



Original Paper

Synopsis of *Dendrophthora* and *Phoradendron* (Santalaceae) in Brazil

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Abstract

Dendrophthora and *Phoradendron* are neotropical genera of mistletoes belonging to the tribe Phoradendreae. The phylogenetic relationships between these two genera are still not entirely understood and, morphologically, *Dendrophthora* differs from *Phoradendron* solely by the presence of one, anther locule, as opposed to two in the latter. This study provides a synopsis of species of both genera for Brazil, where we revised all the names with Brazilian types or cited for the country. A total of 173 names were evaluated and the presence of 44 taxa in Brazil was confirmed: three species of *Dendrophthora* and 41 of *Phoradendron*. An identification key for the confirmed taxa is proposed and taxonomic comments are elaborated, along with an iconography, geographic distribution of the taxa, and original illustrations and photos of some species. Six new synonyms are proposed in *Dendrophthora*, and 12 in *Phoradendron*; 27 names are lectotypified.

Key words: mistletoes, parasitic plants, Phoradendreae, Santalales.

Resumo

Dendrophthora e *Phoradendron* são gêneros neotropicais de ervas-de-passarinho, pertencentes a tribo Phoradendreae. As relações filogenéticas entre estes dois gêneros ainda não são totalmente claras, e morfologicamente, *Dendrophthora* difere de *Phoradendron* unicamente pela presença de um, ao contrário de dois, lóculos na antera neste último. Este estudo traz uma sinopse das espécies destes dois gêneros para o Brasil, na qual foram revisados todos os nomes com tipos brasileiros ou citados para o país. Para esta sinopse, avaliamos 173 nomes e confirmamos a ocorrência de 44 táxons para o Brasil, sendo três espécies de *Dendrophthora* e 41 espécies de *Phoradendron*. É proposta uma chave de identificação para as espécies confirmadas, são feitos comentários taxonômicos, junto com iconografia, distribuição geográfica dos táxons, e ilustrações e fotografias inéditas de algumas espécies. São propostos seis novos sinônimos em *Dendrophthora* e 12 em *Phoradendron*, e 27 nomes são lectotipificados.

Palavras-chave: ervas-de-passarinho, plantas parasitas, Phoradendreae, Santalales.

Introduction

Dendrophthora Eichler and *Phoradendron* Nutt. are neotropical genera of mistletoes currently included in Santalaceae (sensu APG IV 2016). *Phoradendron* was separated from *Viscum* L. by Nuttall (1848) for having bilocular anthers, as opposed to multilocular anthers present in *Viscum*, which occurs in the temperate and tropical “Old World”. Nonetheless, it

was Eichler (1868) who provided a clear circumscription of *Phoradendron* in his treatments in *Flora brasiliensis*, and established the genus *Dendrophthora* for species with unilocular anthers.

Posteriorly, Engler (1889) classified both genera in tribe Phoradendreae Engler, based on the inflorescence morphology, and proposed three sections for each genus. Shortly afterwards,

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Van Tieghem (1896) proposed four sections for *Phoradendron*, and three for species that he recognized in *Dendrophthora*, both based on the inflorescences structure. In the early 20th century, Trelease (1916) elaborated the monograph of the genus *Phoradendron*, which became the main reference for decades, where the author proposed a subdivision of the group in two (based on the presence or absence of cataphylls), later recognized as subgenera by Engler & Krause (1935): *Aequatoriales* Trel. ex Engler & Krause and *Boreales* Trel. ex Engler & Krause. Trelease's work provides photographs of the nomenclatural types for most species, especially from B and W herbaria, which had part of their botanical collections destroyed during the second World War.

In the early 1950's, C.T. Rizzini made significant contributions to the Brazilian flora, namely the Loranthaceae monograph, where several new species were described (Rizzini 1956). His efforts continued until 1980, and included description of species of *Dendrophthora* and *Phoradendron* for Brazil (Rizzini 1968a,b, 1975, 1976, 1980) and Venezuela (Rizzini 1978, 1982).

Kuijt (1961, 2000) reviewed *Dendrophthora* and established two subgenera, *Eudendrophthora* Kuijt and *Paradendrophthora* Kuijt, delimited on the basis of flowers seriation in its fertile bracts: the first former with a single series of flowers (uniseriated) and the latter with two or more series. However, some species were not included under any of these two subgenera. For *Phoradendron*, Kuijt (2003) makes a substantial review, including 234 species, 78 of them new, but no infrageneric organization is proposed, indicating only probable alliances of natural groups of species.

Molecular data from Der & Nickrent (2008) demonstrated that Santalaceae was a polyphyletic group. After reorganizing the species, the remaining genera included in Santalaceae were distributed into six well supported clades, which were recognized as families by Nickrent *et al.* (2010). However, in APG IV (2016) these six families are treated as one, despite the few morphological synapomorphes for those clades. In the studies of Der & Nickrent (2008), Nickrent *et al.* (2010), Su *et al.* (2015) and Nickrent *et al.* (2019), Viscaceae (*sensu* Barlow 1964 and Cronquist 1981) remained intact as the most derived family and was resolved as monophyletic

with good support, as well as Phoradendreae, a clade formed by the genera *Dendrophthora* and *Phoradendron*. In the analysis of these two genera, Ashworth (2000, 2017) confirmed the monophyly of Phoradendreae, but suggested that *Phoradendron* was non-monophyletic and no morphological traits or combinations of traits were found informative to characterize the three major clades. *Dendrophthora* was resolved as monophyletic, nested within *Phoradendron*, and sister to *Phoradendron piperoides* (Kunth) Trel. (Ashworth 2017). Yet, molecular studies in Phoradendreae have poorly represented the taxonomic diversity at species level, with only 6% of the species in the group having been sampled (Ashworth 2000, 2017).

In the early 21st century, ca. 240 species of *Phoradendron*, and 125–130 of *Dendrophthora*, are recognized (Kuijt 2013; Kuijt & Hansen 2015; Canelón *et al.* 2020; Nickrent 2020). Although molecular evidence suggests that *Dendrophthora* occupies a nested position in *Phoradendron* (Ashworth 2000, 2017), Kuijt (2013) did not consider a nomenclatural modification necessary at that moment, due to limited sampling in molecular studies, and difficulties in the identifications in this group.

Phoradendreae comprises perennials hemiparasitic herbs, called mistletoes (“ervas-de-passarinho” in Portuguese) which form primary haustorial connections but do not produce epicortical roots (as in some Loranthaceae). It shows different growth patterns such as: monopodial/percurrent or sympodial/dichotomous, or, frequently, a combination of both (Fig. 1a-c). The stems may be segmented by the presence of cataphylls, which are pairs of bract or scale-like structures, free or fused, present in all internodes or only in proximal lateral internodes (Fig. 1d-e), in variable number. Cataphylls can subtend inactive buds, or buds that develop in inflorescences (fertile cataphylls). Leaves may be squamate or expanded, and exhibit high morphological variability, but are generally fleshy or coriaceous, with somewhat conspicuous veins. The inflorescence type present in *Phoradendron* and *Dendrophthora* is a clear synapomorphy for both genera, and is unique in Santalales, and in all angiosperms (Nickrent *et al.* 2019). Each segment or fertile internode of the inflorescence is formed by the union of two opposite fertile bracts from where the flowers grows (Fig. 1f). Flowers do not arise from

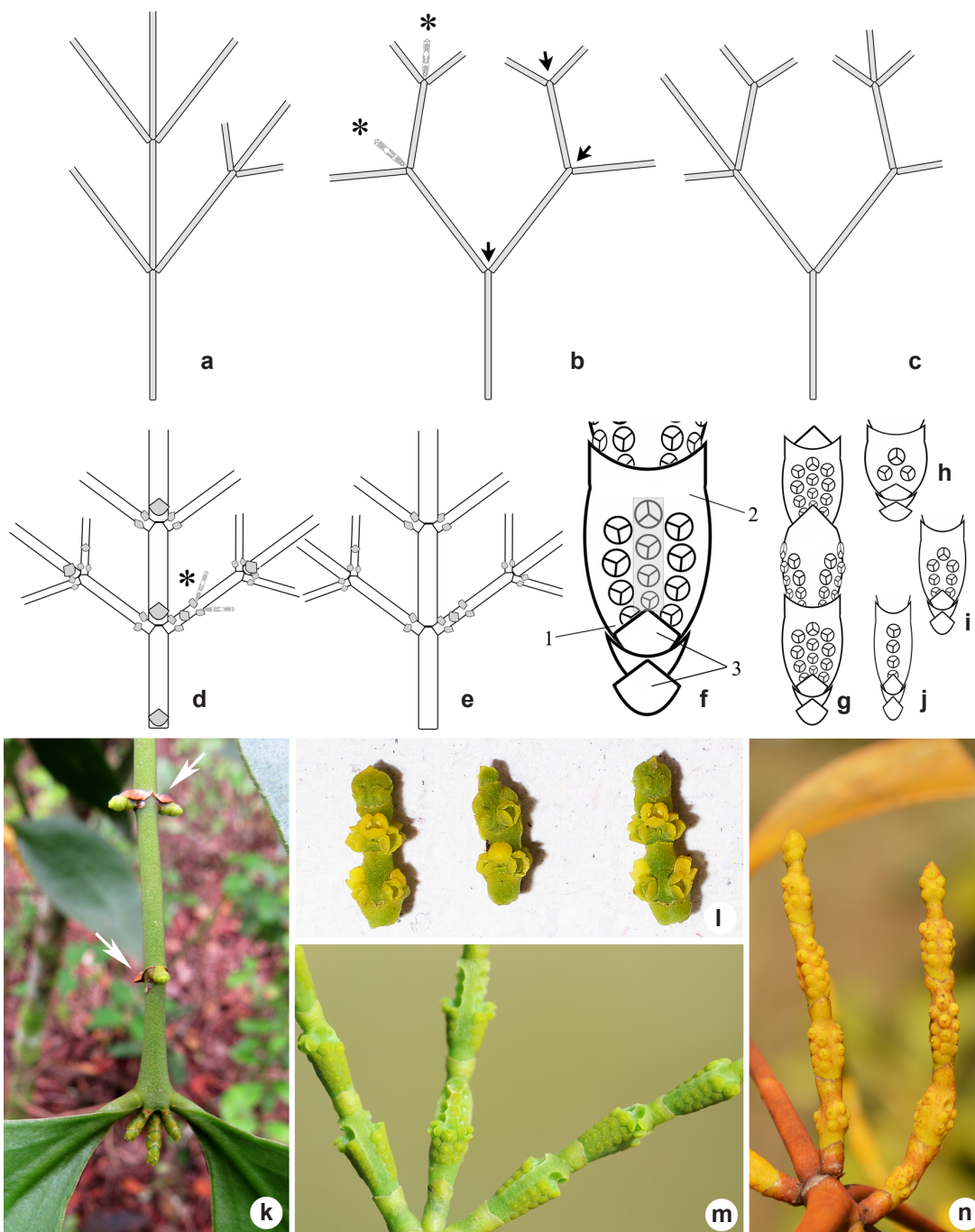


Figure 1 – a-n. Diagram and details of the main characteristics of Phoradendreae – a-c. different growth patterns – a. monopodial/percurrent; b. sympodial/dichotomous; c. combination of both patterns (* = terminal inflorescence; arrows = apical meristem aborted); d-e. cataphylls position – d. present in all internodes (* = fertile cataphylls); e. present only in proximal lateral internodes; f. base of an inflorescence (1 = region of intercalary meristem; 2 = fertile bracts; 3 = sterile bracts; gray rectangle = floral series); g. triseriate inflorescence; h. biseriate inflorescence with three flowers in fertile bract; i. biseriate inflorescence; j. uniseriate inflorescence; k. apical branch with fertile cataphylls (white arrows) and terminal inflorescence of *Phoradendron crassifolium*; l. inflorescences with three flowers per fertile bract (apical staminate) of *P. mucronatum*; m. triseriate staminate inflorescences of *P. coriaceum*; n. triseriate inflorescences of *P. perrottetii*. Photos: k. I.L. Morais; l. G.A. Dettke; m. S.A. Bordignon; n. J. Faria.

the apical meristem, as for most angiosperms. Instead, they are formed by an intercalary meristem, located in the proximal region of each bract. Therefore, the flowers located at the apex of the fertile bract are the most developed, and those at the base the youngest (Kuijt 2003). The presence of segments with sterile bracts at the inflorescence base varies in number according to the species (Kuijt 2003). The flowers are arranged in longitudinal series, from one to many series (uni-, bi-, tri-, multiseriate) (Fig. 1g-j). In the male flower, anther is adnate to each petal. Morphologically, *Dendrophthora* differs from *Phoradendron* solely by the presence of one as opposed to two, anther locules.

More regional studies are necessary to improve the knowledge of these species, to evaluate populations in different environments, rendering the analysis of the morphological variability possible. For example, Dettke & Waechter (2014), when studying *Phoradendron* in Southern Brazil, proposed the reestablishment of one species, *Phoradendron burkartii* Rizzini & Ulib., and nine names as synonyms, after field collections and consultation of the large and small herbaria of the region.

For Brazil, Kuijt (2003) lists 59 species of *Phoradendron*. According to Arruda *et al.* (2012), the ca. 60 species of *Phoradendron* are distributed in all Brazilian phytogeographic domains, while *Dendrophthora* has only three species and a more restricted distribution. Hence, the aim of this study was to review all names cited for Brazil, obtaining a better overview of the diversity in this country. This work was, in part, made possible thanks to the availability of high definition images of the nomenclatural types, through the repatriation project of Brazilian historical collections (Reflora 2020), and recent efforts to catalog the Brazilian flora (BFG 2015, 2018).

Material and Methods

For this study, all names of *Dendrophthora* and *Phoradendron* cited for Brazil, or with a type specimen collected in the Brazilian territory, were analyzed through a personal visit to the herbaria, or analysis of high-definition images provided by the Reflora project, and consulted via the Virtual Herbarium (Reflora 2020). The following herbaria were analyzed: A, B, BM, BR, C, CAS, CEN*, CEPEC*, CGMS*, CM, COL, CORD*, DAO, E, ESA*,

F, G, GH, HBG, HBR*, HUA, HUEFS*, IAC, IAN*, IBGE*, ILL, INPA*, K, L, LE, LP*, M, MA, MBM*, MG*, MICH, MO, NY, P, PH, R*, RB*, RFA, S, SI*, SP*, SPF*, TCD, U, UB*, UC, UEC*, UFMG*, US, W, WIS, acronyms according to Thiers (continuously updated). The acronyms followed by an asterisk (*) were personally visited. Specimens examined are marked with exclamation marks (!). Morphological terminology for growth patterns, cataphylls and inflorescences are in agreement with Eichler (1868) and Kuijt (1961; 2003). For additional images, vouchers list, distribution and descriptions of all Brazilian species, see Dettke & Caires (2020). The illustrations were made by C.S. Caires. An index to the names treated in this synopsis can be found in the Appendix S1 (available on supplementary material <<https://doi.org/10.6084/m9.figshare.16879597.v1>>). The index of type collectors is presented in Appendix S2 (available on supplementary material <<https://doi.org/10.6084/m9.figshare.16879597.v1>>).

Results and Discussion

For this synopsis, 173 names were evaluated, of which 44 taxa are recognized for Brazil, three species in *Dendrophthora* and 41 species in *Phoradendron*. Some more morphological characteristics are shown in Figures 1k-n and some species *in vivo* in Figures 2a-p and Figures 3a-p.

The range of distribution of Brazilian species in the Neotropical region is summarized in Table 1. Eight species are widely distributed, including North, Central America (including Caribbean) and South America; and five species occur in both Central and South America. Almost 70% of the species have exclusive distribution in South America, with eleven endemic species to Brazil. We consider nine species as rare, with few records in Brazil, restricted only by the type or very few collections: *Phoradendron bicarinatum*, *P. dimerostachys*, *P. krukovi* and *P. oliveirae* are only known for the type material collected in Brazil; *Phoradendron juruanum* and *P. laxiflorum* also have type material collected in Brazil, but are registered too in few areas in adjacent countries; and four species, *Dendrophthora fendleriana*, *Phoradendron argentinum*, *P. diminutivum* and *P. singulare*, also occur in neighboring countries, but have few collections in Brazilian territory.



Figure 2 – a-p. *Dendrophthora* and *Phoradendron* species – a-b. *Dendrophthora warmingii*; c. *Phoradendron argentinum*; d. *P. bathyoryctum*; e. *P. berterianum*; f. *P. burkartii*; g. *P. caripense*; h. *P. chrysocladon*; i. *P. congestum*; j. *P. coriaceum*; k. *P. craspedophyllum*; l. *P. crassifolium*; m-o. *P. dipterum*; p. *P. ensifolium*. Photos: a-b,d,o. C.S. Caires; c,f,j,k,m,n,p. G.A. Dettke; e. S.A. Bordignon; g. J. Faria; h. J.R. Fabricante; i. M.R. Zanatta; l. I.L. Morais.

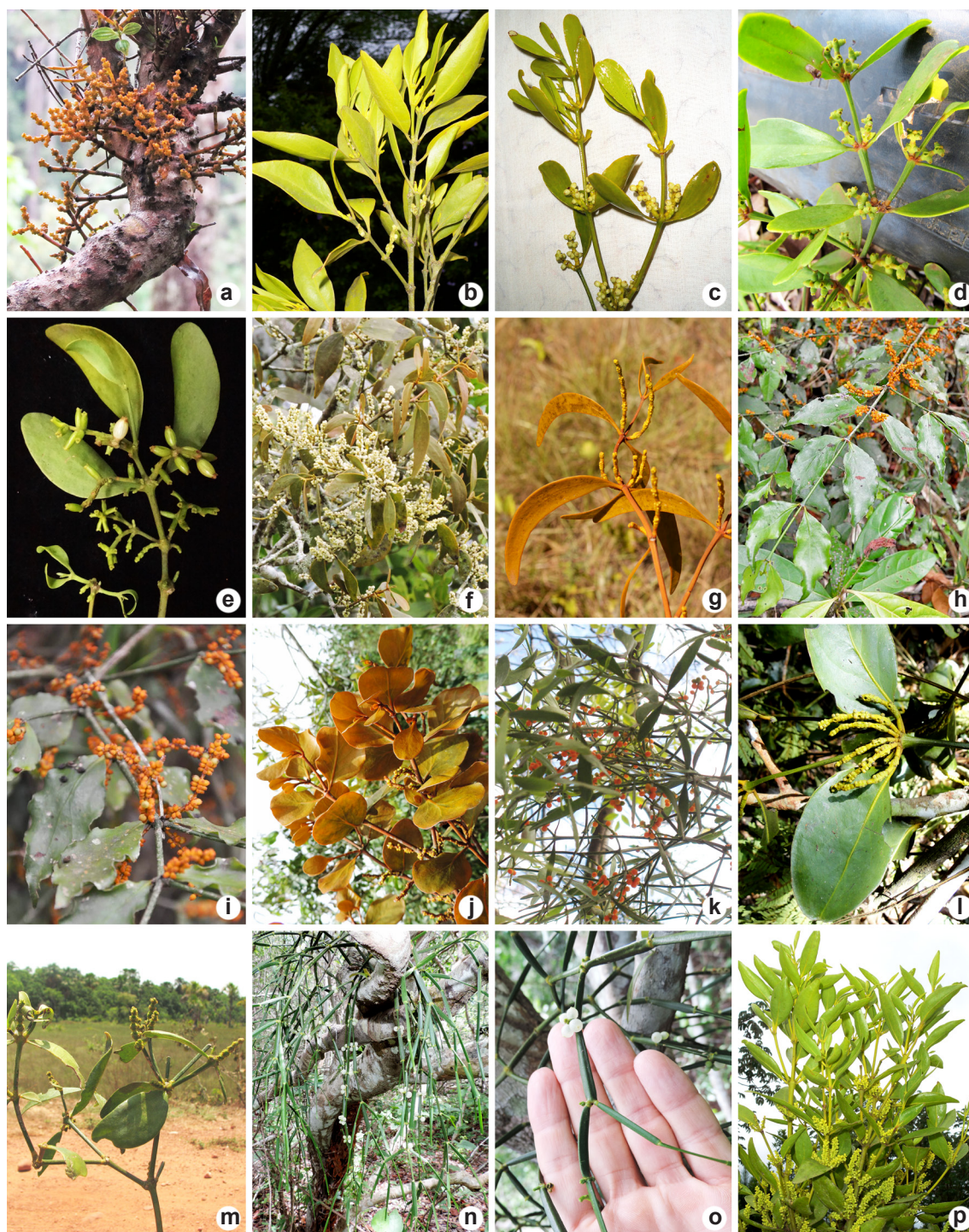


Figure 3 – a-p. *Phoradendron* species – a. *P. fragile*; b. *P. hexastichum*; c. *P. holoxanthum*; d. *P. mucronatum*; e. *P. obtusissimum*; f-g. *P. perrottetii*; h-i. *P. piperoides*; j. *P. pteroneuron*; k. *P. quadrangulare*; l. *P. racemosum*; m. *P. strongylocnados*; n-o. *P. tunaeforme*; p. *P. undulatum*. Photos: a. S.L.X. Tobias; b,c,k,p. G.A. Dettke; d. I.L. Morais; e. M.A. Milaneze-Gutierrez; f,j,n,o. L.J. Leitão; g. J. Faria; h-i. A.S. Farias; l. J. Lira; m. C.S. Caires.

Table 1 – Distribution range of Brazilian species of *Dendrophthora* and *Phoradendron*. (* = rare species in Brazil; # = species only known for the type material collected in Brazil).

