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Synopsis of *Euphorbia* (Euphorbiaceae) in the state of São Paulo, Brazil

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Abstract

Euphorbia is the largest genus of Euphorbiaceae and is among the giant genera of Angiosperms. In the state of São Paulo, the genus is represented by 23 species occurring in savannas, high altitude fields, and anthropic areas. This work includes an identification key, photographs, and comments on morphology, habitat, and geographical distribution. We reestablish *Euphorbia chrysophylla* and recognize *Leptopus brasiliensis* as a synonym of *Euphorbia sciadophila*. Six new records for the state of São Paulo are presented: *Euphorbia adenoptera*, *E. bahiensis*, *E. chrysophylla*, *E. cordeiroae*, *E. foliolosa* and *E. ophthalmica*. Eight lectotypes are designated.

Key words: Neotropical flora, nomenclatural notes, taxonomy

Resumo

Euphorbia é o maior gênero de Euphorbiaceae e está entre os maiores de Angiospermas. No Estado de São Paulo, está representado por 23 espécies ocorrendo no cerrado, campos de altitude e áreas antrópicas. Este trabalho inclui uma chave de identificação, comentários sobre morfologia, habitat e distribuição geográfica. Reestabelecemos *Euphorbia chrysophylla* e reconhecemos *Leptopus brasiliensis* como sinônimo de *Euphorbia sciadophila*. Seis novas ocorrências para o Estado de São Paulo são apresentadas: *Euphorbia adenoptera*, *E. bahiensis*, *E. chrysophylla*, *E. cordeiroae*, *E. foliolosa* e *E. ophthalmica*. Oito lectótipos são designados.

Introduction

Euphorbiaceae are one of the most diverse and complex families of Angiosperms, with 246 genera and 6,300 species distributed worldwide, mainly in the tropics (Govaerts *et al.* 2000, Wurdack & Davis 2009). In Brazil, the family is represented by 63 genera and about 1,000 species distributed all over the country, and in the state of São Paulo it accounts with 37 genera and approximately 160 species (Cordeiro *et al.* 2013, Caruzo & Cordeiro 2007).

Euphorbia Linnaeus (1753: 450), with approximately 2,000 species, is ranked as the fourth biggest genus of flowering plants (Frodin 2004) and is the largest one of Euphorbiaceae (Horn *et al.* 2012). The genus is renowned for its remarkable morphological diversity and diverse growth forms and is characterized by the cyathium, a pseudanthial inflorescence unique in Angiosperms, which consists of four or five staminate cymules surrounding a terminal pistillate flower within a cup-like involucre formed by the fusion of bracts from the staminate cymules. The cyathium has glands along its rim, and the glands can sometimes have appendices (Webster 1994, Radcliffe–Smith 2001, Horn *et al.* 2012, Yang *et al.* 2012).

The cyathium is taxonomically very important for the identification of species and was once used to segregate genera within subtribe Euphorbiineae (Webster 1994, Radcliffe-Smith 2001). These genera include *Chamaesyce* Gray (1821: 260), *Cubanthus* (Boissier 1862: 7) Millspaugh (1913: 371), *Elaeophorbia* Stapf (1906: 646), *Endadenium* Leach (1973: 31), *Monadenium* Pax (1894: 126), *Pedilanthus* Necker ex Poiteau (1812: 388), *Poinsettia* Graham (1836: 412), and *Synadenium* Boissier (1862: 187). After Steinmann & Porter's (2002) molecular phylogenetic work, all these genera are now recognized inside *Euphorbia s.l.*, since their acceptance would turn *Euphorbia* into a paraphyletic group (Bruyns *et al.* 2006, Zimmermann *et al.* 2010).

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Recent phylogenetic studies have shown the monophyly of *Euphorbia* and contributed to the understanding of its infrageneric relationships, finding four big clades, which were recognized as subgenera: subg. *Athymalus* Necker (1790: 353) ex Reichenbach (1829: 194), with about 150 species restricted to the Old World (Peirson *et al.* 2013); subg. *Esula* Persoon (1806: 14), with approximately 500 species, distributed throughout the world, but especially diverse on the temperate regions of Eurasia (Riina *et al.* 2013); subg. *Euphorbia*, the most morphologically diverse, with over 650 species, distributed mainly along the tropics (Dorsey *et al.* 2013); and subg. *Chamaesyce* Rafinesque (1817: 119), with about 600 species, distributed mainly in the New World (Yang *et al.* 2012).

Although the genus is very common in São Paulo, few species of *Euphorbia* have been treated in floristic and taxonomical studies in this state (Cordeiro 1989, 1992), and the most recent checklist indicates 17 species (Wanderley *et al.* 2012). This work is part of the monograph of Euphorbiaceae for the 'Flora Fanerogâmica do Estado de São Paulo', and aims to contribute to the *Euphorbia* Planetary Biodiversity Inventory project (Esser *et al.* 2009).

Here we provide an identification key for the species from São Paulo state as well as the original publication, type collections, relevant synonyms, comments about taxonomy, morphology, geographical distribution and habitat for each species.

Material and methods

This study was based on the analysis of herbarium collections from BOTU, ESA, IAC, MBM, PMSP, RB, SP, SPF, SPSF and UEC (abbreviations according to Thiers 2014, continuously updated), with a total of approximately 400 specimens analyzed, along with field observation of some species. Type specimens were analyzed through images available at the JStor Global Plants website (http://plants.jstor.org/) and the Vienna Virtual Herbarium (http://herbarium.univie.ac.at). The morphological description of *Euphorbia* presented below covers the entire morphological diversity of the genus. For each species we refer to: original publication, type collections, basionyms, synonyms, geographic distribution, one of the specimens examined. A list of all material examined is given in Appendix 1. Data for general geographical distribution were collected from the *Euphorbia* Planetary Biodiversity Inventory database (Riina & Berry 2013) and from herbarium specimens labels.

Taxonomy

Euphorbia Linnaeus (1753: 450).

Lectotype (designated by Millspaugh 1909: 306):—*Euphorbia antiquorum* Linnaeus (1753: 450).

Perennial or annual herbs, shrubs or rarely trees or climbers, prostrate or erect, monoecious or rarely dioecious, glabrous or pubescent, with white milky latex; stems green to reddish, succulent and spiny in some species. Leaves alternate, opposite or verticillate, generally petiolate, stipulate or exstipulate, simple, entire or lobate, glabrous or pubescent, penninerved or palminerved. Inflorescences axillary or terminal, cyathia solitary, in dichasia, pleiochasia or monochasia, usually subtended by bracts (cyathophylls), sometimes showy; cyathia consisting of four or five staminate cymules, with 1–10 flowers each, with or without associated bracteoles, surrounding one terminal pistillate flower, inside a cuplike, gland-bearing involucre, with or without appendages; staminate flowers in lateral cymules, reduced to a single stamen with a slender pedicel; pistillate flower solitary, terminal, achlamydeous (sometimes ovary subtented by a perianth-like structure); ovary (2–)3–locular; styles (2–)3, free or connate, generally bifid; stigmas thickened or not. Fruit capsule, septicidally and loculicidally dehiscent into (2–)3, 2-valved cocci, dehiscence explosive, or rarely fleshy and indehiscent; columella persistent. Seeds generally ovoid; raphe longitudinal on the ventral face; seed coat smooth or ornamented, carunculate or ecarunculatae.

In the State of São Paulo, *Euphorbia* is represented by 23 species of three of the four subgenera currently recognized. The subgenus that has no representatives in São Paulo is subg. *Athymalus*, which is restricted to Africa.

Most of species recorded for São Paulo belong to subg. *Chamaesyce*, and three sections are represented in the state: sect. *Anisophyllum* Roeper in Duby (1828: 412) (11 spp.; *Euphorbia adenoptera, E. bahiensis, E. foliolosa, E. hirta, E. hyssopifolia, E. ophthalmica, E. potentilloides, E. prostrata, E. serpens, E. setosa* and *E. thymifolia*), sect. *Alectoroctonum* (Schlechtendal 1847: 252) Baillon (1858: 284) (2 spp.; *E. insulana* and *E. sciadophila*) and sect. *Poinsettia* (Graham 1836: 412) Baillon (1828: 284) (2 spp.; *E. heterophylla* and *E. zonosperma*).

The subgenus *Euphorbia* is represented by seven species, from two sections: sect. *Nummulariopsis* Boissier (1862: 71) (6 spp.; *Euphorbia chrysophylla, E. cordeiroae, E. elodes, E. papillosa, E. peperomioides* and *E. rhabdodes*) and sect. *Stachydium* Boissier (1862: 65) (1 sp.; *E. comosa*). Subgenus *Esula* is represented by only one species, *E. peplus*, which belongs to sect. *Tithymalyus* (Gaertner 1790: 115) Roeper in Duby (1828: 412).

