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Araceae Juss. from Serra da Tiririca, Rio de Janeiro, Brazil

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Abstract

The study was carried out in Serra da Tiririca, located on the border of the municipalities of Niterói and Maricá, in the state of Rio de Janeiro. It is part of the Serra da Tiririca State Park, which protects 3,514 ha of Atlantic Forest. It is characterized by the Submontane Dense Ombrophylous Forest and vegetation on rocky outcrops in inselbergs. The objective was to inventory the native Araceae species occurring in Serra da Tiririca, present an analytical key for genres, point out the presence of exotic species, indicate the preferred environments where the species are found and conservation measures. The collected material was registered in the RFFP herbarium, with duplicates in RB. Thirty-four species were recorded, classified into 12 genera. Among these, *Philodendron* and *Anthurium* were the richest with 11 species each. *Asterostigma* and *Thaumatophyllum* presented two species each and *Caladium*, *Heteropsis*, *Landoltia*, *Lemna*, *Monstera*, *Pistia*, *Syngonium* and *Wolffia*, one species each. *Anthurium lucidum*, *Anthurium luschnathianum*, *Philodendron hatschbachii* and *Philodendron nadruzianum* are threatened with extinction. Ten species considered new occurrences were identified. Exotic ornamental species considered as invasive are present in forested areas, one terrestrial and three hemiepiphytes. The conservation of Araceae is compromised due to the expansion of urban occupation, deforestation, intense tourist visits, especially in inselbergs, climbing and rappelling, fires, biological invasion and collection of ornamental species, which puts pressure on forested areas and rocky outcrops.

Keywords: Conservation, Floristic, Atlantic Forest, PESET.

Resumo

O estudo foi realizado na Serra da Tiririca, localizada na divisa dos municípios de Niterói e Maricá, no estado do Rio de Janeiro. Integra o Parque Estadual da Serra da Tiririca que protege 3.514 ha de Mata Atlântica. É caracterizada pela Floresta Ombrófila Densa Submontana e vegetação sobre afloramentos rochosos nos inselbergues. O objetivo foi inventariar as espécies nativas de Araceae ocorrentes na Serra da Tiririca, apontar a presença de espécies exóticas, indicar os ambientes preferenciais onde são encontradas as espécies e as medidas conservacionistas. O material coletado foi registrado no herbário RFFP, com duplicatas no RB. Foram registradas 34 espécies, submetidas a 12 gêneros. Dentre esses, *Philodendron* e *Anthurium* foram os mais ricos com 11 espécies cada. *Asterostigma* e *Thaumatophyllum* apresentaram duas espécies cada e *Caladium*, *Heteropsis*, *Landoltia*, *Lemna*, *Monstera*, *Pistia*, *Syngonium* e *Wolffia* uma espécie cada. Estão ameaçados de extinção *Anthurium lucidum*, *Anthurium luschnathianum*, *Philodendron hatschbachii* e *Philodendron nadruzianum*. Foram apontadas dez espécies consideradas novas ocorrências para a Serra da Tiririca. Espécies exóticas ornamentais consideradas invasoras estão presentes nas áreas florestadas, sendo uma terrestre e três hemiepífitas. A conservação de Araceae está comprometida devido à expansão da ocupação urbana, que pressiona as áreas florestadas e os afloramentos rochosos, o desmatamento, a intensa visitação turística, principalmente nos inselbergues, prática de escaladas e rapel, incêndios, invasão biológica e coleta de espécies ornamentais.

Palavras-chave: Conservação, Florística, Mata Atlântica, PESET.

Introduction

With the approval of 160 countries, including Brazil, the “Global Strategy for Plant Conservation” (GSPC) was elaborated in 2002 within the scope of the CBD. Its first goal established the need to share online knowledge on the flora of the signatory countries. In 2010, Brazil achieved this goal with the publication in two volumes of “Catálogo de Plantas e Fungos”, the catalogue for plants and fungi. The GSPC goals were deployed in view of the need for a scientific basis to face global environmental problems. In this context, the world's plant species are being cataloged, in order to support actions for biodiversity conservation (BFG 2018).

In Brazil, the monographs of 3,024 genders and 375 families were completed by December 2020. Among these, 90% of the Angiosperms were completed (Flora e Funga do Brasil 2025). However, taxonomic work still lacks much effort and field expeditions, as there are still little collected and unexplored sites. The remnants of the Atlantic Forest are in this situation, even those close to urbanized areas, such as Serra da Tiririca. Although it has already been inventoried by Barros (2008), new occurrences and species unknown to science are still recorded (Fernandes *et al.* 2023).

Some botanical families have already been studied in Serra da Tiririca as an offshoot of the floristic inventory carried out by Barros (2008). Among these are Bromeliaceae and Cactaceae (Verçoza & Bastos 2013), Piperaceae (Queiroz *et al.* 2014, 2020) and Cactaceae (Vasconcelos *et al.* 2019). After the general floristic inventory, when specifically focusing on families, it is possible to verify new occurrences of species for this locality.