Distribution range	Species
North, Central and South America	8 (<i>Phoradendron berterianum</i> , <i>P. chrysocladon</i> , <i>P. dipterum</i> , <i>P. hexastichum</i> , <i>P. mucronatum</i> , <i>P. piperoides</i> , <i>P. quadrangulare</i> , <i>P. undulatum</i>)
Central and South America	5 (<i>Phoradendron crassifolium</i> , <i>P. inaequidentatum</i> , <i>P. northropiae</i> , <i>P. obtusissimum</i> , <i>P. racemosum</i>)
South America	20 (<i>Dendrophthora elliptica</i> , <i>D. fendleriana</i> *, <i>D. warmingii</i> , <i>Phoradendron argentinum</i> *, <i>P. bathyoryctum</i> , <i>P. burkartii</i> , <i>P. congestum</i> , <i>P. coriaceum</i> , <i>P. diminutivum</i> *, <i>P. ensifolium</i> , <i>P. juruanum</i> *, <i>P. laxiflorum</i> *, <i>P. pellucidulum</i> , <i>P. perrottetii</i> , <i>P. platycaulon</i> , <i>P. poeppigii</i> , <i>P. pteroneuron</i> , <i>P. singulare</i> *, <i>P. strongylocados</i> , <i>P. tunaeforme</i>)
Endemic to Brazil	11 (<i>Phoradendron bicarinatum</i> *#, <i>P. caripense</i> , <i>P. craspedophyllum</i> , <i>P. dimerostachys</i> *#, <i>P. fragile</i> , <i>P. harleyi</i> , <i>P. holoxanthum</i> , <i>P. krukovii</i> *#, <i>P. macrarthrum</i> , <i>P. nigricans</i> , <i>P. oliveirae</i> *#)

Identification key for *Dendrophthora* and *Phoradendron* species in Brazil

1. Plants with squamiform leaves.
 2. Stem dorsiventrally flattened; inflorescence with 1–2 fertile internodes; mature fruit translucent white.....2.40. *Phoradendron tunaeforme*
 - 2'. Stem cylindrical; inflorescence with 3–5 fertile internodes; mature fruit yellowish, orange or reddish.
 3. Plants dioecious; branches erect, internodes short (0.8–3.5 cm long); inflorescences triseriate, with 4–10 flowers per fertile bract 2.16. *Phoradendron fragile*
 - 3'. Plants monoecious; branches pending, internodes long (usually more than 4 cm long); inflorescences biseriate, with only 3 flowers per fertile bract..... 2.34. *Phoradendron poeppigii*
- 1'. Plants with expanded leaves.
 4. Stem dorsiventrally flattened 2.33. *Phoradendron platycaulon*
 - 4'. Stem not flattened, other shapes.
 5. Internodes with fertile cataphylls.
 6. Internode with two or more, pairs of fertile cataphylls..... 2.11. *Phoradendron crassifolium*
 - 6'. Internode with only one pair of fertile cataphylls.
 7. Leaves with pinnate veins, with only one primary vein visible.
 8. Leaf base generally obtuse; leaf blade symmetric; inflorescence internodes cylindrical; 3–5 flowers per fertile bract2.17. *Phoradendron harleyi*
 - 8'. Leaf base acute; leaf blade asymmetric; inflorescence internodes clavate; 7–9 flowers per fertile bract2.29. *Phoradendron oliveirae*
 - 7'. Leaves with palmate veins, with 3–5 primary veins.
 9. Branching sympodial, dichotomous; all inflorescence internodes biseriate 2.10. *Phoradendron craspedophyllum*
 - 9'. Branching predominantly monopodial, percurrent, with rare dichotomies; inflorescence internodes uniseriate, or more rarely, only the basal ones biseriate.
 10. Inflorescence with only a pair of sterile bracts at the base, 2 or 3 fertile internodes; mature fruits ellipsoid2.38. *Phoradendron singulare*
 - 10'. Inflorescence with 2–4 pairs of sterile bracts at the base, 5 or more fertile internodes; mature fruits globose 2.20. *Phoradendron inaequidentatum*

- 5'. Internodes without fertile cataphylls.
11. Cataphylls present in all internodes.
12. Leaves with pinnate veins.
13. Inflorescences triseriate; inflorescence internodes clavate..... 2.21. *Phoradendron juruanum*
- 13'. Inflorescences biseriate; inflorescence internodes cylindrical.
14. Branching predominantly sympodial, dichotomous; lateral internodes with only a pair of basal cataphylls; leaves with rounded or retuse apex; fruits white with closed sepals 2.27. *Phoradendron northropiae*
- 14'. Branching predominantly monopodial, percurrent; lateral internodes with 2–4 pairs of basal cataphylls; leaves with acute or acuminate apex; fruits yellowish to reddish with erect open sepals 2.32. *Phoradendron piperoides*
- 12'. Leaves with palmate veins.
15. Branching predominantly sympodial, dichotomous.
16. Stem with whitish surface and longitudinal fissures; leaves with acuminate apex 2.22. *Phoradendron krukovii*
- 16'. Stem without this characteristic; leaves with acute or rounded apex.
17. Inflorescences triseriate; 9–21 flowers per fertile bract..... 2.3. *Phoradendron berterioanum*
- 17'. Inflorescences biseriate; only 3 flowers per fertile bract.
18. Lateral internodes with 2–3 pairs of cataphylls; leaves with crenulated margin; fruits globose, white 2.5. *Phoradendron burkartii*
- 18'. Lateral internodes with only one pair of cataphylls; leaves with a smooth margin; fruits ovoid, orange or reddish 2.39. *Phoradendron strongylocados*
- 15'. Branching predominantly monopodial, percurrent.
19. Inflorescences triseriate.
20. Internodes with tubular cataphylls; terminal inflorescences present..... 1.2. *Dendrophthora fendleriana*
- 20'. Internodes with free cataphylls; terminal inflorescences absent.
21. Stem with two conspicuous lateral wings; inflorescences bisexual (staminate and pistillate flowers); inflorescences internode clavate 2.7. *Phoradendron chrysocladon*
- 21'. Stem without lateral wings; inflorescences unisexual (with only staminate flowers); inflorescences internodes cylindrical 2.23. *Phoradendron laxiflorum*
- 19'. Inflorescences uni- or biseriate.
22. Lateral internodes with only one pair of cataphylls; leaves predominantly ovate or elliptical, less than 1.5 cm wide 2.39. *Phoradendron strongylocados*
- 22'. Lateral internodes with 2 pairs of cataphylls; leaves predominantly elliptical or obovate, wider than 1.5 cm.
23. Plants dioecious; cataphylls free; leaves elliptical, with apiculate or acuminate apex; pistillate inflorescences uniseriate only 2.23. *Phoradendron laxiflorum*
- 23'. Plants monoecious; cataphylls fused; leaves obovate with a rounded apex; inflorescences biseriate 2.13. *Phoradendron diminutivum*
- 11'. Cataphylls present only in the proximal internodes of lateral branches.
24. Epiparasite of other species of *Phoradendron*; stem winged, with two or four distinct wings 2.14. *Phoradendron dipterum*
- 24'. Hemiparasite of other angiosperms; stem non-winged.
25. Leaves with pinnate veins, only one primary vein conspicuous.
26. Inflorescences triseriate.

- 27. Plants dioecious; internodes with one, rarely two, pairs of cataphylls2.18. *Phoradendron hexastichum*
- 27'. Plants monoecious; internodes with generally 2–5 pairs of lateral cataphylls.....1.3. *Dendrophthora warmingii*
- 26'. Inflorescences biseriate.
 - 28. Branching predominantly sympodial, dichotomous 2.37. *Phoradendron racemosum*
 - 28'. Branching predominantly monopodial, percurrent.
 - 29. Leaves linear-lanceolate to falcate, up to 1.5 cm wide 2.4. *Phoradendron bicarinatum*
 - 29'. Leaves circular, elliptical, ovate, oblong or obovate, rarely falcate, more than 1.5 cm wide.
 - 30. Leaves with acute apex, usually acuminate2.41. *Phoradendron undulatum*
 - 30'. Leaves with obtuse rounded apex.
 - 31. Inflorescence with 1 or 2 pairs of sterile bracts at the base; fruits with erect open petals 1.3. *Dendrophthora warmingii*
 - 31'. Inflorescence with 4 pairs, or more, of sterile bracts at the base; fruits with closed petals 2.35. *Phoradendron pteroneuron*
 - 25'. Leaves with palmate veins, with 3–7 primary veins, generally inconspicuous.
 - 32. Small leaves, maximum 2 cm long; inflorescences with only 1 fertile internode 1.1. *Dendrophthora elliptica*
 - 32'. Larger leaves, more than 2 cm long; inflorescences with 2, or more, fertile internodes.
 - 33. Inflorescences biseriate.
 - 34. Fruits distinctly ellipsoid.....2.28. *Phoradendron obtusissimum*
 - 34'. Fruits globose or ovoid.
 - 35. Fertile bract with only 3 flowers, the apical flowers staminate; fruits with verrucose epicarp.
 - 36. Leaves small, maximum 1 cm wide; young leaves glaucous, covered with epicuticular wax; only the apex of the epicarp verrucose2.1. *Phoradendron argentinum*
 - 36'. Leaves larger, more than 1 cm wide; young leaves green; the entire epicarp verrucose2.25. *Phoradendron mucronatum*
 - 35'. Fertile bract with more than 3 flowers (if 3, all flowers pistillate); fruit with smooth pericarp.
 - 37. Fertile bract with up to 4 flowers2.26. *Phoradendron nigricans*
 - 37'. Fertile bract with more than 5 flowers.
 - 38. Fertile bract with 15–23 flowers.....2.24. *Phoradendron macrarthrum*
 - 38'. Fertile bract with 5–15 flowers.
 - 39. Leaves lanceolate to oblong-lanceolate; infrutescence congested, shorter than 2 cm in length2.8. *Phoradendron congestum*
 - 39'. Leaves of other shapes; infrutescence laxa, longer than 2.5 cm in length.
 - 40. Young stems strongly rhombic or quadrangular; mature fruits dark-orange or reddish....2.36. *Phoradendron quadrangulare*
 - 40'. Young stems cylindrical or ellipsoid; mature fruits yellowish, pink or light-orange.
 - 41. Inflorescences generally clavate, staminate flowers positioned at the apex of the fertile bract, foveae distinctly deep; fruits with closed petals2.2. *Phoradendron bathyoryctum*
 - 41'. Inflorescences cylindrical, staminate flowers mixed with pistillate ones in the fertile bract; foveae medium to shallow; fruits with erect open petals.

42. Small leaves; narrow, 1.5–3 cm wide2.13. *Phoradendron diminutivum*
 42'. Large leaves; wide, 3–7 cm wide.....1.3. *Dendrophthora warmingii*
 33'. Inflorescences triseriate.
 43. Plants monoecious.
 44. Leaves small (3–6 × 1–1.5 cm); inflorescence with the entire basal internode bearing staminate flowers.....2.12. *Phoradendron dimerostachys*
 44'. Leaves large (5–15 × 2–7 cm); inflorescence internodes with staminate flowers, mixed with pistillate flowers.
 45. Fertile bract with 7–9 flowers; fruits ovoid with erect opened petals1.3. *Dendrophthora warmingii*
 45'. Fertile bract with 12–18 flowers; fruits globose with closed petals.....2.31. *Phoradendron perrottetii*
 43'. Plants dioecious.
 46. Inflorescences axillary only.
 47. Branches erect; young leaves translucent *in sicco*; short leaves, up to 5 cm long.....2.30. *Phoradendron pellucidulum*
 47'. Branches pending; young leaves opaque *in sicco*; long leaves, more than 5 cm long....2.15. *Phoradendron ensifolium*
 46'. Inflorescences axillary and terminal.
 48. Plants usually pending; dark brown or black *in sicco*; cataphylls usually with a whitish margin.....2.9. *Phoradendron coriaceum*
 48'. Plants erect; light brown or yellowish *in sicco*; cataphylls without whitish margin.
 49. Inflorescences with only 1 pair of sterile bracts at the base; mature fruits white ...2.19. *Phoradendron holoxanthum*
 49'. Inflorescence usually with 2–3 pairs of sterile bracts at the base; mature fruits yellow or greenish.....2.6. *Phoradendron caripense*

Taxonomic treatment

1. *Dendrophthora* Eichler in Martius, *Fl. bras.* 5(2): 102. 1868. Type species: *Dendrophthora opuntoides* (L.) Eichler in Martius, *Fl. bras.* 5(2): 102. 1868, lectotype designated by N.L. Britton & P. Wilson, *Sci. Surv. Porto Rico* 5: 259. 1924.

1.1. *Dendrophthora elliptica* (Gardner) Krug & Urb., *Ber. Deutsch. Bot. Ges.* 14(8): 285. 1896. *Phoradendron ellipticum* (Gardner) Eichler in Martius, *Fl. bras.* 5(2): 119, Fig. 37-2. 1868. *Viscum ellipticum* Gardner, *London J. Bot.* 4: 106. 1845. Type: BRAZIL. RIO DE JANEIRO: Organ Montains, on *Gaylussacia*, G. Gardner 437 (lectotype, *hic designatus*: K - barcode 00601371! (= Kew Neg 4570); isoelectotypes: BM!, G!, K!, P!). *Dendrophthora elliptica* var. *genuina* Krug & Urb., *Bot. Jahrb. Syst.* 24: 69. 1897, *nom. illeg.* *Dendrophthora rubicunda* Ule, *Notizbl. Bot. Gart. Berlin-Dahlem* 6: 289. 1915. Type: BRAZIL. RORAIMA: II. 1910, E.H.G. Ule 8601 (holotype: B, destroyed; lectotype, designated by Kuijt (1961): K - barcode 00601370!; isoelectotype: IAN).

Dendrophthora hylaeana Rizzini, *Rodriguésia* 41: 8. 1976. Type: BRAZIL. AMAZONAS: Serra Aracá, 10.II.1975, J.M. Pires 15042 (holotype: RB - barcode 00540550!).

Dendrophthora elliptica is a monoecious species with erect habit; the growth pattern is monopodial/percurrent, and possesses cataphylls only on the lateral proximal internodes. The leaves show palmate veins and widely variable in shape and size, elliptical or obovate, and do not exceed 2 cm in length, smaller than in any Brazilian species of *Phoradendron*. The small inflorescence is biserial, with 3–5 flowers in the fertile bract, and the apical one is staminate. Rizzini (1956) illustrates the unilocular anther of *D. elliptica* (Fig. 20-3). This species can be confused with some species of *Phoradendron*, such as *P. argentinum* and *P. mucronatum*, being distinguished from them by the smaller leaves and minute inflorescences (up to 0.5 cm in length), with only one fertile internode.

The holotype was found in two duplicates at the K herbarium and, according to the Code, are considered syntypes, and one of them is selected by us as a lectotype (Turland *et al.* 2018, Art. 9.11).

Iconography: Eichler (1868, Fig. 37-2), Rizzini (1995, Fig. 21), Rizzini (1956, Fig. 20), Kuijt (1961, Fig. 21), Kuijt (2005, Fig. 392).

It is distributed in South America - Brazil (AM, ES, GO, MG, RJ, RR, SP), Colombia and Venezuela (Kuijt 1961; Dettke & Caires 2020).

1.2. *Dendrophthora fendleriana* (Eichler) Kuijt, Taxon 43(2): 190. 1994. *Phoradendron fendlerianum* Eichler in Martius, *Fl. bras.* 5(2): 129. 1868. Type: VENEZUELA. Prope coloniam Tovar, 1854/1855, *A. Fendler 1102* (lectotype, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 211b); lectotype, designated by Kuijt (1994): P barcode 00756353!; isolectotypes: BR!, G!(3x), GH!, GOET!, K!, MO).

Dendrophthora fendleriana is a new occurrence for Brazil, found in an altitude area of “Pico da Neblina”, close to the border with Venezuela, where it is already registered. This species can be recognized by a predominance of monopodial/percurrent branches, and less frequent dichotomies caused by the presence of terminal inflorescences; tubular cataphylls in all internodes; leaves elliptical or circular, with palmate veins and triseriate inflorescences. It resembles *D. warmingii* and *P. racemosum* in leaves morphology, but it is differentiated by the position of cataphylls, in all internodes in *D. fendleriana* and present only on proximal lateral internodes in *D. warmingii* and *P. racemosum*.

Examined material: Santa Isabel do Rio Negro, Parque Nacional do Pico da Neblina, 2.000 m, 00°47'14"N, 66°01'26"W, 22.IX.2012, *R.C. Forzza et al.* 7285 (RB).

Iconography: Trelease (1916, Fig. 211b).

It is distributed in South America - Brazil (AM) and Venezuela (this study; Kuijt & Kellogg 1996).

1.3. *Dendrophthora warmingii* (Eichler) Kuijt, Novon 13(1): 88. 2003. *Phoradendron warmingii* Eichler in Warming, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 209. 1870. Type: BRAZIL. MINAS GERAIS: Lagoa Santa, on *Vochysia elliptica*, 14.I.1865, *E. Warming 383* (lectotype, designated by Trelease (1916): C - barcode 10014053! (= Trelease, 1916, Fig. 198a); isolectotype: C10014050!).

Phoradendron mairaryense Ule, Notizbl. Bot. Gart. Berlin-Dahlem 6: 291. 1920. Type: BRAZIL. AMAZONAS: Rio Branco, Serra de Mairari, XI.1909, *E.H.G. Ule 8383* (holotype: B, destroyed

(= F Neg 18190); lectotype, *hic designatus*: K - barcode 00601485!; isolectotypes: G!, L!), *syn. nov.* *Dendrophthora tepuiana* (Steeyermark) Kuijt, Proc. Kon. Ned. Akad. Wetensch., Biol. 93(2): 138. 1990. *Phoradendron tepuianum* Steeyermark, Fieldiana, Bot. 28: 222. 1951. Type: VENEZUELA. BOLÍVAR: Ptari-tepuí, 1.XI.1944, *J.A. Steeyermark 59688* (holotype: F! (= F Neg 53343); isotypes: K!, NY!, US!).

Phoradendron simile Rizzini, Rodriguésia 18/19: 191. 1956. Type: BRAZIL. MINAS GERAIS: Santa Luzia, Lagoa Santa, on *Qualea*, 11.IX.1932, *H.L. Mello Barreto 6549* (holotype: RB - barcode 00540614!), *syn. nov.*

Phoradendron orbiculare Rizzini, Rev. Fac. Agron. Maracay 8(3): 88. 1975. Type: BRAZIL. MATO GROSSO: 450 km past Cuiabá, route to Goiânia, 30.IX.1963, *B. Maguire et al. 56949* (holotype: RB - barcode 00540517!; isotype: NY!), *syn. nov.* *Phoradendron sulfuratum* Rizzini, Revista Fac. Agron. (Maracay) 8(3): 89, Fig. 6. 1975. TYPE: VENEZUELA. BOLÍVAR: Gran Sabana, km 148 S El Dorado, 20.XII.1970, *J.A. Steeyermark et al. 104137* (holotype: RB (two sheets: barcodes 00540522! and 00545550!); isotype: NY!), *syn. nov.*

Phoradendron triplinervium Rizzini, Rev. Fac. Agron. Maracay 8(3): 90. 1975. Type: BRAZIL. BAHIA: Piau River, 150 km SW Barreiras, on *Vochysia*, *H.S. Irwin et al. 14827* (holotype: RB - barcode 00540618!; isotypes: IAN!, K!, NY!, UB!, US!), *syn. nov.*

Phoradendron linguiforme Rizzini, Mem. New York Bot. Gard. 29: 33. 1978. Type: BRAZIL. AMAPÁ: Araguari River, 5 hours above Mururé River, 01°24'N, 51°57'W, on *Caraipa*, 23.VIII.1961, *J.M. Pires et al. 50445* (holotype: RB - barcode 00540589!; isotypes: IAN, INPA!, K!, NY!), *syn. nov.*

Phoradendron virens Rizzini, Ernstia 32: 3. 1985. Type: BRAZIL, DISTRITO FEDERAL: Brasília, São Bartolomeu River, 01.X.1989, on *Vochysia*, *E.P. Heringer et al. 2136* (holotype: IBGE; isotype: RB (two sheets: barcodes 00540619! and 00545552!)), *syn. nov.*

Figs. 2a-b; 4

Dendrophthora warmingii can be distinguished by the greenish to yellowish color *in vivo*, and light-brown to yellowish *in sicco*. This species presents a combination of growth patterns (monopodial/percurrent and sympodial/dichotomous) with 1–5 pairs of tubular cataphylls only on the lateral proximal internodes. The leaves present a variation of venation patterns, sometimes

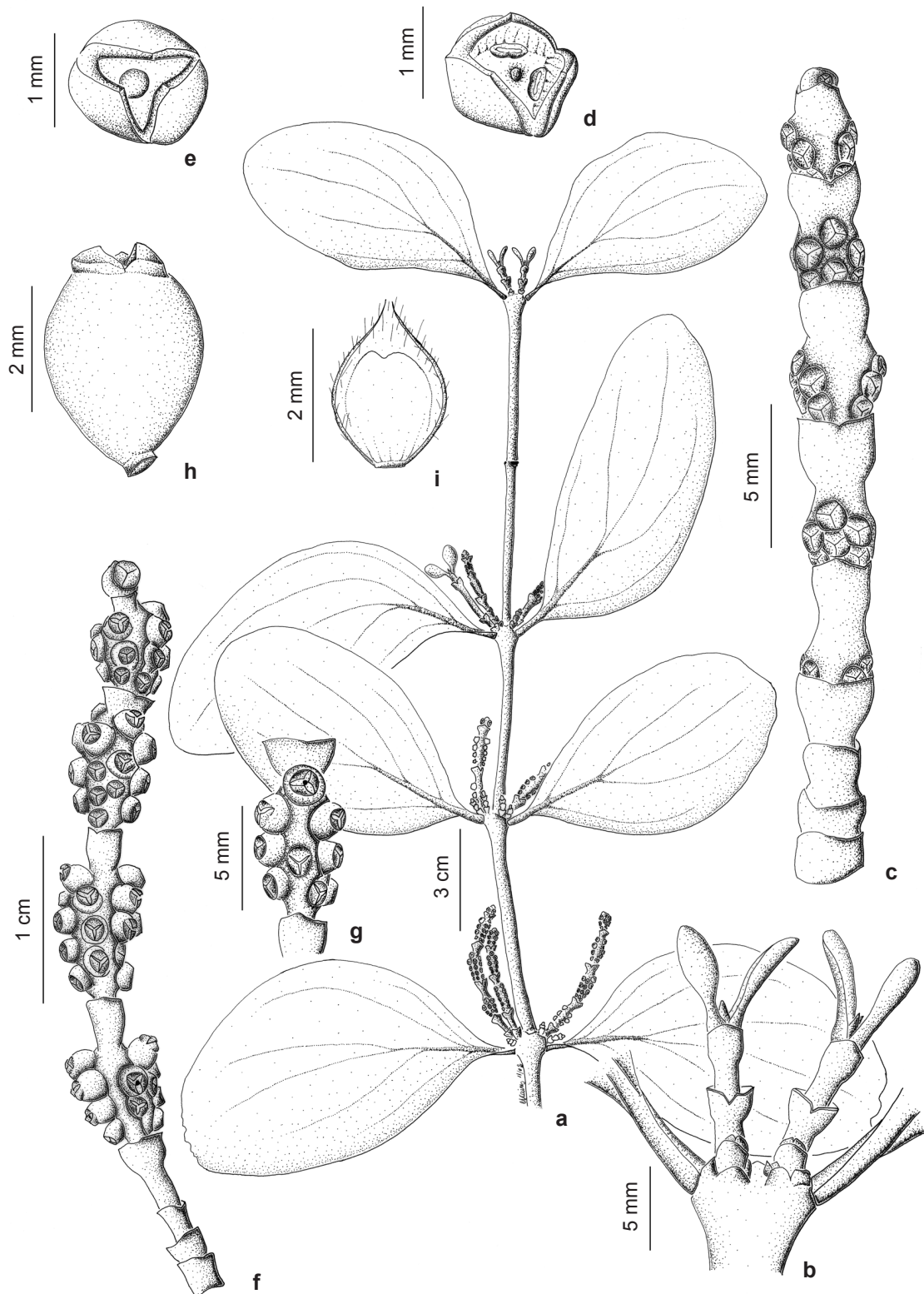


Figure 4—a-i. *Dendrophthora warmingii*—a. habit; b. apex of branches with two lateral shoots; c. young inflorescence; d. staminate flower; e. pistillate flower; f. mature fruits; g. detail of inflorescence; h. fruit; i. seed enclosed in endocarp. (a-b. Caires et al. 207 (UB); c,h,i. Caires et al. 72 (UB); d-g. Caires et al. 211 (UB)).

within the same individuals or population, of pinnate and palmate (1–5 main veins) patterns. The leaf shape is obovate, elliptical or circular, some falcate, with rounded apex. Inflorescences may be tri- or biseriate, with staminate flowers mixed with, and in fewer number than, pistillate flowers. This species is often seen parasiting on Vochysiaceae species (*Qualea* or *Vochysia* spp.), and less frequently on Melastomataceae species or others, but preferably on Myrtales (Caires & Proença 2008). (See comments under *D. fendleriana*, *P. dimunutivum*, *P. inaequidentatum* and *P. pteroneuron*).

After analyzing the type material, we include here *Phoradendron mairaryense* and its two synonyms, *P. sulfuratum* and *P. linguiforme* (Kuijt 2003), under synonymy of *D. warmingii*. We also include the names assigned by Kuijt (2003) as synonyms of *D. tepuinana*: *P. orbiculare*, *P. simile*, *P. triplinervium* and *P. virens*, under synonymy of *D. warmingii*.

Regarding *Phoradendron mairaryense*, the holotype was destroyed during the second World War, and, therefore, a lectotype is here designated (Turland *et al.* 2018, Art. 9.11).

Material selected for illustration (Fig. 4): Brasília, APA de Cafuringa, Dois Irmãos Farm, on *Vochysia pyramidalis* Mart., 21.VIII.2002, C.S. Caires *et al.* 207 (UB), on *Vochysia elliptica* Mart., 21.VIII.2002, C.S. Caires *et al.* 211 (UB). Sobradinho, margin of DF-170 road, on *Vochysia pyramidalis* Mart., 22.III.2002, C.S. Caires *et al.* 72 (UB).

Iconography: Rizzini (1956, Fig. 15, 19-2), Rizzini (1980, Fig. 9, 11), Rizzini (1982, Fig. 75), Caires & Proença (2005, Fig. 1a-c), Kuijt (2005, Fig. 395), Caires (2017, Figs. 1a-b, 2a-d).

