

# GuiaTreeKey, a multi-access electronic key to identify tree genera in French Guiana

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## Abstract

The tropical rainforest of Amazonia is one of the most species-rich ecosystems on earth, with an estimated 16000 tree species. Due to this high diversity, botanical identification of trees in the Amazon is difficult, even to genus, often requiring the assistance of parataxonomists or taxonomic specialists. Advances in informatics tools offer a promising opportunity to develop user-friendly electronic keys to improve Amazonian tree identification.

Here, we introduce an original multi-access electronic key for the identification of 389 tree genera occurring in French Guiana *terra-firme* forests, based on a set of 79 morphological characters related to vegetative, floral and fruit characters. Its purpose is to help Amazonian tree identification and to support the dissemination of botanical knowledge to non-specialists, including forest workers, students and researchers from other scientific disciplines.

The electronic key is accessible with the free access software *Xper<sup>2</sup>*, and the database is publicly available on figshare: <https://figshare.com/s/75d890b7d707e0ffc9bf> (doi: 10.6084/m9.figshare.2682550).

## Keywords

Electronic key, trees identification, *Xper<sup>2</sup>*, morphological characters, Neotropics, French Guiana, Amazonia

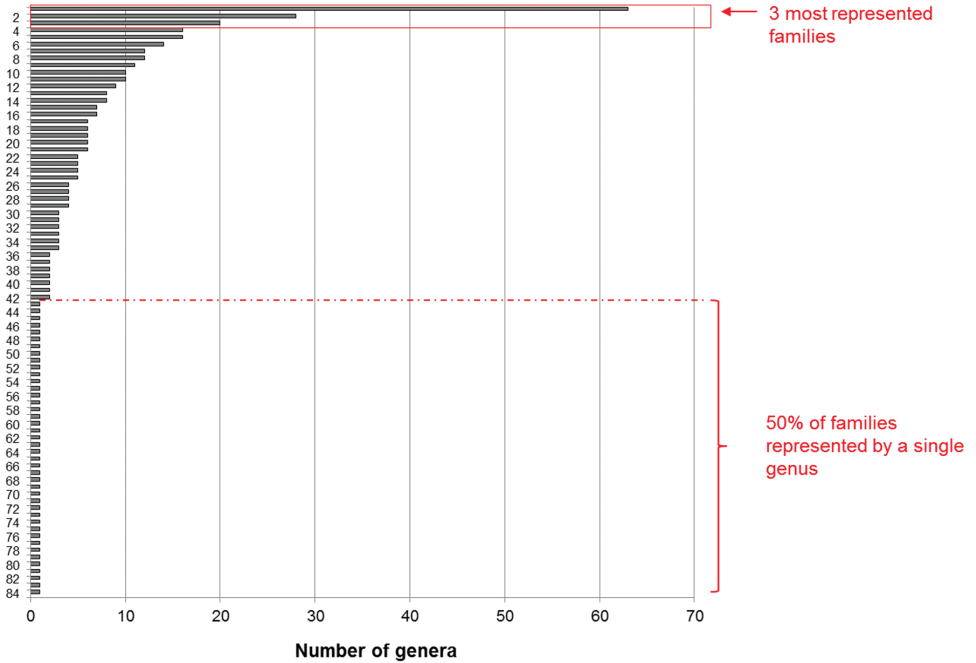
## Introduction

The tropical rainforest of Amazonia is one of the most species-rich ecosystems on earth, with an estimated 16000 tree species and often more than 200 species of trees per hectare (ter Steege et al. 2013). Due to this high diversity, the botanical identification of Amazonian trees is very difficult and often requires the consultation of taxonomic specialists. Taxonomists usually specialize in only one or few families or genera (Bacher 2012; Joppa et al. 2011) with few botanical experts, including generalist taxonomists and parataxonomists (Schmiedel et al. 2016), able to identify specimens of various families to the genus level. As a result, the number of specimens incorrectly named or unnamed is still very high in many forest inventories and more widely in the world's plant collections (Goodwin et al. 2015). Also, traditional dichotomous keys impose constraints on identifying tree samples because they rely on a hierarchical and fixed organization of characters that hampers the identification of a sample when one or several characters are not observed at the time of collection. Moreover, traditional keys often focus on Linnaean characters (flowers and fruits, Rejmánek and Brewer 2001), and only few tools aid the identification of plant species based on vegetative characters (Belhumeur et al. 2008). The identification of sterile samples is therefore difficult even though sterile samples are much more common than fertile ones (the proportion of sterile specimens commonly reaches 90-95%, Aymard et al. 2009; Martinez and Phillips 2000) and taxonomists are often unwilling to review sterile material. Furthermore, printed keys are static and are not frequently revised and republished to reflect taxonomic changes. Here we attempt to modernize botanical identification in Amazonia, by developing a user-friendly electronic key to help tree identification in French Guiana.

French Guiana is a French overseas department of about 85000 km<sup>2</sup> located in the eastern Guiana shield; it is home to approximately 2000 tree and palm species belonging to 404 genera (updated checklist by Molino et al. 2009). We introduce an original multi-access electronic key for the identification of tree genera occurring in French Guiana *terra-firme* forests based on a set of 79 morphological characters related to vegetative, floral and fruit characters that can be selected in any order. In addition, almost all characters and genera are described and illustrated. Its purpose is to help the identification of tree samples and to disseminate botanical knowledge to non-specialists.

## Taxonomic coverage

The key includes all tree genera occurring in French Guiana *terra-firme* forests with a diameter at breast height (d.b.h)  $\geq 10$  cm. Monocots (i.e., palms) and tree genera occurring in other habitats (e.g., mangroves, savannas) are excluded. A total of 389 genera belonging to 84 families are treated, see Suppl. material 1: 'Taxonomic ranks'. The taxonomic validity of genera and families has been checked via the Taxonomic Name Resolution Service (Boyle et al. 2013).



