



UNIVERSIDADE ESTADUAL DE CAMPINAS

INSTITUTO DE BIOLOGIA

GUSTAVO HIROAKI SHIMIZU

**Phylogenetic, taxonomic and nomenclatural studies in  
*Vochysiaceae* and synopsis of *Vochysia* in Brazil**

**Estudos filogenéticos, taxonômicos e nomenclaturais em  
*Vochysiaceae* e sinopse de *Vochysia* no Brasil**

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## RESUMO

O presente trabalho apresenta contribuições à sistemática de Vochysiaceae, na forma dos seguintes capítulos: (1) estudo filogenético molecular de Vochysiaceae, acompanhado por investigação de possíveis sinapomorfias morfológicas; (2) tipificações e sinonimizicações em *Vochysia*; (3) nomenclator para as espécies de *Vochysia* ocorrentes no Brasil; (4) correta atribuição do lectótipo de *Vochysia guianensis* Aubl. e (5) descrição de uma nova espécie de *Qualea*. No estudo filogenético foram recuperados três principais clados: Erismeeae (*Erisma* e *Erismadelphus*), QRC (*Qualea*, *Ruizterania* e *Callisthene*) e VS (*Vochysia* e *Salvertia*), mas sem muita resolução sobre a relação entre eles. *Erisma* surgiu como grupo-irmão de *Erismadelphus*, a maioria das espécies de *Callisthene* foi agrupada em um clado, as linhagens de *Qualea* e *Ruizterania* formaram uma politomia, e *Salvertia* surgiu como grupo-irmão de *Vochysia*. Apesar da formação de um clado, sua relação com *C. fasciculata* Mart. é incerta, pois não foi encontrada resolução. *Ruizterania*, por sua vez, foi incorporado a *Qualea*. Algumas das categorias infragenéricas, previamente baseadas exclusivamente em atributos morfológicos, foram corroboradas como monofiléticas pelos dados moleculares. Entre os caracteres morfológicos mapeados, quatro tiveram estados representados como potenciais sinapomorfias para a família: ausência de glândulas translúcidas nas folhas, presença de cálcar ou proeminência bursiforme na quarta sépala, estame ereto no botão floral e presença de um único estame fértil. Outros nove estados de caráter também foram tidos como potenciais sinapomorfias para alguns clados principais. Em relação aos estudos nomenclaturais de espécies de *Vochysia* no Brasil, 26 lectotipificações foram propostas, sendo 21 de segundo passo e uma outra associada a um epítipo. Quatro novos sinônimos foram também propostos. O nomenclator apresenta uma compilação e análise de informações dos 86 nomes de espécies de *Vochysia* ocorrentes no Brasil, além de alguns de variedades. São apresentados publicação original, dados sobre os tipos, sinonímia, posicionamento infragenérico e distribuição geográfica atualizada para as espécies aceitas. A correta atribuição do lectótipo de *V. guianensis*, espécie-tipo do gênero, foi esclarecida também. O espécime do herbário P (Museu Nacional de História Natural de Paris) havia sido designado antes do espécime do herbário BM (Museu de História Natural de Londres), erroneamente tratado como lectótipo na revisão mais recente de *Vochysia*. A nova espécie de *Qualea* do Piauí pertence a *Qualea* sect. *Costatifolium* Stafleu e é endêmica da área de Serra das Confusões. Também é fornecida uma comparação com *Q. grandiflora* Mart. e *Q. parviflora* Mart., as outras espécies do gênero que ocorrem na Caatinga.

## ABSTRACT

The present work explores the systematics of Vochysiaceae, through the following chapters: (1) molecular phylogenetic study of Vochysiaceae, along with investigation on possible morphological synapomorphies; (2) typifications and synonymizations in *Vochysia*; (3) nomenclator for the species of *Vochysia* occurring in Brazil; (4) the correct assignment of the lectotype of *Vochysia guianensis* Aubl. and (5) description of a new species of *Qualea*. In the phylogenetic study three main clades were recovered: Erismeeae (*Erisma* and *Erismadelphus*), QRC (*Qualea*, *Ruizterania* and *Callisthene*) and VS (*Vochysia* and *Salvertia*), but there is no strong resolution in their relationships. *Erisma* emerged as sister group to *Erismadelphus*, most species of *Callisthene* was grouped in a clade, *Qualea* and *Ruizterania* lineages formed a polytomy, and *Salvertia* is the sister group to *Vochysia*. Although the formation of a clade, its relationship with *C. fasciculata* Mart. is uncertain, because there was no resolution found. *Ruizterania*, in turn, was incorporated into *Qualea*. Several of the infrageneric categories, previously based exclusively on morphological traits, were corroborated as monophyletic by the molecular data. Among the morphological traits mapped, four have states represented as potential synapomorphies for the family: absence of translucent glands in the leaves, presence of a spur or bursiform prominence in the fourth sepal, the erect stamen in the flower bud and only one fertile stamen. Other nine character states are also potential synapomorphies for major clades. Regarding the nomenclatural studies of species of *Vochysia* in Brazil, 26 lectotypifications were proposed, being 21 of second-step and another one associated to an epitype. Four new synonyms were also proposed. The nomenclator presents a compilation and analysis of information for the 86 names of species of *Vochysia* occurring in Brazil, as well as for some varieties. Original publication, data on types, synonymy, infrageneric placement and updated geographic distribution for the accepted species are given. The correct assignment of the lectotype of *V. guianensis*, type species of the genus, was also clarified. The specimen from herbarium P (National Museum of Natural History of Paris) was designated before the specimen from herbarium BM (Natural History Museum of London), erroneously treated as lectotype in the most recent revision of *Vochysia*. The new species of *Qualea* from Piauí belongs to *Qualea* sect. *Costatifolium* Stafleu and is endemic to the Serra das Confusões area. A comparison with *Q. grandiflora* Mart. and *Q. parviflora* Mart., the other species of the genus occurring in the Caatinga, is also provided.



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## Introdução Geral

Grupo de estudo: Vochysiaceae

Vochysiaceae A.St.-Hil. é uma pequena família de Angiospermas da ordem Myrtales, que compreende oito gêneros e cerca de 240 espécies, sendo representada no Brasil por seis gêneros e cerca de 160 espécies. São geralmente árvores, com folhas de filotaxia oposta ou verticilada, simples, flores zigomorfas, isoladas ou em inflorescência geralmente tirso, cálice geralmente calcarado, corola geralmente com número reduzido de pétalas e um único estame fértil. A família é dividida tradicionalmente em duas tribos: Vochysieae Dumort. e Erismeae Dumort. Vochysieae, caracterizada por ovário súpero e trilocular, é composta por cinco gêneros: *Callisthene* Mart. (11 spp.), *Qualea* Aubl. (ca. 50 spp.), *Ruizterania* Marc.-Berti (14 spp.), *Salvertia* A.St.-Hil. (1 sp.) e *Vochysia* Aubl. (ca. 140 spp.). Já Erismeae, caracterizada por ovário ínfero e unilocular, compreende três gêneros: *Erisma* Rudge (16 spp.), *Erismadelphus* Mildbr. (2 spp.) e *Korupodendron* Litt & Cheek (1 sp.).

Warming (1875) realizou a primeira grande revisão para as Vochysiaceae ocorrentes no Brasil, reconhecendo 97 espécies nos gêneros *Callisthene*, *Erisma*, *Qualea*, *Salvertia* e *Vochysia*. Este autor utilizou caracteres como posição do ovário, número de lóculos, número de pétalas, tipo de fruto e tipo de tricomas para separar os gêneros. Stafleu foi o segundo autor a realizar revisões abrangentes para os gêneros de Vochysiaceae, contemplando por sua vez todas as espécies conhecidas à época (Stafleu 1948, 1952, 1953, 1954; Keay & Stafleu 1953). Para o reconhecimento dos gêneros, utilizou as mesmas características distintivas adotadas por Warming (1875), porém, com o acréscimo do gênero *Erismadelphus* (Keay & Stafleu 1953). Para *Callisthene* (Stafleu 1952) e *Erisma* (Stafleu 1954), apenas nomeou as seções criadas por Warming (1875) mas, para *Vochysia* (Stafleu 1948) e *Qualea* (Stafleu 1953), alterou e criou novos grupos infragênicos (Tabela 1). *Vochysia* foi dividida em três seções, com base na pilosidade do ovário, na descamação da casca dos ramos, presença de pétalas e pilosidade do estame. *Qualea* foi separada em dois subgêneros, sendo um deles subdividido em quatro seções, tendo como caracteres taxonomicamente importantes pilosidade da pétala, presença de calcar, densidade de nervuras laterais foliares, pilosidade da antera, forma do botão floral e tipo de inflorescência.

Entre as mudanças taxonômicas mais importantes após os trabalhos de Stafleu, estão a elevação de *Qualea* sect. *Trichanthera* a *Ruizterania* (Marcano-Berti 1969), a exclusão da divisão de *Erisma* em seções (Kawasaki 1998), a descoberta e estabelecimento de *Korupodendron* (Litt & Cheek 2002) e o reconhecimento de *Vochysia* sect. *Apopetala*, ao unir as espécies que partilham ovário glabro e ausência de pétalas (Marcano-Berti 2014). Embora a maioria dos trabalhos de cunho taxonômico atualmente reconheça *Ruizterania* como um gênero à parte, como na Lista de Espécies da Flora do Brasil (Brazil Flora Group 2015), há estudos que não corroboram sua circunscrição fora de *Qualea* (p. ex.: Litt 1999; Sajo & Rudall 2002). Por sua vez, Kawasaki (2007) incluiu *Ruizterania* em *Qualea*, mas não sinonimizou formalmente as espécies de *Ruizterania* sob *Qualea*.

**Tabela 1.** Comparação entre as classificações infragenéricas de Warming e de Stafleu.

	<b>Warming (1875)</b>	<b>Stafleu (1948, 1952, 1953, 1954)</b>	
<i>Callisthene</i>	Seção I	Seção <i>Cataphyllantha</i>	
	Seção II	Seção <i>Callisthene</i>	
<i>Erisma</i>	Seção I	Seção <i>Erisma</i>	
	Seção II	Seção <i>Rixa</i>	
<i>Qualea</i>	Série <i>Amphilochia</i>	Subgênero <i>Qualea</i>	
	Série <i>Calophylloideae</i>	Seção <i>Qualea</i>	
	Série <i>Costatae</i>		Seção <i>Trichanthera</i>
			Seção <i>Costatifolium</i>
			Seção <i>Polytrias</i>
	Subgênero <i>Amphilochia</i>		
<i>Vochysia</i>	Série <i>Calophylloideae</i>	Seção <i>Vochysiella</i>	
	Série <i>Decorticantes</i>	Subseção <i>Decorticantes</i>	
	Série <i>Ferrugineae</i>	Subseção <i>Calophylloideae</i>	
	Série <i>Lutescentes</i>	Seção <i>Ciliantha</i>	
	Série <i>Micranthae</i>	Subseção <i>Micranthae</i>	

Subseção *Lutescentes*

Subseção *Discolores*

Subseção *Ferrugineae*

Subseção *Chrysophyllae*

Subseção *Megalanthae*

Seção *Pachyantha*

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Revisões mais recentes incluem a de Martins (1981) para *Callisthene*, Kawasaki (1998) para *Erisma* e Lisboa (2000) para *Qualea* subgênero *Amphilochia* (Mart.) Stafleu. Novas revisões que focuem também nos grupos mais ricos em espécies, como *Vochysia* e *Q.* subgênero *Qualea*, são altamente desejáveis.

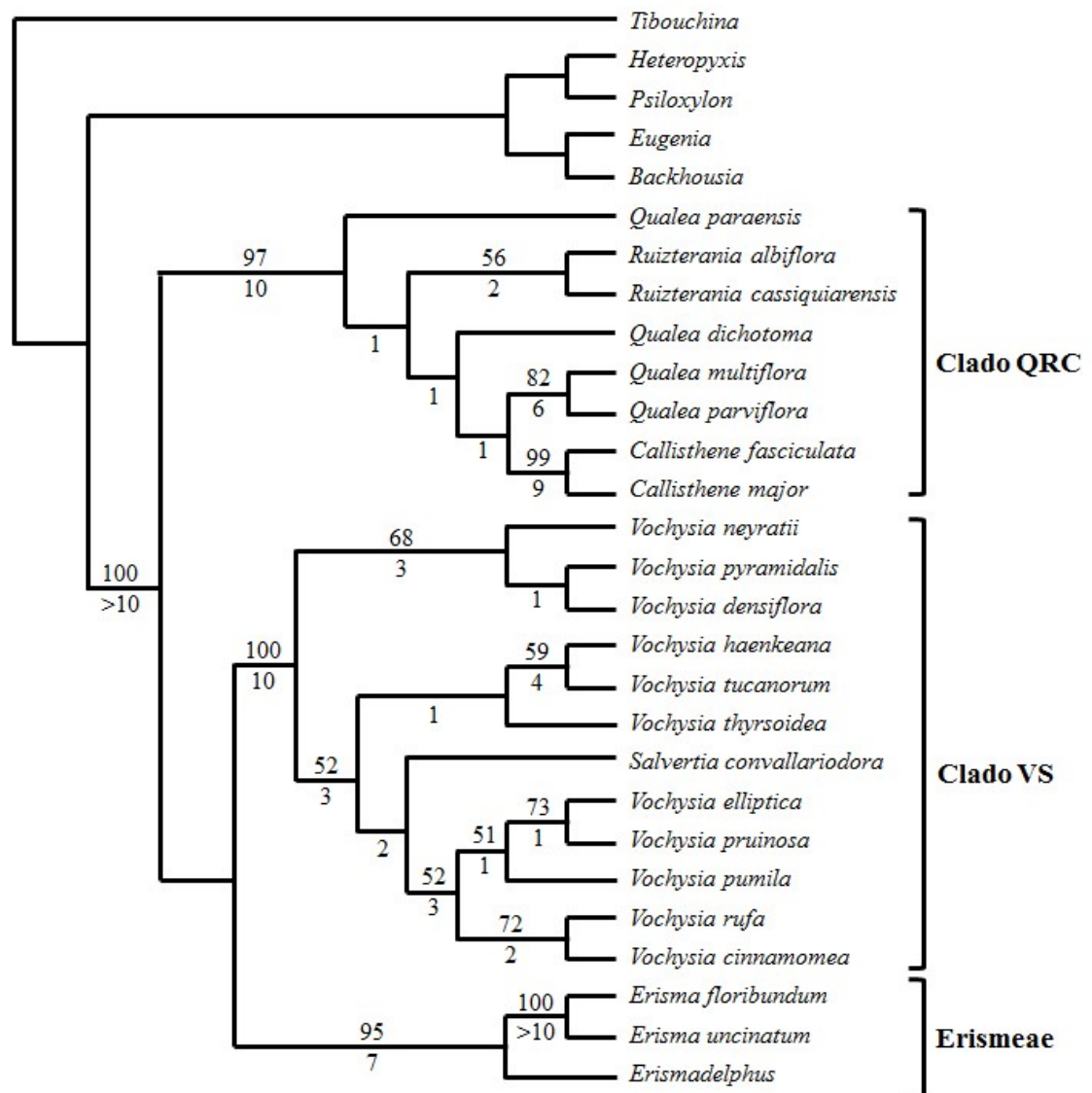
A distribuição da família é anfi-atlântica, mas predominantemente Neotropical (seis dos oito gêneros), sendo apenas *Erismadelphus* e *Korupodendron* exclusivos do oeste e centro da África, ocorrendo em Camarões, Guiné Equatorial, Gabão, República do Congo e República Democrática do Congo (Key & Stafleu 1953; Litt & Cheek 2002; Senterre & Obiang 2005). No continente americano, Vochysiaceae distribui-se no México, América Central, Colômbia, Venezuela, Guiana, Suriname, Guiana Francesa, Equador, Peru, Brasil, Bolívia, Paraguai e Argentina (Marcano-Berti 2005), ocorrendo em florestas tropicais e savanas, principalmente no Brasil (Kawasaki 1998). O padrão de distribuição anfi-atlântico confere à família grande interesse fitogeográfico (p. ex.: Axelrod 1970; Thorne 1972). De acordo com estudos de biogeografia histórica (Sytsma *et al.* 2004; Berger *et al.* 2016), provavelmente um evento de dispersão a longa distância possa explicar esse padrão.

A família Vochysiaceae está bem representada na flora brasileira, em diferentes ecossistemas, tendo seus centros de diversidade situados nas regiões Guiano-Amazônica, Planalto Central Brasileiro e na Floresta Atlântica (Vianna 2006). É um grupo muito importante na caracterização de fitofisionomias, sendo considerada um componente típico nas comunidades vegetais de cerrado (Sarmiento 1983).

Apesar de frequentemente relacionada nos sistemas tradicionais de classificação às Polygalaceae e Trigoniaceae, por características morfológicas como flores zigomorfas (p. ex.: Cronquist 1981; Takhtajan 1997), estudos filogenéticos moleculares (Conti *et al.* 1996, 1997)

posicionam Vochysiaceae na ordem Myrtales, como grupo-irmão de Myrtaceae (Sytsma *et al.* 2004; Berger *et al.* 2016). A associação das Vochysiaceae a esta ordem também é evidenciada pela ocorrência conjunta de floema intraxilemático e de pontoações areoladas guarnecidas nos elementos de vaso, característica de Myrtales (Metcalfe & Chalk 1950; van Vliet & Baas 1984; Jansen *et al.* 2008).

Dentro da ordem Myrtales vários estudos filogenéticos foram feitos para inferir as relações infrafamiliares, sendo que apenas Vochysiaceae não apresenta um estudo mais abrangente. Tan *et al.* (2002) e Maurin *et al.* (2010) realizaram para Combretaceae, Levin *et al.* (2003, 2004) e Ford & Gottlieb (2007) para Onagraceae, Graham *et al.* (2005, 2011) para Lythraceae, Lucas *et al.* (2005, 2007) e Wilson *et al.* (2005) para Myrtaceae, Clausing & Renner (2001) para Melastomataceae e Schönenberger & Conti (2003) para o clado CAROP, atualmente formado pelas famílias Crypteroniaceae, Alzateaceae e Penaeaceae (APG IV 2016). O único estudo filogenético focado exclusivamente em Vochysiaceae foi desenvolvido por Litt (1999), utilizando 23 espécies. Neste estudo, a autora testou o monofiletismo da família e de seus gêneros constituintes, e também da classificação atual em um contexto filogenético, a partir de dados morfo-anatômicos e macromoleculares (sequências parciais do gene *matK*). Os resultados deste trabalho sustentam o monofiletismo de Vochysiaceae, mas são incertos quanto ao monofiletismo das duas tribos reconhecidas em classificações tradicionais, Erismeeae e Vochysieae. Na filogenia obtida por Litt (1999) (Fig. 1), três clados principais podem ser reconhecidos: 1- *Erisma* e *Erismadelphus* (Erismeeae), 2- *Qualea*, *Ruizterania* e *Callisthene* (QRC) e 3- *Vochysia* e *Salvertia* (VS). *Korupodendron*, descrito posteriormente, não fez parte da análise. As relações entre estes clados são inconclusivas, uma vez que Erismeeae surge ora como possível grupo-irmão do clado QRC, ora como potencial grupo-irmão do clado VS. Ainda de acordo com os resultados obtidos, Litt (1999) sugere mudanças na circunscrição de alguns gêneros. Segundo a autora, *Ruizterania* e *Callisthene* deveriam ser incluídos em *Qualea*, e *Salvertia* em *Vochysia*. Todavia, a autora não propôs formalmente essas mudanças, por entender que os resultados obtidos eram preliminares e dependiam de uma maior amostragem de espécies para que os limites genéricos fossem devidamente testados em um contexto filogenético.



**Figura 1.** Uma das duas árvores mais parcimoniosas da análise de dados combinados de Litt (1999). Porcentagens de *bootstrap* > 50% são indicadas acima dos ramos e o índice de Bremer é indicado abaixo. QRC= *Qualea*, *Ruizterania* e *Callisthene*; VS= *Vochysia* e *Salvertia*. Adaptado de Litt (1999).

A separação de *Vochysieae* em dois grupos distintos, QRC e VS, também é corroborada por dados não-moleculares, como a estrutura da superfície estigmática (Carmo-Oliveira & Morretes 2009) e padrões de ácidos graxos de sementes (Mayworm & Salatino 2002). A separação dos gêneros *Qualea* e *Ruizterania*, questionada por Litt (1999), também não é sustentada por dados anatômicos (Sajo & Rudall 2002; León 2003).

## Objetivos

A fim de contribuir tanto com os avanços nos estudos filogenéticos na família, ainda incipientes, quanto com os estudos taxonômicos e nomenclaturais em Vochysiaceae, esta tese é composta de cinco capítulos, apresentados no formato de artigos:

### **Capítulo 1:** Molecular phylogenetics and trends in character evolution in Vochysiaceae

A partir de uma amostragem taxonômica mais abrangente, visa a reconstruir uma hipótese filogenética para a família, que possibilite responder: (1) se as tribos e gêneros são monofiléticos; (2) se há sustentação para alguma das categorias infragenéricas em uso; e (3) se há possíveis sinapomorfias para os diferentes clados surgidos das análises filogenéticas moleculares. (manuscrito a ser submetido à Taxon)

### **Capítulo 2:** Typifications and new synonyms in *Vochysia* (Vochysiaceae)

Após estudo nomenclatural sobre as espécies de *Vochysia* ocorrentes no Brasil, são apresentadas tipificações e novos sinônimos, visando à atualização das informações sobre o gênero, uma vez que a última obra mais abrangente data de 1948. (manuscrito a ser submetido à Taxon)

### **Capítulo 3:** A nomenclator for the genus *Vochysia* (Vochysiaceae) in Brazil

É apresentada uma lista anotada dos nomes aceitos, tipos nomenclaturais, principais sinônimos, classificação infragenérica segundo Stafleu e distribuição geográfica das espécies de *Vochysia* ocorrentes no Brasil. Quando necessário, comentários nomenclaturais também são apresentados. (manuscrito a ser submetido à Phytotaxa)

### **Capítulo 4:** The correct assignment of the lectotype of *Vochysia guianensis* (Vochysiaceae)

Nessa correspondência alerta-se sobre a correta atribuição do lectótipo de *Vochysia guianensis*. (correspondência publicada na Phytotaxa)

**Capítulo 5:** A remarkable new species of *Qualea* (Vochysiaceae) from Piauí state, Brazil

Uma nova espécie de *Qualea* do Piauí, pertencente a *Qualea* sect. *Costatifolium*, é descrita e ilustrada. (manuscrito submetido à Phytotaxa)



## Referências

- APG IV. 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181: 1-20.
- Axelrod, D.I. 1970. Mesozoic paleogeography and early angiosperm history. *The Botanical Review* 36: 277-319.
- Berger, B.A., Kriebel, R., Spalink, D. & Sytsma, K.J. 2016. Divergence times, historical biogeography and shifts in speciation rates of Myrtales. *Molecular Phylogenetics and Evolution* 95: 116-136.
- Brazil Flora Group 2015. Growing knowledge: an overview of seed plant diversity in Brazil. *Rodriguésia* 66: 1085-1113.
- Carmo-Oliveira, R. & Morretes, B.L. 2009. Stigmatic surface in the Vochysiaceae: reproductive and taxonomic implications. *Acta Botanica Brasilica* 23 (3): 780-785.
- Clausing, G. & Renner, S.S. 2001. Molecular phylogenetics of Melastomataceae and Memecylaceae: implications for character evolution. *American Journal of Botany* 88 (3): 486-498.
- Conti, E., Litt, A. & Sytsma, K.J. 1996. Circumscription of Myrtales and their relationships to other Rosids: evidence from *rbcL* sequence data. *American Journal of Botany* 83 (2): 221-233.
- Conti, E., Litt, A., Wilson, P.G., Graham, S.A., Briggs, B.G., Johnson, L.A.S. & Sytsma, K.J. 1997. Interfamilial relationships in Myrtales: molecular phylogeny and patterns of morphological evolution. *Systematic Botany* 22 (4): 629-647.
- Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia University Press, New York.
- Ford, V.S. & Gottlieb, L.D. 2007. Tribal relationships within Onagraceae inferred from *PgiC* sequences. *Systematic Botany* 32 (2): 348-356.
- Graham, S.A., Hall, J., Sytsma, K., & Shi, S. 2005. Phylogenetic analysis of the Lythraceae based on four gene regions and morphology. *International Journal of Plant Sciences* 166 (6): 995-1017.
- Graham, S.A., Diazgranados, M., & Barber, J.C. 2011. Relationships among the confounding genera *Ammannia*, *Hionanthera*, *Nesaea*, and *Rotala* (Lythraceae). *Botanical Journal of the Linnean Society* 166 (1): 1-19.

- Jansen, S., Pletsers, A., Rabaey, D. & Lens, F. 2008. Vestured pits: a diagnostic character in the secondary xylem of Myrtales. *Journal of Tropical Forest Science* 20 (4): 328-339.
- Kawasaki, M.L. 1998. Systematics of *Erisma* (Vochysiaceae). *Memoirs of New York Botanical Garden* 81: 1-40.
- Kawasaki, M.L. 2007. Vochysiaceae. *In* Kubitzki, K. (ed.). *The families and genera of vascular plants*. Vol. IX. Springer, Berlin. p. 480-487.
- Keay, R.W.J. & Stafleu, F.A. 1953. *Erismadelphus*. *Acta Botanica Neerlandica* 1: 594-599.
- León, W. 2003. Anatomía xilemática comparativa de los géneros *Qualea* y *Ruizterania* (Vochysiaceae). *Pittieria* 32: 69-81.
- Levin, R.A., Wagner, W.L., Hoch, P.C., Nepokroeff, M., Pires, J.C., Zimmer, E.A., & Sytsma, K.J. 2003. Family-level relationships of Onagraceae based on chloroplast *rbcL* and *ndhF* data. *American Journal of Botany* 90 (1): 107-115.
- Levin, R.A., Wagner, W.L., Hoch, P.C., Hahn, W.J., Rodriguez, A., Baum, D.A., Katinas, L., Zimmer, E.A., & Sytsma, K.J. 2004. Paraphyly in tribe Onagreae: insights into phylogenetic relationships of Onagraceae based on nuclear and chloroplast sequence data. *Systematic Botany* 29 (1): 147-164.
- Lisboa, M.L.G. 2000. Estudos taxonômicos sobre o subgênero *Amphilochia* (Mart.) Stafl., gênero *Qualea* Aubl. (Vochysiaceae A. St.-Hil.). Dissertação de mestrado. Universidade Estadual de Campinas, Campinas.
- Litt, A. 1999. Floral morphology and phylogeny of Vochysiaceae. PhD dissertation. City University of New York, New York.
- Litt, A. & Cheek, M. 2002. *Korupodendron songweanum*, a new genus and species of Vochysiaceae from West-Central Africa. *Brittonia* 54: 13-17.
- Lucas, E.J., Belsham, S.R., Nic Lughadha, E.M., Orlovich, D.A., Sakuragui, C.M., Chase, M.W. & Wilson, P.G. 2005. Phylogenetic patterns in the fleshy-fruited Myrtaceae – preliminary molecular evidence. *Plant Systematics and Evolution* 251 (1): 35-51.
- Lucas, E.J., Harris, S.A., Mazine, F.F., Belsham, S.R., Nic Lughadha, E.M., Telford, A., Gasson, P.E. & Chase, M.W. 2007. Suprageneric phylogenetics of Myrteae, the generically richest tribe in Myrtaceae (Myrtales). *Taxon* 56 (4): 1105-1128.
- Marcano-Berti, L. 1969. Un nuevo género de las Vochysiaceae. *Pittieria* 2: 3-27.
- Marcano-Berti, L. 2005. Vochysiaceae. *In* Berry, P.E., Holst, B.K. & Yatskievych, K. (eds.). *Flora of the Venezuelan Guayana*. Vol. 9. Rutaceae - Zygophyllaceae. Missouri Botanical Garden Press, Saint Louis. p. 500-524.

- Marcano-Berti, L. 2014. *Apopetala*, una nueva sección de *Vochysia* (Vochysiaceae). *Pittieria* 38: 15--42.
- Martins, H.F. 1981. O gênero *Callisthene* Martius (Vochysiaceae). Ensaio para uma revisão taxonômica. Dissertação de mestrado. Universidade Federal do Rio de Janeiro, Rio de Janeiro.
- Maurin, O., Chase, M.W., Jordaan, M. & van der Bank, M. 2010. Phylogenetic relationships of Combretaceae inferred from nuclear and plastid DNA sequence data: implications for generic classification. *Botanical Journal of the Linnean Society* 162 (3): 453-476.
- Mayworm, M.A.S. & Salatino, A. 2002. Distribution of seed fatty acids and the taxonomy of Vochysiaceae. *Biochemical Systematics and Ecology* 30: 961-972.
- Metcalfé, C.R. & Chalk, L. 1950. *Anatomy of the dicotyledons*. Vol. 1. Clarendon Press, Oxford.
- Sajo, M.G. & Rudall, P.J. 2002. Leaf and stem anatomy of Vochysiaceae in relation to subfamilial and suprafamilial systematics. *Botanical Journal of the Linnean Society* 138: 339-364.
- Sarmiento, G. 1983. The savannas of tropical America. In Bouliere, F. (ed.). *Ecosystems of the world: tropical savannas*. Elsevier, Amsterdam. p. 245-288.
- Schönenberger, J. & Conti, E. 2003. Molecular phylogeny and floral evolution of Penaeaceae, Oliniaceae, Rhynchocalycaceae, and Alzateaceae (Myrtales). *American Journal of Botany* 90 (2): 293-309.
- Senterre, B. & Obiang, D. 2005. Nouvelles découvertes à propos des Vochysiaceae africaines: *Erismadelphus* Mildbr. et *Korupodendron* Litt & Cheek. *Taxonomania* 17: 3-18.
- Stafleu, F.A. 1948. A monograph of Vochysiaceae. I. *Salvertia* and *Vochysia*. *Recueil des Travaux Botaniques Néerlandais* 41: 397-540.
- Stafleu, F.A. 1952. A monograph of Vochysiaceae. II. *Callisthene*. *Acta Botanica Neerlandica* 1: 222-242.
- Stafleu, F.A. 1953. A monograph of Vochysiaceae. III. *Qualea*. *Acta Botanica Neerlandica* 2: 144-217.
- Stafleu, F.A. 1954. A monograph of Vochysiaceae. IV. *Erisma*. *Acta Botanica Neerlandica* 3: 459-480.
- Sytsma, K.J., Litt, A., Zjhra, M.L., Pires, J.C., Nepokroeff, M., Conti, E., Walker, J. & Wilson, P.G. 2004. Clades, clocks, and continents: historical and biogeographical analysis of Myrtaceae, Vochysiaceae, and relatives in the southern hemisphere. *International Journal of Plant Sciences* 165 (suppl. 4): S85-S105.

- Takhtajan, A. 1997. Diversity and classification of flowering plants. Columbia University Press, New York.
- Tan, F., Shi, S., Zhong, Y., Gong, X. & Wang, Y. 2002. Phylogenetic relationships of Combretaceae (Combretaceae) inferred from plastid, nuclear gene and spacer sequences. *Journal of Plant Research* 115 (6): 475-481.
- Thorne, R.F. 1972. Major disjunctions in the geographic ranges of seed plants. *The Quarterly Review of Biology* 47 (4): 365-411.
- van Vliet, C.J.C. & Baas, P. 1984. Wood anatomy and classification of the Myrtales. *Annals of the Missouri Botanical Garden* 71: 783-800.
- Vianna, M.C. 2006. Vochysiaceae na Reserva Biológica de Poço das Antas, Silva Jardim, Rio de Janeiro, Brasil. *Rodriguésia* 57 (3): 659-666.
- Warming, E. 1875. Vochysiaceae. In Martius, C.F.P. (ed.). *Flora Brasiliensis*. Vol. XIII. R. Oldenburg, Monachii. p. 17-116.
- Wilson, P.G., O'Brien, M.M., Heslewood, M.M., & Quinn, C.J. 2005. Relationships within Myrtaceae *sensu lato* based on a *matK* phylogeny. *Plant Systematics and Evolution* 251 (1): 3-19.

## **Capítulo 1**

### **Molecular phylogenetics and trends in character evolution in Vochysiaceae**

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#### **Abstract**

Vochysiaceae is a small family within the order Myrtales, comprising eight genera and about 240 species. This study presents the largest molecular dataset to date for this group, using both plastid (*ndhF* gene) and nuclear (ITS1) DNA sequence data. One hundred and sixty new sequences and eight others retrieved from GenBank were analyzed using maximum parsimony and Bayesian inference. The combined analyses with seven genera and 64 species of Vochysiaceae aimed to test the monophyly of its tribes and genera, as well as start to unravel infrageneric relationships, and to find morphological synapomorphies for major clades. Three main clades were obtained: Erismeeae (*Erisma* and *Erismadelphus*), QRC (*Qualea*, *Ruizterania* and *Callisthene*) and VS (*Vochysia* and *Salvertia*), but there is no strong resolution in their relationships. *Erisma* is sister to *Erismadelphus*, *Callisthene* is uncertain, *Qualea* and *Ruizterania* lineages form a polytomy, and *Salvertia* is sister to *Vochysia*. *Ruizterania* is considered a synonym under *Qualea*. Several of the morphology-based infrageneric categories were corroborated as monophyletic by the molecular data, and some intriguing taxa, like *V. discolor* and *V. pseudopumila*, had their placement clarified. Among

the morphological traits mapped, four have states represented as potential synapomorphies for the family: absence of translucent glands in the leaves, presence of spur or bursiform prominence in the fourth sepal, erect stamen in the flower bud and only one fertile stamen. Other nine character states are also potential synapomorphies for major clades. New in-depth questions inside some groups can be driven based on the present results, but efforts to better resolve the backbone of the family will continue as well.

