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ANA RAQUEL DE LIMA LOURENÇO

CALYPTRANTHES SW. NO DOMÍNIO DA MATA ATLÂNTICA BRASILEIRA – TAXONOMIA E FILOGENIA

RECIFE
2015

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Tese apresentada ao Programa de Pós-Graduação em Biologia Vegetal da Universidade Federal de Pernambuco, como pré-requisito para a obtenção do título de Doutora em Biologia Vegetal.

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“What we obtain too cheap, we esteem too lightly.
It is a dearness only that gives everything its value.
Heaven knows how to put a proper price upon its goods,
and it would be strange indeed if so celestial an article as freedom
should not be highly rated.”
(Thomas Paine)

“Desculpem-me os meus erros, mas trabalhar com Mirtáceas é sinônimo de loucura”.

(Graziela Maciel Barroso)

RESUMO

Calyptranthes (*Myrcia s.l.*) é um gênero Neotropical, ocorrendo desde o Sul da Flórida, México e Caribe até o Norte da Argentina, com aproximadamente 280 espécies reconhecidas. No Brasil, 74 espécies são aceitas atualmente, ocorrendo principalmente no Domínio Amazônico e da Mata Atlântica. O presente trabalho teve como objetivo realizar o tratamento taxonômico das espécies ocorrentes no Domínio da Mata Atlântica Brasileira e realizar uma filogenia molecular para o grupo, a fim de responder as seguintes questões: Quantas espécies de *Calyptranthes* ocorrem no Domínio da Mata Atlântica Brasileiro? *Calyptranthes* é um gênero monofilético? Qual é a sua relação com o gênero *Myrcia* s.s.? As espécies de *Calyptranthes* da Amazônia, Mata Altântica e Caribe formam linhagens distintas na filogenia do grupo? A caliptra, principal caractere que distingue *Calyptranthes* dos gêneros filogeneticamente relacionados, é um bom caractere e deve ser mantido? Pode a filogenia do gênero ajudar na taxonomia do grupo? Ao final da análise de 41 herbários, coletas em áreas de Mata Atlântica e Amazônia Brasileiras e da análise filogenética molecular com quatro marcadores moleculares *trn*Q-*rps*16, *psb*A-*trn*H, *trn*L-*trn*F (plastidiais) e ITS (nuclear), os resultados obtidos são apresentados em cinco capítulos. (1) O primeiro trata da descrição dos principais caracteres morfológicos das espécies de *Calyptranthes* ocorrentes no Domínio da Mata Atlântica Brasileira e da circunscrição do gênero; (2) No segundo, o tratamento taxonômico das espécies do Domínio da Mata Atlântica Brasileira é apresentado - novos sinônimos e lectotipificações são propostos; (3) No terceiro, apresenta-se a descrição de uma nova espécie de *Calyptranthes* endêmica do estado de São Paulo, e uma nova ocorrência para o Espírito Santo, publicados no periódico Phytotaxa; (4) O quarto capítulo é a descrição de uma nova espécie de *Calyptranthes* para o estado de Minas Gerais, previamente identificada como uma espécie de *Myrcia*; (5) O quinto e último capítulo trata da análise filogenética molecular de *Calyptranthes* e gêneros relacionados, bem como de uma rede de haplótipos, onde as perguntas iniciais são respondidas e uma nova proposta de classificação é apresentada.

Palavras-chave: Myrtaceae. *Myrcia* s.l.. Sistemática. Morfologia.

ABSTRACT

Calyptranthes (*Myrcia s.l.*) is a Neotropical genus, occurring since the South of Florida, Mexico and the Caribbean up the North of Argentina, with approximately 280 recognized species. In Brazil, 74 species are currently accepted, occurring mainly in the Amazon Domain and Atlantic Forest. The present work aimed to carry out a taxonomic treatment of the *Calyptranthes* species occurring in the Atlantic Forest Domain and also, to built a molecular phylogeny for the group, in order to answer the following questions: How many species of *Calyptranthes* occur in the of Atlantic Forest Domain? Is *Calyptranthes* a monophyletic group? What is its relationship with *Myrcia* s.s.? The species of *Calyptranthes* from the Amazon, Atlantic Forest and the Caribbean do form distinct lineages? Is the calyptra, the main character that distinguishes *Calyptranthes* from the related groups, a good character and must be kept? Can the phylogeny help in the taxonomy of the group? In the end of the analysis of 41 herbaria, field work in areas of Brazilian Atlantic Forest and Amazon and a molecular phylogeny analysis with four molecular markers trnQ-rps16, psbA-trnH, trnL-trnF (plastidials) and ITS (nuclear), the results are presented in five chapters. (1) the first one describes the main morphological characters of the *Calyptranthes* occurring in the Brazilian Atlantic Forest Domain and circumscribes the genus; (2) In the second, the taxonomic treatment of the species of the Brazilian Atlantic Forest Domain is presented - new synonyms and lectotypes are proposed ; (3) In third, it is presented the description of a new species of *Calyptranthes* endemic of São Paulo state, and a new occurrence for Espírito Santo, published in Phytotaxa; (4) the fourth chapter is the description of a new species of *Calyptranthes* for the state of Minas Gerais, previously identified as a species of *Myrcia*; (5) the fifth and last chapter is the molecular phylogenetic analysis of *Calyptranthes* and related genera, as well as an haplotype network, where the initial questions are answered and new a proposal of classification is presented.

Keywords: Myrtaceae. *Myrcia* s.l.. Systematics. Morphology.

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1 APRESENTAÇÃO

Myrtaceae Juss. é constituída por 132 gêneros e 5.671 espécies (GOVAERTS, 2008) que apresentam distribuição pantropical e cujos principais centros de diversidade são a América do Sul e a Austrália, com baixa diversidade no continente Africano e Ásia (LUGHADHA; SNOW, 2000). Na América do Sul, uma grande diversidade de Myrtaceae ocorre particularmente ao longo da costa leste do Brasil, do Escudo Guianense e do Caribe (MCVAUGH, 1968).

No Brasil, ocorrem 1034 espécies e 23 gêneros de Myrtaceae (SOBRAL et al., 2015), presentes nas diferentes formações vegetais brasileiras, aparecendo como uma das famílias de plantas arbóreas mais ricas em número de espécies em diversas formações naturais, particularmente na Mata Atlântica e Cerrado (BARROSO; PERÓN, 1994; OLIVEIRA-FILHO; FONTES 2000; HOLST et al., 2003).

Calyptranthes Sw. pertence à antiga circunscrição da subtribo Myrciinae, juntamente com os gêneros *Myrcia* DC. *ex* Guill., *Marlierea* Cambess., *Gomidesia* O. Berg, atualmente conhecida como *Myrcia* s.l. possuindo um número aproximado de 280 espécies (*sensu* LUCAS et al., 2011) distribuídas do Sul da Flórida, México e Caribe até o norte da Argentina (LANDRUM; KAWASAKI, 1997). Para o Brasil, são aceitas atualmente 74 espécies, sendo 49 delas endêmicas (FLORA DO BRASIL, 2020 em construção).

A principal característica morfológica do gênero é o cálice fechado no botão floral, abrindo-se por uma caliptra, com hipanto prolongado acima do ovário, este 2(3) locular, com dois óvulos por lóculo, juntamente com as flores reunidas em inflorescências em panícula, esta podendo ser reduzida ou com os ramos terminais abortados, dando uma aparência de tirsóide (LANDRUM; KAWASAKI, 1997 e presente trabalho). As espécies de *Calyptranthes* apresentam uma notável correlação morfológica entre si, fato que contribui para uma grande dificuldade na identificação e delimitação de cada uma delas, o que evidencia a necessidade de abordagem taxonômica detalhada para o grupo.

O objetivo do presente trabalho foi realizar o tratamento taxonômico das espécies de *Calyptranthes* ocorrentes no Domínio da Mata Atlântica Brasileira, identificando os padrões de distribuição dessas espécies, avaliando e buscando caracteres morfológicos que permitam reconhecer e diferenciar as espécies do gênero. Aliado a esses objetivos, também foram analisadas as relações entre as espécies (Atlânticas, Caribenhas e as do Domínio Amazônico), questionando o monofiletismo do gênero em relação à *Myrcia* s.s. e a utilidade do caráter da caliptra, através do tratamento taxonômico das espécies e da filogenia molecular do gênero.

Os resultados aqui apresentados estão organizados da seguinte forma:

Capítulo 1: Morfologia das espécies de *Calyptranthes* Sw. do Domínio da Mata Atlântica Brasileira – Este capítulo expõe, não em forma de artigo científico, mas como parte de um capítulo de tese de doutorado, descrições acerca da morfologia dos órgãos vegetativos e florais das espécies de *Calyptranthes* estudadas. Este capítulo foi incluído à parte do tratamento taxonômico, devido ao volume de informações geralmente permitido na introdução metodologia do formato da revista onde se pretende publicar o tratamento. Espera-se que este capítulo seja útil aos mirtólogos que desejam conhecer mais sobre o gênero, identificar estruturas e materiais em campo e herbário, estando disponível em forma de PDF e impresso.

Capítulo 2: *Calyptranthes* Sw. (Myrtaceae) from the Atlantic Forest Domain, Brazil – Neste Capítulo são reconhecidas 33 espécies para o Domínio da Mata Atlântica Brasileira, das quais 27 são endêmicas deste domínio e 6 ocorrem também em outros países da América do sul e Central. Três espécies têm um padrão de distribuição disjunto. O trabalho inclui uma revisão taxonômica com descrições, dados fenológicos e de distribuição geográfica, atualizações nomenclaturais, novos sinônimos, uma chave de identificação e ilustrações dos principais caracteres morfológicos.

Capítulo 3: A new species and a new geographical record of *Calyptranthes* (*Myrcia s.l.*, Myrtaceae) from Brazil – É apresentada uma nova espécie endêmica das florestas montanas do estado de São Paulo, *Calyptranthes serrana*, e uma nova ocorrência da espécie *Calyptranthes dryadica* para o estado do Espírito Santo, sendo publicado no periódico Phytotaxa.

Capítulo 4: *Calyptranthes ouropretensis* sp. nov. (Myrtaceae, *Myrcia s.l.*) from Minas Gerais, Brazil – Uma nova espécie de *Calyptranthes*, previamente identificada erroneamente como *Myrcia*, é descrita para o estado de Minas Gerais, bem como são abordados esclarecimentos sobre seu material tipo, juntamente com o da espécie *Myrcia subcordata*.