The present study addressed Araceae, which is inserted in the order Alismatales. Currently, this family comprises about 144 genera and 3,676 species (Boyce & Croat 2011, onwards). Araceae has a registered occurrence on all continents and in the most varied types of environments, except for Antarctica. It is best represented in the Neotropics, Southeast

Asia and the Malay Archipelago (Mayo *et al.* 1997). It occurs in all Brazilian biomes with 51 genera and 569 species, 39 genera and 515 native species. Six genera and 287 species are endemic to Brazil (Flora e Funga do Brasil 2025). In the state of Rio de Janeiro, 110 taxa are recorded distributed in 20 genera, with the genus *Idimanthus* E.G.Gonç. and 25 species being endemic (Coelho *et al.* 2014, Gonçalves 2018, Flora e Funga do Brasil 2025).

Araceae has very diverse morphological characteristics and life forms. The main synapomorphy is the terminal or pseudolateral inflorescence, with reduced to long peduncles. These inflorescences are composed of a spadix, in which are gathered small flowers protected by a spathe, which is a modified bract (Mayo *et al.* 1997, Temponi *et al.* 2005). It is separated into eight subfamilies: Aroideae, Gymnostachidoideae, Lasioideae, Lemnoideae, Monsteroideae, Orontioideae, Pothoideae and Zamioculcadoideae (Mayo *et al.* 1997, APG 2016). In Brazil it is represented by five subfamilies Aroideae, Lasioideae, Lemnoideae, Monsteroideae and Pothoideae (Camelo *et al.* 2020).

Different authors have been working with Araceae with broad approaches in the state of Rio de Janeiro which includes Environmental Protection Area (PA) at the federal, state and municipal levels. Some with a specific focus only on Araceae (Coelho 2000, Coelho & Mayo 2000, Schneider & Coelho 2006, Sakuragui *et al.* 2011, Sakuragui 2012, Temponi & Coelho 2014, Calazans *et al.* 2018, Gonçalves 2018, Dutra Junior *et al.* 2021, 2024). And also those in which this family is included in floristic inventories, which contributes to the knowledge of the flora of Rio de Janeiro (Araujo & Oliveira 1988, Coelho 1997, Fontoura *et al.* 1997, Coelho & Schneider 2001, Lopes *et al.* 2004, Barros 2008, Araujo *et al.* 2009, Callado *et al.* 2009, Coelho *et al.* 2009, 2013, 2018, Carvalho & Sá 2011, Cruz & Nunes Freitas 2019).

The knowledge on Araceae in the municipalities of Niterói and Maricá is still incipient. It is possible to record the species in floristic inventories in a general manner (Silva & Oliveira 1989, Araujo & Vilaça 1981, Lopes *et al.* 2004, Andreatta *et al.* 2008, Barros 2008,

Machado *et al.* 2022, Pena-e-Silva *et al.* 2023). In Serra da Tiririca, Dutra Junior *et al.* (2024) pointed to 11 species for the genus *Anthurium*. In Maricá there is the work carried out with *Montrichardia linifera* (Arruda) Schott in Lagoa do São Bento (Dutra Junior *et al.* 2021).

These studies were aimed at knowing the floristic diversity of the corresponding areas, in addition to highlighting the importance of the conservation of native species. Regarding the Atlantic Forest, which is considered a complex of phytogeographies (Stehmann *et al.* 2009), the gap in studies on Araceae in the state of Rio de Janeiro needs to be reviewed. The works are limited to a few locations in the coastal and mountainous region. It is necessary to explore other locations so that it is possible to work on the conservation of the family at a regional level.

The present study aims to inventory the native species of Araceae occurring in Serra da Tiririca, present an analytical key for genera, point out the presence of exotic species, indicate the preferred environments where the species and conservation measures are found.

Material and Methods

Study area

This study was carried out in the Serra da Tiririca sector of the Serra da Tiririca State Park (PESET), located between the municipalities of Niterói and Maricá, in the state of Rio de Janeiro, Brazil (7456000-7466000 S; 702000-712000 W, UTM sad 69). This is the main sector of PESET and the best inventory of flora, covering different environments conducive to the occurrence of Araceae species.

PESET was created by state law n°. 1.901/1991. The definitive limits were instituted through state law n°. 5.079/2007 in 2,077 ha. After three subsequent extensions, the current area is included in state law decree n°. 43.913/2012, in which about 90% of the former Darcy Ribeiro Ecological Reserve, the Pai, Mãe and Menina Islands (only part emerged) and Morro da Peça were attached to PESET, totaling 3,514 ha.

The PESET management plan established its division into four sectors: Serra da Tiririca (Serra da Tiririca and Enseada do Bananal), Darcy Ribeiro (Serra do Cantagalo, Serra do Jacaré, Serra Grande and Serra do Malheiro), Lagunar (Morro das Andorinhas, Morro da Peça, Restinga and Duna de Itaipu) and Insular (Pai, Mãe and Menina Islands, only part emerged) (INEA 2015).

Serra da Tiririca is formed by a set of hills: Pedra do Elefante, Morro do Telégrafo, Alto Mourão, Morro do Catumbi, Morro da Serrinha, Morro do Cordovil, Costão de Itacoatiara and Morro da Penha (Barros 2008). Some of these hills are inselbergs, from German *insel*=island; *berg*=mountain (Porembski *et al.* 2007), which are very characteristic of the region around Guanabara Bay in the state of Rio de Janeiro.

