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# Zingiberales Griseb. in the Núcleo Curucutu, Parque Estadual Serra do Mar, São Paulo State, Brazil

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**Zingiberales Griseb. in the Núcleo Curucutu, Parque Estadual Serra do Mar, São Paulo State, Brazil**

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Título resumido: Zingiberales in the Núcleo Curucutu, PESM, SP, Brazil

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**ABSTRACT** – (Zingiberales Griseb. in the Núcleo Curucutu, Parque Estadual Serra do Mar, São Paulo State, Brazil). This work consists in a taxonomic survey. Identification key, morphological descriptions, illustrations, geographic distribution and phenology are presented. The order is represented in the study area by four species divided into three families: *Goeppertia monophylla* (Vell.) Borchs. & S.Suárez (Marantaceae), *Heliconia farinosa* Raddi (Heliconiaceae), *Hedychium coccineum* Buch.-Ham. ex Sm. and *Renealmia petasites* Gagnep. (Zingiberaceae).

**Keywords:** Atlantic Forest, Heliconiaceae, Marantaceae, Zingiberaceae

**RESUMO** – (Zingiberales Griseb. no Núcleo Curucutu, Parque Estadual Serra do Mar, Estado de São Paulo, SP, Brasil). Este trabalho consiste em um levantamento taxonômico. Chave de identificação, descrições morfológicas, ilustrações, distribuição geográfica e fenologia são apresentados. A ordem está representada na área de estudo por quatro espécies divididas em três famílias: *Goeppertia monophylla* (Vell.) Borchs. & S.Suárez (Marantaceae), *Heliconia farinosa* Raddi (Heliconiaceae), *Hedychium coccineum* Buch.-Ham. ex Sm. e *Renealmia petasites* Gagnep. (Zingiberaceae).

**Palavras-chaves:** Heliconiaceae, Marantaceae, Mata Atlântica, Zingiberaceae

## Introduction

Zingiberales is an order of tropical plants within monocotyledons formed by eight families: Cannaceae Juss., represented by one genus and 10 species; Costaceae Nakai, which has six genera and 143 species; Heliconiaceae Nakai, one genus and 200 species; Lowiaceae Ridl., one genus and 20 species; Marantaceae R. Br., 31 genera and 550 species; Musaceae Juss., three genera and 91 species, Strelitziaceae Hutch., three genera and seven species; and Zingiberaceae Martinov, 56 genera and 1.600 species, totaling 102 genera and 2.621 species (Stevens 2017).

In terms of occurrence, seven of these families have already been identified in Brazil, one of which was introduced (Musaceae); 31 genera and 319 species, being 131 of them endemic. In São Paulo, there are seven families, 20 genera and 65 species (André 2020a, b, c, Almeida & Antar 2020, Braga 2020, Ferreira 2020, Saka *et al.* 2020)

These plants can size from a few centimeters up to 10 meters in height. Some of the characteristics of this groups sort from a rhizomatous stem, that usually stores starch; presence of pseudostem, rarely true stem; parallel-pinned leaf venation; terminal or basal inflorescences, generally surrounded by colored bracts; complete and bisexual flowers, only Musaceae presents unisexual flowers, 1-6 fertile stamens, 1-5 sterile stamens that can look like petals (staminodes); inferior ovary with three locules, each one may have one or more ovules; fleshy or dried fruits; seeds with aryl in general (Costa *et al.* 2011).

From an economic point of view, it is possible to find in the order many species of food interest, such as *Musa paradisiaca* L. (banana tree), which produces edible parthenocarpic fruits (Souza & Lorenzi 2005) and *Zingiber officinale* Roscoe (ginger), used in drinks and confectionery production (Elpo & Negrelle 2004); also species of ornamental interest, such as *Goeppertia ornata* (Lem.) Borchs. & Suárez (pin-stripe calathea) for having attractive leaves (Vieira *et al.* 2012), *Heliconia bihai* (L.) L. (firebird), *Canna indica* L. (canna lily) and *Strelitzia reginae* Banks (bird-of-paradise flower) (Lorenzi & Souza 2001, Souza & Lorenzi 2005, Castro *et al.* 2011) known for producing striking inflorescences; and at last, kinds of popular medicinal interest, like *Curcuma longa* L. (turmeric), used in treatments for respiratory diseases (Santiago *et al.* 2015).

The present work is part of the Flora study of the Núcleo Curucutu, important region, but little-known, even though being a part of São Paulo City (Garcia & Pirani 2005), carried out in partnership with the Universidade Santo Amaro and the Herbarium PMSP. For monocots, works with Iridaceae (Takeuchi *et al.* 2008) and Orchidaceae (Rosa & Affonso 2009) were also developed in the area.

With the main purpose of developing the taxonomic study of Zingiberales in the Núcleo Curucutu, collections, identifications, descriptions, identification key, illustrations and data on the geographic and phenological distribution of the species found were carried out, thus contributing to the knowledge of the local flora, the State of São Paulo and the Atlantic Forest.

## Material and methods

The Núcleo Curucutu located at the coordinates 23°59'09.7"S and 46°44'32.5"W was created in 1977, concomitantly to the Parque Estadual Serra do Mar, covering the municipalities of São Paulo, Itanhaém, Mongaguá and Jquitiba, having its origins in the Fazenda Curucutu, a coal producer, acquired by the State in 1958 and transformed into a Forest Reserve (Bellato & Mendes 2002, PESM 2021a).