**Figure 1** Taxonomic coverage: Number of genera by families: 1 Fabaceae (63); 2 Rubiaceae (27); 3 Euphorbiaceae (20); 4 Annonaceae (16); 5 Malvaceae (16); 6 Lauraceae (14); 7 Apocynaceae (12); 8 Moraceae (12); 9 Myrtaceae (11); 10 Sapindaceae (10); 11 Sapotaceae (10); 12 Rutaceae (9); 13 Chrysobalanaceae (8); 14 Salicaceae (8); 15 Clusiaceae (7); 16 Melastomataceae (7); 17 Anacardiaceae (6); 18 Lecythidaceae (6); 19 Olacaceae (6); 20 Violaceae (6); 21 Burseraceae (5); 22 Capparaceae (5); 23 Humiriaceae (5); 24 Ochnaceae (5); 25 Phyllanthaceae (5); 26 Meliaceae (4); 27 Myristicaceae (4); 28 Urticaceae (4); 29 Vochysiaceae (4); 30 Bignoniaceae (3); 31 Calophyllaceae (3); 32 Celastraceae (3); 33 Malpighiaceae (3); 34 Polygonaceae (3); 35 Proteaceae (3); 36 Achariaceae (2); 37 Bixaceae (2); 38 Combretaceae (2); 39 Linaceae (2); 40 Nyctaginaceae (2); 41 Primulaceae (2); 42 Simaroubaceae (2); 43 Aquifoliaceae (1); 44 Araliaceae (1); 45 Boraginaceae (1); 46 Canellaceae (1); 47 Cannabaceae (1); 48 Cardiopteridaceae (1); 49 Caricaceae (1); 50 Caryocaraceae (1); 51 Dichapetalaceae (1); 52 Ebenaceae (1); 53 Elaeocarpaceae (1); 54 Emmotaceae (1); 55 Erythroxylaceae (1); 56 Goupiaceae (1); 57 Hernandiaceae (1); 58 Hypericaceae (1); 59 Icacinaceae (1); 60 Ixonanthaceae (1); 61 Lacistemataceae (1); 62 Lamiaceae (1); 63 Lepidobotryaceae (1); 64 Loganiaceae (1); 65 Lythraceae (1); 66 Monimiaceae (1); 67 Oleaceae (1); 68 Opiliaceae (1); 69 Pentaphylacaceae (1); 70 Picramniaceae (1); 71 Piperaceae (1); 72 Putranjivaceae (1); 73 Rhabdodendraceae (1); 74 Rhamnaceae (1); 75 Rhizophoraceae (1); 76 Rosaceae (1); 77 Sabiaceae (1); 78 Siparunaceae (1); 79 Solanaceae (1); 80 Stemonuraceae (1); 81 Styracaceae (1); 82 Symplocaceae (1); 83 Ulmaceae (1); 84 Verbenaceae (1).

Figure 1 graphically displays the number of tree genera in each family. The families with the highest number of genera are the Fabaceae (63 genera), Rubiaceae (27 genera) and Euphorbiaceae (20 genera), whereas 42 families (50%) are represented by a single genus.

## Spatial coverage

### General spatial coverage

French Guiana is bordered to the east and south by Brazil and to the west by Suriname (Figure 2). About 90% of the region is covered by evergreen rainforest occurring principally on *terra-firme* soils of granitic or sedimentary origins. The relief is fairly flat with a mean altitude of 140 m and few peaks exceeding 800 m. The climate is equatorial, characterized by a mean annual temperature of 26°C and annual rainfall varying from 2000 mm in the south and west to 4000 mm in the northeast. The rainy season usually occurs between May and August and the dry season between December and January (Guitet et al. 2014).



**Figure 2.** Location of French Guiana in South America.

This key covers French Guiana, but the geographical usefulness is by no means restricted to French Guiana: 99% of the genera included in this key are also present in Brazil (Reflora - Virtual Herbarium. Available at: <http://reflora.jbrj.gov.br/reflora/herbarioVirtual/> Accessed on 21/3/2016), more than 90% in Suriname and Guyana, and more than 80% in the Venezuelan states of Amazonas and Bolivar (Funk et al. 2007). The electronic key may thus also be used in and easily extended to these other regions, although users should keep in mind that these regions also include many other tree genera not covered by this key.

## Coordinates

2°6'42.8"N and 5°45'28.4"N Latitude; 51°38'3.2"W and 54°36'2.7"W Longitude

## Methods

### Electronic key implementation

The electronic key is implemented by a genus × character matrix where the 389 genera are displayed in rows and the 79 characters are displayed in columns, totaling 30731 cells (with less than 3% of missing values). The characters were scored using a comprehensive bibliographic survey of various flora and botanic publications covering the entire region of Amazonia (Acevedo-Rodríguez 2003; Acevedo-Rodríguez 2012; Alford 2009; Alves-Araújo and Alves 2012; Archer and Lombardi 2013; Aymard C and Ireland 2010; Barneby 1989; Barneby et al. 2011; Berg 1972; Berg et al. 1990; Berg and Rosselli 2005; Berry and Wiedenhoeft 2004; Boom 1989; Brandbyge 1986; Chanderbali 2004; 2009; Cornejo 2009; Cowan 1967; Cowan and Lindeman 1989; Da Ribeiro et al. 1999; Da Silva 1986; Da Silva et al. 2010; Daly 1987; De Carvalho-Sobrinho and De Queiroz 2010; De Fraga and Saavedra 2006; Delprete et al. 2010; Díaz 2013; Endress et al. 2014; Esser 2009a; b; Every 2009; 2010; Fernando and Quinn 1995; França 2009; Garcia-Villacorta and Hammel 2004; Gentry 1992; 1993; Graham 2014; Graham and Cavalcanti 2009; Groppo 2010; Groppo et al. 2014; Grose and Olmstead 2007; Guimarães and Monteiro 2010; Gustafsson 2009; Hayden 1990; Hekking 1988; Hiepko 1993; 2000; Hopkins ; Iltis and Cornejo 2011; Jansen-Jacobs 1988; 2007; Jansen-Jacobs and Meijer 1995; Kaastra 1982; Kallunki 1998; Kårehed 2001; Kubitzki and Renner 1982; Landrum and Kawasaki 1997; Maas and Maas-van de Kamer 2012; Maas and Westra 1992; Maas et al. 2003; Madrinan 2004; Marciano-Berti 1998; Mazine and De Faria 2013; McKenna et al. 2011; Melo and França 2009; Mesquita et al. 2009; Michelangeli 2005; Mitchell 1997; Monro and Rodríguez 2009; Morales 2007; Mori et al. 2005; Mori and Prance ; Mori and Prance 1993; Morley 1976; Nee 2001; Pendry 2003; Pennington 1981; 1990; Poppendieck 1981; Prance 1972a; b; 1973; Prance 1986; Prance 2009a; b; c; d; Prance and

Mori 1979; Prance and Stace ; Ramos and Lombardi 2009; Redden 2008; Renner and Hausner 2005; Ribeiro et al. 2015; Rodrigues and Goulart de Acevedo Tozzi 2006; Rodrigues and Goulart de Acevedo Tozzi 2008; Rohwer 1993; Romanov et al. 2007; Rudd 1981; Santo et al. 2012; Sastre 2007; Scharf et al. 2008; Schneider and Zizka 2012a; b; Secco 2004; Shepherd and Alverson 1981; Silva 2009; Silverstone-Sopkin 2015; Sleumer 1980; 1984; Sothers et al. 2014; Steyermark et al. 1995; 1997; 1998; 1999; 2001; 2003; 2004; 2005; Teichert et al. 2012; Vasquez Martinez 2013; Westra and Maas 2012; Woodgyer 2009; Wurdack et al. 1993; Zappi 2009).