Key to the species

1. Stipules interpetiolar. Leaf base asymmetric. Cyathial glands appendages petaloid, sometimes poorly developed or absent.....2
- Stipules absent or, if present, lateral. Leaf base symmetric. Cyathial glands appendages absent or, if present, not petaloid 12
2. Stems hirsute. Cyathia arranged in capitate dichasia 3
- Stems glabrate to pubescent. Cyathia solitary, in pairs or arranged in typical dichasia or pleiochasia.....5
3. Leaves lanceolate, venation cladodromous, margin entire. Involucre campanulate. Cyathial glands appendages erect, covering the glands. Staminate flowers 10–12 per cymule. Styles tomentose. Seeds more than 1 mm long, irregularly alveolate ..... *E. setosa*
- Leaves elliptic, venation actinodromous, margin irregularly serrate. Involucre turbinate. Cyathial glands appendages patent, not covering the glands. Staminate flowers 1–2 per cymule. Styles glabrate. Seeds up to 1 mm long, with transverse ridges 4
4. Erect plants, stems branched only near the base. Capitate dichasia along all the plant ..... *E. hirta*
- Prostrate to decumbent plants, stems branched along all the plant. Capitate dichasia only on the terminal portion of the branches . ..... *E. ophthalmica*
5. Erect plants. Cyathia arranged in dichasia or pleiochasia 6
- Prostrate plants. Cyathia solitary or in pairs, sometimes in lateral, congested branchlets 9
6. Venation hyphodromous. Cyathia arranged in pleiochasia. Involucre campanulate. Seed coat smooth..... *E. potentilloides*
- Venation actinodromous or camptodromous. Cyathia arranged in dichasia. Involucre turbinate. Seed coat ornamented 7
7. Venation cladodromous. Styles entire, more than 1.5 mm long ..... *E. foliolosa*
- Venation actinodromous. Styles bifid, less than 1.5 mm long.....8
8. Synflorescences with lateral axis congested. Weedy plants, occurring in several types of habitats. Seed with 2–4 prominent transverse ridges ..... *E. hyssopifolia*
- Synflorescences with lateral axis not congested. Plants restricted to seashore plains ("restinga" forests), growing only on sandy soils. Seed without prominent transverse ridges ..... *E. bahiensis*
9. Stems totally glabrous, frequently rooting at nodes. Leaves orbicular, margin entire. Stipules largely or completely fused. Ovary and fruit glabrate. Seeds smooth ..... *E. serpens*
- Stems with indumentum only on the adaxial surface, never rooting at nodes. Leaves elliptic to oblong-elliptic, margin serrate to obscurely serrate. Stipules free or fused only at the base. Ovary and fruit with trichomes. Seeds with irregular or regular transverse ridges 10
10. Involucre with trichomes only on the lobes. Anthers dark purple. Ovary and fruit with only two rows of trichomes along the keel of the cocci. Seeds gray, with irregular transverse ridges ..... *E. prostrata*
- Involucre completely covered by trichomes. Anthers yellow, pinkish or purplish. Ovary and fruit completely covered by trichomes. Seeds brown, with regular transverse ridges 11
11. Cyathial glands appendages well developed. Anthers purplish. Fruits distinctly exserted from the cyathia. Seeds with 5–7 transverse ridges ..... *E. adenoptera*
- Cyathial glands appendages absent or inconspicuous. Anthers yellow or pinkish. Fruits hardly emerging from the cyathia. Seeds with 2–4 transverse ridges ..... *E. thymifolia*
12. Cyathial glands without appendages 13
- Cyathial glands with appendages 21
13. Cyathia arranged in monochasia. Cyathophylls decussate, folded in half and orbicular. Seeds prismatic, carunculate..... *E. comosa*
- Cyathia solitary or arranged in dichasia or pleiochasia. Cyathophylls not decussate or folded in half and in other shapes. Seeds ovoid, ecarunculate.....14
14. Cyathia arranged in terminal dichasia. Involucre ovoid. Cyathial glands 1, cupuliform. Seeds tuberculate.....15
- Cyathia solitary or arranged in terminal pleiochasia, sometimes also in axillary dichasia. Involucre campanulate. Glands 4–5, trapezoids. Seeds smooth, verrucose or ruminate 16
15. Involucre glabrate. Ovary and styles glabrate. Fruits glabrous. Seeds without a prominent transverse ridge..... *E. heterophylla*
- Involucre sericeous. Ovary tomentose, styles sericeous on the outter surface. Fruits sericeous. Seeds with a transverse prominent ridge ..... *E. zonosperma*
16. Prostrate herbs. Leaves opposite, orbicular ..... *E. peperomioides*
- Erect herbs. Leaves alternate, linear, oblong, elliptic or narrow-elliptic.....17
17. Stems hirsute to pubescent. Venation hyphodromous. Involucre tomentose. Ovary tomentose. Seeds with smooth coat .... *E. papillosa*
- Stems glabrate. Venation actinodromous or cladodromous. Involucre glabrate. Ovary glabrate. Seeds with ornamented coat 18
18. Leaves with involute or revolute margin when dried. Cyathia in terminal pleiochasia with 5 or lateral axis, sometimes also in axillary dichasia.....19
- Leaves with flat margin. Cyathia in terminal pleiochasia with 3 or 4 rays, never in axillary dichasia.....20
19. Venation actinodromous, margin slightly involute when dried. Cyathial glands 5. Seeds verrucose ..... *E. chrysophylla*
- Venation cladodromous, margin revolute when dried. Cyathial glands 4. Seeds rugose ..... *E. rhabdodes*
20. Leaves linear, trichomes only on the base, petiole up to 1 mm long, stipules present, glanduliform and inconspicuous. Pistillate flower with ovary subtended by a well developed perianth-like whorl. ..... *E. cordeiroae*
- Leaves elliptic to obovate, totally glabrous, petiole less than 1 mm long, stipules absent. Pistillate flower with ovary not subtended by a perianth-like whorl or with it poorly developed. ..... *E. elodes*

21. Leaves obovate, petioles up to 5 mm long, stipules absent. Cyathial glands appendages horn-like. Ovary and fruit with 2 slender ridges along the keel of the cocci. Seeds alveolate on the dorsal face and with sulcate on the ventral surface, caruncle present..... ..... *E. peplus*
- Leaves ovate, orbicular, ovate or lanceolate, petioles 5–60 mm long, stipules present, glanduliform. Cyathial glands appendages with different shapes, never horn-like. Ovary and fruit smooth. Seeds foveolate or mammillate 22
22. Leaves ovate to orbicular. Cyathial glands 4, appendages fimbriate, patent. Styles thin and glabrate. Seeds foveolate..... ..... *E. sciadophila*
- Leaves ovate to lanceolate. Cyathial glands 2(–3), appendages fleshy, erect. Styles thick and pubescent on the outer surface. Seeds mammillate ..... *E. insulana*

1. *Euphorbia adenoptera* Bertoloni (1844: 20) (Fig. 1A–D). Type:—DOMINICAN REPUBLIC. Locality unknown, *C.L.G. Bertero s.n.* (holotype TO, isotypes F!, G-DC!).

Distribution and habitat:—*Euphorbia adenoptera* is a widespread weed, occurring in Mexico, Central America, the Carribean and South America. In the State of São Paulo the species is only known by specimens collected on roadsides.

Representative Specimen:—BRAZIL. **São Paulo**: Atibaia, 28 October 2013, *O.L.M. Silva 93* (SP).

Taxonomic notes:—*Euphorbia adenoptera* is similar to *E. thymifolia*, but differs from it in the cyathial glands appendages (well developed in *E. adenoptera vs.* absent or inconspicuous in *E. thymifolia*). Both species have an inconspicuous growth of the pistillate flower's pedicel, so that the fruit is exposed through an aperture between the two glands bearing bigger appendages in *E. adenoptera*, while the subsessile fruit splits the involucre during its maturation in *E. thymifolia*. *Euphorbia adenoptera* also can be distinguished from *E. thymifolia* by its purplish anthers (*vs.* yellowish in *E. thymifolia*) and the seeds.

2. *Euphorbia bahiensis* (Klotzsch & Garcke) Boissier (1862: 24) (Fig. 1E–F).

Anisophyllum bahiense Klotzsch & Garcke in Klotzsch (1860: 33). Lectotype (designated here):—BRAZIL. Locality unknown, *F. Sellow s.n.* (holotype B†, photo F!, lectotype K 000253848!).

Distribution and habitat:—*Euphorbia bahiensis* occurs in Central America (Costa Rica, Panama), the Caribbean (Jamaica) and South America (Colombia, French Guiana and Brazil). In the State of São Paulo the species occurs only on seashore plains ('restinga' forest), growing on sandy soils.

Representative Specimen:—BRAZIL. **São Paulo:** Iguapé, 10 October 2012, *O.L.M. Silva & M. Pastore 29* (SP).

Taxonomic notes:—The species is commonly misidentified as *E. hyssopifolia*, but it has less branched synflorescences, with fewer cyathia, while in *E. hyssopifolia* the synflorescences are very branched and the lateral axes are congested. Also *E. bahiensis* is restricted to seashores plains, while *E. hyssopifolia* is a common weed species from cerrado vegetation and disturbed areas.

3. *Euphorbia chrysophylla* (Klotzsch & Garcke) Klotzsch ex Boissier (1862: 104) (Fig. 1G–I).

Tithymalus chrysophyllus Klotzsch & Garcke in Klotzsch (1860: 72).—*Euphorbia collina* var. *chrysophylla* (Klotzsch & Garcke) Subils (1977: 215).—Lectotype (designated here):—BRAZIL. Minas Gerais: Serra da Moeda, *F. Sellow s.n.* (holotype B†, photo F!, lectotype BR05102211!, isolectotypes LD14444693!, P00607247!, K00253932!, K00253934!).

Distribution and habitat:—*Euphorbia chrysophylla* occurs in Brazil, Bolivia and Northeastern Argentina. In São Paulo, the species is known by a single collection (from Itirapina Ecological Station), where it occurs in swampy areas in cerrado vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** Itirapina, 20 April 2009, *J.S. Tannus 750* (SPSF).

Taxonomic notes:—*Euphorbia chrysophylla* is similar to *E. elodes*, but can be distinguished from it by leaf shape (elliptic to narrowly elliptic in *E. chrysophylla vs.* obovate in *E. elodes*), number of lateral axes of the pleiochasia (5 in *E. chrysophylla vs.* 3 in *E. elodes*) and cyathial glands (5 in *E. chrysophylla vs.* 4 in *E. elodes*). On dried specimens, leaves of *E. chrysophylla* are distinctly involute, a character not observed in *E. elodes*. Another similar species is *E. rhabdodes*, which also has pleiochasia with 5 lateral axes, but *E. chrysophylla* differs from it by leaf venation (actinodromous in *E. chrysophylla vs.* cladodromous in *E. rhabdodes*) and margin (involute in *E. chrysophylla vs.* revolute in *E. rhabdodes*), number of cyathial glands (5 in *E. chrysophylla vs.* 4 in *E. rhabdodes*) and seed coat (verrucose in *E. chrysophylla vs.* rugose in *E. rhabdodes*).