The vegetation consists predominantly of fields and high-altitude forests. It has a total area of 37.512 hectares, altitude reaching 870 meters, temperate climate, with hot and rainy summers and winter with milder temperatures (Bellato & Mendes 2002, Garcia & Pirani 2003, Infraestrutura e Meio Ambiente 2021).

From the beginning, one of its objectives was the preservation of springs and water sources in the metropolitan region of São Paulo through the Capivari and Embu Guaçu rivers, and in Itanhaém, the Mambu/Rio Branco system. In relation to ecosystem services, the Núcleo contributes in several aspects, such as regulation of air and climate quality, in the protection of hills, slopes and soils, in the preservation of biodiversity, among other attributions (PESM 2021a, b).

The specimens used in this work comes from the plateau sector. They are deposited in the scientific collection of the Universidade Santo Amaro and in the Herbarium PMSP. Field collects

have been done during February of 2018 and November of 2020, period of development of this work. Herborization followed the methodology described by Fidalgo & Bononi (1989).

For the analysis and identification of the samples, specialized literature was consulted (Maas 1977, Santos 1978, Forzza & Wanderley 1999, Catharino 2002, Kamer & Maas 2003, Souza *et al.* 2007, Wongsuwan & Picheansoonthon 2011, Vieira *et al.* 2012, Saka 2016) as such as the Zingiberales collections of the PMSP, SPF and SPSF, in addition to the virtual herbariums: BHCB, CEPEC, E, FURB, HUFU, IBGE, ICN, JBRJ, K, MBM, NY, P/PC, R, RB, UPCB and S (acronyms according to Thiers, continuously updated).

The flowering and fruiting data were obtained through the analysis of the exsiccates, field observations and literature. The morphological terms followed those described in Gonçalves & Lorenzi (2011). The illustrations were free hand made with the aid of a stereomicroscope and finished by illustrator Klei Rodrigo de Sousa.

## Results and discussion

In the Núcleo Curucutu, four species of the Zingiberales order, belonging to three different families, were found, *Goeppertia monophylla* (Vell.) Borchs. & S.Suárez (Marantaceae), *Heliconia farinosa* Raddi (Heliconiaceae), *Hedychium coccineum* Buch.-Ham. ex Sm. and *Renealmia petasites* Gagnep. (Zingiberaceae).

### Identification key for Zingiberales of the Núcleo Curucutu

1. Leaves with ligule; flowers with labellum
  2. Ligule oblong; terminal inflorescence; orange corolla; labellum 2-lobed ..... *Hedychium coccineum*
  2. Ligule truncate; basal inflorescence; white corolla; labellum 3-lobed ..... *Renealmia petasites*
1. Leaves without ligule; flowers without labellum
  3. Puberulous leaf; obovate or widely obovate bract; ellipsoid inflorescence, green ..... *Goeppertia monophylla*
  3. Glabrous leaf; boat-shaped bract; thyrsoid cincinnate inflorescence, predominantly red ..... *Heliconia farinosa*

*Goeppertia monophylla* (Vell.) Brochs. & S.Suárez, Syst. Bot. 37(3): 632. 2012.

Figure 1 a-g

Herbs 1-1.5 m tall. Leaves with sheaths 21-37 cm long, pubescent, denser trichomes along the margin, sericeous at the base; absent ligule; petiole 13-18 cm long, puberulous; pulvinus 2-5 cm long,

glabrous; blade 37-60 x 12-22 cm, elliptic, apex acute to acuminate, base slightly attenuated to acute, puberulous on the abaxial face. Terminal inflorescence, simple 6-10 x 2-4.5 cm, ellipsoid, green; internode below the last leaf oblong or not; peduncle 19-45.5 cm long, minutely pubescent; basic component of inflorescence composed of 5 pairs of flowers; bracts 2-3 x 2-3 cm, monomorphic, obovate or widely obovate, apex erect, rounded, sometimes emarginate and with a slightly wavy margin, green becoming dark brown at the apex, puberulous, densely setose in the basal portion, sometimes with a darker and wavier margin, tearing and blackening as it ages; prophyll ca. 1.8 x 0.4 cm, elliptic to ovate, 2-3-crenate, membranous carenes, sparsely puberulous; interphyll ca. 1.5 x 0.3 cm, elliptic to ovate, concave, membranous, sparsely puberulous; bracteole ca. 1.8 x 0.4 cm, 1 per flower, asymmetrical, lanceolate, crenate, glabrous, darker apex. Flowers ca. 3 cm long, grayish-white or pale-yellow; calyx 1.8-2 x 0.4 cm, elliptic-lanceolate, concave, abaxial surface with tiny trichomes, longer than the corolla tube; corolla tube 2 cm long, lobes 0.8-1.1 cm long, elliptic; absent labellum; external staminode 0.7-0.8 cm long, obovate, apex emarginate; stamen with lateral petaloid appendix ca. 0.4 x 0.2 cm; anther 0.2 cm long; style 0.8-1 cm long, white; stigma 0.2 x 0.2 cm; ovary ca. 0.3 x 0.2 cm, globose, puberulous, grayish-white; one ovule per locule. Capsule 0.8-1.5 x 0.7-1 cm, bi-trilocular, pink. Seeds 0.7 x 0.4 cm, yellow; white aril.

