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Species diversity of Araceae in Ninoy Aquino Parks and Wildlife Center and Arroceros Forest Park, Manila, Philippines

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Abstract. *Brillo SC, Banogon JDA, Aguila NAA, Mones JRM. 2025. Species diversity of Araceae in Ninoy Aquino Parks and Wildlife Center and Arroceros Forest Park, Manila, Philippines. Asian J For 9: 34-44.* Green spaces in urbanized areas are crucial for biodiversity conservation. However, cultivation can influence plant diversity and the ecosystem. Araceae is a plant family usually planted in these areas due to its appeal and adaptability. Despite this, exotic species are often planted without considering their potential effects on ecosystems. This study aimed to create a checklist of aroids in Ninoy Aquino Parks and Wildlife Center (NAWPC) and Arroceros Forest Park (AFP), Manila, Philippines. This study was achieved through an opportunistic, descriptive botanical inventory design. Twenty-five species across 10 genera, namely *Aglaonema, Alocasia, Caladium, Dieffenbachia, Epipremnum, Philodendron, Spathiphyllum, Syngonium, Thaumatophyllum,* and *Typhonium* were identified. Twenty-two and 10 species occur in NAPWC and AFP, respectively. Seven species are native, 12 species are introduced, and 6 species are naturalized. The species surveyed varied in morphology and habitat preference. *Epipremnum pinnatum* and *Typhonium blumei* were the most abundant. *Aglaonema commutatum, Syngonium* spp., and *Alocasia macrorrhizos* were considered site specific. Introduced species like *Dieffenbachia seguine* and *Philodendron* 'Lemon Lime' reflected human cultivation preferences. Additionally, Jaccard index of 0.4 presents a moderate similarity of Aroid species between sites. The findings highlight the underrepresentation of native aroids and prioritizing these species can promote biodiversity and sustainability in urban environments.

Keywords: Araceae, Arroceros Forest Park, inventory, Ninoy Aquino Parks and Wildlife Center, species diversity

Abbreviations: AFP: Arroceros Forest Park, IUCN: International Union for Conservation of Nature, NAPWC: Ninoy Aquino Parks and Wildlife Center, NIPAS: National Integrated Protected Areas System, RA: Republic Act

INTRODUCTION

Urban forest parks enhance well-being and reduce pollution. Arroceros Forest Park, a 2.2 ha "last lung of Manila," which was rehabilitated in 2022, supports over 3,000 trees, 8,000 ornamental plants, and ten bird species, emphasizing urban greenery's importance (PNPCSI 2019; Requejo 2022). Similarly, the 22.7 ha Ninoy Aquino Parks and Wildlife Center (NAPWC) in Quezon City, a NIPAS (National Integrated Protected Areas System)-protected area, combines conservation and education to promote Philippine wildlife preservation. These parks illustrate local and national initiatives for urban green spaces. Aroids, tropical herbs with 143 genera and 3,750 species (Boyce and Croat 2020; POWO 2024), thrive in urban forest parks due to conditions akin to forest understories, supporting terrestrial and epiphytic growth (Matthews 1995; Gerst et al. 2021; Harisin et al. 2021).

Some aroids are economically important as food sources, using their roots, leaves, and stems in the Philippines, such as *Colocasia esculenta*, *Xanthosoma sagittifolium*, *Alocasia macrorrhizos*, *Cyrtosperma merkusii*, and *Amorphophallus* sp. (Pardales Jr. 1997). Other species are used in traditional medicine, while many are cultivated as ornamental plants for their aesthetic appeals, such as *Aglaonema, Alocasia, Anthurium, Dieffenbachia, Monstera, Philodendron,* and *Pothos* (Simpson 2010; Proctor 2012; Timberlake and Martin 2012; Flores et al. 2020). In forest parks, aroids not only enrich the landscape but also contribute to the ecosystem in several ways. Their large leaves create animal habitats, while their underground structures help store nutrients and improve soil quality. Additionally, aroids can serve as food sources for humans and animals, and attract pollinators, thereby supporting broader biodiversity within the parks (Pardales Jr. 1996; Mayo et al. 1997; Chen et al. 2010).

According to Co's Digital Flora of the Philippines (2024), there are 131 native aroids, with 75 species endemic to the Philippines that belong to the following genera: *Aglaonema*, *Alocasia*, *Amorphophallus*, *Arisaema*, *Cryptocoryne*, *Homalomena*, *Pothos*, *Rhaphidophora*, and *Schismatoglottis*. There are 18 introduced species but now naturalized generally due to escape in cultivation, such as *Alocasia cucullata*, *Caladium bicolor*, *Epipremnum amplissimum*, *Epipremnum aureum*, *Gonatopus boivinii*, *Homalomena rubescens*, *Lemna perpusilla*, *Philodendron erubescens*, *P. hederaceum*, *Pistia stratiotes* (invasive per CABI 2017), *Spathiphyllum cannifolium*, *Syngonium podophyllum*, *Syngonium wendlandii*, *Typhonium blumei*, *T. roxburghii*, *T. trilobatum*, *Xanthosoma sagittifolium*, and