Capítulo 5: Phylogenetic relationships in *Calyptranthes* Sw. (*Myrcia s.l.*) reveal a monophyletic diversification on the Atlantic Forest Domain – Este capítulo trata de uma análise filogenética com foco em *Calyptranthes*, porém, incluindo *Myrcia* s.l. e foi realizada usando sequências de DNA de marcadores plastidiais (*trn*Q-*rps*16, *psb*A-*trn*H, *trn*L-*trn*F) e nuclear ribossomal ITS. O objetivo foi entender as relações entre essas linhagens, se o gênero *Calyptranthes* é monofilético e como interpretar esses dados à luz da taxonomia e da biogeografia do grupo.

2 FUNDAMENTAÇÃO TEÓRICA

2.1 A família Myrtaceae Jussieu

2.1.1 História taxonômica – classificação morfológica

Jussieu (1789), na primeira descrição da família (como "*Myrti*" – *Lês Myrtes*), apresenta uma classificação informal (sem indicação de categorias taxonômicas) baseada nas posições e morfologia das flores e inflorescências. A partir de então, as classificações adotadas pelos autores seguintes passaram por diversas circunscrições, nem sempre correspondendo ao mesmo grupo ou categoria hierárquica.

De Candolle (1827) reconheceu cinco tribos em Myrtaceae, conceito esse reconhecido e publicado também por Schlechtendal (1827): Chamaelauciae, Leptospermeae, Barringtonieae, Lecythidae e Myrteae - esta última já sendo o grupo correspondente à atual tribo Myrteae (*sensu* WILSON et al., 2005), à qual pertencem as Myrtaceae Sul-americanas de frutos carnosos (exceto pelo gênero monotípico *Tepualia* Griseb., endêmico do Chile (LANDRUM; KAWASAKI, 1997), porém, com várias diferenças em sua circunscrição. Dentro desse grupo, De Candolle já observou uma distinção a partir do tipo de embrião, reconhecendo três "grupos" que mais tarde viriam a ser reconhecidos como subtribos por Berg (ver adiante). No grupo com o tipo de embrião com cotilédones largos e membranáceos, foliáceos, dobrados entre si ou conduplicados, circundados por uma radícula alongada e curva, ele reconheceu o gênero *Myrcia*; no grupo com embrião mais crasso e carnoso, aparentando ser mais homogêneo, porém mostrando uma discreta linha de separação dos dois cotilédones plano-convexos, conectados por uma radícula curta, ele reconheceu as espécies de *Eugenia*; e no grupo com embrião espiralado, circular, consistindo em uma longa radícula com dois cotilédones muito pequenos, foram reconhecidas espécies de *Campomanesia*, *Psidium* e *Myrtus*. Em 1828, na sua obra "Prodromus", ele realiza uma classificação mais detalhada, baseada em caracteres do cálice, estames e frutos, porém mantendo as cinco tribos reconhecidas anteriormente, além de ter reconhecido e descrito várias espécies novas.

Após os estudos de De Candolle, o maior estudo envolvendo as Myrtaceae brasileiras em sua totalidade foi o tratamento de Berg na *Flora Brasiliensis* (1856–1859), no qual o autor reconheceu cerca de 1.800 espécies, mais de 1.000 descritas como novas. McVaugh, em seus estudos da Flora da Guiana Venezuelana (1958, 1969), afirmou a importância do trabalho de classificação e tratamento de Berg na Flora Brasiliensis, especialmente com relação ao número de espécies estudadas, considerando os herbários e amostras analisadas na época. Berg classificou as Myrtaceae em tribos, assim como De Candolle fez anteriormente, porém, reconheceu somente quatro, com diferentes circunscrições: Barringtonieae, Granateae, Lecythideae e Myrteae. Houve uma inovação, porém, na classificação dentro da tribo Myrteae no trabalho de Berg - a subdivisão em 6 subtribos, com base principalmente na morfologia do embrião. Os três principais tipos seriam o mircióide, eugenióide e o mirtóide, derivados do conceito anterior de De Candolle (para conceitos mais detalhados ver BARROSO, et al., 1991), sendo as subtribos: Eugenioideae, Feijoideae, Myrrinieae, Orthostemonoideae, Pimentoideae e Myrcioideae.

Apesar dos trabalhos de Berg terem sido extremamente importantes na taxonomia de Myrtaceae, sendo utilizados como referência até hoje (as subtribos sendo modificadas pelas regras nomenclaturais para Myrciinae, Eugeniinae e Myrtinae), Niedenzu (1893) simplificou as classificações anteriores, reconhecendo apenas duas subfamílias: Leptospermoideae (que inclui as tribos Chamaelauciae, Leptospermeae) e Myrtoideae (que inclui a tribo Myrteae), transferindo as tribos Barringtonieae e Lecythidae para a família Lecythidaceae – classificação que mais se aproxima da atualmente aceita pelo APG III (STEVENS, 2015).

Dentre outras classificações apresentadas para Myrtaceae, é importante destacar a de McVaugh (1968), que fez uma importante e detalhada abordagem sobre as Myrtaceae Americanas, principalmente com relação à sua circunscrição genérica, baseando-se nos trabalhos anteriores e agregando novos dados e ideias. O foco do trabalho de McVaugh passou a ser de basicamente morfológico para o evolutivo, e a classificação apresentada em seu trabalho segue essa linha de pensamento, comparando a morfologia com afinidades geográficas, citogenética e especialização evolutiva. Apesar de ter relatado que acreditava que as Myrtaceae Americanas não poderiam ser classificadas simplesmente em subtribos que representassem "unidades evolutivas", ele afirmou que a classificação de Berg (considerada por ele "antiga" e "artificial") deveria ser tomada como base para fins de referência. McVaugh dividiu as Myrtaceae em seis grupos informais: "Myrcioid", "Eugenioid", "*Myrcianthes* e gêneros, relacionados", "*Campomanesia* e gêneros relacionados", "*Psidium* e gêneros relacionados" e "*Pseudocaryophyllus* e *Pimenta*".

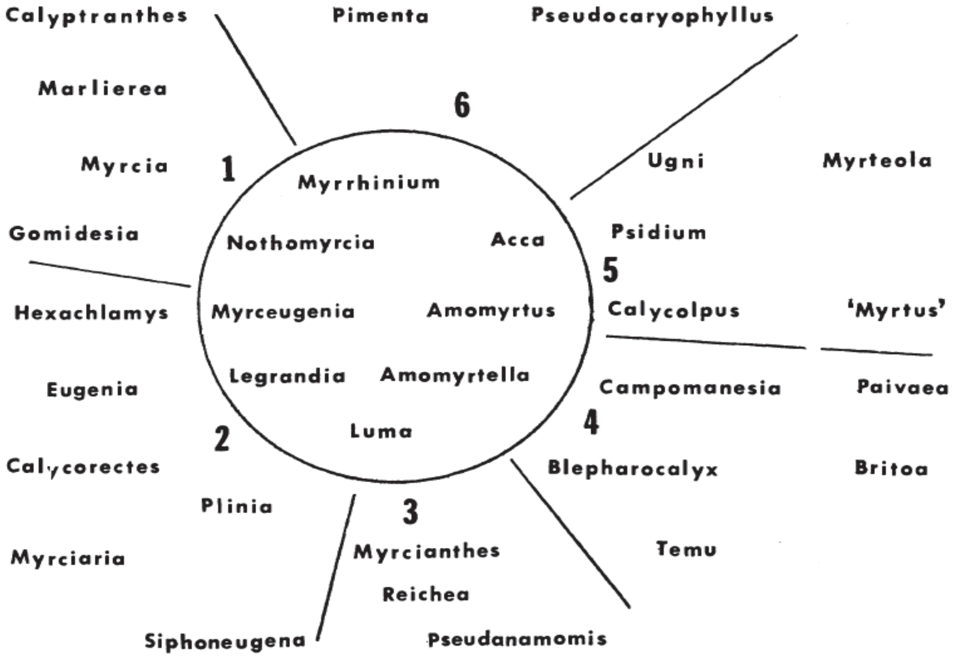
Estudos recentes apontam certa artificialidade das classificações anteriores. Porém, os estudos filogenéticos atuais, baseados em caracteres combinados (ver adiante) e principalmente a taxonomia morfológica clássica, como por exemplo, (BARROSO, 1991; LANDRUM; KAWASAKI, 1997) ainda utilizam a forma do embrião, o cálice, e caracteres do hipanto e do ovário, apontados pelos trabalhos clássicos de Berg, De Candolle e McVaugh mencionados previamente, sendo estes ainda os mais importantes na classificação dos grupos em Myrtaceae.

2.1.2 História taxonômica – filogenia

McVaugh (1968) foi o primeiro a apresentar esboços acerca das afinidades evolutivas em Myrtaceae, porém, utilizando suposições fenéticas, com base nas observações morfológicas e de distribuição geográfica, além de alguns dados paleobotânicos. Com base nesses dados, ele supôs tendências evolutivas em alguns caracteres, do primitivo para o mais derivado, como por exemplo: "muitas partes florais" → "poucas"; "partes florais livres" → "fusionadas"; "inflorescência com crescimento indeterminado" → "crescimento determinado". No mesmo trabalho é apresentada uma representação das assim chamadas "linhas de descendência" observadas (**Figura 1, a seguir**).

Briggs e Johnson foram os pioneiros nos estudos filogenéticos em Myrtaceae, contestando veementemente a fenética como forma de reconstrução evolutiva de um grupo. Em 1979 realizaram um trabalho sobre as inflorescências em Myrtaceae com enfoque evolutivo. Mas foi, porém, em 1984 que realizaram um trabalho de filogenia propriamente dito, utilizando caracteres morfológicos e anatômicos e métodos de analise cladística, contestando o monofiletismo dos grandes grupos vigentes na época.

Figura 1 - Gêneros das Myrtaceae Americanas, arranjados de acordo com suas afinidades evolutivas observadas morfologicamente por McVaugh – o círculo inclui aqueles gêneros que parecem não estar envolvidos em nenhuma das grandes linhas de descendência reconhecidas



Fonte: Retirado de McVaugh (1968).