As for geology, Serra da Tiririca has rocks originating in the Precambrian period, about 600 million years old, comprising the Geological Units Facoidal Gneiss and Cassorotiba Gneiss (Penha 1999). The geomorphology is similar to that attributed to the coast of Rio de Janeiro, composed of shores of gneissic granite alternated with the Holocene sandy plains of marine-continental origin (Barros 2008). It is part of the Geomorphological Unit of Coastal Hills and Massifs (INEA 2015). In the areas of exposed rocky outcrops, the decomposition of the rocks originates a type of shallow soil (lithosol), in which the mineral particles were transported by the action of rain, winds and, mainly, by gravitational processes. These particles were deposited on less steep ramps or accumulated in cracks of rocky walls, in which a characteristic vegetation develops (Barros 2008).

The climate of the region, according to the Köppen-Geiger classification, is of the *Aw* type, hot and humid, with rainy seasons in summer and dry seasons in winter (Kottek *et al.* 2006). The vegetation of Serra da Tiririca presents the phytophysionomies of the Submontane and Lowland Dense Ombrophilous Forest, according to the IBGE classification (2012). It also shows sections with vegetation on rocky outcroppings in the inselbergs and

rocky walls, as well as flooded areas. Forested areas are in different successional stages, due to their historical process of occupation (Barros 2008).

Field procedures

Fertile plant collections were carried out in Serra da Tiririca between April 2018 and November 2021 to expand and complement those previously carried out by Barros (2008). The walking method was used (Filgueiras *et al.* 1994), in which we sought to sample mainly those environments most conducive to the growth of Araceae species, such as the exposed rocky outcrops, the boulders inside the forest, in the trees of the forests (phorophytes) and in the flooded areas. Plants were collected and herborized according to usual botanical collection techniques (Peixoto & Maia 2013). The material was registered in Herbário da Faculdade de Formação de Professores da UERJ (RFFP), with duplicates sent to the Herbário do Jardim Botânico do Rio de Janeiro (RB).

Taxonomic analysis

Species identification was done through specialized bibliography: Coelho (2000, 2010), Coelho *et al.* (2009) and Schneider & Coelho (2006). The taxonomic study also covered face-to-face and/or online consultations to the herbaria FCAB, GUA, HB, HUENF, HRJ, HUNI, R, RB, RBR, RFA and RFFP, acronyms according to Thiers (2019, continuously updated). To point out new occurrences of Araceae species in Serra da Tiririca, Barros (2008), Maurenza *et al.* (2018) and Lourenço & Bove (2019) were followed. The nomenclatural review was carried out to eliminate inconsistencies (synonyms and indeterminate and/or mistakenly determined taxa) based on Flora e Funga do Brasil (2025). Species considered rare and endangered due to their conservation status were identified according to Coelho *et al.* (2009, 2013, 2018), Messina (2012) and MMA (2022). The life forms follow Lima & Guedes Bruni (1997) from field observations and complemented, when necessary, with information from the labels of the materials consulted in the herbariums. The identification key was

elaborated based on Mayo *et al.* (1997). Exotic species were identified according to Barros *et al.* (2020).

Results

Floristic inventory

Thirty-four Araceae species distributed in 12 genera were inventoried for Serra da Tiririca (Tab. 1. Fig. 1 and 2). *Anthurium* and *Philodendron* were the richest genera with 11 species each. *Asterostigma* and *Thaumatophyllum* presented two species each and *Caladium*, *Heteropsis*, *Landoltia*, *Lemna*, *Monstera*, *Pistia*, *Syngonium* and *Wolffia*, one species each.

Twelve new occurrences of Araceae were identified for Serra da Tiririca: *Anthurium lucidum*, *Anthurium solitarium*, *Asterostigma lividum*, *Caladium bicolor*, *Landoltia punctata*, *Philodendron eximium*, *Philodendron glaziovii*, *Philodendron hatschbachii*, *Philodendron martianum*, *Philodendron nadruzianum*, *Pistia stratiotes* and *Wolffia brasiliensis*. Four species are categorized as endangered: *Philodendron hatschbachii* as near-threatened, *Anthurium luschnathianum* and *Philodendron nadruzianum* as endangered, and *Anthurium lucidum* as critically endangered.

Regarding the number of Araceae species per area of Serra da Tiririca, Córrego dos Colibris is the richest region with 21 species (61.76%). Then, there is Alto Mourão with 17 species (50%), Morro do Telégrafo with 15 species (44.11%), Morro do Cordovil with 13 species (38.23%), Enseada do Bananal with seven species (20.58%), Costão de Itacoatiara with four species (11.76%) and Morro da Penha with three species (8.82%). As for life forms, of the 34 species, 14 are hemiepiphytes (41.17%) 14 are saxicolous (41.17%), eleven are rupicolous (32.35%), five are terrestrial (14.70%), four are free floating aquatic (11.76%), four are epiphytes (11.76%), and three geophytes (8.82%). Some species may present more than one life form, and all were considered to show their representativeness Serra da Tiririca.

Figure 1 – A. *Anthurium coriaceum* G. Don. B. *Anthurium intermedium* Kunth. C. *Anthurium luschnathianum* Kunth. D. *Anthurium maximilianii* Schott. E. *Anthurium microphyllum* (Raf.) G. Don. F. *Anthurium parasiticum* (Vell.) Stellfeld. G. *Anthurium pentaphyllum* (Aubl.) G. Don. H. *Anthurium scandens* (Aubl.) Engl. subsp. *scandens*. I. *Anthurium solitarium* Schott. J. *Asterostigma lividum* (Lodd.) Engler. K. *Caladium bicolor* (Aiton) Vent. L. *Heteropsis oblongifolia* Kunth. M. *Landoltia punctata* (G. Mey.) Les & D.J. Crawford. N. *Lemna aequinoctialis* Welw. O. *Monstera adansonii* subsp. *klotzschiana* (Schott) Mayo & I.M. Andrade. P. *Philodendron cordatum* Kunth ex Schott. Photographs: Daniel L. S. Dutra Jr.