It is distributed in South America - Brazil (AM, AP, BA, DF, GO, MG, MT, PA, RJ, RO, SP, TO), Guyana and Venezuela (Kuijt 2003; Caires 2017; Dettke & Caires 2020).

2. *Phoradendron* Nutt., J. Acad. Nat. Sci. Philad., ser. 2, 1: 185. 1848. Type species: *Phoradendron californicum* Nutt., J. Acad. Nat. Sci. Philad., ser. 2, 1: 185. 1848.

2.1. *Phoradendron argentinum* Urb., Bot. Jahrb. Syst. 23, Beibl. 57: 14. 1897. Type: ARGENTINA. CATAMARCA: Chacarita de los Padres, XI.1872, G.W. Hieronymus 419 (lectotype, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 177a); lectotype, designated by Dettke *et al.* (2011): F!, = F Neg 70633!; isolectotypes: CORD!, GOET, K!).

Fig. 2c

This species was first cited for Brazil by Dettke *et al.* (2011), and is characterized by glaucous young leaves, small biseriate inflorescences, with only three flowers per fertile bracts (apical flower staminate), and fruit with tuberculate epicarp in the apical portion. *Phoradendron argentinum* is similar to *P. mucronatum*, which has wider leaves (more than 1 cm), non glaucous leaves and an entirely tuberculate pericarp. (See comments under *Dendrophthora elliptica*).

Iconography: Eliçabe (1973, Figs. 6-7), Kuijt (2003, Fig. 35), Dettke & Waechter (2014, Figs. 1a-f), Dettke & Waechter (2013, Figs. 54-59).

It is distributed in South America - Argentina, Bolivia, Brazil (RS), Paraguay and Uruguay (Kuijt 2003; Dettke *et al.* 2011; Dettke & Waechter 2014).

2.2. *Phoradendron bathyoryctum* Eichler in Martius, Fl. bras. 5(2): 123, Fig. 43-2. 1868. Type: BRAZIL. PIAUÍ: “In prov. Piauí,” VIII.1839, G. Gardner 2626 (lectotype, designated by Trelease (1916): W, destroyed (= Trelease, 1916, Fig. 120a); lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 02441995!; isolectotypes: BM!, K!(2x), ILL!, P!, US!).

Phoradendron ulophyllum Eichler in Martius, Fl. bras. 5(2): 123. 1868. Type: BRAZIL. RIO DE JANEIRO: 1833, M. Gaudichaud 573 (lectotype, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 108a); lectotype, designated by Kuijt (1994): BR - barcode 0000005509416!; isolectotypes: P!(3x), G-DC!(2x)).

Phoradendron alophyllum Eichler ex Glaziov, Bull. Soc. Bot. France, Mem. 3g: 609. 1913. Type: BRAZIL. RIO DE JANEIRO: Villa Nova, A.F.M. Glaziov 7663 (lectotype, *hic designatus*: P - barcode 05455410!; isolectotype: P05455409!).

Phoradendron psittacanthobium Rizzini, Rodriguésia 30/31: 186. 1956. Type: BRAZIL. MATO GROSSO DO SUL: Corumbá, on *Psittacanthus cordatus*, which on *Triplaris*, S.M. Moore 1019 (holotype: BM - barcode 993557!).

Phoradendron pinheirense Rizzini, Arq. Jard. Bot. Rio de Janeiro 24: 35. 1980. Type: BRAZIL. Minas Gerais: Joao Pinheiro-Cristalina road, on *Pterodon emarginatus* [*Pterodon polygalaeflorum*], 6.VIII.1979, E.P. Heringer & C.T. Rizzini 17553 (lectotype, designated by Kuijt (2003): RB (two sheets - barcodes 00540606! and 00545659!); isolectotypes: UC(ex-LEA), R!).

Phoradendron paraguari Kuijt, Candollea 49(1): 268, Fig. 1. 1994. Type: PARAGUAY. PARAGUARÍ: Paraguarí, 27.VIII.1893, C.A.M.

Lindman 1941 (holotype: K - barcode 00568330!; isotypes: RB (ex-R)!, S!(2x)).

Phoradendron lindemanii Kuijt, Syst. Bot. Monogr. 66: 272, Fig. 162. 2003. Type: BRAZIL. PARANÁ: Serra do Mar, forest on Atlantic slope above Bela Vista, on old road from Curitiba to Morretes, 600–800 m, 23.II.1967, *J.C. Lindeman & J.H. de Haas 4641* (holotype: U - barcode 8116!).

Phoradendron pachyneuron Kuijt, Syst. Bot. Monogr. 66: 331, Fig. 208. 2003. Type: BRAZIL. PARANÁ: Morretes, Iacarehy, 17.III.1909, *P.K.H. Dusén 7863* (holotype: S R-9174!; isotype: S 11-24563!). Figs. 2d; 5

Phoradendron bathyoryctum is characterized by a mixture of growth patterns (monopodial/percurrent and sympodial/dichotomous), cataphylls present only on the proximal lateral branches, circular or ellipsoidal stems, sometimes keeled on the distal portion, biseriate inflorescences with staminate flowers, apically positioned, and fruits in deep alveolus. The leaves of these species are highly variable in size and shape among populations (elliptical, ovate, oblong or falcate), and generally possessing a rounded apex. It can be confused with *P. perrottetii*, which has a triseriate inflorescence, or with *P. coriaceum*, which has smaller leaves and is dioecious. Also, it can be confused with *P. macrarthrum*, which has generally longer and falcate leaves, and inflorescences with 15–23 flowers per fertile bract (vs. 5–15 in *P. bathyoryctum*).

Kuijt's species, *P. lindemanii*, *P. pachyneuron* and *P. paraguari*, were considered synonyms of *P. bathyoryctum* by Dettke & Waechter (2014) due to the overlapping morphology of analysed populations from southern Brazil, Paraguay and Argentina.

Two duplicates of the lectotype of *P. bathyoryctum* designated by Kuijt (1994) were located at P herbarium. Here, one of these duplicates is selected for a second-step lectotypification, of which the barcode is indicated (Turland *et al.* 2018, Art. 9.17). For *P. alophyllum*, the original material was found with two syntypes at P herbarium, and one of them is here selected as lectotype.

Material selected for illustration (Fig. 5): Brasília, DF-180 road of S.D.V.S.A. Farm 098-02, *Struthanthus*, 26.III.2002, *C.S. Caires & V.C. Mendes 93* (UB), on *Struthanthus*, 25.VI.2002, *C.S. Caires et al. 169* (UB), S.D.V.S.A. 126-02, on *Magonia pubescens* A-St. Hil., 26.III.2002, *C.S. Caires & V.C. Mendes 81* (UB).

Iconography: Eichler (1868, Fig. 43-2), Rizzini (1956, Fig. 13), Rizzini (1968b, Fig. 9),

Eliçabe (1973, Fig. 10), Kuijt (2003, Figs. 40, 162, 208, 212), Caires & Proença (2005, Fig. 2g), Dettke & Waechter (2013, Figs. 60-67), Rigon & Cervi (2013, Figs. 3a-c), Dettke & Waechter (2014, Figs. 1g-k).

It is distributed in South America - Argentina, Bolivia, Brazil (all states), Colombia, Paraguay, Suriname and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.3. *Phoradendron berterioanum* (DC.) Griseb., Fl. Brit. W. I. 313: 1864, [*berterianum*]. *Viscum berterioanum* DC., Prodr. 4: 281. 1830 [*berterianum*]. *Phoradendron dichotomum* Krug & Urb., Bot. Jahrb. Syst. 24(1): 48. 1897, *nom. illeg.*, non *Phoradendron dichotomum* Ettingsh., 1872. Type: DOMINICAN REPUBLIC. SANTO DOMINGO: *C.L.G. Bertero s.n.* (holotype: G-DC! (= Trelease, 1916, Fig. 238b)).

Phoradendron campinense Trel., *Phoradendron* 160, Fig. 244a. 1916. Type: BRAZIL. SÃO PAULO: Campinas, III.1900, *J.C. Novaes 417a p.p.* (holotype: US – barcode 107471!) [mixed with *P. crassifolium* 417b]. Fig. 2e

Phoradendron berterioanum can be recognized by its erect habit, sympodial/dichotomous branches and terete stems, large leaves with palmate veins, and long triseriate inflorescences, at axillary and terminal position. This species is often confused with *P. crassifolium*, which differs in presenting fertile cataphylls and only axillary inflorescences. (See comments under *P. krukovii*).

Iconography: Rizzini (1956, Fig. 11-1), Kuijt (2003, Figs. 43-44), Rigon & Cervi (2013, Figs. 3d,g), Dettke & Waechter (2014, Figs. 11-o).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Bolivia, Brazil (AC, MG, PR, RS, SP), Colombia, Ecuador, Peru and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.4. *Phoradendron bicarinatum* Kuijt, Syst. Bot. Monogr. 66: 116, Fig. 47. 2003. TYPE: BRAZIL. AMAZONAS: Rio Negro, Serra Jacamim, *Maia et al. 358* (holotype: MO).

Phoradendron bicarinatum was described by Kuijt (2003), based only on two collections from Rio Negro. This species is distinct from other species of *Phoradendron* due to its leaves with pinnate veins, linear-lanceolate to falcate in shape, up to 1.5 cm wide, and short biseriate inflorescences. This species resembles *P.*

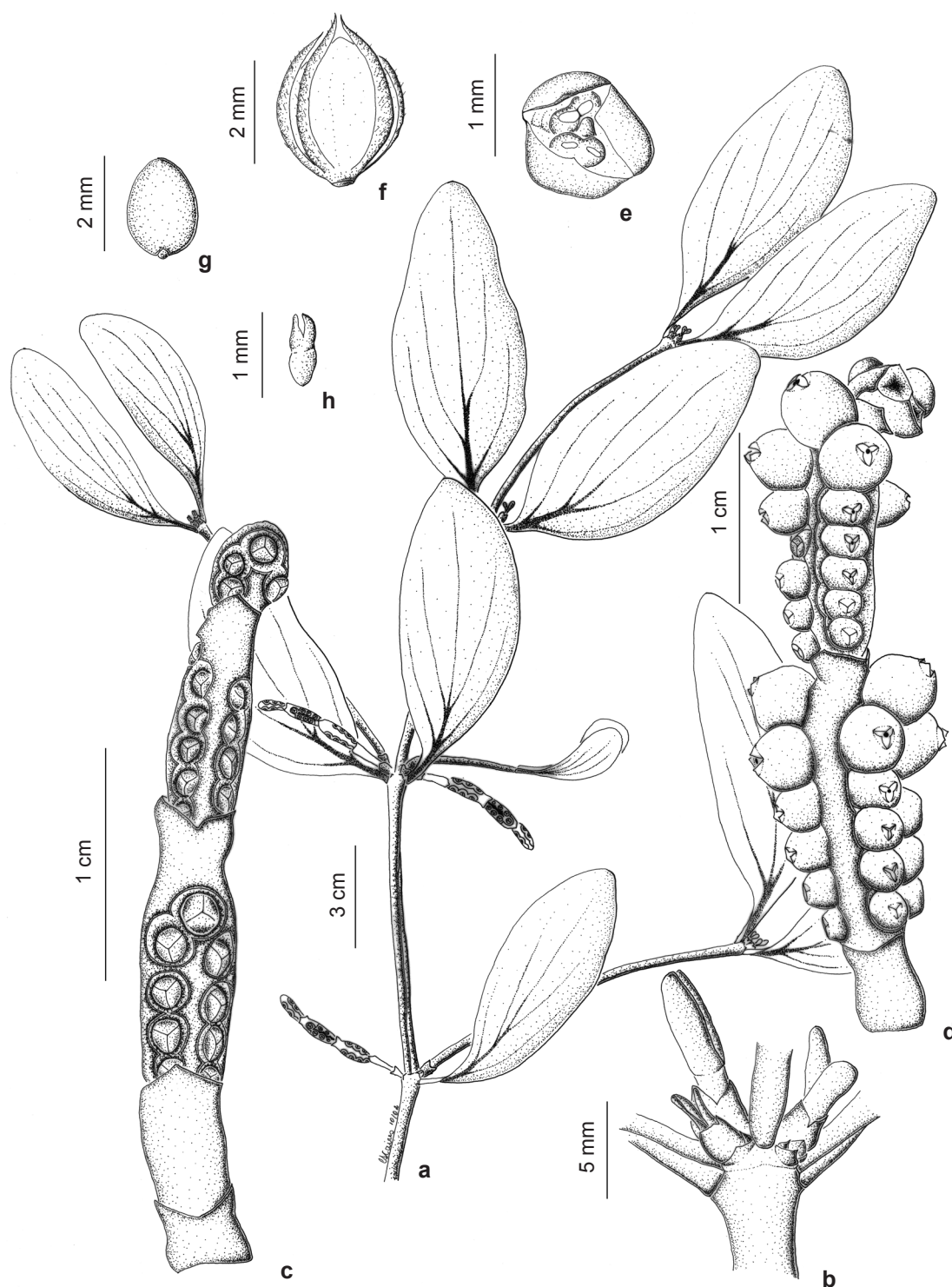


Figure 5—a-h. *Phoradendron bathyoryctum*—a. habit; b. detail of a node with lateral shoots, prophylls and cataphylls; c. inflorescence; d. mature fruits; e. staminate flower; f. seed enclosed in endocarp; g. seed; h. embryo. (a. Caires & Mendes 93 (UB); b-c. Caires & Mendes 81 (UB); d-h. Caires et al. 169 (UB)).

congestum, especially by the rhombic and keeled stem, and inflorescence morphology, differing only in the veins, which are palmate in *P. congestum*. We would not be surprised if, in the future with new collections being made, they will be recognized as synonyms.

Iconography: Kuijt (2003, Fig. 47).

It is distributed in South America - Brazil (AM) (Kuijt 2003).

2.5. *Phoradendron burkartii* Rizzini & Ulib., *Darwiniana* 27: 499, Fig. 1. 1986. Type: ARGENTINA. ENTRE RÍOS: Federación, Rincón del Mocoeta y del Uruguay, 16.IV.1960, *A. Burkart & J.C. Gamero* 21702 (holotype: SI - barcode 2184!; isotypes: SI!(4x)). Fig. 2f

Phoradendron burkartii was reestablished as a species by Dettke & Waechter (2014). This species is easily recognized by its sympodial/dichotomous, branches, crenulated leaf margin, and biseriate inflorescences, with only three flowers per fertile bract (apical flower staminate), located at the distal portion of the bract. (See comments under *P. krukovii*).

Iconography: Rizzini & Ulibari (1986, Fig. 1), Dettke & Waechter (2013, Figs. 68-72), Rigon & Cervi (2013, Figs. c-d), Dettke & Waechter (2014, Figs. 2a-e).

It is distributed in South America - Argentina, Brazil (PR, SC, RS) and Uruguay (Dettke & Waechter 2014).

2.6. *Phoradendron caripense* Eichler in Martius, *Fl. bras.* 5(2): 111. 1868. Type: BRAZIL. PARÁ: usque Caripi, *R. Spruce* 140 (holotype: M!, = Trelease, 1916, Fig. 104b; isotype: BM).

Phoradendron distans Rizzini, *Rev. Fac. Agron. Maracay* 8(3): 87. 1975. Type: BRAZIL. MINAS GERAIS: Cerrado, 2 km SW of Diamantina, on *Vochysia*, 22.I.1969, *H.S. Irwin et al.* 22429 (holotype: RB (two sheets - barcodes 00556325! and 00556326!); isotypes: CAS, UC(ex-LEA), MG!, NY!, UB!).

Phoradendron maguirei Rizzini, *Arq. Jard. Bot. Rio de Janeiro* 24: 33. 1980. Type: BRAZIL. MINAS GERAIS: Serra do Itabirito, 45 km SE of Belo Horizonte, 12.II.1968, *H.S. Irwin et al.* 19911 (holotype: RB - barcode 00540595!; isotypes: R, NY!, UB!).

Phoradendron maguirei var. *parvulum* Rizzini, *Arq. Jard. Bot. Rio de Janeiro* 24: 34. 1980. Type: BRAZIL. MINAS GERAIS: 14 km SW of Diamantina on road to Gouveia, 5.II.1972, *W.R.*

Anderson et al. 35491 (holotype: RB - barcode 00540597!; isotypes: CAS, UC(ex-LEA), NY!, UB!).

Phoradendron aurato-ochraceum Rizzini, *Ernstia* 32: 7. 1985. Type: BRAZIL. MINAS GERAIS: Diamantina, km-165 on road to Conselheiro Mata, on *Lychnophora*, 18.VII.1980, *J. Semir et al.* 234 (holotype: RB - barcode 00540571!; isotype: SPF!). Fig. 2g

Phoradendron caripense can be recognized by its erect habit and monopodial/percurrent, branches, with cataphylls only on the proximal lateral internodes; leaves generally cuneate or obovate, with a short petiole; triseriate inflorescences with 2-3 pairs of sterile bracts at the base. This species is very similar to *P. dimerostachys*, a monoecious species, but *P. caripensis* is dioecious. (See more comments under *P. dimerostachys*).

Iconography: Rizzini (1980, Figs. 6-1, 7-1), Kuijt (2003, Fig. 72).

It is distributed in South America - Brazil (AM, BA, MG, MT, PA, PB) (Kuijt 2003).

2.7. *Phoradendron chrysocladon* A. Gray, *U.S. Explor. Exped. [Bot., Phanerogam.]* 15(1): 43. 1854. Type: BRAZIL. RIO DE JANEIRO: near to Rio de Janeiro, 1838-42, *Wilkes Exped. s.n.* (holotype: US - barcode 00105562!; isotypes: F, GH!, P).

Phoradendron reticulatum Urb., *Bot. Jahrb. Syst.* 23, Beibl. 57: 12. 1897. Type: BRAZIL. RIO DE JANEIRO: Villa Nova, 7.V.1874, *A.F.M. Glaziou* 7664 (lectotype, designated by Kuijt (2003): K; isolectotypes: C (= Trelease, 1916, Fig. 230), F, P!(3x), S!). Fig. 2h

Phoradendron chrysocladon is recognized by the monopodial/percurrent, branches, ellipsoidal and bi-keeled when young; sterile cataphylls present in all internodes; leaves with palmate and conspicuous veins; triseriate and clavate inflorescences. In nature, it presents a dark green to yellow-gold colour. It is often confused, in the collections, with *P. piperoides*, which has veins pinnate. (See comments under *P. laxiflorum* and *P. undulatum*).

Iconography: Kuijt (2003, Fig. 76), Kuijt (2005, Fig. 410), Rigon & Cervi (2013, Figs. 3e-f), Dettke & Waechter (2014, Figs. 2f-i).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Bolivia, Brazil (AL, BA, CE, ES, MG, PB, PE, PR, RJ, SC, SE, SP), Colombia, Ecuador, Guyana, Peru and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.8. *Phoradendron congestum* Trel., *Phoradendron* 80, Figs. 103, 104. 1916. *Phoradendron rubrum* var. *longifolium* Eichler in Martius, *Fl. bras.* 5(2): 121. 1868. Type: BRAZIL. GOIÁS: “In prov. Goyaz”, *G. Gardner 3764* (holotype: BR - barcode 000000550652! (= Trelease, 1916, Fig. 103); isotypes: BM!, K!(2x), P!(2x)).

Phoradendron andersonii Rizzini, *Arq. Jard. Bot. Rio de Janeiro* 24: 29. 1980. Type: BRAZIL. GOIÁS: Cerrado, 8 km S of Niquelândia, on *Piptocarpha*, 23.I.1972, *H.S. Irwin et al. 34866* (holotype: RB - barcode 00540563!; isotypes: UC(ex-LEA), NY, UB!), *syn. nov.* Figs. 2i; 6

Phoradendron congestum is recognized by its large leaves, lanceolate to oblong-lanceolate to falcate and by short and congested inflorescences with 2–4 fertile biseriate segments (5–9 flowers per fertile bract). Under this concept, we include *P. andersonii* as a new synonym due to the overlapping morphological characteristics. *Phoradendron andersonii* was initially considered a synonym of *P. perrottetii* (Kuijt 2003), and was latter reestablished as a separate species by Caires & Proença (2007) due to the differences to *P. perrottetii*, such as the shape of young internodes (compressed in *P. andersonii* × cylindrical in *P. perrottetii*), the length of spikes (short, maximum 2.5 cm × long, maximum 7.5 cm) and type of spike (biserial × triserial). (See comments under *P. bicarinatum*).

Material selected for illustration (Fig. 6): Brasília, Parque Nacional de Brasília, margin of EPCT 001 road, on *Banisteriopsis latifolia* (A. Juss.) B. Gates, 11.VI.2002, *C.S. Caires & V.C. Mendes 160* (UB). Sobradinho, margin of DF-150 road, inside an abandoned house lot, on *Melia azedarach* L., 26.III.2002, *C.S. Caires & V.C. Mendes 77* (UB).

Iconography: Rizzini (1980, Fig. 6-3), Kuijt (2003, Fig. 80), Caires & Proença (2005, Fig. 2c).

It is distributed in South America - Brazil (AM, BA, DF, GO, MG, MT, PA, SP) and Ecuador (Kuijt 2003; Caires & Proença 2007; Dettke & Waechter 2014).

2.9. *Phoradendron coriaceum* Mart. ex Eichler in Martius, *Fl. bras.* 5(2): 121. 1868. Type: BRAZIL. MINAS GERAIS: “in campis Taboleiro prov. Minarum, Alto dos Boys,” *C.F.P. Martius s.n.* (lectotype, designated by Trelease (1916): M - barcode 174063! (= Trelease, 1916, Fig. 107a); isoelectotype: M!).

Phoradendron coriaceum var. *quintense* Urb., *Bot. Jahrb. Syst.* 23, Beibl. 57: 13. 1897. Type:

BRAZIL. RIO DE JANEIRO: Quinta, 15.II.1870, *A.F.M. Glaziov 4010* (holotype: B, destroyed (= Trelease, 1916, Fig. 107b), lectotype, designated by Kuijt (2003): K - barcode 00601409!; isotypes: P!(3x)).

Phoradendron apiciflorum Rizzini, *Rev. Fac. Agron. (Maracay)* 8(3): 86. 1975. Type: BRAZIL. MINAS GERAIS: cerrado 4 km N of Patrocínio, 31.I.1970, *H.S. Irwin et al. 25724* (holotype: RB - barcode 00540568!; isotypes: COL, F!, US!), *syn. nov.*

Phoradendron luisense Rizzini, *Fl. Venezuela* 4(2): 255. 1982. *Phoradendron luisense* var. *retusum* Rizzini, *Fl. Venezuela* 4(2): 257. 1982, *nom. illeg.* Type: VENEZUELA. FALCÓN: Sierra de San Luis, 1.5 km W of Macuquita, 600 m, 20.XII.1978, *H. van der Werff & R. Wingfield 3260* (holotype: RB - barcode 00205522!; isotypes: MO!, U!), *syn. nov.*

Phoradendron bahiense Kuijt, *Syst. Bot. Monogr.* 66: 99, Fig. 38. 2003. Type: BRAZIL. BAHIA: Maracás, BA-026, 6 km SW of Maracás, 5.V.1979, *S.A. Mori & T.S. dos Santos 11798* (holotype: UC (ex-LEA), isotypes: CEPEC!, NY, RB!), *syn. nov.* *Phoradendron irwinianum* Kuijt, *Syst. Bot. Monogr.* 66: 248, Fig. 142. 2003. Type: BRAZIL. DISTRITO FEDERAL: 5 km W of Formosa, road to Brasília, 8.X.1965, *H.S. Irwin et al. 9060* (holotype, F = F Neg 70628!; isotypes: IAN!, NY!, RB!, UB!, US!), *syn. nov.* Figs. 1m; 2j; 7-8

Phoradendron coriaceum is characterized by the robust aspect of stems and leaves, often exhibiting a dark brown or black color *in sicco*. This species presents monopodial/percurrent branches, more rarely with dichotomies; cataphylls and bracts of the inflorescences generally with whitish margins; the nodes are frequently thickened by the formation of many inflorescences. It is a dioecious species with staminate and pistillate, triserial, inflorescences. It can be confused with *P. bathyoryctum*, but it is distinguished by the smaller leaves, cataphylls with whitish margins and pistillate inflorescences with all immature fruits in the fertile bract (in *P. bathyoryctum*, the staminate flowers of the apex are dehiscent and bracts are incomplete in fruiting).