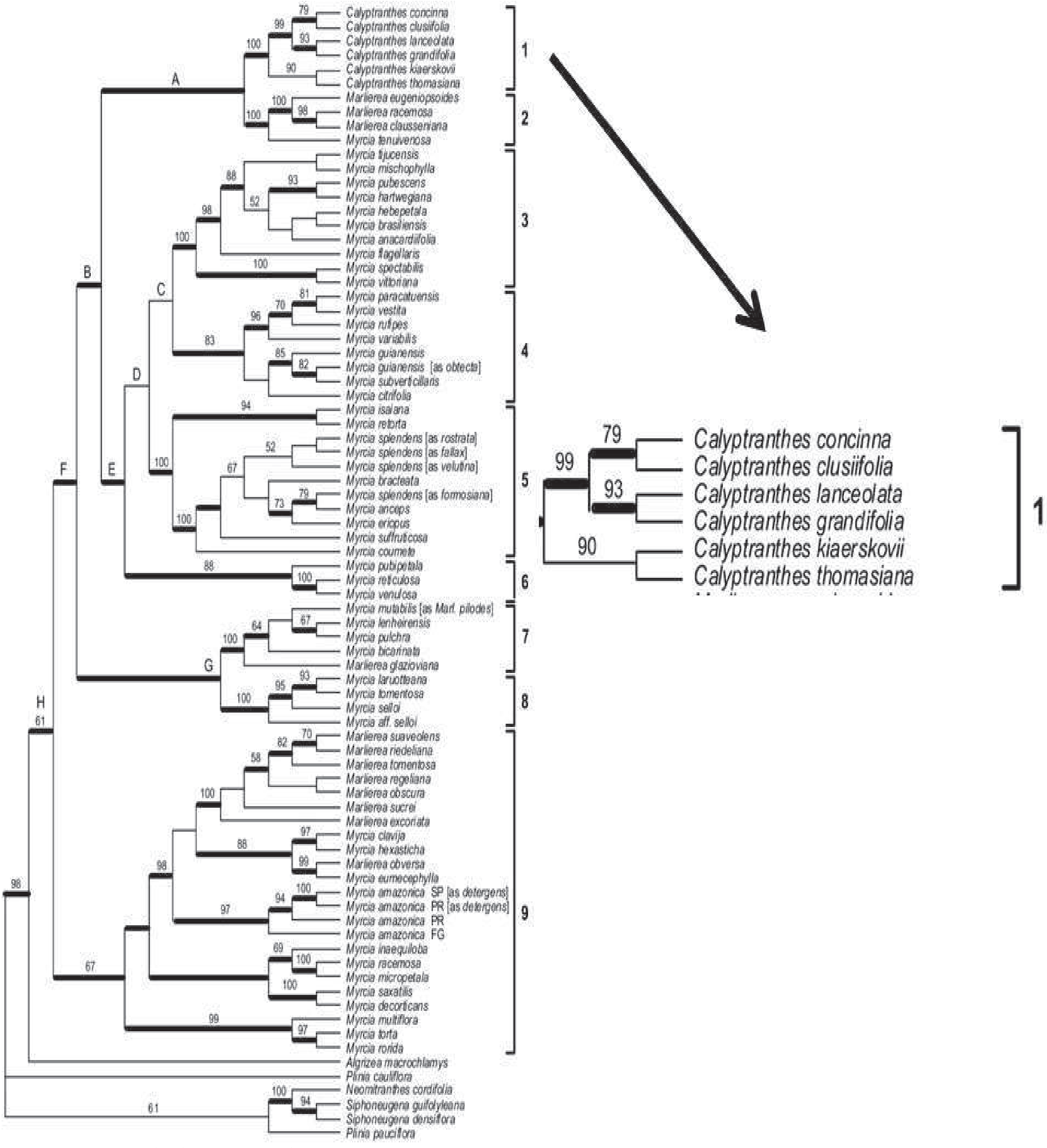
Utilizando da classificação de Schmid (1980) que considerou quatro subfamílias (Myrtoideae, Leptospermoideae, Chamaelaucioideae e Psiloxyloideae) e aplicando métodos cladísticos (como o CLAX) Briggs e Johnson chegaram à conclusão que Myrtaceae não seria monofilética, pois a subfamília Psiloxyloideae emergia em uma linhagem distinta, ressaltando a necessidade do abandono dessa classificação. Outra conclusão importante foi a de que gêneros posicionados em Myrtoideae (frutos carnosos) como *Achmena* e *Syzygium*, apareceram fora do grupo. Além disso, apesar de rejeitarem a fenética e se utilizarem de métodos filogenéticos mais precisos para a época, chegaram às mesmas conclusões de evolução dos caracteres observadas por McVaugh anteriormente.

Wilson (2001) realizou um estudo filogenético molecular utilizando o marcador *matK* e caracteres não moleculares, porém, com maior foco nos grupos de frutos capsulares. Dois grupos de frutos carnosos incluídos na análise emergiram separadamente - o gênero *Achmena* e o grupo “Myrtoid”, o que levou o autor a afirmar que os frutos carnosos provavelmente se tratam de uma homoplasia – característica adquirida independentemente em diferentes linhagens ao longo da evolução. O seu trabalho subsequente (WILSON et al., 2005) foi uma análise filogenética molecular, também utilizando o marcador *matK*, porém, incluindo um maior número de amostras e grupos. Wilson e colaboradores propõem uma divisão de Myrtaceae em subfamílias: Psiloxyloideae e Myrtoideae, com duas e vinte tribos respectivamente, incluídas nessa última a tribo Myrteae, na qual as espécies da América do Sul formam um grupo filogeneticamente coeso, apesar de provavelmente os frutos carnosos terem surgido independentemente três vezes durante a evolução da família. A classificação proposta nesse trabalho é a mais aceita atualmente, servindo de base para os trabalhos de Lucas et al., (2005, 2007 e 2011).

A referida tribo Myrteae (*sensu* WILSON et al., 2005) foi alvo de estudos filogenéticos moleculares baseado nos marcadores ETS, ITS e *psbA-trnH*, para esclarecer as relações entre 31 de seus gêneros. Foram apontados grandes grupos informais: Plinia, Myrcia, Myrceugenia, Myrteola, Pimenta e Eugenia - nomeados de acordo com seu gênero mais diverso (LUCAS et al., 2007). O grupo nomeado "Myrcia" é o maior deles, o qual abrange os gêneros *Calyptranthes* Sw., *Myrcia* DC., *Gomidesia* Berg e *Marlierea* Cambess., *Calyptranthes* o único emergindo como monofilético. Mais recentemente, Lucas et al., (2011) realizaram um trabalho mais amplo, já propondo a unificação dos gêneros anteriormente citados no grupo "Myrcia" como um grande gênero *Myrcia s.l.*, concomitantemente com o encaminhamento da proposta de conservação do nome *Myrcia* em detrimento de *Calyptranthes* (mais antigo) por questões de parcimônia nomenclatural (LUCAS; SOBRAL, 2010). A análise filogenética de quatro marcadores plastidiais e dois ribossomais, em conjunto com caracteres morfológicos e de distribuição geográfica resultaram em uma árvore com nove clados, dos quais um corresponde às espécies de *Calyptranthes* incluídas na análise (**Figura 2, a seguir**).

Uma das hipóteses do presente trabalho é a de que as espécies da Mata Atlântica formam um clado diferente das espécies Amazônicas e Caribenhas. A análise de Lucas et al., (2011) sugere essa hipótese, visto que no clado 1, composto pelas espécies de *Calyptranthes*, observa-se dois clados internos distintos: um formado pelas espécies *C. concinna*, *C. clusiifolia*, *C. lanceolata* e *C. grandifolia* (endêmicas da Mata Atlântica) e outro das espécies Caribenhas *C. kiaerskovii* e *C. thomasiana*. Uma análise filogenética incluindo mais espécies da Mata Atlântica está em andamento para testar essa hipótese com um maior número de espécies.

Figura 2 - Clados resultantes da análise bayesiana com marcadores plastidiais e ribossomais



Fonte: Extraído de Lucas et al., 2011.

2.2 *Calyptranthes* Swartz

Calyptranthes Swartz (1788, p. 79) é um gênero Neotropical, distribuído desde o México e Caribe até o Norte da (LANDRUM; KAWASAKI, 1997), possuindo aproximadamente 260 espécies reconhecidas até o momento (WCSP, 2013). Acredita-se que seus principais centros de dispersão sejam a Amazônia, o Caribe e a Mata Atlântica (LEGRAND, 1962; MCVAUGH, 1969).

No Brasil, são conhecidas 74 espécies, das quais 49 são endêmicas. As espécies de *Calyptranthes* brasileiras são basicamente atlânticas ou amazônicas, com poucos representantes no Cerrado e Caatinga (SOBRAL et al., 2015). Apesar de serem conhecidas as possíveis relações históricas e casos de disjunção de espécies entre a Mata Atlântica e Amazônia, observa-se que a maioria das espécies do gênero apresenta uma distribuição restrita a um desses ecossistemas, sendo poucas as espécies disjuntas. As espécies de *Calyptranthes* distribuem-se preferencialmente em remanescentes próximos a ecossistemas úmidos, tais como rios e lagoas (OLIVEIRA-FILHO; CARVALHO, 1993), sendo assim um potencial gênero indicador da preservação dessas áreas.

2.2.1 História taxonômica – classificação morfológica

Os conceitos genéricos em Myrtaceae se desenvolveram paulatinamente, desde o início do século 19, onde poucas espécies eram conhecidas (MCVAUGH, 1968). Porém, dentro da subtribo Myrciinae, *Calyptranthes* é o que apresenta a classificação mais estável de acordo com os diversos autores (Tabela 1), sendo as primeiras delimitações morfológicas definidas por “cálice truncado, operculado, corola ausente” (SWARTZ, 1788), passando à delimitação morfológica atual dada por Lucas et al., (2011) e a do presente trabalho.

O gênero *Chytraculia* foi descrito por Browne em 1756, na sua obra sobre espécies da Jamaica. A publicação contém uma ilustração de flor abrindo-se em forma de caliptra, o que levou alguns autores a descrever espécies de *Calyptranthes* dentro do gênero, como foi o caso de Kuntze (1891), sendo o gênero posteriormente considerado rejeitado, de acordo com as regras do Código de Nomenclatura Botânica (MCNEIL et al., 2012), assim como *Suzygium*, também descrito por Browne em 1756, sendo *Calyptranthes* o nome conservado.