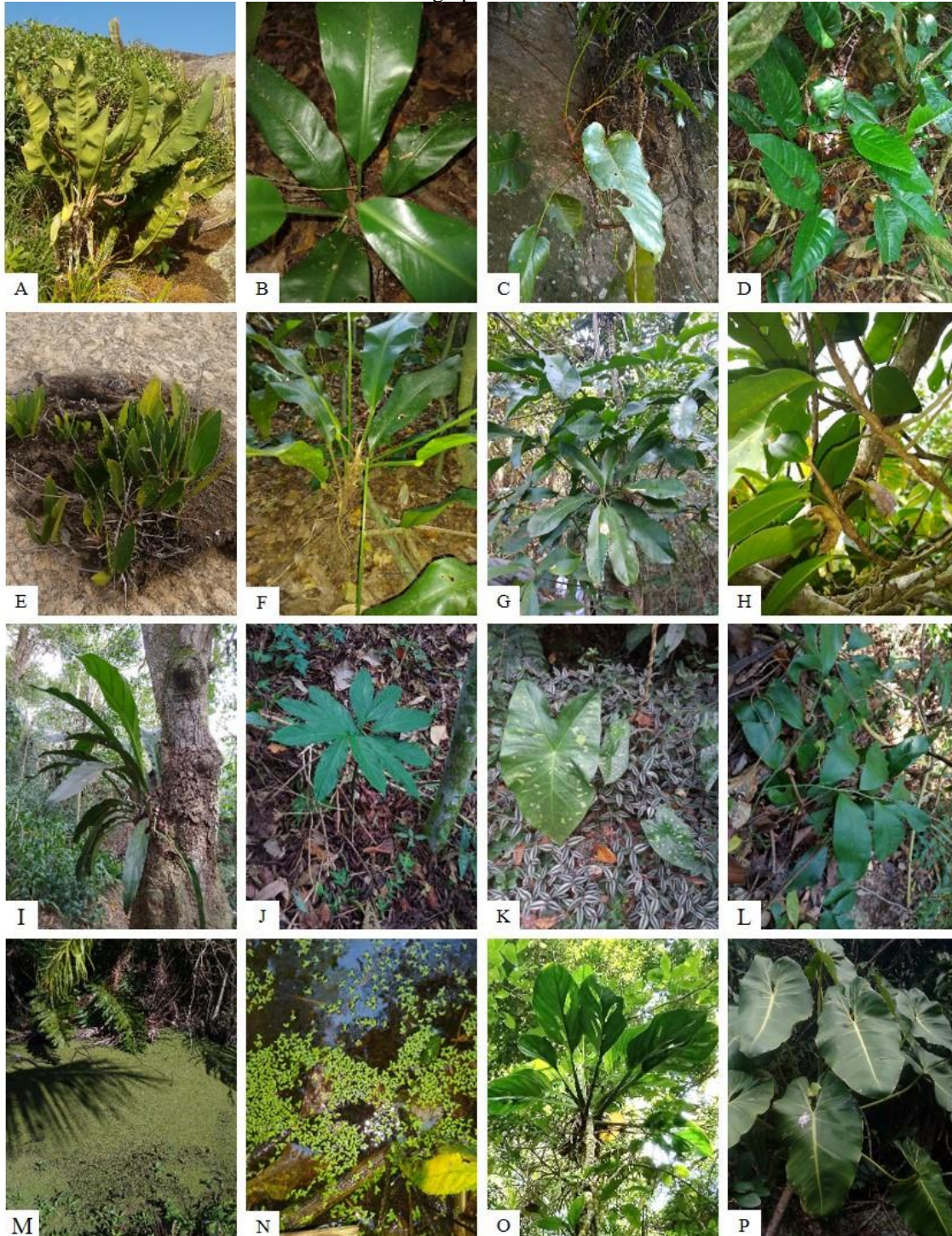


Figure 2 – A. *Philodendron crassinervium* Lindl. B. *Philodendron eximium* Schott. C. *Philodendron glaziovii* Hook. f. D. *Philodendron hatschbachii* Nadruz & Mayo. E. *Philodendron martianum* Engl. F. *Philodendron nadruzianum* Sakur. G. *Philodendron oblongum* (Vell.) Kunth. H. *Philodendron ornatum* Schott. I. *Philodendron pedatum* (Hook) Kunth. J. *Philodendron propinquum* Schott. K. *Pistia stratiotes* L. L. *Syngonium vellozianum* Schott. M. *Thaumatococcus corcovadense* (Kunth) Sakur., Calazans & Mayo. N-O. *Thaumatococcus speciosus* (Schott ex Endl.) Sakur., Calazans & Mayo. P. *Wolffia brasiliensis* Wedd. Photographs: Daniel L. S. Dutra Jr.



Description of the family

ARACEAE Juss., Gen. Pl.: 23. 4 (1789).