In this treatment, we include *P. apiciflorum*, *P. bahiense*, *P. irwinianum* and *P. luisense*, as new synonyms of *P. coriaceum*. *Phoradendron apiciflorum* is distinguished by presenting a distal placement of the fruits, a condition also seen in some populations of *P. coriaceum* with a predominantly southern distribution

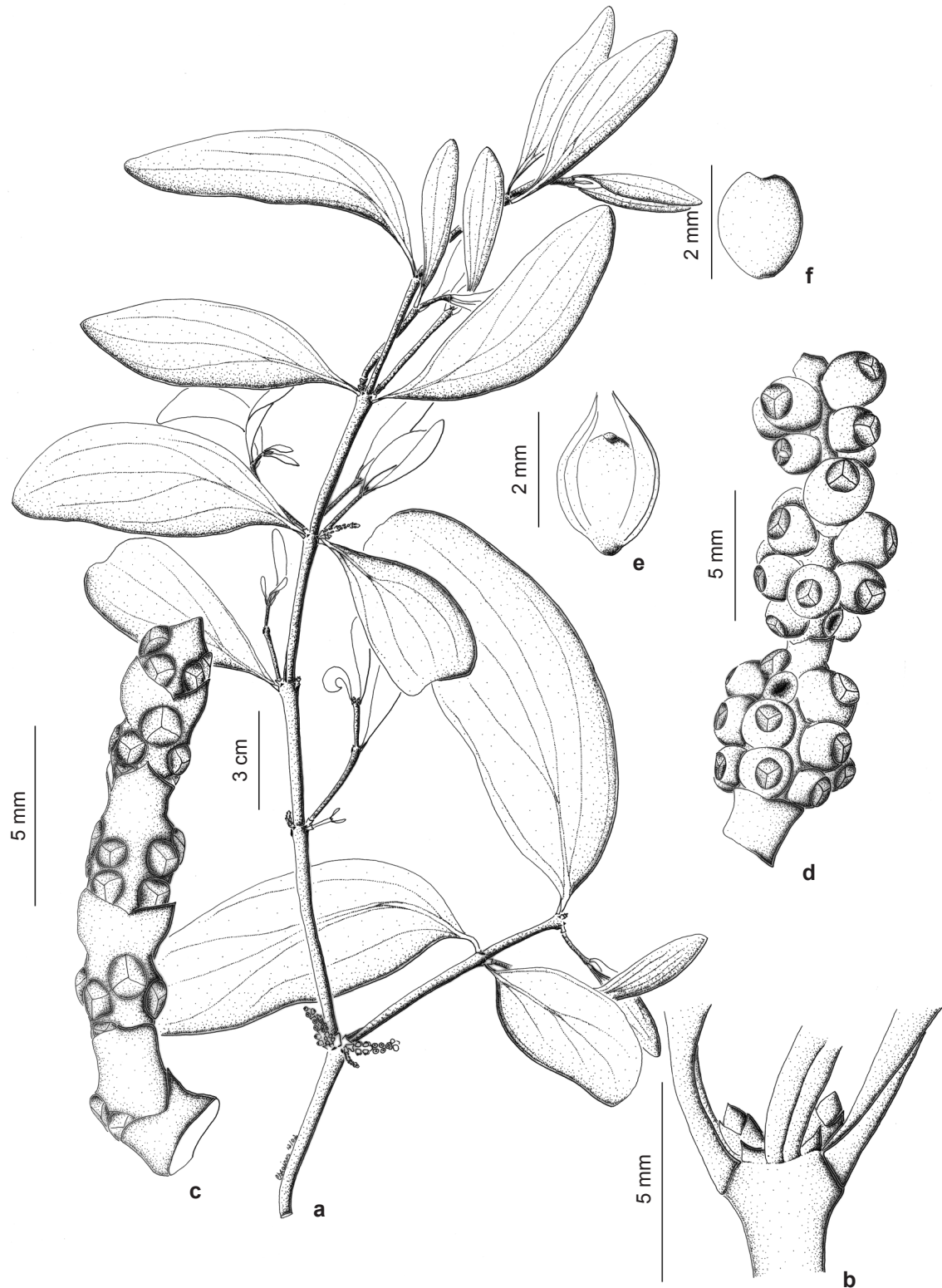


Figure 6 – a-f. *Phoradendron congestum* – a. habit; b. node with two lateral shoots and prophyll; c. inflorescence; d. mature fruit; e. seed enclosed in endocarp; f. seed. (a-c. Caires & Mendes 160 (UB); d-f. Caires & Mendes 77 (UB)).

(Dettke & Waechter 2014, Fig. 3e). The nodes in *P. apiciflorum* are thickened, similarly to *P. coriaceum*. We also include *P. irwinianum*, recognized by Caires & Proença (2007) as synonym of *P. apiciflorum*, as a new synonym of *P. coriaceum*. *Phoradendron bahiense* also has a thickened node and a white-margined cataphyll; and fewer flowers per fertile, pistillate, bract (3–5) which are common in *P. coriaceum*, and therefore we attribute it to variation within the population. The Venezuelan species *P. luisense* also shows black color *in sicco*, white-margined cataphylls and similar inflorescence morphology, overlapping with *P. coriaceum*, for which we propose it as a new synonym.

Material selected for illustration (Figs. 7,8): Brasília, APA de Cafuringa, Campina Verde Farm, on *Machaerium opacum*, 11.VII.2002, C.S. Caires & C.L. Ramalho 181 (UB); 5 km W of Formosa, road to Brasília, 8.X.1965, H.S. Irwin *et al.* 9060 (UB).

Iconography: Kuijt (2003, Figs. 32, 38, 81, 171), Caires & Proença (2005, Figs. 2a-b,d), Dettke & Waechter (2013, Figs. 73-79); Rigon & Cervi (2013, Figs. 4i-l), Dettke & Waechter (2014, Figs. 3a-e).

It is distributed in South America - Argentina, Brazil (AL, AM, BA, ES, MG, MT, PI, PR, RS, RJ, SC, SP), Paraguay and Venezuela (Dettke & Waechter 2014).

2.10. *Phoradendron craspedophyllum* Eichler in Martius, *Fl. bras.* 5(2): 124, Fig. 37-3. 1868. Type: BRAZIL. SÃO PAULO: *F. Sello* 155 (lectotype: B, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 124a); lectotype, designated by Kuijt (1994): P - barcode 00756337!; isolectotype: BR!). Fig. 2k

This species is distinct from the other species of *Phoradendron* for the sympodial/dichotomous branching, with one pair of fertile cataphylls, small leaves with palmate veins and terminal and axillary biserial inflorescences, composed by three flowers, where the apical one is staminate. It may be confused with *P. mucronatum* or *P. harleyi*, which are species with monopodial, percurrent, branches and larger leaves.

Iconography: Eichler (1868, Fig. 37-3), Kuijt (2003, Fig. 82), Dettke & Waechter (2013, Figs. 80-82), Rigon & Cervi (2013, Figs. 5h-j), Dettke & Waechter (2014, Figs. 3f-j).

It is distributed in South America - Brazil (PR, RS, SC, SP) (Kuijt 2003; Dettke & Waechter 2014).

2.11. *Phoradendron crassifolium* (Pohl ex DC.) Eichler in Martius, *Fl. bras.* 5(2): 125, Fig. 40. 1868. *Viscum crassifolium* Pohl ex DC., Prodr. 4: 280. 1830. Type: BRAZIL. GOIÁS: “Serra d’Ourada,” 1839, *J.E. Pohl* 457 (holotype: G-DC! (= Trelease, 1916, Fig. 213a); isotype: BR!).

Phoradendron pepericarpum A. Gray, U.S. Explor. Exped. [Bot., Phanerogam.] 15(1): 742. 1854. Type: BRAZIL. RIO DE JANEIRO: Organ Mountains, *Wilkes Exped. s.n.* (lectotype, designated by Trelease, 1916: US - barcode 00105616!; isolectotypes: GH!, NY!).

Phoradendron crassifolium var. *parvifolium* Eichler in Martius, *Fl. bras.* 5(2): 125. 1868. Type: BRAZIL. MINAS GERAIS: “ad Copacabana, prov. Minarum, *B. Luschnath s.n.* (holotype: not located; lectotype, *hic designatus*: MO - barcode 00204716!).

Phoradendron crassifolium var. *multiflorum* Eichler in Martius, *Fl. bras.* 5(2): 125. 1868. Type: BRAZIL. MINAS GERAIS: Sabará, *L. Riedel s.n.* (lectotype, designated by Trelease, 1916: M).

Figs. 1k; 2l

One of the most common mistletoes in Brazil, *P. crassifolium*, is easily recognized by the presence of 2–5 pairs of fertile cataphylls and large leaves with usually five very prominent palmate veins (3–7 primary veins). (See comments under *P. berterianum*, *P. inaequidens* and *P. undulatum*).

Iconography: Eichler (1868, Fig. 40), Rizzini (1968b, Fig. 7), Rizzini (1982, Fig. 58), Rizzini (1995, Figs. 16-17), Kuijt (2003, Fig. 84), Caires & Proença (2005, Fig. 2f), Kuijt (2005, Fig. 400), Dettke & Waechter (2013, Figs. 83-87), Rigon & Cervi (2013, Figs. 4a-e), Dettke & Waechter (2014, Figs. 3k-p), Caires (2017, Figs. 1c-d, 2e-i).

It is distributed in Central America (including Caribbean) and South America - Bolivia, Brazil (all states), Colombia, Ecuador, French Guiana, Guyana, Paraguay, Suriname and Venezuela (Kuijt 2003).

2.12. *Phoradendron dimerostachys* Rizzini, Arq. Jard. Bot. Rio de Janeiro 24: 31. 1980. Type: BRAZIL. BAHIA: Serra da Água de Rega, 24 km N of Seabra on road to Água de Rega, 24.II.1971, H.S. Irwin *et al.* 30967 (holotype: RB - barcode 00540578!; isotypes: CAS, UC(ex-LEA), MG!, NY!, UB!).

Phoradendron dimerostachys is an intriguing species only known for the type specimen, which presents monopodial/percurrent branches; and,

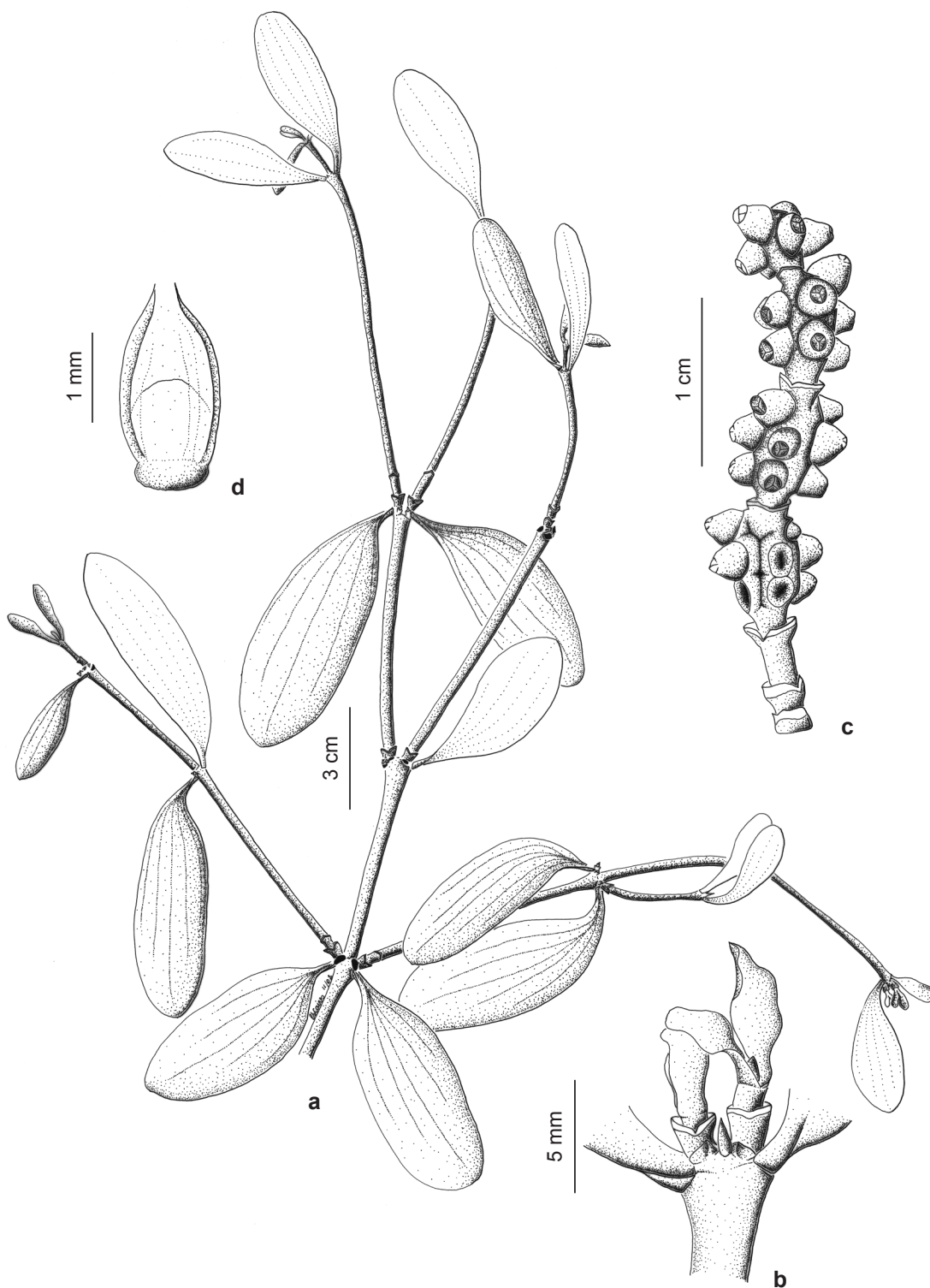


Figure 7 – a-d. *Phoradendron coriaceum* (morphotype of *P. apiciflorum*) – a. habit; b. detail of branch apex with two young shoots, prophylls and cataphylls; c. mature fruits; d. seed enclosed in endocarp. (a-d. Caires & Ramalho 181 (UB)).

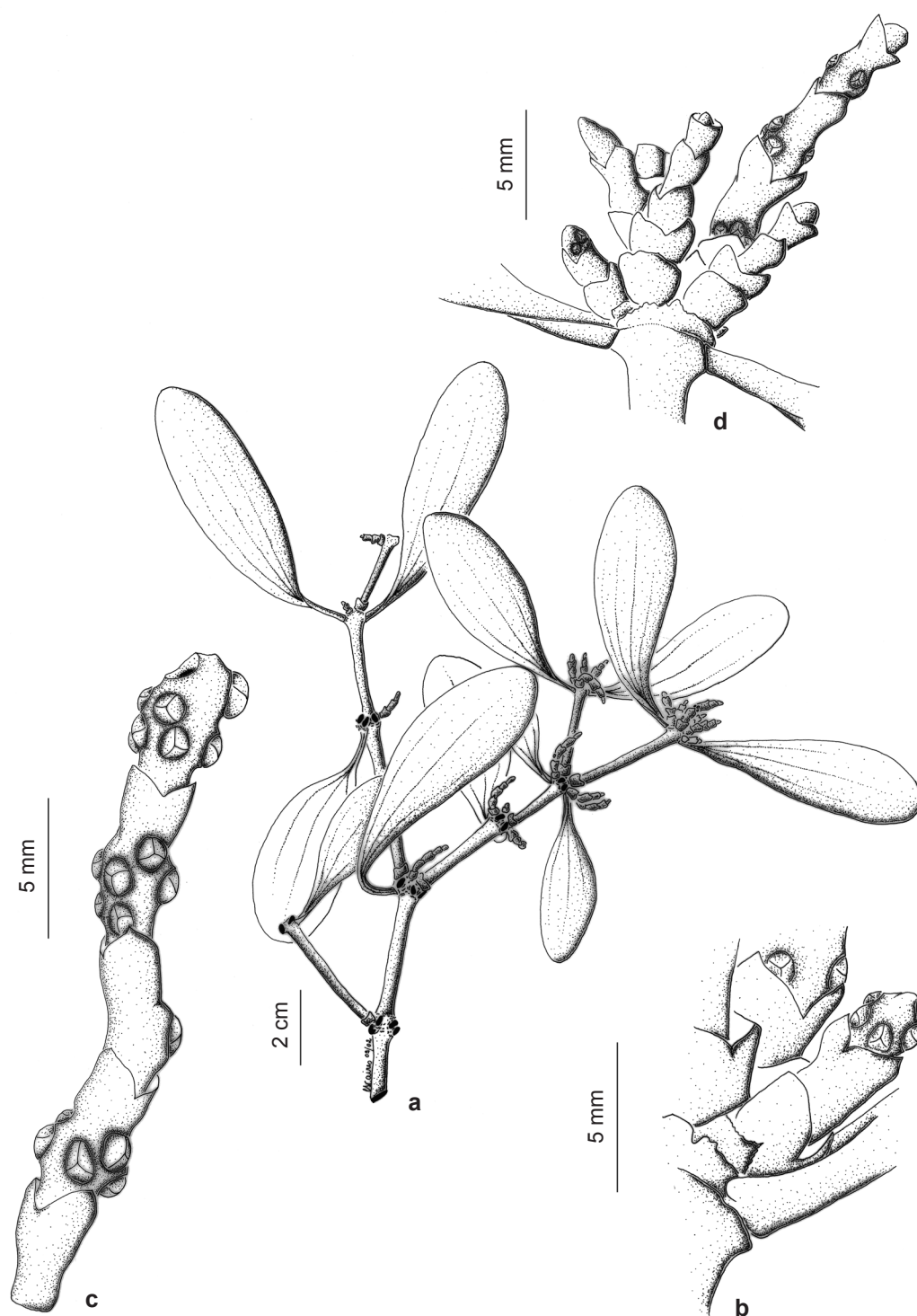


Figure 8 – a-d. *Phoradendron coriaceum* (isotype of *P. irwinianum*) – a. habit; b. detail of lateral inflorescences, with prophylls; c. inflorescence; d. detail of terminal node with inflorescence. (a-d. Irwin *et al.* 9060 (UB)).

generally, elliptical leaves with a rounded apex, and triseriate inflorescences with the single entire, basal fertile internode bearing staminate flowers. This species is very similar to *P. caripense*, which is a dioecious species. However, we have little doubt that, with the appearance of new collections, they will be recognized as synonyms.

Iconography: Rizzini (1980, Figs. 6-2, 7-2), Kuijt (2003, Fig. 89).

It is distributed in South America - Brazil (BA) (Kuijt 2003).

2.13. *Phoradendron diminutivum* E.A. Kellogg, Novon 6: 41, Fig. 5. 1996. Type: VENEZUELA. AMAZONAS: Rio Negro, Rio Pasimoni, between its mouth and its junction with the Rio Baria and the Rio Yatua, on *Vochysia*, 23–25.VII.1984, *G. Davidse* 27772 (holotype: GH; isotypes: UC(ex-LEA), MO).

Phoradendron diminutivum is a curious species where cataphylls may be present, or not, on the main axis. This species has a combination of monopodial/percurrent and sympodial/dichotomous branches, elliptical or obovate leaves, biseriate inflorescences, in axillary and terminal position, and small fruits with erect petals. *Phoradendron diminutivum* somewhat resembles *P. quadrangulare* in the leaf morphology, but possesses circular or elliptical internodes, and *P. quadrangulare* has rhombic or quadrangular internodes, and never presents cataphylls on the main axis. The growth patterns, cataphylls, inflorescences, and fruits resemble *D. warmingii*, and the type specimen (not seen) was collected parasiting *Vochysia* species. In the Brazilian specimens, the leaves are narrower than those of *D. warmingii*, although some are obovate or circular (as seen in *Acevedo-Rodriguez et al.* 8255 (NY!)).

Iconography: Kuijt & Kellogg (1996, Fig. 5), Kuijt (2003, Fig. 90).

It is distributed in South America - Brazil (AM) and Venezuela (Kuijt 2003).

2.14. *Phoradendron dipterum* Eichler in Martius, *Fl. bras.* 5(2): 109. 1868. Type: BRAZIL. CEARÁ: X.1838, *G. Gardner* 1672 (lectotype, designated by Trelease (1916): W, destroyed (= Trelease, 1916: Fig. 89); lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 002441994!; isolectotypes: BM!(2x), GH!, K!(2x), P!). Figs. 2m-o; 9

Phoradendron amplexicaule Eichler in Martius, *Fl. bras.* 5(2): 110. 1868. Type: BRAZIL.

Without locality, 1858, *M. Weddell* s.n. (holotype: not located; lectotype, designated by Trelease (1916): G - barcode 00006176! (= Trelease, 1916, Fig. 94b)).

Phoradendron multifoveolatum Eichler in Martius, *Fl. bras.* 5(2): 110, Fig. 34. 1868. Type: BRAZIL. BAHIA: in caatingas usque Pao d'Espinhas, *C.F.P. Martius* s.n. (lectotype, designated by Trelease, 1916: M! (= Trelease, 1916, Fig. 90)).

Phoradendron crulsii Urb., Bot. Jarb. Syst. 23, Beibl. 57: 11. 1897. Type: BRAZIL. GOIÁS: Près de Jaragua, 22.VII.1895, *A.F.M. Glaziov* 22021 (holotype: B, destroyed (= Trelease, 1916, Fig. 94a); lectotype, *hic designatus*: P - barcode 00756325!; isolectotypes: K!, P!).

Phoradendron glaziovii Urb., Bot. Jahrb. Syst. 23, Beibl. 57: 12. 1897. Type: BRAZIL. RIO DE JANEIRO: Tijuca, 27.II.1870, *A.F.M. Glaziov* 4004 (holotype: B, destroyed (= Trelease, 1916, Fig. 96a); lectotype, *hic designatus*: P - barcode 756324!; isolectotypes: K!, P!(2x)).

Phoradendron anamariae Rizzini ex Kuijt, Syst. Bot. Monogr. 66: 78, Fig. 23. 2003. *Phoradendron anamariae* Rizzini, Rev. Brasil. Biol. 51: 459. 1991, *nom. nud.* [without holotype cited]. Type: BRAZIL. GOIÁS: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros, near Cachoeira de Rio Preto, 6.II.1987, *J.R. Pirani et al.* 1701 (holotype: UC(ex-LEA)!; isotypes: K, RB!, SPF!), *syn. nov.*

Phoradendron dipterum is an epiparasite of other species of *Phoradendron*, although it can also parasitize (rarely) other species of angiosperms. It is easily recognized by its winged stem, with two or four distinct wings, absence of cataphylls in the main internodes, and triseriate clavate inflorescences with staminate flowers on the first to third positions on the fertile bract. Kuijt (2003) described *P. anamariae* based on a single collection, and admitted that it can be a “depauperate form of the hyperparasitic *P. dipterum*”. We agree with that, and consider them as the same species. *Phoradendron dipterum* presents great morphological variation among the populations in Brazil, with variation in the size of the plant, number of flowers and color of the mature fruits. In *P. dipterum*, the staminate apical flowers are the first to open and soon fall off, and, for this, they are often missing from herbarium specimens. This may have led Kuijt (2003) to interpret *P. anamariae* as a possibly dioecious species.