Tabela 1 - História taxonômica de Myrciinae

Taxonomy of Myrciinae Genera According to Various Authors and This Study

Berg 1855–1856, 1857–1859	Bentham 1869	Niedenzu 1893	Kiaerskou 1893	Kausel 1942, 1956, 1966	McVaugh 1968	Landrum 1981*a*	This study
Subtribe Myrcioideae	Myrciinae	Myrciinae	Myrcioideae	Myrcioideae	"Myrcioid" genera	Myrciinae	"*Myrcia* group"
Cerqueiria	=*Myrcia*	=*Gomidesia*			=*Gomidesia*		
Gomidesia	=*Myrcia*	*Gomidesia*	=*Myrcia*	*Gomidesia*	*Gomidesia*	*Gomidesia*	=*Myrcia*
Rubachia	=*Marlierea*	=*Marlierea*	=*Marlierea*		=*Marlierea*		
Marlierea	*Marlierea*	*Marlierea*	*Marlierea*		*Marlierea*	*Marlierea*	=*Myrcia*
Calyptranthes	*Calyptranthes*	*Calyptranthes*	*Calyptranthes*	*Calyptranthes*	*Calyptranthes*	*Calyptranthes*	=*Myrcia*
Calpytromyrciaa	=*Myrcia*	=*Myrcia*			=*Myrcia*		
Aulomyrcia	=*Myrcia*	=*Myrcia*	=*Myrcia*	*Aulomyrcia*	=*Myrcia*		
Eugeniopsis	=*Marlierea*	=*Marlierea*	=*Marlierea*		=*Marlierea*		
Myrcia	*Myrcia*	*Myrcia*	*Myrcia*	*Myrcia*	*Myrcia*	*Myrcia*	*Myrcia*
Myrceugenia	*Myrceugenia*	*Myrceugenia*	=*Myrcia*	*Myrceugenia*	*Myrceugenia*^{a}	*Myrceugenia*	*Myrceugenia*
Calycampe	=*Myrcia*	=*Myrcia*					
				Nothomyrcia	*Nothomyrcia*^{a}	=*Myrceugenia*	=*Myrceugenia*
				Myrceugenella		*Luma*	*Luma*
					Mitranthes	*Mitranthes*	*Mitranthes*?
				Feijoa			

Fonte: Extraído de Lucas et al. 2011.

2.2.2 Trabalhos taxonômicos realizados para o gênero *Calyptranthes* no mundo e no Brasil

As espécies de *Calyptranthes* do escudo Guianense foram tratadas por McVaugh (1968), que também teceu comentários detalhados sobre a morfologia e distribuição geográfica de *Calyptranthes* como um todo, incluindo uma chave de identificação para as espécies de *Calyptranthes* e *Marlierea*.

Tratamentos taxonômicos clássicos incluem ainda o estudo do gênero para a Flora da Guyana Venezuelana, com 12 espécies de *Calyptranthes* (HOLST et al., 2003). Urban (1920) tratou 31 espécies de *Calyptranthes* para as Antilhas.

Berg, na Flora Brasiliensis, tratou 51 espécies. Na classificação genérica de *Calyptranthes*, nada mais foi acrescentado com relação aos trabalhos dos taxonomistas anteriores, que tenha gerado alguma mudança relevante na taxonomia do grupo como aconteceu com as Myrtaceae como um todo. O grande mérito da Flora Brasiliensis foi a descrição de inúmeras espécies novas. Das espécies tratadas por Berg, Legrand, no seu trabalho de *Calyptranthes* para o Brasil Austral (1962), considerou como válidas apenas 38. Todavia, não especificou quais nem publicou sinonimizações, mas tratou 28 espécies e 9 variedades para essa região do Brasil. Apresentou também, uma breve classificação infragenérica informal, onde considerou o caráter "ramificação" como separador de dois grandes grupos: ramificação monopodial e ramificação dicotômica ou simpodial, apresentando também uma chave para separação das espécies. Também publicou o trabalho "Flora Ilustrada Catarinense – *Calyptranthes*", juntamente com Klein (1971), onde tratou 14 espécies para o estado de Santa Catarina, realizando algumas modificações com relação às espécies reconhecidas em seu trabalho anterior, apresentando também chave de identificação, ilustrações e considerações acerca do hábitat de ocorrência.

Para a Mata Atlântica brasileira, dois trabalhos recentes de Sobral et al., (2012, 2013) descrevem espécies novas de *Calyptranthes*: *C. boanova, C. detecta*, *C. curta, C. maritima* no primeiro (endêmicas da Bahia, Minas Gerais e São Paulo, respectivamente) e *C. santalucia* no segundo, espécie endêmica da Mata Atlântica do estado do Espírito Santo.

Rosário et al., (2005) e Rosario & Secco (2006) se dedicaram à sinopses e trabalhos florísticos relativos à *Myrcia s.l.* na Amazônia, com ênfase no estado do Pará. Recentemente, Rosario et al., (2014) publicaram notas taxonômicas para *Calyptranthes* da Amazônia, onde é proposto um sinônimo para a espécie *C. moanensis* (*Marlierea uniflora* McVaugh) e onde são apontados cinco novos registros para o estado do Pará (*C. amshoffae*, *C. crebra*, *C. fasciculada*, *C. cuspidata*, *C. lucida* e *C. blanchetiana*, esta última até então restrita somente às matas do Sul da Bahia, cujo tratamento está incluído no presente trabalho).

Kawasaki e Holst dedicam-se ao estudo de espécies de *Calyptranthes*, além de outros gêneros em Myrtaceae, principalmente das áreas do Equador, Peru e sudeste do Brasil, publicando dezenas de espécies novas (HOLST; KAWASAKI, 2006, 2008; KAWASAKI; HOLST, 1994, 2005, 2006, 2009a, 2009b; KAWASAKI 1996, 1998, 2010). Na Colômbia, destacam-se os trabalhos de Parra, como novas ocorrências e novas espécies de *Calyptranthes* (2002, 2004a, 2004b). Lourenço e Alves descreveram uma nova espécie de *Calyptranthes* endêmica do estado de São Paulo recentemente (2014), *C. serrana*, e apontaram um novo registro da espécie *C. dryadica* para o Estado do Espírito Santo.

O gênero não foi alvo de estudos taxonômicos específicos desde então, principalmente os monográficos. Fica evidente a desproporção entre o número de espécies novas descritas em comparação com a pouca quantidade de estudos, o que indica que o gênero ainda necessita de mais estudos taxonômicos revisionais.

2.2.3 Trabalhos de filogenia molecular realizados para o gênero *Calyptranthes* e suas consequências

Uma filogenia molecular de *Calyptranthes* elaborada por Wilson et al., (in press.) está em andamento, mas o número de espécies de *Calyptranthes* incluídas é menor que a do presente trabalho, pois o objetivo principal do artigo é diferente - testar a hipótese de que o gênero não é monofilético e apoiar a proposta lançada pela Taxon por Sobral e Lucas em (2010). Na realidade, esse artigo é complementar ao da filogenia aqui realizada, com perguntas que se unem com um mesmo objetivo final e em direção a uma possível nova proposta de classificação dos gêneros *Calyptranthes* e *Myrcia*.

3 MÉTODOS

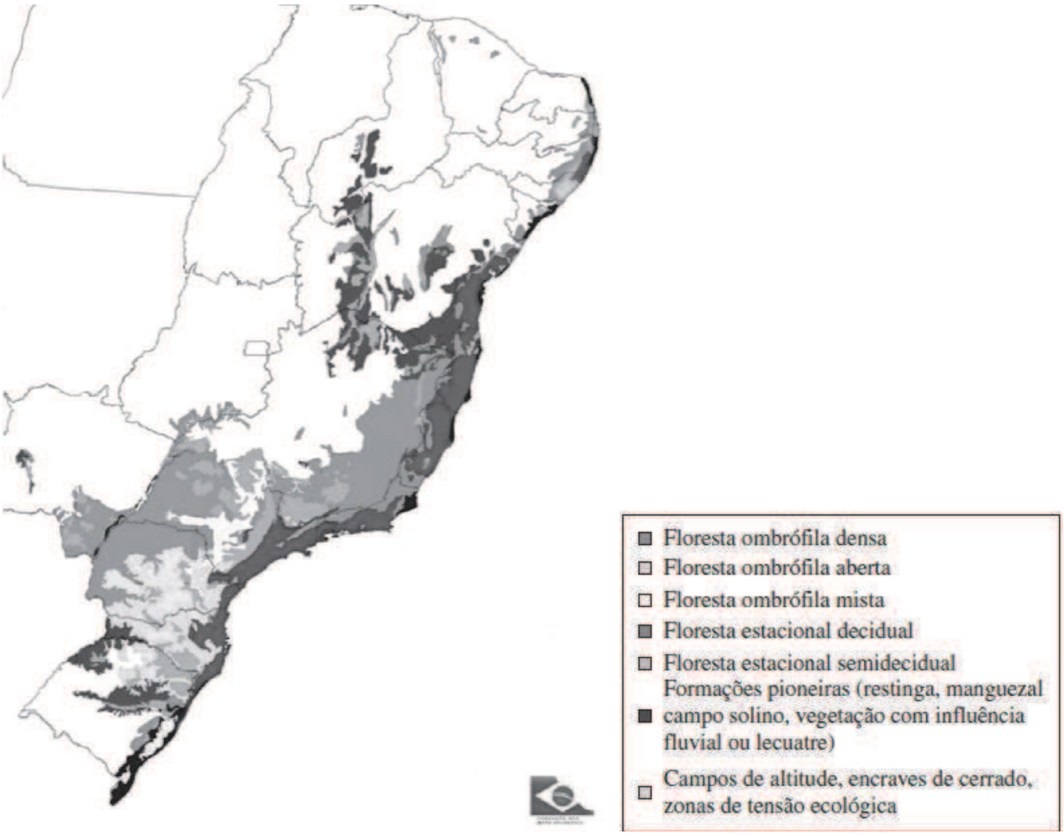
3.1 Área de estudo: O Domínio da Mata Atlântica Brasileiro

O termo Domínio da Mata Atlântica (DMA) no Brasil representa um mosaico de comunidades vegetais que se desenvolvem ao longo da cadeia montanhosa e das terras baixas que ladeiam o Oceano Atlântico, desde o Rio Grande do Sul até o Rio Grande do Norte. Trata-se, provavelmente, do bioma mais devastado e ameaçado do planeta, sendo o *hot spot* em que o ritmo das mudanças está entre os mais rápidos, e necessitando, consequentemente, de ações urgentes para sua conservação. Embora a área de abrangência original da Mata Atlântica seja estimada em algo entre 1 a 1,5 milhão de km^2, restam apenas de 7 a 12% da floresta original (MYERS et al., 2000; GALINDO-LEAL; CÂMARA, 2005; STEHMANN et al., 2009).