Zantedeschia aethiopica (CDFP 2024). According to Aureo et al. (2020), Araceae is a joint family with more than ten representative taxa in Rajah Sikatuna Protected Landscape in Bohol, Philippines. Po-Abit (2008) found native Araceae in Mt. Pangasugan, Leyte, namely *Homalomena philippinensis*, *Schismatoglottis calyptrata*, *Rhaphidophora*, *Amydrium medium*, *Aglaonema*, *Pothoidium lobbianum*, *Alocasia zebrina*, *Alocasia heterophylla*, *Alocasia pubera*, *Spathiphyllum commutatum*, *Rhaphidophora monticola*, *Scindapsus* spp., *S. hederaceus*, *Pothos* spp., and *Pothos ovatifolius*. Banag-Moran et al. (2022) found *Aglaonema commutatum*, *Caladium bicolor*, and *H. philippinensis* in Aklan's disturbed and undisturbed lowland forest. Despite these findings, native aroids are often underutilized in urban forest parks. These findings make aroids valuable for both conservation and landscape design. However, aroids are frequently overlooked in park planning and landscape design due to limited awareness, commercial availability, and a preference for exotic species.

This study aimed to create a checklist of native, naturalized, and introduced Araceae species in two urban forest parks in Metro Manila: Arroceros Forest Park (AFP) and Ninoy Aquino Parks and Wildlife Center (NAPWC) through an inventory survey, which provides baseline data on their occurrence and abundance and identifies species that are unique or common to both parks. This information can help in environmental planning by considering growing native aroid species and managing exotics in the area, contributing to conservation and sustainability efforts.

MATERIALS AND METHODS

Study area

A survey of aroids was conducted in two green spaces in Metro Manila, namely the Ninoy Aquino Parks and Wildlife Center (NAPWC) and Arroceros Forest Park (AFP) located in the City of Manila and Quezon City, Philippines, respectively (Figure 1). The general coordinate of NAPWC is 14° 39’ 7.56” N, 121° 2’ 43.08” E, and is relatively flat in topography, ranging from 37.7 to 44.6 m above sea level, with a man-made 4-ha lagoon located in the northwestern area. The park's soil is shallow, primarily composed of adobe rock and loam, allowing quick water recession despite flooding during heavy rains. The soil is slightly alkaline with essential nutrients, and the terrain's proximity to the lagoon indicates alluvial, silty loam soil. The park experiences a Type I climate with dry seasons from December to May and wet seasons from June to November. Hydrologically, the lagoon drains northern areas through canals and a creek in the south (NAPWC 2019).

Arroceros Forest Park (AFP) was developed in 1993 and is located on the south bank of the Pasig River near Quezon Bridge (14° 35’ 39.12” N, 120° 58’ 54.12” E) and covers an area of 2.72 ha. It consists of a secondary growth forest with 61 tree species, over 3,500 trees, and 8,000 ornamental plants, providing a habitat for 10 bird species, including the long-tailed shrike (*Lanius schach*) and Philippine pied fantail (*Rhipidura nigritorquis*). The park also features tiled pathways, concrete roads, a fish pond, a bridge, and a riverside walk. Trees such as acacia, banyan, and mahogany, along with fruit and ornamental plants, contribute to its rich biodiversity (Roces 2003, 2005).

