vine	-	Native	-
Melastomataceae	<i>Adelobotrys microcarpus</i> Schulman	Vine	-	Native	-
Melastomataceae	<i>Bellucia pentamera</i> Naudin	Tree	-	Native	LC/-
Melastomataceae	<i>Centronia laurifolia</i> D. Don	Tree	-	Native	LC/-
Melastomataceae	<i>Desmoscelis villosa</i> (Aubl.) Naudin	Herb	AG Phorophyte	Native	-
Melastomataceae	<i>Graffenrieda miconioides</i> Naudin	Tree	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Graffenrieda limbata</i> Triana	Tree	-	Native	LC/-
Melastomataceae	<i>Meriania aff. microflora</i> Rob. Fern., R. Goldenb. & Michelang.	Shrub	AG Phorophyte	Native	-
Melastomataceae	<i>Miconia glaucescens</i> Triana	Tree	-	Native	LC/-
Melastomataceae	<i>Miconia</i> sp.	Tree	-	Native	-
Melastomataceae	<i>Miconia sulcicaulis</i> (Poepp. ex Naudin) Ocampo & Almeda	Tree	-	Native	-
Melastomataceae	<i>Miconia affinis</i> DC.	Shrub	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Miconia bullifera</i> (Mart. & Schrank ex DC.) Michelang.	Shrub	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Miconia caquetana</i> (Sprague) Michelang.	Shrub	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Miconia ericalyx</i> Cogn.	Shrub	-	Native	LC/-

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Melastomataceae	<i>Miconia gonoptera</i> (Gleason) Michelang.	Shrub	-	Native	-
Melastomataceae	<i>Miconia klugii</i> Gleason	Shrub	-	Native	-
Melastomataceae	<i>Miconia lasiocalyx</i> Cogn.	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia lourteigiana</i> Wurdack	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia manserichensis</i> (Wurdack) Michelang.	Shrub	-	Endemic	LC/-
Melastomataceae	<i>Miconia membranacea</i> Triana	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia neosecunda</i> Ocampo & Almeda	Shrub	-	Native	-
Melastomataceae	<i>Miconia nervosa</i> (Sm.) Triana	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia prasina</i> (Sw.) DC.	Shrub	-	Native	-
Melastomataceae	<i>Miconia pterocaulon</i> Triana	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia puberula</i> Cogn.	Shrub	-	Native	-
Melastomataceae	<i>Miconia stenoptera</i> (Gleason) Michelang.	Shrub	-	Native	-
Melastomataceae	<i>Miconia theaezans</i> (Bonpl.) Cogn	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia tocosa</i> Michelang.	Shrub	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Miconia tocoronata</i> Michelang.	Shrub	AG Phorophyte	Native	LC/-
Melastomataceae	<i>Miconia stenostachya</i> DC.	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia lamprophylla</i> Triana	Shrub	-	Native	LC/-
Melastomataceae	<i>Miconia livida</i> Triana	Shrub	AG Phorophyte	Native	-
Melastomataceae	<i>Miconia splendens</i> (Sw.) Griseb.	Shrub	-	Native	-
Melastomataceae	<i>Miconia subandicola</i> Wurdack	Shrub	-	Native	-
Melastomataceae	<i>Pleroma ochypetalum</i> (Ruiz & Pav.) D.Don	Shrub	-	Native	LC/-
Melastomataceae	<i>Tibouchina longifolia</i> (Vahl) Baill.	Shrub	-	Native	-
Meliaceae	<i>Guarea guidonia</i> (L.) Sleumer	Tree	-	Native	LC/-
Menispermaceae	<i>Abuta grandifolia</i> (Mart.) Sandwith	Vine	-	Native	LC/-
Menispermaceae	<i>Chondrodendron tomentosum</i> Ruiz & Pav.	Vine	-	Native	LC/-