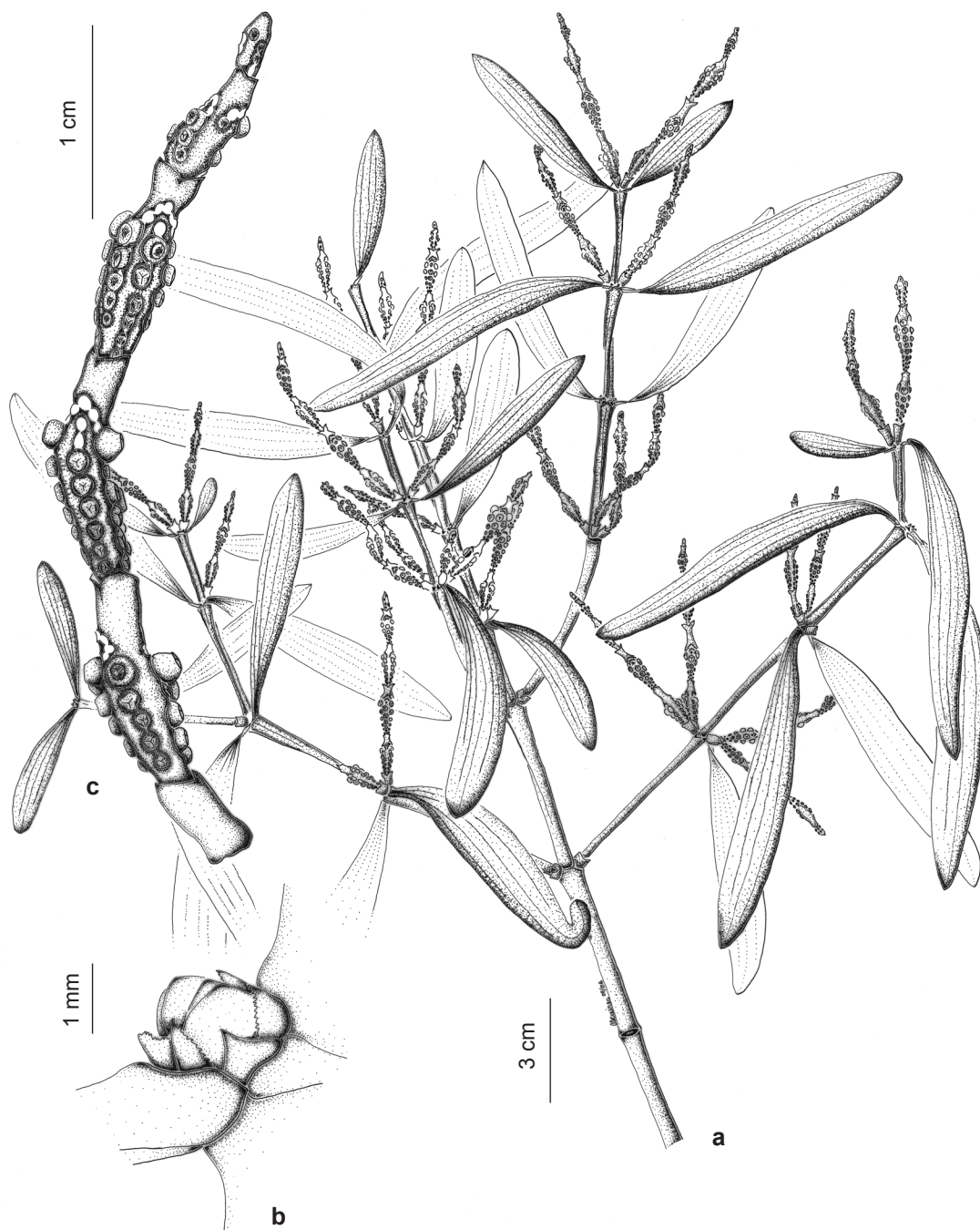


Figure 9 – a-c. *Phoradendron dipterum* – a. habit; b. detail of node with prophylls; c. inflorescence. (a-c. Caires & Mendes 92 (UB)).

The lectotype designated by Trelease (1916) for *P. dipterum* was destroyed during the second World War, and Kuijt (1994) designated a new lectotype from P herbarium. Two sheets were located at P, one of which we now select a second step of lectotypification, according to the Code (Turland *et al.* 2018, Art. 9.17).

For *P. amplexicaule*, Kuijt (2003) indicated as isotypes the herbarium sheets at P and G herbaria. Trelease (1916) only indicated the specimen at G as type, which presents the amplexus base of the leaves, as described in the protologue (“*basiscordata sessilibus amplexicaulibus*”, Eichler 1868: 110), collected in 1858. The specimen at P (Brazil, Minas Gerais, XI.1843, *M. Weddell 1127a*) does not correspond to original material, because the different collection date and the leaves are distinctly petiolate.

For *P. crulsii* and *P. glaziovii*, the Urban’s holotype from B herbarium was also destroyed during the second World War and for this reason, we here designate the lectotypes for these two names.

Material selected for illustration (Fig. 9): Brazlândia, DF-180 road to S.D.V.S.A. Farm 098-02, on *Phoradendron mucronatum* (DC.) Krug & Urb., 26.III.2002, C.S. Caires & V.C. Mendes 92 (UB).

Iconography: Eichler (1868, Fig. 34), Rizzini (1956, Fig. 16-2), Rizzini (1995, Fig. 18), Kuijt (2003, Fig. 91), Caires & Proença (2005, Figs. 2i-j), Dettke & Waechter (2013, Figs. 88-95), Rigon & Cervi (2013, Figs. 4f-h), Dettke & Waechter (2014, Figs. 4a-d), Caires (2017, Figs. 2j-l).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Argentina, Brazil (BA, CE, DF, ES, GO, MG, MT, PA, PE, PR, RJ, RS, SC, SP, TO), Colombia, Ecuador, Paraguay, Peru, Suriname and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.15. *Phoradendron ensifolium* (Pohl ex DC.) Eichler in Martius, *Fl. bras.* 5(2): 114, Fig. 35-2. 1868. *Viscum ensifolium* Pohl ex DC., Prodr. 4: 281. 1830. Type: BRAZIL. MINAS GERAIS: Barbacena, *J.E. Pohl 106* (holotype: G-DC! = Trelease, 1916, Fig. 182a).

Phoradendron interruptum (DC.) B.D. Jacks., Ind. Kew. 2: 502. 1895. *Viscum interruptum* DC., Prodr. 4: 282. 1830. *Phoradendron lanceolato-ellipticum* Eichler in Martius, *Fl. bras.* 5(2): 114, pl. 35, Fig. 1. 1868, *nom. superfl.* Type:

BRAZIL. GOIÁS: Padre Luiz Faria, *J.E. Pohl s.n.* (holotype: G-DC! = Trelease, 1916: Fig. 89a); isotypes: BR!, ILL!, M!, W, destroyed (= Trelease, 1916, Fig. 89b)).

Phoradendron nitidum (Gardner) Eichler in Martius, *Fl. bras.* 5(2): 113. 1868. *Viscum nitidum* Gardner in Hooker, London J. Bot. 4: 105. 1845. Type: BRAZIL. RIO DE JANEIRO: Organ Mountains, II.1837, *G. Gardner 436* (holotype: BM - barcode 0049232!; isotypes: K!(2x), P, W! (= Trelease 1916: Fig. 123a)), *syn. nov.*

Phoradendron habrostachyum Eichler in Martius, *Fl. bras.* 5(2): 111. 1868. Type: BRAZIL. MINAS GERAIS: in silvis usque Ouro Preto, *C.F.P. Martius s.n.* (holotype: M - barcode 0174061! (= Trelease 1916: Fig. 109)), *syn. nov.*

Phoradendron linearifolium Eichler in Martius, *Fl. bras.* 5(2): 115, Fig. 36. 1868. Type: BRAZIL. RIO DE JANEIRO: near to Rio de Janeiro, *L. Riedel s.n.* (lectotype, designated by Trelease (1916): G (= Trelease, 1916, Fig. 181a); isolectotypes: K!(2x), P, US!).

Phoradendron selloi Eichler in Martius, *Fl. bras.* 5(2): 116. 1868. Type: BRAZIL. “Brasiliae austro-orientalis”, *F. Sello 122* (holotype: B, destroyed (= Trelease, 1916, Fig. 123b)). BRAZIL. RIO DE JANEIRO: *A.F.M. Glaziou 4013* (neotype, designated by Kuijt (2003): K - barcode 00568331!; isoneotypes: P!(3x)).

Phoradendron falcifrons (Hook. & Arn.) Eichler in Martius, *Fl. bras.* 5(2): 134m. 1868. *Viscum falcifrons* Hook. & Arn., Bot. Misc. 3: 356. 1833. Type: URUGUAY. On laurels, *J. Tweedie s.n.* (holotype: K - barcode 00601433! (= Trelease 1916: Fig. 85); isotype: E!).

Phoradendron holoxanthum var. *corallispicum* Trel., *Phoradendron* 90, Fig. 122b. 1916. Type: BRAZIL. RIO DE JANEIRO: *A.F.M. Glaziou 8729* (holotype: G - barcode 00301897! (= Trelease, 1916, Fig. 122b); isotypes: K!, P!(2x)), *syn. nov.* Fig. 2p

Phoradendron ensifolium is a dioecious species, easily recognized by the pending branches with monopodial/percurrent growth pattern, eventually with dichotomies, cataphylls only on the proximal lateral internodes, elongated, oblong, linear or falcate leaves, and triseriate, staminate and pistillate inflorescences. Some morphotypes of *Phoradendron ensifolium*, with smaller and wider leaves, can be confused with *P. perrottetii*; however, they can be differentiated by pending branches (generally erect in *P. perrottetii*) often with more cataphylls on the

lateral proximal branches (2–5 vs. 1–2), and pistillate inflorescences with less flowers per fertile bract (4–10 vs. 12–18). (see comments under *P. holoxanthum*).

Dettke & Waechter (2014) expanded the circumscription of the species, including *P. falcifrons*, *P. interruptum* and *P. linearifolium* under its synonymy. After revising the type specimen of *P. nitidum*, we now additionally included them in *P. ensifolium*, because no sufficient morphological differences were found to sustain it as a separate species. Kuijt (2003) uses the simple peduncle (one pair of sterile bracts) in *P. nitidum* to differentiate it from *P. ensifolium*, which has a composed one. Yet, as we analyze the type specimen, we find variation on the same branch, with one or two pairs of sterile bracts, as already described by Trelease (1916). Also, Trelease (1916) recognized the similarity between *P. nitidum* and *P. selloi*, which was already considered synonym of *P. falcifrons* by Kuijt (2003), differing only by the number of flowers.

Here, we also consider *P. habrostachyum* as a synonym of *P. ensifolium*. The holotype used by Eichler (1868) in describing this species is very fragmented, but it presents parts of staminate and pistillate individuals, which are possible to assign to the inflorescence and leaf morphology of *P. ensifolium*. The stems are short, and with distinctly dilated nodes, similarly to the stems seen in the *P. nitidum* and *P. selloi* morphotypes. Kuijt (2003) and Dettke & Waechter (2014) cited as *P. habrostachyum*, the collection of pistillate individuals *Y. Mexia 5463* (F!, US!), with longer internodes and white fruits, which clearly corresponds to *P. ensifolium*. However, collections of pistillate individuals from Paraguay (Dettke & Waechter 2014) and Brazil - Rio Grande do Sul State (Kuijt 2003; Dettke & Waechter 2014), do not correspond to the type of *P. habrostachyum*, remaining with an uncertain placement.

Kuijt (2003) considered *P. holoxanthum* var. *corallispicum* as an uncertainly placed taxon, and we agree, that, indeed, it is not *P. holoxanthum*. The analysis of more duplicates than those available for Kuijt (2003) exposed similarities of the stems, leaves and inflorescences in the type specimen of this taxon, with fruiting individuals of *P. nitidum* and *P. selloi* (*Sello 122* = Trelease, 1916, Fig. 123b). Hence, we consider it as a new synonym of *P. ensifolium*.

Iconography: Eichler (1868, Figs. 35, 36), Rizzini (1956, Fig. 12), Rizzini (1968b, Fig. 8),

Kuijt (2003, Figs. 97, 103, 163), Caires & Proença (2005, Fig. 2k), Dettke & Waechter (2013, Figs. 96–103), Rigon & Cervi (2013, Figs. 5a–g), Dettke & Waechter (2014, Figs. 4e–k).

It is distributed in South America - Argentina, Bolivia, Brazil (AL, BA, CE, DF, ES, GO, MG, MS, MT, PA, PB, PE, PR, RJ, RN, RS, SC, SE, SP), Paraguay and Uruguay (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.16. *Phoradendron fragile* Urb., Bot. Jahrb. Syst. 23, Beibl. 57: 13. 1897. Type: BRAZIL. RIO DE JANEIRO: near Rio de Janeiro, XI.1879, *A.F.M. Glaziou 10898* (lectotype, designated by Trelease, 1916: B, destroyed (= Trelease, 1916, Fig. 210a); lectotype, *hic designatus*: K - barcode 00601385!; isolectotypes: P!(2x)). Figs. 3a; 10

Phoradendron fragile is one of the small aphyllous species of *Phoradendron* in Brazil. This species is distinct from the others by its erect branches and short terete stems (0.8–3.5 cm long); also, they are dioecious plants with triseriate inflorescences (4–10 flowers per fertile bract) and orange and reddish fruits.

Since the lectotype selected by Trelease (1916) was destroyed during the second World War, we have selected a new one from K herbarium.

Material selected for illustration (Fig. 10): Brasília, Catetinho, I.1982, *B.A.S. Pereira 162* (IBGE); Estação Florestal Cabeça de Veado, XII.1980, *E.P. Heringer et al. 5861* (IBGE); Várzea Bonita, II.1978, *E.P. Heringer 16832* (IBGE).

Iconography: Rizzini (1956, Fig. 25), Rizzini (1980, Fig. 8), Kuijt (2003, Fig. 114), Caires & Proença (2005, Fig. 1d).

It is distributed in South America - Brazil (DF, GO, MG, RJ, SP) (Kuijt 2003; Dettke & Caires 2020).

2.17. *Phoradendron harleyi* Kuijt, Syst. Bot. Monogr. 66: 224, Fig. 125. 2003. Type: BRAZIL. BAHIA: Rio de Contas, Pico das Almas, SE of Campo do Queiroz, 13°32'S, 41°57'W, on Rubiaceae, 24.XII.1988, *R.M. Harley et al. 27359* (holotype: SP - barcode 001695!; isotypes: CEPEC!, K!, NY!, SPF!, UC(ex-LEA)).

Phoradendron harleyi can be recognized by the combination of monopodial/percurrent and sympodial/dichotomous branches, presence of one pair of fertile cataphylls in all internodes, elliptical leaves and biseriate inflorescences with 3–5 flowers per fertile bract. This species is very close to *P. craspedophyllum*, which has a predominantly

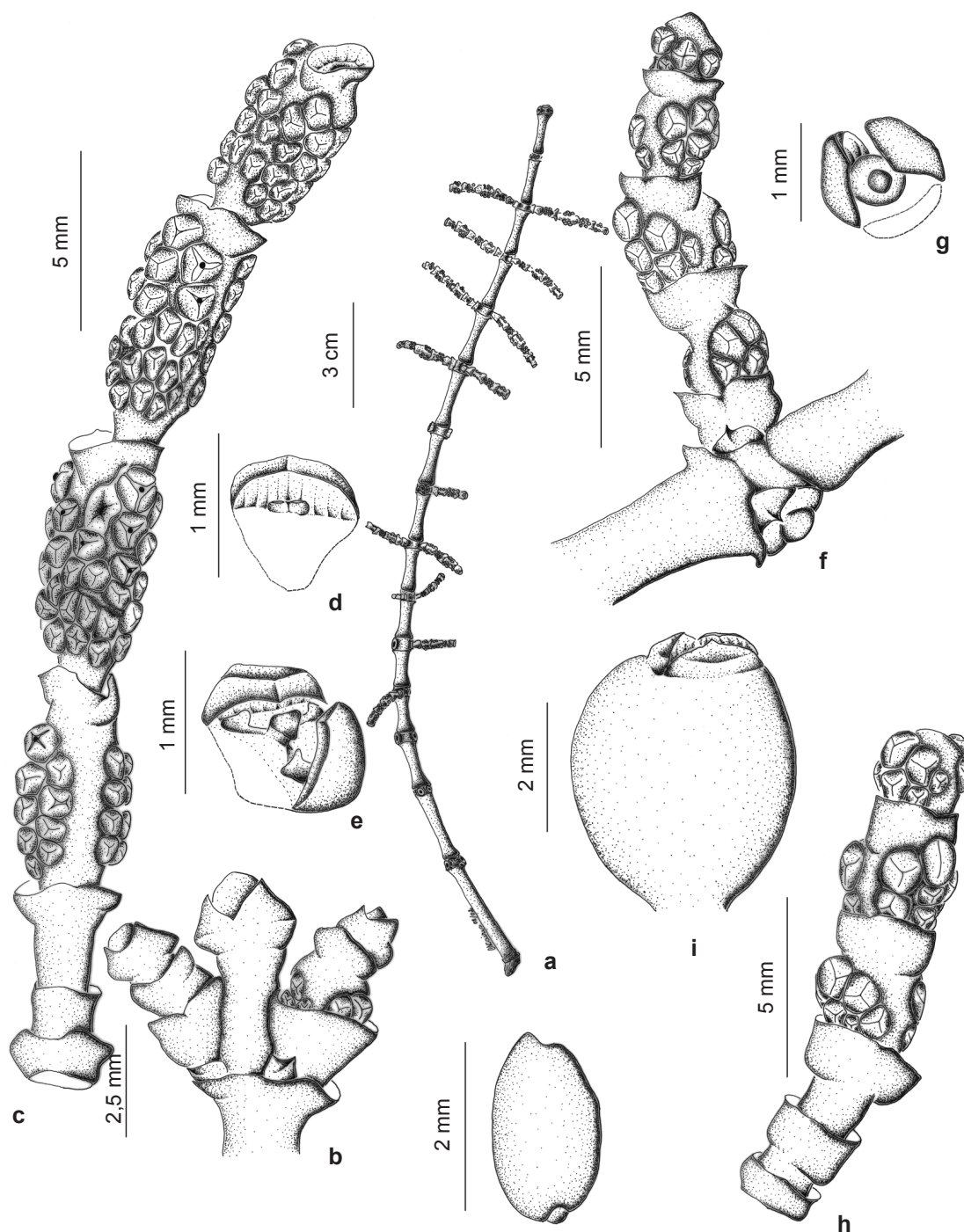


Figure 10 – a-j. *Phoradendron fragile* – a. habit; b. detail of apical branches, with prophylls, two axillary young inflorescence and squamiform leaves; c. staminate inflorescence; d. petal with anther; e. vestigial stigma on staminate flower; f. detail of node with pistillate inflorescence; g. pistillate flower; h. pistillate inflorescence with compound peduncle; i. fruit; j. seed. (a. *Pereira 162* (IBGE); b,f,j. *Heringer et al. 5861* (IBGE); c-e. *Heringer 16832* (IBGE)).

southern distribution, is a smaller plant, with more dichotomies in the stems and persistently only three flowers per fertile bract. Perhaps future evidence will demonstrate they are the same species.

Iconography: Kuijt (2003, Fig. 125).

It is distributed in South America - Brazil (BA) (Kuijt 2003).

2.18. *Phoradendron hexastichum* (DC.) Griseb., Fl. Brit. W. I. 313. 1860. *Viscum hexastichum* DC., Prodr. 4: 282. 1830. Type: CUBA. LA HABANA: Havana, 1825, *A. de la Ossa s.n.* (holotype: G-DC! (= Trelease, 1916, Fig. 200a).

Phoradendron hexastichum var. *longispicum* Eichler in Martius, Fl. bras. 5(2): 129. 1868. TYPE: BRAZIL. AMAZONAS: prope San Gabriel da Cachoeira, usque Rio Negro, R. Spruce 2112 (holotype: M; isotypes: BM!(2x), G! (= Trelease, 1916, Fig. 204b) (3x), GH!, K, NY!, P!(2x), TCD!). *Phoradendron productipes* Trel., Phoradendron 138, Fig. 204a. 1916. Type: BRAZIL. CEARÁ: X.1838, G. Gardner 1676 (holotype: W, destroyed (= Trelease, 1916, Fig. 204a); lectotype, *hic designatus*, K - barcode 0016683!; isolectotypes: BM, GH!, K!, L, NY!, P!(3x)).

Phoradendron brachyklados Rizzini, Ernstia 32: 2. 1985. Type: BRAZIL. DISTRITO FEDERAL: Brasília, 25.X.1979, E.P. Heringer et al. 2600 (holotype: IBGE!; isotypes: RB!). Figs. 3b; 11

Phoradendron hexastichum is characterized by monopodial/percurrent branches, cataphylls only on the proximal lateral branches, leaves with pinnate veins and triseriate inflorescences. This species can be confused with *P. racemosum*, which has dichotomous branches and biseriate inflorescences, or with *P. pteroneuron*, which has shorter leaves and biseriate inflorescences. (See comments at *P. juruanum* and *P. oliveirae*).

Material selected for illustration (Fig. 11): Brasília, Núcleo Rural Tabatinga, DF-250 road to S.D.V.S.A Farm 08, Sete Veredas Farm, on *Richeria grandis* Vahl., 6.VIII.2002, C.S. Caires et al. 189 (UB); APA de Cafuringa, Dois Irmãos Farm, on *Richeria grandis* Vahl., 21.VIII.2002, C.S. Caires et al. 209 (UB). Guará, EPTG road between Guará e Taguatinga, margin to Vicente Pires stream (near the bridge), on *Calophyllum brasiliense* Camb., 19.III.2002, C.S. Caires et al. 65 (UB).

Iconography: Eichler (1868, Fig. 43-1), Rizzini (1956, Fig. 29-2), Rizzini (1982, Fig. 64), Kuijt (2003, Fig. 133), Caires & Proença (2005, Figs. 1e-g), Kuijt (2005, Fig. 402), Dettke & Waechter (2013, Figs. 104-107), Dettke & Waechter (2014, Figs. 5e-h).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Bolivia, Brazil (AM, BA, CE, DF, GO, MG, RR, RS, SC, SP, TO), Colombia, Ecuador, Guyana, Peru and Venezuela (Kuijt 2003; Dettke & Waechter 2014).

2.19. *Phoradendron holoxanthum* Eichler in Martius, Fl. bras. 5(2): 116. 1868. Type: BRAZIL. “Brasiliae austro-orientalis,” F. Sello 5847 (lectotype, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 122a); lectotype, *hic designatus*: P - barcode 05010576!). Fig. 3c

Phoradendron holoxanthum is recognized by its erect habit, with a combination of monopodial, percurrent, and sympodial, dichotomous, growth patterns, cataphylls only on the proximal lateral internodes, obovate leaves and triseriate inflorescences in axillary and terminal positions. This is a dioecious species that may be confused with *P. ensifolium*, which has a pendulous habit, and longer and falcate leaves.

A duplicate of the F. Sello collection was found in P herbarium and, is, therefore, here designated as lectotype for *P. holoxanthum*, rendering the neotypification of Kuijt (2003) superfluous.

Iconography: Kuijt (2003, Fig. 137), Dettke & Waechter (2013, Figs. 108-113); Dettke & Waechter (2014, Figs. 5i-o).

It is distributed in South America - Brazil (RS) (Dettke & Waechter 2014).

2.20. *Phoradendron inaequidentatum* Rusby, Bull. Torrey Bot. Club 27: 137. 1900. *Dendrophthora inaequidentata* (Rusby) Trel., Phoradendron 218. 1916. Type: BOLIVIA. LA PAZ: Guanai, V.1886, H.H. Rusby 1544 (lectotype, *hic designatus*: NY - barcode 00285343!; isolectotypes: F!, GH!, NY!(2x), PH!, US!).

Phoradendron prancei Rizzini, Rev. Fac. Agron. Maracay 8(3): 89. 1975. TYPE: BRAZIL. AMAZONAS: km 10 between Manaus and Caracarai, near Igarape Leão, on Moraceae, 19.X.1966, C.K. Allen et al. 2713 (holotype: RB (two sheets - barcodes 00540608! and 00545660!); isotypes: K, MO!, NY!, R, U, US!).