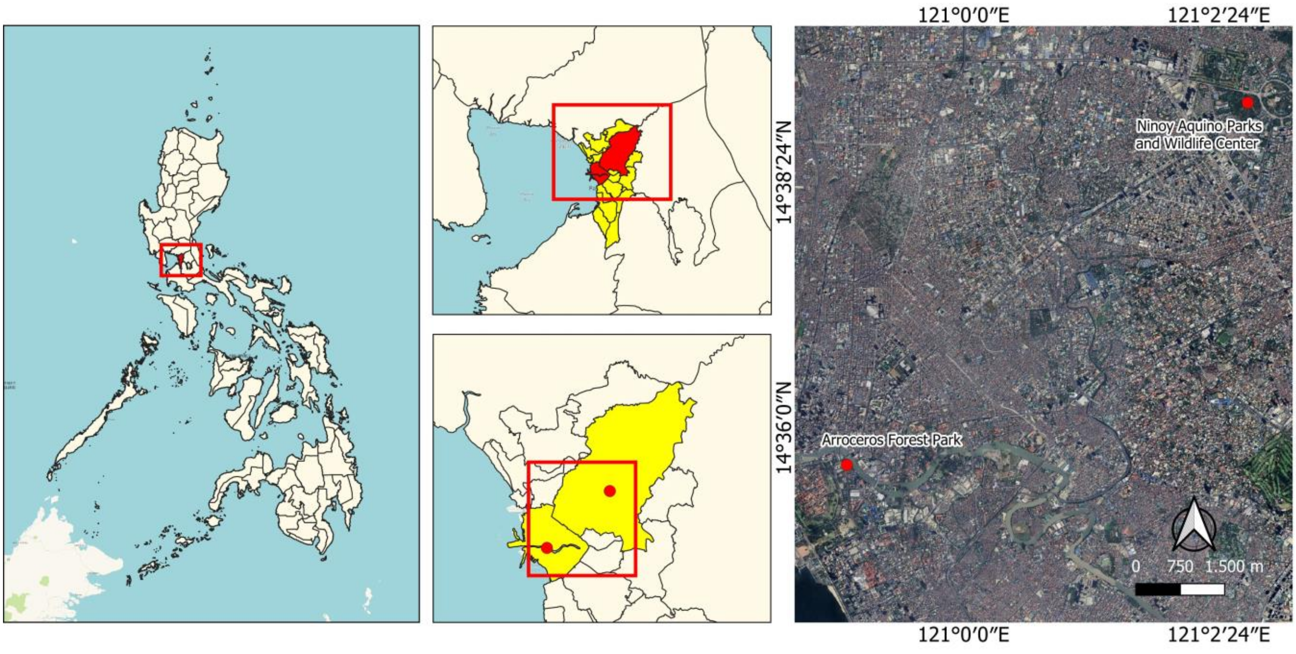

Figure 1. Study area in the Arroceros Forest Park (AFP), and Ninoy Aquino Parks and Wildlife Center (NAPWC), Philippines

These sites were selected to ensure that the aroids observed are most likely growing naturally due to their status of being a protected area. The whole area was surveyed as much as possible, except in some areas restricted to visitors with respect to the rules and regulations of the parks.

Procedures

Study design

This study follows a descriptive botanical inventory design that involves an opportunistic survey of plants in an area. This type of survey was carried out to record the plant species prior to conducting more in-depth or targeted studies. The results from this study are crucial for gaining a comprehensive understanding of the occurrence, composition, and diversity of aroids in the area.

Data collection and documentation

The study was conducted on different days between May and June 2024. Repeated walks throughout these areas were done to search for Aroid plants between 9:00 am and 12:00 pm or 1:00 pm to 4:00 pm. Equipped with a smartphone camera, all encountered Aroid species were photographed, with their abundance estimated through the direct count method, for terrestrial and epiphytic species (Hill et al. 2005). A high-definition smartphone camera and OM Systems Tough TG7 Camera were used to capture plant structures. Species included in the inventory were plants rooted in the natural substrate of the soil making up NAPWC. Plants inside pots and enclosures that were otherwise inaccessible to the researchers were excluded from the study. Furthermore, damaged plants (i.e., incomplete or torn leaves) were also not included as it would have proven challenging for identification. A measuring tape was used to measure the sizes of plant structures relevant for identification. Leaf vouchers were taken from the plant for further inspection after survey, when consulting taxonomic references.

Taxonomic identification of aroids

Identification to applicable taxonomic level below family Araceae (such as genus, species, and variety/cultivar, if necessary) was achieved using the key to the genera of Araceae of Mayo et al. (1997) and supplemented by taxonomic keys available from the International Aroid Society and online databases such as Co’s Digital Flora of the Philippines (https://www.philippineplants.org/) and Plants of the World Online (https://powo.science.kew.org/), and consulting citizen science websites such as iNaturalist (https://www.inaturalist.org/). Furthermore, digitized local herbaria from the Global Biodiversity Information Facility (https://www.gbif.org/) were utilized for identification. Taxonomic names used in identifying specimens follow POWO-accepted names. Following this process, a checklist was created to document the presence, observed growth habits, general distribution, and conservation status of all Aroid species in the park.

Data analysis

Species richness was used to present the number of species identified in the area. The similarity of species richness found between NAPWC and AFP was determined using the Jaccard Similarity Index (Jaccard 1912). It was obtained using the number of common species found in both locations. It is then divided into the total number of unique species across all locations. The index value ranges from 0-1, wherein as the value approaches 1, the observed species are more similar in both locations. Thus, a value of 1 means both locations have the same species observed, and 0 means there are no common species found. To express in a formula:

$$Jaccard\ Index\ (Ji) = \frac{Number\ of\ common\ species\ (NAPWC \cap AFP)}{Total\ unique\ species\ in\ both\ sets\ (NAPWC \cup AFP)}$$

RESULTS AND DISCUSSION

Species diversity of Araceae in Ninoy Aquino Parks and Wildlife Center

Twenty-two plant species (Figure 2) along with their estimated abundance, distribution status, and conservation status. Ten Aroid genera were identified as occurring in the wildlife center, with varying estimated abundance: *Aglaonema, Alocasia, Caladium, Dieffenbachia, Epipremnum, Philodendron, Spathiphyllum, Syngonium, Thaumatophyllum,* and *Typhonium* (Table 1). Of the 22 species, eight were native, nine were introduced, and five were naturalized, according to Co's Digital Flora of the Philippines. The IUCN had not evaluated all species, except *Alocasia odora* (Figure 2.E) with their 'Least Concern' status. *Alocasia* spp. (Figures 2.C-H) were the most well represented, with six species identified, followed by *Epipremnum* spp. (Figures 2.K-M) and *Dieffenbachia* spp. (Figures 2.I-J).