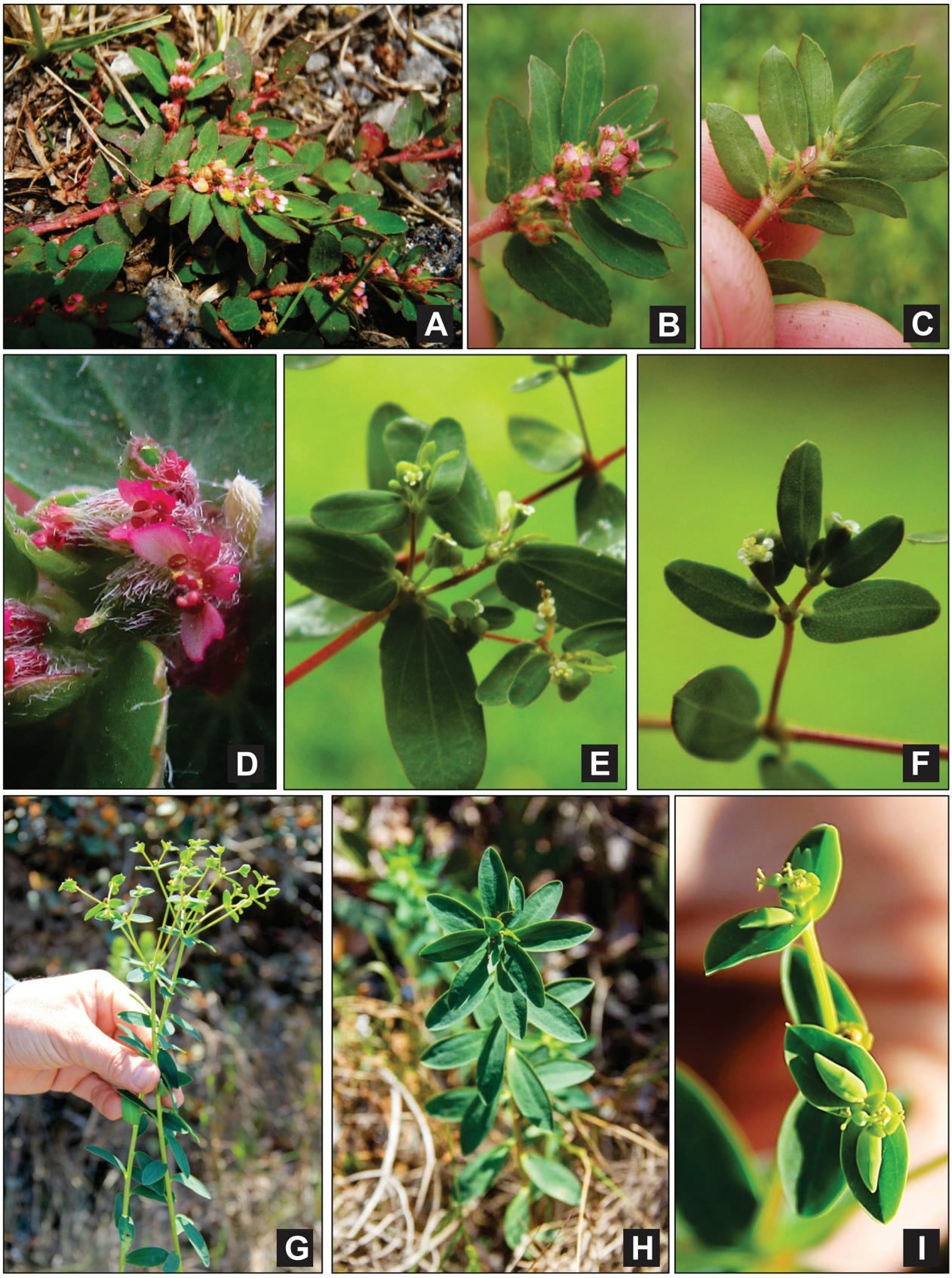

FIGURE 1. A–D: *Euphorbia adenoptera*. **A.** habit, **B.** branch with cyathia, **C.** abaxial surface of a branch, **D.** cyathium. **E–F.** *Euphorbia bahiensis*. **E.** synflorescence, **F.** branch with cyathia. **G–I:** *Euphorbia chrysophylla*. **G:** habit, **H:** leaves, **I:** branch with cyathia. Photos: A–D: O.L.M. Silva, E–F: M. Pastore, G–I: R. Dayrell.

Euphorbia chrysophylla was recognized by Riina & Berry (2013) as a synonym of *E. portulacoides* Linnaeus (1753: 456) subsp. c*ollina* (Philippi 1857: 41) Croizat (1943: 188). However, the synonymization of *E. collina* with *E. portulacoides* made by Croizat was not accepted by Subils (1977). One of the characteristics distinguishing *Euphorbia collina* Philippi (1857: 41) from *E. portulacoides* is the color of cyathial glands, which is green in *E. collina* and purple in *E. portulacoides*, a characteristic also observed by Boissier in the treatment of tribe Euphorbieae for Candolle's Prodromus (Boissier 1862). Apparently, Croizat (1943) was unable to see this difference, since his synonymization was based only on involucre and fruit sizes. Subils (1977) recognized, therefore, two distinct species: *E. collina*, with 7 varieties, one of them *E. collina* var. *chrysophylla*, and *E. portulacoides*, with 3 varieties.

We believe the synonymization of *Euphorbia chrysophylla* under *E. collina* is not supported due to the following characteristics which are different between both species: leaf shape (elliptic to narrowly elliptic in *E. chrysophylla* and linear in *E. collina*), number of lateral axes of the pleiochasia (5 in *E. chrysophylla* and 3 in *E. collina*) and seed coat (verrucose in *E. chrysophylla* and smooth in *E. collina*), and so we accept the name *E. chrysophylla*.

4. *Euphorbia comosa* Vellozo (1829: 202) (Fig. 2A–B). Lectotype (designated here):—BRAZIL. Rio de Janeiro: "*Euphorbia comosa*" in Vellozo (1831: tab. 15).

Distribution and habitat:—*Euphorbia comosa* occurs in Colombia, Venezuela and Brazil. In the State of São Paulo the species occurs in cerrado vegetation and disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Paulo de Faria, 25 April 1995, *V. Stranghetti 506* (SPSF).

Taxonomic notes:—*Euphorbia comosa* can be easily recognized among the other species of *Euphorbia* from the state of São Paulo by its characteristic synflorescence, typically of *E.* sect. *Stachydium* in subg. *Euphorbia*, which consist of a monochasium with decussate, orbicular, folded in half cyathophylls. Others singular characteristics of *E. comosa* are its glands, with an extension with thick and slightly crenate margin, and prismatic, carunculate seeds.

5. *Euphorbia cordeiroae* Carrillo-Reyes & Steinmann (2011: 170). Type:—BRAZIL. Goiás: Alto Paraíso de Goiás, estrada para Colinas, a 1 km da entrada do Parque Nacional da Chapada dos Veadeiros, 20 November 1987, *I. Cordeiro, M.C.H. Mamede, M.G. Sajo & E.M. Varanda 388* (holotype SP!, isotype IEB).

Distribution and habitat:—*Euphorbia cordeiroae* was first published as endemic from "Chapada dos Veadeiros", in northeastern Goiás state, Brazil. We found one collection for São Paulo state, but no information about its habitat is given on the herbarium label. According to the original publication (Carillo-Reyes & Steinmann 2011), the species occurs in cerrado vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** Itararé, 22 April 1993, *C.A.M. Scaramuzza et al. 977* (ESA).

Taxonomic notes:—*Euphorbia cordeiroae* is similar to *E. rhabdodes* and *E. elodes*, but differs from *E. rhabdodes* by the number of lateral axes of the pleiochasia (3 in *E. cordeiroae* vs. 5 in *E. rhabdodes*), leaf margin (not revolute in *E. cordeiroae vs.* revolute in *E. rhabdodes*) and seed coat (inconspicually verrucose in *E. cordeiroae* vs. ruminate in *E. rhabdodes*). *Euphorbia elodes*, which also possess cyathia arranged in pleiochasia with 3 lateral axes, differs from *E. cordeiroae* due to the shape of the cyathophylls (linear in *E. cordeiroae* vs. elliptic to obovate in *E. elodes*), stipules (lateral and glanduliform in *E. cordeiroae vs.* absent in *E. elodes*) and the perianth-like whorl on the pistillate flower (well developed in *E. cordeiroae* vs. absent or poorly developed in *E. elodes*).

6. *Euphorbia elodes* Boissier (1860: 29) (Fig. 2C–E). Types:—BRAZIL. São Paulo: In paludosis Brasiliae inter Mugy et Santo-Paulo, *L. Riedel s.n.* (syntype LE, isoyntypes P00716352!, P00716351!); Minas Gerais: *A.F. Regnell s.n.*(syntype S); same locality, *J.F. Widgren s.n.* (syntype S).

Distribution and habitat:—*Euphorbia elodes* is endemic to Brazil (Distrito Federal, Goiás, Minas Gerais, São Paulo, Rio de Janeiro and Paraná). In the State of São Paulo it occurs in high montane habitats, frequently on swampy areas or riversides.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Barreiro, 21 January 2013, *O.L.M. Silva et al. 71* (SP).

Taxonomic notes:—*Euphorbia elodes* is very similar to *E. rhabdodes* but differs from it due to its actinodromous, short-petiolate leaves (*vs.* cladodromous and sessile leaves with revolute margin in *E. rhabdodes*, number of lateral axes of the pleiochasia (3 in *E. elodes vs.* 5 in *E. rhabdodes*), and seed coat (verrucose in *E. elodes vs.* rugose in *E. rhabdodes*). Another similar species is *E. cordeiroae*, which differs from *E. elodes* by the shape of cyathophylls, stipules and the perianth-like whorl of the pistillate flower (see notes on *Euphorbia cordeiroae*).

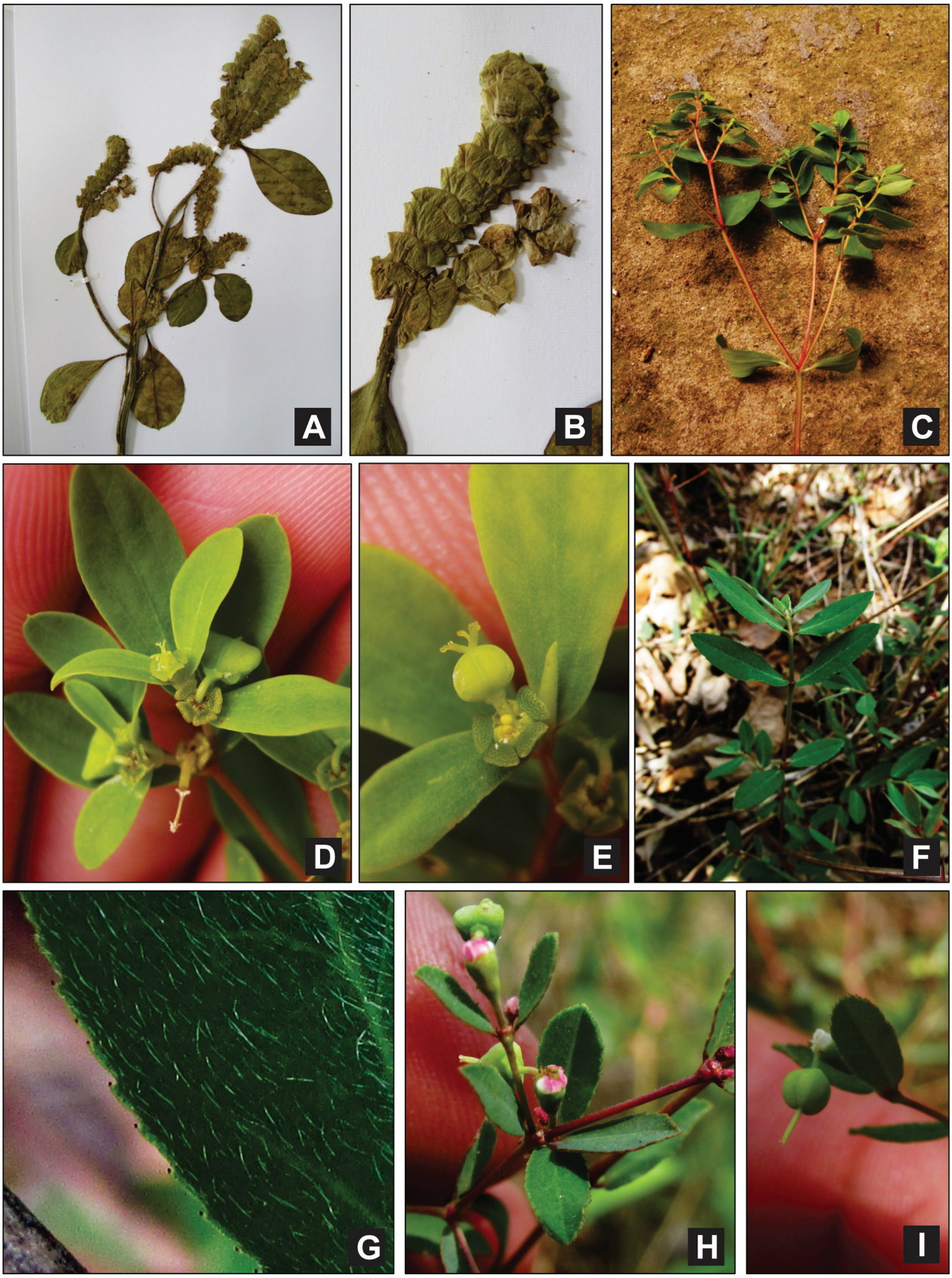

FIGURE 2. A–B: *Euphorbia comosa*. **A.** habit, **B.** synflorescence. **C–E:** *Euphorbia elodes*. **C.** synflorescence, **D.** branch with cyathia, **E.** cyathium. **F–I:** *Euphorbia foliolosa*. **F.** habit, **G.** detail of leaf margin, **H.** branch with cyathia, **I.** detail of a cyathium. Photos: A–B: I. Cordeiro, C–I: O.L.M. Silva.