This species is easily recognized by the presence of one pair of fertile cataphylls, leaves with palmate veins, the presence of axillary and terminal inflorescences, uniseriate (except for the biseriate basal segment) and by large fruits

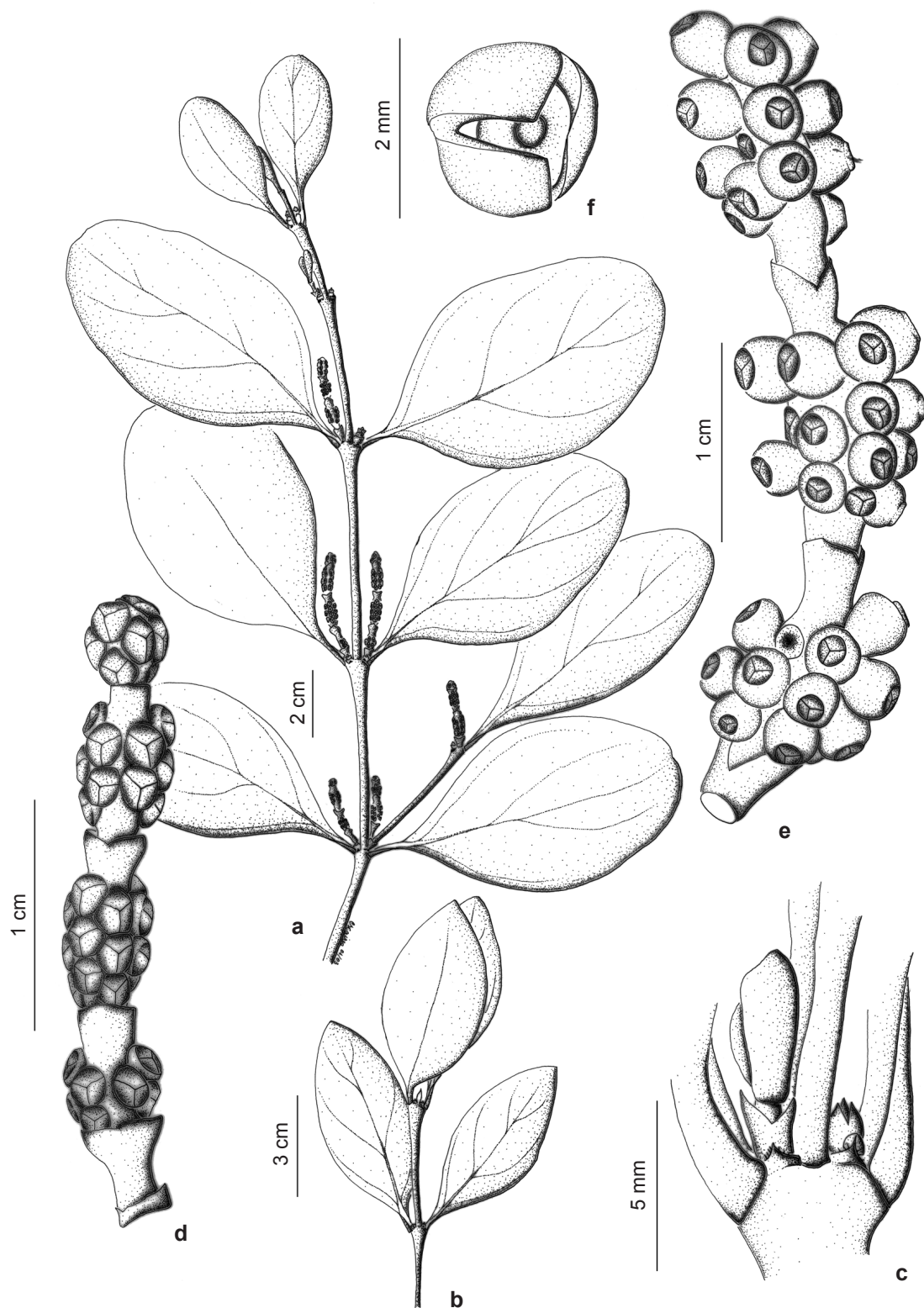


Figure 11 – a-f. *Phoradendron hexastichum* – a. habit; b. branches with lanceolate leaves; c. detail of node with lateral shoots, prophylls and cataphylls; d. pistillate inflorescence; e. mature fruits; f. pistillate flower. (a,d,f. Caires et al. 65 (UB); b-c. Caires et al. 189 (UB); e. Caires et al. 209 (UB)).

with opening petals. It can be confused with *P. crassifolium*, which presents more than two pairs of fertile cataphylls, biseriate inflorescences and smaller fruits, and also with *Dendrophthora warmingii*, which doesn't have fertile cataphylls and presents bi-triseriate inflorescences. (See comments under *P. nothropiae*).

In what concerns *P. inaequidentatum*, the type collection has three syntypes at NY herbarium and one of which we have selected as a lectotype (Turland *et al.* 2018, Art. 9.11).

Iconography: Kuijt (2003, Fig. 139), Kuijt (2005, Fig. 412), Dettke & Waechter (2014, Figs. 6a-d).

It is distributed in Central America - Panama, and South America - Bolivia, Brazil (AC, AM, AP, BA, MT, PA, RO, RS), Colombia, Ecuador, French Guiana, Guyana, Peru and Venezuela (Kuijt 2003; Dettke & Waechter 2014).

2.21. *Phoradendron juruanum* Kuijt, Syst. Bot. Monogr. 66: 251, Fig. 145. 2003. Type: BRAZIL. AMAZONAS: Basin of Rio Jurua, Manariao, *B.A. Krukoff* 4592 (holotype: MICH; isotypes: F!, GH!, K!, LP!, MICH, MO!, NY!, S!, U!, UC!, US!).

Phoradendron juruanum is characterized by monopodial/percurrent branches, with cataphylls in all internodes, leaves with pinnate veins and triseriate clavate inflorescences. It is similar to *P. hexastichum* in the morphology of leaves and inflorescence, but differs in the presence of cataphylls in all internodes, absent in the main branches of *P. hexastichum*. Also, it looks like *P. piperoides* in growth pattern and leaf morphology, differing in the inflorescence arrangement: triseriate in *P. juruanum*, and biseriate in *P. piperoides*. (See comments under *P. oliveirae*).

Iconography: Kuijt (2003, Fig. 145).

It is distributed in South America - Brazil (AM) and Venezuela (Kuijt 2003).

2.22. *Phoradendron krukovii* Kuijt, Syst. Bot. Monogr. 66: 256, Fig. 150. 2003. Type: BRAZIL. AMAZONAS: basin of Madeira River, Humaita, near Tres Casas, IX-X.1934, *B.A. Krukoff* 6514 (holotype: BM - barcode 0049240!; isotypes: A!, GH!, IAN!, K!, MICH!, MO!, NY!, S! U, US!).

This species is distinct from the other species of *Phoradendron* for the predominance of sympodial/dichotomous branches, cataphylls present in all internodes, leaves with palmate veins and acuminate apex, and biseriate inflorescences with 3–4 flowers per fertile bract. However,

Phoradendron krukovii bears an older stem with whitish appearance, and longitudinal and elongated fissures, which is unique in the genus. *Phoradendron krukovii* resembles *P. berterianum* and *P. burkartii*, which do not have a fissured stem, and have acute or rounded leaves, in contrast with the acuminate apex in *P. krukovii*.

Iconography: Kuijt (2003, Fig. 150).

It is distributed in South America - Brazil (AM) (Kuijt 2003).

2.23. *Phoradendron laxiflorum* Ule, Verh. Bot. Vereins Prov. Brandenburg 48: 158. 1906. Type: BRAZIL. AMAZONAS: Juruá River, Santa Clara, Oct 1900, *E.H.G. Ule* 5251 (holotype: B, destroyed (= Trelease, 1916, Fig. 236); lectotype, *hic designatus*: MG - barcode 005223!; isoelectotypes: CORD!, K!, L).

Phoradendron laxiflorum is easily recognized by its monopodial/percurrent branches, cataphylls in all internodes, leaves with acuminate apex, and three conspicuous palmate veins, uniseriate pistillate inflorescences and triseriate staminate inflorescences. This species closely resembles *P. piperoides*, except for the leaves with pinnate veins and biseriate inflorescence in *P. piperoides*. *Phoradendron laxiflorum* may also be confused with *P. chrysocladon* which is a monoecious species, with clavate triseriate inflorescence.

As Urban's holotype at B was destroyed, we now designate the MG sheet as a lectotype.

Iconography: Rizzini (1956, Fig. 17-5), Kuijt (2003, Figs. 156-157).

It is distributed in South America - Bolivia, Brazil (AM), Colombia, Ecuador and Peru (Kuijt 2003).

2.24. *Phoradendron macrarthrum* Eichler in Martius, *Fl. bras.* 5(2): 107, 124, Fig. 43-3. 1868. Type: BRAZIL. GOIÁS: Conceição, *G. Gardner* 3765 (lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 756307!; isoelectotypes: BM, G (= Trelease, 1916, Fig. 184a), K, P!, W destroyed (= Trelease, 1916, Fig. 194b)).

Phoradendron harmsianum Ule, Notizbl. Bot. Gart. Berlin-Dahlem 6: 290. 1915. Type: BRAZIL. AMAZONAS: gallery forest near São Marcos on Rio Branco, I.1909, *E.H.G. Ule* 7889 (holotype: B, destroyed (= F Neg 18188); lectotype, *hic designatus*: K - barcode 00601401!; isoelectotypes: IAN, L, MO), *syn. nov.*

Phoradendron macrarthrum can be distinguished by the combination of the monopodial/percurrent and sympodial/dichotomous growth patterns, cataphylls only on the proximal lateral branches, distal portion of young stems keeled and flattened, obovate to linear-lanceolate leaves with rounded apex, and biseriate inflorescences with 15–23 flowers per fertile bract.

This species may be confused with *P. bathyoryctum*, which has less than 15 flowers per fertile bract; or with *P. perrottetii*, which bears triseriate inflorescence. Kuijt (2003) correctly called for further studies in the species delimitation, as its distribution is probably wider than presented here. After analyzing the type, we here include *P. harmsianum* as a new synonym of *P. macrarthrum*, as we have observed that it is morphologically closer to this species than to *P. perrottetii*, as Kuijt had suggested (2003).

Iconography: Eichler (1868, Fig. 43-3), Kuijt (173).

It is distributed in South America - Brazil (AM, GO) (this study; Kuijt 2003).

2.25. *Phoradendron mucronatum* (DC.) Krug & Urb., Bot. Jahrb. Syst. 24: 352. 1897. *Viscum mucronatum* DC., Prodr. 4: 282. 1830. Type: DOMINICAN REPUBLIC. C.L.G. Bertero s.n. (holotype: G-DC).

Phoradendron cearense Eichler in Martius, *Fl. bras.* 5(2): 118. 1868. Type: BRAZIL. CEARÁ: *G. Gardner 1675* (lectotype, designated by Trelease (1916): W, destroyed (= Trelease, 1916, Fig. 176a); lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 00756305!; isolectotypes: BM(2x), G!(4x), ILL, K!(2x), L, NY, P!(2x)).

Phoradendron cearense var. *minor* Eichler in Martius, *Fl. bras.* 5(2): 118. 1868. TYPE: BRAZIL. CEARÁ: *G. Gardner 1669* (lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 005456217!; isolectotypes: BM(2x), G! (= Trelease, 1916, Fig. 175b)(3x); GH, ILL, K, P!(2x), W destroyed (= Trelease, 1916, Fig. 175a).

Phoradendron emarginatum Martius ex Eichler in Martius, *Fl. bras.* 5(2): 118, Fig. 38-1. 1868. *Phoradendron mucronatum* var. *emarginatum* (Martius ex Eichler) Rizzini, Rodriguésia 46: 72. 1978. Type: BRAZIL. MINAS GERAIS: *M. Claussen 252* (lectotype, designated by Trelease (1916): G - barcode 0020029!; isolectotypes: P!, K, S).

Phoradendron emarginatum var. *minor* Eichler in Martius, *Fl. bras.* 5(2): 119. 1868. *Phoradendron minor* (Eichler) Trel., *Phoradendron* 117, Fig. 172a. 1916. Type: BRAZIL. PIAUÍ: “super arbores campestres inter Olho d’Agoa et Alegre, praedia,” C.F.P. Martius s.n. (holotype: B, destroyed; lectotype, designated by Trelease (1916): M (= Trelease, 1916, Fig. 172a).

Phoradendron tetragonum Ule, Notizbl. Bot. Gart. Berlin-Dahlem 6(59): 290. 1915. Type: BRAZIL. AMAZONAS: near São Marcos, Rio Branco, on Leguminosae, I.1909, E.H.G. Ule 7890 (holotype: B, destroyed (= F Neg 18192); lectotype, *hic designatus*: K - barcode 00601483!; isolectotypes: IAN, MO, L, UC).

Phoradendron macedonis Rizzini, Rodriguésia 30/31: 163, Fig. 29-1. 1956, *in clavi, nomen nudum*. Type: BRAZIL. MINAS GERAIS: Ituiutaba, São Vicente, 26.VI.1949, A. Macedo 1893 (RB).

Phoradendron cuspidatum Rizzini, Rodriguésia 30/31: 182. 1956. Type: BRAZIL. SÃO PAULO: Campinas, Riqueza Farm, J. Egidio, 6.XI.1938, J. Gregorio s.n. (lectotype, *hic designatus*: IAC 002838; isotypes: IAC, IAN!, SP!), *syn. nov.*

Figs. 11; 3d; 12

Phoradendron mucronatum is one of the most common species of mistletoes in the Brazilian flora. This species is recognized for presenting cataphylls only on the proximal lateral internodes, leaves with palmate veins, generally obovate with an acute, emarginate or retuse apex, biseriate inflorescences with three flowers per fertile bract, and an entirely tuberculate pericarp. It may be confused with *P. argentinum*, which has narrower leaves and only the apical, tuberculate, pericarp, or with *P. craspedophyllum*, which has fertile cataphylls. (See comments under *D. elliptica*).

Kuijt (1994) correctly designated lectotypes for *P. cearense* and for *P. cearense* var. *minor* at P herbarium. However, we have found duplicates of these two collections in this herbarium. Hence, we here carry out a second-step lectotypification, selecting one of the duplicates for each name, in accordance with Art. 9.17 of the Code (Turland *et al.* 2018). For *P. tetragonum*, which holotype at B was destroyed in the second World War, we here designate a lectotype.

The name *Phoradendron macedonis* is cited only in the identification key and illustration by Rizzini (1956, Fig. 29-1). Therefore, it is not a validly published name. At RB herbarium, we have located two duplicates, carrying the author’s handwriting and similar to the illustration of *P. mucronatum*.

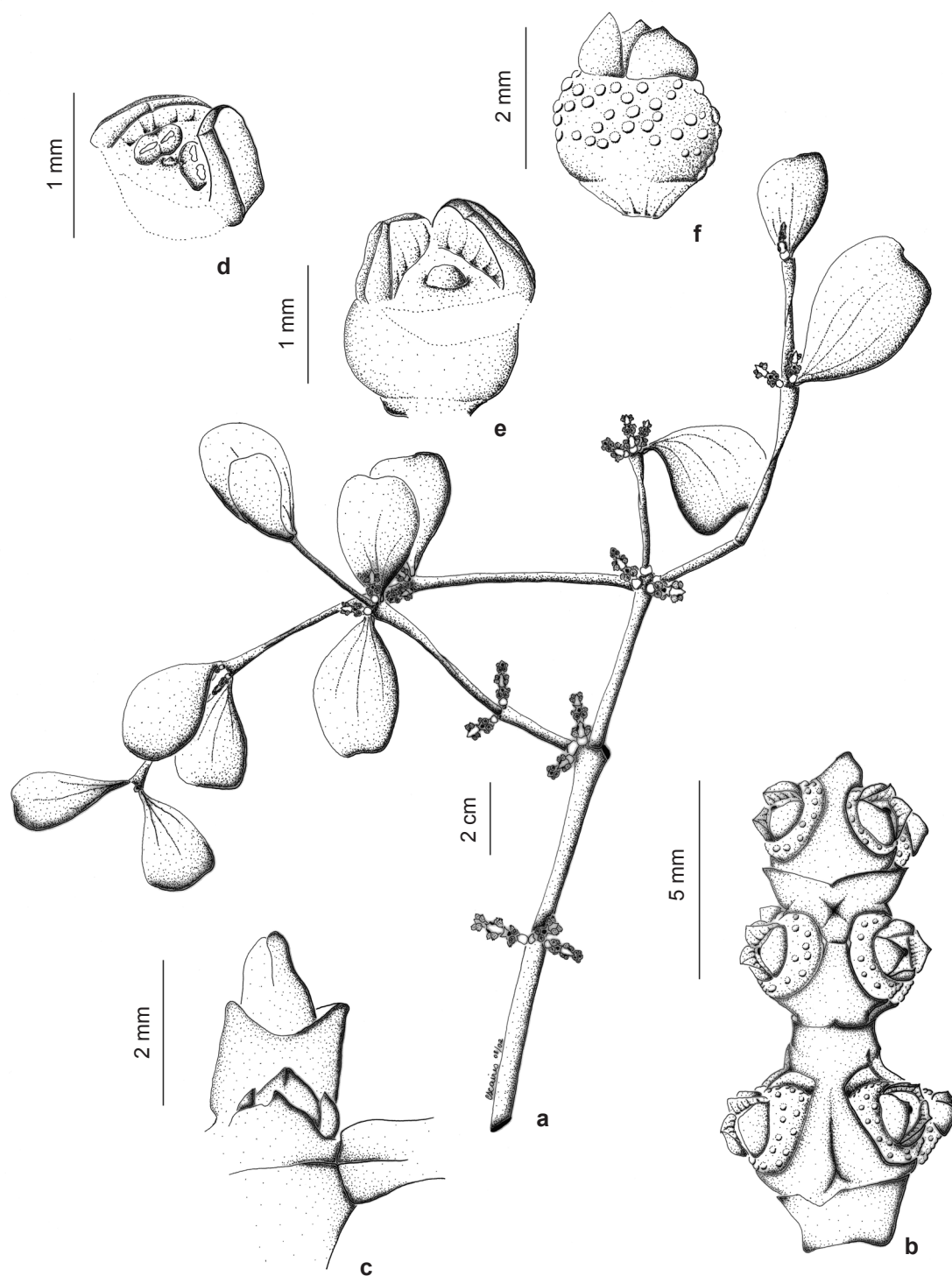


Figure 12 – a-f. *Phoradendron mucronatum* – a. habit; b. immature fruits; c. detail of a node with prophylls and cataphylls; d. staminate flower; e. pistillate flower; f. immature fruit. (a-f. Caires & Mendes 96 (UB)).

Phoradendron cuspidatum was considered a synonym of *P. quadrangulare* by Kuijt (2003). Analyzing the type specimen, we conclude that it represents *P. mucronatum* and, therefore, we propose it as a new synonym. Since two syntypes of Rizzini's name were located at IAC, it was necessary to choose a lectotype.

Material selected for illustration (Fig. 12): Sobradinho, DF-205, inside a property, on *Aspidosperma subincanum* Mart., 2.IV.2002, C.S. Caires & V.C. Mendes 96 (UB).

Iconography: Eichler (1868, Fig. 38-1), Kuijt (2003, Fig. 191), Caires & Proença (2005, Fig. 2e), Dettke & Waechter (2013, Figs. 114-117), Rigon & Cervi (2013, Figs. 6f-j), Dettke & Waechter (2014, Figs. 6e-h), Caires (2017, Figs. 2m-p).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Argentina, Bolivia, Brazil (AM, BA, CE, DF, ES, MA, MG, MS, MT, PA, PB, PE, PR, RJ, SP, TO), Colombia, Guyana, Paraguay and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.26. *Phoradendron nigricans* Rizzini, Rodriguésia 30/31: 187. 1956. Type: BRAZIL. RIO DE JANEIRO: Morro Queimado, 13.V.1945, *P. Occhioni* 212 (holotype: RB (three sheets - barcodes 00540601!, 00545656! and 00545655!); isotype: RFA).

Phoradendron irwinii Rizzini, Arq. Jard. Bot. Rio de Janeiro 24: 33. 1980. Type: BRAZIL. MINAS GERAIS: Serra do Espinhaço, 4 km N of São João da Chapada, 23.III.1970, *H.S. Irwin et al.* 28178 (holotype: RB (two sheets - barcodes 00540587! and 00545648!); isotypes: F, IAN!, NY!, UB!, US!).

Phoradendron nigricans can be recognized by its monopodial/percurrent branches with cataphylls only on the proximal lateral internodes, rhombic and flattened young branches, leaves with palmate veins, elliptical in shape and that *in sicco* are characteristically black, and biseriate inflorescences with three flowers per fertile bracts, all pistillate.

The type collection of *P. nigricans*, *Occhioni* 212, is sometimes misinterpreted as having been collected in Distrito Federal, the state where the capital of Brazil (Brasília) is located today; but this sample was actually collected in the state of Rio de Janeiro, capital of Brazil until 1960. Therefore, the label on the sheet should include the information "Distrito Federal" or "ex-Distrito Federal".

Iconography: Kuijt (2003, Fig. 198).

It is distributed in South America - Brazil (BA, DF, ES, MG, PB, PE, RJ) (Kuijt 2003).

2.27. *Phoradendron northropiae* Urb., Mem. Torrey Bot. Club 12: 33, Fig. 4. 1902. Type: BAHAMAS. ANDROS ISLAND: Conch Sound, *J.I. Northrop & A.R. Northrop* 551 (holotype: B, destroyed (= Trelease, 1916, Fig. 189a); lectotype, designated by Gillis (1976): F! (= F Neg 63689); isolectotypes: GH!, K!, NY!).

Phoradendron excisum Rizzini, Rodriguésia 30/31: 192. 1956. Type: BRAZIL. MARANHÃO: Mongunça Island, VII.1914, *A. Lisboa* 20 (holotype: RB (two sheets - barcodes 00545646! and 00540581!); isotypes: F!, MBM!, MO, NY!).

Phoradendron northropiae is distinguished by the presence of cataphylls on all the internodes, a combination of monopodial/percurrent and sympodial/dichotomous branches, obovate leaves with rounded or retuse apex, and biseriate inflorescences. This species resembles *P. racemosum* and, in fact, Gillies (1976), when studying the Bahamas flora, considered this species a synonym of *P. racemosum*. We agree with Kuijt's (2003) circumscription, which considers these two species as distinct. In *P. racemosum*, the dichotomies are much more frequent and present cataphylls only on the lateral branches. Thus, the leaves are larger than in *P. northropiae*, and generally elliptical with an acute apex. *Phoradendron northropiae* may be confused with *P. inaequidentatum*, which presents fertile cataphylls (vs. absent in *P. northropiae*), generally four pairs of cataphylls on the internodes (vs. one pair), leaves with veins palmate (vs. veins pinnate) and inflorescences entirely biseriate (vs. bi-uniseriate).

Iconography: Urban (1902; Fig. 4), Rizzini (1956, Fig. 10-2), Rizzini (1982, Fig. 66), Kuijt (2003, Fig. 201).

It is distributed in Central America (including Caribbean), and South America - Bolivia, Brazil (GO, MA, MT, PA), Guyana, Peru and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.28. *Phoradendron obtusissimum* (Miq.) Eichler in Martius, *Fl. bras.* 5(2): 134m. 1868. *Viscum obtusissimum* Miq., Linnaea 18: 602. 1844. Type: SURINAME. "Para Superiore," IX.1844, *H.C. Focke* 1019 (holotype: U!; isotype: K!).

Phoradendron acinacifolium Eichler in Martius, *Fl. bras.* 5(2): 117, Fig. 37-1. 1868. Type: BRAZIL.

RIO DE JANEIRO: *M. Gaudichaud* 574 (lectotype, designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 00756338!; isoelectotypes: G!, P!).

Phoradendron craspedophylloides Trel., *Phoradendron* 92, Fig. 124b. 1916. Type: BRAZIL. ESPÍRITO SANTO: Vittoria, *F. Sello s.n.* (holotype: B, destroyed (= Trelease, 1916, Fig. 124b). BRAZIL. PIAUÍ: near Areias, on *Inga*, *G. Gardner* 2622 (neotype, first step designated by Kuijt (2003): K, second step, *hic designatus*: K - barcode 0016719!; isoneotypes: BM, G!, K!, P!, US!).