The checklist of aroids in the Ninoy Aquino Parks and Wildlife Center (NAPWC) reveals a diverse collection of species with varying levels of abundance, distribution, and conservation status. Native species such as *Aglaonema commutatum* and *Epipremnum pinnatum* are well-represented, with the latter showing a high abundance of over 100 individuals. The presence of the vulnerable species *Alocasia micholitziana* (Figure 2.D) (DAO 2007) with an estimated abundance of less than 20 suggests that areas like NAPWC can serve as important refuges for threatened species, which can be a potential way in ex situ conservation. Ismail (2021) reported that urban green spaces can substantially strengthen conservation by broadening ex situ living collections and increasing genetic diversity for restoration and reintroduction programs in particular. In contrast, introduced species like *Alocasia robusta* (Figure 2.F) and *Philodendron giganteum* (Figure 2.O) are less abundant, typically with fewer than ten individuals. Several species, including *Typhonium blumei* (Figure 2.T) and *Syngonium podophyllum* (Figure 2.Q), have naturalized and thrived in the local environment, with *T. blumei* being particularly abundant with over 100 individuals. While most species are listed as "Not Evaluated" (NE) in terms of conservation status, either they have not been assessed for extinction risk or they are a cultivar or variety of horticultural importance, *A. odora* is marked as Least Concern (LC). Overall, the table underscores the wide variety of aroids in NAPWC, with a mix of native, introduced, and naturalized species, though many lack formal conservation assessments.

Among the identified aroids, *E. pinnatum* (Figure 2.L) was the most abundant in the area with >100 estimated individuals. It was primarily found in clusters and climbing in various trees, but it can also be observed crawling on the ground in different life stages. It grows in tropical to subtropical regions, in warm temperatures, and tolerates extreme heat and drought but prefers areas receiving more significant precipitation. The species can also grow on different soil types, such as in clay, sand, and loam soils, with pH 4-6 (Rojas-Sandoval and Acevedo-Rodríguez 2022). These characteristics may be the reason for the abundant growth of *E. pinnatum* in NAPWC, as the Philippines, in general, is in a tropical region that receives very high annual precipitation. They are also widely cultivated and can be found in areas with high human activity. These characteristics also support their invasiveness outside their natural habitat. It is considered an aggressive vine that forms in dense colonies, monopolizing resources, engulfing the native species, and shading the plants growing in the understory or forest floor. In the end, this resulted in a change to the community structure of the area to which it was introduced.

Typhonium blumei (Figure 2.T) was also more abundant in the area than other aroids, with >100 estimated individuals often found in the ground. Unlike *E. pinnatum,* which is often found climbing trees or other structures, *T. blumei* tends to be more ground-dwelling. This characteristic makes it more commonly found on forest floors or in low-lying areas. In addition, *T. blumei* can be found in shaded and moist environments with well-drained soils. It thrives in forests and disturbed areas such as in gardens or on the roadside. The NAPWC provides a suitable environment for *T. blumei,* with its shaded area moist and rich soil condition. These factors create an ideal microhabitat that supports the growth and proliferation of these species. Furthermore, several research studies have shown the potential medicinal uses of these plant species. Various parts of the plant showed anti-inflammatory and pain-relieving properties (Korinek et al. 2017; Pradeepika et al. 2018; Anandhi et al. 2020).

Aglaonema commutatum 'Brilliant Beauty' (Figure 2.B), *Syngonium* spp. (Figure 2.Q-R), and *Alocasia macrorrhizos* (Figure 2.C) were also abundant, but in particular sites. *Aglaonema commutatum* 'Brilliant Beauty' was highly abundant in the area where the enclosures of birds, reptiles, and mammals were found. They were present along the walkway and on the soil surrounding the cages. Their abundance can be due to their ease of spread and the assistance of the gardeners in the area, as it is a cultivar known for its ornamental value. *Syngonium* species were mostly found climbing alongside *E. pinnatum* or growing at the sides of abandoned cages in NAPWC. The specimen for *S. angustatum* was collected near a reticulated python cage, where it dominated a circular patch of land. A possible reason why it can easily dominate is due to its inherent invasiveness. According to Chong et al. (2010), *Syngonium* species were assessed in Singapore for their invasiveness. They found out that it was only recently naturalized in the area, can spontaneously spread, and can produce viable seeds. *Syngonium* spp. was naturalized in the Philippines as well (Pelser et al. 2024). However, *S. angustatum* is not yet included in the database, indicating its exotic and "introduced" status, which is characteristic of an invasive species. Despite the potential invasiveness, *Syngonium* spp. (particularly *S. podophyllum*) can be a phytoremediator by removing toxic gasses such as benzene and formaldehyde in the air (Balan and Chandrasekaran 2022). On the other hand, *A. macrorrhizos* were abundant near the river and alongside walking roads. Unlike *Syngonium* spp., *A. macrorrhizos* is native to the Philippines. Locally, *A. macrorrhizos,* known as *gabi* is a commercially important plant for polycropping, ornamentals, and food products (Müller and Guzzon 2024). It is often planted alongside other plants, such as cassava (*Manihot esculenta*), to promote more growth and robustness of target crops. It grows in humid and sub-tropical climates and does not tolerate drought as much. This explains why most of the *A. macrorrhizos* found in NAPWC were discovered nearby rivers and water bodies.