The characters are grouped into four main sections: ‘leaves’, ‘other vegetative characters’, ‘flowers’, and ‘fruits and seeds’. A substantial proportion of characters (33 of 79) is related to leaves which are almost always observable. In addition, many vegetative characters rarely used in classical dichotomous keys are suggested (e.g., presence of latex, type of trichomes, leaf base venation). Almost all genera and characters are defined and illustrated with more than 9000 photographs (mainly herbarium specimens). Among the 79 characters, 74 are qualitative and 5 are quantitative. Qualitative characters are scored by the presence or absence of the character (e.g., opposite leaves), while quantitative characters are scored by the minimum and maximum number of modalities potentially observable for each genus (e.g., number of calyx segments ranging from three to five): the user may thus select the exact number of modalities observed in the sample.

### Genera-characters matrix file description

The electronic key consists of a genus  $\times$  character matrix consultable with *Xper<sup>2</sup>*, a software dedicated to taxonomic descriptions and computer-aided identification (Ung et al. 2010). *Xper<sup>2</sup>* is a user-friendly management system for creating interactive identification keys available on Windows, Mac or Linux in French, English or Spanish versions. It is free software and the botanical keys can be installed locally in order to be used without an internet connection, which is not allowed in the most recent version of the program (*Xper<sup>3</sup>*).

Object name: ‘GuiaTreeKey’

Distribution:

- *Xper<sup>2</sup>* download page: <http://www.infosyslab.fr/lis/?q=en/resources/software/cai/xper2/downloads/last>
- ‘GuiaTreeKey’ dataset & User Manual: <https://figshare.com/s/75d890b7d7-07e0ffc9bf> (doi: 10.6084/m9.figshare.2682550).

Publication date of data: 23.02.2016

Language: English

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Software overview and technical features (Figure 3)

*PANE 1: Characters box:* In the left pane, the characters are listed and organized by categories and sub-categories (i.e. ‘leaves’, ‘other vegetative characters’, ‘flowers’, and ‘fruits and seeds’, Box a). The user is invited to describe his/her sample using the characters listed in this pane. During the identification process, the user can access a summary of the characters that have been selected (Box b).

*PANE 2: Definition and illustration box:* The middle pane displays the definition and illustration of characters and retained genera.

*PANE 3: Results box:* The right pane displays the results in real time. It lists the genera that fit the selected characters. Genera are listed in alphabetic order and they are combined with their family name. A botanical description and photographs of each genus may be displayed in pane 2 by clicking on the genus.

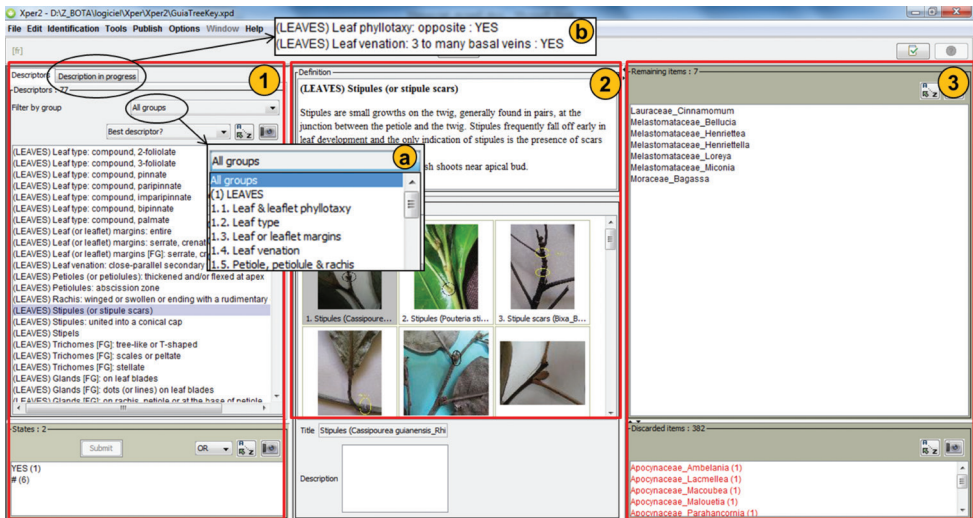


Figure 3. GuiaTreeKey overview.

Examples of identification using GuiaTreeKey

In this section, we provide several examples of identification using the electronic key (Figures 4–7).



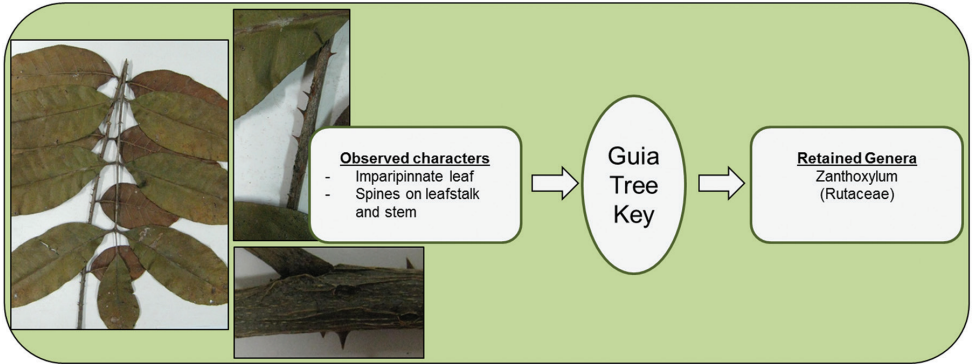


Figure 4. Identification of *Zanthoxylum pentandrum* (Rutaceae).