Material examined: BRAZIL. SÃO PAULO: São Paulo. Parque Estadual Serra do Mar – Núcleo Curucutu, Floresta Ribeirinha ao longo do Rio Mambu, 13-IV-2001, fl., *E. Furlan 157* (SPSF); Trilha da Captação d'água, 16-III-2018, fl., *L.C. Vaz 03* (UNISA); Trilha da Captação d'água, 14-XII-2018, fl., *L.C. Vaz 05* (UNISA); Trilha da Bica, 22-II-2019, fr., *L.C. Vaz 07* (UNISA).

Additional material examined: BRAZIL. RIO DE JANEIRO: Itatiaia, Parque Nacional do Itatiaia, 16-II-2015, fr., *F.A. Silva 103* (JBRJ); Rio de Janeiro, Horto, entorno do Jardim Botânico do Rio de Janeiro, 23-III-2004, fl., fr., *J.M.A. Braga 7416* (NY).

*Goeppertia monophylla* is endemic in Brazil, found in the Atlantic Forest in the States of Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Saka *et al.* 2020). In the Núcleo Curucutu, it is mainly observed in humid, shaded environments close to watercourses.

In the study area it blooms from December to March and bears fruit in February. According to Forzza & Wanderley (1999), outside the Núcleo Curucutu the species blooms practically all year, although fruiting data have not been recorded.

The species showed few fruiting records throughout this research, the fruits of *G. monophylla* were seen only once, being present in a few individuals. The absence of fruiting records may be due to a failure in the collection, since the fruits develop inside the bracts that are usually going through a blackening process, which are very hard to visualize.

The materials from Rio de Janeiro (according to: *J.M.A. Braga 7416* and *F.A. Silva 103*) registered flowering in February and fruiting from February to March, a period in which we also recorded these occurrences in the study area. It is possible that the hottest the period of the year, the more intensified the processes for this species are.

*Goeppertia monophylla* has the capacity to form large populations, exceeding 30 individuals (Saka 2016). In the Núcleo Curucutu it was possible to observe this phenomenon.

According to Saka (2016), the species may have purple, grayish-white and pale-yellow flowers, the last two observed in this study of interest.

The species in both vegetative and reproductive states, when placed in 70° alcohol or herborized, gets blackened, an important process that enables the collection of descriptive data about the color of the plant in the field.

*Goeppertia monophylla* and *G. fatimae* (H.Kenn. & J.M.A.Braga) Borchs. & S.Suárez are very similar to each other, with few morphological differences, such as the distribution of hair on the peduncle, while *G. monophylla* has a minimally pubescent peduncle, *G. fatimae* has a hirsute one (Saka 2016).

It can be differentiated from all species of the order Zingiberales found in the Núcleo Curucutu by its pulvinus, the green color of its inflorescence and the presence of flowers with grayish-white or pale-yellow colors.

In comparison with the other native species in this work, *G. monophylla* is the only one that has never appeared on the list of threatened species, the species has a “Least Concerned” conservation status (CNCFlora 2012a).

***Heliconia farinosa*** Raddi, Mem. Mat. Fis. Soc. Ital. Sci. Moderna, Pt. Mem. Fis. 18: 393. 1820.

Figure 1 h-n

Robust herb 2-3 m tall. Leaves distichous, glabrous 4-6 per pseudostem; absent ligule; petiole 1.13-1.36 m long; absent pulvinus; blade 47.5-67.5 x 18-27 cm, apex acute to acuminate, base obtuse, mostly lacerated, asymmetric, with prominent central vein in the abaxial surface and canaliculated in the adaxial surface, green in both surfaces. Terminal inflorescence, erect 22.4-34 cm long; red rachis, thyrsoid cincinnate, glabrous, with apparent internode 1-4 cm long; bracts 6-10, distichous, internally green, yellow and red, externally red, getting yellowish and slightly greenish in the apex, showy, boat-shaped, persistent, apex acuminate, slightly auriculate base being the lower ones generally more foliose, fertile or sterile, the first fertile basal 12-16 x 2-3 cm in the base, narrowing towards the apex. Flowers in a fascicle in the internal base of bracts, with only part of the perianth apparent, pedicellate, 6-16 in the lower fascicle, decreasing in number toward the apex; white bracteoles, slightly greenish or reddish, oval-lanceolate, glabrous, with median vein marked 2-2.3 x 1-1.5 cm in the base; glabrous

pedicels 0.8-1 cm long, bigger in the fruits; bent perianth 4-4.5 cm long, boat-shaped sepals, glabrous, the upper free up to the base, the lower connate, green-yellowish or yellow; absent labellum; staminode lanceolate 0.8-1.2 x 0.1-0.2 cm in the base, apex acuminate; stamen with partially exerted anther when mature 1.1-1.4 cm long, cream when are new; filament 2.8-3.5 cm long, white; style 3.5-4.5 cm long, angulose, cream; stigma 0.1 x 0.1 cm; ovary ca. 1 x 0.5 cm, glabrous, white-greenish; one ovule per locule. Drupe 1.5-2 x 1-1.3 cm, slightly triangular, glabrous, dark blue when mature. Seeds 3, 0.8-1 x 0.4-0.8 cm, brown-greenish; absent aril.

Material examined: BRAZIL. SÃO PAULO: São Paulo, Parque Estadual Serra do Mar – Núcleo Curucutu, Trilha da Captação d'água, 27-I-1999, fr., *P. Affonso 313* (PMSP); Trilha da Captação d'água, 15-XII-2017, fl., *P. Affonso 1390* (UNISA); Trilha da Captação d'água, 14-XII-2018, fl., fr., *L.C. Vaz 06* (UNISA); Trilha da Captação d'água, 22-II-2019, fr., *L.C. Vaz 08* (UNISA).