7. *Euphorbia foliolosa* Boissier (1862: 24) (Fig. 2F–I). Lectotype (designated here):—BRASIL. Minas Gerais: ad Trinidade, *J.B.E. Pohl 1670* (holotype B†, photo F!, lectotype W0031076!, isolectotype W0031077!).

Distribution and habitat:—*Euphorbia foliolosa* is endemic to Brazil (São Paulo and Minas Gerais). In the State of São Paulo the species occurs in cerrado vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** Pedregulho, 30 October 2013, *O.L.M. Silva et al. 97* (SP).

Taxonomic notes:—*Euphorbia foliolosa* is very similar to *E. hyssopifolia* and *E. bahiensis* but may be easily identified among them by its longer (> 1.5 mm in *E. foliolosa vs.* up to 1.5 mm in *E. hyssopifolia* and *E. bahiensis*) and entire (*vs.* bifid in *E. hyssopifolia* and *E. bahiensis*) styles, and venation pattern (cladodromous in *E. foliolosa vs.* actinodromous in *E. hyssopifolia* and *E. bahiensis*). One notable characteristic of *E. foliolosa*, besides its very long styles, is the blackish apex of the teeth of the leaf margin.

8. *Euphorbia heterophylla* Linnaeus (1753: 453) (Fig. 3A–B). Lectotype (designated by Radcliffe-Smith in Bosser *et al.* 1982: 94):—"*Tithymalus Curassavicus, Salicis & Atriplicis foliis variis, caulibus viridantibus*" in Plukenet (1691: t. 112).

Distribution and habitat:—*Euphorbia heterophylla* is a worldwide tropical and subtropical weed. In the State of São Paulo the species is very common, mainly in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Barreiro, 21 January 2013, *O.L.M. Silva et al. 75* (SP).

Taxonomic notes:—*Euphorbia heterophylla* may be easily identified by having only one cyathial gland, as in *E. zonosperma*, from which it differs by the absence of indumentum on the involucre, ovary and styles, while these are sericeous or tomentose in *E. zonosperma*. *Euphorbia heterophylla* also may be easily recognized in the field by its highly heteromorphic leaves, sometimes with two different shapes (ovate and panduriform, for example) on the same individual.

Euphorbia heterophylla is also similar to *E. cyathophora* Murray (1786: 81), which, among specimens from São Paulo, can be easily recognized by the color of the base of the bracts (usually completely green with the very base whitish in *E. heterophylla* and often red to pinkish at base in *E. cyathophora*), the cyathial glands (with round opening in *E. heterophylla* and flattened in *E. cyathophora*), and the seeds (apex acute in *E. heterophylla* and truncate in *E. cyathophora*) (H.-J. Esser, pers. comm.). *Euphorbia. cyathophora* is an ornamental species only recorded in the State of São Paulo from gardens, as a cultivated species, so it is not covered in this treatment.

9. *Euphorbia hirta* Linnaeus (1753: 454) (Fig. 3C–E). Lectoype (designated by Wheeler 1939: 72):—INDIA. Locality unknown, *Anonymous s.n.* (LINN 630.7!).

Distribution and habitat:—*Euphorbia hirta* is a worldwide tropical and subtropical weed. In the state of São Paulo the species is very common, mainly in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Barreiro, 21 January 2013, *O.L.M. Silva et al. 77* (SP).

Taxonomic notes:—*Euphorbia hirta* is very similar to *E. ophthalmica*, but differs from it in having capitate dichasia along all the stem while, while *E. ophthalmica* these are restricted to the terminal portion of the stems. Besides, *E. hirta* is an erect herb, with stems branched only near the base, and its leaves are generally bigger than those of *E. ophthalmica*.

10. *Euphorbia hyssopifolia* Linnaeus (1759: 1048) (Fig. 3F–H). Lectotype (designated by Fawcett & Rendle 1920: 339):—JAMAICA. Locality unknown, *Anonymous s.n.* (LINN 630.9!).

Distribution and habitat:—*Euphorbia hyssopifolia* is a worldwide tropical and subtropical weed. In the State of São Paulo the species is very common in cerrado vegetation and disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Angatuba, 17 December 2013, *O.L.M. Silva et al. 40* (SP).

Taxonomic notes:—*Euphorbia hyssopifolia* is similar to *E. foliolosa* and *E. bahiensis*. The species can be distinguished from *E. foliolosa* by leaf venation and styles (see notes on *Euphorbia foliolosa*). The distinction between *E. hyssopifolia* and *E. bahiensis* lies on their dichasia and their habitat (see notes on *Euphorbia bahiensis*).
Euphorbia hyssopifolia is also similar to another common weedy species, *E. hypericifolia* Linnaeus (1753: 454) which was however not observed among the herbarium collections examined or during the fieldwork for this treatment. *Euphorbia hypericifolia* may be distinguished from *E. hyssopifolia* by the synflorescences with aphyllous distal nodes (vs. distal nodes with narrow and smaller leaves in *E. hyssopifolia*) and fruits 1.3–1.4 × 1.1–1.5 mm (*vs.* 1.5–1.6 × 1.7–1.8 mm in *E. hyssopifolia*).

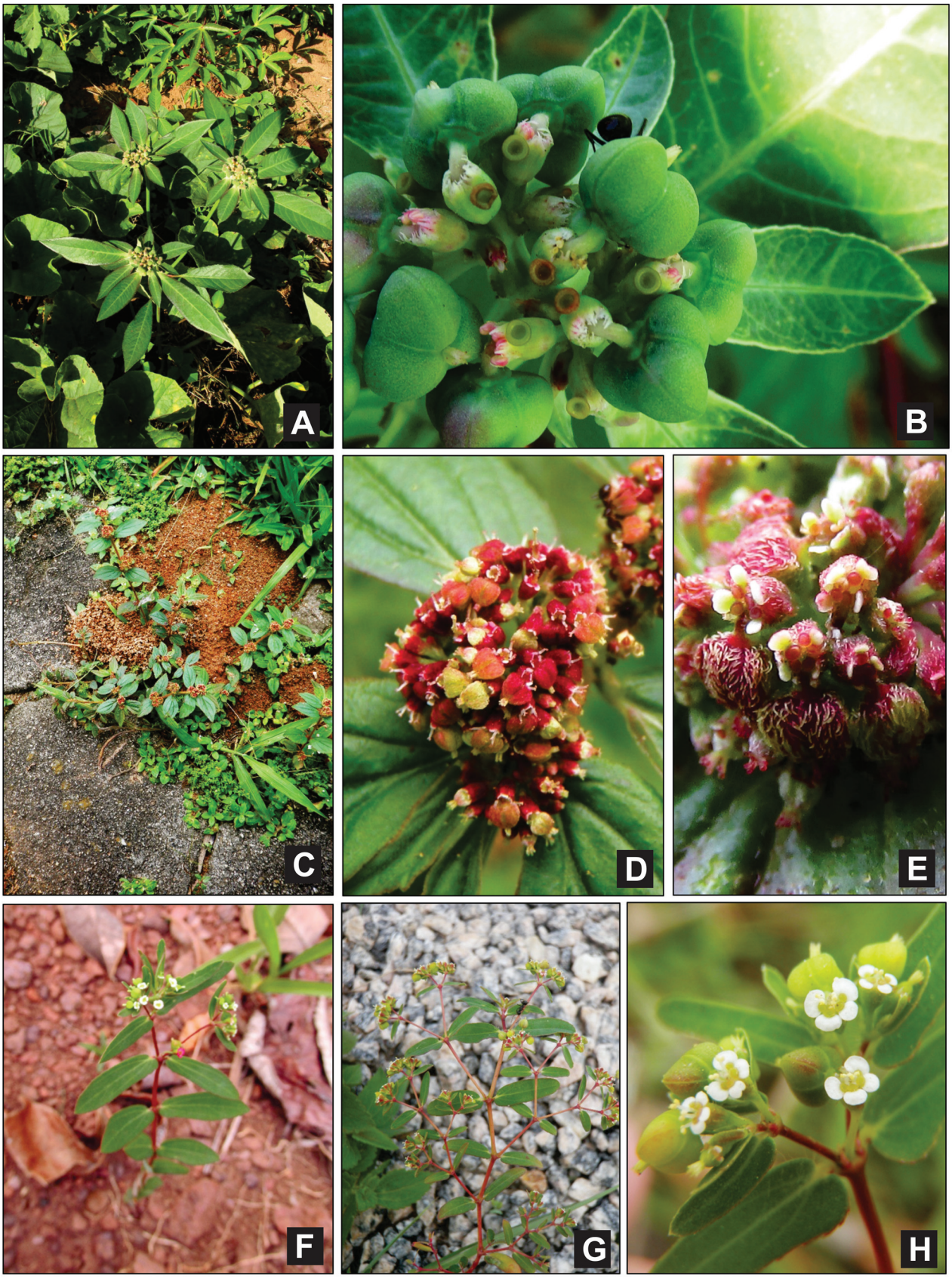

FIGURE 3. A–B: *Euphorbia heterophylla*. **A.** habit, **B.** branch with cyathia. **C–E:** *Euphorbia hirta*. **C.** habit, **D.** branch with cyathia, **E.** cyathium. **F–H:** *Euphorbia hyssopifolia*. **F.** habit, **G.** synflorescence, **H.** branch with cyathia. Photos: O.L.M. Silva.

11. *Euphorbia insulana* Vellozo (182: 202) (Fig. 4A–C). Lectotype (designated here):—BRAZIL. Rio de Janeiro: "*Euphorbia insulana*" in Vellozo (1831: tab. 14).

Distribution and habitat:—*Euphorbia insulana* occurs in Venezuela, Bolivia, Colombia, Brazil, Argentina and Paraguay. In the State of São Paulo the species occurs in seaside habitats, mainly on islands.

Representative Specimen:—BRAZIL. **São Paulo:** Cananéia, 21 September 2008, *I. Ascencio 2* (ESA).

Taxonomic notes:—The species may be easily recognized among the others ones occurring in the state of São Paulo by its two, or sometimes three, cyathial glands with fleshy and erect appendages, thick styles and seed coat mammillate. Also, the species is restricted to seashore plains on islands, something uncommon among the species of São Paulo.

12. *Euphorbia ophthalmica* Persoon (1806: 13) (Fig. 4D–E). Type:—BRAZIL. Rio de Janeiro: July 1767, *P. Commerson 238* (holotype P-JU!, fragment F).

Distribution and habitat:—*Euphorbia ophthalmica* is a worldwide tropical and subtropical weed. In the State of São Paulo the species is very common, mainly on disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Iperó, 19 December 2012, *O.L.M. Silva et al. 59* (SP).

Taxonomic notes:—*Euphorbia ophthalmica* is very similar to *E. hirta* due to the cyathia arranged in capitate synflorescences, but the species differ, mainly, on the position of them (see notes under *Euphorbia hirta*).