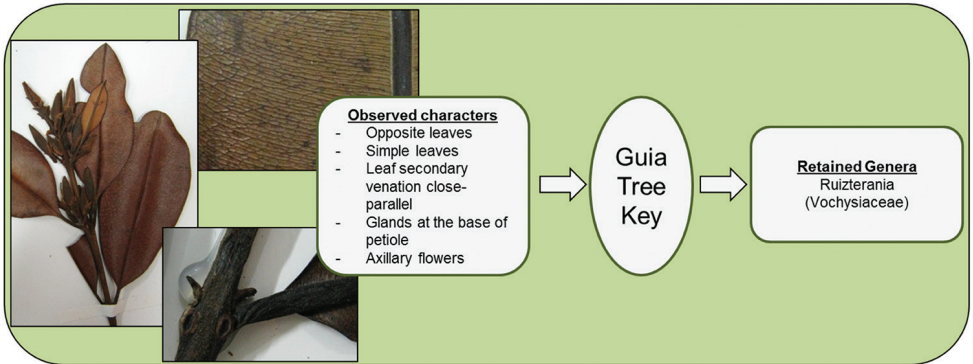


Figure 5. Identification of *Ruizterania ferruginea* (Vochysiaceae).

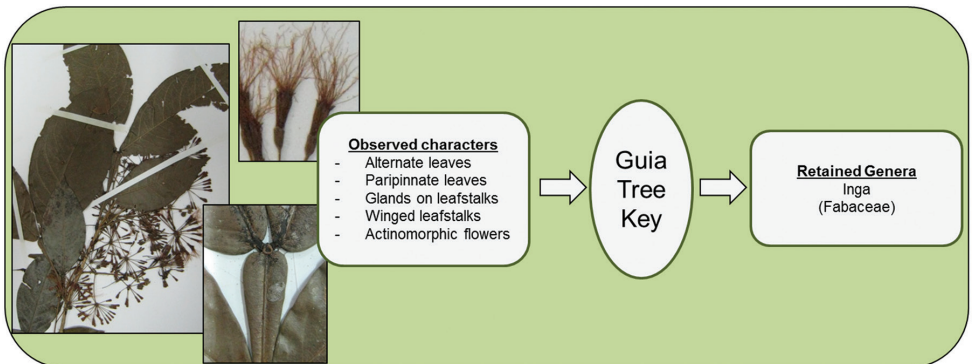
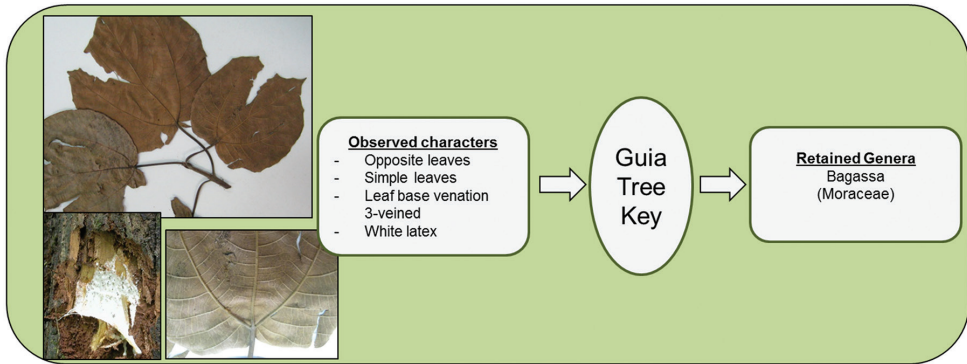


Figure 6. Identification of *Inga umbellifera* (Fabaceae).





**Figure 7.** Identification of *Bagassa guianensis* (Moraceae).

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## References

- Acevedo-Rodríguez P (2003) Flora Neotropica Vol87: Melicocceae (Sapindaceae): *Melicoccus* and *Talisia*. The New York Botanical Garden Press, 178 pp.
- Acevedo-Rodríguez P (2012) Flora of the Guianas Vol29: Sapindaceae. Mota De Oliveira S, 198 pp.
- Alford MH (2009) Neotropical Achariaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey – Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Achariaceae.htm>
- Alves-Araújo A, Alves M (2012) Two new species and a new combination of Neotropical Sapotaceae. *Brittonia* 64: 23–29. doi: 10.1007/s12228-011-9195-z
- Archer RH, Lombardi JA (2013) Neotropical Celastraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Celastraceae.htm>

- Aymard C GA, Ireland HE (2010) A new species of *Bocoa* (Leguminosae-Swartzieae) from the upper Essequibo region, Guyana. *Blumea - Biodiversity, Evolution and Biogeography of Plants* 55: 18–20. doi: 10.3767/000651910X499132
- Aymard G, Schargel R, Berry P, Stergios B (2009) Estudio de los suelos y la vegetación (estructura, composición florística y diversidad) en bosques macrotérmicos no-inundables, estado Amazonas Venezuela (aprox. 01°30'–05°55'N; 66°00'–67°50'O). *BioLlania* 9 (Edic. Esp.): 6–251.
- Bacher S (2012) Still not enough taxonomists: reply to Joppa et al. *Trends in Ecology & Evolution* 27: 65–66. doi: 10.1016/j.tree.2011.11.003
- Barneby RC (1989) A review of *Lecointea* (Fabaceae: Swartzieae) in South America. *Brittonia* 41: 351–355. doi: 10.2307/2807546
- Barneby RC, Grimes JW, Poncy O (2011) *Flora of the Guianas Vol28: Leguminosae-Mimosoideae*. Jansen-Jacobs, M.J, 386 pp.
- Belhumeur PN, Chen D, Feiner S, Jacobs DW, Kress WJ, Ling H, Lopez I, Ramamoorthi R, Sheorey S, White S, Zhang L (2008) Searching the world's herbaria: A system for visual identification of plant species. In: Forsyth D, Torr P, Zisserman A (Eds) *Computer Vision – ECCV 2008: 10th European Conference on Computer Vision, Marseille, France, October 12–18, 2008, Proceedings, Part IV*. Springer Berlin Heidelberg, Berlin, Heidelberg, 116–129. doi: 10.1007/978-3-540-88693-8\_9
- Berg CC (1972) *Flora Neotropica Vol7: Olmedieae, Brosimeae (Moraceae)*. Hafner Publishing Company, 228 pp.
- Berg CC, Akkermans RWA, Heusden ECH (1990) *Flora Neotropica Vol51: Cecropiaceae*. The New York Botanical Garden Press, 208 pp.
- Berg CC, Rosselli PF (2005) *Flora Neotropica Vol94: Cecropia*. The New York Botanical Garden Press, 230 pp.
- Berry PE, Wiedenhoef AC (2004) *Micrandra inundata* (Euphorbiaceae), a new species with unusual wood anatomy from black-water river banks in southern Venezuela. *Systematic Botany* 29: 125–133. doi: 10.1600/036364404772974040
- Boom MB (1989) New species of *Ternstroemia* (Theaceae) from the Guayana highland. *Brittonia* 41: 136–142. doi: 10.2307/2807518
- Boyle B, Hopkins N, Lu Z, Raygoza Garay JA, Mozzherin D, Rees T, Matasci N, Narro ML, Piel WH, McKay SJ, Lowry S, Freeland C, Peet RK, Enquist BJ (2013) The taxonomic name resolution service: an online tool for automated standardization of plant names. The Taxonomic Name Resolution Service [Internet]. iPlant Collaborative. Version 4.0 [Accessed: Oct 2015]. <http://tnrs.iplantcollaborative.org>. *BMC Bioinformatics* 14: 1–15. doi: 10.1186/1471-2105-14-16
- Brandbyge J (1986) A revision of the genus *Triplaris* (Polygonaceae). *Nordic Journal of Botany* 6: 545–570. doi: 10.1111/j.1756-1051.1986.tb00454.x
- Chanderbali AS (2004) *Flora Neotropica Vol91: Endlicheria* (Lauraceae). The New York Botanical Garden Press, 141 pp.
- Chanderbali AS (2009) Neotropical Lauraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) *Neotropikey - Interactive key and information resources for flowering plants of the Neotropics*. <http://www.kew.org/science/tropamerica/neotropikey/families/Lauraceae.htm>