Additional material examined: BRAZIL. ESPÍRITO SANTO: Cariacica, São Paulo Viana, beira da estrada, Floresta Ombrófila Densa Montana, Reserva Biológica de Duas Bocas, 06-V-2008, fr., *C.N. Fraga 2047* (RB); PARANÁ: Antonina, along road to Morretes a few km from municipality border, 06/I/1986, fl., *L. Andersson 1530* (S); RIO DE JANEIRO: Mangaratiba, Reserva Ecológica Rio das Pedras, Trilha das Borboletas, 15-IX-1996, fl., *J.M.A. Braga 3512* (RB); Paraty, ca. de 18km do trevo de Paraty, até a entrada de Laranjeiras mais 9km em direção a fazenda do Sr. Gibrail, estrada para a praia do sono, antes do portão da fazenda, 30-VI-1993, fl., *R. Marquete 1096* (RB); Paraty, Caminho para a Praia do sono, após a 1ª porteira, 04-V-1992, fl., *L.C. Giordano 1362* (RB); Paraty, Praia da Trindade, 16-X-1977, fl., *G. Martinelli 3264* (RB); Rio de Janeiro, Parque Nacional da Tijuca, Trilha para o Bico do Papagaio, 06-IX-2004, fr., *H.V.M. Gomes 23* (RB); Santa Maria Madalena, Serra da Forquilha, Fazenda São Sebastião, 20-XII-1991, fl., *T. Wendt 230* (RB); SÃO PAULO: Itanhaém, Rio Branco, Beira de rio, 25-IX-2005, fl., *R.J.F. Garcia 2591* (PMSP); São Miguel Arcanjo, Parque Estadual Carlos Botelho, 01-X-1999, fl., *G. Martinelli 15798* (RB); São Paulo, Jabaquara, Parque Nabuco, Trilha entre a caixa d'água e viveiro, Sub-bosque, 30-X-2003, fl., *S.J. Sordi 16* (PMSP).

Endemic species in Brazil, found in the ombrophilous regions of the Atlantic Forest in the States of Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Braga 2020). The collected specimens were found in an isolated population, in humid soil, close to the watercourse and covered by tree vegetation.

In the Núcleo Curucutu, *H. farinosa* blooms from December to February and bears fruit from January to March. The species blooms between April and December and bears fruit between May and August (Catharino 2002). There are also flowering records in January and fruiting in September (according to: *Andersson 1530* and *H.V.M. Gomes 23*).

The specimens of the Núcleo Curucutu present tricolor bracts (red, yellow and green). The presence of three colors in bracts is rarely mentioned, both in literature and in the exsiccates



descriptions. We noticed that in many cases there was only the predominant color, red, recorded, even when a second color was present in study.

According to Simão & Scatena (2004), the bracts of the material collected from the Núcleo Picinguaba and the have red-orange coloration both internally and externally, differentiating from the material of this work even though both share the same origin. These records lead us to consider that the species must present bicolor and tricolor bracts, the last one less frequently.

Among the species of *Heliconia* that occur in the State of São Paulo, *H. farinosa* is similar to *H. subulata* Ruiz & Pav., being differentiated by the presence of an elliptical or oblong blade, fertile basal bract and elliptical bracteole, while *H. farinosa* has only elliptical blades, foliate, fertile or sterile basal bract and oval-lanceolate bracteole (Braga 2020). This species can be differentiated from other Zingiberales of the Núcleo Curucutu due to its boat-shaped bracts and leaves, mostly lacerated.

The species is currently in a “Least Concern” situation (CNCFlora 2012b), but as its occurrence becomes rare outside protected areas, your registration in the Núcleo Curucutu brings hope for the species to survive (Braga 2008).

***Hedychium coccineum*** Buch.-Ham. ex Sm. Cycl. 17: Hedychium n° 5. 1811.

Figure 2 a-g

Pseudostem 1.2-2 m tall. Leaves with sheaths, bladeless sheaths 2-3; ligule oblong 1.3-2.5 x 0.9-1.5 cm, apex obtuse to shallowly bilobed or acute, green with brownish margin; absent petiole; absent pulvinus; blade oblong 33-47 x 2.5-4.5 cm, apex acuminate, base cuneate, upper surface glabrous, lower surface pubescent. Terminal inflorescence, erect 10-21 cm long, hairy; peduncle 10-15 cm long, hairy; bracts lax 2.5-3.9 x 0.7-1.7 cm, folded, oblong, apex obtuse-acute, hairy, green, each subtending a cincinnus of 3-6 flowers; tubular bracteoles; first bracteole ca. 1.6 x 1 cm, apex acute, hairy, greenish; second bracteole ca. 1.2 x 0.5 cm, apex acute, membranous, hairy, greenish; third bracteole ca. 1 x 0.4 cm, membranous, hairy, greenish. Flowers orange; calyx tubular 2-2.7 x 0.5-0.7 cm, apex 2-dented, hairy; corolla tube slender, 2.8-3.2 x 0.2-0.3 cm, 3-lobed, lobes linear 2.9-3.2 x 0.3-0.4 cm; labellum suborbicular 2.2-2.4 x 1.8-2 cm, 2-lobed, base attenuate 0.7-1 cm long, apex deeply divided 0.9-1.2 cm long; lateral staminodes oblanceolate 2.2-2.4 x 0.5-0.7 cm, base attenuate 0.7-1 x 0.3-0.4 cm; anther dorsifixed 0.8-1 x 0.3 cm, red; filament 4.5-5.2 cm long, red; stigma ca. 0.1 cm wide, densely ciliate, green; epigynous glands 2, slender 0.3-0.4 x 0.2 cm; ovary 0.3-0.5 x 0.3-0.4 cm, 3-loculed, pubescent, orange; multiple ovules per locule. Unobserved fruits.