Philodendron ×domesticum 'Lemon Lime' (Figure 2.N) and *Dieffenbachia seguine* (Figure 2.J) were abundant in specific sites such as nearby restrooms and signs due to their origin as ornamental plants. All the *P. ×domesticum* 'Lemon Lime' and *D. seguine* thriving in the area were the result of artificial introduction (gardening) as indicated by a caretaker in NAPWC. It is also because of their notorious cultivated aroids as well as their non-inclusion in Co's Digital Flora database, indicating their "Introduced" status. *P. ×domesticum* 'Lemon Lime' especially is a popular *Philodendron* variety and is often used for ornamentation of interior and exterior infrastructures (Phonpho et al. 2021), which can explain its abundance in the park. According to Aigbokhan and Agbontaen (2013), *D. seguine* was correlated with invasiveness in the rainforest ecosystem of Nigeria. Their findings suggested that *D. seguine* contributed to the sparse vegetation of the infested sites. One possible reason could be their deterrent mechanism against herbivory due to the abundance of oxalate crystals in their tissues (Coté 2009). It is thus essential to re-evaluate the use of *D. seguine* as an ornamental plant in natural parks such as NAPWC.

Table 1. Checklist of Aroids in NAPWC and AFP, Manila, Philippines

Species/cultivar	Location	Common or local name	Estimated abundance (NAWPC, AFP)	Distribution status	Conservation status
Aglaonema commutatum Schott	NAWPC	Philippine evergreen	<20	Native	NE
Aglaonema commutatum Schott 'Brilliant Beauty'	NAWPC, AFP	Brilliant beauty Aglaonema	>50, ~40	Native	NE
Alocasia macrorrhizos (L.) G.Don	NAWPC, AFP	giant taro (local: *badiang*)	>50, 1	Native	NE
Alocasia micholitziana Sander	NAWPC	green velvet Alocasia 'Frydek'	<20	Native	NE; VU[1]
Alocasia odora (G.Lodd.) Spach	NAWPC	night-scented lily	<20	Introduced	LC
Alocasia robusta M.Hotta	NAWPC	Borneo giant	<10	Introduced	NE
Alocasia sp. 'Amazonica'	NAWPC	Alocasia Amazonica	<20	Introduced	NE
Alocasia sp. 'Pseudosanderiana'	NAWPC	Alocasia Pseudosanderiana	<20	Possibly naturalized from cultivation	NE
Caladium bicolor (Aiton) Vent.	NAWPC, AFP	Heart of Jesus, angel wings	<10, ~10	Naturalized	NE
Dieffenbachia longispatha Engl. & K.Krause	NAWPC	Dumb cane	<10	Introduced	NE
Dieffenbachia seguine (Jacq.) Schott	NAWPC	Dumb cane	>50, ~100-200	Introduced	NE
Dieffenbachia sp. Schott	NAWPC	Dumb cane	<10	Introduced	NE
Dieffenbachia 'Tropic Marian'	AFP	Dumb cane, Tropic Marian	~50-100	Introduced	NE
Epipremnum aureum (Linden & André) G.S.Bunting	NAWPC, AFP	Golden pothos	>30, ~50-100	Naturalized	NE
Epipremnum pinnatum (L.) Engl.	NAWPC, AFP	Dragon-tail	>100, ~50-100	Native	NE
Epipremnum amplissimum (Schott) Engl.	NAWPC	Devil's ivy	<10	Naturalized	NE
Philodendron ×domesticum 'Lemon Lime'	NAWPC, AFP	Lemon lime Philodendron	<30, ~20	Introduced	NE
Philodendron giganteum Schott	NAWPC	Giant elephant ear Philodendron	<10	Introduced	NE
Spathiphyllum wallisii Regel	NAWPC	Peace lily	<20	Native	NE
Spathiphyllum sp. Schott	AFP	Peace lily	~50	Native	NE
Syngonium angustatum Schott	NAWPC	Five fingers	<30	Introduced	NE
Syngonium neglectum Schott	AFP	Arrowhead plant	~50-100	Introduced	NE
Syngonium podophyllum Schott	NAWPC	Arrowhead plant	>50	Naturalized	NE
Thaumatophyllum bipinnatifidum (Schott ex Endl.) Sakur., Calazans & Mayo	NAWPC, AFP	Selloum (local: *sahod-yaman*)	<10, ~30	Introduced	NE
Typhonium blumei Nicolson & Sivad.	NAWPC	Voodoo lily; (local: sometimes *gabing-nuno* for related species *T. trilobatum*)	>100	Naturalized	NE

Note: LC: Least Concern, NE: Not Evaluated, [1]Conservation status per DAO No. 2007-01

Figure 2. Species diversity of Araceae in NAPWC, Manila, Philippines: A. *Aglaonema commutatum*; B. *A. commutatum* 'Brilliant Beauty'; C. *Alocasia macrorrhizos*; D. *A. micholitziana*; E. *A. odora*; F. *A. robusta*; G. *A.* 'Pseudosanderiana'; H. *Caladium bicolor*; I. *Dieffenbachia longispatha*; J. *D. seguine*; K. *Epipremnum aureum*; L. *E. pinnatum*; M. *E. amplissimum*; N. *Philodendron* ×*domesticum* 'Lemon Lime'; O. *P. giganteum*; P. *Spathiphyllum wallisii*; Q. *Syngonium angustatum*; R. *S. podophyllum*; S. *Thaumatophyllum bipinnatifidum*; T. *Typhonium blumei*