**Keywords:** ITS1; molecular phylogenetics; morphological character evolution; *ndhF*; plant systematics; Vochysiaceae

**Short title:** Phylogeny and character evolution of Vochysiaceae

## Introduction

Vochysiaceae encompasses eight genera and nearly 240 species, mostly Neotropical, but with an interesting amphi-Atlantic disjunct distribution pattern (e.g., Sytsma & al., 2004; Berger & al., 2016). They are usually trees, with opposite or whorled simple leaves, zygomorphic flowers, isolated or in thyrses, spurred calyx, corolla with a reduced number of petals, a single fertile stamen and dry fruits (e.g., Kawasaki, 2007). Some of their morphological diversity is represented in Fig. 1. The family is traditionally divided into two tribes: Vochysieae and Erismeeae (Dumortier, 1829; Stafleu, 1952; Kawasaki, 2007). Vochysieae, with mainly superior (Litt & Stevenson, 2003) trilocular ovary and loculicide capsule, is composed of five genera: *Callisthene* Mart. (11 spp.), *Qualea* Aubl. (ca. 50 spp.), *Ruizterania* Marc.-Berti (14 spp.), *Salvertia* A.St.-Hil. (1 sp.), and *Vochysia* Aubl. (ca. 140 spp.). Erismeeae is characterized by inferior unilocular ovary and indehiscent winged fruit, and comprises three genera: *Erisma* Rudge (16 spp.), *Erismadelphus* Mildbr. (2 spp.), and *Korupodendron* Litt & Cheek (1 sp.). An alternative division into two subfamilies, Erismoideae and Vochysioideae, was proposed by Takhtajan (2009), but the traditional classification is preferred by the specialists in the family.

A comparison of Warming's (1875) and Stafleu's (1948, 1952, 1953, 1954) classifications for the genera with infrageneric categories is shown in Table 1. After Stafleu, important taxonomic changes were the elevation of *Qualea* sect. *Trichanthera* Stafleu to *Ruizterania* (Marcano-Berti, 1969), the elimination of the subdivision into sections in *Erisma*

(Kawasaki, 1998), and the recognition of a new section in *Vochysia*, *Vochysia* sect. *Apopetala* Marc.-Berti (Marcano-Berti, 2014).

The raise of *Ruizterania* as a separate genus segregated from *Qualea*, based on characters such as barbate thecae, basifixed anther, and spurred sepal larger than other sepals (Marcano-Berti, 1969), is not a consensus. Several works accept this circumscription (e.g., Marcano-Berti, 2005; Rodríguez & Sanoja, 2008; Rodríguez & al., 2014; Brazil Flora Group, 2015; Marcano-Berti, 2016), while several others do not (e.g., Litt, 1999; Sajo & Rudall, 2002; León, 2003; Kawasaki, 2007; Takhtajan, 2009). Kawasaki (1998) agrees with the utility of the division proposed by Warming (1875) and followed by Stafleu (1954), based on the size and persistence of bracts, but decides not to use their systems in her taxonomic revision of *Erisma* (Kawasaki, 1998). The new section of *Vochysia* recognized by Marcano-Berti (2014), on the basis of glabrous ovary and absence of petals, gathers nine species previously assigned to other subsections of *Vochysia* sect. *Ciliantha* Stafleu, namely *Vochysia* subsect. *Ferrugineae* (Warm.) Stafleu and *Vochysia* subsect. *Lutescentes* (Warm.) Stafleu.

Six genera (*Callisthene*, *Erisma*, *Qualea*, *Ruizterania*, *Salvertia*, and *Vochysia*) occur in the Americas, ranging from Mexico to Brazil (Marcano-Berti, 2005), mostly inhabiting tropical rain forests and savannas (Kawasaki, 1998). The two African genera (*Erismadelphus* and *Korupodendron*) are found in forests of West-Central Africa (Keay & Stafleu, 1953; Litt & Cheek, 2002; Senterre & Obiang, 2005). According to historical biogeographic studies (Sytsma & al., 2004; Berger & al., 2016), this distribution pattern could be explained by a long-distance dispersal and establishment (LDDE) event.

**Table 1.** Comparison of two landmark classifications for the genera of Vochysiaceae with infrageneric categories.

	<b>Warming (1875)</b>	<b>Stafleu (1948, 1952, 1953, 1954)</b>
<i>Callisthene</i>	Section I	Section <i>Cataphyllantha</i>
	Section II	Section <i>Callisthene</i>
<i>Erisma</i>	Section I	Section <i>Erisma</i>
	Section II	Section <i>Rixa</i>
<i>Qualea</i>		Subgenus <i>Qualea</i>
	Series <i>Calophylloideae</i>	Section <i>Qualea</i>
	Series <i>Calophylloideae</i>	Section <i>Trichanthera</i>
	Series <i>Costatae</i>	Section <i>Costatifolium</i>
	--	Section <i>Polytrias</i>
<i>Vochysia</i>	Series <i>Amphilochia</i>	Subgenus <i>Amphilochia</i>
		Section <i>Vochysiella</i>
	Series <i>Decorticantes</i>	Subsection <i>Decorticantes</i>
	Series <i>Calophylloideae</i>	Subsection <i>Calophylloideae</i>
		Section <i>Ciliantha</i>
	Series <i>Micranthae</i>	Subsection <i>Micranthae</i>
	Series <i>Lutescentes</i>	Subsection <i>Lutescentes</i>
	Series <i>Lutescentes</i>	Subsection <i>Discolores</i>
	Series <i>Ferrugineae</i>	Subsection <i>Ferrugineae</i>
	Series <i>Ferrugineae</i>	Subsection <i>Chrysophyllae</i>
--	Subsection <i>Megalanthae</i>	
--	Section <i>Pachyantha</i>	

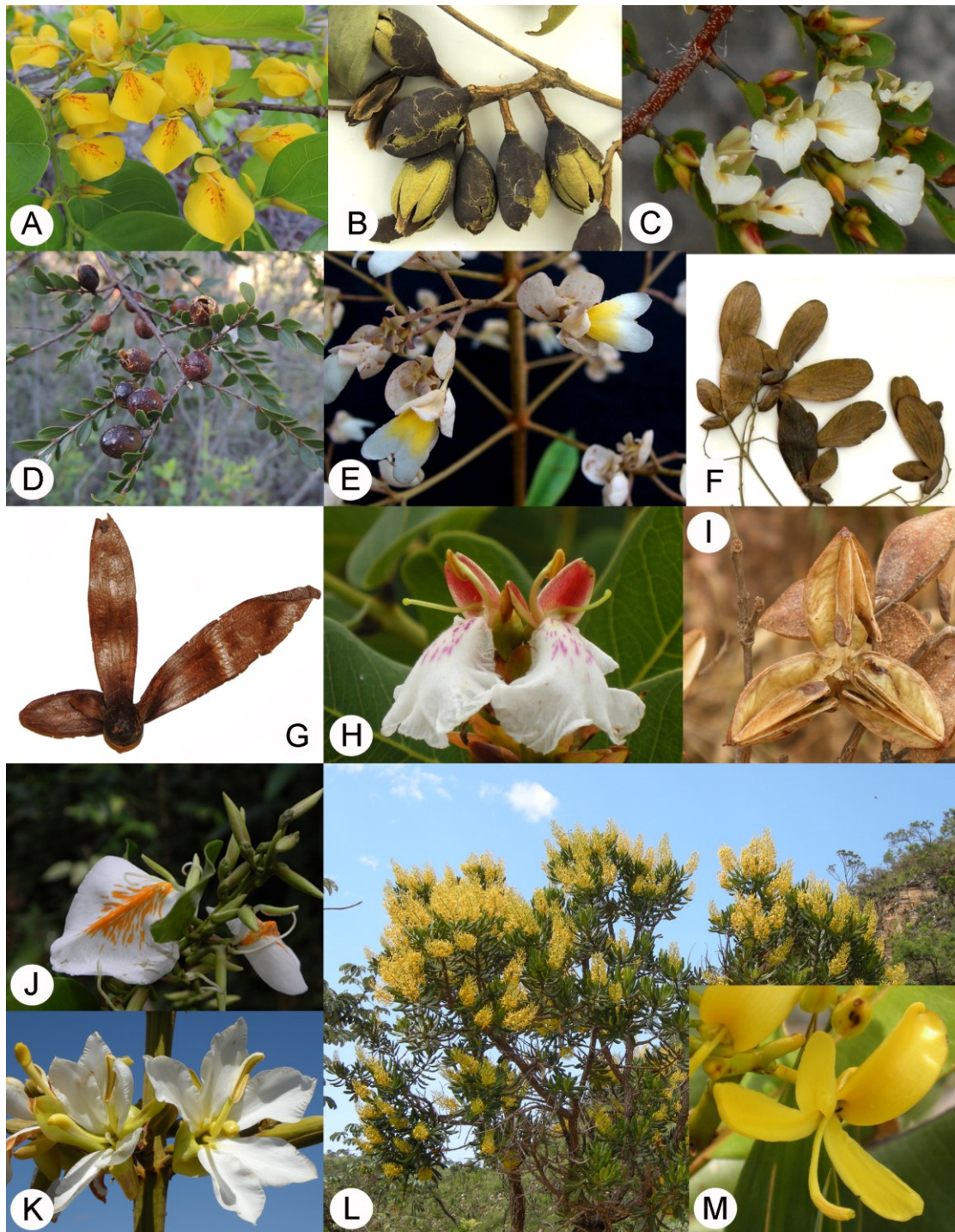
Blank space, not recognized by author; --, not described at the time of the study.

Although being historically associated with families such as Polygalaceae and Trigoniaceae in previous classifications (e.g., Cronquist, 1981; Takhtajan, 1997), molecular studies placed Vochysiaceae within Myrtales (Conti & al., 1996, 1997), as the sister group to Myrtaceae (Sytsma & al., 2004; Berger & al., 2016). The placement in Myrtales is supported by the association of bicollateral vascular bundles in the primary stem and vestured pits in the secondary xylem (Quirk, 1980; van Vliet & Baas, 1984; Baas & al., 2000; Jansen & al., 2008), and has been accepted by recent classifications like APG IV (2016). To date, the combined phylogeny with *matK* and morphology conducted by Litt (1999) is the only focused exclusively on Vochysiaceae, employing 23 species (all genera but *Korupodendron*). Three main clades were retrieved: (1) *Erisma* and *Erismadelphus* (Erismeeae), (2) *Qualea*, *Ruizterania* and *Callisthene* (QRC), and (3) *Vochysia* and *Salvertia* (VS). The relationships between these clades were inconclusive, since Erismeeae was either sister to QRC clade or to



VS clade, depending on the analysis. *Erisma* and *Erismadelphus* were recognized as separate genera, but *Callisthene* and *Ruizterania* were embedded in *Qualea* and *Salvertia* in *Vochysia*.

With a broadened taxon sampling and combining plastid (*ndhF*) and nuclear (ITS1) sequences, we aim to address the following questions: (1) Are the tribes and genera monophyletic? (2) Does the molecular phylogeny support any of the current infrageneric classification of the genera? (3) Which morphological traits are congruent with the clades recovered from the molecular phylogenetic analysis?



**Fig. 1.** Morphological diversity in Vochysiaceae. **A--B**, *Callisthene fasciculata*: **A**, flowers; **B**, fruits (exocarp irregularly fragmented). **C--D**, *Callisthene microphylla*: **C**, flowers; **D**, fruits (exocarp irregularly fragmented). **E**, *Erisma floribundum* - flowers. **F**, *Erisma arietinum* - fruits (samaroid). **G**, *Erismadelphus exsul* - fruit (samaroid). **H**, *Qualea cordata* - flowers (showing enantiostyly). **I**, *Qualea parviflora* - fruit (with two seeds per locule). **J**, *Ruizterania albiflora* - flowers. **K**, *Salvertia convallariodora* - flowers. **L--M**, *Vochysia thyrsoidea*: **L**, flowering tree; **M**, flower (showing three petals). **A**: L.J. Leitão; **B--D**, **F--M**: G.H. Shimizu; **E**: M.F. Simon.

## Materials and Methods

**Taxon sampling and data matrices.** --- The ingroup corresponds to Vochysiaceae terminals (64 spp.) and the outgroup to Myrtaceae terminals (2 spp.), since Myrtaceae is well-established as its sister group (e.g., Conti & al., 1996, 1997; Berger & al., 2016). Representatives of all recognized genera in Vochysiaceae were sampled, except for the monotypic *Korupodendron*. The number of species analyzed per total number of species for each genus are: *Callisthene* (5/11), *Erisma* (4/16), *Erismadelphus* (1/2), *Qualea* (12/ca. 50), *Ruizterania* (5/14), *Salvertia* (1/1) and *Vochysia* (36/ca. 140). For genera with infrageneric categories (following Stafleu's classification, Table 1), the corresponding numbers of categories sampled for each genus are: *Callisthene* (2/2 sections), *Erisma* (2/2 sections), *Qualea* (2/2 subgenera; 3/4 sections) and *Vochysia* (2/3 sections; 6/8 subsections). The species analyzed represent the morphological variation and the infrageneric categories that we were able to access. For several taxa more than one specimen was used, in order to see if they would group or not. The Myrtaceae species were *Campomanesia guazumifolia* (Cambess.) O.Berg and *Psidium guajava* L. Data for four species were based exclusively on GenBank accessions.

We prepared three different datasets for the molecular studies: *ndhF* (accessions = 120: ingroup = 118 / outgroup = 2), ITS1 (46: 45/1) and combined (101: 99/2). The *ndhF* dataset assembled all sequences obtained in the present molecular work, plus some sequences retrieved from the GenBank. Just 46 satisfactory sequences were obtained for ITS1, so its dataset is smaller in comparison to the *ndhF* dataset. The combined dataset (*ndhF* and ITS1) assembles all ITS1 sequences, the corresponding *ndhF* sequences (except for *Q. hannekesaskiarum* Marc.-Berti and *V. palmirana* F.França & Proença), and sequences obtained just for *ndhF*. Some *ndhF* sequences of repeated taxa were excluded from the combined dataset, to reduce the missing data. The percentage of missing data in the combined dataset is 28.2%.

Appendix 1 lists the taxa analyzed, voucher information and GenBank accession numbers for the combined dataset, representing 66 species (64 species of Vochysiaceae and two of Myrtaceae). Appendix 2 lists the Vochysiaceae used in the combined analysis that were identified at species level and their corresponding infrageneric categories according to Stafleu (1948, 1952, 1953, 1954). The *ndhF* accessions not present in the combined dataset are listed in Table S1 (Electr. Suppl.).

**DNA extraction, amplification, and sequencing.** --- Total genomic DNA was extracted with the NucleoSpin Plant II Kit (Macherey-Nagel, Dueren, Germany) or the DNeasy Plant Mini Kit (Qiagen, Hilden, Germany) from silica-dried leaf material or herbarium specimens, following the manufacturer's protocol, except for the addition of proteinase K (2  $\mu$ l per sample, 20 mg/ml) to the lysis buffer step. The *ndhF* gene was amplified using the primers 1252f (5'-GATGAAATTMTTAATGATAGTTGGT-3') and 2063r (5'-CATTTGGAATTCCATCAATTA-3') (Biffin & al., 2006). The ITS1 region was amplified using the primers 17SE (5'-ACGAATTCATGGTCCGGTGAAGTGTCCTG-3') and 5.8/1 (5'-GTTGCCGAGAGTCGT-3') (Sun & al., 1994). PCR reagents and conditions are given in Table 2. Quality of PCR products was checked in a 1% agarose gel; they were purified using ExoSAP-IT (Affymetrix, Cleveland, USA) or the Wizard Genomic DNA purification kit (Promega, Madison, USA). After quantifying the amplicons with 1% agarose gel or NanoDrop 2000 (Thermo Scientific, Waltham, USA), they were sent to the Plant Molecular Biology Lab (CBMEG, Unicamp) for sequencing in an ABI 3500xL Genetic Analyzer (Applied Biosystems, Foster City, USA).

**Table 2.** PCR reagents and conditions. BSA: bovine serum albumin; DMSO: dimethyl sulfoxide; dNTP: deoxynucleotide triphosphate.

	<i>ndhF</i>	ITS1
Reagents	0.2 $\mu$ l of Platinum Taq DNA Polymerase (Invitrogen), 2 $\mu$ l of Taq buffer, 1.5 $\mu$ l of MgCl <sub>2</sub> , 1 $\mu$ l of 10 mM dNTPs, 2 $\mu$ l of forward primer (1252f), 2 $\mu$ l of reverse primer (2063r), 2 $\mu$ l of BSA, 1 $\mu$ l of genomic DNA, and 13.3 $\mu$ l of MilliQ water; total reaction volume = 25 $\mu$ l	12.5 $\mu$ l of GoTaq Green Master Mix (Promega), 1.5 $\mu$ l of forward primer (17SE), 1.5 $\mu$ l of reverse primer (5.8/1), 4 $\mu$ l of 10% DMSO, 2 $\mu$ l of BSA, 1.5 $\mu$ l of genomic DNA, and 2 $\mu$ l of MilliQ water; total reaction volume = 25 $\mu$ l
Conditions	4 min at 94°C followed by 30 cycles of 1 min at 94°C, 1 min at 55°C, 1 min at 72°C, and final extension of 7 min at 72°C	2 min at 94°C followed by 30 cycles of 1 min at 94°C, 1 min at 60°C, 1 min at 72°C, and final extension of 5 min at 72°C

**Sequence alignment and phylogenetic analyses.** --- Sequence contigs were assembled and consensus sequences were built for each taxon using Geneious R8.1.5 (Kearse & al., 2012). Alignments were performed in MAFFT v.7 (Kato & Standley, 2013; available at <http://mafft.cbrc.jp/alignment/server/>), using the default parameters. Additional manual adjustments and further dataset assembly were made in Mesquite v.3.04 (Maddison & Maddison, 2015).

Phylogenetic analyses of *ndhF*, ITS1, and the combined dataset were conducted using maximum parsimony (MP) and Bayesian inference (BI). For MP, analyses were carried out in PAUP\* v.4.0b10 (Swofford, 2002). All characters and character states were unordered and equally weighted. The parameters used were the same of Simões & al. (2016), as follows. A heuristic search for the most parsimonious trees included an initial round of tree searches with 1000 random addition sequence replicates (RASR), holding 10 trees at each step, and tree-bisection-reconnection (TBR) branch swapping with MulTrees and steepest descent in effect, saving a maximum of 50 trees at each replicate. All shortest trees retained in the memory were then included in a second round of searches involving exhaustive TBR branch swapping. Relative support for each node was estimated using the bootstrap resampling procedure (Felsenstein, 1985) as implemented in PAUP, employing a heuristic search with 1000 replicates, 250 RASR with three trees held at each step, and TBR branch swapping with steepest descent and MulTrees in effect, saving 10 trees at each RASR. Bootstrap support (BS) values of 50%--74% were considered weakly, 75%--84% as moderately, and  $\geq 85\%$  as strongly supported.

The optimal models of sequence evolution were selected using jModelTest v.2.1.1 (Guindon & Gascuel, 2003; Darriba & al., 2012), applying the Bayesian information criterion (BIC). A combined dataset of the two partitions was analyzed applying separate models to each data partition. Bayesian analyses were performed with MrBayes v.3.2.6 (Ronquist & al., 2012) as implemented in the CIPRES platform (Miller & al., 2010). Four Markov chain Monte Carlo (MCMC) heuristic searches of 20 million generations were performed in two independent runs. Sampling frequency was set to 2000. Convergence of the MCMC chains was examined with Tracer v.1.6 (Rambaut & al., 2014). The first 25% of the sampled generations, considered as burn-in, were discarded, and the post burn-in trees were imported into TreeAnnotator v.1.8.2 (Drummond & al., 2012) in order to obtain a maximum clade credibility tree. This tree was then analyzed and edited in FigTree v.1.4.2 (Drummond & al., 2012). Posterior probabilities  $\geq 0.95$  were considered strongly supported, and those  $< 0.95$  as weakly supported.

**Character mapping.** --- Thirty-four morphological characters, potentially useful in taxonomic circumscriptions, were selected and coded to identify synapomorphies for our study group (Table 3). The scoring was based on direct observation of herbarium specimens, field observations and literature (Stafleu, 1948, 1953; Keay & Stafleu, 1953; Marcano-Berti, 1969; Martins, 1981; Boesewinkel & Venturelli, 1987; Aveiro, 1997; Kawasaki, 1998, 2007;

Barbosa, 1999; Lisboa, 2000; Vianna, 2002; Vianna & Pereira, 2002; França & Proença, 2007; Lima & al., 2011; Oliveira & al., 2012; Shimizu & al., 2012). When polymorphic, the specific state for each terminal was scored. The complete morphological matrix with 64 species of Vochysiaceae and two of Myrtaceae (101 accessions, corresponding to the combined dataset) is presented in Appendix 3. All character states were considered unordered and unweighted. As there are two major hypotheses for the relationships between the three main clades (one in which Vochysiaceae is monophyletic and the other in which it is not), both topologies were used in our analyses. Characters were mapped onto two topologically divergent trees (representing these two major hypotheses), chosen randomly from the trees with higher posterior probability values obtained in the Bayesian analysis. The character state changes were mapped using the Parsimony Ancestral State Reconstruction Package in Mesquite v.3.04 (Maddison & Maddison, 2015). All possible most parsimonious reconstructions (MPRs) on the selected trees were checked for alternative optimizations.

**Table 3.** List of morphological characters and character states used in ancestral state reconstruction.

- 
- 1. Habit:** (0) subshrub; (1) shrub; (2) tree.
  - 2. Exfoliating cortex:** (0) absent; (1) only branches; (2) stem and branches.
  - 3. Phyllotaxis:** (0) alternate; (1) opposite; (2) whorled.
  - 4. Leaf margin:** (0) flat; (1) revolute or subrevolute.
  - 5. Abaxial surface of mature leaves:** (0) glabrous; (1) scarce indument; (2) dense indument.
  - 6. Stellate trichomes:** (0) absent; (1) present.
  - 7. Leaves with translucent glands:** (0) no; (1) yes.
  - 8. Leaves glaucous:** (0) no; (1) yes.
  - 9. Stipules:** (0) absent; (1) present.
  - 10. Extrafloral nectaries:** (0) absent; (1) present.
  - 11. Spur or bursiform prominence in the fourth sepal:** (0) absent; (1) present.
  - 12. Only the fourth sepal deciduous:** (0) no; (1) yes.
  - 13. Number of petals:** (0) 1; (1) 3; (2) 5.
  - 14. Corolla symmetry:** (0) actinomorphic; (1) zygomorphic.
  - 15. Petal color:** (0) yellow; (1) white; (2) blue/violet/purple/pink.
  - 16. Petal stains (nectar guides):** (0) absent; (1) magenta/red; (2) yellow/white.
-

- 
17. **Petal adaxial surface indument:** (0) absent; (1) present.
18. **Inflexed stamen in the flower bud:** (0) no; (1) yes.
19. **Number of fertile stamens:** (0) 1; (1) >1.
20. **Stamen indument:** (0) glabrous; (1) pubescent/pilose.
21. **Barbate anther:** (0) no; (1) yes.
22. **Anther attachment:** (0) basifixed; (1) dorsifixed.
23. **Staminodes:** (0) absent; (1) present.
24. **Ovary position:** (0) superior; (1) inferior.
25. **Number of locules:** (0) 1; (1) 3; (2) >3.
26. **Number of ovules per locule:** (0) 1; (1) 2; (2) > 2.
27. **Ovary indument:** (0) glabrous; (1) pubescent/pilose.
28. **Fruit dehiscence (dry):** (0) dehiscent; (1) indehiscent.
29. **Sepals in fruit:** (0) not accrescent; (1) accrescent.
30. **Fruit segments separated from the central column in dehiscence:** (0) no; (1) yes.
31. **Irregular exocarp fragmentation:** (0) no; (1) yes.
32. **Number of seeds per locule:** (0) 1; (1) >1.
33. **Dispersal unit (wind dispersal):** (0) fruit; (1) seed.
34. **Seed wing:** (0) circular; (1) unilateral.
- 

## Results

**Molecular phylogenetic analyses.** --- The models of sequence evolution selected were TVM+G for *ndhF* and TrN+I+G for ITS1. Character and tree statistics of the MP analysis are summarized in Table 4. The partitions were combined into a single matrix, since there was no strongly supported incongruent clade between the separate partitions, either in the MP or in the BI analyses. Both maximum clade credibility tree from the BI analysis (Fig. 2) and the strict consensus tree from the MP analysis (Electr. Suppl.: Fig. S1) will be used in the further discussion. Trees from the separate analyses of *ndhF* and ITS1 are available in the Electronic Supplement (Figs. S2--S5).

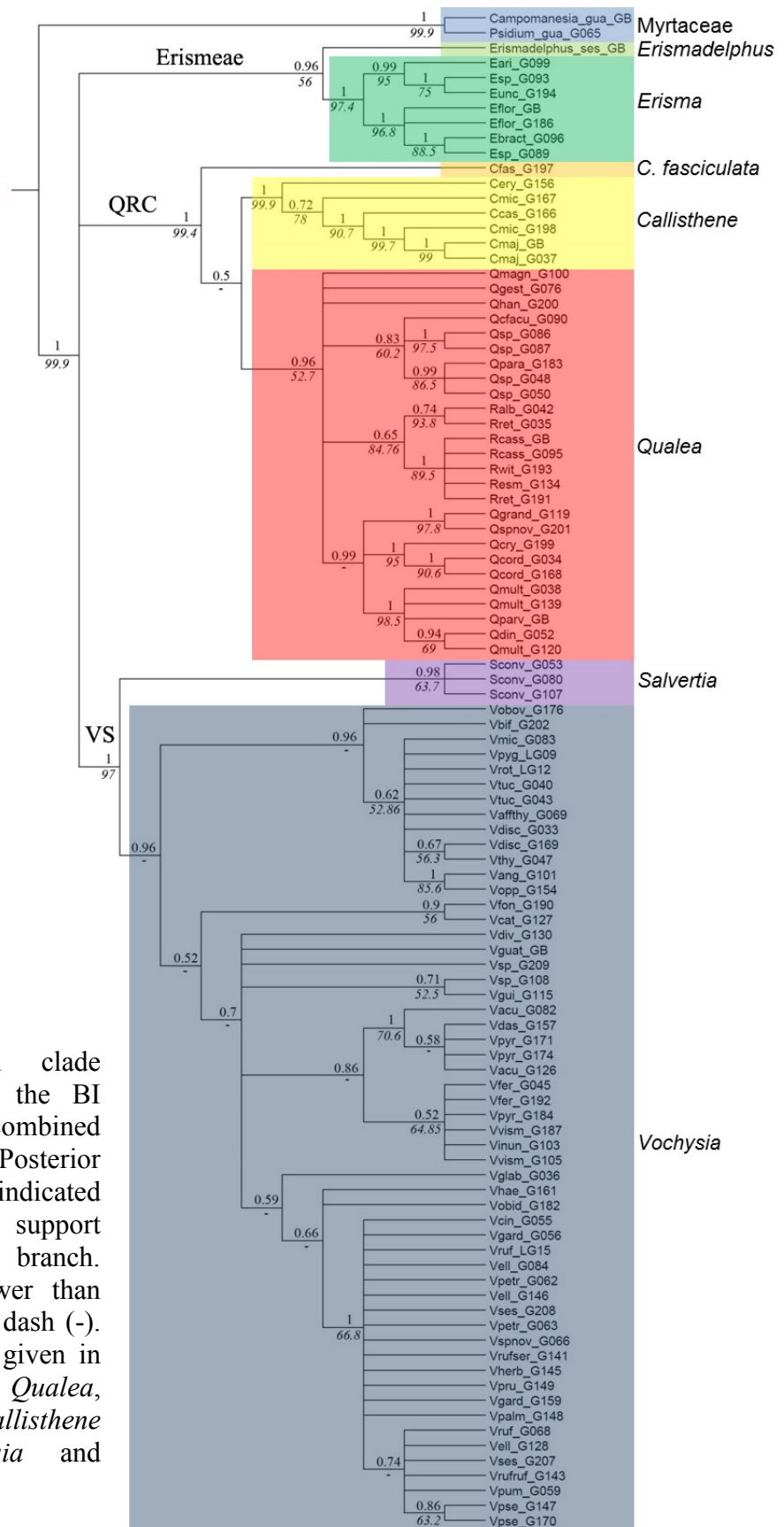
Within Vochysiaceae, three main clades, Erismeeae, QRC and VS, were recovered. Again, there was no strong support for the relationships among these three clades. *Erismadelphus sessilis* Keay & Stafleu was supported as sister to the sampled species of *Erisma* (PP = 0.96, BS = 56%). Within *Erisma*, two clades were recovered, corresponding to the sections of Stafleu (1954). *Erisma arietinum* M.L.Kawas. and *E. uncinatum* Warm.

represent *Erisma* sect. *Erisma*, while *E. bracteosum* Ducke and *E. floribundum* Rudge represent *Erisma* sect. *Rixa*. In the QRC clade (BS = 99.4%, PP = 1), two clades were retrieved: (1) all sampled species of *Callisthene* (BS = 99.9%, PP = 1) but *C. fasciculata* Mart. and (2) a polytomy with lineages of *Qualea* and *Ruizterania*. There is no resolution in the relationship between *C. fasciculata* and these two clades. *Qualea* and *Ruizterania* are grouped in a well-supported clade in the BI analysis (PP = 0.96, but BS = 52.7%), although the relationships between them are still unclear. The species of *Ruizterania* form a clade not strongly supported (BS = 84.76%, PP = 0.65). The division of *Qualea* into two subgenera is not supported, as the members of *Qualea* subg. *Amphilochia* (Mart.) Stafleu are nested in a clade in the BI analysis (PP = 0.99) with members of *Qualea* subg. *Qualea* sect. *Costatifolium* Stafleu. *Qualea* sect. *Qualea* is not monophyletic, but some species formed a weakly supported clade in the BI analysis (PP = 0.83). *Vochysia* is monophyletic in the BI analysis (PP = 0.96), being sister to *Salvertia*. It was not possible to test the monophyly of the sections of *Vochysia*, due to lack of resolution. *Vochysia* sect. *Ciliantha* subsect. *Lutescentes* was recovered in the BI analysis (PP = 0.96), except for the exclusion of *V. guatemalensis* Donn.Sm. and the inclusion of *V. discolor* Warm. (from *Vochysia* sect. *Ciliantha* subsect. *Discolores* Stafleu). Members of *Vochysia* sect. *Ciliantha* subsect. *Micranthae* (Warm.) Stafleu were not recovered as a clade. A low-supported *Vochysia* sect. *Ciliantha* subsect. *Ferrugineae* (PP = 0.86) was recovered in the BI analysis, but without one member (*Vochysia* sp. G209). The two members sampled from *Vochysia* sect. *Vochysiella* subsect. *Calophylloideae* (Warm.) Stafleu did not form a clade, but composed a polytomy with a well-supported (PP = 1) *Vochysia* sect. *Vochysiella* subsect. *Decorticantes* (Warm.) Stafleu in the BI analysis, excluding *V. divergens* Pohl and including *V. pseudopumila* Rizzini & Heringer (from *Vochysia* sect. *Ciliantha* subsect. *Micranthae*).