Material examined: BRAZIL. SÃO PAULO: São Paulo, Parque Estadual Serra do Mar – Núcleo Curucutu, Trilha do Mirante, 07-III-1998, fl., *P. Affonso* 222 (PMSP); Mata de frente do centro de visitação da sede, 22-II-2019, fl., *L.C. Vaz* 09 (UNISA); Mata de frente do centro de visitação da sede, 22-III-2019, fl., *L.C. Vaz* 11 (UNISA).

Additional material examined: BANGLADESH. CHITTAGONG DIVISION: Chittagong, 1867, fl., *L.H.B. 6547* (K). BRAZIL. DISTRITO FEDERAL: Brasília, Catetinho, 06-I-1982, fl., *Pereira B.A.S. 163* (IBGE); PARANÁ: Curitiba. Santo Inácio, 26-I-1999, fl., *Griep I. 51* (MBM); RIO DE JANEIRO: Rio de Janeiro, Parque do Jardim Botânico, 22-I-1985, fl., fr., *IRC/RCC 696* (RB); Rio de Janeiro, Parque do Jardim Botânico, 04-II-1986, fl., fr., *L.C. Giordano 31* (RB); Teresópolis, Estrada da Barreira, Parque Nacional Serra dos Órgãos, 02-II-2017, *P. Feliz 178* (RB); RIO GRANDE DO SUL: Torres, Morro Azul, 19-XII-1977, fl., *Baptista L. 673* (ICN); SANTA CATARINA: Rodeio, Ipiranga, 26-XII-2016, fl., *Funez L.A. 5940* (FURB); SÃO PAULO: Piracicaba, Campus ESALQ/USP, 23-I-1993, *Souza V.C. 2145* (HUFU); São Paulo, Parque Natural Municipal da Cratera de Colônia, Mata de Turfeira, 10-I-2008, *S.L. Marçon 43* (PMSP); CHINA. YUNNAN: Longling, Below Hupa village, 22-VIII-2003, fr., *Gaoligong Shan Biodiversity Survey 17531* (E); FRANCE. REUNION: No municipality, s.d., fr., *F. Friedmann 1684* (P/PC); INDIA. KHASI HILLS: Nambar Forest, 07-III-1949, fl., *F. Kingdon-Ward 1862* (NY); LAOS. LAO PEOPLE'S DEMOCRATIC REPUBLIC (LA): Xieng Khouang, I-1903, fr., *C.J. Spire 1511* (P/PC).

*Hedychium coccineum* is the only species of Zingiberales found in the Núcleo Curucutu that is cultivated in Brazil, it has its original distribution in Asian countries such as Bhutan, India, Laos, Myanmar, Nepal, Sri Lanka and Thailand (Wongsuwan & Picheansoonthon 2011). In Brazil the species is found in Rio de Janeiro, São Paulo, Paraná, Santa Catarina and possible occurrence in Pernambuco (André 2020c). Its occurrence in Distrito Federal and Rio Grande do Sul was also recorded (according to: *Pereira B.A.S. 163* and *Baptista L. 673*).

In the study area, flowers could be seen in the species from February to March, and although being monitored for two years, there was no occurrence of fruiting during this period.

In Brazil, flowering occurrences were recorded in the Distrito Federal and Paraná in January (according to: *Pereira B.A.S. 163* and *Griep I. 51*), Rio Grande do Sul and Santa Catarina in December (according to: *Baptista L. 673* and *Funez L.A. 5940*) and in Rio de Janeiro it blooms and bears fruit between January and February (according to: *IRC/RCC 696* and *L.C. Giordano 31*). According to Wongsuwan & Picheansoonthon (2011), in native regions, the species blooms between June and August and fruiting occurs between July and September.

The fruits are rare in Brazilian and foreign herbariums. In Brazil, only two materials were found, both from the Herbarium RB; and in relation to the foreign ones, only exsiccates from the P/PC and E herbariums presented fruits.

Gao *et al.* (2012), pointed out that *H. coccineum* is pollinated by three species of Lepidoptera (Butterflies), which do not occur in Brazil; in addition, spontaneous self-pollination also was not observed, despite being a self-compatible species.

*Hedychium coccineum* can be confused with *H. gardnerianum* Sheph. ex Ker Gawl. when herborized, both present yellowish to brownish flowers. Nevertheless, it can be differentiated by the width of the blade, 2.5-4.5 cm wide for *H. coccineum* and 4-12 cm wide for *H. gardnerianum*, such and the shape of the labellum, deeply divided and apex division, respectively (according to: *P. Feliz 178, Souza V.C. 2145 and S.L. Marçon 43*).

*Hedychium coccineum* can be distinguished from the Zingiberales in the study area by sessile leaves, 2-3 sheaths without blades and by the orange terminal inflorescence. It is found in an isolated population within high solar incidence.