Species diversity of Araceae in Arroceros Forest Park

Thirteen Aroid species were observed in AFP (Figure 3). Among these species, nine genera were as occurring in the park, with differences in estimated abundance. These are identified *Aglaonema, Alocasia, Caladium, Dieffenbachia, Epipremnum, Philodendron, Spathiphyllum, Syngonium*, and *Thaumatophyllum*. Most species are either introduced or naturalized, with only a few being native (Table 1). Most species have not been assessed for risk, as shown in the conservation status for most species, and some are cultivars or varieties, which are listed as "NE" (Not Evaluated) per IUCN. Native species include *Aglaonema commutatum* 'Brilliant Beauty' (Figure 3.F), with an estimated abundance of around 40, and *Spathiphyllum* sp. (Figure 3.H), with about 50 individuals. However, *Alocasia macrorrhizos*, an endemic species, has only one recorded individual. *Dieffenbachia seguine* (Figure 3.J) and *D.* 'Tropic Marian' (Figure 3.K) are introduced and show higher abundances, ranging from 50 to 200 individuals. Several species are naturalized or possibly naturalized, such as *Epipremnum aureum* (Figure 3.B) and *Syngonium podophyllum* (Figure 3.E), which are more abundant than most of the aroids in AFP. The differences in native, introduced, and naturalized species indicate the diversity within the collection, with varying levels of abundance and conservation considerations.

Figure 3. Species diversity of Araceae in AFP, Manila, Philippines: A. *Epipremnum pinnatum* and its host tree; B. *Epipremnum aureum* attached to the tree host *Gmelina arborea*; C. Epiphytic habit of *Syngonium neglectum*; D. Terrestrial habit of *S. angustatum*; E. *S. podophyllum* population; F. *Aglaonema* 'Brilliant Beauty'; G. *Thaumatophyllum bipinnatifidum*; H. A patch of juvenile *Spathiphyllum* sp. along with variegated *Euphorbia tithymaloides*, and a *Terminalia* seedling; I. *Caladium bicolor*; J. *Dieffenbachia seguine*; K. *Dieffenbachia* 'Tropic Marian' along with few *Syngonium* spp.

Both species of *Epipremnum* were often observed scaling trees at great heights, suggesting a strong inclination towards vertical growth. *Epipremnum pinnatum* (Figure 3.A) is a hemiepiphyte, considered native (Pelser et al. 2024), and exhibits fenestrated leaves, a characteristic adaptation for efficient light capture in its epiphytic growth. Observed individuals mostly climb on trees at elevated heights, some trailing on the ground; almost all individuals have fenestrated leaves, entirely green in color. This species appears to dominate the area by clinging to different species of trees, such as *Terminalia elliptica, Dracontomelon dao,* and *Adonidia merillii*. In contrast, *E. aureum* individuals mostly climb on trees at an elevated height, some trailing on the ground, and others occur in dense patches; two forms were observed: green and variegated "aurea." The latter is native to French Polynesia (Haigh et al. 2011), and although considered initially as an exotic species, its naturalization around cities and towns in the Philippines could be due to extensive cultivation or escaping from cultivation areas (Pelser et al. 2024), indicating that *E. aureum* has effectively acclimated to the local environment. *E. aureum* was observed attaching to some trees like *T. elliptica* and *Gmelina arborea* (Figure 3.B).

Syngonium is native to Mexico and the Tropical Americas, as documented by Haigh et al. (2011). It was later introduced in the Philippines, as reported by Stuart Jr. (2023) and Pelser et al. (2024). There is a significant number of *Syngonium* species in the park, which are primarily non-native, compared to *Epipremnum*. *Syngonium neglectum* and *S. angustatum* appear to be more prevalent than *S. podophyllum*, displaying a preference for climbing, which indicates their established presence. On the other hand, *S. podophyllum* has been observed to primarily set itself on the ground, often at the base of trees, suggesting its recent introduction to the area. This species demonstrates a notable presence with 100-200 individuals, suggesting a successful adaptation as an exotic species. The dense patches indicate that it flourishes in the terrestrial environments found within the park.

Aglaonema ‘Brilliant Beauty’ likely originated as a cultivar or a hybrid under *Aglaonema commutatum* complex (Nicolson 1969). Despite its potential native status, it is not as commonly found in the park, with only around 40 individuals. The distribution pattern exhibits clusters of individuals scattered randomly. *Caladium bicolor* (Figure 3.I) and *Spathiphyllum* sp. (Figure 3.H) have a relatively small number of occurrences, with *C. bicolor* having less than ten individuals and *Spathiphyllum* sp. having around 50 individuals. Their unique status and small population size indicate that they could be relatively new additions rather than being less well-suited to the park's ecosystem.

Thaumatophyllum bipinnatifidum (Figure 3.G) and *Philodendron ×domesticum'* Lemon Lime' were both found near the park's nursery area, suggesting that they are intentionally grown by gardeners for specific planting purposes. The limited locations emphasize the carefully managed introduction and potential ongoing acclimatization efforts. The diversity and distribution of Aroid species in the park indicate a combination of native and non-native species, with some being firmly established while others are still relatively scarce. The presence of naturalized and exotic species, like *E. aureum* and *D. seguine,* suggests a potential influence on the native flora and park ecology.