Estima-se que cerca da metade dos remanescentes da Mata Atlântica de grande extensão estão protegidos na forma de Unidades de Conservação (UC's). A maioria desses fragmentos se encontra hoje nas regiões serranas, principalmente na fachada da Serra do Mar (COLOMBO; JOLY, 2010). Já no Nordeste brasileiro, as maiores influências recebidas da Mata são da Floresta Amazônica e da Mata Atlântica do Sul e Sudeste do Brasil, representando 6,4% do universo brasileiro da vegetação. Todavia, é nesta região que a MA apresenta um dos piores status de conservação devido ao desmatamento para monocultura e formação de pastos.

O conceito adotado para o Domínio da Mata Atlântica brasileira, no presente trabalho, é o conceito "*sensu lato*" (IBGE 2008; COLOMBO; JOLY, 2010) que abrange 17 estados brasileiros e três tipos básicos de florestas - Floresta Ombrófila Densa, Floresta Estacional Semidecidual e as Florestas de Araucárias no Sul do Brasil, mais os seus ecossistemas associados, como as restingas, os tabuleiros litorâneos, encraves de cerrado, campos de altitude, zonas de tensão ecológica, os brejos de altitude (fragmentos florestais isolados que ocorrem acima dos 600 m de altitude, desde o estado do Ceará até Alagoas) e as florestas estacionais da Cadeia do Espinhaço (Minas Gerais e Bahia principalmente) (**Figura 3, a seguir**).

Figura 3 - Fitofisionomias do Domínio da Mata Atlântica



Fonte: Retirado de Colombo e Joly (2010).

3.2 Coletas e processamento de dados

O trabalho de campo destinou-se a coleta de material botânico fértil pertencente ao gênero *Calyptranthes*, sendo proposto para o período dos quatro primeiros semestres do doutorado, com frequência mensal, contemplando os períodos seco e chuvoso. As áreas foram previamente selecionadas de acordo com sua importância biológica e facilidades de acesso. Foram realizadas expedições de coleta durante o período de Março de 2011 a Novembro de 2012, contemplando os seguintes estados: Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia (tanto em áreas de Mata Atlântica como em áreas de Caatinga), Rio de Janeiro e São Paulo. Durante o período julho de 2012 a maio 2013, as coletas foram mais esparsas e pontuais, restritas a remanescentes localizados no nordeste do Brasil, no estado do Espírito Santo e Minas Gerais, onde foi possível coletar indivíduos de *Calyptranthes brasiliensis* Spreng., *Calyptranthes pulchella* DC. e espécies pertencentes a gêneros relacionados.

Apesar do esforço inicial, observou-se uma dificuldade na coleta de espécies de *Calyptranthes*, a maioria dos indivíduos ocorrendo pontualmente em áreas bem preservadas, sendo as populações escassas e com poucos indivíduos. Este padrão se repetiu ao longo do desenvolvimento do projeto no último ano, e por este motivo priorizou-se a visita às coleções (herbários), onde um grande número de exemplares pôde ser analisado em menor espaço de tempo, em detrimento das idas a campo neste momento do projeto. No total, foram coletadas onze espécies de *Calyptranthes*: *C. aromatica* A. St.-Hil., *C. brasiliensis* Spreng., *C. caudata* Gardner, *C. clusiifolia* O. Berg, *C. concinna* DC., *C. dardanoi* Mattos, *C. fusiformis* M.L. Kawasaki, *C. grandifolia* O. Berg, *C. lucida* Martius ex DC., *C. ouropretensis* A.R. Lourenço e *C. pulchella* DC. Parte das amostras foi submetida às técnicas usuais em taxonomia (MORI et al. 1989) e os vouchers foram depositados no Herbário Geraldo Mariz – UFP da Universidade Federal de Pernambuco. Outras amostras foram depositadas nos herbários dos estados onde as amostras foram coletadas, as duplicatas tendo sido incorporadas ao UFP.

3.3 Coleções Botânicas

Inicialmente foram levantadas, consultadas e estudadas morfologicamente as amostras de *Calyptranthes* depositadas nos herbários de importância local/regional de cada estado de abrangência da Mata Atlântica, seguida dos principais herbários de referência nacional. Posteriormente, foram consultadas as coleções de referência internacional para o gênero (**Tabela 2**). Após esse período, foram realizadas consultas e análises nos herbários com materiais oriundos em sua maioria de áreas extra-MA, como Amazônia e Cerrado, para a complementação do estudo das espécies e entendimento do gênero como um todo. Os estudos morfológicos consistiram na análise macromorfológica das espécies para a posterior descrição e identificação dos principais caracteres diagnósticos. As amostras de gêneros próximos e de Myrtaceae indeterminadas, quando possível, também foram analisadas nas coleções botânicas, para minimizar os prováveis e detectados erros de identificação. Os status de conservação apontados para cada espécie no tratamento taxonômico seguiram os critérios sugeridos na IUCN Red List criteria (2011). Os acrônimos dos herbários analisados da tabela 2 seguiram o proposto por Thiers (2014).

3.4 Estudos moleculares

Para os estudos moleculares foram coletadas amostras frescas deste material proveniente do campo, mais especificamente das folhas, armazenadas em sílica-gel (ROGERS; BENDICH, 1985), visto que amostras de herbário não se mostraram eficazes para os estudos moleculares de acordo com o analisado e testado previamente por Lucas et al., (2007, 2011). Também foram coletados e fixados materiais de outros gêneros próximos a *Calyptranthes*, pertencentes ao grupo *Myrcia s.l.*

Tabela 2 - Acrônimos e instituições visitadas e/ou consultadas online/fotos (*)

Acrônimos	Instituições
ALCB	Universidade Federal da Bahia, Salvador, Brasil
ASE	Universidade Federal de Sergipe, Aracajú, Brasil
BHCB	Universidade Federal de Minas Gerais, Belo Horizonte, Brasil
B*	Botanischer Garten und Botanisches Museum Berlin-Dahlem, Zentraleintichtung der Freien Universität Berlin, Berlim, Alemanha
BM	The Natural History Museum, Londres, Inglaterra
BR*	National Botanic Garden of Belgium, Meise, Bélgica
CEN	EMBRAPA, CENARGEN, Brasília, Brasil
CEPEC	Centro de Pesquisas do Cacau, CEPLAC, Ilhéus, Brasil
CVRD	Reserva Natural da Vale, Linhares, Brasil
EAC	Universidade Federal do Ceará, Fortaleza, Brasil
EAN	Universidade Federal da Paraíba, Campus III, Areia, Brasil
G*	Conservatoire et Jardin Botaniques de la Ville de Gèneve, Genebra, Suíça
HB	Universidade Estadual do Rio de Janeiro, Brasil
HBR	Universidade Federal de Santa Catarina, Itajaí, Brasil
HRB	IBGE, Salvador, Brasil
HST	Universidade Federal Rural de Pernambuco, Recife, Brasil
HUEFS	Universidade Estadual de Feira de Santana, Feira de Santana, Brasil
HUESB	Universidade Estadual do Sudoeste da Bahia, Jequié, Brasil
HVASF*	Universidade Federal do Vale do Rio São Francisco, Petrolina, Brasil
INPA	Instituto Nacional de Pesquisas da Amazônia, Manaus, Brasil
IPA	Empresa Pernambucana de Pesquisa Agropecuária, Recife, Brasil
JPB	Universidade Federal da Paraíba, João Pessoa, Brasil
K	Royal Botanic Gardens, Kew, Londres, Inglaterra
LE*	V.L. Komarov Botanical Institute, São Petesburgo, Rússia
M*	Botanische Staatssammlung München, Munique, Alemanha
MAC	Instituto do Meio Ambiente, Maceió, Brasil
MBM	Museu Botânico Municipal, Curitiba, Brasil
MBML	Museu de Biologia Melo Leitão, Santa Teresa, Brasil
NY*	The New York Botanical Garden, Nova York, EUA
OUPR	Universidade Federal de Ouro Preto, Ouro Preto, Brasil
P	Muséum National d'Histoire Naturelle, Paris, França
PEUFR	Universidade Federal Rural de Pernambuco, Recife, Brasil
R	Museu Nacional, Rio de Janeiro, Brasil
RB	Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brasil
S*	Swedish Museum of Natural History, Estocolmo, Suécia
SP	Instituto de Botânica, São Paulo, Brasil
SPF	Universidade de São Paulo, São Paulo, Brasil
UB	Universidade Federal de Brasília, Brasília, Brasil
UFP	Universidade Federal de Pernambuco, Recife, Brasil
UFRN	Universidade Federal do Rio Grande do Norte, Natal, Brasil
VIES	Universidade Federal do Espírito Santo, Vitória/ São Mateus, Brasil
W*	Naturhistorisches Museum Wien, Viena, Áustria

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Capítulo 1

Morfologia das espécies de *Calyptranthes* Sw. do Domínio da Mata Atlântica Brasileira

5.1 Introdução

Calyptranthes Swartz (1788) é um gênero Neotropical que ocorre desde o Sul da Flórida, México, Caribe, América do Sul, alcançando o Norte da Argentina até o Uruguai (Landrum & Kawasaki 1997, Lucas & Sobral 2011). Atualmente, são reconhecidas cerca de 280 espécies de *Calyptranthes* (Lucas *et al.* in press), e representa um dos nove clados delimitados dentro do gênero *Myrcia* De Candolle (1827), que emerge como monofilético (*sensu* Lucas *et al.* 2011), e era previamente reconhecido como a subtribo Myrciinae (Berg 1855–1856). A diversidade de *Calyptranthes* é maior no Caribe (Lucas & Sobral 2011b), mas também é considerável na Mata Atlântica e na Floresta Amazônica (Legrand 1962, McVaugh 1969, Lourenço & Alves 2015, Lourenço & Lucas in prep.).