***Renealmia petasites*** Gagnep., Bull. Soc. Bot. France 49: 26. 1902.

Figure 2 h-m

Pseudostem 1-2 m tall. Leaves with striated sheaths; ligule truncated 0.1-0.25 cm long, brown; subsessile leaves; absent pulvinus; blade narrowly elliptic 13-54.4 x 3.5-12.5 cm; apex acuminate, base cuneate, glabrous on both sides. Basal raceme inflorescence in aphyllous scapes 3-7.2 x 3.5-8.5 cm; scape 8.5-37.4 cm long, pink. Flowers with pink pedicel 0.5-1.5 cm long; bracts narrowly elliptic-obovate 1.5-8 x 1-2.5 cm, pink; bracteole 1.5-2.3 x 1-1.5 cm; calyx 1-2 x 1-1.9 cm, pinkish-red; corolla tube 0.6-1.4 cm, lobes narrowly elliptic 0.8-1.1 cm long, 3-lobed, white; labellum 3-lobed, slightly pink target, pubescent base 0.6-1.2 cm long, lateral lobes involut, rounded, middle lobe entire or bilobulate 1-1.5 cm long; linear lateral staminodes ca. 0.3 cm long; claw ca. 0.1 cm long; anther 0.6-0.8 x 0.3-0.4 cm; filament ca. 0.2 cm long; style 1.7-2 cm long, red; stigma 0.2-0.3 cm wide, cordiform, puberulous, red; nectaries ca. 0.3 x 0.3 cm; ovary 1-1.3 x 0.5-0.7 cm, glabrous, red; multiple ovules per locule. Capsule 1-2 x 1.2-2 cm, dark red, becoming black when mature. Seeds 0.3-0.5 cm long, bright brown; orange aril.

Material examined: BRAZIL. SÃO PAULO: São Paulo, Parque Estadual Serra do Mar – Núcleo Curucutu, Trilha do Embú, 22-VIII-1997, fl., *P. Affonso 199* (UNISA); Trilha da Captação d'água, 14-XII-2011, fr., *P. Affonso 1275* (UNISA); Trilha da Bica, próxima à sede, 29-IX-2017, fl. fr., *P. Affonso 1378* (UNISA); Trilha da Captação d'água, 16-III-2018, fr., *L.C. Vaz 02* (UNISA); Trilha nova do mirante, 11-V-2018, fl. fr., *L.C. Vaz 04* (UNISA).

Additional material examined: BRAZIL. BAHIA: Amargosa, Serra do Timbó, Área de estudos do projeto Timbó/Centro Sapucaia, 27-I-2007, fr., *D. Cardoso 1668* (CEPEC); Barro Preto, Serra da Pedra Lascada, na estrada que passa pela Fazenda São Miguel, em direção à serra, 21-XI-2005, fr., *M.M.M. Lopes 312* (NY); Una, Fazenda São Rafael, 11-XII-1997, fl., *L.A. Mattos Silva 3673* (NY). ESPÍRITO SANTO: Cariacica, Localidade de Alegre, Trilha do Pau Oco, Reserva Biológica de Duas Bocas, 15-II-2008, fl. fr., *R.C. Forzza 5017* (RB); PARANÁ: Antonina, Pinheirinho, 06-X-1976, fl. fr., *Kummrow R. 1145* (MBM); Morretes, Rio Sagrado, 06-XII-2016, fr., *Völtz R.R. 1124* (UPCB); RIO

DE JANEIRO: Paraty, Cairucu, 10-VIII-1996, fl., *R. Mello-Silva 1230* (SPF); Rio de Janeiro, Tijuca, X-1915, fl. fr., *Lutz A. 838* (R); SANTA CATARINA: Palhoça, Pilões, 26-X-1956, fl., *Reitz & Klein 4027* (S); SÃO PAULO: Sorocaba, 10-XII-1874, fl., *H. Mosén 2966* (S).

*Renealmia petasites* is endemic in Brazil, with occurrences in the Atlantic Forest, distributed in the States of Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná and Santa Catarina (André 2020c). Its occurrence in Bahia was also recorded (according to: *L.A. Mattos Silva 3673*, *M.M.M. Lopes 312* and *D. Cardoso 1668*).

In the Núcleo Curucutu, flowers were present in the species between August and May and bears fruit between March and September. Outside the study area, flowering records from August to December and fruiting from October to February. Kamer & Maas (2003) cite flowering throughout the year.

The fruits of *R. petasites* were observed in the field and laboratory, and its seeds released in a state of extreme maturity, beginning the opening at the base until arriving the apex.

*Renealmia petasites* is very similar to *R. chrysotricha* Petersen, presenting minimal differences, differentiating by the leaf blade wider 4-13 cm wide, shorter calyx 1-2 cm long, bigger pedicel 0.5-1.5 cm long, white labellum slightly pink and approximately 50 seeds per fruit, while *R. chrysotricha* presents 4.5-9.5 cm wide leaf blade, longest calyx 1.8-2.5 cm long, smaller pedicel 0.2-0.6 cm long, completely white labellum and up to 25 seeds per fruit (Maas 1977, Lima *et al.* 2018)

Maas (1977) pointed out that *R. petasites* is a relatively variable species, which may present a great difference in the size of the inflorescences according to the collection site. This variation can be observed when comparing the specimens in the study area with other locations. The specimens in the study area showed scapes with 8.5-37.4 cm long and inflorescences of 3-7.2 cm long, which are small structures compared to specimens from other locations, reaching 50 cm long of scape and 30 cm long of inflorescence (according to: *H. Mosén 2966*, *Reitz & Klein 4027* and *L.A Mattos Silva 3673*).