It is characterized by being terrestrial, rupicolous, epiphytic, hemiepiphytic or aquatic herbs; perennials, subperennials or annuals; aerial, prostrate or creeping, climber or underground stem such as rhizomes, tubers or bulbs; fixing or adventitious roots; generally large leaves, long to short petiole, short or long sheath, simple or compound leaf blade, whole or lobed, pinatifide or pinatipart; presence of primary, secondary, tertiary and/or depending on the genus. Flowers gathered in inflorescence of the spadix type and a modified bract, the spathe; spadix can present bisexual or unisexual flowers, being pistillate at the base and staminate at the apex, with sterile zone dividing the male portion from the female, sometimes above the male portion, depending on the gender; discrete flowers with evident perigoneum or very reduced or absent tepals, hypogines, actinomorpha, protogynes; free or connate stamens with usually hypertrophied connective and extrorse anthers; syncarpal gynecium, 1-47-locular, 1-ovulate ovules per locule; berry-like fruits or, sometimes, dry, almost always free or syncarpal; seeds with or without endosperm, often encompassed by mucilaginous substance (Mayo *et al.* 1997).

**Identification key for the genera of Araceae present in
Serra da Tiririca, Niterói and Maricá, RJ**

1. Aquatic plant.
2. Plant over 5 cm diameter, leaves in rosettes..... *Pistia*
2. Plant less than 1 cm in diameter, without rosette leaves.
3. Absence of pigment cells..... *Lemna*
- 3'. Pigment cells present.
4. Front with 3 ribs, 2-6 roots..... *Landoltia*
- 4'. Unribbed front, no root..... *Wolffia*
- 1'. Terrestrial plant.

5. Underground stem plant.
6. Pinathyphid blade..... *Asterostigma*
- 6'. Whole blade..... *Caladium*
- 5'. Aerial stem plant.
7. Fenestrated leaf blade..... *Monstera*
- 7'. Whole leaf blade.
8. Leaf blade without crosslinked ribs.
9. Petiole with genicle, spadix with bisexual flowers..... *Heteropsis*
- 9'. Petiole without genicle, spadix with unisexual flowers.
10. Tree stem, intermediate sterile zone equal to or longer than the female zone..... *Thaumatophyllum*
- 10'. Non-arborescent stem, intermediate sterile zone smaller than female zone... *Philodendron*
- 8'. Leaf blade with crosslinked secondary and tertiary ribs.
11. Absence of milky latex, non-conated stamens, flowers with perigone, free berries..... *Anthurium*
- 11'. Presence of milky latex, conate stamens forming sinandrium, flowers without perigoneum, conate berries forming a syncarp..... *Syngonium*

Discussion

In the present study, 34 taxa of Araceae were identified for Serra da Tiririca, while the floristic inventory carried out by Barros (2008) recorded 25 species. Andreata *et al.* (2008) documented eleven species of Araceae only for Alto Mourão, while the present study increased this value to 17 species in the same area. When these works were carried out, the circumscription of this PA was different from the current one and included only Serra da Tiririca, Morro das Andorinhas and the marine part of Enseada do Bananal.

Anthurium harrisii, *A. minarum* and *A. validinervium* are listed in the PESET of Barros (2008), but do not occur in the Serra da Tiririca Sector. *Anthurium sucreei* follows the synonymization made by Valadares (2019) as *Anthurium microphyllum*. *Philodendron bipennifolium* was reassessed for identification as *Philodendron nadruzianum*. Of the species mentioned in the two studies, two changed their taxonomic position, according to the circumscription proposed by Sakuragui *et al.* (2018): *Philodendron corcovadense* (= *Thaumatophyllum corcovadense*) and *Philodendron speciosum* (= *Thaumatophyllum speciosum*), as the subgenus *Meconostigma* was elevated to the genus *Thaumatophyllum*. With these changes and the new records, there is a total of twelve species as new occurrences for Serra da Tiririca.

Of the inventoried species, 13 are endemic to Brazil (38.23%): *Anthurium comtum*, *A. coriaceum*, *A. intermedium*, *A. maximilianii*, *A. solitarium*, *Asterostigma lividum*, *Philodendron cordatum*, *P. crassinervium*, *P. eximium*, *P. martianum*, *P. oblongum*, *P. propinquum* and *Thaumatophyllum corcovadense*. Six are endemic to the Southeast Region (17.64%): *Anthurium microphyllum*, *A. parasiticum*, *Asterostigma lombardii*, *Philodendron glaziovii*, *P. hatschbachii* and *Thaumatophyllum speciosum*. Three are endemic to the state of Rio de Janeiro (8.82%): *Anthurium lucidum*, *A. luschnathianum* and *Philodendron nadruzianum*. Among these species *P. hatschbachii* is the first record for the metropolitan region of Rio de Janeiro. Thus, Serra da Tiririca protects the biodiversity characteristic of the Atlantic Forest in relation to the Araceae, corroborating the concept of hotspot in the region, as described by Mittermeier *et al.* (2011)

Serra da Tiririca is the locality of the state of Rio de Janeiro which presents the greatest richness of Araceae species so far, also reflected in the diversity of life forms. This highlights the high adaptation to environmental conditions and heterogeneity, exploring a variety of ecological niches, as indicated by Croat & Ortiz (2020) for this family. The co-

predominance of hemiepiphytic and saxicolous life forms has not been commonly explored in the literature. According to Mayo *et al.* (1997), tropical Araceae have a high rate of hemiepiphyte and epiphyte species, which are adapted to humid environments. However, the affinity for rock outcrops is briefly discussed, both for saxicolous and rupicolous life forms as well, referred to as lithophytes or rheophytes.