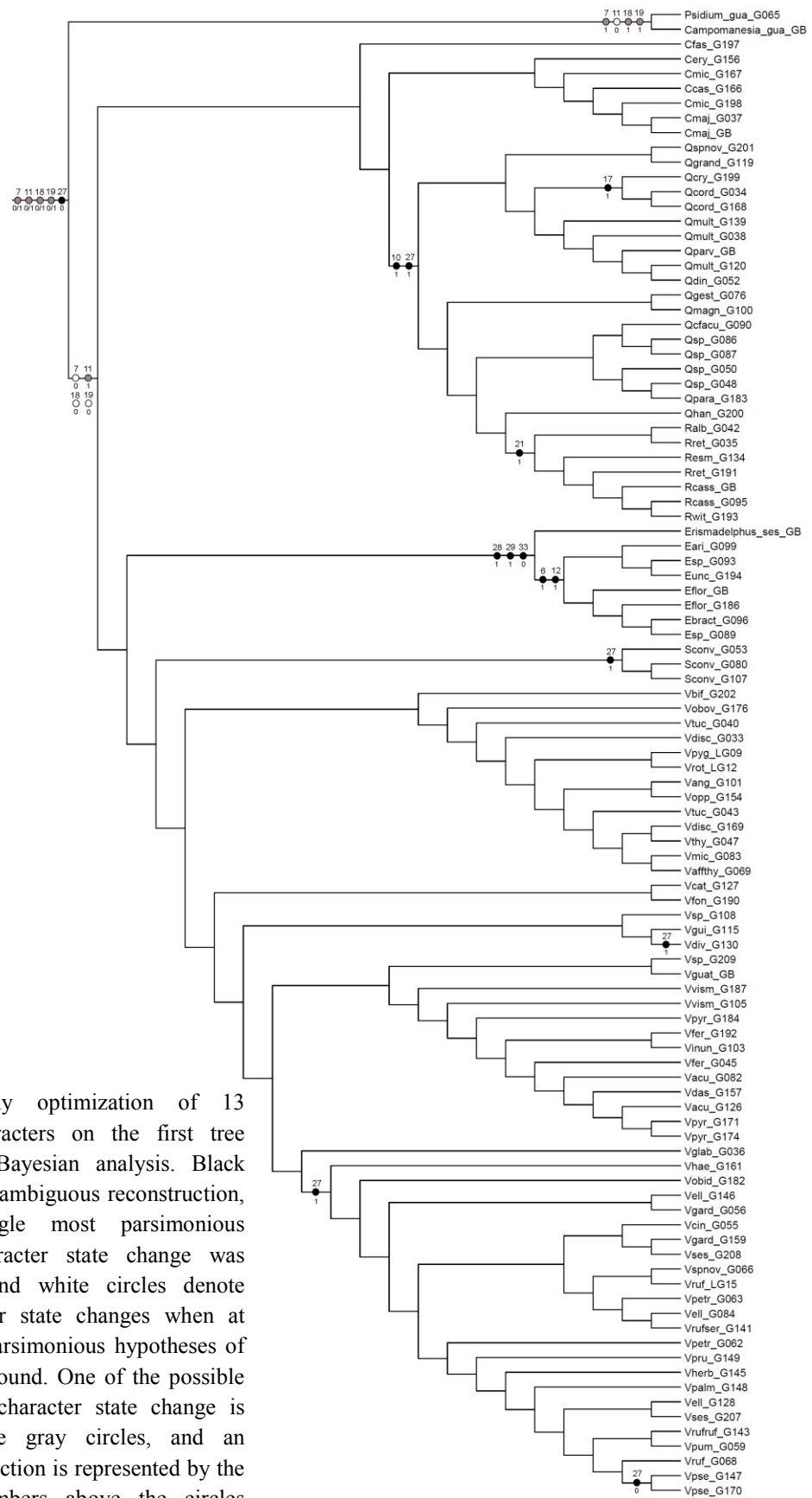


**Table 4.** Number of accessions for each marker, character statistics and tree statistics. Tree length, consistency index and retention index were calculated based on parsimony-informative characters only.

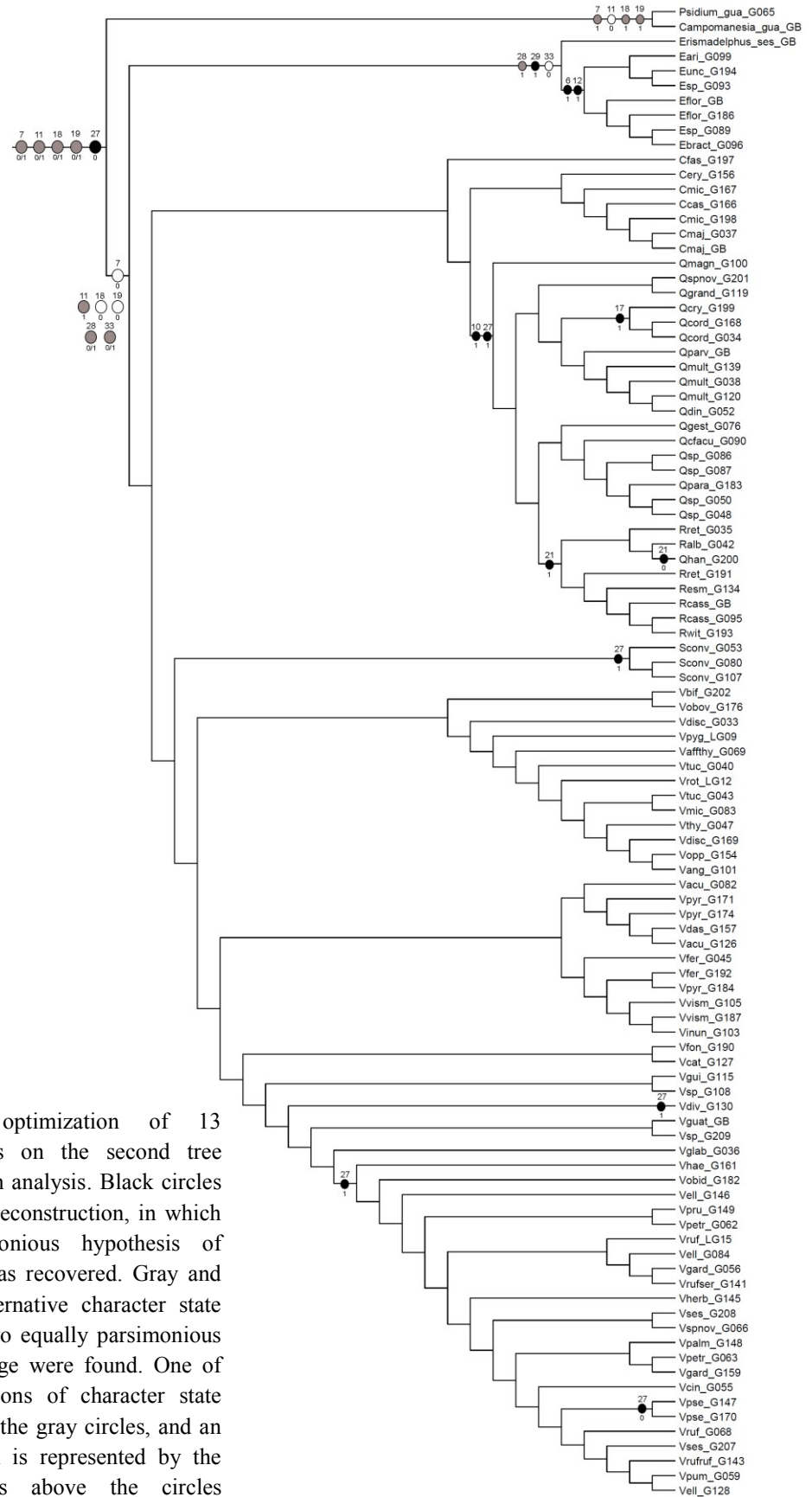
	<i>ndhF</i>	ITS1	Combined
Number of accessions (ingroup/outgroup)	120 (118/2)	46 (45/1)	101 (99/2)
Aligned length (bp)	861	486	1347
Variable characters (%)	219 (25.4)	207 (42.6)	422 (31.3)
Parsimony informative characters (%)	150 (17.4)	139 (28.6)	286 (21.2)
Tree length	328	513	772
Consistency index	0.71	0.56	0.67
Retention index	0.94	0.77	0.89



**Fig. 2.** Maximum clade credibility tree from the BI analysis of the combined molecular dataset. Posterior probabilities (PP) are indicated above, and bootstrap support (BS) below on each branch. Bootstrap support lower than 50% is indicated by a dash (-). Full taxon names are given in Appendix 1. QRC: *Qualea*, *Ruizterania* and *Callisthene* clade; VS: *Vochysia* and *Salvertia* clade.



**Fig. 3.** Parsimony optimization of 13 morphological characters on the first tree chosen from the Bayesian analysis. Black circles denote an unambiguous reconstruction, in which a single most parsimonious hypothesis of character state change was recovered. Gray and white circles denote alternative character state changes when at least two equally parsimonious hypotheses of state change were found. One of the possible reconstructions of character state change is represented by the gray circles, and an alternative reconstruction is represented by the white circles. Numbers above the circles correspond to character numbers, numbers below correspond to the character state as listed in the Table 3.



**Fig. 4.** Parsimony optimization of 13 morphological characters on the second tree chosen from the Bayesian analysis. Black circles denote an unambiguous reconstruction, in which a single most parsimonious hypothesis of character state change was recovered. Gray and white circles denote alternative character state changes when at least two equally parsimonious hypotheses of state change were found. One of the possible reconstructions of character state change is represented by the gray circles, and an alternative reconstruction is represented by the white circles. Numbers above the circles correspond to character numbers, numbers below correspond to the character state as listed in the Table 3.

**Morphological character evolution.** --- The number of characters and corresponding MPRs (most parsimonious reconstructions) are, for the first topology (tribe Vochysieae not monophyletic, Fig. 3): 13 (1 MPR), 10 (2 MPRs) and 11 (3 or more MPRs), and for the second topology (tribe Vochysieae monophyletic, Fig. 4): 11 (1 MPR), 12 (2 MPRs) and 11 (3 or more MPRs). Thirteen of the 34 morphological characters have states reconstructed as potential synapomorphies for major clades within Vochysiaceae (see Discussion and Figs. 3 and 4).

## Discussion

This study presents the largest molecular dataset and taxon sampling to date for Vochysiaceae. The family is supported by four potential morphological synapomorphies: absence of translucent glands in the leaves (char. 7:0), presence of spur or bursiform prominence in the fourth sepal (char. 11:1), erect stamen in the flower bud (char. 18:0) and only one fertile stamen (char. 19:0). All these traits have an alternative hypothesis of character state change, in both trees of the ASR (Ancestral State Reconstruction). In each case, the possible scenarios are the presence or absence of a state in the MRCA (Most Recent Common Ancestor) of Myrtaceae and Vochysiaceae. Within the Myrtales, translucent glands are known in Myrtaceae, erect stamen in the flower bud is found in Vochysiaceae and *Votomita* Aubl. and some species of *Mouriri* Aubl. (Melastomataceae) (Morley, 1976), while the presence of spurred forth sepal (or bursiform prominence) and only one fertile stamen are exclusive of Vochysiaceae.

Despite the improvement in the number of taxa and accessions analyzed, there is still no resolution in the relationship between the clades Erismeeae, QRC and VS. The tribe Erismeeae was retrieved as monophyletic, but Vochysieae is uncertain. Character states related to the fruit are possible synapomorphies for Erismeeae: indehiscent fruit (char. 28:1), fruit with accrescent sepals (char. 29:1) and fruit as the dispersal unit (char. 33:0). The second trait is the only one with an unambiguous reconstruction in both trees of the ASR.

*Erismadelphus sessilis* was supported as sister to a clade composed of samples of *Erisma*. This placement diverges with the one found by Berger & al. (2016), where *Erismadelphus* was retrieved as sister to the rest of the family. As the aims of the studies were different (Vochysiaceae-centered phylogeny versus Myrtales historical biogeography and speciation rates), so were the taxon sampling and the molecular datasets. Based on morphological grounds, the sister relationship of *Erisma* and *Erismadelphus* is reinforced by

the inferior ovary and the indehiscent samaroid fruit, with accrescent calyx lobes (Kawasaki, 2007). Anyhow, further studies with more taxa and markers are desirable, specially adding the other African genus, *Korupodendron*, to test its placement within Erismeeae. We would expect *Korupodendron* to be more closely related to *Erismadelphus*, as they share a pentamerous white corolla, and then this group sister to *Erisma*.

Although sampling few species of *Erisma*, the recovery of two clades corresponding to the sections proposed by Stafleu (1954) is very interesting. *Erisma* sect. *Erisma* (represented here by *E. arietinum* and *E. uncinatum*) is characterized by the late deciduous outer bracts that overlap the flower buds, and *Erisma* sect. *Rixa* (*E. bracteosum* and *E. floribundum*) has early deciduous outer bracts that are very small and do not overlap the flower buds. Kawasaki (1998) has eliminated these infrageneric categories in the most recent taxonomic revision, but our results indicate they could be re-established in the future, if a more comprehensive species sampling corroborates this topology. Potential synapomorphies for *Erisma* are the presence of stellate trichomes (char. 6:1) and the caducous forth sepal (char. 12:1). Both traits had an unambiguous reconstruction, in both trees of the ASR.

The strongly supported QRC clade was composed of a polytomy with: (1) *Callisthene fasciculata*, (2) the rest of *Callisthene*, and (3) a polytomy of *Qualea* and *Ruizterania* lineages. There is no resolution to place *C. fasciculata*, either as sister group to the rest of *Callisthene* or to *Qualea* plus *Ruizterania*. In the current classification the genus is divided into two sections, *Callisthene* sect. *Callisthene* and *Callisthene* sect. *Cataphyllantha* Stafleu, mainly based on number of flowers per cincinnus, association with cataphylls and leaf size (Stafleu, 1952). The latter section has only one species, *C. fasciculata*. It is easily distinguishable by the 2--3 flowered cincinni in the axils of cataphylls, usually large leaves (up to ca. 20 cm long when mature), elongate flower buds and spur, and yellow flowers. We feel that further studies with more markers and samples may solve the polytomy in the QRC clade. The characteristic fruit of *Callisthene*, with irregular exocarp fragmentation, might be a symplesiomorphic state or a twice evolved state in the QRC clade, in both trees of the ASR. Among the members of *Callisthene* sect. *Callisthene* sampled in our study, the two accessions of *C. microphylla* Warm. did not group, whereas the two accessions of *C. major* Mart. formed a clade. The molecular markers used here might not be able to separate species properly, so additional efforts using species-specific markers are needed. The remaining clade within QRC clade assembles several lineages of *Qualea* and one of *Ruizterania*. The presence of extrafloral nectaries (char. 10:1) is a potential synapomorphy for this clade, reconstructed unambiguously in both trees of the ASR. The two species (three accessions) of *Qualea* subg.

*Amphilochia* form a clade, in which trichomes on the adaxial surface of the petal (char. 17:1) is a potential synapomorphy. However, they are embedded in a clade with members of *Qualea* subg. *Qualea* sect. *Costatifolium*, thus not supporting the division of *Qualea* into two subgenera. Three (*Qualea* sect. *Qualea*, *Qualea* sect. *Trichanthera* [ $\equiv$  *Ruizterania*] and *Qualea* sect. *Costatifolium*) of the four sections of *Qualea* subg. *Qualea* (Stafleu, 1953) were sampled, except for *Qualea* sect. *Polytrias* Stafleu. A low-supported clade of some species of *Qualea* sect. *Qualea* (*Q.* cf. *acuminata* Spruce ex Warm. and *Q. paraensis* Ducke) was retrieved. The members of *Qualea* sect. *Costatifolium*, separated in two lineages [(*Q. grandiflora* Mart. and *Qualea* sp. nov.) and (*Q. dinizii* Ducke, *Q. multiflora* Mart. and *Q. parviflora* Mart.)], formed a polytomy with members of *Qualea* subg. *Amphilochia*, as mentioned before. With our data, it is not possible to ascertain whether *Qualea* sect. *Costatifolium*, in the traditional circumscription, is monophyletic. Although not sampled in the present study, we expect that members of *Qualea* sect. *Polytrias* (*Q. amapaensis* Balslev & S.A.Mori and *Q. cymulosa* Schery) would be related to this group of *Qualea* sect. *Costatifolium* plus *Qualea* subg. *Amphilochia*, based on their shared morphological traits, like the leaves with secondary veins more close to each other (less than eight per cm). They are distinguished from *Qualea* sect. *Costatifolium* by the inflorescence architecture, with lateral peduncled compound cymes (Stafleu, 1953).

*Ruizterania* is moderately supported just in the MP analysis, but is strongly supported (BS = 92.5%, PP = 1) in the *ndhF* trees (Electr. Suppl.: Figs. S2, S3). The presence of barbate anther (char. 21:1) is a potential synapomorphy, with unambiguous reconstruction in both trees of the ASR. The relationship with the other *Qualea* clades is uncertain, but even if *Ruizterania* becomes sister to the rest in further studies, is possible to treat them all as *Qualea*. They share morphological traits such as extrafloral nectaries, pilose ovary and entire pericarp, which separate them from *Callisthene*. We corroborate then the inclusion of *Ruizterania* in *Qualea*, as proposed by Kawasaki (2007), now supported by a phylogenetic framework. All names of *Ruizterania* species already have corresponding basionyms in *Qualea*.

The VS clade has strong support (BS = 97%, PP = 1) and *Vochysia* is strongly supported as monophyletic just in the BI analysis, being sister to *Salvertia*. Taking into account this placement and the very distinctive morphology of *Salvertia convallariodora* A.St.-Hil. flowers, probably related to pollination by hawk moths (Oliveira, 1996), we opted for accepting them as separate genera. *Salvertia* is monospecific and has white flowers with five petals, while *Vochysia*, the most species-rich (ca. 140 spp.) genus in the family, has yellow flowers usually with three petals (less frequently one or none). Additional studies with

alternative markers are desirable to further investigate this relationship. According to the ASR, the corolla with five petals is possibly a symplesiomorphy in the family, shared with *Erismadelphus* and *Salvertia*. *Korupodendron*, not included in our study, also has five petals.

Our taxon sampling, encompassing representatives of two of the three sections and six of the eight subsections of *Vochysia* (Appendix 2), did not allow us to test the monophyly of all the sections and subsections of *Vochysia*, but some of the traditional infrageneric categories have emerged as weakly to strongly supported clades in the BI analysis. A weakly supported *Vochysia* sect. *Vochysiella* was retrieved, with the two samples of *Vochysia* sect. *Vochysiella* subsect. *Calophylloideae* [*V. haenkeana* Mart. and *V. obidensis* (Huber ex Ducke) Ducke] and a strongly supported *Vochysia* subsect. *Decorticantes* (except for the exclusion of *V. divergens*). Among the *Vochysia* taxa analyzed, the pilose ovary (char. 27:1) is a potential synapomorphy, with unambiguous reconstruction in both trees of the ASR. The *V. divergens* accession was unexpectedly out of this group, despite possessing all the morphological traits to be placed there. New accessions of this species will be added in order to reassess its placement. On the other hand, *V. pseudopumila* was expected to group with other species from this subsection, since the only difference between this species and *V. pumila* Pohl is the glabrous versus pilose ovary, probably a reversion in the former entity. *Vochysia* sect. *Ciliantha* subsect. *Lutescentes* was strongly supported, but our analyses showed that *V. guatemalensis* should be excluded and *V. discolor* included in this subsection. Adding new accessions and more markers would also help to reassess the placement of *V. guatemalensis*. Like the pair *V. pumila* and *V. pseudopumila*, we suspected that *V. thyrsoides* Pohl and *V. discolor* could be a single species, because they differ only by the dense ferruginous indument on the abaxial leaf surface of the latter. However, we will not propose a synonymization at this moment, since there is a third element not included here (very similar to *V. discolor* and possibly a new species) from the Atlantic Forest in Brazil that we would like to evaluate on a phylogenetic context first. Although not sampled in this study, we would also expect the two other species of *Vochysia* subsect. *Discolores* (*V. gummifera* Mart. ex Warm. and *V. schwackeana* Warm.) to be in *Vochysia* subsect. *Lutescentes*, based on morphological features. These two subsections are separated solely by the usual dense indument on adult branchlets and abaxial leaf surface in *Vochysia* subsect. *Discolores*, but we expect that would be only a variation inside *Vochysia* subsect. *Lutescentes*.

A weakly supported *Vochysia* sect. *Ciliantha* subsect. *Ferrugineae* was recovered, but without one member (*Vochysia* sp. G209). This subsection was expected to be monophyletic, based on its morphology. The species in it have branches without exfoliating cortex, nearly



always opposite leaves, mostly ferruginous puberulous inflorescences, pilose stamen and glabrous ovary. As this is the most species-rich group in *Vochysia* (more than 50 spp.), more sampling efforts are needed to better assess its diversity. Members of *Vochysia* sect. *Ciliantha* subsect. *Micranthae* were not recovered as a clade, so any consideration on this group may be premature now. We expect that the use of species-specific markers could improve our understanding about this subsection.

As the first attempt toward a comprehensive molecular phylogeny of Vochysiaceae, the present study revealed the sister relationship of *Erisma* and *Erismadelphus*, the paraphyly of *Callisthene*, the reassignment of *Qualea* s.l. (including *Ruizterania*), and the sister relationship of *Vochysia* and *Salvertia*. Several of the morphology-based infrageneric groups were corroborated as monophyletic by the molecular data, and some intriguing taxa, like *V. discolor* and *V. pseudopumila*, have their taxonomic relationships more clarified. There are still some goals to pursue, notably the inclusion of *Korupodendron* in the sampling and the disentangling of the relationships of the three main clades. Our results enable us to address new in-depth questions inside some groups, but efforts to better resolve the backbone of the family will continue as well.

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### Literature Cited

- APG IV.** 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Bot. J. Linn. Soc.* 181: 1--20.  
<http://dx.doi.org/10.1111/boj.12385>
- Aveiro, S.M.G.** 1997. *Biologia da reprodução e crescimento inicial de Qualea cordata Spreng. (Vochysiaceae), uma espécie arbórea do Cerrado*. Ph.D. thesis, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.
- Baas, P., Wheeler, E. & Chase, M.W.** 2000. Dicotyledonous wood anatomy and the APG system of angiosperm classification. *Bot. J. Linn. Soc.* 134: 3--17.  
<http://dx.doi.org/10.1111/j.1095-8339.2000.tb02343.x>
- Barbosa, A.R.** 1999. *As espécies do gênero Vochysia Aubl. (Vochysiaceae) ocorrentes no Estado de São Paulo*. M.Sc. thesis, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.
- Berger, B.A., Kriebel, R., Spalink, D. & Sytsma, K.J.** 2016. Divergence times, historical biogeography and shifts in speciation rates of Myrtales. *Molec. Phylogen. Evol.* 95: 116--136. <http://dx.doi.org/10.1016/j.ympev.2015.10.001>
- Biffin, E., Craven, L.A., Crisp, M.D. & Gadek, P.A.** 2006. Molecular systematics of *Syzygium* and allied genera (Myrtaceae): evidence from the chloroplast genome. *Taxon* 55: 79--94.  
<http://dx.doi.org/10.2307/25065530>
- Boesewinkel, F.D. & Venturelli, M.** 1987. Ovule and seed structure in Vochysiaceae. *Bot. Jahrb. Syst.* 108: 547--566.
- Brazil Flora Group** 2015. Growing knowledge: an overview of seed plant diversity in Brazil. *Rodriguésia* 66: 1085--1113. <http://dx.doi.org/10.1590/2175-7860201566411>

- Conti, E., Litt, A. & Sytsma, K.J.** 1996. Circumscription of Myrtales and their relationships to other Rosids: evidence from *rbcL* sequence data. *Amer. J. Bot.* 83: 221--233.
- Conti, E., Litt, A., Wilson, P.G., Graham, S.A., Briggs, B.G., Johnson, L.A.S. & Sytsma, K.J.** 1997. Interfamilial relationships in Myrtales: molecular phylogeny and patterns of morphological evolution. *Syst. Bot.* 22: 629--647. <http://dx.doi.org/10.2307/2419432>
- Cronquist, A.** 1981. *An integrated system of classification of flowering plants*. New York: Columbia University Press.
- Darriba, D., Taboada, G.L., Doallo, R. & Posada, D.** 2012. jModelTest 2: more models, new heuristics and parallel computing. *Nature, Meth.* 9: 772. <http://dx.doi.org/10.1038/nmeth.2109>
- Drummond, A.J., Suchard, M.A., Xie, D. & Rambaut, A.** 2012. Bayesian phylogenetics with BEAUti and the BEAST 1.7. *Molec. Biol. Evol.* 29: 1969--1973. <http://dx.doi.org/10.1093/molbev/mss075>
- Dumortier, B.C.** 1829. *Analyse des familles des plantes avec l'indication des principaux genres qui s'y rattachent*. Tournay: J. Casterman.
- Felsenstein, J.** 1985. Confidence limits on phylogenies: An approach using the bootstrap. *Evolution* 39: 738--791. <http://dx.doi.org/10.2307/2408678>
- França, F. & Proença, C.E.B.** 2007. *Vochysia palmirana* (Vochysiaceae), a new species from Goiás and Tocantins, Brazil. *Brittonia* 59: 374--376. <http://dx.doi.org/10.1007/BF03159555>
- Guindon, S. & Gascuel, O.** 2003. A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. *Syst. Biol.* 52: 696--704. <http://dx.doi.org/10.1080/10635150390235520>
- Jansen, S., Pletsers, A., Rabaey, D. & Lens, F.** 2008. Vestured pits: a diagnostic character in the secondary xylem of Myrtales. *J. Tropic. Forest Sci.* 20: 328--339.
- Katoh, K. & Standley, D.M.** 2013. MAFFT Multiple sequence alignment software version 7: improvements in performance and usability. *Molec. Biol. Evol.* 30: 772--780. <http://dx.doi.org/10.1093/molbev/mst010>
- Kawasaki, M.L.** 1998. Systematics of *Erismia* (Vochysiaceae). *Mem. New York Bot. Gard.* 81: 1--40.
- Kawasaki, M.L.** 2007. Vochysiaceae. Pp. 480--487 in: Kubitzki, K. (ed.), *The families and genera of vascular plants*, vol. 9, *Flowering plants: Eudicots; Berberidopsidales, Buxales, Crossosomatales, Fabales p.p., Geraniales, Gunnerales, Myrtales p.p.*,

*Proteales, Saxifragales, Vitales, Zygophyllales, Clusiaceae Alliance, Passifloraceae Alliance, Dilleniaceae, Huaceae, Picramniaceae, Sabiaceae*. Berlin: Springer.

[http://dx.doi.org/10.1007/978-3-540-32219-1\\_55](http://dx.doi.org/10.1007/978-3-540-32219-1_55)

- Kearse, M., Moir, R., Wilson, A., Stones-Havas, S., Cheung, M., Sturrock, S., Buxton, S., Cooper, A., Markowitz, S., Duran, C., Thierer, T., Ashton, B., Mentjies, P., & Drummond, A.** 2012. Geneious Basic: an integrated and extendable desktop software platform for the organization and analysis of sequence data. *Bioinformatics* 28: 1647--1649. <http://dx.doi.org/10.1093/bioinformatics/bts199>
- Keay, R.W.J. & Stafleu, F.A.** 1953. *Erismadelphus*. *Acta Bot. Neerl.* 1: 594--599.
- León, W.** 2003. Anatomía xilemática comparativa de los géneros *Qualea* y *Ruizterania* (Vochysiaceae). *Pittieria* 32: 69--81.
- Lima, D.F., Goldenberg, R. & Sobral, M.** 2011. O gênero *Campomanesia* (Myrtaceae) no estado do Paraná, Brasil. *Rodriguésia* 62: 683--693.
- Lisboa, M.L.G.** 2000. *Estudos taxonômicos sobre o subgênero Amphilochia (Mart.) Stapf., gênero Qualea Aubl. (Vochysiaceae A. St.-Hil.)*. M.Sc. thesis, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.
- Litt, A.** 1999. *Floral morphology and phylogeny of Vochysiaceae*. Ph.D. thesis, City University of New York, New York, New York, USA.
- Litt, A. & Cheek, M.** 2002. *Korupodendron songweanum*, a new genus and species of Vochysiaceae from West-Central Africa. *Brittonia* 54: 13--17.  
[http://dx.doi.org/10.1663/0007-196X\(2002\)054\[0013:KSANGA\]2.0.CO;2](http://dx.doi.org/10.1663/0007-196X(2002)054[0013:KSANGA]2.0.CO;2)
- Litt, A. & Stevenson, D.W.** 2003. Floral development and morphology of Vochysiaceae. I. The structure of the gynoeceum. *Amer. J. Bot.* 90: 1533--1547.  
<http://dx.doi.org/10.3732/ajb.90.11.1533>
- Maddison, W.P. & Maddison, D.R.** 2015. Mesquite: a modular system for evolutionary analysis, version 3.04. <http://mesquiteproject.org>
- Marcano-Berti, L.** 1969. Un nuevo género de las Vochysiaceae. *Pittieria* 2: 3--27.
- Marcano-Berti, L.** 2005. Vochysiaceae. Pp. 500--524 in: Berry, P.E., Holst, B.K. & Yatskievych, K. (eds.), *Flora of the Venezuelan Guayana*. vol. 9. *Rutaceae-Zygophyllaceae*. Saint Louis: Missouri Botanical Garden Press.
- Marcano-Berti, L.** 2014. *Apopetala*, una nueva sección de *Vochysia* (Vochysiaceae). *Pittieria* 38: 15--42.
- Marcano-Berti, L.** 2016. Vochysiaceae. Pp. 2473--2477 in: Bernal, R., Gradstein, R. & Celis, M. (eds.), *Catálogo de plantas y líquenes de Colombia*. vol. 2. *Magnoliaceae a*

*Zygophyllaceae - Especies introducidas y cultivadas*. Bogotá: Editorial Universidad Nacional de Colombia.

- Martins, H.F.** 1981. *O gênero Callisthene Martius (Vochysiaceae). Ensaio para uma revisão taxonômica*. M.Sc. thesis, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil.
- Miller, M.A., Pfeiffer, W. & Schwartz, T.** 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees. Pp. 45--52 in: *Proceedings of the Gateway Computing Environments Workshop (GCE)*, New Orleans, Louisiana, 14 Nov 2010. Piscataway: IEEE. <http://dx.doi.org/10.1109/GCE.2010.5676129>
- Morley, T.** 1976. Memecyleae (Melastomataceae). *Fl. Neotrop. Monogr.* 15: 1--295.
- Oliveira, M.I.U., Funch, L.S. & Landrum, L.R.** 2012. Flora da Bahia: *Campomanesia* (Myrtaceae). *Sitientibus, Sér. Ci. Biol.* 12: 91--107.  
<http://dx.doi.org/10.13102/scb115>
- Oliveira, P.E.** 1996. Biología floral de *Salvertia convallariodora* (Vochysiaceae): uma espécie de cerrado polinizada por mariposas. *Revista Brasil. Bot.* 19: 49--53.
- Quirk, J.T.** 1980. Wood anatomy of the Vochysiaceae. *I.A.W.A. Bull.* 1: 172--179.  
<http://dx.doi.org/10.1163/22941932-90000717>
- Rambaut, A., Suchard, M.A., Xie, D. & Drummond, A.J.** 2014. Tracer, version 1.6.  
<http://beast.bio.ed.ac.uk/Tracer>
- Rodríguez, L. & Sanoja, E.** 2008. Fenología, biología floral de polinización de especies de la familia Vochysiaceae en la Guayana Venezolana. *Acta Bot. Venez.* 31: 331--366.
- Rodríguez, L., Escala, M. & Sanoja, E.** 2014. Morfología y anatomía de diásporas de especies de la familia Vochysiaceae y su relación con su diseminación. *Pittieria* 38: 59--81.
- Ronquist, F., Teslenko, M., Van der Mark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B., Liu, L., Suchard, M.A. & Huelsenbeck, J.P.** 2012. MrBayes 3.2: Efficient Bayesian phylogenetic inference and model choice across a large model space. *Syst. Biol.* 61: 539--542. <http://dx.doi.org/10.1093/sysbio/sys029>
- Sajo, M.G. & Rudall, P.J.** 2002. Leaf and stem anatomy of Vochysiaceae in relation to subfamilial and suprafamilial systematics. *Bot. J. Linn. Soc.* 138: 339--364.  
<http://dx.doi.org/10.1046/j.1095-8339.2002.00025.x>
- Senterre, B. & Obiang, D.** 2005. Nouvelles découvertes à propos des Vochysiaceae africaines: *Erismadelphus* Mildbr. et *Korupodendron* Litt & Cheek. *Taxonomania* 17: 3--18.

- Shimizu, G.H., Rodrigues, L.C. & Yamamoto, K.** 2012. *Vochysia microphylla* (Vochysiaceae), a new species from Serra do Cipó, Minas Gerais, Brazil. *Phytotaxa* 56: 10--14. <http://dx.doi.org/10.11646/phytotaxa.56.1.3>
- Simões, A.O., Kinoshita, L.S., Koch, I., Silva, M.J. & Endress, M.E.** 2016. Systematics and character evolution of Vinceae (Apocynaceae). *Taxon* 65: 99--122. <http://dx.doi.org/10.12705/651.7>
- Stafleu, F.A.** 1948. A monograph of Vochysiaceae. I. *Salvertia* and *Vochysia*. *Recueil Trav. Bot. Néerl.* 41: 397--540.
- Stafleu, F.A.** 1952. A monograph of Vochysiaceae. II. *Callisthene*. *Acta Bot. Neerl.* 1: 222--242.
- Stafleu, F.A.** 1953. A monograph of Vochysiaceae. III. *Qualea*. *Acta Bot. Neerl.* 2: 144--217.
- Stafleu, F.A.** 1954. A monograph of Vochysiaceae. IV. *Erisma*. *Acta Bot. Neerl.* 3: 459--480.
- Sun, Y., Skinner, D.Z., Liang, G.H. & Hulbert, S.H.** 1994. Phylogenetic analysis of *Sorghum* and related taxa using internal transcribed spacers of nuclear ribosomal DNA. *Theor. Appl. Genet.* 89: 26--32.
- Swofford, D.L.** 2002. PAUP\*: Phylogenetic analysis using parsimony (\*and other methods), version 4.0b10. Sunderland, Massachusetts: Sinauer.
- Sytsma, K.J., Litt, A., Zjhra, M.L., Pires, J.C., Nepokroeff, M., Conti, E., Walker, J., Wilson, P.G.** 2004. Clades, clocks, and continents: historical and biogeographical analysis of Myrtaceae, Vochysiaceae, and relatives in the Southern Hemisphere. *Int. J. Pl. Sci.* 165: S85--S105. <http://dx.doi.org/10.1086/421066>
- Takhtajan, A.** 1997. *Diversity and classification of flowering plants*. New York: Columbia University Press.
- Takhtajan, A.** 2009. *Flowering Plants*. Berlin: Springer. <http://dx.doi.org/10.1007/978-1-4020-9609-9>
- Vianna, M.C.** 2002. *Vochysia Aubl. (Vochysiaceae) na Mata Atlântica: Morfologia e Taxonomia*. Ph.D. thesis, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil.
- van Vliet, C.J.C. & Baas, P.** 1984. Wood anatomy and classification of the Myrtales. *Ann. Missouri Bot. Gard.* 71: 783--800. <http://dx.doi.org/10.2307/2399162>
- Vianna, M.C. & Pereira, J.F.** 2002. Novitates vochysiae - I. *Bol. Mus. Nac. Rio de Janeiro, Bot.* 117: 1--11.