Phoradendron reductum Trel., *Phoradendron* 93, Fig. 127b. 1916. Type: PARAGUAY: Süd Paraguay, IX.1982, *O. Kuntze* 151 [as *Kuntze* 15 in Trelease, 1916] (lectotype, designated by Trelease (1916): B, destroyed (= Trelease, 1916, Fig. 127b); lectotype, designated by Dettke & Waechter (2014): NY - barcode 00285364!; isoelectotype: US!). Fig. 3e

This species is characterized by a combination of branches with growth pattern monopodial/percurrent and sympodial/dichotomous, cataphylls presents only on the proximal lateral internodes, leaves generally obovate, inflorescences biseriate and a remarkable ellipsoidal fruit. *Phoradendron obtusissimum* is similar to *P. singulare* in growth pattern, leaves and fruit morphology, but the latter is distinct by the presence of fertile cataphylls and uniseriate inflorescences. (See comments under *P. pellucidulum*).

Kuijt (1994) designated a collection at P herbarium as lectotype of *P. acinacifolium*, but we have located two duplicates in this herbarium. Hence, we have selected one of them for a second-step lectotypification (Turland *et al.* 2018, Art. 9.17). The same process was followed for the neotype designated by Kuijt (2003) for of *P. craspedophylloides*, housed at K herbarium, and here we designated a second-step neotypification.

Iconography: Eichler (1868, Fig. 37-1), Eliçabe (1973, Fig. 5), Rizzini (1982, Fig. 52), Kuijt (2003, Fig. 203), Kuijt (2005, Fig. 406), Dettke & Waechter (2013, Figs. 118-123), Rigon & Cervi (2013, Figs. 6c-e), Dettke & Waechter (2014, Figs. 6i-m), Caires (2017, Figs. 3a-e).

It is distributed in Central America and South America - Argentina, Bolivia, Brazil (AC, AL, AM, BA, CE, DF, ES, GO, MA, MG, MS, MT, PA, PB, PE, PI, PR, RJ, RO, RR, SE, SP, TO), Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.29. *Phoradendron oliveirae* Kuijt, Syst. Bot. Monogr. 66: 329, Fig. 206. 2003. Type: BRAZIL. PARÁ: Maracanã, forest of “IDESP” Training Center, 13.XII.1977, *E. Oliveira* 6742 (holotype: RB (two sheets - barcodes 00540603! and 00545658!); isotype: MBM!).

Phoradendron oliveirae is a curious species, known only for its very fragmented type collection. It is very similar to *P. piperoides* as both species present monopodial/percurrent branches, leaves with pinnate veins, similar position and shape of the cataphylls, and biseriate inflorescences. However, *P. oliveirae* differs in the presence of fertile cataphylls, which have never been reported to *P. piperoides*. This species also resembles *P. hexastichum* and *P. juruanum*, which bear triseriate inflorescences (*vs.* biseriate in *P. oliveirae*). We have decided to keep, for the time being, *P. oliveirae* as a distinct species, in the absence of sufficient data to make other decision. The paratype (*M. Silva* 1053 (RB - barcodes 206875 and 206088) clearly does not belong to the same taxon, because it doesn't bear any fertile cataphylls, and presents dichotomous branches; therefore, it is better placed in *P. racemosum*.

Iconography: Kuijt (2003, Fig. 206).

It is distributed in South America - Brazil (PA) (Kuijt 2003).

2.30. *Phoradendron pellucidulum* Eichler in Martius, *Fl. bras.* 5(2): 112. 1868. Type: BRAZIL. AMAZONAS: San Carlos usque Rio Negro, *R. Spruce* 3480 (lectotype, designated by Trelease (1916): W, destroyed (= Trelease, 1916, fig. 121); lectotype, designated by Kuijt (1994): P - barcode 002441991!; isoelectotypes: K!(2x)).

The species is recognized by its erect, monopodial/percurrent branches with cataphylls only on the proximal lateral internodes, short internodes, usually ellipsoidal and flattened on the nodes, leaves with glistening surface, young leaves translucent and inflorescences triseriate. It may be confused with *P. obtusissimum*, which bears biseriate inflorescences, and a remarkable ellipsoidal fruit (*vs.* globose).

Iconography: Dettke & Waechter (2014, Figs. 7a-f), Kuijt (2003, Fig. 217), Kuijt (2005, Fig. 401).

It is distributed in South America - Brazil (AC, AM, AP, BA, DF, MG, MT, PA, PE, RR, SC, SE), Colombia, Guyana, Paraguay, Peru and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.31. *Phoradendron perrottetii* (DC.) Eichler in Martius, *Fl. bras.* 5(2): 112. 1868. *Viscum perrottetii* DC., Prodr. 4: 280. 1830. Type: FRENCH GUIANA. *G.S. Perrottet* 228 (holotype: G-DC - barcode 006223! (= Trelease, 1916, Fig. 119a); isotype: G-DC!).

Phoradendron perrottetii var. *parvifolium* Eichler in Martius, *Fl. bras.* 5(2): 113. 1868. Type: BRAZIL. PIAUÍ: *G. Gardner* 3763 (lectotype, designated by Kuijt (2003): P; isoelectotype: BM!). *Phoradendron perrottetii* var. *curvifolium* Rizzini, Rev. Brasil. Biol. 51: 458. 1991. Type: BRAZIL. MINAS GERAIS: Águas Santas, *A. Castellanos* 25420 (holotype: RB - barcode 001208764! (ex-GUA); isotype: NY!). Figs. 1n; 3f-g; 13

This species is easily recognized by the monopodial/percurrent branches with cataphylls only on the proximal lateral internodes; large, oblong or falcate, leaves; and long triseriate inflorescences. It can be confused with *P. bathoryoctum* and *P. macrarthrum*, but both these species possess biseriate inflorescences. (See comments under *P. congestum* and *P. ensifolium*).

Phoradendron harmsianum was considered a synonym of *P. perrottetii* by Kuijt (2003), but presents biseriate inflorescences, and therefore, it is placed in *P. macrarthrum* in this taxonomic treatment.

Material selected for illustration (Fig. 13): Brasília, Núcleo Bandeirante, margin lagoon, very anthropic, on *Tapirira guianensis* Aubl., 14.III.2002, C.S. Caires & Gonçalves 59 (UB); Planaltina, Córrego Vargem de Trás, near the old Cerâmica Reunidas Dom Bosco, on *Tapirira guianensis* Aubl., 10.VIII.2001, C.S. Caires & V.C. Mendes 5 (UB).

Iconography: Rizzini (1995, Fig. 20), Kuijt (2003, Fig. 221), Kuijt (2005, Fig. 404), Dettke & Waechter (2014, Figs. 7g-k).

It is distributed in South America - Argentina, Bolivia, Brazil (AM, BA, DF, GO, MA, MG, MS, MT, PA, PB, PE, PR, RR, SC, SE, SP, TO), Colombia, French Guiana, Guyana, Peru, Surinam and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.32. *Phoradendron piperoides* (Kunth) Trel., *Phoradendron* 145, Figs. 217-222. 1916. *Loranthus piperoides* Kunth, Nov. gen. sp. 3: 443. 1818. *Viscum piperoides* (Kunth) DC., Prodr. 4: 281. 1830. Type: COLOMBIA. CAUCA: Popayan, 1871, *F.W.H.A. Humboldt* & *A.J.A Bonpland* s.n. (holótipo: P-HBK! (= Trelease, 1916, Fig. 217a).

Phoradendron schottii (Pohl ex DC.) A. Gray, U.S. Explor. Exped. [Bot., Phanerogam.] 15: 742. 1854. *Viscum schottii* Pohl ex DC., Prodr. 4: 281. 1830. Type: BRAZIL. RIO DE JANEIRO: Organ Mountains, 1828, *H.W. Schott* s.n. (holotype: G-DC).

Phoradendron piperoides f. *compositum* Trel., *Phoradendron* 148. 1916, [*composita*]. Type: BRAZIL. RIO DE JANEIRO: Cabo Frio, in restinga, *E.H.G. Ule* 4800 (holotype: B, destroyed). Fig. 3h-i

Phoradendron piperoides is one of the most common Brazilian mistletoes, easily recognized by its monopodial/percurrent branches, sterile cataphylls present in all internodes, veins pinnate and generally elliptical leaves, and biseriate inflorescences. In herbarium collections, it is often confused with *P. crassifolium*, which has fertile cataphylls and leaves with palmate veins. (See comments under *P. chrysocladon*, *P. juruanum*, *P. laxiflorum* and *P. oliveirae*).

Iconography: Eichler (1868, Fig. 41), Rizzini (1956, Fig. 14), Eliçabe (1973, Fig. 8), Kuijt (2003, Fig. 223), Caires & Proença (2005, Fig. 1i), Kuijt (2005, Fig. 407), Dettke & Waechter (2013, Figs. 124-129), Rigon & Cervi (2013, Figs. 6a-b), Dettke & Waechter (2014, Figs. 8a-f), Caires (2017, Figs. 3f-i).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Argentina, Bolivia, Brazil (all states), Colombia, Ecuador, French Guiana, Paraguay, Peru, Surinam and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.33. *Phoradendron platycaulon* Eichler in Martius, *Fl. bras.* 5(2): 108. Fig. 33. 1868. Type: BRAZIL. PARÁ: Santarém, *R. Spruce* 228 (lectotype, designated by Trelease, 1916: M - barcode 00174058! (= Trelease, 1916, Fig. 227b)).

This species is the only one within the genus bearing the expanded leaves, which are characteristic of *Phoradendron*, with flattened stems. Also, *P. platycaulon* has a pair of cataphylls in all the internodes, and biseriate inflorescences with three flowers per fertile bract (where the apical one is staminate). (See comments under *P. tunaeforme*).

Iconography: Eichler (1868, Fig. 33), Kuijt (2003, Fig. 226), Kuijt (2005, Fig. 405).

It is distributed in South America - Bolivia, Brazil (AM, BA, MG, MT, PA, RO, RR), Colombia, Peru and Venezuela (Kuijt 2003).

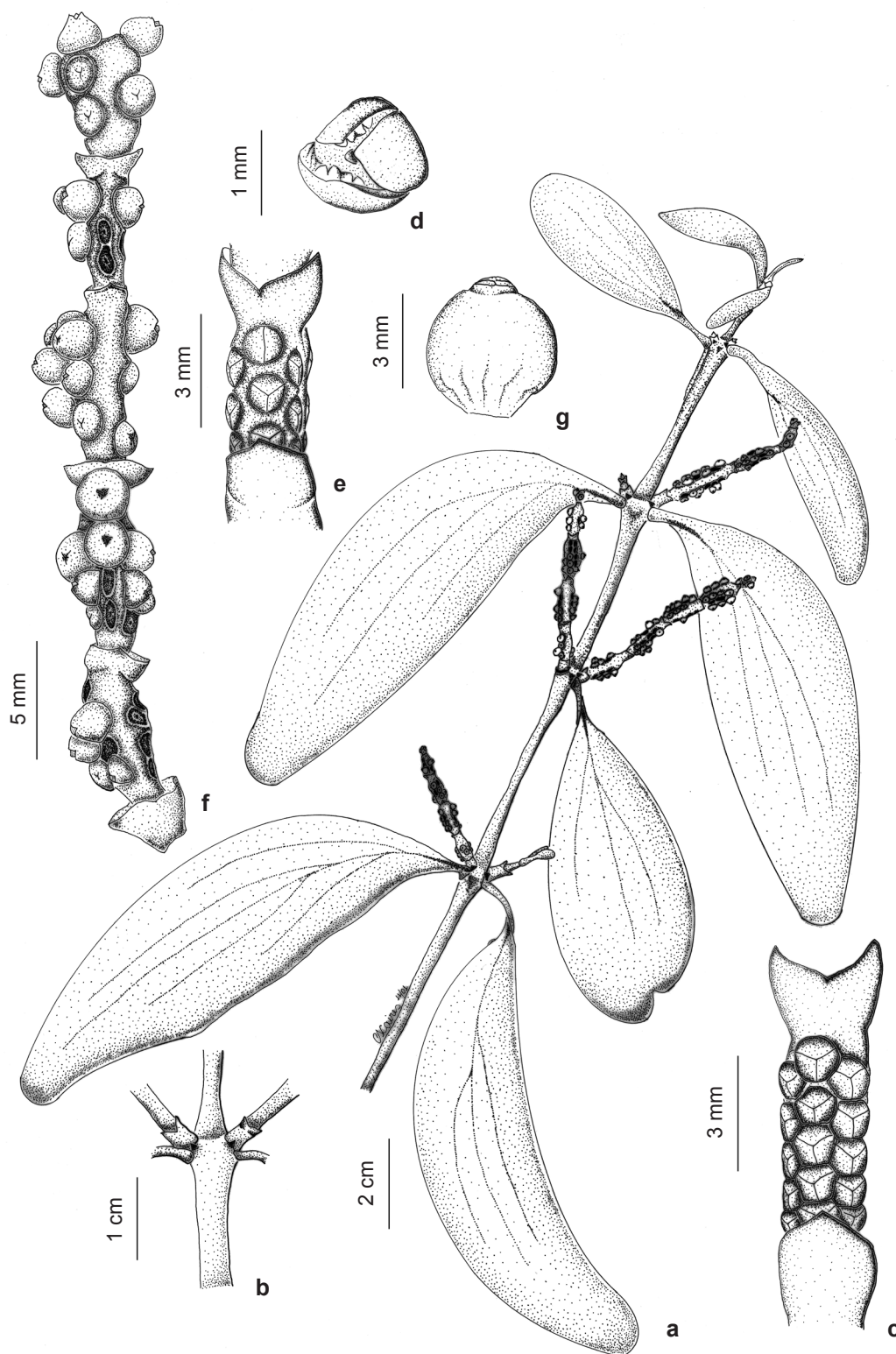


Figure 13 – a-g. *Phoradendron perrottetii* – a. habit; b. detail of a node with lateral shoots, prophylls and cataphylls; c. detail of staminate inflorescence; d. staminate flower; e. detail of pistillate inflorescence; f. mature fruits; g. fruit. (a,b,f,g. *Caires & Mendes* 5 (UB); c-e. *Caires & Gonçalves* 59 (UB)).

2.34. *Phoradendron poeppigii* (Tiegh.) Kuijt, Acta Bot. Neerl. 10: 199. 1961. *Dendrophthora poeppigii* Tiegh., Bull. Soc. Bot. France 43: 182. 1896. Type: BRAZIL. “Brasilia borealis”, *E.F. Poeppig s.n.* (holotype: P - barcode 005339370!).

Phoradendron poeppigii is an aphyllous species of the Amazon rainforest, characterized by terete and pendulous stems with long internodes (usually longer than 4 cm); biseriate inflorescences, with only 3 flowers per fertile bract, and the apical flower staminate.

Iconography: Kuijt (2003, Fig. 227).

It is distributed in South America - Brazil (AM, PA) and Guyana (Kuijt 2003).

2.35. *Phoradendron pteroneuron* Eichler in Martius, *Fl. bras.* 5(2): 127. 1868. Type: BRAZIL. RIO DE JANEIRO: “crescit circa Rio de Janeiro”, *A.F.M. Glaziou 1462* (lectotype, first step designated by Kuijt (1994): BR, second step, *hic designatus*: BR - barcode 0000005629589!; isolectotypes: BR!(2x), P!(2x)).

Phoradendron rugulosum Urb., Bot. Jahrb. Syst. 23, Beih., 57: 13. 1897. *Phoradendron warmingii* var. *rugulosum* (Urb.) Rizzini, Rev. Brasil. Biol. 51: 459. 1991. Type: BRAZIL. RIO DE JANEIRO: “Aux Orgues”, Organ Mountains, *A.F.M. Glaziou 4012* (holotype: B, destroyed; lectotype, designated by Trelease (1916): C - barcode 10014049! (= Trelease, 1916, Fig. 198b); isolectotypes: C!, K!, P!(2x)). Fig. 3j

Phoradendron pteroneuron can be recognized by the monopodial/percurrent growth pattern, with cataphylls only on the proximal lateral branches, leaves with pinnate veins and a conspicuous central vein, and biseriate inflorescences. This species may be confused with *D. warmingii*, *P. northropiae* and *P. racemosum*. It differs from *D. warmingii* by presenting four, or more, pairs of sterile bracts in the inflorescences (vs. one, or two, in *D. warmingii*) and by the closed petals in the fruit (vs. opened). It differs from *P. northropiae* and *P. racemosum*, by the rarity of dichotomous branches (vs. frequent dichotomies in *P. northropiae* and *P. racemosum*). It also differs from *P. northropiae* by the presence of cataphylls only on proximal lateral internodes (vs. presents in all internodes in *P. northropiae*).

Kuijt (1994) designated the collection from BR herbarium as lectotype of *P. pteroneuron*. However, we have located three duplicates at BR, one of which we select for a second-step lectotypification, according to the Code (Turland *et al.* 2018, Art. 9.17).

Iconography: Rizzini (1956, Fig. 16-1), Kuijt (2003, Fig. 231).

It is distributed in South America - Bolivia, Brazil (AM, AL, AP, BA, CE, ES, MG, MS, MT, PA, PE, RJ, SP), Colombia, Surinam and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.36. *Phoradendron quadrangulare* (Kunth) Griseb., Fl. Brit. W. I. 711. 1864. *Loranthus quadrangularis* Kunth, Nov. Gen. Sp. [H.B.K.] 3: 444. 1818. *Viscum quadrangulare* (Kunth) DC., Prodr. 4: 283. 1830. Type: COLOMBIA. CUNDINAMARCA: near to Pandi and Fusagasuga, on *Guazuma*, IX.1795, *F.W.H.A. Humboldt & A.J.A Bonpland s.n.* (holotype: P-HBK - barcode 00322225! (= Trelease, 1916, Fig. 155a).

Phoradendron affine (Pohl ex DC.) Engl. & Krause, Nat. Pflanzenfam. 16b: 191. 1935. *Viscum affine* Pohl ex DC., Prodr. 4: 281. 1830. Type: BRAZIL. MINAS GERAIS: São João Baptista, *J.E. Pohl 544* (holotype: G-DC! (= Trelease, 1916, Fig. 165a); isotype: ILL!, W, destroyed (= Trelease, 1916, Fig. 165b)).

Phoradendron microphyllum (Pohl ex DC.) Trel., *Phoradendron* 113, Fig. 164a. 1916. *Viscum microphyllum* Pohl ex DC., Prodr. 4: 283. 1830. *Phoradendron rubrum* var. *microphyllum* (Pohl ex DC.) Eichler in Martius, *Fl. bras.* 5(2): 120. 1868. Type: BRAZIL. *H.W. Schott s.n.* (holotype: G-DC), *syn. nov.*

Phoradendron liga (Gillies ex Hook. & Arn.) Eichler in Martius, *Fl. bras.* 5(2): 134m. 1868. *Viscum liga* Gillies ex Hook. & Arn., Bot. Misc. 3: 355. 1833. Type: ARGENTINA. SAN JUAN: near to Los Cerrillos de San Juan, *J. Gillies s.n.* (holotype: K - barcode 00601434! = Trelease (1916), Fig. 179); isotype: E!).

Phoradendron rubrum var. *longispicum* Eichler in Martius, *Fl. bras.* 5(2): 121. 1868, [*longispica*]. *Phoradendron piauhyanum* Trel., *Phoradendron* 110. 1916. Type: BRAZIL. PIAUÍ: *G. Gardner 2617* (lectotype, designated by Trelease, 1916: W, destroyed (= Trelease, 1916, Fig. 157a); lectotype, first step designated by Kuijt (1994): P, second step, *hic designatus*: P - barcode 005447871!; isolectotypes: BM, G!(4x), K!(2x), US!).

Phoradendron wiesnerianum Trel., *Phoradendron* 109, Fig. 156. 1916. Type: BRAZIL, CEARÁ: Villa do Crato, *G. Gardner 1674* (holotype: W, destroyed (= Trelease, 1916, Fig. 156; lectotype, *hic designatus*: BM - barcode 0049235!; isolectotypes: BM!, G!, K, NY!, P!(3x)).

Phoradendron stenophyllum Trel., *Phoradendron* 81, Fig. 106b. 1916, non *Viscum stenophyllum* Sprengel, 1824 [“1825”]. Type: BRAZIL. BAHIA: Machado Portello, 19–23.VI.1915, *J.N. Rose & P.G. Russell 19908* (holotype: US - barcode 00731090! (= Trelease, 1916, Fig. 106b); isotype: NY!).

Phoradendron martianum Trel., *Phoradendron* 114, Fig. 166. 1916. Type: BRAZIL. ALAGOAS: *G. Gardner 1321* (holotype: G - barcode 006233! (= Trelease, 1916, Fig. 166a); isotypes: BM!(2x), G!, ILL!, K!(3x), P!(2x)).

Phoradendron lineolatum Rizzini, *Rodriguésia* 30/31: 184. 1956. Type: BRAZIL, CEARÁ: *Dias da Rocha 118* (holotype: RB - barcode 00540588!).

Phoradendron fusco-erubescens Rizzini, *Arq. Jard. Bot. Rio de Janeiro* 24: 32. 1980. Type: BRAZIL. GOIÁS: Chapada dos Veadeiros, 20 km N of Alto do Paraíso, on *Byrsonima*, 20.III.1971, *H.S. Irwin et al. 32748* (holotype: RB - barcode 00540583!; isotypes: CAS, MO, NY!, UC(ex-LEA)), *syn. nov.* *Phoradendron saxicola* Rizzini, *Arq. Jard. Bot. Rio de Janeiro* 24: 37. 1980. Type: BRAZIL. MATO GROSSO: Chapada dos Guimarães, road Buriti to Cuiabá, on *Byrsonima*, 22.X.1973, *G.T. Prance et al. 19292* (holotype: RB - barcode 00540611!; isotypes: INPA!, NY!, R), *syn. nov.* Figs. 3k, 14

Phoradendron quadrangulare is one of the most common species of mistletoes in the Brazilian flora. This species, according to our observations, has predominance of monopodial/percurrent branches, cataphylls only on the proximal lateral internodes, young branches generally rhombic or quadrangular, elliptical or obovate leaves, biseriate inflorescences, and globose fruits with vibrant orange or reddish color. (See comments under *P. diminutivum*).

Dettke & Waechter (2014), through the observation of several populations in Brazil, and adjacent countries (Argentina, Paraguay and Uruguay), included *P. affine* and *P. liga* under synonymy of *P. quadrangulare*. In the present study, we include three additional names: *P. microphyllum*, which was recognized as a separate species by Kuijt (2003), and *P. fusco-erubescens* and *P. saxicola*, considered synonyms of *P. trinervium* (Lam.) Griseb. (Kuijt 2003). *P. quadrangulare* is a widely distributed species, morphologically variable across its distribution range, presenting delicate to more robust plants, depending on the habitat. However, the characteristics listed above are constant in all distributional records. It likely

constitutes the same taxon, or a species complex with *P. trinervium* and *P. rubrum* (L.) Griseb., which occurs in Central (including Caribbean) and northern South America, but additional studies at population level are necessary to confirm this statement. *Phoradendron cuspidatum*, previously considered a synonym of *P. affine* (Kuijt 2003), is here placed under synonymy of *P. mucronatum*.

Material selected for illustration (Fig. 14): Brasília, Asa Norte, Estação Experimental de Biologia-UnB, on *Anadenanthera*, 9.XI.2001, *C.S. Caires & V.C. Mendes 26* (UB); Chácara Sossêgo, DF-238 road to Unai, on *Anadenanthera*, 21.I.2002, *C.S. Caires et al. 40* (UB). São Sebastião, DF-251 road to Unai/PADDF, over bridge of São Bartolomeu River, on *Anadenanthera*, 16.IV.2002, *C.S. Caires & V.C. Mendes 144* (UB).