- Cornejo X (2009) Neotropical Capparaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Capparaceae.htm>
- Cowan RS (1967) Flora Neotropica Vol1: Swartzia. Hafner Publishing Company, 228 pp.
- Cowan RS, Lindeman JC (1989) Flora of the Guianas Vol7: Caesalpiniaceae. A.R.A. Görtsvan Rijn, 166 pp.
- Da Ribeiro JEL, Hopkins MJG, Vicentini A, Sothers CA, Da S. Costa MA, De Brito JM, De Souza MAD, Martins LHP, Lohmann LG, Assuncao PACL, Da C. Pereira E, Da Silva CF, Mesquita MR, Procópio LC (1999) Flora da Reserva Ducke. Guia de identificação das plantas vasculares de uma floresta de terra-firme na Amazonia Central. INPA, 816 pp.
- Da Silva MF (1986) Flora Neotropica Vol44: *Dimorphandra* (Caesalpiniaceae). The New York Botanical Garden Press, 127 pp.
- Da Silva MJ, Goulard de Azevedo Tozzi AM, Lewis GP (2010) Two new species of *Lonchocarpus* (Leguminosae, Papilionoideae, Millettieae) from Brazil. Kew Bulletin 65: 29–35. doi: 10.1007/s12225-009-9170-y
- Daly D (1987) Studies in Neotropical Burseraceae I. A synopsis of the genus *Crepidospermum*. Brittonia 39: 51–58. doi: 10.2307/2806974
- De Carvalho-Sobrinho JG, De Queiroz LP (2010) Three new species of *Pseudobombax* (Malvaceae, Bombacoideae) from Brazil. Novon: A Journal for Botanical Nomenclature 20: 13–20. doi: 10.3417/2007054
- De Fraga CN, Saavedra MM (2006) Three new species of *Elvasia* (Ochnaceae) from the Brazilian Atlantic Forest, with an emended key for subgenus *Hostmannia*. Novon: A Journal for Botanical Nomenclature 16: 483–489. doi: 10.3417/1055-3177(2006)16[483:TNSOEO]2.0.CO;2
- Delprete PG, Achille F, Mouly A (2010) Four new combinations in *Chomelia* and *Stenostomum* (Rubiaceae, Guettardeae) from Central America, the Guianas and the Amazon Basin. Blumea - Biodiversity, Evolution and Biogeography of Plants 55: 164–170. doi: 10.3767/000651910X526906
- Díaz DMV (2013) Multivariate analysis of morphological and anatomical characters of *Calophyllum* (Calophyllaceae) in South America. Botanical Journal of the Linnean Society 171: 587–626. doi: 10.1111/boj.12012
- Endress ME, Liede-Schumann S, Ulrich M (2014) An updated classification for Apocynaceae. Phytotaxa 159: 175–194. doi: 10.11646/phytotaxa.159.3.2
- Esser H-J (2009a) Neotropical Euphorbiaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Euphorbiaceae.htm>
- Esser H-J (2009b) Neotropical Putranjivaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Putranjivaceae.htm>
- Every JLR (2009) Neotropical Stemonuraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of

- the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Stemonuraceae.htm>
- Every JLR (2010) Neotropical Picramniaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Picramniaceae.htm>
- Fernando ES, Quinn CJ (1995) Picramniaceae, a new family, and a recircumscription of Simaroubaceae. *Taxon*: 177–181.
- França F (2009) Neotropical Vochysiaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Vochysiaceae.htm>
- Funk V, Hollowell T, Berry P, Kelloff C, Alexand SN (2007) Checklist of the plants of the Guiana Shield (Venezuela: Amazonas, Bolivar, Delta Amacuro; Guyana, Surinam, French Guiana). United States National Herbarium, 584 pp.
- García-Villacorta R, Hammel BE (2004) A noteworthy new species of *Tovomita* (Clusiaceae) from Amazonian white sand forests of Peru and Colombia. *Brittonia* 56: 132–135. doi: 10.1663/0007-196X(2004)056[0132:ANNSOT]2.0.CO;2
- Gentry AH (1992) *Flora Neotropica* Vol25(II): Bignoniaceae. The New York Botanical Garden Press, 367 pp.
- Gentry AH (1993) A field guide to the families and genera of woody plants of northwest South America (Colombia, Ecuador, Peru), with supplementary notes on herbaceous taxa. Washington, DC : Conservation International, 920 pp.
- Goodwin ZA, Harris DJ, Filer D, Wood JRI, Scotland RW (2015) Widespread mistaken identity in tropical plant collections. *Current Biology* 25: R1066–R1067. doi: 10.1016/j.cub.2015.10.002
- Graham (2014) Ovary, fruit, and seed morphology of the Lythraceae. *International Journal of Plant Sciences* 175: 202–240. doi: 10.1086/674316
- Graham S, Cavalcanti TB (2009) Neotropical Lythraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Lythraceae.htm>
- Grosso M (2010) Neotropical Rutaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Rutaceae.htm>
- Grosso M, Simmons MP, Cappa JJ, Biral L, Lombardi JA (2014) A new species of *Maytenus* (Celastraceae) with fleshy fruits from eastern Brazil, with notes on the delimitation of *Maytenus*. *Systematic Botany* 39: 478–484. doi: 10.1600/036364414X680726
- Grose SO, Olmstead RG (2007) Taxonomic revisions in the polyphyletic genus *Tabebuia* s. l. (Bignoniaceae). *Systematic Botany* 32: 660–670. doi: 10.1600/036364407782250652
- Guimarães EF, Monteiro D (2010) Neotropical Piperaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Piperaceae.htm>