**Appendix 1.** Taxa analyzed, voucher information and GenBank accession numbers for the two datasets (*ndhF* and ITS1).

Terminal	Taxon	Collection	GenBank Accession	
			<i>ndhF</i>	ITS1
Campomanesia_gua_GB	<i>Campomanesia guazumifolia</i> (Cambess.) O.Berg	P. Wilson 22385 (UNSW)	AY498777.1	
Ccas_G166	<i>Callisthene castellanosii</i> H.F.Martins	M. Monge 3233 (UEC)		
Cery_G156	<i>Callisthene erythroclada</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 439 (UEC)		
Cfas_G197	<i>Callisthene fasciculata</i> Mart.	D.J.P. Gonçalves <i>et al.</i> 640 (UEC)		
Cmaj_G037	<i>Callisthene major</i> Mart.	(UEC)		
Cmaj_GB	<i>Callisthene major</i> Mart.	A. Litt 10 (NY)	AY498826.1	
Cmic_G167	<i>Callisthene microphylla</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 546 (UEC)		
Cmic_G198	<i>Callisthene microphylla</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 624 (UEC)		
Eari_G099	<i>Erisma arietinum</i> M.L.Kawas.	G.H. Shimizu <i>et al.</i> 963 (UEC)		
Ebract_G096	<i>Erisma bracteosum</i> Ducke	G.H. Shimizu <i>et al.</i> 937 (UEC)		
Eflor_G186	<i>Erisma floribundum</i> Rudge	M.F. Simon <i>et al.</i> 1029 (CEN)		
Eflor_GB	<i>Erisma floribundum</i> Rudge	S. Mori 22847 (NY)	AY498827.1	
Erismadelphus_ses_GB	<i>Erismadelphus sessilis</i> Keay & Stafleu	A. Litt 19 (NY)	AY498828.1	
Esp_G089	<i>Erisma</i> sp.	G.H. Shimizu <i>et al.</i> 929 (UEC)		
Esp_G093	<i>Erisma</i> sp.	G.H. Shimizu <i>et al.</i> 933 (UEC)		
Eunc_G194	<i>Erisma uncinatum</i> Warm.	M.F. Simon <i>et al.</i> 1723 (CEN)		
Psidium_gua_G065	<i>Psidium guajava</i> L.	G.H. Shimizu s.n. (UEC)		
Qcfacu_G090	<i>Qualea</i> cf. <i>acuminata</i> Spruce ex Warm.	G.H. Shimizu <i>et al.</i> 930 (UEC)		
Qcord_G034	<i>Qualea cordata</i> Spreng.	M.V. Martins s.n. (UEC)		
Qcord_G168	<i>Qualea cordata</i> Spreng.	D.J.P. Gonçalves <i>et al.</i> 380 (UEC)		
Qcry_G199	<i>Qualea cryptantha</i> (Spreng.) Warm.	D.J.P. Gonçalves <i>et al.</i> 641 (UEC)		
Qdin_G052	<i>Qualea dinizii</i> Ducke	G.H. Shimizu <i>et al.</i> 558 (UEC)		
Qgest_G076	<i>Qualea gestasiana</i> A.St.-Hil.	R.N.C. Teixeira 103 (UEC)		
Qgrand_G119	<i>Qualea grandiflora</i> Mart.	R.B. Pinto 396 (UEC)		
Qhan_G200	<i>Qualea hannekesaskiarum</i> Marc.-Berti	D.J.P. Gonçalves <i>et al.</i> 634 (UEC)		
Qmagn_G100	<i>Qualea magna</i> Kuhlman.	G.H. Shimizu <i>et al.</i> 959 (UEC)		
Qmult_G038	<i>Qualea multiflora</i> Mart.	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Qmult_G120	<i>Qualea multiflora</i> Mart.	A.V. Scatigna 307 (UEC)		
Qmult_G139	<i>Qualea multiflora</i> Mart.	R.J. Trad s.n. (UEC)		
Qpara_G183	<i>Qualea paraensis</i> Ducke	G.P. Silva <i>et al.</i> 15717 (CEN)		
Qparv_GB	<i>Qualea parviflora</i> Mart.	M.W. Chase 168 (K)	EU002253.1	
Qsp_G048	<i>Qualea</i> sp. (sect. <i>Qualea</i> )	G.H. Shimizu & A.V. Scatigna 535 (UEC)		

## Appendix 1. Continued.

Terminal	Taxon	Collection	GenBank Accession	
			<i>ndhF</i>	ITS1
Qsp_G050	<i>Qualea</i> sp. (sect. <i>Qualea</i> )	G.H. Shimizu & A.V. Scatigna 534 (UEC)		
Qsp_G086	<i>Qualea</i> sp. (sect. <i>Qualea</i> )	G.H. Shimizu <i>et al.</i> 921 (UEC)		
Qsp_G087	<i>Qualea</i> sp. (sect. <i>Qualea</i> )	G.H. Shimizu <i>et al.</i> 922 (UEC)		
Qspnov_G201	<i>Qualea</i> sp. nov.	D.J.P. Gonçalves <i>et al.</i> 623 (UEC)		
Ralb_G042	<i>Ruizterania albiflora</i> (Warm.) Marc.-Berti	T. Marinho <i>et al.</i> 258 (INPA)		
Rcass_G095	<i>Ruizterania cassiquiarensis</i> (Spruce ex Warm.) Marc.-Berti	G.H. Shimizu <i>et al.</i> 936 (UEC)		
Rcass_GB	<i>Ruizterania cassiquiarensis</i> (Spruce ex Warm.) Marc.-Berti	J.E.L.S. Ribeiro <i>et al.</i> 1473 (INPA)	AY498830.1	
Resm_G134	<i>Ruizterania esmeraldae</i> (Standl.) Marc.-Berti	F.N. Cabral 1133 (UEC)		
Rret_G035	<i>Ruizterania retusa</i> (Spruce ex Warm.) Marc.-Berti	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Rret_G191	<i>Ruizterania retusa</i> (Spruce ex Warm.) Marc.-Berti	M.F. Simon <i>et al.</i> 1613 (CEN)		
Rwit_G193	<i>Ruizterania wittrockii</i> (Malme) Marc.-Berti	M.F. Simon <i>et al.</i> 1718 (CEN)		
Sconv_G053	<i>Salvertia convallariodora</i> A.St.-Hil.	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Sconv_G080	<i>Salvertia convallariodora</i> A.St.-Hil.	G.H. Shimizu & A.V. Scatigna 900 (UEC)		
Sconv_G107	<i>Salvertia convallariodora</i> A.St.-Hil.	G.H. Shimizu <i>et al.</i> 997 (UEC)		
Vacu_G082	<i>Vochysia acuminata</i> Bong.	G.H. Shimizu & A.V. Scatigna 904 (UEC)		
Vacu_G126	<i>Vochysia acuminata</i> Bong.	A.V. Scatigna 101 (UEC)		
Vaffthy_G069	<i>Vochysia</i> aff. <i>thyrsoides</i> Pohl	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Vang_G101	<i>Vochysia angelica</i> M.C.Vianna & Fontella	G.H. Shimizu <i>et al.</i> 961 (UEC)		
Vbif_G202	<i>Vochysia bifalcata</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 643 (UEC)		
Vcat_G127	<i>Vochysia catingae</i> Ducke	N. Dávila 6416 (UEC)		
Vcin_G055	<i>Vochysia cinnamomea</i> Pohl	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Vdas_G157	<i>Vochysia dasyantha</i> Warm.	D.J.P. Gonçalves & M.M.T. Cota 232 (UEC)		
Vdisc_G033	<i>Vochysia discolor</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 98 (UEC)		
Vdisc_G169	<i>Vochysia discolor</i> Warm.	D.J.P. Gonçalves & M.M.T. Cota 141 (UEC)		
Vdiv_G130	<i>Vochysia divergens</i> Pohl	R.B. Pinto 380 (UEC)		
Vell_G084	<i>Vochysia elliptica</i> Mart.	G.H. Shimizu & A.V. Scatigna 915 (UEC)		
Vell_G128	<i>Vochysia elliptica</i> Mart.	A.V. Scatigna 92 (UEC)		
Vell_G146	<i>Vochysia elliptica</i> Mart.	R.J. Trad s.n. (UEC)		
Vfer_G045	<i>Vochysia ferruginea</i> Mart.	J.G. Rando & A. Nogueira 1190 (SPF)		
Vfer_G192	<i>Vochysia ferruginea</i> Mart.	M.F. Simon <i>et al.</i> 1669 (CEN)		
Vfon_G190	<i>Vochysia fontellae</i> Paula	M.F. Simon <i>et al.</i> 1578 (CEN)		
Vgard_G056	<i>Vochysia gardneri</i> Warm.	G.H. Shimizu <i>et al.</i> s.n. (UEC)		



## Appendix 1. Continued.

Terminal	Taxon	Collection	GenBank Accession	
			<i>ndhF</i>	ITS1
Vgard_G159	<i>Vochysia gardneri</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 456 (UEC)		
Vglab_G036	<i>Vochysia glaberrima</i> Warm.	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Vguat_GB	<i>Vochysia guatemalensis</i> Donn.Sm. [ <i>V. hondurensis</i> Sprague]	H. Iltis s.n. (WIS)	AY498832.1	
Vgui_G115	<i>Vochysia guianensis</i> Aubl.	Marked tree from EMBRAPA Amazônia Oriental		
Vhae_G161	<i>Vochysia haenkeana</i> Mart.	D.J.P. Gonçalves 566 (UEC)		
Vherb_G145	<i>Vochysia herbacea</i> Pohl	R.J. Trad s.n. (UEC)		
Vinun_G103	<i>Vochysia inundata</i> Ducke	G.H. Shimizu <i>et al.</i> 984 (UEC)		
Vmic_G083	<i>Vochysia microphylla</i> G.H.Shimizu & K.Yamam.	G.H. Shimizu & A.V. Scatigna 908 (UEC)		
Vobid_G182	<i>Vochysia obidensis</i> (Huber ex Ducke) Ducke	A.A. Santos <i>et al.</i> 3591 (CEN)		
Vobov_G176	<i>Vochysia obovata</i> Stafleu	G.H. Shimizu <i>et al.</i> 1044 (UEC)		
Vopp_G154	<i>Vochysia oppugnata</i> (Vell.) Warm.	Cultivated tree from IAC		
Vpalm_G148	<i>Vochysia palmirana</i> F.França & Proença	R.J. Trad s.n. (UEC)		
Vpetr_G062	<i>Vochysia petraea</i> Warm.	A.R. Rech 50 (UEC)		
Vpetr_G063	<i>Vochysia petraea</i> Warm.	A.R. Rech 51 (UEC)		
Vpru_G149	<i>Vochysia pruinosa</i> Pohl	R.J. Trad s.n. (UEC)		
Vpse_G147	<i>Vochysia pseudopumila</i> Rizzini & Heringer	R.J. Trad s.n. (UEC)		
Vpse_G170	<i>Vochysia pseudopumila</i> Rizzini & Heringer	D.J.P. Gonçalves 592 (UEC)		
Vpum_G059	<i>Vochysia pumila</i> Pohl	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Vpyg_LG09	<i>Vochysia pygmaea</i> Bong.	G.H. Shimizu & A.V. Scatigna 903 (UEC)		
Vpyr_G171	<i>Vochysia pyramidalis</i> Mart.	G.H. Shimizu <i>et al.</i> 1028 (UEC)		
Vpyr_G174	<i>Vochysia pyramidalis</i> Mart.	G.H. Shimizu <i>et al.</i> 1039 (UEC)		
Vpyr_G184	<i>Vochysia pyramidalis</i> Mart.	G.P. Silva <i>et al.</i> 15827 (CEN)		
Vrot_LG12	<i>Vochysia rotundifolia</i> Mart.	G.H. Shimizu & A.V. Scatigna 909 (UEC)		
Vruf_G068	<i>Vochysia rufa</i> Mart.	G.H. Shimizu <i>et al.</i> s.n. (UEC)		
Vruf_LG15	<i>Vochysia rufa</i> Mart.	G.H. Shimizu & A.V. Scatigna 912 (UEC)		
Vrufruf_G143	<i>Vochysia rufa</i> Mart. subsp. <i>rufa</i>	R.J. Trad s.n. (UEC)		
Vrufser_G141	<i>Vochysia rufa</i> subsp. <i>sericea</i> (Pohl) Stafleu	R.J. Trad s.n. (UEC)		
Vses_G207	<i>Vochysia sessilifolia</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 613 (UEC)		
Vses_G208	<i>Vochysia sessilifolia</i> Warm.	D.J.P. Gonçalves <i>et al.</i> 619 (UEC)		
Vsp_G108	<i>Vochysia</i> sp.	G.H. Shimizu <i>et al.</i> 1009 (UEC)		
Vsp_G209	<i>Vochysia</i> sp. (subsect. <i>Ferrugineae</i> )	R.J. Trad s.n. (UEC)		
Vspnov_G066	<i>Vochysia</i> sp. nov.	D.J.P. Gonçalves 492 (UEC)		

## Appendix 1. Continued.

Terminal	Taxon	Collection	GenBank Accession	
			<i>ndhF</i>	ITS1
Vthy_G047	<i>Vochysia thyrsoidea</i> Pohl	D.J.P. Gonçalves & M.M.T. Cota 146 (UEC)		
Vtuc_G040	<i>Vochysia tucanorum</i> Mart.	M.V. Martins 255 (UEC)		
Vtuc_G043	<i>Vochysia tucanorum</i> Mart.	M.V. Martins 255 (UEC)		
Vvism_G105	<i>Vochysia vismiifolia</i> Spruce ex Warm.	G.H. Shimizu <i>et al.</i> 987 (UEC)		
Vvism_G187	<i>Vochysia vismiifolia</i> Spruce ex Warm.	M.F. Simon <i>et al.</i> 1036 (CEN)		

**Appendix 2.** List of the Vochysiaceae used in the combined analysis identified at species level with the corresponding infrageneric categories. *Erismadelphus* has no subdivision and *Salvertia* is monospecific. The classification used for each genus is as follows: *Callisthene* (Stafleu, 1952), *Erisma* (Stafleu, 1954), *Qualea* (Stafleu, 1953), *Vochysia* (Stafleu, 1948).

<b>Taxon</b>	<b>Infrageneric classification</b>
<i>Callisthene castellanosii</i> H.F.Martins	<i>Callisthene</i> sect. <i>Callisthene</i>
<i>Callisthene erythroclada</i> Warm.	<i>Callisthene</i> sect. <i>Callisthene</i>
<i>Callisthene major</i> Mart.	<i>Callisthene</i> sect. <i>Callisthene</i>
<i>Callisthene microphylla</i> Warm.	<i>Callisthene</i> sect. <i>Callisthene</i>
<i>Callisthene fasciculata</i> Mart.	<i>Callisthene</i> sect. <i>Cataphyllantha</i>
<i>Erisma bracteosum</i> Ducke	<i>Erisma</i> sect. <i>Erisma</i>
<i>Erisma floribundum</i> Rudge	<i>Erisma</i> sect. <i>Erisma</i>
<i>Erisma arietinum</i> M.L.Kawas.	<i>Erisma</i> sect. <i>Rixa</i>
<i>Erisma uncinatum</i> Warm.	<i>Erisma</i> sect. <i>Rixa</i>
<i>Qualea cordata</i> Spreng.	<i>Qualea</i> subg. <i>Amphilochia</i>
<i>Qualea cryptantha</i> (Spreng.) Warm.	<i>Qualea</i> subg. <i>Amphilochia</i>
<i>Qualea dinizii</i> Ducke	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Costatifolium</i>
<i>Qualea grandiflora</i> Mart.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Costatifolium</i>
<i>Qualea multiflora</i> Mart.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Costatifolium</i>
<i>Qualea parviflora</i> Mart.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Costatifolium</i>
<i>Qualea</i> sp. nov.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Costatifolium</i>
<i>Qualea</i> cf. <i>acuminata</i> Spruce ex Warm.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Qualea</i>
<i>Qualea gestasiana</i> A.St.-Hil.	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Qualea</i>
<i>Qualea hannekesaskiarum</i> Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Qualea</i>
<i>Qualea magna</i> Kuhlman	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Qualea</i>
<i>Qualea paraensis</i> Ducke	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Qualea</i>
<i>Ruizterania albiflora</i> (Warm.) Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Trichanthera</i>
<i>Ruizterania cassiquiarensis</i> (Spruce ex Warm.) Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Trichanthera</i>
<i>Ruizterania esmeraldae</i> (Standl.) Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Trichanthera</i>
<i>Ruizterania retusa</i> (Spruce ex Warm.) Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Trichanthera</i>
<i>Ruizterania wittrockii</i> (Malme) Marc.-Berti	<i>Qualea</i> subg. <i>Qualea</i> sect. <i>Trichanthera</i>
<i>Vochysia discolor</i> Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Discolores</i>
<i>Vochysia acuminata</i> Bong.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia dasyantha</i> Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia ferruginea</i> Mart.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia inundata</i> Ducke	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia pyramidalis</i> Mart.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia vismiifolia</i> Spruce ex Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Ferrugineae</i>
<i>Vochysia angelica</i> M.C.Vianna & Fontella	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia bifalcata</i> Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia guatemalensis</i> Donn.Sm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia microphylla</i> G.H.Shimizu & K.Yamam.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia obovata</i> Stafleu	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia oppugnata</i> (Vell.) Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia pygmaea</i> Bong.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia rotundifolia</i> Mart.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia thyrsoidea</i> Pohl	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia tucanorum</i> Mart.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Lutescentes</i>
<i>Vochysia catingae</i> Ducke	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Micranthae</i>

## Appendix 2. Continued.

<b>Taxon</b>	<b>Infrageneric classification</b>
<i>Vochysia fontellae</i> Paula	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Micranthae</i>
<i>Vochysia glaberrima</i> Warm.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Micranthae</i>
<i>Vochysia guianensis</i> Aubl.	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Micranthae</i>
<i>Vochysia pseudopumila</i> Rizzini & Heringer	<i>Vochysia</i> sect. <i>Ciliantha</i> subsect. <i>Micranthae</i>
<i>Vochysia haenkeana</i> Mart.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Calophylloideae</i>
<i>Vochysia obidensis</i> (Huber ex Ducke) Ducke	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Calophylloideae</i>
<i>Vochysia cinnamomea</i> Pohl	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia divergens</i> Pohl	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia elliptica</i> Mart.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia gardneri</i> Warm.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia herbacea</i> Pohl	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia palmirana</i> F.França & Proença	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia petraea</i> Warm.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia pruinosa</i> Pohl	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia pumila</i> Pohl	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia rufa</i> Mart.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia sessilifolia</i> Warm.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>
<i>Vochysia</i> sp. nov.	<i>Vochysia</i> sect. <i>Vochysiella</i> subsect. <i>Decorticantes</i>

**Appendix 3.** Morphological matrix coded. Polymorphisms are indicated by “&” between the numbers, unknown by “?”, and inapplicable by “-”.

Taxon (terminal)	Characters and character states																																	
	0								1								2								3									
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4
Campomanesia_gua_GB	2	2	1	0	1	0	1	0	0	0	0	0	2	0	1	0	0	1	1	0	0	0	0	1	2	2	-	-	0	-	0	1	-	-
Psidium_gua_G065	2	2	1	0	1	0	1	0	0	0	0	0	2	0	1	0	0	1	1	0	0	0	0	1	2	2	-	-	0	-	0	1	-	-
Ccas_G166	2	0	1	0	0	0	0	0	1	0	1	0	0	1	1	?	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cmic_G198	2	0	1	0	0	0	0	0	1	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cmaj_GB	2	0	1	0	1	0	0	0	1	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cmaj_G037	2	0	1	0	0	0	0	0	1	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cmic_G167	2	0	1	0	0	0	0	0	1	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cery_G156	2	0	1	0	1	0	0	0	1	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Cfas_G197	2	0	1	0	1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0&1	1	0
Qcfacu_G090	2	0	1	0	0	0	0	0	1	1	1	0	0	1	?	?	0	0	0	0	0	1	1	0	1	2	1	0	0	1	0	1	1	1
Qmagn_G100	2	0	1	0	0	0	0	0	1	1	1	0	0	1	1	1&2	0	0	0	0	0	1	1	0	1	2	1	0	0	1	0	1	1	1
Qgest_G076	2	0	1	0	0	0	0	0	1	1	1	0	0	1	1	1&2	0	0	0	0	0	1	1	0	1	2	1	0	0	1	0	1	1	1
Qpara_G183	2	0	1	0	0	0	0	0	1	1	1	0	0	1	1	1&2	0	0	0	1	0	1	1	0	1	2	1	0	0	1	0	1	1	1
Qsp_G048	2	0	1	0	0	0	0	0	1	1	1	0	0	1	?	?	0	0	0	?	0	1	?	0	1	2	1	0	0	1	0	1	1	1
Qsp_G050	2	0	1	0	0	0	0	0	1	1	1	0	0	1	?	?	0	0	0	?	0	1	?	0	1	2	1	0	0	1	0	1	1	1
Qsp_G086	2	0	1	0	0	0	0	0	1	1	1	0	0	1	?	?	0	0	0	?	0	1	?	0	1	2	1	0	0	1	0	1	1	1
Qsp_G087	2	0	1	0	0	0	0	0	1	1	1	0	0	1	?	?	0	0	0	?	0	1	?	0	1	2	1	0	0	1	0	1	1	1
Qcord_G034	2	0	1	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0	1	2	1	0	0	1	0	1	1	1
Qcry_G199	2	0	1	0	0	0	0	0	1	1	1	0	0	1	1	1	1	0	0	1	0	1	0	0	1	2	1	0	0	1	0	1	1	1
Qcord_G168	2	0	1	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0	1	2	1	0	0	1	0	1	1	1
Qdin_G052	2	0	1	0	0	0	0	0	1	1	1	0	0	1	2	?	0	0	0	0	0	1	0	0	1	2	1	0	0	1	0	1	1	1
Qmult_G038	2	0	1	0	2	0	0	0	1	1	1	0	0	1	0&1	1&2	0	0	0	0	0	0	0	0	0	1	2	1	0	0	1	0	1	1
Qmult_G139	2	0	1	0	2	0	0	0	1	1	1	0	0	1	0&1	1&2	0	0	0	0	0	0	0	0	0	1	2	1	0	0	1	0	1	1









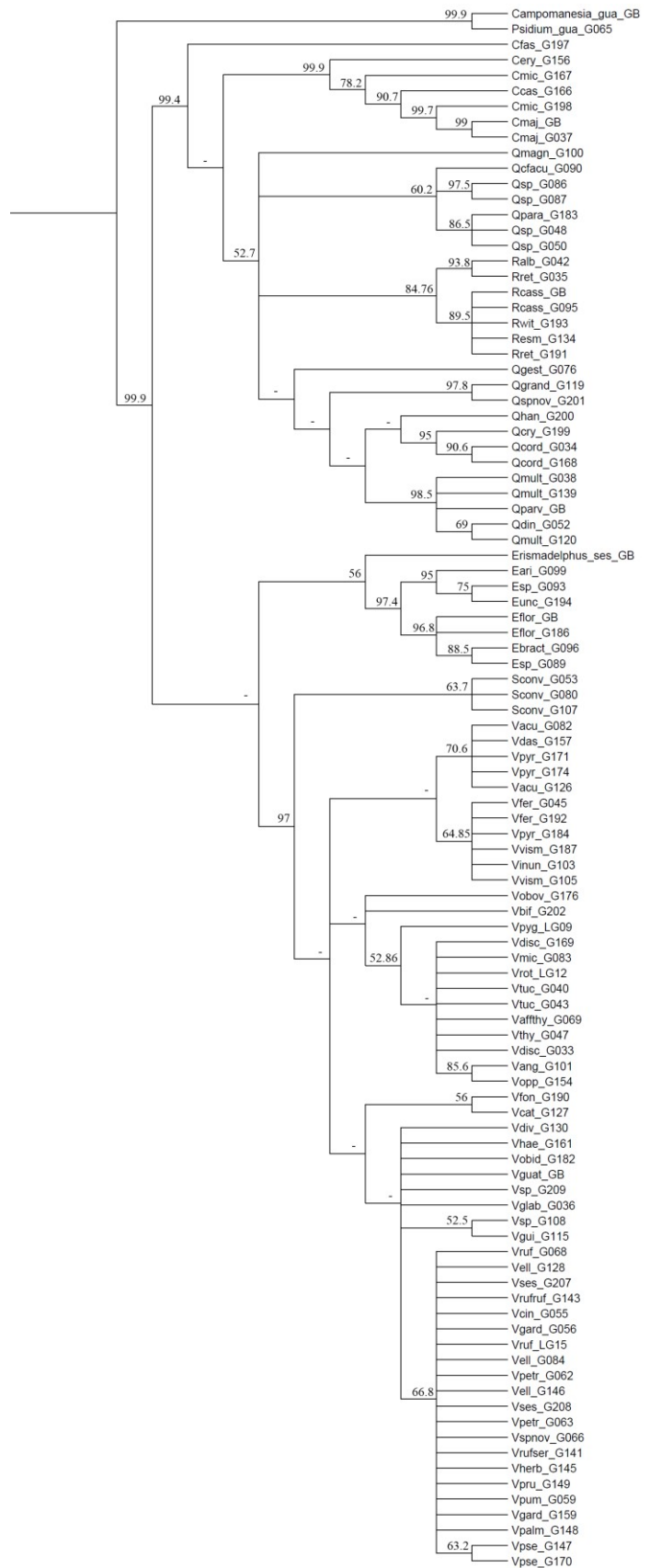


## Electronic Supplement

**Table S1.** Taxa codes, names, voucher information and GenBank accession numbers for the terminals present just in the *ndhF* dataset.

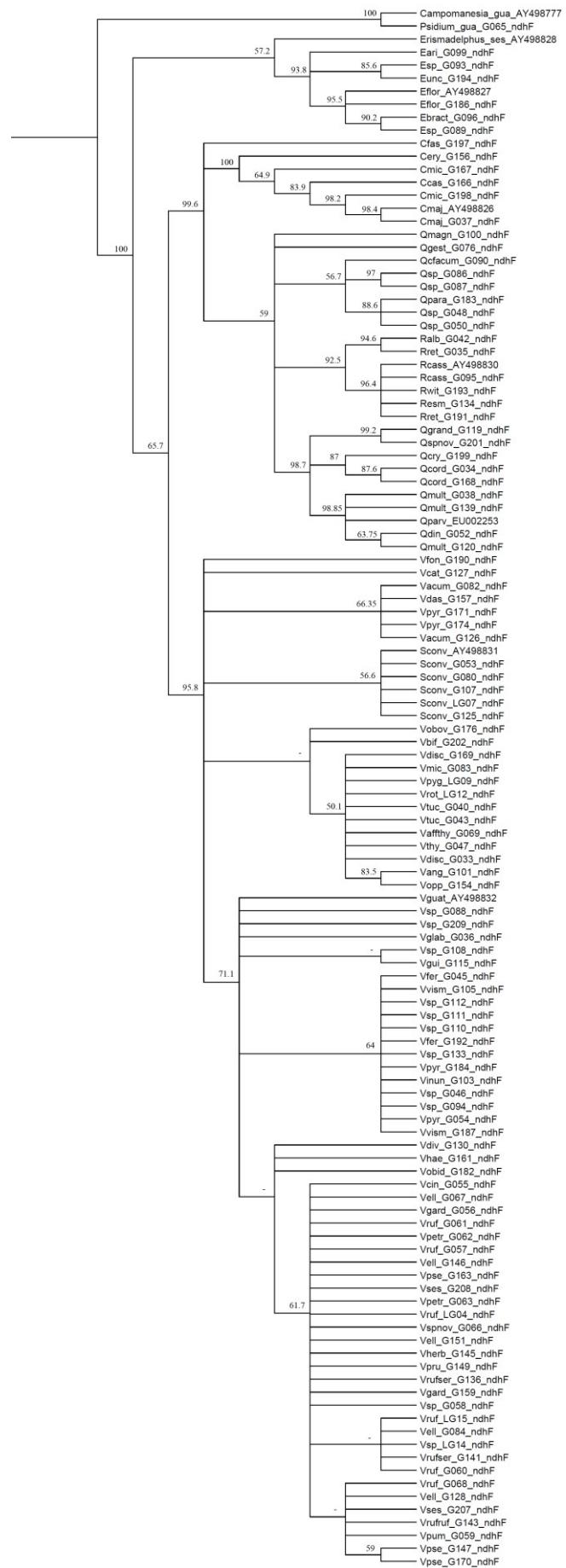
Terminal	Taxon	Collection	GenBank Accession
Sconv_AY498831	<i>Salvertia convallariodora</i> A.St.-Hil.	A. Litt <i>et al.</i> 15 (NY)	AY498831.1
Sconv_G125_ndhF	<i>Salvertia convallariodora</i> A.St.-Hil.	A.V. Scatigna 50 (UEC)	
Sconv_LG07_ndhF	<i>Salvertia convallariodora</i> A.St.-Hil.	G.H. Shimizu & A.V. Scatigna 900 (UEC)	
Vell_G067_ndhF	<i>Vochysia elliptica</i> Mart.	D.J.P. Gonçalves <i>et al.</i> 531 (UEC)	
Vell_G151_ndhF	<i>Vochysia elliptica</i> Mart.	R.J. Trad s.n. (UEC)	
Vpse_G163_ndhF	<i>Vochysia pseudopumila</i> Rizzini & Heringer	D.J.P. Gonçalves 591 (UEC)	
Vpyr_G054_ndhF	<i>Vochysia pyramidalis</i> Mart.	G.H. Shimizu <i>et al.</i> s.n. (UEC)	
Vruf_G057_ndhF	<i>Vochysia rufa</i> Mart.	G.H. Shimizu <i>et al.</i> s.n. (UEC)	
Vruf_G060_ndhF	<i>Vochysia rufa</i> Mart.	A.R. Rech 53 (UEC)	
Vruf_G061_ndhF	<i>Vochysia rufa</i> Mart.	A.R. Rech 52 (UEC)	
Vruf_LG04_ndhF	<i>Vochysia rufa</i> Mart.	A.R. Rech 55 (UEC)	
Vrufser_G136_ndhF	<i>Vochysia rufa</i> subsp. <i>sericea</i> (Pohl) Stafleu	R.J. Trad s.n. (UEC)	
Vvism_G111_ndhF	<i>Vochysia vismiifolia</i> Spruce ex Warm.	G.H. Shimizu <i>et al.</i> 1013 (UEC)	
Vsp_G046_ndhF	<i>Vochysia</i> sp. (subsect. <i>Ferrugineae</i> )	A.O. Simões s.n. (UEC)	
Vsp_G058_ndhF	<i>Vochysia</i> sp. (subsect. <i>Decorticantes</i> )	G.H. Shimizu <i>et al.</i> s.n. (UEC)	
Vsp_G088_ndhF	<i>Vochysia</i> sp.	G.H. Shimizu <i>et al.</i> 924 (UEC)	
Vsp_G094_ndhF	<i>Vochysia</i> sp.	G.H. Shimizu <i>et al.</i> 934 (UEC)	
Vsp_G110_ndhF	<i>Vochysia</i> sp. (subsect. <i>Decorticantes</i> )	G.H. Shimizu <i>et al.</i> 1012 (UEC)	
Vsp_G112_ndhF	<i>Vochysia</i> sp.	G.H. Shimizu <i>et al.</i> 1022 (UEC)	
Vsp_G133_ndhF	<i>Vochysia</i> sp.	F.N. Cabral 1123 (UEC)	
Vsp_LG14_ndhF	<i>Vochysia</i> sp. (subsect. <i>Decorticantes</i> )	G.H. Shimizu & A.V. Scatigna 913 (UEC)	

## Electronic Supplement



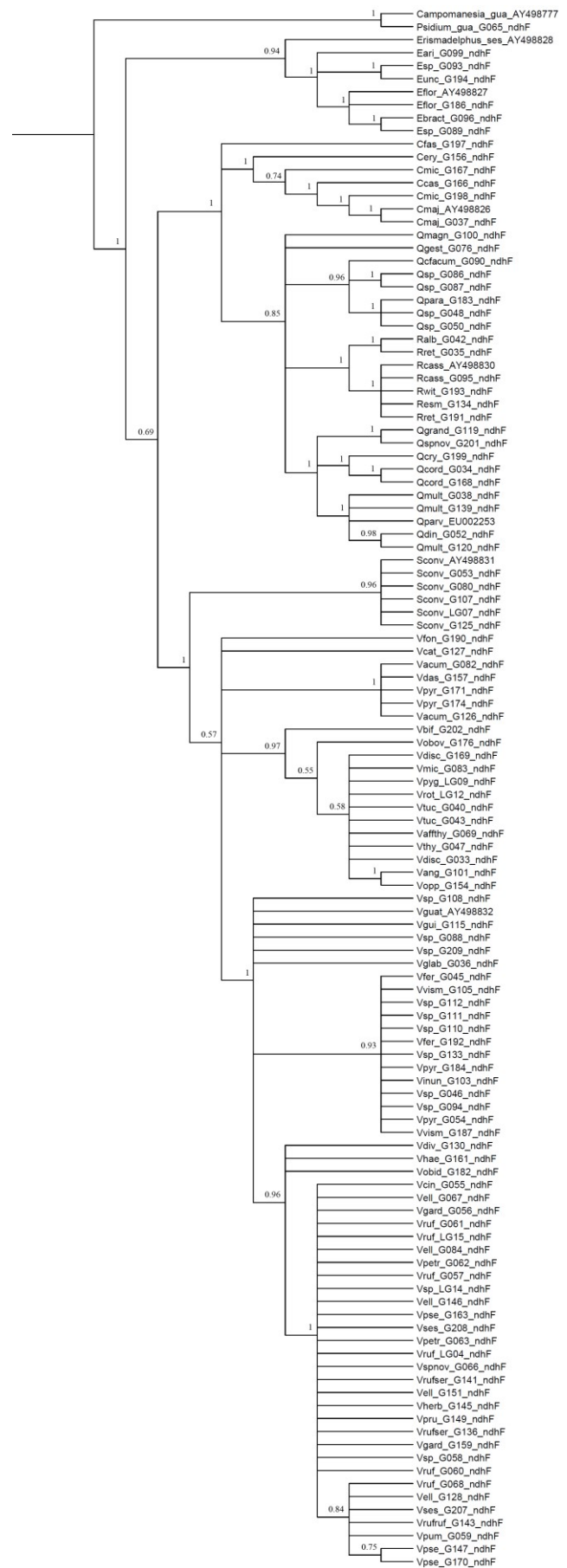
**Fig. S1.** Strict consensus tree from the MP analysis of the combined molecular dataset. Bootstrap support (BS) is indicated above, on each branch. Bootstrap support lower than 50% is indicated by a dash (-). Full taxon names are given in Appendix 1.