According to Barros (2008), in the PESET flora, hemiepiphyte plants have a small representation of 1.8%, with only 16 species. Of these, 14 are Araceae, which represents 87.5% of the total hemiepiphytes. Among these, the genus *Philodendron* stands out with about 56.25% of the total hemiepiphytes, with nine species. In Serra da Tiririca, *Philodendron*, in addition to the phorophytes, is also associated with the boulders inside the forests and the rocky outcrops exposed to light in the saxicolous form. Its presence is linked to the areas of inselbergs and the forest matrix around these environments. Hence its constant presence in Alto Mourão, Córrego dos Colibris and, mainly, in Morro do Cordovil, where 58% of the species sampled are observed.

The genus *Anthurium* has 11 species in Serra da Tiririca, which represents 25% of the native species in the state of Rio de Janeiro, according to Dutra Junior *et al.* (2024). In general, this genus presents a great diversity of life forms and can be found in tropical humid forests of low and medium elevations, in addition to cloud forests, swampy areas, on rocky outcrops, open sandy areas and even in semi-arid regions, according to Mayo *et al.* (1997). Even so, some species are extremely restricted and adapted to specific environments, such as *Anthurium luschnathianum*, endemic to the state of Rio de Janeiro and which only occurs in some sandbanks and submontane forests up to about 250 meters in altitude. Also, *Anthurium microphyllum*, endemic to the states of Rio de Janeiro and Espírito Santo and occurring only in coastal rocky outcrops (Flora e Funga do Brasil 2025).

Andreato *et al.* (2008) cite *Thaumatophyllum speciosum* as a pioneer plant, little collected and practically extinct. However, this species was collected after years in a place of difficult access, on a boulder. A small saxicolous population was observed only in Alto Mourão. *Thaumatophyllum corcovadense* has already been listed by Barros (2008) as a species that stands out for forming true root curtains, together with *Philodendron oblongum*, in rocky blocks inside the forests. In addition, *Thaumatophyllum corcovadense* has wide adaptation to different environmental conditions, occupying ecological niches similar to *Philodendron cordatum*. In different locations, it was found that these species can form dense barriers along the trails, or even large populations near the sea, occupying both the interior of the forests and rocky outcrops and coastal areas.

Heteropsis oblongifolia is a hemiepiphytic plant that had been collected only in Morro do Cordovil by Barros (2008) and indicated as the most restricted Araceae species in Serra da Tiririca. In the present study, it was collected in Morro do Cordovil and had a new record in Córrego dos Colibris. Species with more restricted and rare distribution that occur only in a single locality include: *Anthurium comtum*, *A. lucidum*, *Asterostigma lombardii*, *Philodendron eximium*, *P. glaziovii*, *P. hatschbachii* and *P. martianum*, in addition to the aquatic *Landoltia punctata*, *Lemna aequinoctialis*, *Pistia stratiotes* and *Wolffia brasiliensis*. On the other hand, the species with the greatest distribution, that is, those that occur in five or six locations are: *Anthurium coriaceum*, *A. intermedium*, *Monstera adansonii* subsp. *klotzschiana* and *Philodendron pedatum*.

Of these, *Anthurium coriaceum* is widely distributed and has a presence associated with rock outcrops exposed to light, composing the islands of vegetation (Dutra Junior *et al.* 2024). *Monstera adansonii* subsp. *klotzschiana* is the taxon with the largest and densest populations. It is a hemiepiphyte plant that begins its life phase as a scandent, often using phorophytes with larger trunk circumferences. This selection strategy may confer adaptive

advantages to individuals, but the benefit of this strategy has not yet been elucidated. It is believed that phototropism may be related to some physiological mechanism (Romitelli *et al.* 2012).

Caladium bicolor is a geophyte species that was found in the hills of Cordovil, Penha and Telégrafo. Even though it is highly toxic, due to the presence of calcium oxalate, it is commonly used in landscape projects due to its lush leaves (Baltar *et al.* 2017, Santos & Silva 2020). According to Almeida *et al.* (2005), the genus *Asterostigma* also presents the geophyte life form, but is not indicated for ornamental use. It is usually observed in soils susceptible to flooding near the edge of small streams. The species *Asterostigma lividum* and *Asterostigma lombardii* occur in Morro do Telégrafo and Córrego dos Colibris in areas rich in litter. These three species are seasonally dormant and, for this reason, are difficult to collect in the field. Few populations were found during the present study.

Two species of *Syngonium* were observed in Serra da Tiririca: *S. vellozianum*, native and found only in the interior of the forests, and *S. podophyllum*, exotic and very common in the study area, present on the edges of the forests. Unlike the exotic species, *S. vellozianum* does not form dense populations, being distributed in small, isolated populations. *S. podophyllum* dominates large extensions in the herbaceous stratum of the forest and phorophytes. Both have ornamental use, but the native species should be used more for this purpose. This strategy could reduce the dispersal of *S. podophyllum*, reducing the impacts caused by the exotic species.

Four species of floating aquatic plants were inventoried in Serra da Tiririca, not sampled in the inventory of Barros (2008): *Landoltia punctata*, *Lemna aequinoctialis*, *Pistia stratiotes* and *Wolffia brasiliensis*. These species are commonly observed in eutrophic environments. The flooded areas in Serra da Tiririca suffer constant impacts due to water pollution and the presence of solid waste that is thrown into the water.