13. *Euphorbia papillosa* Saint-Hilaire (1824:18) (Fig. 4F–H). Type:—BRAZIL. Pasturages naturels du midi de la province de Sainte-Catherine et daus ceux de la province de Rio grande do sul, *A.F.C.P. Saint-Hilaire 6952* (holotype P!, isotypes P!, MPU!).

Distribution and habitat:—*Euphorbia papillosa* occurs in Brazil, Paraguay, Uruguay and Argentina. In the State of São Paulo, the species is known by only one specimen, collected between rocks in a pasture.

Representative Specimen:—BRAZIL. **São Paulo:** "Córrego Alegre", 03 January 1897, *A. Löfgren CGG3465* (SP).

Taxonomic notes:—*Euphorbia papillosa* may be easily distinguished among species with cyathia arranged in pleiochasia by its conspicuous indumentum all over the plant, while the others species (*E. chrysophylla, E. cordeiroae, E. elodes* and *E. rhabdodes*) are glabrate to glabrescent.

The only record for the state of São Paulo is a collection by A. Löfgren, from the Geological-Geographic Comission of São Paulo, from a locality called "Córrego Alegre" in 1897, in the region of Serra da Mantiqueira. During the fieldwork for this treatment, we did not succed in collecting this species. Since no new specimen was collected in the state of São Paulo in the last century, the species is considered "Presumably Extinct" in the state according to the criteria of Mamede *et al.* (2007).

14. *Euphorbia peperomioides* Boissier (1860: 17) (Fig. 5A–B). Type:—BRAZIL. São Paulo: In campis montosis As Furnas dictis, 4000 ft, *L. Riedel s.n.* (holotype LE).

Distribution and habitat:—*Euphorbia peperomioides* is endemic to Brazil (Minas Gerais, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul). In the state of São Paulo the species occurs on high montane habitats, frequently on swampy areas or riversides.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Barreiro, 21 January 2013, *O.L.M. Silva et al. 72* (SP).

Taxonomic notes:—*Euphorbia peperomioides* differs from all other prostrate *Euphorbia* in the state of São Paulo by having leaves with symmetric base, lateral, glanduliform stipules and cyathial glands without petaloid appendages, sometimes with irregular margins that looks like horns.

15. *Euphorbia peplus* Linnaeus (1753: 456) (Fig. 5C–E). Lectotype (designated by El Hadidi & Fayed 1978: 46):—Locality unknown, *Anonymous s.n.* (LINN 630.24!).

Distribution and habitat:—*Euphorbia peplus* occurs in the Mediterranean region, Europe and temperate Asia, being introduced and naturalized as a weed in temperate, subtropical and tropical regions around the world. In the State of São Paulo the species occurs in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Atibaia, 28 October 2013, *O.L.M. Silva & R. Hoinaski* 95 (SP).

Taxonomic notes:—*Euphorbia peplus* may be recognized by its ovary and fruit with two slender longitudinal ridges along the keel of the cocci. The species is similar to *Euphorbia elodes*, but cyathial glands of *E. peplus* have two white, horn-like and well developed appendages (vs. appendages absent in *E. elodes*) and its seed are carunculate, with two sulci on the ventral face and alveolate on the dorsal face (*vs.* ecarunculate and verrucose in *E. elodes*).

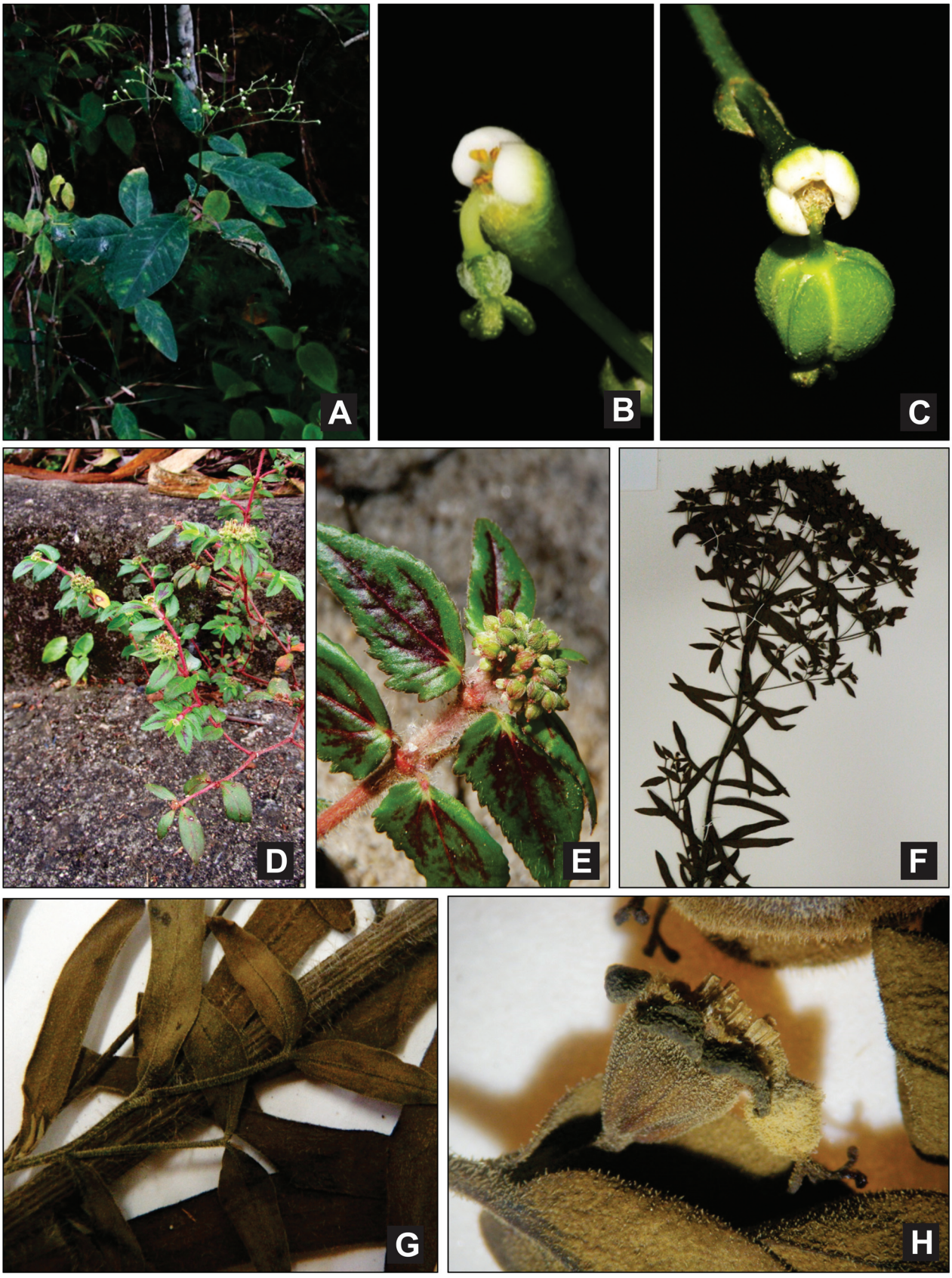

FIGURE 4. A–C: *Euphorbia insulana*. **A.** habit, **B.** cyathium with female flower exserted, **C.** cyathium with fruit. **D–E:** *Euphorbia ophthalmica*. **D.** habit, **E.** branch with synflorescence. **F–H:** *Euphorbia papillosa*. **F.** habit, **G.** stem and leaves, **H.** cyathium. Photos: A–C: R. Riina, D–H: O.L.M. Silva.

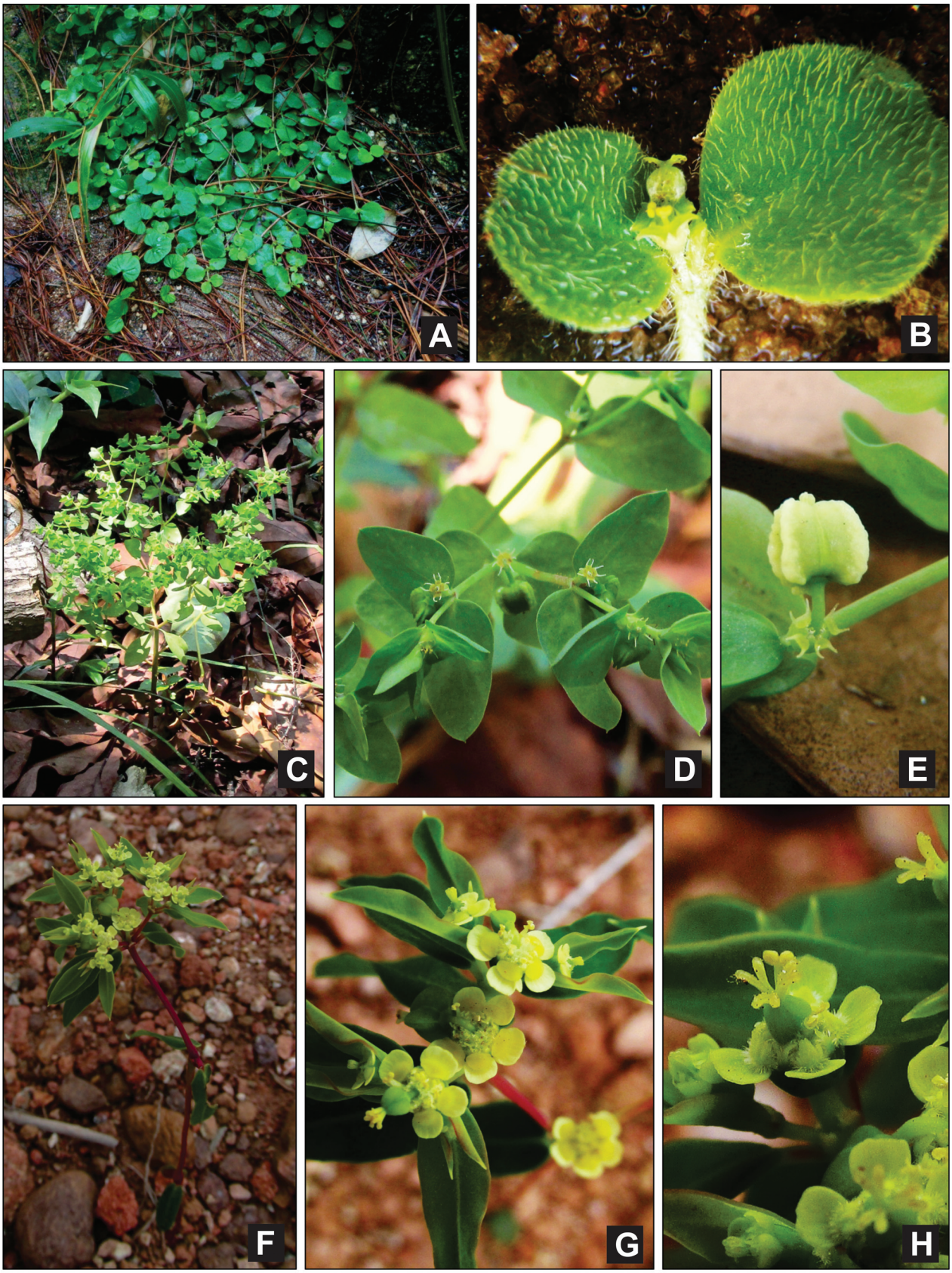

FIGURE 5. A–B: *Euphorbia peperomioides*. **A.** habit, **B.** cyathium. **C–E:** *Euphorbia peplus*. **C.** habit, **D.** branch with cyathia, **E.** cyathium. **F–H:** *Euphorbia potentilloides*. **F.** habit, **G.** branch with synflorescence, **H.** cyathium. Photos: O.L.M. Silva.