## Electronic Supplement



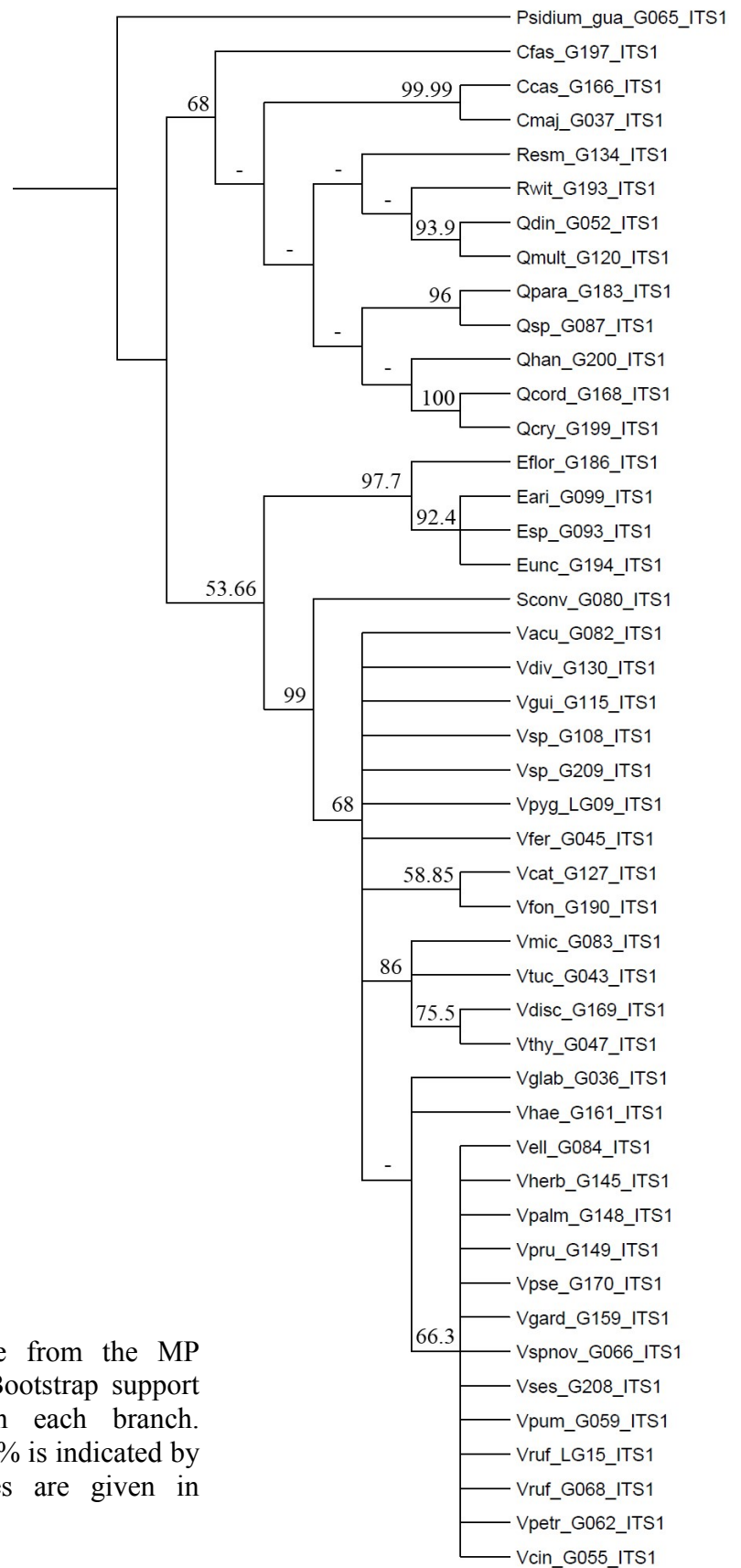
**Fig. S2.** Strict consensus tree from the MP analysis of the *ndhF* dataset. Bootstrap support (BS) is indicated above, on each branch. Bootstrap support lower than 50% is indicated by a dash (-). Full taxon names are given in Appendix 1 and Table S1.

## Electronic Supplement



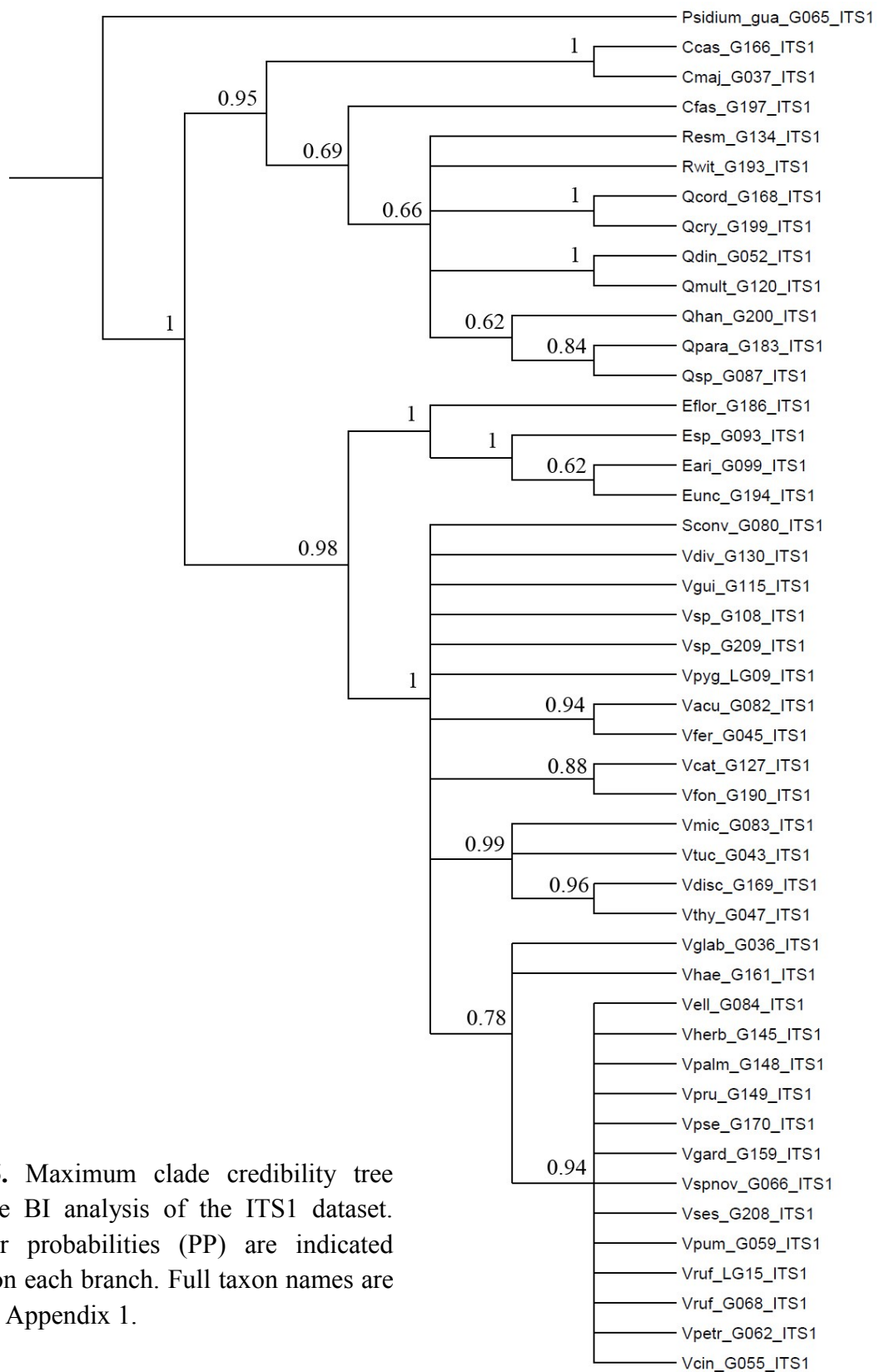
**Fig. S3.** Maximum clade credibility tree from the BI analysis of the *ndhF* dataset. Posterior probabilities (PP) are indicated above, on each branch. Full taxon names are given in Appendix 1 and Table S1.

## Electronic Supplement



**Fig. S4.** Strict consensus tree from the MP analysis of the ITS1 dataset. Bootstrap support (BS) is indicated above, on each branch. Bootstrap support lower than 50% is indicated by a dash (-). Full taxon names are given in Appendix 1.

## Electronic Supplement



**Fig. S5.** Maximum clade credibility tree from the BI analysis of the ITS1 dataset. Posterior probabilities (PP) are indicated above, on each branch. Full taxon names are given in Appendix 1.

## **Capítulo 2**

### **Typifications and new synonyms in *Vochysia* (Vochysiaceae)**

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#### **Abstract**

As a result of nomenclatural studies on names of *Vochysia* (Vochysiaceae) from Brazil, we propose 26 lectotypifications, out of which 21 are second-step and another one is associated to an epitype. Also, four new synonyms are proposed.

#### **Key words**

Brazil; taxonomy; typification; *Vochysia*

#### **Introduction**

*Vochysia* Aubl. is the largest genus within Vochysiaceae, comprising ca. 140 spp. Since the last monographic treatment for the whole genus by Stafleu (1948), ca. 50 new species were described. We focused on the taxa occurring in Brazil, which holds 86 spp., in order to update



the nomenclatural data. Stafleu (1948) had already made most of the necessary typifications, but some are still needed. For several cases, the lack of sufficient information prevents us from making further decisions. We were able to indicate 26 lectotypes. Also, after an extensive examination of herbarium specimens, four new synonyms are addressed here.

### Typifications and synonymy

*Vochysia assua* Stafleu, Recueil Trav. Bot. Néerl. 41: 510. 1948 – **Lectotype (designated here):** BRAZIL. Amazonas: Parintins, “terras ao sul do Lago José-Assú”, 28 Dec 1935, *Ducke s.n.*, RB 34649 (U barcode 0007145!; isolectotypes: G barcode 00342615!, IAN 50546!, K barcode 000566093 [photo!], P barcode 00733844 [photo!], RB barcode 00544502!, S [S-R-10177]!, U barcode 0007144!, US barcode 00108782 [photo!]).

There are two sheets of *Ducke s.n.*, RB 34649 in U (the herbarium Stafleu cited in the protologue). Stafleu labeled one as “typus” and the other as “typi duplum”, but did not distinguish them in his publication (Stafleu, 1948). Now they have barcodes and the sheet annotated as “typus” by Stafleu was selected.

*Vochysia bifalcata* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 84. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Rio de Janeiro: “Cachoeira, route de Nova Friburgo”, 14 Mar 1870, *Glaziou 3952* (C!; isolectotypes: C! [annotated as “typi duplum” by Stafleu], K barcode 000565938 [photo!], P barcodes 00733838 [photo!], 00733839 [photo!], 00733840 [photo!], R barcode 000007540!; B, destroyed, F negative 12904!) – **Lectotype (second-step, designated here):** *Glaziou 3952* (C! [annotated as “typus” by Stafleu]).

The type designation made by Stafleu (1948) should be treated as the first-step lectotypification, because he did not distinguish the two sheets from C in his publication, although annotating one as “type” and the other as “typi duplum”. Following McNeill & al. (2012: Art. 9.17), a second-step lectotype is needed, so we have chosen the specimen annotated as “typus” by Stafleu.

*Vochysia biloba* Ducke, Arq. Inst. Biol. Veg. 2 (1): 52. 1935 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Amazonas: “São Paulo de Olivença, Rio

Solimões”, 30 Oct 1931, *Ducke s.n.*, RB 24080 (RB barcodes 00544503!, 00561255!, 00561256!, 00561257!; isolectotypes: G barcode 00342614!, IAN 50575!, K barcode 000566188 [photo!], NY barcode 00001034 [photo!], P barcodes 00733835 [photo!], 00733836 [photo!], S [S-R-10180]!, U barcodes 0007148!, 0007149!, US barcode 00108786 [photo!]) – **Lectotype (second-step, designated here):** *Ducke s.n.*, RB 24080 (RB barcode 00544503!).

There are four sheets of *Ducke s.n.*, RB 24080 in RB, but just one bears a herbarium label. This one, annotated as “typus”, is selected as the second-step lectotype.

*Vochysia calophylla* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 98, t. 18, fig. 1. 1875 – Lectotype (first-step, designated by Stafleu [1948]): VENEZUELA. “Ad flum. Guainia v. Rio Negro supra ostium fluminis Casiquiari”, Aug 1854, *Spruce 3538* (K barcodes 000565990 [photo!], 000565991 [photo!]; isolectotypes: BM barcode 000566756!, BR barcode 0000005529278!, F 838004 [fragment][photo!], 937827 [fragment][photo!], G barcodes 00342607!, 00342608!, 00342609!, GH barcode 00045234 [photo!], GOET barcode 011623 [photo!], LD barcode 1214116 [photo!], NY barcode 00001039 [photo!], OXF 84993 [photo!], P barcodes 00733833 [photo!], 00733834 [photo!], W 1889-0000712 [photo!]) – **Lectotype (second-step, designated here):** *Spruce 3538* (K barcode 000565991 [photo!]).

There are two sheets of *Spruce 3538* in K. Stafleu annotated one as “typus”, but did not distinguish them in his publication (Stafleu, 1948). Here we select the second-step lectotype, the one annotated as “typus” by Stafleu.

*Vochysia cinnamomea* Pohl, Pl. Bras. Icon. Descr. 2: 29, t. 120. 1828 or 1829 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Goiás: “Habitat in locis siccis, aridis, camporum montosorum in Serra de Cristaës, Capitaniae Goyaz”, Dec 1818, *Pohl 1056* (W 0066824 [photo!], 0066825 [photo!]; isolectotypes: BR barcodes 0000005628810!, 0000005629145!, F 838013 [fragment][photo!], M barcodes 0239499!, 0239500!) – **Lectotype (second-step, designated here):** *Pohl 1056* (W 0066824 [photo!]).

There are two sheets of *Pohl 1056* in W. Stafleu annotated one as “typus”, but did not distinguish them in his publication (Stafleu, 1948). Here we select the second-step lectotype, the one annotated as “typus” by Stafleu.

***Vochysia dasyantha*** Warm. in Martius & Eichler, Fl. Bras. 13 (2): 95. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Minas Gerais: “between Villa do Principe and Cocaes”, Aug 1840, *Gardner 4549* (K barcodes 000566052 [photo!], 000566053 [photo!]; isolectotypes: BM barcode 000566766!, E barcode 00285634 [photo!], F 1537708 [photo!], FI barcode 005836 [photo!], G barcodes 00342870!, 00342871!, 00342872!, GH barcode 00045236 [photo!], NY barcodes 00001042 [photo!], 00001043 [photo!], OXF, P barcodes 00733823 [photo!], 00733824 [photo!], US barcode 00108794 [photo!], W 0066826 [photo!], 1889-0000693 [photo!]) – **Lectotype (second-step, designated here):** *Gardner 4549* (K barcode 000566052!).

There are two sheets of *Gardner 4549* in K. Stafleu annotated one as “typus”, but did not distinguish them in his publication (Stafleu, 1948). Here we select the second-step lectotype, the one annotated as “typus” by Stafleu.

***Vochysia densiflora*** Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 101, t. 19. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Amazonas: “Prope Panurè ad Rio Uaupès”, Nov 1852, *Spruce 2627* (K barcodes 000566088 [photo!], 000566090 [photo!]; isolectotypes: BM barcode 000566762!, BR barcode 0000005529605!, C! [2 sheets], E barcode 00285636 [photo!], F 838983 [photo!], 937825 [photo!], 1537738 [photo!], G barcode 00342869!, GH barcode 00045237 [photo!], GOET barcode 011624 [photo!], LD barcode 1223227 [photo!], MPU barcode 014258 [photo!], NY barcode 00001044 [photo!], OXF barcodes 85000 [photo!], 85001 [photo!], RB barcode 00544507!, US barcode 00108795 [photo!], W 1889-0000711 [photo!], 1889-0146252 [photo!]; B, destroyed, F negative 12909!) – **Lectotype (second-step, designated here):** *Spruce 2627* (K barcode 000566090 [photo!]).

There are two sheets of *Spruce 2627* in K. One (K barcode 000566088) was annotated as “typi duplum” by Stafleu and the other is divided in two parts, each one of them with a different barcode and collection date, but bearing the same collection number. The lowermost part (K barcode 000566090), dated as Nov 1852, was annotated as “typus” by Stafleu, and the

uppermost part (K barcode 000566089), dated as Jan 1853, is a posterior collection under the same collection number. The element annotated as “typus” by Stafleu was selected as the second-step lectotype.

***Vochysia discolor*** Warm. in Martius & Eichler, Fl. Bras. 13 (2): 81. 1875 – **Lectotype (designated here)**: BRAZIL. Minas Gerais: Serra da Lapa, Nov 1824, *Riedel 1097* (LE [photo!]; isoelectotypes: G barcode 00342868!, GH barcode 00045238 [photo!], K barcode 000565992 [photo!], NY barcode 00001046 [photo!], OXF barcode 00085094 [right side, photo!], P barcode 00733821 [photo!]; B, destroyed, F negative 12910!).

Stafleu (1948) expected that the type would probably be in LE, the only specimen he was not able to analyze. After seeing a photo of this material from LE, we are able to designate it as the lectotype.

***Vochysia ferruginea*** Mart., Nov. Gen. Sp. Pl. 1: 151, t. 92. 1826 (‘1824’) ≡ *Cucullaria ferruginea* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9. 1827 – Lectotype (first-step, designated by Marcano-Berti [1998]): BRAZIL. Amazonas: “in sylvis campestribus ad pagum Coari Provinciae Rio Negro”, 1819, *Martius Obs.* [Observationes botanicae] 2861 (M barcodes 0239512!, 0239513!, 0239514!, 0239515!; isoelectotypes: K barcode 000565986 [photo!], L barcodes 0016749!, 0016750!) – **Lectotype (second-step, designated here)**: *Martius Obs.* 2861 (M barcode 0239512!).

Stafleu analyzed the K and L specimens, but did not see the material from M. He stated that the type material would be there (Stafleu, 1948). Marcano-Berti (1998) named one of the four sheets from M as the holotype, thus making the first-step lectotypification. Consulting Martius’ field book (“Observationes”), we have found that the collection number is 2861. The plate number from the original description of *Vochysia ferruginea* (“t. 92”) is written in his field book, associated to the collection information. Just two of the four sheets have labels indicating “Obs. 2861”, but the ones lacking this information are much likely to be duplicates. For the second-step lectotype, we have chosen the one with more complete label.

***Vochysia floribunda*** Mart., Nov. Gen. Sp. Pl. 1: 149, t. 91. 1826 (‘1824’) ≡ *Cucullaria floribunda* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9. 1827 – **Lectotype (designated here)**: BRAZIL. Amazonas: “in sylvis primaevae ad Ega (currently Tefé), oppidulum

juxta fluvium Solimões in Provincia Rio Negro”, Dec 1819, *Martius Obs. 2981* (M barcode 0239522!; isolectotypes: K barcode 000565985 [photo!], L barcodes 0016751!, 0016752!, M barcodes 0239519!, 0239520!, 0239521!).

Stafleu did not see the material from M, but expected that the type would be in that herbarium (Stafleu, 1948). There are four sheets in M, but just one with the “Obs. 2981” information. The plate number (“t. 91”) also accompanies the collection information presented in the field book. The sheet annotated with “Obs. 2981” was chosen as the lectotype.

***Vochysia gardneri*** Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 70. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Goiás: “S. Domingos et Posse”, May 1840, *Gardner 4126* (K barcodes 000494711 [photo!], 000494734 [photo!]; isolectotypes: BM barcode 000566738!, BR barcode 0000005530021!, E barcodes 00285646 [photo!], 00285647 [photo!], F [fragment][photo!], FI barcode 005837 [photo!], G barcodes 00342861!, 00342862! 00342863!, 00342864!, OXF barcode 00085002 [photo!], P barcodes 00733906 [photo!], 00733907 [photo!], 00733908 [photo!], 00733909 [photo!], W 0066819 [photo!], 1889-0000695 [photo!]; B, destroyed, F negative 12913!) – **Lectotype (second-step, designated here):** *Gardner 4126* (K barcode 000494734 [photo!]).

There were two sheets in K, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

***Vochysia grandis*** Mart., Nov. Gen. Sp. Pl. 1: 146, t. 88. 1826 (‘1824’) ≡ *Cucullaria grandis* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9. 1827 – **Lectotype (designated here):** BRAZIL. Amazonas: “in sylvis primaevae prope Coari et Ega, Provinciae Rio Negro”, 1819, *Martius Obs. 2924* (M barcode 0239527!; isolectotypes: G barcode 00342859!, M barcodes 0239524!, 0239525!, 0239526!).

Stafleu did not see the material from M, but expected that the type would be in that herbarium (Stafleu, 1948). There are four sheets in M, but just one with the “Obs. 2924” information. The sheet annotated with “Obs. 2924” was chosen as the lectotype.

*Vochysia grandis* var. *uaupensis* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 75. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Amazonas: “Prope Panuré ad Rio Uaupés”, Oct 1852–Jan 1853, *Spruce 2657* (K [3 sheets][photo!]; isolectotypes: BM barcode 000566747!, BR barcode 0000005529759!, C!, E barcode 00285643 [photo!], F [photo!], G barcodes 00342856!, 00342857!, 00342858!, GH barcode 00045241 [photo!], GOET barcode 011625 [photo!], LD barcode 1762723 [photo!], MPU barcode 014256 [photo!], NY barcode 00001050 [photo!], OXF barcodes 00085010 [photo!], 00085011 [photo!], P barcodes 00733915 [photo!], 00733916 [photo!], RB barcode 00544510!; B, destroyed, F negative 12920!) – **Lectotype (second-step, designated here):** *Spruce 2657* (K barcode 000565949 [photo!]).

There are three sheets in K under *Spruce 2657*, each one with different date information: October 1852 (K barcode 000565948), December 1852 (K barcode 000565947), and October 1852–January 1853 (K barcode 000565949). They represent, at least, two gatherings (October 1852 and December 1852). As most duplicates in other herbaria bear the label with the period October 1852–January 1853, it is not possible to ascertain precisely to which gathering they correspond. Since Stafleu (1948) made the first-step lectotypification by designating *Spruce 2657* in K, we are choosing here the second-step lectotype, the sheet annotated as October 1852–January 1853.

*Vochysia magnifica* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 85. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Minas Gerais: Serra de Caldas, 14 Nov 1874, *Regnell s.n.*, “*Ex herb. Regnelli., Ser. III, No. 531, 14.11.1874*” (S [S08-15933]!, [S-R-10188]!; isolectotypes: C! [mounted in 2 sheets], P barcode 00733884 [photo!]) – **Lectotype (second-step, designated here):** *Regnell s.n.*, “*Ex herb. Regnelli., Ser. III, No. 531, 14.11.1874*” (S [S-R-10188]!).

There were two sheets in S with the same date, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

*Vochysia oblongifolia* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 84. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Pernambuco: Colony of Catucá, Nov 1837, *Gardner 995* (K barcodes 00565939 [photo!], 00565940 [photo!];

isolectotypes: BM barcode 000566752!, E barcode 00285645 [photo!], F [photo!], FI barcode 005839 [photo!], G barcode 00343015 [photo!], GH barcode 00045247 [photo!], NY barcode 00001066 [photo!], OXF barcodes 00085084 [photo!], 00085085 [photo!], P barcodes 00733901 [photo!], 00733902 [photo!], 00733903 [photo!], S [S-R-10190]!, US barcode 00108814 [photo!], W 0066831 [photo!], 1889-0000696 [photo!] – **Lectotype (second-step, designated here):** *Gardner 995* (K barcode 00565939 [photo!]).

There were two sheets in K, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

***Vochysia obscura*** Warm. in Martius & Eichler, Fl. Bras. 13 (2): 73, t. 13. 1875 – Lectotype (first-step, designated by Stafleu [1948]): VENEZUELA. “In fl. Negro”, Oct 1854, *Spruce 3700* (K barcodes 000572815 [photo!], 000572816 [photo!]; isolectotypes: BM barcode 000939001 [photo!], BR barcode 0000005530113!, E barcode 00285642 [photo!], G barcodes 00343011 [photo!], 00343012 [photo!], P barcodes 00733899 [photo!], 00733900 [photo!], W 1889-0000683 [photo!]) – **Lectotype (second-step, designated here):** *Spruce 3700* (K barcode 000572816 [photo!]).

There were two sheets of *Spruce 3700* in K, so a second-step lectotypification was needed. The specimen annotated as “lectotypus” by Stafleu was selected.

***Vochysia oppugnata*** (Vell.) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 87. 1875 ≡ *Strukeria oppugnata* Vell., Fl. Flumin.: 8. 1829 (‘1825’); Fl. Flumin. Icon. 1: t. 20. 1831 (‘1827’) – **Lectotype (designated here):** BRAZIL. Rio de Janeiro: “Silvis maritimis Regii Praedii Sanctae Crucis habitat”; [illustration] Original parchment plate of *Flora Fluminensis* in the Manuscript Section of the Biblioteca Nacional, Rio de Janeiro [cat. no.: mss1095062\_024] and later published in Vellozo, Fl. Flum. Icon. 1: t. 20. 1831 – **Epitype (designated here):** BRAZIL. Rio de Janeiro: Rio de Janeiro, 1863, *Glaziou 671* (C! [sheet with Stafleu’s identification label on top of the herbarium C label]; isoeotypes: BR barcodes 0000013089337!, 0000013089344!, 0000013089351!, 0000013089368!, C!, K barcode 001108307 [photo!], P barcodes 00733892 [photo!], 00733893 [photo!], R 000007534!).

As happened in several other cases (e.g., Lima, 1995; Moraes, 2005; Vaz, 2011; Pastore, 2013; Aona-Pinheiro & al., 2014; Knapp & al., 2015) for Vellozo's names in *Flora Fluminensis*, we have chosen the plate of *Strukeria oppugnata* Vell., held at the Biblioteca Nacional of Rio de Janeiro, as lectotype. Since the original specimen is missing, this illustration is the only original material available. However, we also have chosen an epitype, previously stated as lectotype by Stafleu (1948), to help recognize the species, because the illustration alone is not elucidative enough, and this species can be confused with *Vochysia tucanorum* Mart.

***Vochysia pruinosa*** Pohl, Pl. Bras. Icon. Descr. 2: 22, t. 114. 1828 or 1829 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Goiás: “in Serra d’Ourada prope Metropolitim Capitaniae Goyaz”, Mar 1819, *Pohl 1640* (W 0067627 [photo!], 0067628 [photo!], 0067629 [photo!]; isolectotypes: BR barcode 0000005629152!, F [fragment][photo!], G, OXF barcode 00054853 [photo!], PR) – **Lectotype (second-step, designated here):** *Pohl 1640* (W 0067627 [photo!]).

There were two sheets of *Pohl 1640* in W, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

***Vochysia pumila*** Pohl, Pl. Bras. Icon. Descr. 2: 21, t. 113. 1828 or 1829 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Minas Gerais: “in Serra de Spilons [Serra dos Pilões, near Guarda-Mor]”, Nov 1818, *Pohl 654* (W barcodes 0066832 [photo!], 0066833 [photo!]; isolectotypes: BR barcode 0000005299355!, F barcode 0074880F [fragment][photo!], M barcodes 0239544!, 0239545!, OXF barcode 00054851 [photo!]) – **Lectotype (second-step, designated here):** *Pohl 654* (W 0066832 [photo!]).

= *Vochysia pseudopumila* Rizzini & Heringer, Anais Acad. Brasil. Ci. 38 (supl): 107, fig. 12. 1966 – Lectotype: BRAZIL. Goiás, prope S. João da Aliança, 18 Jul 1963, *Mattos et al.* 386 (RB 118805! [mounted in three sheets: RB barcodes 00544524, 00561248, 00561249]), **syn. nov.**

There were two sheets of *Pohl 654* in W, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected. This specimen is very similar to the illustration from the protologue.



The only difference between *V. pseudopumila* and *V. pumila* is the glabrous versus pilose ovary, probably a reversion in the former entity, as suggested by molecular and morphological data. The populations bearing glabrous ovary are restricted to the Chapada dos Veadeiros region, in Goiás state. We therefore propose to treat *V. pseudopumila* as a synonym of *V. pumila*.

***Vochysia punctata*** Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 102. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Amazonas: “Prope Panuré ad Rio Uaupés”, Oct 1852–Jan 1853, *Spruce 2675* (K [3 sheets][photo!]; isolectotypes: BM barcode 000566770!, BR barcode 0000005299324!, E barcode 00285633 [photo!], F [photo!], G barcodes 00343001 [photo!], 00343002 [photo!], GH barcode 00045252 [photo!], GOET barcode 011628 [photo!], LD barcode 1214716 [photo!], MPU barcode 014255 [photo!], NY barcode 00001091 [photo!], OXF barcodes 00085006 [photo!], 00085007 [photo!], P barcodes 00733937 [photo!], 00733939 [photo!], RB barcode 00544525!, W 1889-0000705 [photo!], 1889-0146240 [photo!]; B, destroyed, F negative 12925!) – **Lectotype (second-step, designated here):** *Spruce 2675* (K barcode 000566047 [photo!]).

There are three sheets in K under *Spruce 2675*, each one with different date information: November 1852 (K barcode 000566047), January 1853 (K barcode 000566048), and October 1852–January 1853 (K barcode 000566049). They represent, at least, two gatherings (November 1852 and January 1853). Stafleu (1948) made the first-step lectotypification by designating *Spruce 2675* in K, so a second-step lectotypification was needed. The specimen dated as November 1852 and annotated as “typus” by Stafleu had a more complete label, and thus was selected.

***Vochysia pyramidalis*** Mart., Nov. Gen. Sp. Pl. 1: 148, t. 90. 1826 (‘1824’) ≡ *Cucullaria pyramidalis* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9. 1827 – Lectotype (first-step, designated by Passos & França [2003]): BRAZIL. Minas Gerais: “Inter Sette Lagoas et Vão do Paranán, Provinciae Minas Gerães, in confiniis Provinciae Goyazanae”, *Martius Obs. 1829* (M barcodes 0239547!, 0239548!, 0239549!; isolectotype: L barcode 0016755!) – **Lectotype (second-step, designated here):** *Martius Obs. 1829* (M barcode 0239549!).

Stafleu did not see the material from M, but expected that the type would be there (Stafleu, 1948). Passos & França (2003) provided the first-step lectotypification by indicating *Martius s.n.* in M, and here we designate the second-step lectotype. Among the three sheets in M, just one has “Obs. 1829” written, but all are from the Vão do Paranã region. Consulting Martius’ field book, the plate number from the protologue (“t. 90”) is also associated with the collection information. The sheet annotated with “Obs. 1829” was chosen as the second-step lectotype.