Family	Species	Growth Habit	Ant Garden Association	Origin	UICN/DS
Moraceae	<i>Brosimum guianense</i> (Aubl.) Huber	Tree	-	Native	-
Moraceae	<i>Brosimum alicatrum</i> Sw.	Tree	-	Native	LC/-
Moraceae	<i>Brosimum rubescens</i> Taub.	Tree	-	Native	LC/-
Moraceae	<i>Ficus americana</i> Aubl.	Tree	-	Native	LC/-
Moraceae	<i>Ficus insipida</i> Willd.	Tree	-	Native	LC/-
Moraceae	<i>Ficus maxima</i> Mill.	Tree	-	Native	LC/-
Moraceae	<i>Ficus obtusifolia</i> Kunth	Tree	-	Native	LC/-
Moraceae	<i>Ficus pertusa</i> L. f.	Tree	-	Native	LC/-
Moraceae	<i>Ficus trigona</i> L.f.	Tree	AG Phorophyte	Native	-
Moraceae	<i>Ficus velutina</i> Humb. & Bonpl. ex Willd.	Tree	-	Native	LC/-
Moraceae	<i>Ficus citrifolia</i> Mill.	Tree	AG Phorophyte	Native	LC/-
Moraceae	<i>Helicostylis tomentosa</i> (Poepp. & Endl.) Rusby	Tree	-	Native	LC/-
Moraceae	<i>Helicostylis scabra</i> (J. F. Macbr.) C. C. Berg	Tree	-	Native	LC/-
Moraceae	<i>Naucleopsis oblongifolia</i> (Kuhlm.) Carauta	Tree	-	Native	LC/-
Moraceae	<i>Pseudolmedia laevigata</i> Trécul	Tree	-	Native	LC/-
Moraceae	<i>Pseudolmedia rigida</i> (Klotzsch & H. Karst.) Cuatrec.	Tree	-	Native	LC/-
Moraceae	<i>Trophis caucana</i> (Pittier) C.C. Berg	Tree	-	Native	LC/-
Moraceae	<i>Trophis racemosa</i> (L.) Urb.	Tree	-	Native	LC/-
Myristicaceae	<i>Otoba parvifolia</i> (Markgr.) A.H. Gentry	Tree	-	Native	-
Myristicaceae	<i>Virola pavonis</i> (A. DC.) A.C. Sm.	Tree	-	Native	LC/-
Myristicaceae	<i>Virola sebifera</i> Aubl.	Tree	AG Phorophyte	Native	LC/-
Myrtaceae	<i>Eugenia muricata</i> DC.	Tree	-	Native	LC/-
Myrtaceae	<i>Myrcia bracteata</i> (Rich.) DC.	Tree	-	Native	VU/-
Myrtaceae	<i>Myrcia egensis</i> (O. Berg) McVaugh	Tree	-	Native	EN/-
Myrtaceae	<i>Myrcia paivae</i> O. Berg	Tree	-	Native	LC/-

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Myrtaceae	<i>Myrcia splendens</i> (Sw.) DC.	Shrub	-	Native	LC/-
Myrtaceae	<i>Psidium acutangulum</i> DC.	Tree	-	Native	LC/-
Myrtaceae	<i>Securidaca divaricata</i> Nees & Mart.	Vine	AG Phorophyte	Native	LC/-
Nyctaginaceae	<i>Neea macrophylla</i> Poepp. & Endl.	Tree	-	Native	LC/-
Nyctaginaceae	<i>Neea divaricata</i> Poepp. & Endl.	Shrub	-	Native	-
Ochnaceae	<i>Cespedesia spathulata</i> (Ruiz & Pav.) Planch.	Tree	-	Native	LC/-
Ochnaceae	<i>Ouratea iquitosensis</i> J.F. Macbr.	Tree	-	Native	-
Onagraceae	<i>Ludwigia latifolia</i> (Benth.) H. Hara	Herb	-	Native	LC/-
Onagraceae	<i>Ludwigia decurrens</i> Walter	Herb	-	Native	LC/-
Orchidaceae	<i>Epidendrum macrocarpum</i> Rich.	Epiphyte	AG epiphyte	Native	-
Orchidaceae	<i>Epidendrum</i> sp.	Epiphyte	AG epiphyte	Native	LC/-
Orchidaceae	<i>Epidendrum ibaguense</i> Kunth	Herb	-	Native	LC/-
Orchidaceae	<i>Epidendrum smaragdinum</i> Lindl.	Herb	AG epiphyte	Native	LC/-
Orchidaceae	<i>Lycomormium squalidum</i> (Poepp. & Endl.) Rchb. f.	Epiphyte	-	Native	-
Orchidaceae	<i>Maxillaria alticola</i> C.Schweinf.	Epiphyte	-	Native	LC/-
Orchidaceae	<i>Pleurothallis velaticaulis</i> Rchb. f.	Epiphyte	-	Native	LC/-
Orchidaceae	<i>Sobralia violaceae</i> Linden ex Lindl.	Herb	-	Native	-
Passifloraceae	<i>Passiflora vitifolia</i> Kunth	Vine	-	Native	-
Phyllanthaceae	<i>Hieronyma alchorneoides</i> Allemão	Tree	-	Native	LC/-
Phyllanthaceae	<i>Hieronyma oblonga</i> (Tul.) Müll. Arg.	Tree	AG Phorophyte	Native	LC/-
Phyllanthaceae	<i>Margaritaria nobilis</i> L.f.	Shrub	-	Native	LC/-
Piperaceae	<i>Peperomia alata</i> Ruiz & Pav.	Epiphyte	-	Native	-
Piperaceae	<i>Peperomia macrostachyos</i> (Vahl) A. Dietr.	Epiphyte	AG epiphyte	Native	LC/-
Piperaceae	<i>Piper aduncum</i> L.	Shrub	-	Native	-
Piperaceae	<i>Piper</i> cf. <i>recreoense</i> Trel.	Shrub	-	Native	-
Piperaceae	<i>Piper inaequale</i> C. DC.	Shrub	-	Native	LC/-