Filogenias moleculares iniciais (Lucas *et al.* 2005, 2007, 2011) mostraram que *Calyptranthes* emerge como um grupo monofilético, porém, inserido dentro de *Myrcia s.l.*, resultando em uma proposta de conservação de *Myrcia* em detrimento de *Calyptranthes* ((Lucas & Sobral 2011). Todavia, o Comitê Geral de Plantas Vasculares não atingiu uma maioria de votos para aprovar ou reprovar a proposta (Applequist 2014). Estudos moleculares mais recentes (Wilson *et al.* 2016, Lourenço *et al.* in prep.) mostram que espécies que possuem caliptra, o principal caractere usado para distinguir *Calyptranthes* de *Myrcia*, não corresponde a um grupo monofilético. Uma espécie de *Calyptranthes* emerge em *Myrcia* sect. *Aulomyrcia*: *Calyptranthes multiflora* Poepp. ex O. Berg, ocorrente na Amazônia.

Diante desse panorama, todas as espécies de *Calyptranthes* do Domínio da Mata Atlântica incluídas neste trabalho se encaixam no conceito morfológico clássico da caliptra descrito anteriormente por diversos autores (Berg 1855–1856; Legrand 1962; McVaugh 1958, 1968, 1969; Landrum & Kawasaki 1997; Rosário et al. 2006, 2014). Os trabalhos publicados para o gênero no Brasil, incluindo os que tratam dos *Calyptranthes* na Amazônia brasileira (Rosário et al. 2005, 2014; Rosário & Secco 2006, 2013; Ferreira et al. 2013), concordam em, por hora, manter o gênero *Calyptranthes* como uma entidade taxonômica independente.

Apesar de o grupo ter emergido como monofilético nas análises filogenéticas realizadas até o momento, inserido, porém, dentro do grupo parafilético *Myrcia s.l.*, e da concordância entre alguns autores com relação à circunscrição morfológica, a caliptra nem sempre é tão evidente com relação à sua abertura regular. Algumas espécies do Caribe e da Amazônia apresentam uma caliptra intermediária entre a forma regular e a forma irregular, como a apresentada pelas espécies de *Marlierea*. Lucas et al. (2011) afirmam que a inclusão de mais espécies na análise filogenética pode indicar se a caliptra continuará se mostrando um caráter distintivo, e se *Calyptranthes* continuará emergindo como monofilético. Com base nas análises morfológicas e de filogenia preliminares em *Calyptranthes* (Lourenço & Alves in press, Wilson et al. in press,) e com diferentes grupos em *Myrcia s.s.* e *Marlierea*, acredita-se que o caráter "cálice rompendo em forma de caliptra" tanto regular quanto irregularmente, pode ter surgido mais de uma vez na evolução do grupo. Porém, no grupo das espécies do DMA, esse caráter se mantém constante.

Lucas et al. (2011) afirmam que homoplasias ocorrem em quase todos os caracteres morfológicos utilizados na análise filogenética. Esse dado corrobora a proposta de Lucas & Sobral (2012) que propõe o estabelecimento de um grande gênero *Myrcia sensu lato*. Porém, ainda não existe um conjunto de caracteres seguros que defina o grande grupo *Myrcia* com relação à sua morfologia – tampouco um consenso com relação às sinapomorfias dos clados informais nomeados por Lucas et al. (2011), como subgrupos dentro de *Myrcia*. Ainda é necessário que estudos de revisão taxonômica e filogenia sejam realizados com esses subgrupos, para que se tenha uma base mais estabelecida para uma possível mudança nomenclatural.

Com base nesse paradoxo: manter o gênero *Calyptranthes* como uma entidade taxonômica independente, identificável por caracteres morfológicos, ou optar por seguir a classificação filogenética proposta por Lucas and Sobral (2011), fica evidente a necessidade de que as espécies no gênero necessitam ser revisadas morfologicamente, taxonomicamente e filogeneticamente, envolvendo também as espécies Amazônicas e Caribenhas, até que a decisão da International Association for Plant Taxonomy, aguardada até o próximo congresso internacional de botânica em 2017, na China, seja tomada.

Considerando o panorama, tomou-se a decisão, nesse trabalho, de manter o nome *Calyptranthes*, e chegou-se a conclusão que as espécies do Domínio da Mata Atlântica aqui tratadas são caracterizadas morfologicamente pela combinação dos seguintes caracteres:

- Inflorescência panícula com eixo principal abortado, também chamada de panícula com ramificações cimosas, podendo ser ramificadas ou congestas, os ramos laterais opostos, ou estar reduzidas a um único eixo não ramificado terminado em três a uma única flor. Estes caracteres são evidentes nas espécies endêmicas do Domínio da Mata Atlântica. Nas espécies disjuntas entre Amazônia/DMA, Caribe/DMA ou Cerrado/DMA, essa ramificação é não cimosa e os ramos laterais são basicamente assimétricos, ou seja, subopostos, assim como em outros clados de *Myrcia s.l.*, como o "clado 9" (*Aulomyrcia*, Staggemeier 2014).

- Cálice fundido, rompendo-se em forma de caliptra na antese, com bordas regulares – raramente sutilmente regulares, a caliptra podendo ser decídua ou persistente no ápice do hipanto depois da antese, e por vezes persistindo no fruto.

5.2 Morfologia das espécies de *Calyptranthes* do DMA brasileira em comparação com as do Domínio da Amazônia brasileira

Rosário et al. (2014), baseado no trabalho realizado e nas referências dos estudos de *Calyptranthes* para o Domínio da Amazônia (McVaugh 1958, 1969, Holst *et al.* 2003, Rosário & Secco 2006) apresentam uma circunscrição morfológica para o gênero, baseando-se em amostras coletadas ou herborizadas, proveniente da Amazônia Brasileira (com ênfase nas espécies Paraenses) bem como extra-brasileiras, e acredita-se ser importante agregar essa circunscrição com a considerada no presente trabalho, a fim de que se possa comparar e saber se as espécies tem ou não um padrão morfológico relacionado à sua distribuição geográfica.

Foram encontradas algumas características morfológicas que diferenciam estas espécies daquelas tratadas para o DMA, porém somente em algumas espécies e ocorrendo sobrepostas em outras, não sendo características que, por hora, poderiam servir de separação em grupos morfológicos ou que descaracterize o gênero *Calyptranthes* conforme a circunscrição aqui adotada. Essas características, porém, revelam-se úteis na delimitação de espécies entre si. Algumas delas incluem padrão de inflorescência paniculiforme com flores subsésseis a distintamente pediceladas (como no exemplo da espécie *Calyptranthes moanensis* Alain que pode apresentar um pedicelo de até 9 mm de comprimento). Espécies Amazônicas brasileiras e extra-brasileiras analisadas em herbário no presente trabalho apresentaram um padrão paniculiforme com ramificações não cimosas e assimétricas (ou subopostas).

Ao contrário das espécies discutidas por Rosário et al. (2014), e das analisadas em herbários, em algumas espécies do DMA estudadas no presente trabalho, o padrão de ramificação pode ser monopodial, o eixo sendo alongado e as flores de sésseis a subsésseis, com pedicelo muito curto, além das diferenças citadas anteriormente com relação à ramificação faz inflorescências. Legrand (1962) incluiu uma classificação informal para as espécies de *Calyptranthes* tratadas por ele para o Brasil austral, baseada no padrão de ramificação das inflorescências, dividindo as espécies em dois grandes grupos. O primeiro com inflorescências que apresentam ramificação monopodial, composto por quatro espécies e o segundo com ramificação simpodial (ou dicotômica) composto pelas vinte e quatro espécies restantes.

Seria necessário um estudo mais aprofundado das espécies Amazônicas brasileiras e extra-brasileiras para verificar se o padrão se mantém ou se surgiriam outros caracteres informativos taxonomicamente. Mas até o momento, caracteres do botão floral e da inflorescência são os mais informativos, não só para *Calyptranthes*, como também para todo o grupo *Myrcia s.l.*

5.3 Caule e padrões de ramificação

Lucas et al. (2011) afirmam que o tipo de ramificação mais comum em *Myrcia s.l.* é o monopodial, com exceção de algumas espécies de *Marlierea*, *Myrcia* e a maioria dos *Calyptranthes*, onde o padrão dominante é o simpodial dicotômico - quando crescimento dos ramos não se dá por um eixo principal, mas sim por ramos laterais emergindo dicotomicamente. Este padrão, de fato, se confirmou no presente trabalho como sendo o mais comum nas espécies observadas em campo e herbário (Figura 3- A).

Calyptranthes é um gênero composto basicamente por árvores, arvoretas e arbustos, raramente com troncos muito grossos. O caule em *Calyptranthes* apresentou-se, na maioria das espécies analisadas, com coloração acinzentada, o ritidoma ora desprendendo-se em placas rígidas, ora desprendendo-se em lâminas menos espessas (de acordo com a classificação de Ribeiro 1999), dependendo da espessura do caule. A cor do caule após a retirada do ritidoma pareceu variar entre indivíduos da mesma espécie, variando entre uma coloração creme, marrom-amarelada até avermelhado (Figura 3- B e C). Os ramos distais podem ser alados ou não, e esse caráter pode variar entre indivíduos de uma mesma espécie, como por exemplo, em *C. lucida*, que pode apresentar ramos cilíndricos ou ligeiramente alados. *Calyptranthes tetraptera* foi a única espécie que apresentou ramos visivelmente alados, principalmente os mais distais, em todos os indivíduos analisados.

5.4 Folhas

As folhas em *Calyptranthes* são opostas e com margem inteira, na maioria das vezes não revoluta, raramente levemente revolutas. O tipo mais comum de filotaxia é a oposta dística, mas algumas espécies apresentam folhas opostas decussadas, tais como *C.*

ouropretensis e *C. tetraptera*. *C. ouropretensis* pode apresentar folhas amplexicaules. Não foram observadas espécies com filotaxia verticilada, como pode ser observado em algumas espécies de *Myrcia s.s.* As folhas podem variar bastante de tamanho, desde 1 cm de compr. em *C. angustifolia*, podendo chegar a 38 cm em *C. aromatica* (Figura 4- A e B). Todavia, apesar de ter se mostrado um caráter extremamente variável dentro da mesma espécie, especialmente nas espécies de ampla distribuição, mostrou-se ser um caráter distintivo para algumas poucas espécies nas quais essa diferença é relevante e constante, como as acima citadas.