***Vochysia rufa* subsp. *sericea*** (Pohl) Stafleu, Recueil Trav. Bot. Néerl. 41: 429. 1948.

Basionym: *Vochysia sericea* Pohl, Pl. Bras. Icon. Descr. 2: 28. 1828 or 1829  $\equiv$  *Vochysia rufa* var. *sericea* (Pohl) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 66. 1875 – Lectotype (first-step designated by Stafleu [1948]): BRAZIL. Goiás: “Ad Olho d’Agua”, Mar 1819, *Pohl 1286* (W 0066836 [photo!], 0066837 [photo!]; isolectotypes: BR barcodes 0000005628490!, 0000013347437!, F [fragment][photo!], M barcode 0239554!, OXF barcode 00084992 [photo!]) – **Lectotype (second-step, designated here):** *Pohl 1286* (W 0066837 [photo!]).

One of the two sheets from herbarium W, annotated as “typus” by Stafleu, was selected as the second-step lectotype.

***Vochysia spathulata*** Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 25. 1889 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Rio de Janeiro: Alto de Bôa Vista de Nova Friburgo, 22 Jan 1874, *Glaziou 6876* (C! [2 sheets]; isolectotypes: BR barcode 0000005299140!, K barcode 000566051 [photo!], P barcodes 00733926 [photo!], 00733927 [photo!], 00733928 [photo!], RB barcode 00282276!, S [S-R-10200]!; B, destroyed, F negative 12936!) – **Lectotype (second-step, designated here):** *Glaziou 6876* (C! [annotated as “typus” by Stafleu]).

There were two sheets of *Glaziou 6876* in C, so a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

***Vochysia splendens*** Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 101. 1875 – Lectotype (first-step, designated by Stafleu [1948]): BRAZIL. Amazonas: “Prope Panuré ad Rio Uaupés”, Oct 1852–Jan 1853, *Spruce 2697* (K barcodes 000566096

[photo!], 000566097 [photo!]; isolectotypes: BM barcode 000566761 [photo!], BR barcode 0000005530137!, E barcode 00285637 [photo!], F [2 sheets][photo!], G barcodes 00343250 [photo!], 00343251 [photo!], GH barcode 00045254 [photo!], GOET barcode 011629 [photo!], LD barcode 1214056 [photo!], MPU barcode 014254 [photo!], NY barcode 00001099 [photo!], OXF barcodes 00085003 [photo!], 00085004 [photo!], P barcodes 00733930 [photo!], 00733931 [photo!], 00733932 [photo!], RB barcode 00544530!, US barcode 0108828 [photo!], W 0066830 [photo!], 1889-0146241 [photo!]; B, destroyed, F negative 12937!) – **Lectotype (second-step, designated here):** *Spruce 2697* (K barcode 000566097 [photo!]).

There are two sheets of *Spruce 2697* in K, one dated as December 1852 (K barcode 000566097) and the other as October 1852–January 1853 (K barcode 000566096). Although presenting different dates, they are likely to be part of the same gathering. The first sheet has a more complete label, while the other has less information and the period of the expedition is indicated (same as in the duplicates from other herbaria). Since Stafleu (1948) designated the first-step lectotype (*Spruce 2697* in K), a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

***Vochysia tucanorum*** Mart., Nov. Gen. Sp. Pl. 1: 142, t. 85. 1826 (‘1824’) ≡ *Vochysia tucanorum* Mart. var. *tucanorum* (as *Vochysia tucanorum* var. *vulgaris* Mart.), Nov. Gen. Sp. Pl. 1: 143, t. 85. 1826 (‘1824’) ≡ *Cucullaria tucanorum* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9. 1827 – **Lectotype (designated here):** BRAZIL. São Paulo: “Prope Aldeia da Escada, Mogy et Ypanema”, Dec 1817, *Martius Obs.* 577 (M barcode 0239561!; probable isolectotypes: M barcodes 0239559!, 0239560!).

= *Vochysia tucanorum* var. *fastigiata* Mart., Nov. Gen. Sp. Pl. 1: 142. 1826 (‘1824’), **syn. nov.** ≡ *Vochysia fastigiata* (Mart.) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 91. 1875 – Lectotype (designated by Stafleu [1948: 473]): BRAZIL. São Paulo: Cubatão, s. dat., *Sellow s.n.* (L barcode 0016756!; isolectotypes: BM barcode 000566754!, F 1537614 [photo!], G barcodes 00343126 [photo!], 00343239 [photo!], 00343240 [photo!], HAL barcode 0136883 [photo!], K barcode 000565997 – left side [photo!], NY barcode 00001108 [photo!], P barcode 4660273 – left side [photo!], US barcode 00108830 [photo!]; B, destroyed, F negative 12912!).

Martius (1826) described *Vochysia tucanorum* with four varieties: *V. tucanorum* var. *fastigiata* Mart., *V. tucanorum* var. *macrostachya* Mart., *V. tucanorum* var. *hexaphylla* Mart., and *V. tucanorum* var. *vulgaris* Mart., the last one representing the typical variety. He cited the collections for all varieties but *V. tucanorum* var. *vulgaris*, stating that it was represented by the illustration in that work. In his revision for the genus, Stafleu (1948) cited *Martius 1179* as the type collection, probably held in M. After analyzing the Vochysiaceae collection from M, we found out that it was a mistake indeed. The number 1179 refers to a serial number of “Martius Herbarium Florae Brasiliensis” collection, which was studied and distributed by Martius but not collected by him. This specific gathering has no collector known and was erroneously attributed to Martius.

On the other hand, there is a specimen collected by Martius under the number 577, preceded by “Obs.”, which refers to the “Observationes”, his field book. Looking for the number 577 in his field book, it was in effect a *Vochysia tucanorum* collection, with “t. 85” written next to the species name. The illustration for *V. tucanorum* var. *vulgaris* cited by Martius (1826) is the plate 85, thus corresponding to his annotation in the field book. The illustration agrees perfectly with the herbarium specimen, so we choose here *Martius Obs. 577* as the lectotype. There are two probable isoelectotypes, also in M, with the same label information, except for the lack of collector’s data. Although the collection place is not accurate, we could identify the cities cited by Martius as Guararema [Aldeia da Escada], Mogi das Cruzes [Mogy], and Iperó [Ypanema], within the São Paulo state. Based on his journey records, we could also state that this collection was made in December 1817.

During its taxonomic history, *V. tucanorum* presented many subdivisions and synonymizations, due to its morphological variability. Stafleu (1948) just maintained *V. tucanorum* var. *fastigiata*, but with doubts. Both Barbosa (1999) and Vianna (2002) proposed to synonymize this variety under *V. tucanorum* in their theses, but neither have published it properly. Here, after analyzing the type collection, we formally propose its synonymization.

***Vochysia venulosa*** Warm. in Martius & Eichler, Fl. Bras. 13 (2): 74. 1875 – Lectotype (first-step designated by Stafleu [1948]): BRAZIL. Amazonas: “Prope Panuré ad Rio Uaupés”, Oct 1852–Jan 1853, *Spruce 2717* (K barcodes 000565977 [photo!], 000565978 [photo!]; isoelectotypes: BR barcode 0000005530151!, F [fragment][photo!], P barcode 00733968 [photo!], W 1889-0000680 [photo!]) – **Lectotype (second-step, designated here): *Spruce 2717*** (K barcode 000565977 [photo!]).

There are two sheets of *Spruce 2717* in K, one dated as December 1852 (K barcode 000565977) and the other as October 1852–January 1853 (K barcode 000565978). Although presenting different dates, they are likely to be part of the same gathering. The first sheet has a more complete label, while the other has less information and the period of the expedition is indicated (same as in the duplicates from other herbaria). Since Stafleu (1948) designated the first-step lectotype (*Spruce 2717* in K), a second-step lectotypification was needed. The specimen annotated as “typus” by Stafleu was selected.

### **New synonyms based on the analysis of *Vochysia* species from Brazil**

*Vochysia divergens* Pohl, Pl. Bras. Icon. Descr. 2: 19, t. 111. 1828 or 1829 – Lectotype (designated by Stafleu [1948]): BRAZIL. Goiás: “Habitat ad margines fluvii Tocantini, non procul ab ingressu Rio Manuel Alvez”, Aug 1819, *Pohl 2254* (W 0066827 [photo!]; isolectotypes: BR barcodes 0000005529360!, 0000005529698!, 0000005529933!, F [fragment][photo!], JE barcode 00000878 [photo!], M barcodes 0239502!, 0239503!, OXF barcode 00084995 [photo!]).

= *Vochysia mariziana* Paula & J.L.H.Alves, Rodriguésia 30 (46): 166, t. 23-31. 1978 – Holotype: BRAZIL. Pará, São João do Araguaia, lago Juruá, 13 Jul 1976, *Paula 715* (UB 54119a!; isotype UB 54119b!), **syn. nov.**

After a careful analysis of the type collection of *V. mariziana*, restricted to Pará state, we found no significant differences between this species and the more widely distributed *V. divergens*. *Vochysia mariziana* has little bit thinner flower buds, but not to justify a species status. So we suggest to treat it as a synonym of *V. divergens*.

*Vochysia riedeliana* Stafleu, Recueil Trav. Bot. Néerl. 41: 463. 1948 – Holotype: BRAZIL. Espírito Santo, Rio Doce, 26 Mar 1934, *Kuhlmann 63* (U barcode 0007167 [photo!]; isotypes: K 001096158 [photo!], MBML 44592!, NY barcode 01842921 [photo!], RB barcodes 00544527!, 00688118!, 00702906!).

= *Vochysia grandis* var. *douvillei* Briq., Annuaire Conserv. Jard. Bot. Genève 20: 386. 1919 – Holotype: BRAZIL. Bahia: “Ilheos”, s. dat., *Douville s.n.* (G barcode 00342881!), **syn. nov.**

*Vochysia grandis* var. *douvillei* Briq. was already treated as synonym of *V. riedeliana* Stafleu by Vianna (2002) in her thesis, as it fits in the morphological description of this species. After analyzing the type collection, we agree with her circumscription and formally propose the synonymization.

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### **Literature Cited**

**Aona-Pinheiro, L.Y.S., Bittrich, V. & Amaral, M.C.E.** 2014. Two new species of *Dichorisandra* (Commelinaceae) from Rio de Janeiro and comments on the two species included in Vellozo's "Flora Fluminensis". *Phytotaxa* 184: 223--234.

<http://dx.doi.org/10.11646/phytotaxa.184.4.3>

**Barbosa, A.R.** 1999. *As espécies do gênero Vochysia Aubl. (Vochysiaceae) ocorrentes no Estado de São Paulo*. Dissertation, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.

**Knapp, S., Barboza, G.E., Romero, M.V., Vignoli-Silva, M., Giacomini, L.L. & Stehmann, J.R.** 2015. Identification and lectotypification of the Solanaceae from Vellozo's *Flora Fluminensis*. *Taxon* 64: 822--836.

**Lima, H.C.** 1995. Leguminosas da Flora fluminensis – J.M. da C. Vellozo – Lista atualizada das espécies arbóreas. *Acta Bot. Brasil.* 9: 123--146. <http://dx.doi.org/10.1590/S0102-33061995000100006>

**Marcano-Berti, L.** 1998. 123. Vochysiaceae. Pp: 1--44 in: Görts-van Rijn, A.R.A. & Jansen-Jacobs, M.J. (eds.), *Flora of the Guianas*. Series A: Phanerogams, Fascicle 21. London, Royal Botanic Gardens, Kew.

**Martius, C.F.P.** 1826. *Nova genera et species plantarum*, vol. 1. Munich: Typis Lindaueri.

**McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (eds.)** 2012. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011*. Regnum Vegetabile 154. Königstein: Koeltz Scientific Books.

<http://www.iapt-taxon.org/nomen/main.php>

**Moraes, P.L.R.** 2005. Lectotypification of names of Brazilian species of *Cryptocarya* (Lauraceae). *Taxon* 54: 789--795.

**Passos, V.M. & França, F.** 2003. Vochysiaceae da Chapada Diamantina, Bahia, Brasil. *Sitientibus, Sér. Ci. Biol.* 3 (1/2): 35--43.

**Pastore, J.F.B.** 2013. A review of Vellozo's names for Polygalaceae in his Flora Fluminensis. *Phytotaxa* 108: 41--48. <http://dx.doi.org/10.11646/phytotaxa.108.1.2>

**Stafleu, F.A.** 1948. A monograph of Vochysiaceae. I. *Salvertia* and *Vochysia*. *Recueil Trav. Bot. Néerl.* 41: 397--540.

**Vaz, A.M.S.F.** 2011. Typification of names of taxa of *Bauhinia* L. (*Leguminosae: Cercidae*) from Brazil. *Taxon* 60: 1464--1474.

**Vianna, M.C.** 2002. *Vochysia Aubl. (Vochysiaceae) na Mata Atlântica: Morfologia e Taxonomia*. Dissertation. Universidade Federal do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil.

### **Capítulo 3**

#### **A nomenclator for the genus *Vochysia* (Vochysiaceae) in Brazil**

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#### **Abstract**

*Vochysia* is the largest genus of Vochysiaceae, holding more than half of the family diversity. As the most comprehensive taxonomic revision was undertaken almost 70 years ago, an update regarding information about the currently known species is mandatory. The present work lists 86 accepted species of *Vochysia* from Brazil, with place of publication, data on types, synonymy, sectional and subsectional placement, and updated distribution range. When necessary, nomenclatural accounts are also provided.

**Key words:** Myrtales, Neotropics, nomenclature, taxonomy, type

#### **Introduction**

*Vochysia* is a neotropical genus represented mainly by large trees with exuberant yellow inflorescences, occurring mostly in Brazil. The first broad work synthesizing its diversity was



prepared by Warming (1875), for the *Flora Brasiliensis* monograph. Based mainly on cortex exfoliation, leaf phyllotaxy, flower size and indument of the floral parts, he divided the genus in five series, reaching about 50 species. The second and even more complete revision for the whole genus was undertaken by Stafleu (1948). He divided *Vochysia* in three sections: *Vochysiella*, *Ciliantha* and *Pachyantha*, and eight subsections, totalling 97 species (Table 1). After that, no other comprehensive monograph was made, but almost 50 new species were described. In order to start organizing and gathering these data, we present this nomenclator, with a set of information on the currently accepted species occurring in Brazil.

**Table 1.** Stafleu's classification for *Vochysia*.

<i>Vochysia</i>
Section <i>Vochysiella</i>
Subsection <i>Decorticantes</i> (10 spp.)
Subsection <i>Calophylloideae</i> (10 spp.)
Section <i>Ciliantha</i>
Subsection <i>Micranthae</i> (11 spp.)
Subsection <i>Lutescentes</i> (23 spp.)
Subsection <i>Discolores</i> (3 spp.)
Subsection <i>Ferrugineae</i> (31 spp.)
Subsection <i>Chrysophyllae</i> (1 sp.)
Subsection <i>Megalanthae</i> (5 spp.)
Section <i>Pachyantha</i> (3 spp.)

## Material and Methods

All nomenclatural data was retrieved mainly from Tropicos (<http://www.tropicos.org/>), IPNI (<http://www.ipni.org/>), and Stafleu (1948), and each protologue was checked, especially helped by BHL (<http://www.biodiversitylibrary.org/>). Information on the types is given just for accepted species. Besides analyzing several herbarium collections in person, we also used Global Plants (<http://plants.jstor.org/>) to access type material.

Each accepted species was assigned to a section and subsection (when applicable), following Stafleu's (1948) classification. We decided to not accept the recently-created *V.* section *Apopetala* (Marcano-Berti 2014), which merges some taxa from two different subsections, based on glabrous ovary and flowers without petals.

The distribution data was based on either literature or herbarium specimens. The *speciesLink* network (<http://www.splink.org.br/>) and other online herbaria were used as well,

when images of the specimens were available. For Brazil, the states and the Federal District (Distrito Federal) are specified. For other places in which the taxon also occurs, just the country name is given.

## Results and Discussion

The current nomenclator (List 1) of *Vochysia* in Brazil, with 86 species, is a first attempt to update nomenclatural information, which is also directly important for taxonomic and floristic studies.

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## References

- De Candolle, A.P. (1828) *Prodromus Systematis Naturalis Regni Vegetabilis* 3. Sumptibus Sociorum Treuttel et Würtz, Paris, 494 pp.  
<http://dx.doi.org/10.5962/bhl.title.286>
- Ducke, A. (1915) Plantas novas ou pouco conhecidas da região amazônica. I. *Archivos do Jardim Botânico do Rio de Janeiro* 1: 42–51.
- Ducke, A. (1922) Plantas novas ou pouco conhecidas da região amazônica. III. *Archivos do Jardim Botânico do Rio de Janeiro* 3: 193–198.
- Egler, W. & Cavalcante, P.B. (1963) Adolpho Ducke—traços bibliográficos, viagens e trabalhos. *Boletim do Museu Paraense Emílio Goeldi—série nova - Botânica* 18: 1–129.
- Lanjouw, J. & Uittien, H. (1940) Un nouvel herbier de Fusée Aublet découvert en France. *Recueil des Travaux Botaniques Néerlandais* 37: 133–170.
- Leal, E.S., Costa, D.P. & Forzza, R.C. (2010) Lectotypification of the taxa of Adolpho Ducke from the Brazilian Amazon. *Phytotaxa* 13: 49–55.  
<http://dx.doi.org/10.11646/phytotaxa.13.1.4>

- Marcano-Berti, L. (2014) *Apopetala*, una nueva sección de *Vochysia* (Vochysiaceae). *Pittieria* 38: 15–42.
- Marcano-Berti, L. (2016) Vochysiaceae. In: Bernal, R., Gradstein, R. & Celis, M. (Eds.) *Catálogo de plantas y líquenes de Colombia*. Vol. 2. *Magnoliaceae a Zygophyllaceae - Especies introducidas y cultivadas*. Editorial Universidad Nacional de Colombia, Bogotá, pp. 2473–2477.
- Martius, C.F.P. (1826) Vochysiaceae. In: Martius, C.F.P. & Zuccarini, J.G. (Eds.) *Nova genera et species plantarum* 1. Typis Lindaueri, Munich, pp. 123–154.  
<http://dx.doi.org/10.5962/bhl.title.450>
- Poiret, J.L.M. (1817) *Encyclopédie méthodique. Botanique*. Supplément, Tome V. Chez Mme. veuve Agasse, Paris, 526 pp.  
<http://dx.doi.org/10.5962/bhl.title.826>
- Shimizu, G.H., Gonçalves, D.J.P., Litt, A., Simões, A.O. & Yamamoto, K. (2016) The correct assignment of the lectotype of *Vochysia guianensis* (Vochysiaceae). *Phytotaxa* 260 (2): 199–200.  
<http://dx.doi.org/10.11646/phytotaxa.260.2.10>
- Smith, A.C. (1940) A collection of flowering Plants from Mount Roraima and adjacent Venezuela, British Guiana, and Brazil. *Bulletin of the Torrey Botanical Club* 67: 283–299.
- Stafleu, F.A. (1948) A monograph of Vochysiaceae. I. *Salvertia* and *Vochysia*. *Recueil des Travaux Botaniques Néerlandais* 41: 397–540.
- Stafleu, F.A. & Cowan, R.S. (1983) *Taxonomic Literature. A selective guide to botanical publications and collections with dates, commentaries and types*. Vol. IV (P-Sak). Ed. 2. *Regnum Vegetabile* 110. Bohn, Scheltema & Holkema, Utrecht/Antwerpen; dr. W. Junk b.v., Publishers, The Hague/Boston, 1214 pp.  
<http://dx.doi.org/10.5962/bhl.title.48631>
- Steyermark, J.A. (1981) Erroneous citations of Venezuelan localities. *Taxon* 30 (4): 816–817.  
<http://dx.doi.org/10.2307/1220084>
- Urban, I. (1906) *Vitae itineraque collectorum botanicorum, Notae collaboratorum biographicae, Florae Brasiliensis ratio edendi chronologica, Systema, Index Familiarum*. In: Martius, C.F.P., Eichler, A.W. & Urban, I. (Eds.) *Flora brasiliensis* 1 (1). R. Oldenbourg in comm., Munich, Leipzig, pp. 1–268.

- Vahl, M. (1804) *Enumeratio Plantarum, vel ab aliis, vel ab ipso observatarum cum earum differentiis specificis, synonymis selectis et descriptionibus succinctis*. Vol. 1. Impensis Auctoris, & prostat apud J.H. Schubothe, Copenhagen, 381 pp.  
<http://dx.doi.org/10.5962/bhl.title.272>
- Warming, J.E.B. (1867) Symbolae ad floram Brasiliae centralis cognoscendam. Particula prima. Fam. Cordiaceae, Asperifoliae, Vochysiaceae, Mayaceae. *Videnskabelige meddelelser fra den Naturhistoriske Forening i Kjøbenhavn* 1: 1–45.
- Warming, J.E.B. (1875) Vochysiaceae. In: Martius, C.F.P. & Eichler, A.W. (Eds.) *Flora Brasiliensis* 13 (2). Frid. Fleischer, Leipzig, pp. 17–116.  
<http://dx.doi.org/10.5962/bhl.title.454>

**List 1.** Nomenclator for all published names of *Vochysia* occurring in Brazil, including accepted species, synonyms, infrageneric placement, and distribution.

1. *Vochysia acuminata* Bong., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3 (2): 5 (1840). *Vochysia acuminata* Bong. subsp. *acuminata* [as *Vochysia acuminata* subsp. *quadrangulata* (Warm.) Stafleu], Recueil Trav. Bot. Néerl. 41: 514 (1948). Type:—BRAZIL. *Riedel s.n.* (Probable lectotype: LE; probable isolectotypes: G, GH, K, NY).

*Vochysia quadrangulata* Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 39 (1867).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Bahia, Minas Gerais).

There are *Riedel s.n.* gatherings determined as *V. acuminata*, *V. laurifolia* Warm. and *V. quadrangulata* var. *longifolia* Warm., and most duplicate labels do not show much more information. The analysis of material from LE, which probably has more information, is essential to clarify the present type issue. Photos of this specimen (the possible lectotype of *V. acuminata*) were requested to the LE herbarium, but it was not found. A visit to that herbarium would enable us to verify if it is under another name and also to confirm that it is not there. The type of *V. quadrangulata*, probably collected by Mathieu Libon (Warming 1867, 1875, Stafleu 1948) was analyzed in C.

2. *Vochysia angelica* M.C.Vianna & Fontella, Bol. Mus. Nac. Rio de Janeiro, Bot. 117: 4 (2002). Type:—BRAZIL. *Silva 305* (Holotype: CVRD; isotypes: GUA, RB).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia, Espírito Santo, Rio de Janeiro).

3. *Vochysia angustifolia* Ducke, Bull. Mus. Natl. Hist. Nat., Sér. 2, 4: 738 (1932). Type:—BRAZIL. *Ducke s.n.*, RB 23499 (Holotype: RB barcodes 00544500, 00561259 [material mounted in 2 sheets]; isotypes: G, K, NY, P, RB, S, U, US).

*Vochysia javitensis* Stafleu, Recueil Trav. Bot. Néerl. 41: 509 (1948).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Colombia (possibly), Venezuela.

4. *Vochysia assua* Stafleu, Recueil Trav. Bot. Néerl. 41: 510 (1948). Type:—BRAZIL. *Ducke s.n.*, RB 34649 (Lectotype: U barcode 0007145, designated by Shimizu *et al.* [201X]; isolectotypes: G, IAN, K, P, RB, S, U, US).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas, Rondônia).

5. *Vochysia bifalcata* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 84 (1875). Type:—BRAZIL. *Glaziou 3952* (Lectotype: C, first-step designated by Stafleu [1948]; isolectotypes: C, K, P, R). *Glaziou 3952* (Lectotype: C [annotated as “typus” by Stafleu], second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Paraná, Rio de Janeiro, São Paulo).

6. *Vochysia biloba* Ducke, Arq. Inst. Biol. Veg. 2 (1): 52 (1935). Type:—BRAZIL. *Ducke s.n.*, RB 24080 (Lectotype: RB [4 sheets], first-step designated by Stafleu [1948]; isolectotypes: G, IAN, K, NY, P, S, U, US). *Ducke s.n.*, RB 24080 (Lectotype: RB barcode 00544503, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Bolivia, Brazil (Acre, Amazonas, Rondônia), Colombia, Ecuador, Peru.

7. *Vochysia calamana* Stafleu, Recueil Trav. Bot. Néerl. 41: 498 (1948). Type:—BRAZIL. *Krukoff 1299* (Holotype: U barcode 0007151; isotypes: A, BM, G, K, NY, P, S [2 sheets]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Pará, Rondônia).

The type specimen was collected in the rio Madeira region, near Calama, which is now assigned to Rondônia state. At the time of the collection this region was part of Amazonas state.

8. *Vochysia calophylla* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 98 (1875). Type:—VENEZUELA. *Spruce 3538* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, BR, F [fragment][2 sheets], G [3 sheets], GH, GOET, K, LD, NY, OXF, P [2 sheets], W). *Spruce 3538* (Lectotype: K barcode 000565991, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Chrysophyllae.

Distribution: Brazil (Amazonas, Roraima), Venezuela.

9. *Vochysia catinae* Ducke, Arq. Inst. Biol. Veg. 4 (1): 33 (1938). Type:—BRAZIL. *Ducke s.n.*, RB 34651 (Holotype: RB barcode 00544504; isotypes: G, IAN, K, U, US).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas), Colombia, Venezuela.

10. *Vochysia cinnamomea* Pohl, Pl. Bras. Icon. Descr. 2: 29 (1828 or 1829). Type:—BRAZIL. *Pohl 1056* (Lectotype: W [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BR [2 sheets], F [fragment], M [2 sheets]). *Pohl 1056* (Lectotype: W 0066824, second-step designated by Shimizu *et al.* [201X]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Bahia, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Rondônia, São Paulo), Paraguay.

According to Stafleu & Cowan (1983), the effective publication date is 1828 or January 1829, for the part of Pohl's *Icones* in which *V. cinnamomea* is described.

11. *Vochysia citrifolia* Poir., Encycl., Supp. 5: 491 (1817). *Cucullaria citrifolia* (Poir.) Schult., Mantissa 1: 52 (1822). Type:—BRAZIL. *Ferreira s.n.* (Holotype: P barcode 00673994; isotypes: G [fragment], K, LISU).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Bolivia, Brazil (Acre, Amazonas, Rondônia), Peru.

Part of the material collected in Brazil by Alexandre Rodrigues Ferreira and housed in Museu da Ajuda (Lisbon, Portugal) was taken to the Muséum National d'Histoire Naturelle (Paris, France), as a result of the French invasion in 1808. When describing *V. citrifolia*, Poiret (1817) cited the collection in Herbarium Jussieu (P-JU). The remaining material of Ferreira's gatherings was transferred to the Escola Politécnica de Lisboa and a set of duplicates was sent to K.

12. *Vochysia complicata* Ducke, Bull. Mus. Natl. Hist. Nat., Sér. 2, 4: 738 (1932). Type:—BRAZIL. *Ducke s.n.*, RB 23498 (Holotype: RB barcodes 00544506, 00561254 [material mounted in 2 sheets]; isotypes: G, K, P, S, U, US).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Amazonas), Colombia, Venezuela.

13. *Vochysia crassifolia* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 77 (1875). Type:—probably VENEZUELA. *Schomburgk 964* (Lectotype: K, designated by Stafleu [1948]; isolectotypes: BM, FI, G, GH, OXF, P, W).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas, Roraima), Guyana, Venezuela.

Although the label in many sheets refers to Robert Hermann Schomburgk 585, the correct collection number corresponds to Moritz Richard Schomburgk 964, according to Stafleu (1948). The collecting place is probably Venezuela, instead of Guyana (Steyermark 1981).

14. *Vochysia dardanoi* M.C.Vianna & Fontella, Bol. Mus. Nac. Rio de Janeiro, Bot. 117: 7 (2002). Type:—BRAZIL. *Andrade Lima s.n.* (Holotype: GUA; isotype: IPA).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Alagoas, Paraíba, Pernambuco).

15. *Vochysia dasyantha* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 95 (1875). Type:—BRAZIL. *Gardner 4549* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, E, F, FI, G [3 sheets], GH, NY [2 sheets], OXF, P [2 sheets], US, W [2 sheets]). *Gardner 4549* (Lectotype: K barcode 000566052, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro).

16. *Vochysia densiflora* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 101 (1875). Type:—BRAZIL. *Spruce 2627* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, BR, C [2 sheets], E, F [3 sheets], G, GH, GOET, K, LD, MPU, NY, OXF [2 sheets], P, RB, US, W [2 sheets]). *Spruce 2627* (Lectotype: K barcode 000566090, second-step designated by Shimizu *et al.* [201X]).



Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas, Mato Grosso, Roraima), Colombia, French Guiana, Guyana, Suriname.

17. *Vochysia discolor* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 81 (1875). Type:—BRAZIL. *Riedel 1097* (Lectotype: LE, designated by Shimizu *et al.* [201X]; isolectotypes: G, GH, K, NY, OXF, P).

Section: Ciliantha, Subsection: Discolores.

Distribution: Brazil (Minas Gerais).

18. *Vochysia divergens* Pohl, Pl. Bras. Icon. Descr. 2: 19 (1828 or 1829). Type:—BRAZIL. *Pohl 2254* (Lectotype: W, designated by Stafleu [1948]; isolectotypes: BR [3 sheets], F [fragment], JE, M [2 sheets], OXF).

*Vochysia mariziana* Paula & J.L.H.Alves, Rodriguésia 30 (46): 166 (1978).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Bolivia, Brazil (Amazonas, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Rondônia, Tocantins).

19. *Vochysia diversa* J.F.Macbr., Publ. Field Mus. Nat. Hist., Bot. Ser. 11: 67 (1931). Type:—PERU. *Klug 685* (Holotype: F; isotypes: G, NY, US).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Amazonas), Colombia (possibly), Peru.

20. *Vochysia elegans* Stafleu, Acta Bot. Neerl. 3: 405 (1954). Type:—BRAZIL. *Ducke s.n.*, RB 34656 (Holotype: U; isotype: RB).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Venezuela.

21.1. *Vochysia elliptica* Mart., Nov. Gen. Sp. Pl. 1: 141 (1826). *Cucullaria elliptica* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius s.n.* (Holotype: M barcode 0152584).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Bahia, Distrito Federal, Goiás, Mato Grosso, Minas Gerais, Tocantins).

There is just one specimen (M barcode 0152584) matching the collection information provided by Martius (1826), as “campis territorii adamantum, Minas Gerais”, which resembles the illustration in his work. Another specimen (M barcode 0239505) is just attributed to Minas Gerais state, without further information.

21.2. *Vochysia elliptica* var. *firma* Mart. ex Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 69 (1875). Type:—BRAZIL. *Martius s.n.* (Holotype: M barcode 0239517).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Rio de Janeiro).

Warming (1875) cited a specimen in Munich (now M barcode 0239517), collected by Martius in “apricis montanis prope Rio de Janeiro”, when describing this variety. Although we have analyzed this specimen *in loco*, we are not sure about its circumscription. We suspect it could be more closely related to *V. rufa* than to *V. elliptica*.

22. *Vochysia emarginata* (Vahl) Poir., Encycl. 8: 682 (1808).

Basionym: *Cucullaria emarginata* Vahl, Enum. Pl.: 5 (1804). Type:—BRAZIL. *Velloso de Miranda s.n.* (Holotype: C; isotype: P).

*Vochysia alpestris* Mart., Nov. Gen. Sp. Pl. 1: 145 (1826). *Cucullaria alpestris* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia, Minas Gerais).

Vahl (1804) described *Cucullaria emarginata* based on a duplicate from herbarium Jussieu (P) and held in C. The specimen in P (P barcode 00673993) was sent by Vandelli from Lisbon in 1790. In his turn, Vandelli was known to use material collected by Joaquim Velloso de Miranda in Brazil (Urban 1906). So, according to Stafleu (1948), one of the duplicates acquired by Jussieu was sent to Vahl. This specimen was verified in C.

23. *Vochysia eximia* Ducke, Arch. Jard. Bot. Rio de Janeiro 1: 45 (1915). Type:—BRAZIL. *Ducke s.n.*, MG 10519 (Lectotype: MG, designated by Stafleu [1948]; isolectotypes: BM, F [fragment]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas, Pará).

24. *Vochysia expansa* Ducke, Arq. Inst. Biol. Veg. 4 (1): 32 (1938). Type:—BRAZIL. *Ducke s.n.*, RB 34655 (Holotype: RB; isotypes: G, K, NY, P, S, U, US).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Amazonas, Pará), Venezuela.

25. *Vochysia ferruginea* Mart., Nov. Gen. Sp. Pl. 1: 151 (1826). *Cucullaria ferruginea* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius s.n.* (Lectotype: M [4 sheets], first-step designated by Marcano-Berti [1998]; isolectotypes: K, L [2 sheets]). *Martius Obs. 2861* (Lectotype: M barcode 0239512, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Rondônia, Roraima), Colombia, Costa Rica, Ecuador, Guyana, Nicaragua, Panama, Peru, Venezuela.

26. *Vochysia floribunda* Mart., Nov. Gen. Sp. Pl. 1: 149 (1826). *Cucullaria floribunda* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius Obs. 2981* (Lectotype: M barcode 0239522, designated by Shimizu *et al.* [201X]; isolectotypes: K, L [2 sheets], M [3 sheets]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Acre, Amazonas, Mato Grosso, Pará).