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Piperaceae	<i>Piper riojanum</i> Trel.	Shrub	-	Native	LC/-
Poaceae	<i>Melinis minutiflora</i> P.Beauv.	Herb	-	Non-native	LC/-
Poaceae	<i>Olyra latifolia</i> L.	Herb	-	Native	-
Poaceae	<i>Panicum dichotomiflorum</i> Michx.	Herb	-	Non-native	-
Poaceae	<i>Polypogon elongatus</i> Kunth	Herb	-	Native	LC/-
Poaceae	<i>Urochloa fusca</i> (Sw.) B. F. Hansen & Wunderlin	Herb	-	Native	LC/-
Poaceae	<i>Urochloa brizantha</i> (Hochst. ex A. Rich.) R.D. Webster	Herb	-	Native	LC/-
Primulaceae	<i>Cybianthus aff.pastensis</i> (Mez) G. Agostini	Shrub	-	Native	-
Primulaceae	<i>Cybianthus spicatus</i> (Kunth) G. Agostini	Shrub	-	Native	-
Primulaceae	<i>Myrsine coriacea</i> (Sw.) R. Br. ex Roem. & Schult.	Tree	-	Native	LC/-
Primulaceae	<i>Myrsine oligophylla</i> Zahlbr.	Shrub	-	Native	LC/-
Primulaceae	<i>Myrsine youngii</i> Pipol	Tree	-	Endemic	LC/-
Primulaceae	<i>Stylogyne bracteolata</i> (Lundell) Pipoly	Shrub	-	Native	LC/-
Primulaceae	<i>Stylogyne serpentina</i> Mez	Shrub	-	Native	LC/-
Proteaceae	<i>Roupala montana</i> Aubl.	Tree	-	Native	LC/-
Pteridaceae	<i>Pteris quadriaurita</i> Retz.	Herb	-	Native	LC/-
Rosaceae	<i>Prunus debilis</i> Koehne	Shrub	-	Native	LC/-
Rubiaceae	<i>Coccocypselum condalia</i> Pers.	Herb	-	Native	LC/-
Rubiaceae	<i>Cosmibuena grandiflora</i> (Ruiz & Pav.) Rusby	Tree	-	Native	LC/VU
Rubiaceae	<i>Faramea glandulosa</i> Poepp. & Endl.	Shrub	-	Native	LC/-
Rubiaceae	<i>Faramea tamberlikiana</i> Müll. Arg.	Shrub	-	Native	LC/-
Rubiaceae	<i>Ferdinandusa chlorantha</i> (Wedd.) Standl.	Tree	AG Phorophyte	Native	LC/-
Rubiaceae	<i>Genipa americana</i> L.	Tree	-	Native	LC/-
Rubiaceae	<i>Kutchubaea sericantha</i> Standl.	Tree	-	Native	LC/-
Rubiaceae	<i>Ladenbergia amazonensis</i> Ducke	Tree	AG Phorophyte	Native	LC/-
Rubiaceae	<i>Ladenbergia discolor</i> K. Schum.	Tree	-	Native	LC/-