The Araceae environments in Serra da Tiririca

The hemiepiphyte and epiphyte life forms are survival strategies of the Araceae already much discussed (Mayo *et al.* 1997, Croat & Ortiz 2020) for tropical forest environments, where soil conditions are limited and the search for available tree canopy lighting is plentiful. However, in the Serra do Mar Dense Ombrophilous Forest, another niche is available to occupy the Araceae, which are the large rock blocks arranged inside the forest, which are called boulders (Mortara 2012).

The boulders are characterized by being blocks of facoidal gneiss rock intermingled in the forest matrix, which are detached by fragmentation due to chemical weathering processes, such as spheroidal exfoliation, or by the wear of blocks dragged by river currents, as described by Guerra (1980) and Mantovani *et al.* (2009). The vegetation in boulders has already been investigated by Barros *et al.* (2009) and Mortara (2012) with a focus on ferns. These studies evaluated the diversity of species and found the importance of the saxicolous substrate, which offers a wide variety of microhabitats, due to the geology, shading and water availability in these areas.

In Serra da Tiririca, the high number of boulders inside the forest and the rocky walls exposed to light influence the floristic composition of Araceae. About 41.17% of the inventoried species present saxicolous life form and occur in the boulders. As noted by Barros (2008), on the surface of the Serra da Tiririca boulders, there is the accumulation of particulate organic matter, which is sufficient for the development of herbaceous-shrub species, which includes several species of Araceae. However, it was found that these plants colonize not only the substrates with organic matter, but also bare rocks, being a pioneer group in the succession process of this new environment. The roots help in the fixation of the particulate organic substrate, resulting in richer and more diverse environments, where the Araceae provide the stabilization of populations, supported by the adventitious roots. Among

the common species in these environments, the following stand out: *Anthurium comtum*, *A. intermedium*, *A. lucidum*, *A. luschnathianum*, *A. maximilianii*, *A. parasiticum*, *Philodendron cordatum*, *P. crassinervium*, *P. eximium*, *P. glaziovii*, *P. hatschbachii*, *P. nadruzianum* and *Thaumatophyllum speciosum*.

Thus, forests with boulders have greater complexity and structural heterogeneity when compared to adjacent areas without this component. Because they offer different conditions and resources, they allow the coexistence of a greater number of species. For these reasons, in agreement with Barros *et al.* (2009), the boulders of the interior of forests are places that enhance the increase in the richness of plant species and need further investigation.

Among the species observed, two have rupicolous life forms with exclusive presence in the inselberg: *Anthurium coriaceum* and *A. microphyllum*. Others are associated exclusively with the large rocks in the forest matrix: *Anthurium luschnathianum*, *A. maximilianii*, *Philodendron cordatum*, *P. crassinervium*, *P. glaziovii*, *P. pedatum* and *P. nadruzianum*.

Similarly, wetlands play a crucial role in conservation, but they are also being neglected. Historically, in the state of Rio de Janeiro, these environments have been degraded over time, a practice that in the past was seen as a symbol of civilizing progress. Lagoon swamps and coastal regions are often replaced by landfills, allotments and urban projects, which causes the loss of biodiversity and local extinctions. The flooded areas in Serra da Tiririca also proved to be important environments for certain species of Araceae, however, it also went through this historical process of degradation.

According to Barros (2008), the flooded areas of Serra da Tiririca come from the outcropping of water from the groundwater, however, due to the destruction of the vegetation cover, the number of springs and streams has been decreasing. The species of aquatic Araceae are restricted to these little explored environments floristically. Part of the flooded areas are

not included in PESET, but in the zone surrounding the legal perimeter of the Protected Area, which highlights the importance of this region for the conservation of aquatic species (Costa *et al.* (2007).

Exotic species of Araceae in Serra da Tiririca

In PESET, the presence of exotic and invasive species has already been pointed out (Barros 2008, Barros *et al.* 2020). Biological invasion is the process of introducing and adapting species that are not naturally part of an ecosystem, but that have been taken to a new environment, intentionally or accidentally, and can become naturalized and cause changes in their functioning (Barros *et al.* 2020). Specifically in the Serra da Tiririca sector, four exotic Araceae species registered as invasive by Barros *et al.* (2020) were inventoried: *Dieffenbachia seguine* (Jacq.) Schott (dumb cane), *Epipremnum aureum* (Linden & André) G.S. Bunting (devil's ivy), *Philodendron hederaceum* (Jacq.) Schott (heart leaf philodendron) and *Syngonium podophyllum* Schott (arrowhead plant). *Dieffenbachia seguine* originates from South America and the Caribbean, *E. aureum* from the Solomon Islands and *Philodendron hederaceum* and *S. podophyllum* from Mexico to Tropical America (Boyce 1998, POWO 2025). Of these, *D. Seguine* presents terrestrial life form, and the others are hemiepiphytes.

Dieffenbachia seguine is a species commonly cultivated as an ornamental plant due to its lush leaves (Lorenzi 2015). Also used in cultural practices, especially in Brazilian religions of African matrix (Barros 2011). According to Oliveira (2015), the presence of this species is often observed in forested areas near the ruins of ancient dwellings, where it can be cultivated for its cultural and symbolic associations with the environment. In some places of Serra da Tiririca, it was widely found occupying the herbaceous stratum, particularly in places with high humidity and shading, conditions that are favorable for its growth. This species tends to compete with native ones, displacing them and interfering with the natural regeneration of

vegetation. This process can impact the ecological dynamics of forest areas, as found by Barros *et al.* (2020).