27. *Vochysia fontellae* Paula, Bol. Mus. Paraense “Emilio Goeldi”, N.S., Bot. 31: 3 (1969). Type:—BRAZIL. *Black & Cordeiro 52-14568* (Holotype: IAN).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas, Rondônia).

28. *Vochysia gardneri* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 70 (1875). Type:—BRAZIL. *Gardner 4126* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, BR, E, F [fragment], FI, G [4 sheets], OXF, P [4 sheets], W [2 sheets]). *Gardner 4126* (Lectotype: K barcode 000494734, second-step designated by Shimizu *et al.* [201X]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Bahia, Goiás, Maranhão, Mato Grosso, Minas Gerais, Piauí, Tocantins).

29. *Vochysia glaberrima* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 78 (1875). Type:—probably VENEZUELA. *Schomburgk 841* (Lectotype: K, designated by Stafleu [1948]; isolectotypes: BM, FI, G [4 sheets], GH, L, OXF, P [2 sheets], W).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas, Roraima), Guyana, Suriname, Venezuela.

Although the label in many sheets refers to Robert Hermann Schomburgk 642, the correct collection number corresponds to Moritz Richard Schomburgk 841, according to Stafleu (1948). The collecting place is probably Venezuela, instead of Guyana (Steyermark 1981).

30. *Vochysia glazioviana* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 86 (1875). Type:—BRAZIL. *Glaziou 3953* (Lectotype: C, designated by Stafleu [1948]; isolectotype: P).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Minas Gerais, Rio de Janeiro, São Paulo).

31.1. *Vochysia grandis* Mart., Nov. Gen. Sp. Pl. 1: 146 (1826). *Cucullaria grandis* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius Obs. 2924* (Lectotype: M barcode 0239527, designated by Shimizu *et al.* [201X]; isolectotypes: G, M [3 sheets]).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas), Colombia, Ecuador, Venezuela.

31.2. *Vochysia grandis* var. *uaupensis* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 75 (1875). Type:—BRAZIL. *Spruce 2657* (Lectotype: K [3 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, BR, C, E, F, G [3 sheets], GH, GOET, K, LD, MPU, NY, OXF [2 sheets], P [2 sheets], RB, W). *Spruce 2657* (Lectotype: K barcode 000565949, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas), Colombia, Venezuela.

32. *Vochysia guianensis* Aubl., Hist. Plantes Guiane 1: 18 (1775). Type:—FRENCH GUIANA. *Aublet s.n.* (Lectotype: P barcode 00680428, designated by Lanjouw & Uittien [1940]; isolectotypes: BM, LINN).

*Vochysia melinonii* Beckmann, Bot. Jahrb. Syst. 40: 280 (1908).

*Vochysia paraensis* Huber ex Ducke, Arch. Jard. Bot. Rio de Janeiro 1: 44 (1915).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Pará, Rondônia), French Guiana, Suriname.

Shimizu *et al.* (2016) reinforced that the correct lectotype is the material in P (Rousseau Herbarium), instead of the BM specimen.

33. *Vochysia gummifera* Mart. ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 82 (1875).

Type:—BRAZIL. *Peckolt 345* (Holotype: BR).

Section: Ciliantha, Subsection: Discolores.

Distribution: Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro).

34. *Vochysia haenkeana* Mart., Nov. Gen. Sp. Pl. 1: 147 (1826). *Cucullaria haenkeana* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—PERU. *Haenke s.n.* (Holotype: M).

*Vochysia haenkeana* var. *lanceolata* Kuntze, Revis. Gen. Pl. 3 (3): 12 (1898).

*Vochysia haenkeana* var. *microphylla* Briq., Annuaire Conserv. Jard. Bot. Genève 20: 386 (1919).

*Vochysia haenkeana* var. *sprucei* Briq., Annuaire Conserv. Jard. Bot. Genève 20: 386 (1919).

*Vochysia micrantha* Pohl, Pl. Bras. Icon. Descr. 2: 20 (1828 or 1829).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Bolivia, Brazil (Acre, Amazonas, Distrito Federal, Goiás, Maranhão, Mato Grosso, Pará, Rondônia, Tocantins), Peru.

35. *Vochysia hannekesaskiarum* Marc.-Berti, Pittieria 18: 7 (1989). Type:—BRAZIL.

*Cordeiro 2* (Holotype: probably MER; isotypes: MG, NY).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas).

The holotype, not seen by the present authors, is probably in MER. The isotype bears a posterior label by Marcano-Berti, identifying the material as *V. elegans*. Further investigation is needed, since both species are currently poorly known.

36. *Vochysia herbacea* Pohl, Pl. Bras. Icon. Descr. 2: 27 (1828 or 1829). Type:—BRAZIL. *Pohl 1219* (Lectotype: W, designated by Stafleu [1948]; isolectotypes: BR [2 sheets], F [fragment], G, M, OXF).

*Vochysia douradensis* Taub., Bot. Jahrb. Syst. 21 (4): 440 (1896).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Goiás, Mato Grosso).

37. *Vochysia ingens* Ducke, Arq. Inst. Biol. Veg. 2 (1): 50 (1935). Type:—BRAZIL. *Ducke s.n.*, RB 24153 (Holotype: RB; isotypes: IAN, K, P, S, U, US).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas).

38. *Vochysia inundata* Ducke, Arch. Inst. Biol. Veg. 3: 194 (1922). Type:—BRAZIL. *Ducke s.n.*, MG 10137 (Holotype: MG; isotypes: BM, RB).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amapá, Amazonas, Pará).

39. *Vochysia laurifolia* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 96 (1875). *Vochysia acuminata* subsp. *laurifolia* (Warm.) Stafleu, Recueil Trav. Bot. Néerl. 41: 514 (1948). Type:—BRAZIL. *Glaziou 12* (Lectotype: BR, designated by Stafleu [1948]; isolectotype: RB).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Bahia, Ceará, Espírito Santo, Minas Gerais, Pernambuco, Rio de Janeiro, São Paulo).

40. *Vochysia ledouxii* Paula, Bol. Mus. Paraense “Emilio Goeldi”, N.S., Bot. 31: 4 (1969). Type:—BRAZIL. *Fróes 28779* (Holotype: IAN; isotype: UB).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Amazonas).

The holotype bears a label with a wrong collection number (*Fróes “78366”*), which is actually the herbarium number (IAN 78366). According to the protologue and the isotype label, the correct collection number is *Fróes 28779*.

41. *Vochysia lomatophylla* Standl., Field Mus. Bot. 22 (3): 150 (1940). Type:—PERU. *Schunke 14* (Holotype: F; isotypes: NY, US).

*Vochysia polyantha* Ducke, Bol. Técn. Inst. Agron. N. 4: 14 (1945).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Colombia, Peru.

42. *Vochysia lucida* C.Presl, Symb. Bot. 2 (6): 12 (1834). Type:—BRAZIL. *Lhotsky s.n.* (Lectotype: G, designated by Stafleu [1948]; isolectotype: PRC).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Bahia, Sergipe).

43. *Vochysia magnifica* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 85 (1875). Type:—BRAZIL. *Regnell s.n.*, “*Ex herb. Regnelli., Ser. III, No. 531, 14.11.1874*” (Lectotype: S [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: C [mounted in 2 sheets], P). *Regnell s.n.*, “*Ex herb. Regnelli., Ser. III, No. 531, 14.11.1874*” (Lectotype: S [S-R-10188], second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Espírito Santo, Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina, São Paulo).

44. *Vochysia mapuerae* Huber ex Ducke, Arch. Jard. Bot. Rio de Janeiro 1: 44 (1915). Type:—BRAZIL. *Ducke s.n.*, MG 9048 (Lectotype: MG, designated by Stafleu [1948]; isolectotype: RB [mounted in two sheets]).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Pará).

45. *Vochysia maxima* Ducke, Bull. Mus. Natl. Hist. Nat., Sér. 2, 4: 739 (1932). Type:—BRAZIL. *Ducke s.n.*, MG 15595 (Lectotype: MG, designated by Stafleu [1948]; isolectotypes: BM, G, P, US).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Pará).

46. *Vochysia microphylla* G.H.Shimizu & K.Yamam., Phytotaxa 56: 10 (2012). Type:—BRAZIL. *Shimizu et al. 231* (Holotype: UEC).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Minas Gerais).

47. *Vochysia obidensis* (Huber ex Ducke) Ducke, Arch. Inst. Biol. Veg. 3: 193 (1922).

Basionym: *Vochysia obscura* var. *obidensis* Huber ex Ducke, Arch. Jard. Bot. Rio de Janeiro 1: 43 (1915). Type:—BRAZIL. *Ducke s.n.*, MG 7220 (Holotype: MG; isotypes: BM, F [fragment], G, RB, US).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Mato Grosso, Pará, Rondônia).

When describing this taxon as a variety, Ducke (1915) cited explicitly the MG (as HAMP) catalogue number in the protologue. Some years later, Ducke (1922) raised it to species level, citing the number 7220 (without herbarium name) and adding other gathering (number 16316), with different collection date. He did not cite the herbarium this time, but with the previous information (Ducke 1915) and label checking, we were able to assign the second gathering to MG. Probably the way Ducke (1922) cited the two gatherings led Egler & Cavalcante (1963) to interpret them as syntypes. After that, Leal *et al.* (2010) also mistakenly proposed a lectotypification based on MG 16316, which has no type status.

48. *Vochysia oblongifolia* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 84 (1875). Type:—BRAZIL. *Gardner 995* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, E, F [fragment], FI, G, GH, NY, OXF [2 sheets], P [3 sheets], S, US, W [2 sheets]). *Gardner 995* (Lectotype: K barcode 00565939, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Paraíba, Pernambuco).

49. *Vochysia obovata* Stafleu, Acta Bot. Neerl. 3: 409 (1954). Type:—BRAZIL. *Fróes 20139* (Holotype: NY; isotypes: IAN, US).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia).

50. *Vochysia obscura* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 73 (1875). Type:—VENEZUELA (according to Stafleu [1948]). *Spruce 3700* (Lectotype: K [2 sheets], first-step



designated by Stafleu [1948]; isoelectotypes: BM, BR, E, G [2 sheets], P [2 sheets]). *Spruce 3700* (Lectotype: K barcode 000572816, second-step designated by Shimizu *et al.* [201X]).

*Vochysia urubuensis* Ducke, Trop. Woods 76: 17 (1943).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Amazonas, Pará, Rondônia), Colombia, Peru, Venezuela.

51. *Vochysia oppugnata* (Vell.) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 87 (1875).

Basionym: *Strukeria oppugnata* Vell., Fl. Flumin.: 8 (1829); Fl. Flumin. Icon. 1: t. 20 (1831).

Type:—BRAZIL. Illustration. Original parchment plate of *Flora Fluminensis* in the Manuscript Section of the Biblioteca Nacional, Rio de Janeiro [cat. no.: mss1095062\_024] and later published in Vellozo, Fl. Flum. Icon. 1: t. 20. 1831 (Lectotype, designated by Shimizu *et al.* [201X]). *Glaziou 671* (Epitype: C [sheet with Stafleu's identification label on top of the herbarium C label], designated by Shimizu *et al.* [201X]; isoelectotypes: BR, C, K, P [2 sheets], R).

*Vochysia tucanorum* var. *hexaphylla* Mart., Nov. Gen. Sp. Pl. 1: 143 (1826).

*Vochysia vahlii* Pohl ex Ettinghausen, Die blatt-skelete der Dikotyledonen: 186 (1861).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia, Minas Gerais, Rio de Janeiro, São Paulo).

52. *Vochysia pachyantha* Ducke, Arq. Inst. Biol. Veg. 4 (1): 36 (1938). Type:—BRAZIL.

*Ducke s.n.*, RB 34653 (Holotype: RB; isotypes: G, IAN, K, NY, P, S, U, US).

Section: Pachyantha.

Distribution: Brazil (Amazonas).

53. *Vochysia palmirana* F.França & Proença, Brittonia 59 (4): 374 (2007). Type:—BRAZIL.

*Silva & Rocha 97b* (Holotype: UB).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Goiás, Tocantins).

54. *Vochysia parviflora* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 75 (1875).

Type:—BRAZIL. *Spruce 1974* (Lectotype: K, designated by Stafleu [1948]; isoelectotypes: BM, C, E, F, FI, G, GH, GOET, LD, M, NY, OXF, P, RB, W).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas).

55. *Vochysia petraea* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 63 (1875). Type:—BRAZIL. *Riedel 990* (Holotype: LE; isotype: OXF).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Mato Grosso).

56. *Vochysia pinkusii* A.C.Sm., Bull. Torrey Bot. Club 67: 288 (1940). Type:—BRAZIL. *Pinkus 167* (Holotype: NY; isotypes: F, G, GH, K, MO, NY, S, US [2 sheets]).

Section: Pachyantha.

Distribution: Brazil (Amazonas [probably Roraima now]), Venezuela.

Smith (1940) declares that the type collection of his expedition is deposited in NY, unless otherwise noted.

57. *Vochysia pruinosa* Pohl, Pl. Bras. Icon. Descr. 2: 22 (1828 or 1829). Type:—BRAZIL. *Pohl 1640* (Lectotype: W [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BR, F [fragment], G, OXF, PR). *Pohl 1640* (Lectotype: W 0067627, second-step designated by Shimizu *et al.* [201X]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Distrito Federal, Goiás, Tocantins).

58. *Vochysia pumila* Pohl, Pl. Bras. Icon. Descr. 2: 21 (1828 or 1829). Type:—BRAZIL. *Pohl 654* (Lectotype: W [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BR, F [fragment], M, OXF). *Pohl 654* (Lectotype: W 0066832, second-step designated by Shimizu *et al.* [201X]).

*Vochysia alternifolia* Briq. & Glaz., Annuaire Conserv. Jard. Bot. Genève 20: 384 (1919).

*Vochysia pseudopumila* Rizzini & Heringer, Anais Acad. Brasil. Ci. 38 (supl): 107 (1966).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Distrito Federal, Goiás, Minas Gerais).

59. *Vochysia punctata* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 102 (1875). Type:—BRAZIL. *Spruce 2675* (Lectotype: K [3 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, BR, E, F, G [2 sheets], GH, GOET, LD, MPU, NY, OXF [2

sheets], P [2 sheets], RB, W [2 sheets]). *Spruce 2675* (Lectotype: K barcode 000566047, second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Ecuador, Venezuela.

60. *Vochysia pygmaea* Bong., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3 (2): 7 (1840). Type:—BRAZIL. *Riedel 1361* (Lectotype: LE, designated by Stafleu [1948]; isolectotypes: OXF, P).

*Vochysia martiana* Stafleu, Recueil Trav. Bot. Néerl. 41: 478 (1948).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Minas Gerais).

According to the Berlin negative (F negative 12927), the collection is *Riedel 1361*. Unfortunately, it was not found in the LE herbarium, like the *V. acuminata* sheet.

61. *Vochysia pyramidalis* Mart., Nov. Gen. Sp. Pl. 1: 148 (1826). *Cucullaria pyramidalis* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius s.n.* (Lectotype: M [3 sheets], first-step designated by Passos & França [2003]; isolectotype: L). *Martius Obs. 1829* (Lectotype: M barcode 0239549, second-step designated by Shimizu *et al.* [201X]).

*Vochysia acuminata* Pohl ex Ettingshausen, Die blatt-skelete der Dikotyledonen: 185 (1861) (non Bong. 1839).

*Vochysia chapadensis* Malme, Ark. Bot. 5: 11 (1905).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Bahia, Ceará, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Pernambuco, Piauí, Tocantins).

62.1. *Vochysia rectiflora* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 96 (1875). Type:—BRAZIL. *Sellow s.n.* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isolectotypes: BM, L, MO, NY, P, US).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro).

The second-step lectotype was not selected yet because some doubts about the lectotype still persist. The sheet K barcode 000566062 bears two branches, each one with separate

identification label. The branch on the right side was annotated as “lectotypus” by Stafleu and the one on the left side as “typi duplum”.

62.2. *Vochysia rectiflora* var. *glabrescens* Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 27 (1889). Type:—BRAZIL. *Glaziou 13434* (Lectotype: C, designated by Stafleu [1948]; isolectotypes: G, GUA, K, P, R).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro).

63. *Vochysia revoluta* Ducke, Arq. Inst. Biol. Veg. 2 (1): 51 (1935). Type:—BRAZIL. *Ducke s.n.*, RB 24155 (Holotype: RB [mounted in 2 sheets]; isotypes: (K, NY, P, U, US).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Amazonas).

64. *Vochysia riedeliana* Stafleu, Recueil Trav. Bot. Néerl. 41: 463 (1948). Type:—BRAZIL. *Kuhlmann 63* (Holotype: U; isotypes: MBML, NY, RB).

*Vochysia grandis* var. *douvillei* Briq., Annuaire Conserv. Jard. Bot. Genève 20: 386 (1919).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia, Espírito Santo).

65. *Vochysia rotundifolia* Mart., Nov. Gen. Sp. Pl. 1: 140 (1826). *Cucullaria rotundifolia* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius s.n.* (Holotype: M).

*Vochysia cipoana* Stafleu, Acta Bot. Neerl. 3: 409 (1954).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Minas Gerais).

66.1.1. *Vochysia rufa* Mart., Nov. Gen. Sp. Pl. 1: 144 (1826). *Cucullaria rufa* (Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). Type:—BRAZIL. *Martius s.n.* (syntypes: M! [3 sheets]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Bolivia, Brazil (Bahia, Distrito Federal, Goiás, Mato Grosso, Minas Gerais, São Paulo).

66.1.2. *Vochysia rufa* subsp. *rufa* var. *brevipetiolata* Warm. in Mart. & Eichler, Fl. Bras. 13 (2): 66 (1875). Type:—BRAZIL. *Gardner 4127* (Lectotype: K, designated by Stafleu [1948]; isoelectotypes: BM, BR, E, F, G, NY, OXF, P, W).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Goiás, Minas Gerais, Pará).

66.2.1. *Vochysia rufa* subsp. *sericea* (Pohl) Stafleu, Recueil Trav. Bot. Néerl. 41: 429 (1948). Basionym: *Vochysia sericea* Pohl, Pl. Bras. Icon. Descr. 2: 28 (1828 or 1829). *Vochysia rufa* var. *sericea* (Pohl) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 66 (1875). Type:—BRAZIL. *Pohl 1286* (Lectotype: W [2 sheets], first-step designated by Stafleu [1948]; isoelectotypes: BR [2 sheets], F [fragment], OXF). *Pohl 1286* (Lectotype: W 0066837, second-step designated by Shimizu *et al.* [201X]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Goiás, Minas Gerais, São Paulo).

66.2.2. *Vochysia rufa* subsp. *sericea* var. *fulva* Stafleu, Recueil Trav. Bot. Néerl. 41: 430 (1948). Type:—BRAZIL. *Malme 1540 B 8-5-1894* (Holotype: S; isotype: GH).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Goiás, Mato Grosso).

67. *Vochysia rufescens* W.A.Rodrigues, Acta Amazonica 1 (2): 33 (1971). Type:—BRAZIL. *Rodrigues 8671* (Holotype: INPA; isotype: MG).

Section: Pachyantha.

Distribution: Brazil (Amazonas, Pará).

68. *Vochysia saccata* Stafleu, Recueil Trav. Bot. Neerl. 41: 508 (1948). Type:—BRAZIL. *Ducke s.n.*, RB 34654 (Holotype: U; isotypes: G, IAN, K, P, S, US).

*Vochysia inundata* var. *venosa* Ducke, Arq. Inst. Biol. Veg. 4 (1): 35 (1938).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Venezuela.

69. *Vochysia saldanhana* Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 26 (1889). Type:—BRAZIL. *Glaziou 6874* (Lectotype: C, designated by Stafleu [1948]; isoelectotypes: BR, C, F, IAN, K, P).

*Vochysia stenophylla* Briq., Annuaire Conserv. Jard. Bot. Genève 20: 387 (1919).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Minas Gerais, Rio de Janeiro, São Paulo).

70. *Vochysia santaluciae* M.C.Vianna & Fontella, Bol. Mus. Nac. Rio de Janeiro, Bot. 117: 1 (2002). Type:—BRAZIL. *Fernandes 2771* (Holotype: MBML; isotype: GUA).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Espírito Santo).

71. *Vochysia schwackeana* Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 25 (1889). Type:—BRAZIL. *Glaziou 6872* (Lectotype: C, designated by Stafleu [1948]; isolectotypes: BR, C, F, GH, IAN, K, NY, P, RB, S, US, W).

*Vochysia goeldii* Huber, Bol. Mus. Paraense Hist. Nat. Ethnogr. 2: 383 (1898).

*Vochysia schwackeana* var. *glabra* Stafleu, Recueil Trav. Bot. Néerl. 41: 483 (1948).

Section: Ciliantha, Subsection: Discolores.

Distribution: Brazil (Minas Gerais, Rio de Janeiro, São Paulo).

72. *Vochysia selloi* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 86 (1875). Type:—BRAZIL. *Sellow s.n.* (Probable type: G).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (São Paulo).

73. *Vochysia sessilifolia* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 67 (1875). Type:—BRAZIL. *Manso 51* (Lectotype: G, designated by Stafleu [1948]).

Section: Vochysiella, Subsection: Decorticantes.

Distribution: Brazil (Mato Grosso, Minas Gerais, São Paulo).

74. *Vochysia spathiphylla* Stafleu, Acta Bot. Neerl. 6: 341 (1957). Type:—BRAZIL. *Allen 3248* (Holotype: US).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Colombia.

75. *Vochysia spathulata* Warm., Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn: 25 (1889). Type:—BRAZIL. *Glaziou 6876* (Lectotype: C [2 sheets], first-step designated by Stafleu

[1948]; isoelectotypes: BR, K, P [3 sheets], RB, S). *Glaziou 6876* (Lectotype: C [annotated as “typus” by Stafleu], second-step designated by Shimizu *et al.* [201X]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Bahia, Minas Gerais, Rio de Janeiro).

76. *Vochysia speciosa* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 79 (1875). Type:—FRENCH GUIANA. *Poiteau s.n.* (Lectotype: LE, designated by Stafleu [1948]; isoelectotypes: G, K, P, W).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Pará), French Guiana.

77. *Vochysia splendens* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 101 (1875). Type:—BRAZIL. *Spruce 2697* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isoelectotypes: BM, BR, E, F [2 sheets], G [2 sheets], GH, GOET, LD, MPU, NY, OXF [2 sheets], P [3 sheets], RB, US, W [2 sheets]). *Spruce 2697* (Lectotype: K barcode 000566097, second-step designated by Shimizu *et al.* [201X]).

*Vochysia vismiifolia* var. *robusta* Ducke, Arq. Inst. Biol. Veg. 4 (1): 35 (1938).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Amazonas), Colombia, Ecuador, Venezuela.

78. *Vochysia stafleui* Marc.-Berti, Pittieria 9: 31 (1981). Type:—BRAZIL. *Fróes 23782* (Lectotype: MER, designated by Marcano-Berti [1989]; isoelectotypes: NY, U).

Section: Pachyantha.

Distribution: Brazil (Amazonas), Colombia, Ecuador, Peru.

79. *Vochysia surinamensis* Stafleu, Recueil Trav. Bot. Néerl. 41: 439 (1948). Type:—SURINAME. *Boswezen 6915* (Holotype: U; isotypes: COL, F, K, NY, RB).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Amapá, Pará), French Guiana, Guyana, Suriname, Venezuela.

80. *Vochysia talmonii* M.C.Vianna, Fontella & F.França, Bol. Mus. Nac. Rio de Janeiro, Bot. 118: 1 (2002). Type:—BRAZIL. *Santos 2465* (Holotype: CEPEC; isotypes: GUA, HUEFS, NY).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Bahia).

81. *Vochysia tetraphylla* (G.Mey.) DC., Prodr. 3: 27 (1828).

Basionym: *Cucullaria tetraphylla* G.Mey., Prim. Fl. Esseq.: 12 (1818). Type:—GUYANA.

*Rodschied s.n.* (Type: probably GOET).

*Vochysia arcuata* Garcke, Linnaea 22: 58 (1849).

Section: Ciliantha, Subsection: Micranthae.

Distribution: Brazil (Amazonas), French Guiana, Guyana, Suriname, Venezuela.

82. *Vochysia thyrsoides* Pohl, Pl. Bras. Icon. Descr. 2: 24 (1828 or 1829). Type:—BRAZIL.

*Pohl 653* (Lectotype: W, designated by Stafleu [1948]; isolectotypes: BR, F [fragment]).

*Vochysia cuneata* Pohl, Pl. Bras. Icon. Descr. 2: 26 (1828 or 1829). *Vochysia thyrsoides* var.

*cuneata* (Pohl) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 89 (1875).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Brazil (Bahia, Ceará, Distrito Federal, Goiás, Minas Gerais, São Paulo).

83. *Vochysia tomentosa* (G.Mey.) DC., Prodr. 3: 26 (1828).

Basionym: *Cucullaria tomentosa* G.Mey., Prim. Fl. Esseq.: 13 (1818). *Cucullaria excelsa*

Vahl, Enum. Pl.: 4 (1804) (non Willd. 1797). Type:—FRENCH GUIANA. *Richard s.n.*

(Lectotype: C, designated by Stafleu [1948]; isolectotypes: G, P [2 sheets]).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Brazil (Pará), French Guiana, Guyana, Suriname, Venezuela.

84. *Vochysia tucanorum* Mart., Nov. Gen. Sp. Pl. 1: 142 (1826). *Cucullaria tucanorum*

(Mart.) Spreng., Syst. Veg. 16 (4, 2): 9 (1827). *Vochysia tucanorum* Mart. var. *tucanorum* (as

*Vochysia tucanorum* var. *vulgaris* Mart.), Nov. Gen. Sp. Pl. 1: 143 (1826). Type:—BRAZIL.

*Martius 577* (Lectotype: M barcode 0239561, designated by Shimizu *et al.* [201X]; probable isolectotypes: M [2 sheets]).

*Vochysia elongata* Pohl, Pl. Bras. Icon. Descr. 2: 25 (1828 or 1829). *Vochysia tucanorum* var.

*elongata* (Pohl) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 90 (1875).

*Vochysia tucanorum* var. *fastigiata* Mart., Nov. Gen. Sp. Pl. 1: 142 (1826). *Vochysia*

*fastigiata* (Mart.) Warm. in Martius & Eichler, Fl. Bras. 13 (2): 91 (1875).

*Vochysia tucanorum* var. *macrostachya* Mart., Nov. Gen. Sp. Pl. 1: 143 (1826).



*Vochysia tucanorum* var. *microphylla* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 90 (1875).

Section: Ciliantha, Subsection: Lutescentes.

Distribution: Bolivia, Brazil (Bahia, Distrito Federal, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio de Janeiro, São Paulo, Tocantins), Paraguay.

85. *Vochysia venulosa* Warm. in Martius & Eichler, Fl. Bras. 13 (2): 74 (1875). Type:—BRAZIL. *Spruce 2717* (Lectotype: K [2 sheets], first-step designated by Stafleu [1948]; isoelectotypes: BR, F [fragment], P, W). *Spruce 2717* (Lectotype: K barcode 000565977, second-step designated by Shimizu *et al.* [201X]).

Section: Vochysiella, Subsection: Calophylloideae.

Distribution: Brazil (Amazonas), Ecuador, Peru.

86. *Vochysia vismiifolia* Spruce ex Warm. in Martius & Eichler, Fl. Bras. 13 (2): 99 (1875). Type:—BRAZIL. *Spruce 1823* (Lectotype: K; isoelectotypes: BM, C, E, FI, G, GH, GOET, LD, M, MG, NY, OXF, P, W).

Section: Ciliantha, Subsection: Ferrugineae.

Distribution: Bolivia, Brazil (Amazonas, Mato Grosso, Pará), Colombia, Ecuador, Peru, Venezuela.

## **Capítulo 4**

### **The correct assignment of the lectotype of *Vochysia guianensis* (Vochysiaceae)**

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*Vochysia* Aublet (1775: 18) encompasses ca. 140 species, distributed from Mexico to southern Brazil. They are mainly large trees, with spurred yellow flowers, usually 3-petaled and with a single fertile stamen (Kawasaki 2007). The genus was described by Aublet (1775) in his work on plants from French Guiana as ‘*Vochy*’, taken from a native name among the Caribs, and after several latinizations the form ‘*Vochysia*’, proposed by Poiret (1808), was conserved.

*Vochysia guianensis* Aublet (1775: 18), the only species name published under *Vochysia* by Aublet (1775), is the type of the genus name. In the most recent comprehensive monograph for the genus, Stafleu (1948) mentioned *Aublet s.n.* in BM as the type specimen of the species name, with duplicates in LINN and herbarium Denaiffe. He was not able to see the latter in person, but observed a photo in Lanjouw & Uittien (1940). Currently Aublet’s collections from herbarium Denaiffe are housed in P-JJR (Rousseau Herbarium at Muséum National d’Histoire Naturelle). Following Stafleu’s designation, Marcano-Berti (1998) cited the BM specimen as the holotype.

As pointed out by Delprete (2015), Lanjouw & Uittien (1940) stated that the specimens they listed in their article were to be considered the “types” (i.e., nomenclatural types) of Aublet’s names. So we emphasize here this overlooked lectotypification, which precedes the one proposed by Stafleu (1948), and we give more precise information on specimen data. Also we hope avoid future miscitations of this type, considering that Stafleu’s (1948) monograph is the current basis for anyone studying the genus.

## Nomenclature

*Vochysia guianensis* Aublet (1775: 18)

**Type:**—FRENCH GUIANA. In sylvis Sinemariensibus, *J.B.C.F. Aublet s.n.* (lectotype P 680428 [P-JJR][digital image]!, designated by Lanjouw & Uittien [1940]; isolectotypes BM barcode 566742!, LINN [HS 15.1][digital image]!). Fig. 1.

## Acknowledgements

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## References

- Aublet, J.B.C.F. (1775) *Histoire des plantes de la Guiane Française*. Tome 1. Pierre-François Didot jeune, London, Paris, 976 pp.  
<http://dx.doi.org/10.5962/bhl.title.674>
- Delprete, P.G. (2015) Typification and etymology of Aublet’s Rubiaceae names. *Taxon* 64: 595–624.  
<http://dx.doi.org/10.12705/643.13>
- Kawasaki, M.L. (2007) Vochysiaceae. In: Kubitzki, K. (Ed.) *The families and genera of vascular plants*. Vol. 9. Springer, Berlin, pp. 480–487.  
[http://dx.doi.org/10.1007/978-3-540-32219-1\\_55](http://dx.doi.org/10.1007/978-3-540-32219-1_55)

- Lanjouw, J. & Uittien, H. (1940) Un nouvel herbier de Fusée Aublet découvert en France. *Recueil des Travaux Botaniques Néerlandais* 37: 133–170.
- Marcano-Berti, L. (1998) 123. Vochysiaceae. *In*: Görts-van Rijn, A.R.A. & Jansen-Jacobs, M.J. (Eds.) *Flora of the Guianas*. Series A: Phanerogams, Fascicle 21. Royal Botanic Gardens, Kew, London, pp. 1–44.
- Poiret, J.L.M. (1808) *Encyclopédie méthodique. Botanique*. Tome 8. Chez H. Agasse, Paris, 879 pp.  
<http://dx.doi.org/10.5962/bhl.title.824>
- Stafleu, F.A. (1948) A monograph of Vochysiaceae. I. *Salvertia* and *Vochysia*. *Recueil des Travaux Botaniques Néerlandais* 41: 397–540.



**FIGURE 1.** Lectotype of *Vochysia guianensis* (J.B.C.F. Aublet s.n., P 680428 [P-JJR], available at <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00680428>).

## **Capítulo 5**

### **A remarkable new species of *Qualea* (Vochysiaceae) from Piauí state, Brazil**

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#### **Abstract**

*Qualea insignis*, a new species of Vochysiaceae endemic to the Serra das Confusões area, Piauí state, Brazil, is here described and illustrated. The species is placed in *Q.* sect. *Costatifolium*, due to the number of secondary veins per cm and the inflorescence architecture. A comparison with *Q. grandiflora* and *Q. parviflora*, the other species of the genus occurring in the Caatinga, is also provided.

#### **Resumo**

*Qualea insignis*, uma nova espécie de Vochysiaceae endêmica da área de Serra das Confusões, estado do Piauí, Brasil, é aqui descrita e ilustrada. A espécie é posicionada em *Q.* sect. *Costatifolium*, devido ao número de nervuras secundárias por cm e à arquitetura da inflorescência. Também é fornecida uma comparação com *Q. grandiflora* e *Q. parviflora*, as outras espécies do gênero que ocorrem na Caatinga.