Another characteristic observed was that the specimens of the Núcleo Curucutu have a more compact and globular inflorescence, while those analyzed from other locations have a more lax inflorescence, as in the case of the specimens analyzed from Bahia (according to: *L.A. Mattos Silva 3673*), Rio de Janeiro (according to: *R. Mello-Silva 1230*) and Santa Catarina (according to: *Reitz & Klein 4027*).

*Renealmia petasites* differs from other Zingiberales species in the Núcleo Curucutu because it is the only one that presents subsessile leaves and tiny staminodes. Only four adult specimens were found, therefore, is the species with the least number of individuals along the explored trails.

The species was considered extinct in Minas Gerais due to the absence of collections for 30 years, leaving the list in 2008 (Diário do Executivo 1997, Diário do Executivo 2008). In 2012 it was classified as “Least Concern” (CNCFlora 2012c).

For São Paulo the species did not reach a critical situation as pointed out for Minas Gerais, but being part of a species found in a Conservation Unit in the State, a "Least Concern" status is regularly maintained.

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### **Conflicts of interest**

There is no conflict of interest.

### **Author Contributions**

**Leandro Matheus de Carvalho Vaz:** Contribution in the concept and design of the study; Contribution to data collection; Contribution in identifications of the studied species; Contribution to data analysis and interpretation; Contribution to manuscript preparation.

**Paulo Affonso:** Contribution in the concept and design of the study; Contribution to data collection; Contribution in identifications of the studied species; Contribution to data analysis and interpretation; Contribution to critical revision, adding intellectual content.

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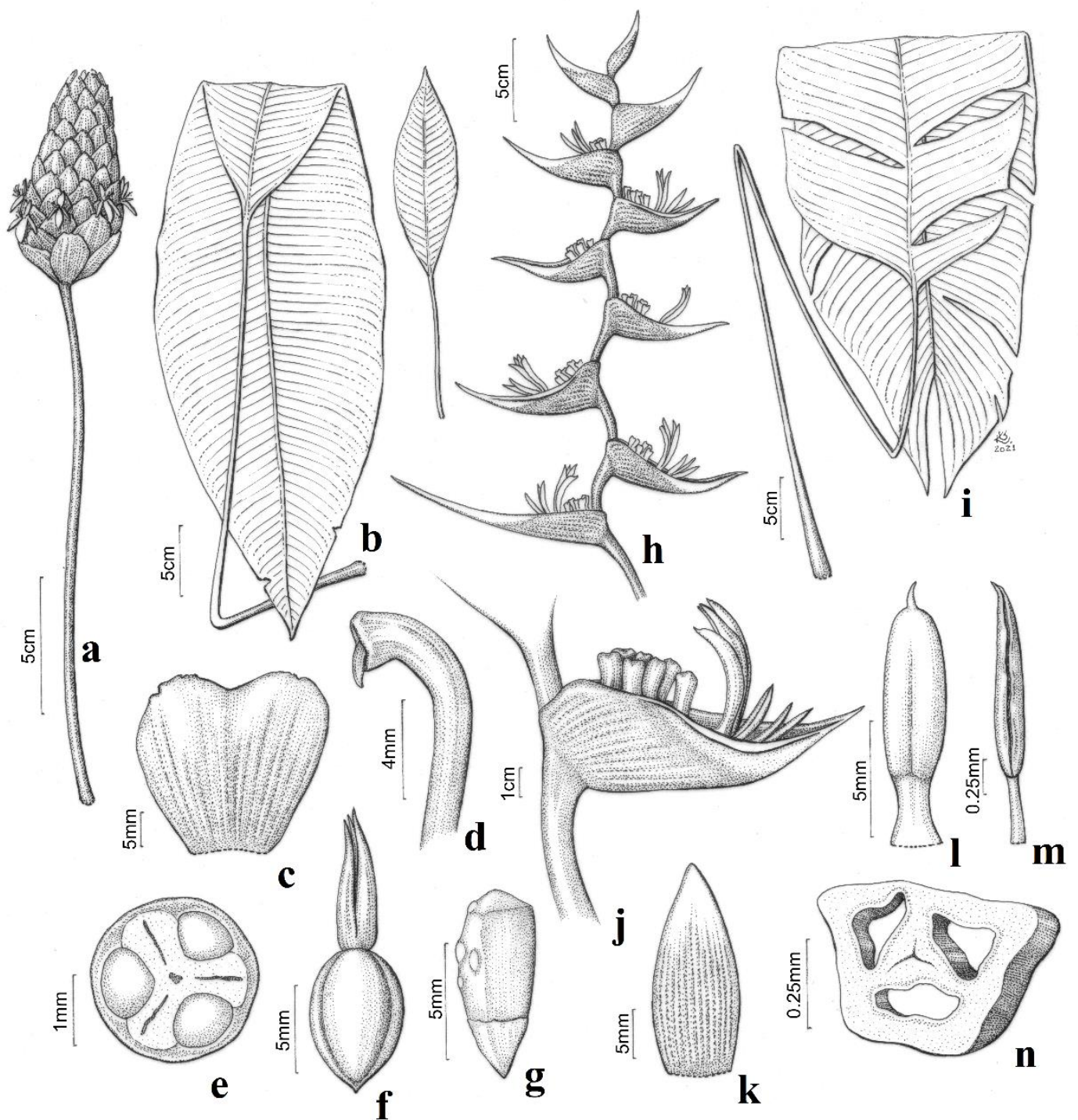


Figure 1. a-g. *Goeppertia monophylla* (Vell.) Brochs. & S.Suárez. a. Inflorescence. b. Leaf. c. Bract. d. Style and stigma. e. Cross-section of the ovary. f. Fruit. g. Seed. h-n. *Heliconia farinosa* Raddi. h. Basal bract leaf highlighted inflorescence. i. Leaf. j. Bract, flowers and fruits in detail. k. Bracteole. l. Staminodium. m. Stamen. n. Cross-section of the ovary.