Epipremnum aureum prefers more shaded and humid places and it was found by Barros *et al.* (2020) that this species has a high frequency, dominance and importance value in Serra da Tiririca. Due to its vegetative reproduction and rusticity, it can be widely dispersed through the forests. In addition, it competes directly with other native hemiepiphytes, representing a serious problem of biological invasion in Serra da Tiririca, as observed in Córrego dos Colibris. The higher its occupation, the lower the presence of other herbaceous species, because in its initial phase of growth on the soil it can hinder the emergence of new seedlings. In addition, growth on some tree and palm species generates moisture in the phorophyte, which causes stem rot, thus causing the death of these plants (Siqueira 2007).

Philodendron hederaceum and *Syngonium podophyllum* can also compete directly with other native Araceae species as they occupy the same ecological niche. Like *E. aureum*, the propagules of these species ensure their dispersal, not requiring seeds to do so. Although no specific work has been done with these species in relation to their invasive character, they need to be further studied in the area, as they have similar characteristics of occupation of the environment. Both can reach the canopy of the phorophytes, spreading forcefully. Small propagules stand out from the plant, especially when winds occur, and when falling on the ground they can take root without the need for direct planting, growing quickly. It is recommended to remove them from the area where they are observed, before they spread, as management is very difficult to carry out.

According to Dehnen Schmutz *et al.* (2007), Santos *et al.* (2010) and Barros *et al.* (2020), in urban centers there are exotic plants introduced for landscaping and their presence ends up functioning as a potential precursor of biological invasions. The same can be seen in Serra da Tiririca. Proximity to the urban environment makes it conducive to the dispersal of

these exotic species. Thus, the buffer zone of the PESET can function as an irradiator of exotic species for the PA, due to direct contact with the urban environment. Generally neglected, the buffer zone should be monitored more closely by the PA management.

Threats to the conservation of Araceae in Serra da Tiririca

The conservation of Araceae in Serra da Tiririca is compromised due to the expansion of urban occupation that puts pressure on forested areas and rock outcrops. Deforestation, intense tourist visitation, the practice of climbing and abseiling, fires, biological invasion and collection of ornamental species are also environmental impacts, especially in the inselbergs, recorded in Serra da Tiririca. Some species of Araceae recorded by Barros (2008) are no longer found in the places previously observed.

The practice of religious rites in PESET has also been a problem for the conservation of local biodiversity. An example of this is in Córrego dos Colibris, where 21 species of Araceae were recorded. According to Barros *et al.* (2020), this locality is considered a sacred space, characterized by its natural attributes related to the presence of ritualistic species, which attract practitioners of religions of African matrix to perform cults with nature. Despite being a prominent location in relation to the Araceae, easy access allows environmental damage to occur commonly.

Monte das Orações, located in Várzea das Moças, Niterói, it had already been indicated in the PESET management plan as an area intensely visited by evangelical believers. Religious services are held on the highest point of the hill. This situation increased the trampling of vegetation, soil compaction, visual pollution and vandalization of signposts. In addition to promoting the opening of clearings and disposal of solid waste (INEA 2015, Pacheco *et al.* 2020). The only species of Araceae observed in this region was the exotic *Dieffenbachia seguine*, which highlights the noticeable anthropogenic pressure that seriously threatens the biodiversity of this area.

It is essential that the government promotes environmental education policies aimed at this public in Serra da Tiririca. It is important to approach users to establish a mutual dialogue, as information is essential to avoid conflicts. Eventually, there should be access control with daily limitation of visitors in these areas of PESET, as part of a public use planning.

The areas focused on climbing and abseiling practices in PESET are Morro das Andorinhas, Costão de Itacoatiara, Morro do Telégrafo, Alto Mourão, Agulha George Guarischi, Morro do Ubá, Córrego dos Colibris, Falésia Peixoto, Enseada do Bananal, Morro do Cantagalo and Mirante do Carmo (Porto 2008, Daflon & Daflon 2014). In this PA, climbers represent a small audience when compared to ecological hikers (visitors in general). However, this is an activity that has been growing every year and is a real threat to the conservation of the flora of Serra da Tiririca.

In Enseada do Bananal and Córrego dos Colibris, impacts on vegetation caused by these practices are already observed. In Enseada do Bananal, Araceae is the family with the greatest richness of species present in the rocky outcrops, although it is one of the most used areas for climbing and abseiling, while in Córrego dos Colibris this activity is more recent. In this place it is possible to observe one of the few rocky walls of Serra da Tiririca that still has typical and conserved vegetation due to the steep slope, which makes it difficult to access for hiking.

The problems caused by these activities come from the trampling and grabbing that climbers do in the plateaus and crevices, which are the places where sediments accumulate, and which promote the development of vegetation. In addition, the rope used in the safety of climbers can remove the plants from the substrate. It is indicated the disabling of places where the vegetation is more conserved, such as the wall of Córrego dos Colibris. The PESET

management plan fails to stimulate the public use of rock outcrops, since INEA does not have effective mechanisms for inspection, mitigation and monitoring of impacts.

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