16. *Euphorbia potentilloides* Boissier (1860: 3) (Fig. 5F–H). Lectotype (designated here):—BRAZIL. Goiás: Chapadas de San-Marcos, *N.T. Lund s.n.* (G00311067!); remaining syntype: same locality, *L. Riedel s.n.* (LE, isosyntype K!).

Distribution and habitat:—*Euphorbia potentilloides* occurs in Brazil, Argentina, Bolivia, Paraguay and Uruguay. In the State of São Paulo the species occurs in cerrado vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** Pedregulho, 30 October 2013, *O.L.M. Silva et al. 96* (SP).

Taxonomic notes:—*Euphorbia potentilloides* is morphologically diverse, but this variation is restricted mostly to the vegetative characteristics (leaves and cyathophylls; see Simmons & Hayden 1997). The species may be easily recognized among the others species with interpetiolar stipules, opposite leaves and cyathial glands with petaloid appendages occurring in the State of São Paulo because it is the only one with cyathia arranged in pleiochasia. Also, the species may bear up to 7 cyathial glands (although in São Paulo state only specimens with up to 6 cyathial glands were observed) and has smooth seeds, a characteristic found only on *Euphorbia serpens*, from which it differs by its erect stem (vs. prostrate in *E. serpens*), linear to narrowly elliptic leaves (*vs.* orbicular in *E. serpens*) and cyathia in pleiochasia (vs. solitary in *E. serpens*).

17. *Euphorbia prostrata* Aiton (1789: 139) (Fig. 6A–C). Type:—ENGLAND. Richmond, Surrey: Cultivated in Kew Gardens from seeds collected in the West Indies, *Miller s.n.* (holotype BM).

Distribution and habitat:—*Euphorbia prostrata* is a worldwide tropical and subtropical weed. In the State of São Paulo the species is very common, mainly in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Angatuba, 18 December 2012, *O.L.M. Silva et al. 45* (SP).

Taxonomic notes:—*Euphorbia prostrata* differs from all other prostrate *Euphorbia* species in São Paulo by its ovary and fruit with trichomes in two rows along the keel of the cocci, and, on the involucre, only on the lobes. Also, the species is unique by having dark purple anthers, while the others species have yellow, pinkish or reddish anthers.

18. *Euphorbia rhabdodes* Boissier (1860: 30). Type:—BRAZIL. Ad Fazenda de Ilama, *F. Sellow 2096* (holotype B†, photo F!).

Distribution and habitat:—*Euphorbia rhabdodes* is endemic to Brazil (Distrito Federal, Minas Gerais, São Paulo and Santa Catarina). In the State of São Paulo the species occurs in high altitude fields, frequently on swamp areas or riversides.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Barreiro, 23 January 1998, *L. Freitas & M. Sazima 216* (SP).

Taxonomic notes:—*Euphorbia rhabdodes* is very similar to *E. elodes* but differs from it due to leaves, number of rays of the pleiochasia and seed coat (see notes in under *Euphorbia elodes*).

19. *Euphorbia sciadophila* Boissier (1862: 57) (Fig. 6C–E).—*Leptopus brasiliensis* Klotzsch & Garcke in Klotzsch (1860: 45). Lectotype (designated here):—BRAZIL. São Paulo: Prope Ipanema, *J.B.E. Pohl s.n.* (BR05102464!, isolectotype W); remaining syntypes: same locality, *L. Riedel s.n.* (LE); Minas Gerais, *A.F. Regnell s.n.* (B).

Distribution and habitat:—*Euphorbia sciadophila* occurs in Bolivia, Brazil, Argentina, Paraguay and Uruguay. In the State of São Paulo the species occurs in forest edges, usually in shaded environments.

Representative Specimen:—BRAZIL. **São Paulo:** Atibaia, 28 October 2013, *O.L.M. Silva & R. Hoinaski 94* (SP).

Taxonomic notes:—*Euphorbia sciadophila* may be easily recognized among the other *Euphorbia* species from the state of São Paulo by its cyathial glands with fimbriate appendages, not observed in any other species. Also, the species shows very long petiolate, ovate leaves and foveolate seeds.

The name *Leptopus brasiliensis* was considered, after the recognition of *Euphorbia* in its broad sense, as a synonym of *Euphorbia brasiliensis* Lamarck (1788: 423) (which was recognized as a synonym of *Euphorbia hyssopifolia* by Govaerts *et al.* [2000]), but, after analyzing the protologue and type collection assigned to *Leptopus brasiliensis*, we concluded that this name does not fit to any species of the section *Aniysophyllum*. Furthermore, *Leptopus brasiliensis* was indicated by Boissier on his treatment of tribe Euphorbieae for Candolle's Prodromus (Boissier 1862), where the name *Euphorbia sciadophila* was proposed, as a synonym of this species.

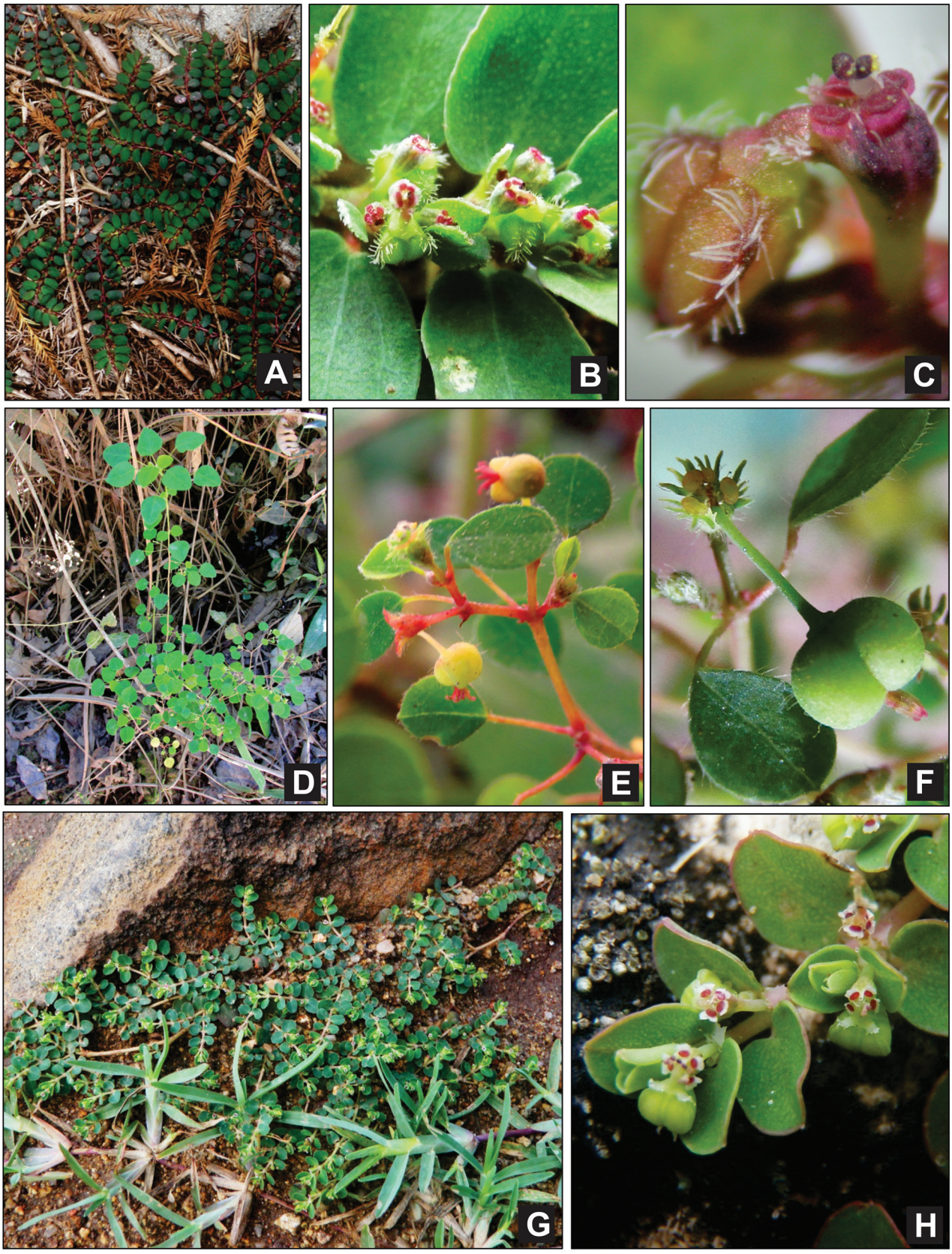

FIGURE 6. A–C: *Euphorbia prostrata*. **A.** habit, **B.** branch with cyathia. **C.** cyathium. **D–F:** *Euphorbia sciadophila*. **D:** habit, **E:** branch with cyathia, **F.** cyathium. **G–H:** *Euphorbia serpens*. **G.** habit, **H.** branch with cyathia. Photos: O.L.M. Silva.

For some reason, Govaerts *et al.* (2000) thought that *L. brasiliensis* would be a combination for *Euphorbia brasiliensis*, what led to its equivocal recognition as synonym of *E. hyssopifolia*, but what happened is that the epithet

"*brasiliensis*" was already in use in *Euphorbia* when Boissier transferred several species from other genera to *Euphorbia* in its broad sense, so the author needed to create a new name, *Euphorbia sciadophila*.

20. *Euphorbia serpens* Kunth in Humboldt *et al.* (1817: 52) (Fig. 6E–F). Type:—VENEZUELA. Vargas, Distrito Federal, Crescit in umbrosis Cumanae prope Bordones et Punta Araya, *A.J.A. Bonpland & F.W.H.A. von Humboldt 407* (holotype P!).

Distribution and habitat:—*Euphorbia serpens* is a worldwide tropical and subtropical weed. In the State of São Paulo the species is quite common (not as much so as *E. prostrata* and *E. thymifolia*), mainly in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Guarulhos, 03 April 2012, *O.L.M. Silva 80* (SP).

Taxonomic notes:—*Euphorbia serpens* differs from all other prostrate *Euphorbia* in the state of São Paulo by its complete absence of an indumentum, fused, whitish triangular intrapetiolar stipules, cyathial glands with petaloid appendages well developed and equal in size, presence of adventitious roots and a smooth seed coat.

21. *Euphorbia setosa* (Boiss.) Müller Argoviensis (1874: 672) (Fig. 7A–C).

Euphorbia selloi var. *setosa* Boissier (1862: 50). Lectotype (designated here):—BRASIL. Goiás: in campis incultis, *N.T. Lund s.n.* (G00311064!); remaining syntypes: same locality, *L. Riedel s.n.* (LE); Tijuco, *F. Sellow s.n.* (not located); Minas Gerais: in cacumine montis Urubu, *J.B.E. Pohl 1674* (W0031069!).