- Guitet S, Sabatier D, Brunaux O, Hérault B, Aubry-Kientz M, Molino J-F, Baraloto C (2014) Estimating tropical tree diversity indices from forestry surveys: a method to integrate taxonomic uncertainty. *Forest Ecology and Management* 328: 270–281. doi: 10.1016/j.foreco.2014.05.045
- Gustafsson MHG (2009) Neotropical Clusiaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Clusiaceae.htm>
- Hayden WJ (1990) Notes on Neotropical *Amanoa* (Euphorbiaceae). *Brittonia* 42: 260–270. doi: 10.2307/2806814
- Hekking WHA (1988) *Flora Neotropica* Vol46: Violaceae PartI. The New York Botanical Garden Press, 207 pp.
- Hiepko P (1993) *Flora of the Guianas* Vol14: Olacaceae, Opiliaceae. A.R.A. Görts-van Rijn, 3–39.
- Hiepko P (2000) *Flora Neotropica* Vol82: Opiliaceae. The New York Botanical Garden Press, 53 pp.
- Hopkins HCF *Flora Neotropica* Vol43: *Parkia* (Leguminosae: Mimosoideae). The New York Botanical Garden Press, 119 pp.
- Iltis HH, Cornejo X (2011) Two new genera and three new combinations in Neotropical Caparaceae. *Harvard Papers in Botany* 16: 65–70. doi: 10.3100/025.016.0110
- Jansen-Jacobs MJ (1988) *Flora of the Guianas* Vol4: Verbenaceae. A.R.A. Görts-van Rijn, 114 pp.
- Jansen-Jacobs MJ (2007) *Flora of the Guianas* Vol24: Hernandiaceae. Jansen-Jacobs, M.J., 1–12.
- Jansen-Jacobs MJ, Meijer W (1995) *Flora of the Guianas* Vol17: Tiliaceae. A.R.A. Görts-van Rijn, 5–49.
- Joppa LN, Roberts DL, Pimm SL (2011) The population ecology and social behaviour of taxonomists. *Trends in Ecology & Evolution* 26: 551–553. doi: 10.1016/j.tree.2011.07.010
- Kaastra RC (1982) *Flora Neotropica* Vol33: Pilocarpinae (Rutaceae). The New York Botanical Garden Press, 196 pp.
- Kallunki JA (1998) Revision of *Ticorea* Aubl. (Rutaceae, Galipeinae). *Brittonia* 50: 500–513. doi: 10.2307/2807761
- Kårehed J (2001) Multiple origin of the tropical forest tree family Icacinaceae. *American Journal of Botany* 88: 2259–2274. doi: 10.2307/3558388
- Kubitzki K, Renner S (1982) *Flora Neotropica* Vol31: Lauraceae I. The New York Botanical Garden Press, 124 pp.
- Landrum L, Kawasaki M (1997) The genera of Myrtaceae in Brazil: an illustrated synoptic treatment and identification keys. *Brittonia* 49: 508–536. doi: 10.2307/2807742
- Maas PJM, Maas-van de Kamer H (2012) Neotropical Ixonanthaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Ixonanthaceae.htm>
- Maas PJM, Westra LYT (1992) *Flora Neotropica* Vol57: *Rollinia*. The New York Botanical Garden Press, 188 pp.

- Maas PJM, Westra LYT, Chatrou LW (2003) Flora Neotropica Vol88: *Duguetia* (Annonaceae). The New York Botanical Garden Press, 274 pp.
- Madrinan S (2004) Flora Neotropica Vol92: *Rhodostemonodaphne* (Lauraceae). The New York Botanical Garden Press, 102 pp.
- Marcano-Berti L (1998) Flora of the Guianas Vol21: Vochysiaceae. A.R.A. Görts-van Rijn & Jansen-Jacobs, M.J., 1–44.
- Martinez RV, Phillips OL (2000) Allpahuayo: floristics, structure, and dynamics of a high-diversity forest in Amazonian Peru. *Annals of the Missouri Botanical Garden* 87: 499–527. doi: 10.2307/2666143
- Mazine FM, De Faria JEQ (2013) A new species of *Eugenia* (Myrtaceae) from South America. *Phytotaxa* 151: 53–57. doi: 10.11646/phytotaxa.151.1.5
- McKenna MJ, Simmons MP, Bacon CD, Lombardi JA (2011) Delimitation of the segregate genera of *Maytenus* s. l. (Celastraceae) based on morphological and molecular characters. *Systematic Botany* 36: 922–932. doi: 10.1600/036364411X604930
- Melo E, França F (2009) Neotropical Polygonaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Polygonaceae.htm>
- Mesquita MR, Ferraz IDK, Camargo JLC (2009) Angelim-vermelho, *Dinizia excelsa* Ducke. INPA, 12 pp.
- Michelangeli FA (2005) Flora Neotropica Vol98: *Tococa* (Melastomataceae). The New York Botanical Garden Press, 114 pp.
- Mitchell JD (1997) Flora of the Guianas Vol19: Anacardiaceae. A.R.A. Görts-van Rijn & Jansen-Jacobs, M.J., 79 pp.
- Molino J-F, Sabatier D, Prévost M-F, Frame D, Gonzalez S, Bilot-Guérin V (2009) Etablissement d'une liste des espèces d'arbres de la Guyane Française - Rapport final. IRD, 59 pp. doi: 10.3417/2006121
- Monro AK, Rodríguez A (2009) Three new species and a nomenclatural synopsis of *Urera* (Urticaceae) from Mesoamerica. *Annals of the Missouri Botanical Garden* 96: 268–285.
- Morales JF (2007) Estudios en las Apocynaceae Neotropicales: nuevas especies de *Lacmellea* (Rauvolfioideae, Willughbeae) para Sur América. *Brazilian Journal of Botany* 30: 205–210. doi: 10.1590/S0100-84042007000200005
- Mori SA, Cremers G, Gracie CA, De Granville JJ, Heald SV, Hoff M, Mitchell JD (2005) Guide to the vascular plants of Central French Guiana. Part 2. Dicotyledons. New York Botanical Garden, 944 pp.
- Mori SA, Prance GT Flora Neotropica Vol21(II): Lecythydaceae -PartII: The zygomorphic-flowered New World genera. The New York Botanical Garden Press, 373 pp.
- Mori SA, Prance GT (1993) Flora of the Guianas Vol12: Lecythydaceae. A.R.A. Görts-van Rijn, 135 pp.
- Morley T (1976) Flora Neotropica Vol15: Memecyleae (Melastomataceae). The New York Botanical Garden Press, 294 pp.
- Nee M (2001) A new species of *Banara* (Flacourtiaceae) from Bolivia. *Brittonia* 53: 472–475. doi: 10.1007/BF02809803