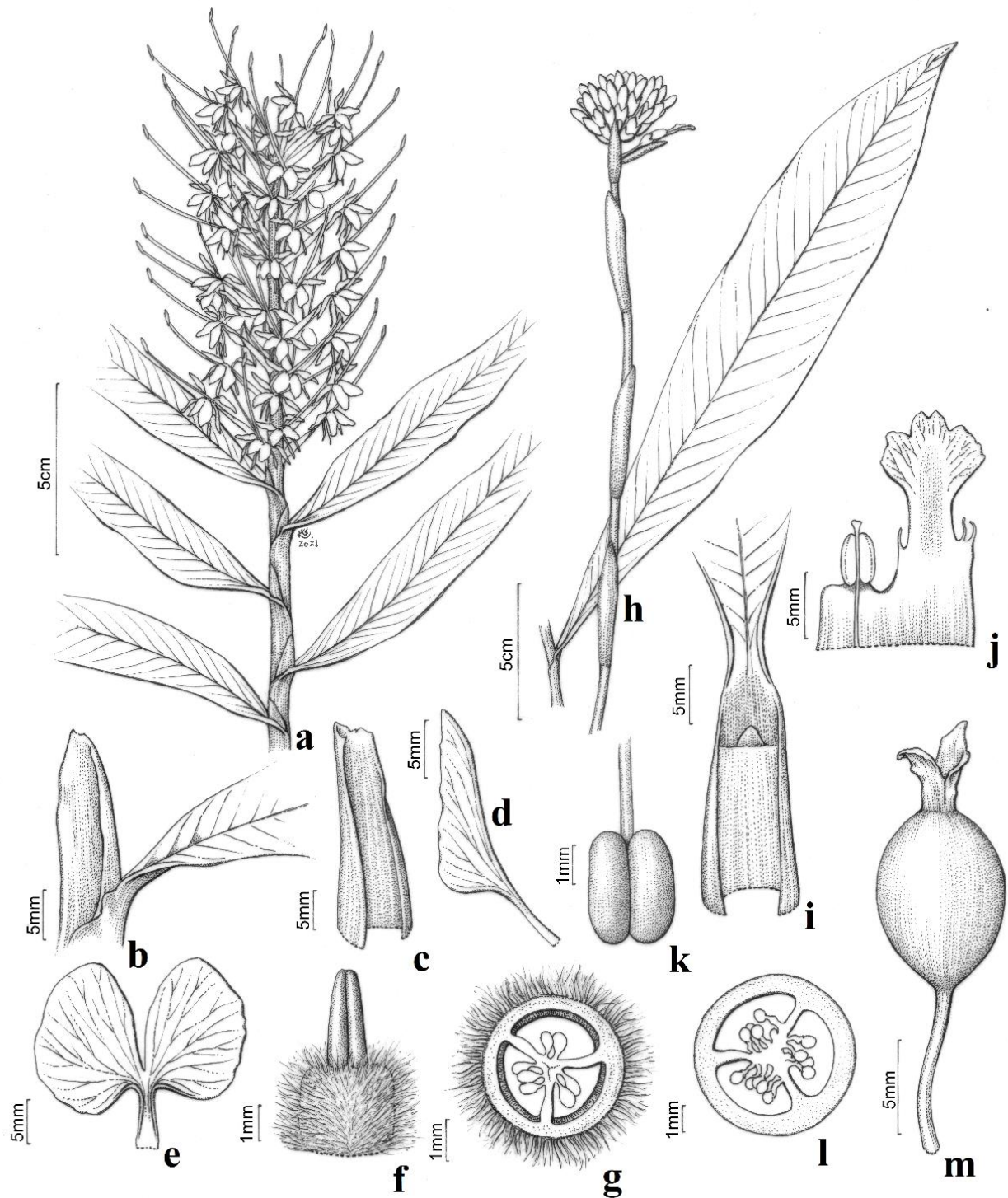


Figure 2. a-g. *Hedychium coccineum* Buch.-Ham. Ex Sm. a. Inflorescence and leaves. b. Ligule. c. Bract. d. Lateral Staminodium. e. Labellum. f. Epiginous glands and ovary. g. Cross-section of the ovary. h-m. *Renealmia petasites* Gagnep. h. Inflorescence and leaf. i. Sheath and ligule. j. Labellum and stamen inserted in the corolla tube. k. Nectaries. l. Cross-section of the ovary. m. Fruit.

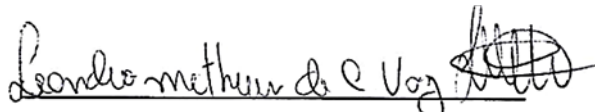
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