Distribution and habitat:—*Euphorbia setosa* is endemic to Brazil (Distrito Federal, Goiás, Minas Gerais and São Paulo). In the State of São Paulo it occurs in cerrado vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** Pedregulho, 06 November 1997, *W. Marcondes-Ferreira et al. 1555* (SP, SPSF).

Taxonomic notes:—*Euphorbia setosa* may be easily identified among the species in the state of São Paulo by its cyathial glands with erect and pubescent petaloid appendages, while others species' petaloid appendages are always patent and glabrate. By having cyathia arranged in capitate dichasia and hirsute stems, *Euphorbia setosa* may be misidentified as *E. hirta* or *E. ophthalmica*, but these species may be distinguished by their lanceolate blades, cladodromous venation, entire leaf margin (*vs.* elliptic blades, actinodromous venation, serrate leaf margin in *E. hirta* and *E. ophthalmica*), number of flowers in each staminate cymule (10–12 in *E. setosa vs.* 1–2 in *E. hirta* and *E. ophthalmica*), and alveolate seeds coat (*vs.* seeds with transverse ridges in *E. hirta* and *E. ophthalmica*).
The species is commonly misidentified as *Euphorbia selloi* (Klotzsch & Garcke in Klotzsch 1860: 32) Boissier (1862: 50), which is in fact very similar to it. However, it can be distinguished from it by its cyathial glands with erect and pubescent petaloid appendages (*vs.* patent and glabrous in *E. selloi*). Besides this, the geographic distribution is distinct between both species: *E. setosa* occurs in central–southeastern Brazil and *E. selloi* occurs in southern Brazil, northern Argentina and Uruguay (Simmons & Hayden 1997).

22. *Euphorbia thymifolia* Linnaeus (1753: 454) (Fig. 7D–E). Lectotype (designated by Wheeler 1941: 253):—Locality unknown, *Anonymous s.n.* (LINN 630.10!).

Distribution and habitat:—*Euphorbia thymifolia* is a worldwide tropical and subtropical weed. In the state of São Paulo the species is very common, mainly in disturbed areas.

Representative Specimen:—BRAZIL. **São Paulo:** Eldorado, 11 October 2012, *O.L.M. Silva & M. Pastore 35* (SP).

Taxonomic notes:—*Euphorbia thymifolia* is very similar to *E. adenoptera,* but these species may be distinguished by cyathial glands appendages, anther color and fruiting pedicel (see notes under *E. adenoptera*).
The species is commonly misidentified as *Euphorbia prostrata* because of its prostrate growth, but differs from it due to its cyathial glands with unequal appendages, completely pubescent ovary and fruit (*vs.* cyathial glands with equal appendages and trichomes restricted to the keel of the cocci in *E. prostrata*), yellow to reddish anthers (*vs.* blackish in *E. prostrata*) and brown seeds (*vs.* grayish in *E. prostrata*).

23. *Euphorbia zonosperma* Müller Argoviensis (1874: 696) (Fig. F–H). Type:—BRAZIL. Minas Gerais: Lagoa Santa, *J.B.E. Warming s.n.* (holotype G [photo and fragment F!], isotype G).

Distribution and habitat:—*Euphorbia zonosperma* is endemic to Brazil (Goiás, Minas Gerais and São Paulo). In the State of São Paulo the species occurs in open vegetation, forest edges or riversides, usually in riparian vegetation.

Representative Specimen:—BRAZIL. **São Paulo:** São José do Rio Pardo, 25 April 2013, *M. Pastore 281* (SP).

Taxonomic notes:—*Euphorbia zonosperma* is very similar to *E. heterophylla*, but may be distinguished by the conspicuous indumentum on the cyathia and seed ornamentation (see notes under *E. heterophylla*).

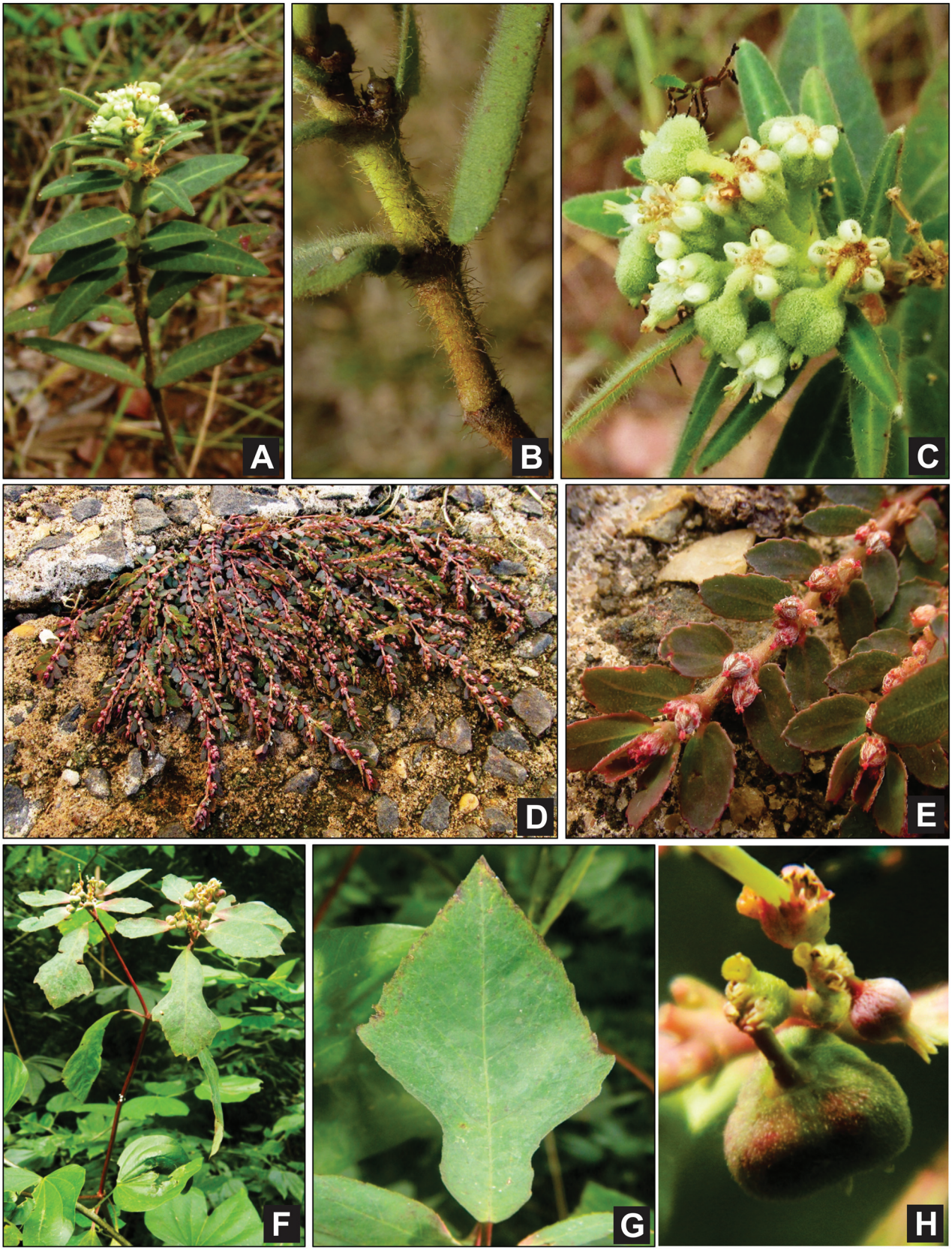

FIGURE 7. A–C: *Euphorbia setosa*. **A.** habit, **B.** stem, **C.** branch with cyathia. **D–E:** *Euphorbia thymifolia*. **D.** habit, **E.** branch with cyathia. **F–H:** *Euphorbia zonosperma*. **F.** habit, **G.** leaf, **H.** cyathia. Photos: A–E: O.L.M. Silva, F–H: M. Pastore.

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Appendix 1: Numerical list of taxa and list of collections examined

Numerical list of taxa

1. *Euphorbia adenoptera*
2. *Euphorbia bahiensis*
3. *Euphorbia chrysophylla*
4. *Euphorbia comosa*
5. *Euphorbia cordeiroae*
6. *Euphorbia elodes*
7. *Euphorbia foliolosa*
8. *Euphorbia heterophylla*
9. *Euphorbia hirta*
10. *Euphorbia hyssopifolia*
11. *Euphorbia insulana*
12. *Euphorbia ophthalmica*
13. *Euphorbia papillosa*
14. *Euphorbia peperomioides*
15. *Euphorbia peplus*
16. *Euphorbia potentilloides*
17. *Euphorbia prostrata*
18. *Euphorbia rhabdodes*
19. *Euphorbia sciadophila*
20. *Euphorbia serpens*
21. *Euphorbia setosa*
22. *Euphorbia thymifolia*
23. *Euphorbia zonosperma*

Collections examined

Collections from São Paulo that were examined during this treatment are presented to allow curator of herbaria to update their collections. Collections are arranged in alphabetical order by main collector's name, with initials when known, followed by the collection number in increasing order (s.n. = without number) and species number in parentheses. Herbarium serial numbers are provided when collector number is missing.

Ahn, Y.J.: 44 (8)
Aloisi, J.: 54 (9)
Alves, F.F.: SP42197 (17)
Amaral, M.C.E.: 19 (4)
Andrade, N.: SP24517 (16)
Angela: 4 (10)
Aragaki, S.: 117 (16)
Aranha, C.: 10074 (9)
Ascencio, I.: 2 (11)
Atila, S.M.: 33 (8)
Barban, J.R.: 11617 (22)
Barreto, K.D.: 2097 (8), 2500 (10), 2670 (10), 3194 (16)
Barros, C.M.: BOTU1643 (8)
Barros, F.: 2943 (10), 3075 (11)
Bernacci, L.C.: 184 (4), 1357 (4), 3755 (8), 21401 (19), 23974 (9), 30223 (4), 34121 (9)
Berto, W.J.: BOTU1608 (8), BOTU1656 (8)
Blanco, H.G.: IAC39642 (10), IAC39645 (8)
Botter, K.R.: 24219 (9)
Brade, A.C.: 5976 (6), 5977 (16), 5978 (10), 12965 (16), 16072 (16), RB85265 (14), SP7154 (8)
Brantjes, N.B.M.: 101103 (16)
Campos, C.J.: BOTU5424 (16), SP258961 (16)
Campos, S.M.: 20 (16), 238 (16), 239 (16)
Capellari Jr., L.: ESA5569 (10), SP292507 (10), UEC75422 (10)
Carmo, M.: IAC39643 (9)
Caruzo, M.B.R.: 44 (10), 47 (16), 50 (10), 51 (10)
Carvalho, A.: IAC531 (8), IAC593 (17)
Cavalcante, F.S.: 2 (16)
Cerati, T.M.: 347 (11)
Coleman, M.A.: 106 (10), 141 (10), 183 (8)
Cordeiro, I.: 474 (10), 499 (11), 517 (15), 555 (2), 3076 (14)
Correa Gomes Jr., J.: 242 (4), 2700 (8), 3616 (17), 3618 (9)
Costa, A.: BOTU8135 (9)
Costa, A.S.: 782 (4)
Costa, F.: 13 (16)
Cruz, P.A.: 8 (8)
Custodio Filho, A.: 1403 (10)
Custodio, L.: 538 (9)
Davidse, G.: 10495 (12)
Davis, P.H.: 3076 (14), 59873 (2), 60288 (9), 60289 (8)
Deslandes, J.: 83 (8)
Dias, O.S.: IAC3104 (16)
Djuragin, B.: ESA4124 (9)
Duarte, K.M.R.: ESA7478 (9), ESA7485 (10)
Edwall, G.: CGG1906 (6), CGG2284 (9), SP13719 (22), SP13853 (4)
Egler, W.: 99 (14)
Ehrendorfer, F.: 73822-6 (16)
Eiten, G.: 1548 (8), 1725 (8), 1787 (16), 1896 (8), 2118 (16), 2283 (16), 3300 (2), 3312 (2), 3436 (16), 5078 (16)
Elias de Paula, J.: 116 (16)
Esposito, M.C.: 3 (8)