**Key words:** Caatinga, Cerrado, Myrtales, Serra das Confusões National Park, taxonomy

## Introduction

*Qualea* Aublet (1775: 5) is the second species-rich genus within Vochysiaceae, encompassing about 50 species, from which 37 occur in Brazil (França 2016). The last monograph of the genus (Stafleu 1953) presented a total of 59 species, with 51 species in *Q.* subg. *Qualea* and eight in *Q.* subg. *Amphilochia* (Martius 1826: 127) Stafleu (1953: 202). The autonymic subgenus was divided in four sections, as follows: *Q.* sect. *Qualea*, *Q.* sect. *Trichanthera* Stafleu (1953: 153), *Q.* sect. *Costatifolium* Stafleu (1953: 192) and *Q.* sect. *Polytrias* Stafleu (1953: 201). Based on morphological traits as basifixed anther, barbate thecae, and spurred sepal larger than other sepals, *Q.* sect. *Trichanthera* was raised to genus level, as *Ruizterania* Marcano-Berti (1969). This circumscription has been opposed by several studies (e.g. Litt 1999, Sajo & Rudall 2002, León 2003, Kawasaki 2007), but is still adopted in works dealing with the family (e.g. Marcano-Berti 2005, Rodríguez & Sanoja 2008, Rodríguez *et al.* 2014, Brazil Flora Group 2015). Following previous efforts undertaken by Litt (1999), a molecular phylogenetic study is being conducted for the family (Shimizu *et al.* in prep.), and will contribute to better understand the relationships between *Qualea* and *Ruizterania*. Here we provisionally consider them as separate genera.

While studying the Vochysiaceae collection from HUEFS, a set of specimens of a distinctive *Qualea* from Piauí state, Brazil, was found to match photos sent years ago by the colleague Antonio Sergio F. Castro to the first author. At that time the species identity was unknown, but now, based on more herbarium specimens analyzed and personal field observation, we are able to recognize it as a new species, endemic to the Caatinga in the Serra das Confusões area, southwestern Piauí. The well developed cylindrical spur, leaves with less than eight secondary veins per cm, and thyrses composed of cincinni allow its placement in *Q.* sect. *Costatifolium*.

## Material & Methods

The extent of occurrence (EOO) and the area of occupancy (AOO) were both estimated using the software GeoCAT (Bachman *et al.* 2011), considering the cell width of 2 km, as recommended by the IUCN Red List guidelines (IUCN Standards and Petitions Subcommittee 2016).

## Taxonomic treatment

*Qualea insignis* G.H.Shimizu, D.J.P.Gonç., F.França & K.Yamam., *sp. nov.* (Figs. 1–4)

*Qualea insignis* is characterized by leaves with less than eight secondary veins per cm, foliose thyrses composed of 1-florous cincinni, and a big (4–6 × 5.6–6 cm) obcordate petal, white to magenta, with pinkish patches and yellow stripes on the adaxial surface.

**Type:**—BRAZIL. Piauí: Caracol, Próximo à torre logo após a bifurcação, em direção à entrada do Parque, 09°14'43,1" S, 43°25'46,6" W, 07 January 2015, *D.J.P. Gonçalves, G.H. Shimizu, F. França, E. Melo, B.M. Silva & O.P. Lopes 623* (holotype HUEFS!, isotypes TEX!, UEC!).

Tree or shrub, 1–6 m tall; trunk cortex thin and not suberose; branches and branchlets glabrous to puberulous, or sericeous, with blackish to yellowish hairs; cortex of the branchlets exfoliating in thin strips. Perulate buds ovoid, with acute apex. Stipular glands crateriform, ca. 1 mm diam., sometimes absent; usually a small wart-like accessory gland, below the stipular gland, sometimes inconspicuous. Leaves opposite; petiole 2–4 mm long, pubescent; leaf blade (2.6–)3.2–6.3(–7) × 1.8–3.1(–3.8) cm, elliptic, ovate to oblong, chartaceous, discolor or not; secondary veins (1–)3–5 per cm; adaxial surface glabrous, midrib impressed and secondary veins flat; abaxial surface glabrous to glabrescent, with slightly ferruginous hairs mainly along the midrib, midrib prominent and secondary veins prominulous; apex cuspidate, acumen rounded or acute, base cordate, margin entire, flat. Inflorescence a foliose thyrses of cincinni, terminal, 2.5–5.5 cm long, pubescent; cincinni 1-florous, pedicel 5–7 mm long; bracts 2, ovate-navicular, 5–6 × 3–4 mm, puberulous in both surfaces. Flower bud 1.6–2.1 × 0.6–1 cm, ovoid, apex acute. Calyx greenish to reddish, 5-lobed, lobes ovate to orbicular, the 3 smaller outer lobes asymmetric, 0.7–1.8 × 0.9–2 cm, the inner non-spurred lobe 1.5–1.7 × 2–2.5 cm, with margins slightly enrolled, adaxial surface glabrous and abaxial sericeous, the inner spurred lobe (fourth sepal) ovate, 2–2.5 × 2.2–2.6 cm, with margins strongly enrolled to form a tube, adaxial surface glabrous and abaxial tomentose; the spur cylindrical and slightly flattened, 1–1.3 × 0.3–0.5 cm, incurved and folded within the outer sepal lobes in flower bud, spreading at preanthesis, but partly enclosed by the adjacent sepal lobes at anthesis, densely tomentose. Petal obcordate, 4–6 × 5.6–6 cm, white to magenta, with pinkish patches and yellow stripes, both surfaces glabrous. Stamen 1, anther 0.6–0.8 cm long,



glabrous, filament 0.6–1.5 cm long, glabrous, deflected to the left or right. Ovary globose, 0.4–0.5 × 0.4 cm, sericeous; style 1.2–2 cm long, glabrous, deflected to the left or right (making the flowers reciprocally enantiostylous); stigma capitate. Fruit capsule, 2–3.5 cm long, surface not exfoliating. Seeds 1–1.4 cm long.

**Distribution and habitat:**—*Qualea insignis* is presently known only from the Serra das Confusões area, in southwestern Piauí, Brazil (Fig. 4). It occurs in caatinga formations, with cerrado elements, at 500–700 m. It is now the third species of *Qualea* recorded for the Caatinga Phytogeographical Domain, along with *Q. grandiflora* Martius (1826: 133) and *Q. parviflora* Martius (1826: 135), previously listed by Moro *et al.* (2014). The latter species was found co-occurring (pers. obs.) with *Q. insignis* in the Serra das Confusões area.

**Phenology:**—Flowering specimens were found from December to May. Fruiting specimens were found in January, February, March, and November.

**Conservation status:**—With estimated EOO = 562 km<sup>2</sup> and AOO = 28 km<sup>2</sup> (.kml file available at [http://figshare.com/articles/Qualea\\_insignis\\_kml/3146317](http://figshare.com/articles/Qualea_insignis_kml/3146317)), *Qualea insignis* is evaluated as endangered [EN B1ab(iii)+2ab(iii)], due to low number of locations and possible decline of habitat quality. However, most of the known collections are protected within a conservation unit, the Serra das Confusões National Park. The gathering from Eliseu Martins, the most separated among the examined specimens, was not included in this conservation status assessment, since it lacks geographic coordinates and no other recent record from that place is known.

**Etymology:**—The specific epithet refers to the showy, remarkable aspect of this species, mainly owing to the beautiful large petal.

**Additional specimens examined (paratypes):**—BRAZIL. Piauí: Caracol, Área próxima aos cálices rochosos, 677 m, 09°13'15" S, 43°28'56" W, 24 November 2010, *E. Melo, B.M. Silva, L. Damascena & O.P. Lopes* 8885 (HUEFS!); idem, 681 m, 09°13'15" S, 43°28'56" W, 26 February 2011, *E. Melo, B.M. Silva, M. Anunciação, K.M. Pimenta & O.P. Lopes* 9257 (HUEFS!); idem, Ladeira de terra próximo à guarita, 25 April 2007, *R. Barros, G. Sousa, F. Vieira, L. Oliveira & J. Sousa* 3023 (HUEFS!, TEPB); idem, Estrada a SW de Caracol para o Parque Nacional da Serra das Confusões, 697 m, 09°14'45" S, 43°25'47" W, 24 May 2010,

*L.P. Queiroz, D. Cardoso, P.G. Ribeiro & R.M. Salas 14770* (HUEFS!, UEC!); idem, Estrada Guaribas–Santa Luz, 09°12'20,3" S, 43°28'10,1" W, 08 January 2015, *D.J.P. Gonçalves, G.H. Shimizu, F. França, E. Melo & B.M. Silva 629* (HUEFS!, TEX!, UEC!); idem, Parque Nacional da Serra das Confusões, 643 m, 09°08'29" S, 43°33'41" W, 22 June 2007, *R.M. Santos, F.A. Vieira, D.S. Carneiro-Torres & M.M. Silva-Castro 1481* (HUEFS!); idem, Parque Nacional da Serra das Confusões, entre o Portal do Parque e a descida da Serra das Confusões, 650 m, 09°13'18" S, 43°29'20" W, 20 February 2013, *G. Martinelli, N. Pougy, E. Fernandez, L. Santos, D. Judice, D. Maurenza, T. Lima & M. Moraes 18046* (HUEFS, RB!); idem, entre sítio arqueológico e localidade de Moquém, 500 m, 09°09'17" S, 43°35'54" W, 20 February 2013, *G. Martinelli, N. Pougy, E. Fernandez, L. Santos, D. Judice, D. Maurenza, T. Lima & M. Moraes 17980* (RB!, UEC!). Eliseu Martins, 15 December 1977, *A. Fernandes & Matos s.n.* (EAC 3598 [photo!]). Jurema, Boqueirão do Mato, 09°06'865" S, 43°15'994" W, 23 March 2006, *R. Barros, G. Sousa, F. Vieira, S. Soares, J. Sousa Filho, L. Farias & A. Silva 2731* (HUEFS!, TEPB). São Braz do Piauí, ca. 40 km de São Braz do Piauí, na estrada para Caracol, 614 m, 08°55'49" S, 43°06'06" W, 11 March 2005, *L.P. Queiroz, J.A. Costa, T.S. Nunes & J.G. Nascimento 10127* (HUEFS!, UEC!).

**Discussion:**—*Qualea insignis* is placed in *Q.* subg. *Qualea* sect. *Costatifolium* due to the well developed cylindrical spur, leaves with less than eight secondary veins per cm, and thyrses composed of cincinni. This small section has half of its species [*Q. dinizii* Ducke (1915: 49), *Q. psidiifolia* Spruce ex Warming (1875: 46), *Q. rupicola* Ducke (1938: 41) and *Q. tessmannii* Mildbraed (1924: 141)] occurring mainly in the Amazon, while the other half [*Q. grandiflora*, *Q. insignis*, *Q. multiflora* Martius (1826: 134) and *Q. parviflora*] is found mainly in the Cerrado and Caatinga phytogeographical domains. *Qualea grandiflora*, the most widespread woody angiosperm species from the Brazilian cerrado vegetation (Ratter *et al.* 2003), also occurs in Amazonian savanna. Of this section, *Q. insignis* is most morphologically similar to *Q. grandiflora*, mainly based on the large petal and exfoliating cortex of branchlets. Morphological comparison between these two species and *Q. parviflora*, as they are the only *Qualea* species from Caatinga, is presented on Table 1. Further phylogenetic studies, along with the current one in progress, will address the relationships within this section and how this set of species spread throughout different Neotropical domains.

#### Acknowledgements

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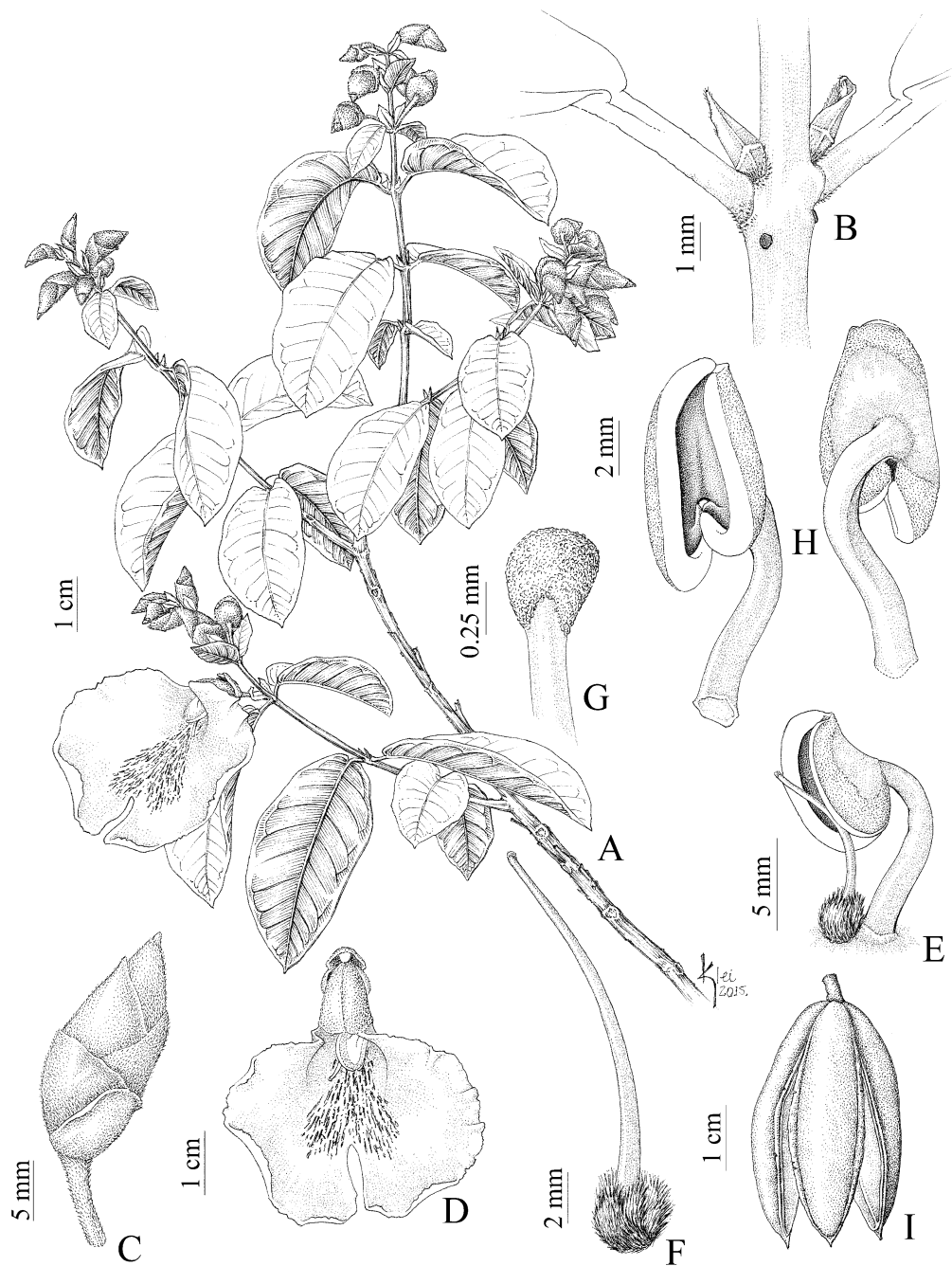
## References

- Aublet, J.B.C.F. (1775) *Histoire des plantes de la Guiane Française* 1. Pierre-François Didot jeune, London & Paris, 976 pp.  
<http://dx.doi.org/10.5962/bhl.title.674>
- Bachman, S., Moat, J., Hill, A.W., Torre, J. & Scott, B. (2011) Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* 150: 117–126.  
<http://dx.doi.org/10.3897/zookeys.150.2109>
- Brazil Flora Group (2015) Growing knowledge: an overview of seed plant diversity in Brazil. *Rodriguésia* 66: 1085–1113.  
<http://dx.doi.org/10.1590/2175-7860201566411>
- Ducke, A. (1915) Plantes nouvelles ou peu connues de la région amazonienne. *Archivos do Jardim Botânico do Rio de Janeiro* 1: 5–57.
- Ducke, A. (1938) Plantes nouvelles ou peu connues de la région amazonienne. X. *Archivos do Instituto de Biologia Vegetal* 4: 1–64.
- França, F. (2016) Vochysiaceae. In: *Lista de Espécies da Flora do Brasil*. Jardim Botânico do Rio de Janeiro. Available from: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB250/> (accessed: 10 January 2016).
- Gonçalves, D.J.P. (2013) *Vochysiaceae na região do Planalto de Diamantina e padrões de distribuição geográfica das espécies na Cadeia do Espinhaço, Brasil*. Instituto de Biologia, Universidade Estadual de Campinas, Campinas, 156 pp.
- IUCN Standards and Petitions Subcommittee (2016) *Guidelines for Using the IUCN Red List Categories and Criteria*, version 12. Cambridge UK. Available from: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed: 4 April 2016)
- Kawasaki, M.L. (2007) Vochysiaceae. In: Kubitzki, K. (ed.) *The families and genera of vascular plants*. Vol. 9. Springer, Berlin, pp. 480–487.

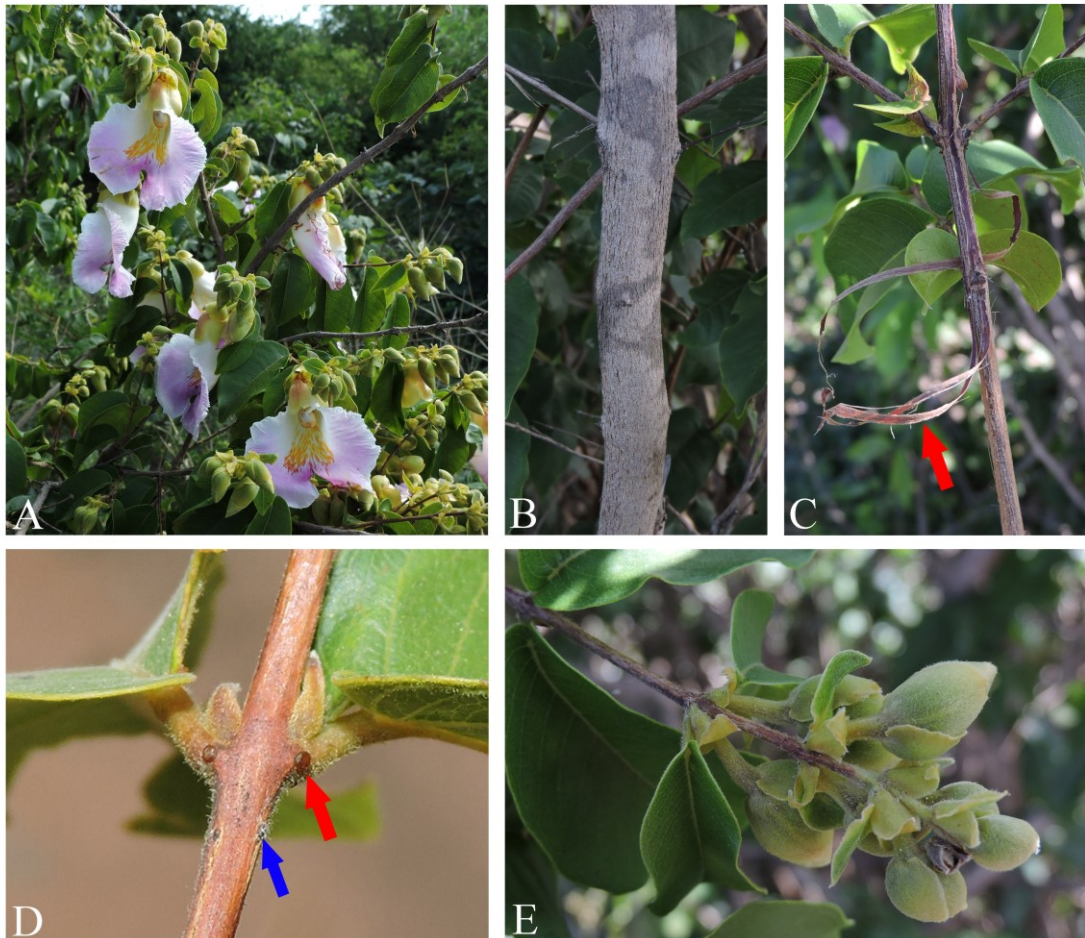
- [http://dx.doi.org/10.1007/978-3-540-32219-1\\_55](http://dx.doi.org/10.1007/978-3-540-32219-1_55)
- León, W. (2003) Anatomía xilemática comparativa de los géneros *Qualea* y *Ruizterania* (Vochysiaceae). *Pittieria* 32: 69–81.
- Litt, A. (1999) *Floral morphology and phylogeny of Vochysiaceae*. City University of New York, New York, 264 pp.
- Marcano-Berti, L. (1969) Un nuevo género de las Vochysiaceae. *Pittieria* 2: 3–27.
- Marcano-Berti, L. (1998) 123. Vochysiaceae. In: Görts-van Rijn, A.R.A. & Jansen-Jacobs, M.J. (Eds.) *Flora of the Guianas*. Series A: Phanerogams, Fascicle 21. Royal Botanic Gardens, Kew, London, pp. 1–44.
- Marcano-Berti, L. (2005) Vochysiaceae. In: Berry, P.E., Holst, B.K. & Yatskievych, K. (eds.). *Flora of the Venezuelan Guayana*. Vol. 9. Rutaceae-Zygophyllaceae. Missouri Botanical Garden Press, Saint Louis, pp. 500–524.
- Martius, C.F.P. (1826) Vochysiaceae. In: Martius, C.F.P. & Zuccarini, J.G. (eds.) *Nova genera et species plantarum* 1. Typis Lindaueri, Munich, pp. 123–154.  
<http://dx.doi.org/10.5962/bhl.title.450>
- Mildbraed, J. (1924) Plantae Tessmannianae peruvianae. I. *Notizblatt des Botanischen Gartens und Museums zu Berlin-Dahlem* 9: 136–144.  
<http://dx.doi.org/10.2307/3994397>
- Moro, M.F., Lughadha, E.N., Filer, D.L., Araújo, F.S. & Martins, F.R. (2014) A catalogue of the vascular plants of the Caatinga Phytogeographical Domain: a synthesis of floristic and phytosociological surveys. *Phytotaxa* 160: 1–118.  
<http://dx.doi.org/10.11646/phytotaxa.160.1.1>
- Passos, V.M. & França, F. (2003) Vochysiaceae da Chapada Diamantina, Bahia, Brasil. *Sitientibus série Ciências Biológicas* 3: 35–43.
- Ratter, J.A., Bridgewater, S. & Ribeiro, J.F. (2003) Analysis of the floristic composition of the Brazilian Cerrado Vegetation III: comparison of the woody vegetation of 376 areas. *Edinburgh Journal of Botany* 60: 57–109.  
<http://dx.doi.org/10.1017/S0960428603000064>
- Rodríguez, L. & Sanoja, E. (2008) Fenología, biología floral de polinización de especies de la familia Vochysiaceae en la Guayana Venezolana. *Acta Botanica Venezuelica* 31: 331–366.
- Rodríguez, L., Escala, M. & Sanoja, E. (2014) Morfología y anatomía de diásporas de especies de la familia Vochysiaceae y su relación con su diseminación. *Pittieria* 38: 59–81.

- Sajo, M.G. & Rudall, P.J. (2002) Leaf and stem anatomy of Vochysiaceae in relation to subfamilial and suprafamilial systematics. *Botanical Journal of the Linnean Society* 138: 339–364.  
<http://dx.doi.org/10.1046/j.1095-8339.2002.00025.x>
- Shimizu, G.H. & Yamamoto, K. (2012) Flora da Serra do Cipó, Minas Gerais: Vochysiaceae. *Boletim de Botânica da Universidade de São Paulo* 30: 63–87.  
<http://dx.doi.org/10.11606/issn.2316-9052.v30i1p57-61>
- Stafleu, F.A. (1953) A monograph of Vochysiaceae. III. *Qualea*. *Acta Botanica Neerlandica* 2: 144–217.
- Warming, J.E.B. (1875) Vochysiaceae. In: Martius, C.F.P. & Eichler, A.W. (Eds.) *Flora Brasiliensis* 13(2). Frid. Fleischer, Leipzig, pp. 17–116.  
<http://dx.doi.org/10.5962/bhl.title.454>

**FIGURE 1.** *Qualea insignis*. **A.** Flowering branch. **B.** Nodal region, showing the crateriform stipular glands. **C.** Flower bud. **D.** Flower in front view. **E.** Gynoecium (left) and androecium (right). **F.** Gynoecium. **G.** Stigma detail. **H.** Stamen in front (left) and back (right) view. **I.** Fruit. **A–I.** *D.J.P. Gonçalves et al.* 623. Drawn by Klei Sousa.



**FIGURE 2.** *Qualea insignis*. **A.** Habit. **B.** Trunk. **C.** Branchlet cortex exfoliating in thin strips (red arrow). **D.** Nodal region, showing the crateriform stipular glands (red arrow) and the accessory glands (blue arrow). **E.** Young inflorescence. **A–E.** *D.J.P. Gonçalves et al. 623*. All photos by G.H. Shimizu.



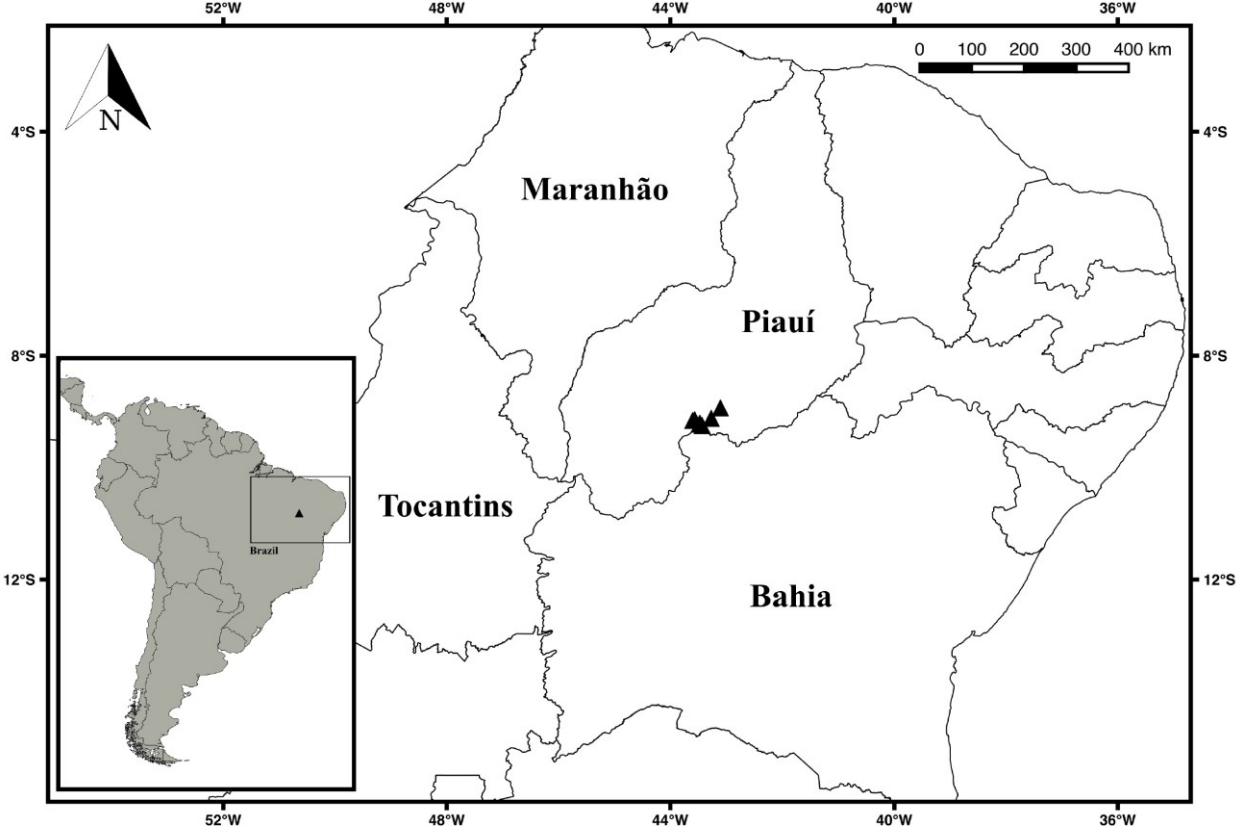


**FIGURE 3.** *Qualea insignis*. **A.** Inflorescence with flower buds at different development stages. **B.** Preanthetic flower bud, with spur spreading out (red arrow). **C.** Flower in front view. **D.** Pair of open flowers. **E.** Fruit. **A–E.** *D.J.P. Gonçalves et al. 623*. All photos by G.H. Shimizu.





FIGURE 4. Geographic distribution of *Qualea insignis* (▲).



**TABLE 1.** Diagnostic morphological characters between *Q. grandiflora*, *Q. insignis* and *Q. parviflora*. Data for *Q. grandiflora* and *Q. parviflora* are based on Stafleu (1953), Marcantoni-Berti (1998), Passos & França (2003), Shimizu & Yamamoto (2012), and Gonçalves (2013).

Character	<i>Qualea grandiflora</i>	<i>Qualea insignis</i>	<i>Qualea parviflora</i>
Trunk cortex	thick, suberose	thin, not suberose	thick, suberose
Cortex of branchlets	exfoliating in plates	exfoliating in thin strips	not exfoliating
Leaf size	7.5–24 × 3.5–9 cm	(2.6–)3.2–6.3(–7) × 1.8–3.1(–3.8) cm	3.7–11 × 1.6–5 cm
Number of flowers per cincinnus	1–5	1	1–5
Spur at anthesis	well exposed	partly enclosed by the adjacent sepal lobes	well exposed
Petal size	2–4.7 × 3.5–6 cm	4–6 × 5.6–6 cm	1–2 × 0.7–2 cm
Petal color	yellow	white to magenta, with pinkish patches and yellow stripes	violaceous, with central white stripe
Fruit length	6–12 cm	2–3.5 cm	2–4 cm
Fruit surface	not exfoliating	not exfoliating	exfoliating

## Considerações Finais

O estudo filogenético molecular de Vochysiaceae (Capítulo 1) recuperou os três principais clados: Erismeeae (*Erisma* e *Erismadelphus*), QRC (*Qualea*, *Ruizterania* e *Callisthene*) e VS (*Vochysia* e *Salvertia*), mas sem muita resolução sobre a relação entre eles. *Erisma* surgiu como grupo-irmão de *Erismadelphus*, as espécies de *Callisthene* emergiram em duas linhagens, as linhagens de *Qualea* e *Ruizterania* formaram uma politomia, e *Salvertia* surgiu como grupo-irmão de *Vochysia*. Apesar da formação de duas linhagens, *Callisthene* foi mantido, pois ainda não houve resolução que indique ou contrarie seu monofiletismo. *Ruizterania*, por sua vez, foi incorporado a *Qualea*. Algumas das categorias infragenéricas, previamente delineadas exclusivamente com base em atributos morfológicos, foram corroboradas como monofiléticas pelos dados moleculares, e alguns táxons intrigantes como *V. discolor* e *V. pseudopumila* tiveram seu posicionamento esclarecido. Entre os caracteres morfológicos mapeados, quatro tiveram estados representados como potenciais sinapomorfias para a família: ausência de glândulas translúcidas nas folhas, presença de cálcar ou proeminência bursiforme na quarta sépala, estame ereto no botão floral e presença de um único estame fértil. Outros nove estados de caráter também foram tidos como potenciais sinapomorfias para alguns clados importantes. Novas questões mais aprofundadas podem ser direcionadas agora para grupos mais específicos, baseadas nos presentes resultados moleculares, mas o esforço para resolver as relações entre os três principais clados da família deverá continuar também.

Em relação aos estudos nomenclaturais de espécies de *Vochysia* no Brasil, 26 lectotipificação foram propostas, sendo 21 de segundo passo e uma outra associada a um epítipo. Quatro novos sinônimos foram também propostos (Capítulo 2). O nomenclator (Capítulo 3) apresenta uma compilação e análise de informações dos 86 nomes de espécies de *Vochysia* ocorrentes no Brasil, além de alguns de variedades. São apresentados publicação original, dados sobre os tipos, sinonímia, posicionamento infragenérico e distribuição geográfica atualizada para as espécies aceitas. Quando necessário, comentários nomenclaturais também foram fornecidos. A correspondência já publicada sobre o lectótipo de *V. guianensis* também fez parte dos estudos nomenclaturais, mas achamos mais adequado realizar uma publicação separada, pois não se tratava de uma lectotipificação (Capítulo 4).

Finalmente, uma das espécies novas descobertas durante o doutorado (Capítulo 5) ilustra como são importantíssimos os esforços de coleta e visitas a herbário. De forma

conjunta, tanto os estudos moleculares quanto os estudos de campo e de coleções científicas são essenciais para avançar no conhecimento da biodiversidade vegetal.

## Anexo 1



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## DECLARAÇÃO

Em observância ao §5º do Artigo 1º da Informação CCPG-UNICAMP/001/15, referente a Bioética e Biossegurança, declaro que o conteúdo de minha Tese de Doutorado, intitulada "*Estudos filogenéticos, taxonômicos e nomenclaturais em Vochysiaceae e sinopse de Vochysia no Brasil*", desenvolvida no Programa de Pós-Graduação em Biologia Vegetal do Instituto de Biologia da Unicamp, não versa sobre pesquisa envolvendo seres humanos, animais ou temas afetos a Biossegurança.

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Data: 12/07/2016

**Anexo 2**

**Profa. Dra. Rachel Meneguello**  
Presidente  
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**Declaração**

As cópias de artigos de minha autoria ou de minha co-autoria, já publicados ou submetidos para publicação em revistas científicas ou anais de congressos sujeitos a arbitragem, que constam da minha Dissertação/Tese de Mestrado/Doutorado, intitulada **Estudos filogenéticos, taxonômicos e nomenclaturais em Vochysiaceae e sinopse de Vochysia no Brasil**, não infringem os dispositivos da Lei n.º 9.610/98, nem o direito autoral de qualquer editora.

Campinas, 12/07/2016

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