A nervura central é de sulcada a plana na face abaxial e proeminente na abaxial, exceto na espécie *C. lanceolata*, onde a nervura na face abaxial pode ser visivelmente proeminente (Figura 5- A–C). As nervuras secundárias confluem para a nervura marginal e podem variar entre visíveis, ligeiramente visíveis ou inconspícuas, sendo na maioria das vezes impressas em ambas as faces, não sendo possível contar o número de pares (Figura 6- A e B). As nervuras secundárias não se revelaram um caráter informativo para a separação de espécies, exceto em alguns casos: na separação entre *C. concinna* e *C. widgreniana*, esta última possuindo as nervuras secundárias proeminentes e visíveis a olho nu na face abaxial e entre *C. lanceolata* e *C. maritima*, as nervuras secundárias sendo visíveis nesta última, e quase indistinguíveis em *C lanceolata*. A nervura marginal é presente e visível em todas as espécies, sua distância do bordo do limbo variando consideravelmente desde menos de 0.1 mm em espécies com limbo diminuto como *C. angustifolia*, a 11 mm em espécies com limbo maiores, como *C. ouropretensis* (Figura 7- A e B). A nervura intramarginal é presente na maioria das espécies e a uma curta distância do bordo (geralmente até 1 ou 2 mm). Porém, principalmente nas espécies com nervuras secundárias inconspícuas, como por exemplo, *C. caudata*, *C. grammica*, *C. pauciflora, C. pileata* e *C. pulchella*, esta nervura está ausente ou invisível a olho nu. O pecíolo pode variar consideravelmente de tamanho, desde diminuto nas folhas sésseis a subsésseis até pecíolos de 2 cm de compr., sendo em sua maioria sulcado.

O ápice foliar demonstrou ser um caráter importante na delimitação de alguns táxons, como por exemplo, o ápice uncinado (em *C. angustifolia* e o abrupto-acuminado em *C. serrana*) (Figura 8- A e B). As demais espécies apresentam os mais variados tipos de ápice, os mais comuns sendo o agudo ou acuminado. As bases foliares apresentam uma variedade menor, a maioria delas sendo cuneada ou atenuada, não constituindo um caráter importante taxonomicamente.

5.5 Inflorescências

As inflorescências em *Calyptranthes* constituem o caráter taxonomicamente mais informativo, por ser o mais variável. Briggs & Johnson (1979) realizaram um trabalho detalhado sobre as inflorescências em Myrtaceae, com um enfoque evolutivo, assim como Weberling, que também focou na origem, mas também na morfologia das inflorescências. Contudo, o conceito para inflorescências adotado no presente trabalho seguiu uma adaptação de McVaugh (1956), Barroso (1991) e Endress (2010), com o objetivo de entender a taxonomia e consequentemente a identificação das espécies do grupo.

McVaugh (1956) denominou a inflorescência em *Calyptranthes* de "panícula mircióide", conceito adotado também por Barroso (1991) e no presente trabalho. Esse tipo de inflorescência consiste em uma panícula composta por um eixo principal, cada um dos ramos laterais terminando em uma flor ou mais. Nesse padrão, o eixo principal pode ser abortado no nó onde o ramo lateral distal emerge. Na ponta desse ramo apical e nos laterais, as flores sésseis ou subsésseis emergem nos nós logo abaixo da flor apical, podendo produzir o efeito de flores aglomeradas, ou ainda o que ele chamou de "falso dicásio", fazendo com que, à primeira vista, as inflorescências em *Calyptranthes* pareçam tirsóides. Algumas dessas inflorescências podem parecer, ainda, cimeiras compostas, visto que nas pontas dos ramos, as flores laterais abaixo do botão apical podem estar sustentadas por ramos parecidos com pedicelos longos (Figura 9- A e B). McVaugh aponta que esse padrão foi analisado por ele em espécies de *Calyptranthes* e *Marlierea*, não tendo sido observado em nenhuma das espécies de *Myrcia*.

Lucas et al. (2011) discutiram a morfologia das inflorescências à luz dos resultados obtidos na filogenia molecular para o grupo *Myrcia s.l.*, e observou esse padrão descrito por McVaugh no clado 1 (composto pelas espécies de *Calyptranthes*), no clado 2 (composto por algumas espécies de *Marlierea*) e também no clado 7 (composto por espécies de *Myrcia*) o que indica mais um caso de homoplasia para caracteres morfológicos descritas como existentes para *Myrcia s.l.*

Ainda no padrão básico da panícula mircióide, McVaugh descreve que os ramos laterais são opostos ou subopostos e decussados, os proximais mais alongados e os apicais mais reduzidos, dando uma aparência de pirâmide. Porém é importante salientar que o desenvolvimento desse tipo de panícula pode ser bastante irregular, o que implica na análise de um grande número de material, coletado em vários estágios de desenvolvimento, para afirmar com clareza o tipo de inflorescência de cada espécie. O mesmo afirma Weberling (1992), que apesar de utilizar termos mais específicos do que os aqui adotados, diz que a extensão do eixo principal da panícula e o grau de ramificação desta podem variar entre indivíduos da mesma espécie dependendo do estágio de desenvolvimento, mas que por outro lado, diferenças nessa complexidade podem ser importantes na distinção de diferentes espécies.

Com base na análise morfológica de várias coleções científicas visitadas e de observações em campo, foi possível identificar os padrões das inflorescências de *Calyptranthes* do Domínio da Mata Atlântica e suas variações, sendo dois principais: panículas reduzidas, não ramificadas, terminando em uma a três flores apicais (Figura 10- A) e panículas ramificadas em um a cinco ramos laterais (Figura 10- B e C). Algumas panículas possuem apenas um ramo lateral, que quando longo, confere uma aparência de cruz (Figura 10- D), e quando não desenvolvido, as flores sésseis emergem na lateral do eixo principal ao longo do seu comprimento, apresentando uma aparência de espiga (Figura 10- E). Foi observado que os ramos laterais podem ser opostos ou subopostos, decussados em sua grande maioria, podendo ramificar-se novamente.

Devido ao desenvolvimento variável e por vezes irregular das panículas em *Calyptranthes*, o número de flores médio de cada espécie só pode ser definido em um conceito amplo, após a análise de uma grande quantidade de material. Algumas espécies possuem a extensão da panícula bastante variável, *C. lanceolata*, por exemplo, que pode possuir de dois ramos laterais reduzidos a cinco ramos laterais bem desenvolvidos, o número de flores variando consideravelmente de espécime para espécime. Enquanto algumas espécies podem possuir cerca de 60 flores por panícula, outras possuem apenas uma flor no ápice do eixo principal e três nos ápices dos ramos laterais. Convencionou-se, no presente trabalho, chamar as espécies com "poucas flores" quando estas possuem um número médio abaixo de 20 flores, e "muitas flores" para números acima deste.

As estruturas utilizadas na descrição e medição das inflorescências seguiram os seguintes conceitos, baseados em: Barroso (1991), Font Quer (1979), Beentje 2012, McVaugh (1968, 1969):

- "Axis": eixo principal da inflorescência, desde sua base até a última flor apical (Figura 11- A);

- "Lateral branch": ramo lateral da inflorescência (Figura 11- B).

- "Basal bracts": brácteas situadas na base da inflorescência, que assim como as brácteas e as bractéolas, podendo ser totalmente ausentes, presentes e caducas (sendo possível a distinção de uma cicatriz resultante da queda) ou presentes e persistentes, podendo apresentar também um aspecto foliáceo (Figura 11- C);

- "Peduncle": eixo principal que sustenta a inflorescência, indo da sua base inflorescência até a base da primeira ramificação (Figura 11- D);

- "Bracts" e "bracteoles": Neste trabalho, as brácteas estão situadas na base das ramificações laterais e as bractéolas estão situadas na base das flores, respectivamente. Termo introduzido por Lineu, "bráctea", de uma maneira geral, é um órgão foliáceo situado na proximidade das flores, e distinto por sua forma, tamanho, consistência e cor das que formam o cálice e a corola. Sobral (2003) complementa e juntamente como Lineu, concorda que esses termos são utilizados em um sentido informal, referindo-se às estruturas foliáceas subentendendo as flores, para fins de facilitar a identificação a partir da morfologia em campo e herbário. A origem dessas estruturas não é homóloga de acordo com Briggs & Johnson (1979) e os termos mais precisos adotados por esses e outros autores (Weberling 1992, Rua 1999) não são utilizados aqui, principalmente porque os termos utilizados não são consensuais tampouco fáceis de entender (Figura 11- E);

- "Hypanthium": (hipanto) extensão do receptáculo, parte basal da flor, geralmente espessada, tubular (também chamada de "tubo do cálice" por alguns autores), que circula o ovário e porta o cálice, a corola e os estames (Figura 11- F).

5.6 Flores

Nas espécies de *Calyptranthes* do Domínio da Mata Atlântica analisadas, as flores são sésseis ou raramente subsésseis, o pedicelo sendo diminuto e pouco distinguível. Algumas vezes, ramos da inflorescência se prolongam e dão a impressão de serem pedicelos longos, porém, é possível distinguir que não se tratam de pedicelos verdadeiros. A forma e tamanho do botão é um caráter distintivo dentro de algumas espécies, variando entre arredondados, piriformes, prolados e fusiformes, a caliptra também variando de forma e textura (de membranácea a coriácea) de arredondadas, passando por fusiformes a completamente rostradas (Figura 12- A–G).

As pétalas podem ser ausentes ou presentes, sendo este um caráter constante de espécie para espécie e podendo ser taxonomicamente informativo. Quando presentes estão reduzidas de 1 a 2 por flor, espatuladas, e muitas vezes ficam aderidas à caliptra após a antese (Figura 13- A e B). Os estames variam entre 50 a mais de 100 por flor, sendo a média de 50 a 60, não sendo considerado um caráter informativo para as espécies do DMA, assim como o estilete e estigma, este às vezes puntiforme, sendo o mesmo padrão encontrado na maioria das Myrtaceae. O ovário em *Calyptranthes* é descrito na literatura como bilocular com dois óvulos por lóculo, com a exceção de Landrum & de Kawasaki (1997), que afirmam que ele pode ser 2(–3) locular. Na revisão taxonômica em curso para o domínio da Mata Atlântica, várias espécies com ovário trilocular e variáveis óvulos por lóculo foram observadas. A consistência deste caráter como diagnóstico, portanto, é questionável, pois parece variar entre indivíduos de uma mesma espécie.

5.7 Frutos

Os frutos em *Calyptranthes* são muitos semelhantes entre si, com relação à forma, textura e coloração, com algumas exceções. A maioria é globoso a subgloboso, não ultrapassando 5-6 mm de diâmetro. Há poucas exceções nesse padrão, como por exemplo, *Calyptranthes pileata* que apresenta frutos piriformes e que podem chegar a 1.5 cm de diâmetro (Figura 13- B e C).