Similarity of species richness between NAPWC and AFP

This study emphasizes the significant ecological aspects of species that overlap between the two areas (Table 2). The Jaccard Index of 0.4 suggests a moderate level of similarity in the composition of species between the two areas (Goettsch and Hernández 2006), with 10 out of 25 species being common to both. Four species have been introduced to the Philippines, namely *D. seguine, P. domesticum'* Lemon Lime', *S. angustatum,* and *T. bipinnatifidum.* These non-indigenous species may have been deliberately introduced for decorative purposes or inadvertently introduced through various human activities. Their occurrence in both regions implies that they are either highly suited to the specific environmental conditions or deliberately controlled to sustain their numbers. The presence of introduced species in both areas indicates the existence of comparable environmental conditions or management practices.

Introduced species that have successfully established themselves in the wild are known as naturalized species. These species have adapted to the local ecosystems and are spreading autonomously. These three species, *C. bicolor, E. aureum,* and *S. podophyllum* are found in both areas of the Philippines and have become naturalized. Both regions demonstrate successful assimilation into the indigenous plant life. According to a note from CDFP (Pelser et al. 2024), *C. bicolor* is grown for its leaves with different colors, and sometimes it can be found outside of cultivation, but it is always found close to human settlements. In addition, *S. podophyllum* is found in secondary forests adjacent to bodies of water, whereas *E. aureum* is naturalized in urban areas and cultivated regions (Suarez 2021, pers.com.). These signs indicate their adaptability but also raise concerns regarding their potential impact on native species and ecosystems, particularly if they become invasive.

The occurrence of native species in both regions (*A. commutatum, A. macrorrhizos,* and *E. pinnatum*) serves as a favorable indication of the conservation of local biodiversity. However, the results of the inventory study show that these native aroids are still underrepresented, with only three being common in both areas. *A. commutatum* is native to the Philippines, and the cultivar 'Brilliant Beauty' may have been primarily produced in cultivation locally. The precise geographic range of *A. macrorrhizos* is uncertain. However, it has been observed in its natural state in India, Sri Lanka, and Peninsular Malaysia (Pelser et al. 2024). It has a broad distribution as both a cultivated crop and an ornamental plant. Several cultivars have been identified, often initially classified as species, with or without specific examples being mentioned. *E. pinnatum* is a prevalent epiphytic Aroid that typically inhabits dense vegetation and forests at various altitudes, ranging from sea level to moderate heights (Pelser et al. 2024). These species play a vital role in the local ecosystem, enhancing its stability and ability to recover from disturbances. The presence of overlap between the two areas suggests that both habitats possess comparable ecological characteristics, which in turn promote the growth of native flora.

Opportunities for cultivating native Aroid species

The utilization of empty spaces is an excellent opportunity to promote the conservation of plant species, particularly Aroid species native to the Philippines. Aroids of various life habits can be cultivated in the park, whether terrestrial or epiphytic. Aquatic aroids, such as *Lemna aequinoctialis*, *L. minor*, *L. trisulca*, *Spirodela oligorrhiza*, *S. polyrhiza*, and *Wolffia globosa*, can also be grown in artificial aquatic ecosystems within the park. The typical habitat features of AFP and NAPWC for native terrestrial aroids consist of elevated humidity levels, damp to saturated soil conditions, and a preference for organic-rich soils. Such native terrestrial aroids include *Aglaonema* (*A. commutatum, A. cordifolium, A. densinervium, A. nitidum, A. philippinense, A. robeleynii, A. simplex, A. tricolor*), *Alocasia* (*A. atropurpurea, A. boyceana, A. clypeolata, A. culionensis, A. heterophylla, A. macrorrhizos, A. maquilingensis, A. micholitziana, A. portei, A. ramosii, A. sanderiana, A. scalprum, A. sinuata, A. zebrina*), *Arisaema* (*A. filiforme, A. laminatum, A. polyphyllum*), *Colocasia* (*C. esculenta, C. formosana*), *Cyrtosperma merkusii*, *Homalomena* (*H. humilis, H. palawanensis, H. philippinensis*), *Leucocasia gigantea*, *Schismatoglottis* (*S. bogneri, S. calyptrata*), and *Spathiphyllum commutatum* (Nicolson 1968b, 1969; Hay 1988, 1999; Yeng et al. 2013; Boyce et al. 2015; Matthews et al. 2015, 2017; Pelser et al. 2024).

Aglaonema species, native to South Asia, Southeast Asia, and New Guinea, are ideal aroids to be planted in urban parks due to their ability to thrive in low-light environments and their contribution to enhancing urban biodiversity plus their low-maintenance nature makes them suitable for sustainable urban greening initiatives (Lestari and Asih 2017). On the other hand, *Alocasia* species which are commonly found in Asia and eastern Australia, thrive in soil that drains well and has a high level of humidity and tend to grow in areas with partial shade, such as near streams or consistently moist environments (Hay and Wise 1991; Hay 1999). However, *Colocasia* (taro) and their close relatives *Leucocasia*, *Homalomena*, and *Cyrtosperma*, are well-suited for wetland environments, such as riverbanks and marshy areas (Matthews et al. 2015, 2017; Pelser et al. 2024). They flourish in nutrient-rich, loamy soils and prefer areas with ample sunlight. These plants typically thrive in stagnant water and thrive in consistently damp to saturated environments. Although numerous plants are well-suited for shaded or partially shaded environments as understory plants, a few, such as *Colocasia* and *Leucocasia*, can thrive in full sun (Mahr 2024).