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Rubiaceae	<i>Ladenbergia graciliflora</i> K. Schum.	Tree	AG Phorophyte	Native	-
Rubiaceae	<i>Ladenbergia oblongifolia</i> (Humb. ex Mutis) L. Andersson	Tree	-	Native	LC/-
Rubiaceae	<i>Ladenbergia macrocarpa</i> (Vahl) Klotzsch	Tree	-	Native	LC/-
Rubiaceae	<i>Malanea boliviana</i> Standl.	Vine	-	Native	LC/-
Rubiaceae	<i>Mitracarpus frigidus</i> (Willd. ex Roem. & Schult.) K. Schum.	Herb	-	Native	LC/-
Rubiaceae	<i>Palicourea tomentosa</i> (Aubl.) Borhidi	Shrub	-	Native	-
Rubiaceae	<i>Psychotria carthagenensis</i> Jacq.	Shrub	-	Native	LC/-
Rubiaceae	<i>Sabicea cana</i> Hook. f.	Vine	-	Native	-
Rubiaceae	<i>Spermacoce capitata</i> Ruiz & Pav.	Herb	-	Native	-
Rutaceae	<i>Esenbeckia grandiflora</i> Mart. var. <i>Grandiflora</i>	Tree	-	Native	LC/-
Salicaceae	<i>Banara nitida</i> Spruce ex Benth	Tree	-	Native	LC/-
Salicaceae	<i>Banara guianensis</i> Aubl.	Shrub	-	Native	LC/-
Salicaceae	<i>Casearia decandra</i> Jacq.	Tree	-	Native	LC/-
Salicaceae	<i>Casearia arborea</i> (Rich.) Urb.	Shrub	-	Native	LC/-
Sapindaceae	<i>Talisia carinata</i> Radlk.	Tree	-	Native	LC/-
Sapindaceae	<i>Talisia cerasina</i> (Benth.) Radlk.	Tree	-	Native	-
Sapotaceae	<i>Chrysophyllum argenteum</i> Jacq.	Tree	-	Native	LC/-
Sapotaceae	<i>Chrysophyllum ovale</i> Rusby	Tree	-	Native	LC/-
Sapotaceae	<i>Chrysophyllum prieurii</i> (A.DC.) Aubrév.	Tree	-	Native	LC/-
Sapotaceae	<i>Micropholis guyanensis</i> (A. DC.) Pierre	Tree	-	Native	LC/-
Sapotaceae	<i>Micropholis gnaphaloclados</i> (Mart.) Pierre	Shrub	-	Native	-
Sapotaceae	<i>Pouteria bangii</i> (Rusby) T.D. Penn.	Tree	-	Native	LC/-
Sapotaceae	<i>Pouteria vernicosa</i> T.D. Penn.	Tree	-	Native	LC/-
Simaroubaceae	<i>Simarouba amara</i> Aubl.	Tree	-	Native	-

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Siparunaceae	<i>Siparuna cervicornis</i> Perkins	Shrub	-	Native	LC/-
Solanaceae	<i>Solanum riparium</i> Pers.	Shrub	-	Native	-
Solanaceae	<i>Solanum lepidotum</i> Dunal	Shrub	-	Native	-
Solanaceae	<i>Solanum appressum</i> K.E. Roe	Herb	-	Native	LC/-
Solanaceae	<i>Solanum schlechtendalianum</i> Walp.	Herb	-	Native	LC/-
Symplocaceae	<i>Symplocos arechea</i> L'Hér.	Tree	-	Native	LC/-
Urticaceae	<i>Cecropia ficifolia</i> Warb. ex Snethl.	Tree	-	Native	LC/-
Urticaceae	<i>Cecropia montana</i> Warb. ex Snethl.	Tree	-	Native	-
Urticaceae	<i>Pourouma bicolor</i> Mart.	Tree	-	Native	LC/-
Urticaceae	<i>Pourouma cecropiifolia</i> Mart.	Tree	-	Native	LC/-
Violaceae	<i>Leonia glycyarpa</i> Ruiz & Pav.	Tree	-	Native	-
Violaceae	<i>Rinorea lindeniana</i> (Tul.) Kuntze	Shrub	-	Native	LC/-
Vochysiaceae	<i>Qualea tessmannii</i> Mildbr.	Tree	-	Native	LC/-

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