Iconography: Eichler (1868, Fig. 38-2), Rizzini (1956, Fig. 29-3), Eliçabe (1973, Fig. 9), Rizzini (1980, Fig. 10), Rizzini (1995, Fig. 19), Kuijt (2003, Figs. 16, 161, 185, 234), Kuijt (2005, Fig. 399), Dettke & Waechter (2013, Figs. 130-136), Rigon & Cervi (2013, Figs. 7e-f), Dettke & Waechter (2014, Figs. 8g-l), Caires (2017, Figs. 1e-g, 3j-m, 4a-b).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Argentina, Bolivia, Brazil (all states), Colombia, Ecuador, Guyana, Paraguay and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

2.37. *Phoradendron racemosum* (Aubl.) Krug & Urb., *Bot. Jahrb. Syst.* 24: 46. 1897. *Viscum racemosum* Aublet, *Hist. pl. Guiane* 2: 895. 1775. *Viscum flavens* Swartz, *Prodr.* 32. 1788, *nom. superfl.* *Phoradendron flavens* (Swartz) Griseb., *Fl. Brit. W. I.* 313. 1860. Type: (lectotype, designated by Kuijt (2003): Plate 258, Fig. 4, in C. Plumier (ed. J. Burman), *Plantarum americanarum*, 1760). *Phoradendron pennivenium* Eichler in Martius, *Fl. bras.* 5(2): 128, Fig. 42. 1868 (excl. syn. De Candolle), non *Viscum pennivenium* DC. (= *Oryctanthus florulentus* (Rich.) Tiegh.). Type: GUIANA, 1821, *G.S. Perrottet s.n.* (lectotype, *hic designatus*: P - barcode 05447927!). Fig. 3l

This species is distinguishable by the sympodial/dichotomous growth pattern of branches, cataphylls only on the proximal lateral branches, leaves with pinnate veins and rounded apex, and biseriate inflorescences. *Phoradendron racemosum* can be mistaken with *P. hexastichum*, which has monopodial percurrent branches and triseriate inflorescences, or with *P. northropiae*

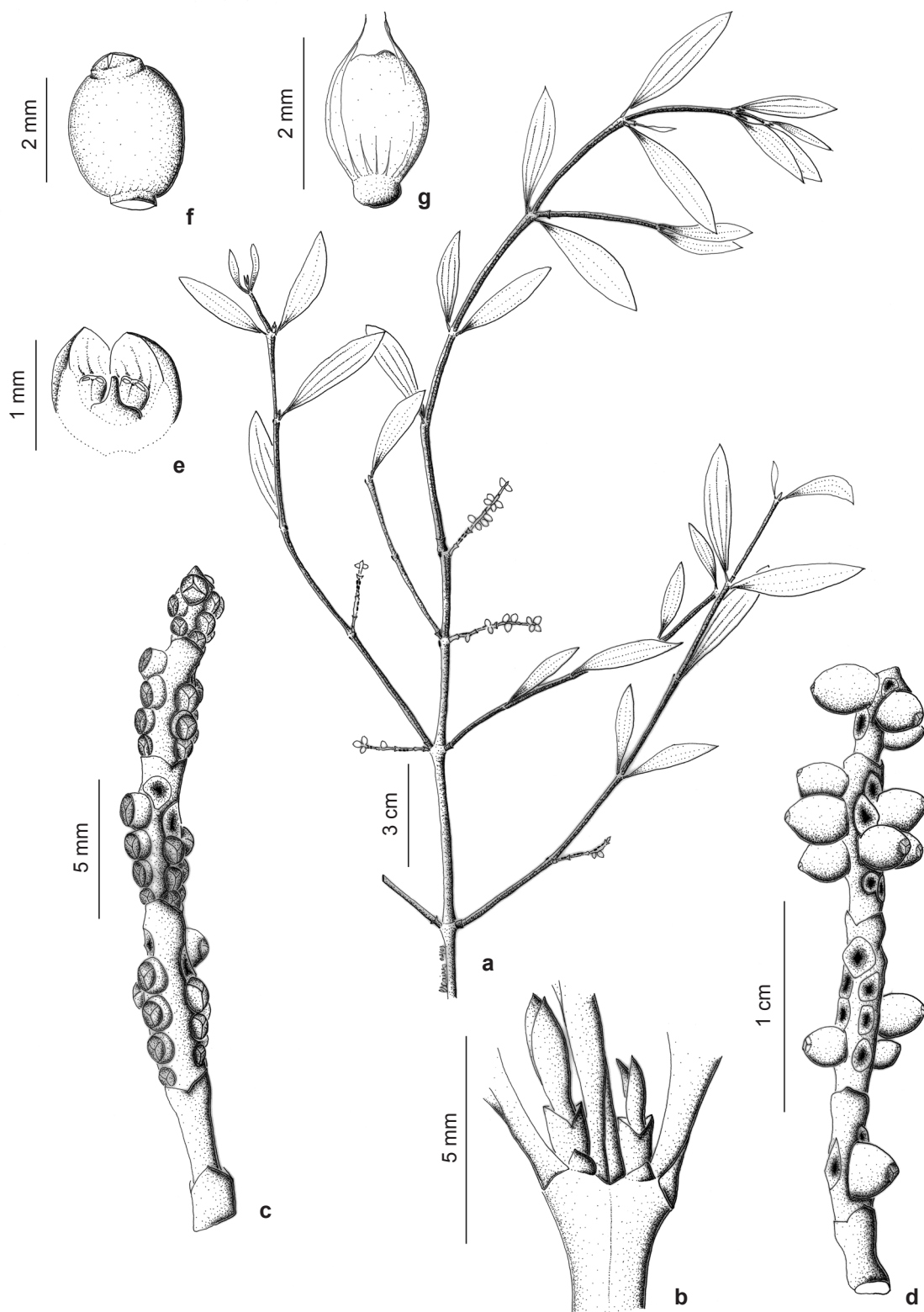


Figure 14 – a-g. *Phoradendron quadrangulare* – a. habit; b. detail of lateral shoots; c. inflorescence; d. mature fruits; e. staminate flower; f. fruit; g. seed enclosed in endocarp. (a,b,d,f. Caires & Mendes 144 (UB); c. Caires & Mendes 26 (UB); e,g. Caires et al. 40 (UB)).

that has cataphylls in all internodes and smaller leaves. (See comments at *D. fendleriana* and *P. pteroneuron*).

The interpretation of *Phoradendron pennivenium* has been controversial, because of a confusion between Perrottet's collections. It is clear that De Candolle (1830) described *Viscum pennivenium* based on a collection of *Oryctanthus florulentus* (Rich.) Tiegh. (isotypes seen: GUIANA, *Perrottet s.n.* P - barcodes 05455466! and 05455466!), considering the morphological characteristics described in the protologue (De Candolle 1830: 282-283): “*ramulis tetragonis subteretibus*”, “*spicis axillaribus solitariis*” and “*baccis oblongis*”. However, Eichler (1868) used another unnumbered collection of Perrottet from Guiana, of the same year (1821), to describe *P. pennivenium* in *Flora brasiliensis*. This specimen does not have the characteristics described by De Candolle, and represents *P. racemosum*. After excluding De Candolle's synonym, Eichler's names are recognized and attributed to him, according to the Code (Turland *et al.* 2018, Art. 48.1). We, here, select a lectotype from P herbarium, among the syntypes listed by Eichler (1868) for *P. pennivenium*.

Iconography: Eichler (1868, Fig. 42), Kuijt (2003, Fig. 237), Kuijt (2005, Fig. 409).

It is distributed in Central America (including Caribbean) and South America - Brazil (AC, AM, AP, BA, CE, DF, GO, MG, MT, PA, RR, TO), Colombia, French Guiana, Surinam and Venezuela (Kuijt 2003).

2.38. *Phoradendron singulare* Kuijt, Syst. Bot. Monogr. 66: 424, Fig. 265. 2003. Type: COLOMBIA. CAQUETA: Sierra de Chiribiquete, Campamento Norte, 01°07'N, 72°50'W, on *Clusia*, *S. Castroviejo et al.* 12057 (holotype: HUA - barcode 000217!).

Phoradendron singulare is a conspicuous Amazon species that is characterized by monopodial/percurrent branches; presence of fertile cataphylls, located on the upper or middle portion of the internodes; and uniseriate inflorescences in both axillary and terminal positions. It resembles *P. obtusissimum* due to the similarity of the obovate leaves, and ellipsoid fruits with opening petals, but is distinguished by the fertile cataphylls (*vs.* sterile) and uniseriate inflorescences (*vs.* biseriate).

Iconography: Kuijt (2003, Fig. 265).

It is distributed in South America - Brazil (AM) and Colombia (Kuijt 2003).

2.39. *Phoradendron strongyloclados* Eichler in Martius, *Fl. bras.* 5(2): 109. 1868. Type: BRAZIL. PERNAMBUCO: Itamaracá, *G. Gardner* 1029 (holotype: B, destroyed; lectotype, designated by Trelease (1916): GH - barcode 0035780! (= Trelease, 1916, Fig. 224a); isoelectotypes: BM!(2x), E!, K!(2x), P!(3x), NY).

Phoradendron gardnerianum Urb., Bot. Jahrb. Syst. 23, Beibl. 57: 11. 1897. Type: BRAZIL. PIAUÍ: Serra da Batalha, *G. Gardner* 2885 (holotype: B, destroyed (= Trelease, 1916, Fig. 223a); lectotype, *hic designatus*: BM - barcode 00993575!; isoelectotype: K!).

Phoradendron caesalpiniae Ule, Bot. Jahrb. Syst. 42: 200. 1908. Type: BRAZIL. BAHIA: Caldeirão, X.1906, on Caesalpinaceae, *E.H.G. Ule* 7243 (holotype: B, destroyed (= Trelease, 1916, Fig. 225b); lectotype, *hic designatus*: K - barcode 0016535!; isoelectotypes: G!, HBG!). Figs. 3m; 15

Phoradendron strongyloclados is characterized by a mixture of monopodial/percurrent and sympodial/dichotomous branches, one pair of cataphylls on all the internodes, small leaves, generally ovate or elliptical less than 1.5 cm wide, biseriate inflorescences with three flowers per fertile bracts, the apical one staminate, and ovate fruits with opening petals.

The holotypes of *P. gardnerianum* and *P. caesalpiniae* at B herbarium were destroyed during the second World War, and so, we designate here the lectotypes for both names.

Material selected for illustration (Fig. 15): Brasília, basin of São Bartolomeu River, V.1981, *E.P. Heringer et al.* 6991 (IBGE); Jardim Botânico de Brasília, VIII. 1990, *P.E.A.M. Oliveira* 1563 (HEPH); 7 km W of Brasília, near Sobradinho, 30.IX.1965, *H.S. Irwin et al.* 8832 (UB).

Iconography: Rizzini (1982, Fig. 74), Kuijt (2003, Fig. 273), Caires & Proença (2005, Fig. 2h), Kuijt (2005, Fig. 397).

It is distributed in South America - Bolivia, Brazil (AM, AP, BA, DF, GO, MA, MG, MS, MT, PA, PB, PE, PI, RJ, SE, TO), Colombia, French Guiana, Guyana, Surinam and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.40. *Phoradendron tunaforme* (DC.) Eichler in Martius, *Fl. bras.* 5(2): 108, Fig. 32. 1868. *Viscum tunaforme* DC., Prodr. 4: 284. 1830. Type: BRAZIL. Serra de San Feliz, Musquitos, *J.E. Pohl s.n.* (holotype: G-DC; isotypes: BR!, ILL!, M, P). Fig. 3n-o

Phoradendron tunaforme is an aphyllous plant, clearly distinguished from the other species of *Phoradendron* by the flattened and pendulous

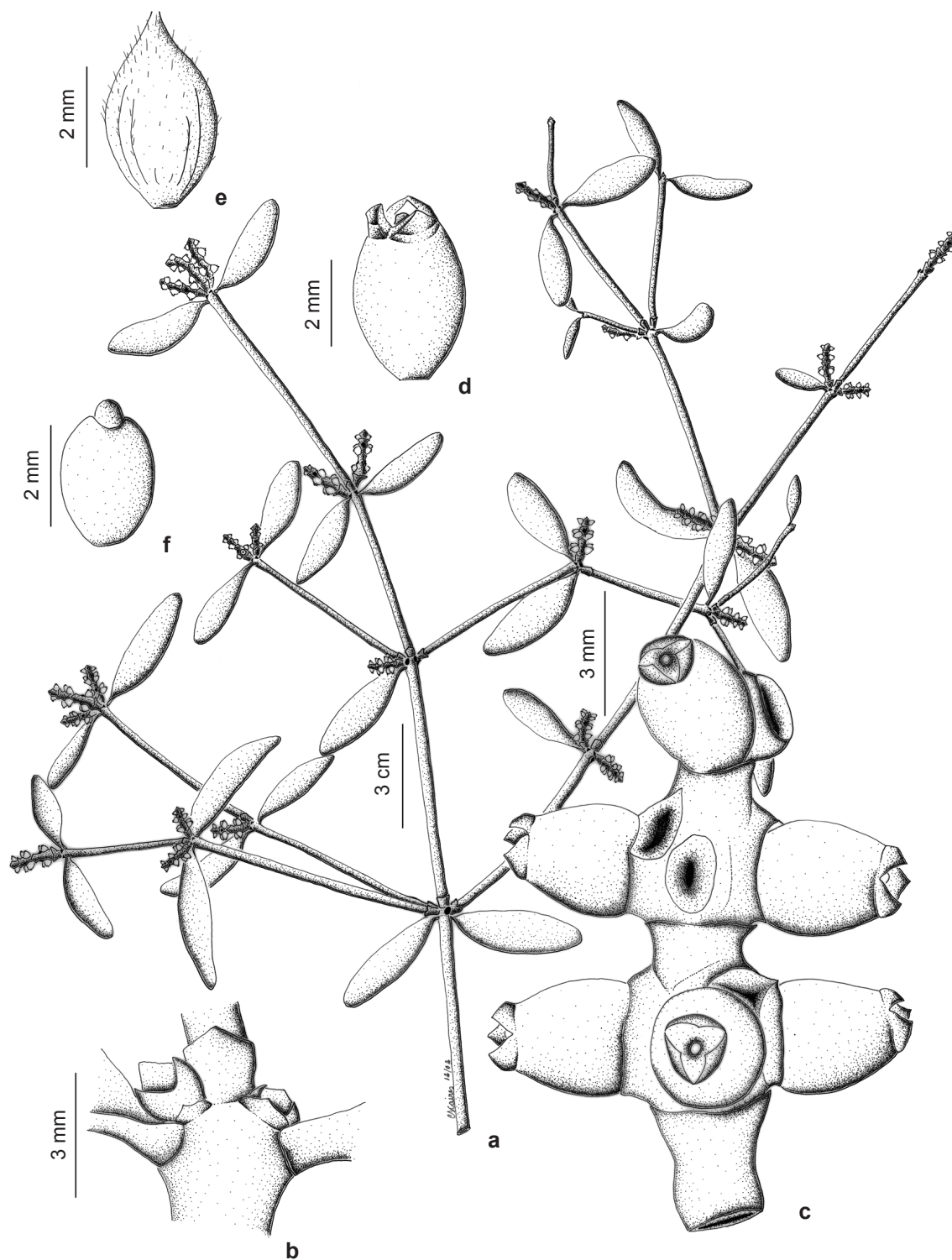


Figure 15 – a-f. *Phoradendron strongylocados* – a. habit; b. detail of lateral shoots; c. mature fruits; d. fruit; e. seed enclosed in endocarp; f. seed. (a. *Heringer et al.* 6991 (IBGE); b-d. *Irwin et al.* 8832 (UB); e-f. *Oliveira 1563* (HEPH)).

stems, and by the short inflorescences, with only one or two fertile biseriate segments. It can be confused with *P. platycaulon*, for the identical stems, but the expanded leaves and larger inflorescences of *P. platycaulon* clearly separates them.

Iconography: Eichler (1868, Fig. 32), Kuijt (2003, Fig. 293), Caires & Proença (2005, Figs. 1j-k), Caires (2017, Figs. 3n-q, 4c-f).

It is distributed in South America - Brazil (AM, AL, BA, CE, DF, GO, MG, PA, PB, PE, RN, SE, SP) and Venezuela (Kuijt 2003; Dettke & Caires 2020).

2.41. *Phoradendron undulatum* (Pohl ex DC.)

Eichler in Martius, *Fl. bras.* 5(2): 122, Fig. 39. 1868. *Viscum undulatum* Pohl ex DC., Prodr. 4: 282. 1830. Type: BRAZIL. MINAS GERAIS: Barbacena, 1828, *J.E. Pohl s.n.* (holotype: G-DC! (= Trelease, 1916, Fig. 190a); isotype: BR!).

Phoradendron hamatifolium Rizzini in Reitz, Flora III. Catarinensis 1: 20. 1968. Type: BRAZIL. SANTA CATARINA: Blumenau, Morro Spitzkopf, 20.III.1952, *R. Reitz 4633* (holotype: HBR 4757!; isotypes: RB!, MO).

Phoradendron uleanum Steyererm., Fieldiana Bot. 28(1): 223. 1951. *Phoradendron macrophyllum* Ule, Notizbl. Bot. Gart. Berlin-Dahlem 6: 291. 1915, *nom. illeg.*, non *Phoradendron macrophyllum* (Engelmann) Cockerell, 1900, *nom. illeg.*; non *Phoradendron macrophyllum* Spreng., 1825. Type: BRAZIL. RORAIMA: *E.H.G. Ule 8603* (holotype: B, destroyed (=F Neg 18191); lectotype, designated by Kuijt (2003): K!; isoelectotypes: IAN!, MO).

Figs. 3p; 16

Phoradendron undulatum is easily distinguished from other species of *Phoradendron* by monopodial/percurrent branches, with cataphylls only on the proximal lateral internodes, veins pinnate and long-ovate elliptical leaves, with an acute or acuminate apex, and biseriate inflorescences. In collections, it is often confused with *P. crassifolium*, which has fertile cataphylls and leaves with palmate veins, or with *P. chrysocladon*, that has cataphylls in all internodes, leaves with palmate veins and triseriate inflorescences.

Material selected for illustration (Fig. 16): Brasília, Mansão Dois Irmãos, near road to FAL, *Styrax ferrugineus* Nees. & Mart., 5.II.2002, C.S. Caires & V.C. Mendes 44 (UB); São Bartolomeu River, X.1979, E.P. Heringer 2137 (IBGE). Planaltina, CPAC - reserva cerrado, on *Emmotum nitens* (Benth.) Miers, 2.IV.2002, C.S. Caires et al. 110 (UB).

Iconography: Eichler (1868, Fig. 39), Kuijt (2003, Figs. 294, 295), Caires & Proença (2005, Fig. 1h), Kuijt (2005, Fig. 411), Dettke & Waechter (2013, Figs. 137-140), Rigon & Cervi (2013, Figs. 7a-b), Dettke & Waechter (2014, Figs. 8m-p).

It is distributed in North America - Mexico, Central America (including Caribbean) and South America - Bolivia, Brazil (AM, BA, DF, ES, GO, MG, MT, PA, PE, PR, RJ, RR, RS, SC, SP), Colombia, Ecuador, Peru and Venezuela (Kuijt 2003; Dettke & Waechter 2014; Dettke & Caires 2020).

Excluded names for the Brazilian flora
Phoradendron bilineatum Urb.

This species does not occur in Brazil. The two vouchers listed for Brazil by Kuijt (2003) are refer to other species: *C.A. Cid Ferreira et al. 1494* (NY!, RB!, US!) is *Phoradendron macrarthrum* and *G.T. Prance et al. 4370* (US!) is *Phoradendron racemosum*.

Phoradendron brittonianum Rusby.

This species does not occur in Brazil. Kuijt (2003) cited a possible record, based on the collection *G. Martinelli et al. 12087* (MO!), which actually represents *Phoradendron pteroneuron*.

Phoradendron herbert-smithii Trel.

This species does not occur in Brazil. The only collection cited by Kuijt (2003), *B. Maguire & C.K. Maguire 40236* (US!), is actually a pistillate individual of *P. coriaceum*.

Phoradendron polygynum (H. Karst.) Eichler.

This species does not occur in Brazil. The voucher cited by Kuijt (2003) for Brazil, *B.E. Dahlgreen 888* (F!, NY!) is *Phoradendron bathyoryctum*.

Phoradendron trinervium (Lam.) Griseb.

In this treatment, we consider that this species does not occur in Brazil. Species documented by Kuijt (2003), with Brazilian types (*P. fusco-erubescens* and *P. saxicola*), have been proposed here as synonyms of *Phoradendron quadrangulare*.

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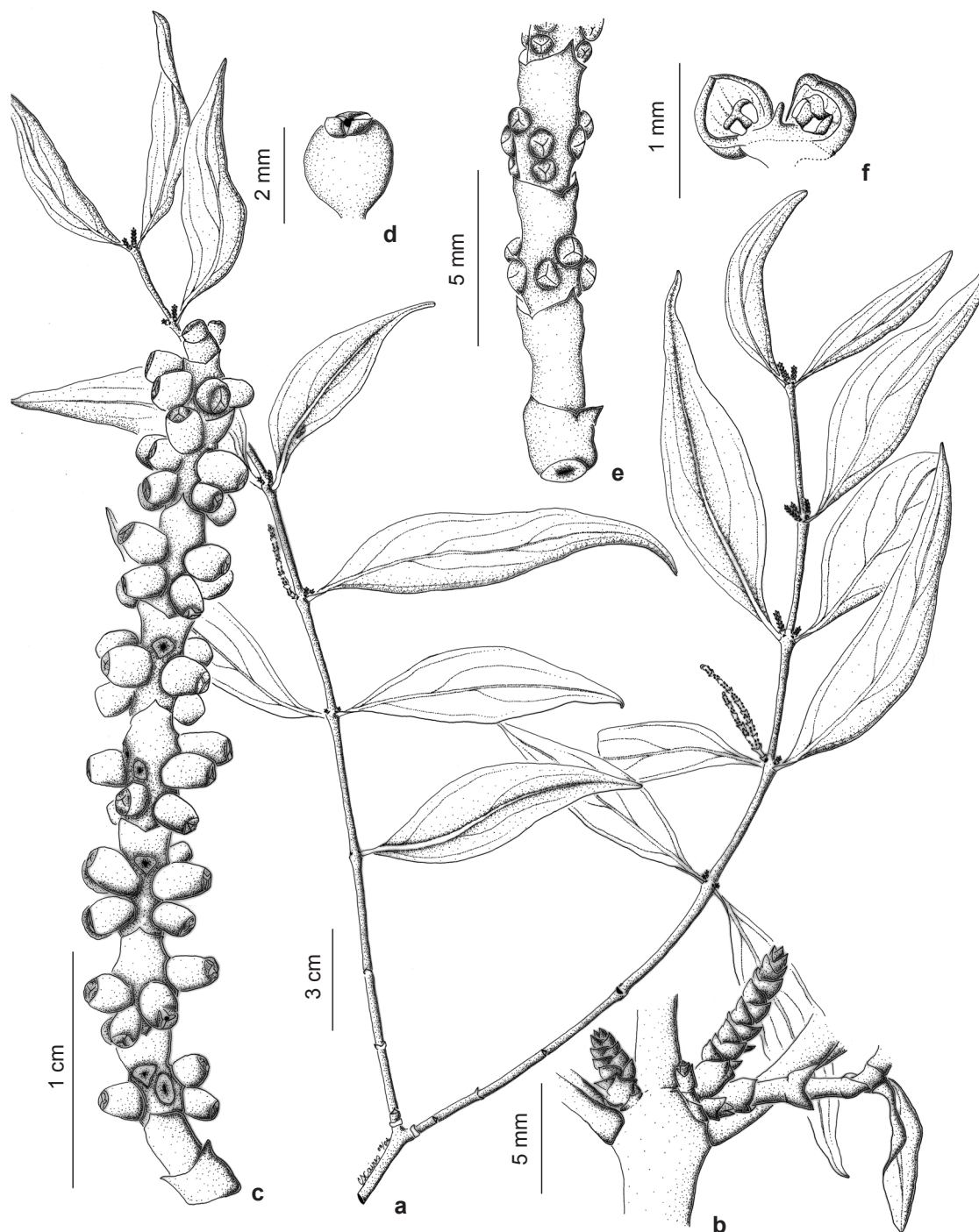


Figure 16 – a-f. *Phoradendron undulatum* – a. habit; b. node with two young inflorescences and a lateral shoot with three pairs of basal cataphylls; c. mature fruits; d. fruit; e. detail of inflorescence; f. staminate flower. (a-b. Caires *et al.* 110 (UB); c-d. Caires & Mendes 44 (UB); e-f. Heringer *et al.* 2137 (IBGE)).

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