Table 2. Similarity of species richness between NAPWC and AFP, Manila, Philippines using Jaccard Index

Species	NAPWC	AFP	NAPWC ∩ AFP
Aglaonema commutatum Schott	+		
Aglaonema commutatum Schott 'Brilliant Beauty'	+	+	++
Alocasia macrorrhizos (L.) G.Don	+	+	++
Alocasia micholitziana Sander	+		
Alocasia odora (G.Lodd.) Spach	+		
Alocasia robusta M.Hotta	+		
Alocasia sp. 'Amazonica'	+		
Alocasia sp. 'Pseudosanderiana'	+		
Caladium bicolor (Aiton) Vent.	+	+	++
Dieffenbachia longispatha Engl. & K.Krause	+		
Dieffenbachia seguine (Jacq.) Schott	+	+	++
Dieffenbachia sp. Schott		+	
Dieffenbachia 'Tropic Marian'	+		
Epipremnum aureum (Linden & André) G.S.Bunting	+	+	++
Epipremnum pinnatum (L.) Engl.	+	+	++
Epipremnum amplissimum (Schott) Engl.	+		
Philodendron ×domesticum 'Lemon Lime'	+	+	++
Philodendron giganteum Schott	+		
Spathiphyllum wallisii Regel	+		
Spathiphyllum sp. Schott		+	
Syngonium angustatum Schott	+	+	++
Syngonium neglectum Schott		+	
Syngonium podophyllum Schott	+	+	++
Thaumatophyllum bipinnatifidum (Schott ex Endl.) Sakur., Calazans & Mayo	+	+	++
Typhonium blumei Nicolson & Sivad.	+		

Note: (+) indicates a species is present, (++) indicates a species is present in both areas

The abundance of tree species in AFP and NAPWC can host native epiphytic aroids, such as *Amydrium* (*A. medium, A. zippelianum*), *Anadendrum* (*A. latifolium, A. microstachyum, A. montanum*), *Pothoidium lobbianum, Pothos* (*P. cylindricus, P. dolichophyllus, P. inaequilaterus, P. insignis, P. luzonensis, P. ovatifolius, P. philippinensis, P. scandens*), *Rhaphidophora* (*R. acuminata, R. banosensis, R. conocephala, R. cretosa, R. elmeri, R. korthalsii, R. minor, R. monticola, R. perkinsiae, R. philippinensis, R. todayensis*), and *Scindapsus* (*S. curranii, S. falcifolius, S. hederaceus, S. longistipitatus, S. pictus, S. treubii*) (Nicolson 1968a; Boyce 2000; Othman et al. 2010; Pelser et al. 2024). These aroids have evolved to thrive in the distinct environment of tropical rainforests, where they can be found flourishing on the trunks and branches of trees. The microclimate that the forest park provides is suitable for these aroids to thrive.

While there are native aroids in the genera *Amorphophallus*, *Cryptocoryne*, and *Schismatoglottis,* introducing them into a forest park necessitates careful deliberation because of their distinct habitat requirements, strict environmental requirements, biology, and conservation statuses (Pelser et al. 2024). The genus *Amorphophallus* is commonly found in tropical and subtropical regions, thrive in well-drained, fertile soils with dappled light, which the forest park can simulate. It is worth noting that many of these species are currently classified as vulnerable, threatened, or critically endangered (Pelser et al. 2024), so ethical acquisition of these species from the wild and to be introduced in the park may be a challenge. *Cryptocoryne* is commonly found along streams and riverbanks in the Philippines, thrive in stable aquatic environments with clean, nutrient-rich water and optimal pH levels and are pretty elusive and consist of species that are vulnerable or critically endangered (Lansdown et al. 2023). Species of *Schismatoglottis* flourish in environments with high humidity and shaded rainforest understories and usually are found near bodies of water, like *Cryptocoryne* (Delos Angeles et al. 2023). While these species show promise for enriching Aroid diversity, their habitat types may not be replicable in AFP or NAPWC. Therefore, a thorough study of their habitat preferences and growth requirements is essential before planting them.

In order to effectively incorporate these plants, the forest parks or wildlife centers must create environments that closely resemble their native habitats. This involves carefully matching climate conditions, adjusting soil and water conditions, and taking into account the ecological impact to maintain the existing balance of the ecosystem. Continual monitoring and maintenance are crucial to maintain their growth, development, and preservation.

In conclusion, this study identified 25 Aroid species across 10 genera in NAPWC and AFP sites. A checklist was created to provide valuable baseline data for understanding their composition and distribution in urban forest parks in Metro Manila. The findings reveal that aroids in these areas are predominantly introduced and naturalized, with native species significantly underrepresented. This highlights the anthropogenic influences shaping green spaces, often through accidental or intentional cultivation without considering the ecological identity and impacts of plant species. Despite differences in park size, a Jaccard index value of 0.4 shows a moderate overlap in species composition, with introduced and naturalized species remaining dominant, reflecting the shared ecological characteristics of these areas. To optimize park spaces for conservation, prioritizing the introduction and propagation of Philippine native Aroid species is essential. It is strongly recommended that park authorities focus on planting native aroids to enhance biodiversity, support ecosystems dependent on these plants, promote ecological sustainability, and contribute to the conservation of native species in urban environments.

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