- Pendry CA (2003) Nine new species of *Ruprechtia* (Polygonaceae) from Central and South America. *Edinburgh Journal of Botany* 60: 19–42. doi: 10.1017/S0960428603000039
- Pennington TD (1981) *Flora Neotropica* Vol28: Meliaceae. The New York Botanical Garden Press, 461 pp.
- Pennington TD (1990) *Flora Neotropica* Vol52: Sapotaceae. The New York Botanical Garden Press, 770 pp.
- Poppendieck H (1981) *Flora Neotropica* Vol27: Cochlospermaceae. The New York Botanical Garden Press, 33 pp.
- Prance GT (1972a) *Flora Neotropica* Vol9: Chrysobalanaceae. Hafner Publishing Company, 409 pp.
- Prance GT (1972b) *Flora Neotropica* Vol11: Rhabdodendraceae. Hafner Publishing Company, 22 pp.
- Prance GT (1973) *Flora Neotropica* Vol12: Caryocaraceae. Hafner Publishing Company, 75 pp.
- Prance GT (1986) *Flora of the Guianas* Vol2: Chrysobalanaceae. A.R.A. Görts-van Rijn, 140 pp.
- Prance GT (2009a) Neotropical Caryocaraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Caryocaraceae.htm>
- Prance GT (2009b) Neotropical Proteaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Proteaceae.htm>
- Prance GT (2009c) Neotropical Rhabdodendraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Rhabdodendraceae.htm>
- Prance GT (2009d) Neotropical Rhizophoraceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Rhizophoraceae.htm>
- Prance GT, Mori SA (1979) *Flora Neotropica* Vol21(I): Lecythidaceae -PartI: The actinomorphic-flowered New World genera. The New York Botanical Garden Press, 268 pp.
- Prance GT, Stace GA *Flora of the Guianas* Vol27: Rhabdodendraceae, Proteaceae, Combretaceae, Dichapetalaceae. Jansen-Jacobs, M.J, 14–112.
- Ramos E, Lombardi JA (2009) Neotropical Sabiaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Sabiaceae.htm>
- Redden KM (2008) A new species of *Paloue* (Leguminosae: Caesalpinioideae: Detarieae) from Guyana, South America. *Brittonia* 60: 257–260. doi: 10.1007/s12228-008-9037-9
- Rejmánek M, Brewer SW (2001) Vegetative identification of tropical woody plants: state of the art and annotated bibliography. *Biotropica* 33: 214–228. doi: 10.1111/j.1744-7429.2001.tb00173.x
- Renner S, Hausner G (2005) *Flora Neotropica* Vol95: Siparunaceae. The New York Botanical Garden Press, 247 pp.



- Ribeiro RD, Cardoso DBOS, De Lima HC (2015) A new species of *Hymenaea* (Leguminosae: Caesalpinioideae) with a revised identification key to the genus in the Brazilian Atlantic Forest. *Systematic Botany* 40: 151–156. doi: 10.1600/036364415X686440
- Rodrigues RS, Goulart de Acevedo Tozzi AM (2006) *Guianodendron*, a new genus of Leguminosae (Papilionoideae) from South America. *Novon: A Journal for Botanical Nomenclature* 16: 129–132. doi: 10.3417/1055-3177(2006)16[129:GANGOL]2.0.CO;2
- Rodrigues RS, Goulart de Acevedo Tozzi AM (2008) A new species of *Lonchocarpus* (Leguminosae, Papilionoideae) from Mato Grosso do Sul, Brazil. *Brittonia* 60: 34–37. doi: 10.1007/s12228-008-9010-7
- Rohwer JG (1993) *Flora Neotropica Vol60: Lauraceae: Nectandra*. The New York Botanical Garden Press, 332 pp.
- Romanov MS, Endress PK, Bobrov AVFC, Melikian AP, Bejerano AP (2007) Fruit structure and systematics of Monimiaceae s.s. (Laurales). *Botanical Journal of the Linnean Society* 153: 265–285. doi: 10.1111/j.1095-8339.2007.00609.x
- Rudd VE (1981) Two new species of *Paramachaerium* (Leguminosae) and a brief résumé of the genus. *Brittonia* 33: 435–440. doi: 10.2307/2806433
- Santo FdSdE, da Silva-Castro MM, Rapini A (2012) Two new species of *Handroanthus* Mattos (Bignoniaceae) from the state of Bahia, Brazil. *Acta Botanica Brasilica* 26: 651–657. doi: 10.1590/S0102-33062012000300014
- Sastre (2007) Six nouvelles espèces d'*Ouratea* (Ochnaceae) des Guyanes. *Adansonia* 29: 77–91.
- Scharf U, Maas PJM, Prévost MF (2008) An unusual new species of *Guatteria* (Annonaceae) from French Guiana and adjacent Brazil (Amapá). *Blumea - Biodiversity, Evolution and Biogeography of Plants* 53: 515–523. doi: 10.3767/000651908X607468
- Schmiedel U, Araya Y, Bortolotto MI, Boeckenhoff L, Hallwachs W, Janzen D, Kolipaka SS, Novotny V, Palm M, Parfondry M, Smanis A, Toko P (2016) Contributions of paracologists and parataxonomists to research, conservation, and social development. *Conservation Biology* 30: 506–519. doi: 10.1111/cobi.12661
- Schneider JV, Zizka G (2012a) *Quiina maracaensis* J. V. Schneid. & Zizka and *Quiina zamorensis* J. V. Schneid. & Zizka (Quiinaceae), Two new species of *Quiina* Aubl. from the Neotropics. *Candollea* 67: 261–267.
- Schneider JV, Zizka G (2012b) Taxonomic revision of the Neotropical genus *Lacunaria* (Quiinaceae / Ochnaceae s. l.). *Systematic Botany* 37: 165–188.
- Secco R (2004) *Flora Neotropica Vol93: Alchorneae* (Euphorbiaceae). The New York Botanical Garden Press, 194 pp.
- Shepherd J, Alverson W (1981) A new *Catostemma* (Bombacaceae) from Colombia. *Brittonia* 33: 587–590. doi: 10.2307/2806768
- Silva MJ (2009) Neotropical Phyllanthaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) *Neotropikey - Interactive key and information resources for flowering plants of the Neotropics*. <http://www.kew.org/science/tropamerica/neotropikey/families/Phyllanthaceae.htm>
- Silverstone-Sopkin PA (2015) A new species of *Chloroleucon* (Leguminosae, Mimosoideae) from the Cauca Valley, Colombia. *Novon: A Journal for Botanical Nomenclature* 24: 50–54. doi: 10.3417/2014027