Feliciano, C.D.: 5 (2)
Felippe, G.M.: 67 (16)
Ferraro Jr., L.A.: ESA6226 (10)
Francener, A.: 1303 (16), 1304 (16), 1305 (10), 1306 (9), 1310 (7)
Frasão, A.: RB83645 (10)
Freire, E.S.: 2 (8)
Freitas, L.: 214 (18), 216 (18), 799 (14)
Garcia, D.: 48 (8)
Garcia, L.C.: 86 (8), 125 (9)
Garcia, M.A.: 72 (8)
Garcia, P.B.C.: ESA50873 (11)
Gehrt, A.: SP13872 (9), SP4579 (11), SP54297 (12), SP54298 (17), SP7151 (15), UEC111591 (11), UEC4744 (9), UEC4783 (17)
Gemtchújnicov, I.D.: BOTU12270 (4), BOTU12271 (16), BOTU12273 (8), BOTU12274 (12), BOTU12276 (17)
Gibbs, P.E.: 2863 (10)
Godoy, S.A.P.: 524 (11)
Gorgati, V.: ESA2991 (10)
Grombone-Guaratini, M.T.: 21495 (19)
Groppo Jr., M.: SPF144411 (8), SPF144412 (8)
Grotta, A.S.: MBM320889 (4), SPF15105 (10), SPF15205 (4)
Guedes, C.R.F.: 12 (11)
Guillaumon, J.R.: 150 (7)
Guinena, A.: 16 (9), 22 (8), 31 (8)
Hammar, A.: 34 (16)
Hashimoto, G.: 30 (15), 38 (17), 321 (18)
Hatschbach, G.: MBM41629 (17)
Hell, K.G.: 2319 (8), 2320 (17)
Heraldo, J.: 96 (8)
Hernani, L.L.: ESA1186 (10)
Higa Jr., N.: ESA6606 (8)
Hoehne, F.C.: ESA98249 (15), MBM320888 (15), MBM320891 (8), MBM358034 (10), MBM358035 (8), RB485216 (15), RB579633 (10), SP1066 (8), SP1330 (17), SP1417 (16), SP1623 (8), SP3057 (8), SP8710 (14), SP13637 (19), SP17566 (10), SP20280 (8), SP20283 (9), SP20641 (15), SP36783 (16), SP46276 (4), SP347000 (4), SPF10826 (15), SPF10873 (9), SPF10875 (8), SPF11758 (16), SPF11876 (4), SPF12352 (6), SPF12353 (6), SPF12354 (14), SPF12655 (10), SPF12895 (16), SPF13305 (15), SPF13380 (10), SPF13827 (15), UEC4756 (16)
Hojo, K.: BOTU1600 (8)
Honda, S.: PMSP612 (9), SP312932 (12), SPF50960 (9)
Houk, W.G.: 535 (4)
Jesus, D.M.: 33 (8)
Joly, A.B.: SPF16587 (8), SPF16591 (16), SPF19658 (15), SPF19662 (16), SPF84333 (15), SPF84334 (9)
Jung-Mendaçolli, S.L.: 176 (4)
Kawazoe, U.: 23928 (9), 23940 (17)
Kinhoshita, L.S.: 94 (16)
Kirizawa, M.: 2581 (11), 3381 (10)
Klein, A.: 16002 (8), 16011 (10), 16012 (9), 16028 (17)
Kral, R.: 75692 (15), SPF164894 (15)
Krieger, L.: 16422 (9)
Krug, H.P.: 1437 (9), IAC3171 (16)
Kuhlmann, M.: 38 (12), 1816 (20), 1822 (15), 1826 (8), 1827 (12), 2153 (14), 4631 (4), SP31263 (20)
Labouriau, L.G.: 1059 (16)
Leitão Filho, H.F.: 7 (10), 7 (9), 1800 (10), 4691 (10), 6038 (16), 33280 (10)
Löfgren, A.: CGG2124 (7), CGG2344 (6), CGG2355 (14), CGG2381 (18), CGG2398 (18), CGG3465 (13), RB86079 (16)
Lopes, D.: IAC24147 (10)

Luederwaldt, H.: SP13865 (6), SP13866 (8), SP13877 (12)
M.G.F.: 10416 (14)
Macedo, E.E.: 115 (16), 117A (21)
Mafra, G.L.: 9 (2)
Magenta, M.A.G.: 34 (4)
Makino, H.: UEC4751 (16)
Mamede, M.C.H.: 263 (2)
Mano, A.: 41 (17)
Mantovani, W.: 249 (16), 825 (16), 881 (16), 890 (16), 965 (16), 989 (16), 1185 (16), 1214 (16)
Marcondes-Ferreira, W.: 997 (16), 1555 (21), 1564 (16)
Marinis, G.: 322 (8)
Martini, M.H.: 21 (8)
Martins, A.B.: 31495 (19)
Martins, E.: 29214 (2), 29214 (10)
Mattos, J.: 15268 (14), SP113935 (10)
Mattos, J.R.: 8310 (16), 11694 (23), 12835 (16), 13035 (8), 15805 (14)
Melloni, R.: ESA5025 (10), SP292082 (10)
Mendes, J.E.T.: IAC145 (9)
Mendes, O.T.: 53 (8), 54 (9), 222 (4)
Mimura, I.: 87 (16), 131 (16), 505 (16), 532 (16)
Miranda, L.C.: 161 (10)
Monteiro, R.: 4083 (10)
Mor, G.: BOTU12277 (17)
Munrj, W.R.: 30 (8)
Nakagawa, R.: 5 (9), 20 (8)
Netto, A.A.: SPF16592 (16)
Nicolau, S.A.: 2412 (9)
Otero, J.R.: RB85259 (8)
Pacheco, C.: IAC10707 (9)
Pardini, J.R.: 41 (8)
Paschoal, M.E.S.: 2478 (20)
Pastore, M.: 214 (10), 220 (2), 230 (9), 242 (16), 253 (16), 254 (10), 269 (9), 281 (23), 287 (10)
Paula-Souza, J.: 3772 (10)
Perches, E.: ESA7903 (8), ESA7913 (9), SP292187 (9), SP292188 (8)
Pereira, F.G.: 201 (8), 289 (10)
Pereira, M.A.: SP53374 (12), SPSF27218 (12), UEC111019 (9)
Petrechen, E.H.: 6 (9)
Pickel, B.J.: 270 (12), SPSF1126 (10), SPSF1201 (8), SPSF1347 (16), SPSF1714 (15), SPSF270 (12)
Pirani, J.R.: SPF34334 (8)
Polo, M.: 10263 (4), 10265 (9)
Ribas, O.S.: 1999 (10)
Righetti, S.M.: 5 (8)
Robim, M.J.: 438 (18), SP299924 (2), SPSF19706 (2)
Romaniuc Neto, S.: 149 (8)
Romão, G.O.: 237 (9)
Rosa, N.A.: 3825 (8)
Rossi, L.: 1339 (2), PMSP541 (8), SP312919 (8), SPF116140 (8)
Roth, L.: 809 (8), 810 (14), SPSF1798 (14)
Russel, A.: 109 (16), 211 (17)
Sakane, M.: 242 (14)
Sanstyack, S.: RB86128 (18)
Santoro, J.: 666 (9), IAC33 (8), IAC480 (9), IAC483 (8), IAC666 (9), IAC667 (17)
Savina: 385 (10), IAC25293 (9), IAC25926 (10), IAC26718 (8)
Scaramuzza, C.A.M.: 783 (14), 977 (5), ESA63444 (14), ESA63445 (14), ESA63446 (14), ESA63447 (14), ESA63453

(14), ESA63454 (14)
Semir, J.: 31179 (8)
Sendulsky, T.: 808 (15)
Silva, A.L.R.: 2 (11)
Silva, O.L.M.: 12 (10), 13 (9), 14 (8), 16 (22), 17 (8), 18 (9), 20 (14), 21 (22), 24 (1), 25 (10), 26 (22), 27 (12), 28 (22), 29 (2), 30 (1), 31 (8), 32 (9), 33 (10), 34 (9), 35 (22), 36 (17), 37 (9), 38 (22), 39 (8), 40 (10), 45 (17), 46 (22), 47 (9), 50 (12), 51 (10), 52 (8), 53 (12), 55 (8), 57 (10), 58 (9), 59 (12), 60 (8), 61 (10), 62 (9), 64 (22), 65 (14), 71 (6), 72 (14), 74 (10), 75 (8), 76 (17), 77 (9), 80 (20), 81 (9), 82 (12), 83 (10), 84 (22), 85 (20), 86 (10), 87 (10), 88 (8), 89 (1), 93 (1), 94 (19), 95 (15), 96 (16), 97 (7)
Silva, P.: SP39080 (17)
Simões, H.: 23 (8)
Souza, A.J.: 7 (8)
Souza, H.M.: IAC18684 (8)
Souza, J.P.: 2016 (14)
Souza, O.: SP40742 (16)
Souza, V.C.: 527 (9), 527 (12), 1629 (10), 1668 (10), 1957 (9), 4228 (15), 4270 (16), 7063 (16), 8942 (15), 9376 (16), 9711 (8), 11061 (11), PMSP925 (15), PMSP979 (17), SP312933 (17), SP312934 (15)
Stranghetti, V.: 506 (4), Sucre, D.: 1501 (9)
Tamashiro, J.Y.: T337 (19)
Tannus, J.L.S.: 750 (3)
Taroda, N.: 2179 (4)
Toledo, F.T.: RB120889 (10)
Torres, R.B.: 666 (8)
Tsuji, R.: 3 (8)
Udulutsch, R.G.: 315 (19)
Usteri, A.: SP13869 (16), SP13870 (10), SP13874 (6), SP13875 (16)
Vallota, F.Q.: BOTU1595 (17)
Vasconcellos, M.B.: 10367 (4)
Viégas, A.P.: 66 (9), IAC3587 (10), IAC4076 (17), IAC4258 (4), IAC4514 (9), IAC5283 (15), IAC6263 (4), IAC8043 (16), SP41931 (10), SP43933 (9), SP43936 (15)
Villibon Filho, G.: ESA1187 (10)
Zocchi, S.S.: ESA2982 (22).