- Sleumer HO (1980) *Flora Neotropica* Vol22: Flacourtiaceae. The New York Botanical Garden Press, 499 pp.
- Sleumer HO (1984) *Flora Neotropica* Vol38: Olacaceae. The New York Botanical Garden Press, 158 pp.
- Sothers C, Prance GT, Buerki S, De Kok R, Chase MW (2014) Taxonomic novelties in Neotropical Chrysobalanaceae: towards a monophyletic *Couepia*. *Phytotaxa* 172: 176–200. doi: 10.11646/phytotaxa.172.3.2
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (1995) *Flora of the Venezuelan Guayana* Vol2: Acanthaceae-Araceae. Missouri Botanical Garden Press, 256–541.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (1997) *Flora of the Venezuelan Guayana* Vol3: Araliaceae-Cactaceae. Missouri Botanical Garden Press, 774 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (1998) *Flora of the Venezuelan Guayana* Vol4: Caesalpiniaceae-Ericaceae. Missouri Botanical Garden Press, 799 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (1999) *Flora of the Venezuelan Guayana* Vol5: Eriocaulaceae-Lentibulariaceae. Missouri Botanical Garden Press, 833 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (2001) *Flora of the Venezuelan Guayana* Vol6: Liliaceae-Myrsinaceae. Missouri Botanical Garden Press, 803 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (2003) *Flora of the Venezuelan Guayana* Vol7: Myrtaceae-Plumbaginaceae. Missouri Botanical Garden Press, 200 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (2004) *Flora of the Venezuelan Guayana* Vol8: Poaceae-Rubiaceae. Missouri Botanical Garden Press, 874 pp.
- Steyermark JA, Berry PE, Yatskievych K, Holst BK (2005) *Flora of the Venezuelan Guayana* Vol9: Rutaceae-Zygophyllaceae. Missouri Botanical Garden Press, 600 pp.
- Teichert H, Dötterl S, Frame D, Kirejtshuk A, Gottsberger G (2012) A novel pollination mode, saprocanthrophily, in *Duguetia cadaverica* (Annonaceae): A stinkhorn (Phallales) flower mimic. *Flora - Morphology, Distribution, Functional Ecology of Plants* 207: 522–529. doi: 10.1016/j.flora.2012.06.013
- ter Steege H, Pitman NCA, Sabatier D, Baraloto C, Salomão RP, Guevara JE, Phillips OL, Castilho CV, Magnusson WE, Molino J-F, Monteagudo A, Núñez Vargas P, Montero JC, Feldpausch TR, Coronado ENH, Killeen TJ, Mostacedo B, Vasquez R, Assis RL, Terborgh J, Wittmann F, Andrade A, Laurance WF, Laurance SGW, Marimon BS, Marimon B-H, Guimarães Vieira IC, Amaral IL, Brienen R, Castellanos H, Cárdenas López D, Duivenvoorden JF, Mogollón HF, Matos FDdA, Dávila N, García-Villacorta R, Stevenson Diaz PR, Costa F, Emilio T, Levis C, Schiatti J, Souza P, Alonso A, Dallmeier F, Montoya AJD, Fernandez Piedade MT, Araujo-Murakami A, Arroyo L, Gribel R, Fine PVA, Peres CA, Toledo M, Aymard C. GA, Baker TR, Cerón C, Engel J, Henkel TW, Maas P, Petronelli P, Stropp J, Zartman CE, Daly D, Neill D, Silveira M, Paredes MR, Chave J, Lima Filho DdA, Jørgensen PM, Fuentes A, Schöngart J, Cornejo Valverde F, Di Fiore A, Jimenez EM, Peñuela Mora MC, Phillips JF, Rivas G, van Andel TR, von Hildebrand P, Hoffman B, Zent EL, Malhi Y, Prieto A, Rudas A, Ruschell AR, Silva N, Vos V, Zent S, Oliveira AA, Schutz AC, Gonzales T, Trindade Nascimento M, Ramirez-Angulo H, Sierra R, Tirado M, Umaña Medina MN, van der Heijden G, Vela CIA, Vilanova Torre E, Vriesendorp C, Wang O, Young KR, Baider C, Balslev H, Ferreira C, Mesones I, Torres-Lezama A, Urrego

- Giraldo LE, Zagt R, Alexiades MN, Hernandez L, Huamantupa-Chuquimaco I, Milliken W, Palacios Cuenca W, Pauletto D, Valderrama Sandoval E, Valenzuela Gamarra L, Dexter KG, Feeley K, Lopez-Gonzalez G, Silman MR (2013) Hyperdominance in the Amazonian tree flora. *Science* 342. doi: 10.1126/science.1243092
- Ung V, Dubus G, Zaragüeta-Bagils R, Vignes-Lebbe R (2010) Xper2: introducing e-taxonomy. *Bioinformatics* 26: 703–704. doi: 10.1093/bioinformatics/btp715
- Vasquez Martinez R (2013) Una nueva especie de *Hasseltia* (Salicaceae) del Perú. *Arnaldoa* 20: 253–258.
- Westra LYT, Maas PJM (2012) *Tetrameranthus* (Annonaceae) revisited including a new species. *PhytoKeys* 1–21.
- Woodgyer EM (2009) Neotropical Melastomataceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Melastomataceae.htm>
- Wurdack JJ, Renner S, Morley T (1993) Flora of the Guianas Vol13: Melastomataceae. A.R.A. Görts-van Rijn, 426 pp.
- Zappi D (2009) Neotropical Caricaceae. In: Milliken W, Klitgård B, Baracat A (2009 onwards) Neotropikey - Interactive key and information resources for flowering plants of the Neotropics. <http://www.kew.org/science/tropamerica/neotropikey/families/Caricaceae.htm>

## Supplementary material I

### Taxonomic ranks

Authors: Julien Engel, Louise Brousseau, Christopher Baraloto

Data type: list of genera

Explanation note: Taxonomic coverage of the electronic key 'GuiaTreeKey': Kingdom, Phylum, Class, Order, Family, Genus

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