5.8 Referências

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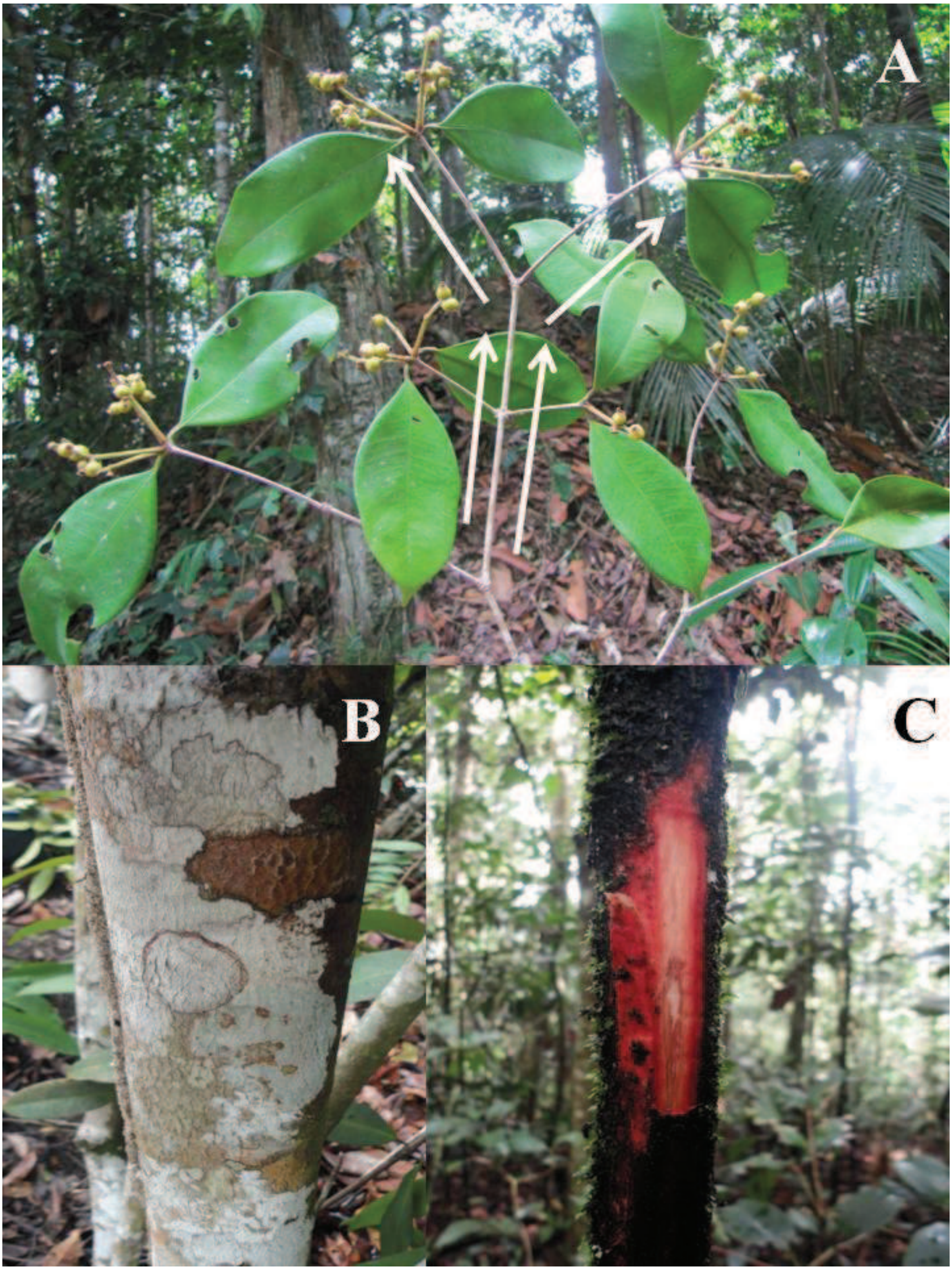
Figura 1. **A**: Padrão de ramificação dicotômico em *C. brasiliensis*; **B**: Caule em *C. brasiliensis*; **C**: Caule com ritidoma removido em outro indivíduo de *C. brasiliensis*.



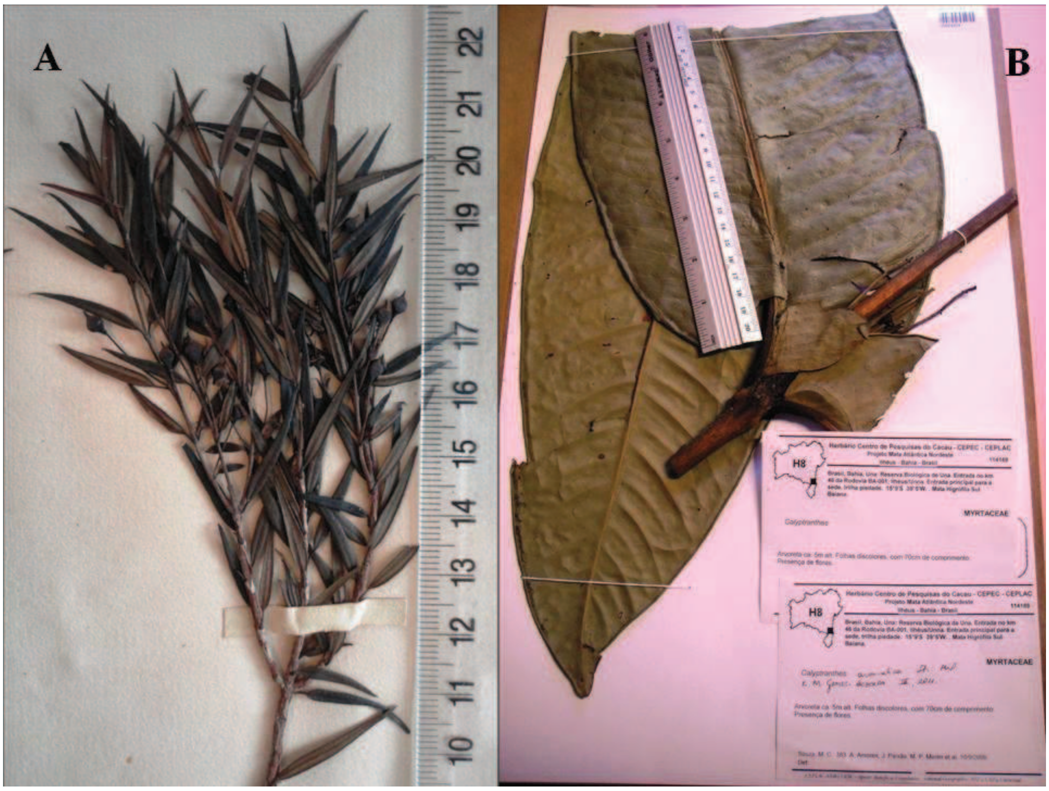


Figura 2. A: Folhas em *C. angustifolia*, medindo 1–2.8 cm de compr.; **B**: Folhas em *C. aromatica*, medindo até 38 cm de compr.

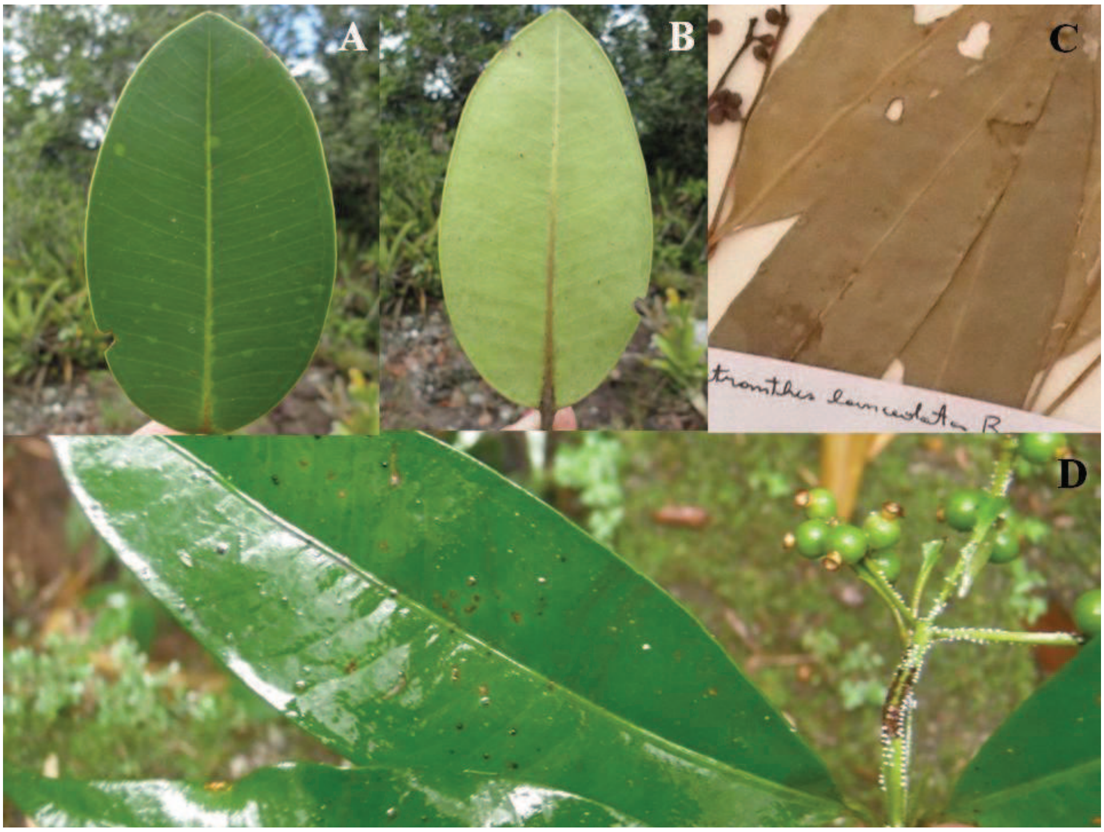


Figura 3. A: Folha em *C. brasiliensis* – nervura central sulcada a impressa na face adaxial; **B**: nervura central proeminente na face abaxial; **C-D**: Folha em *C. lanceolata*– nervura central proeminente em ambas as faces.

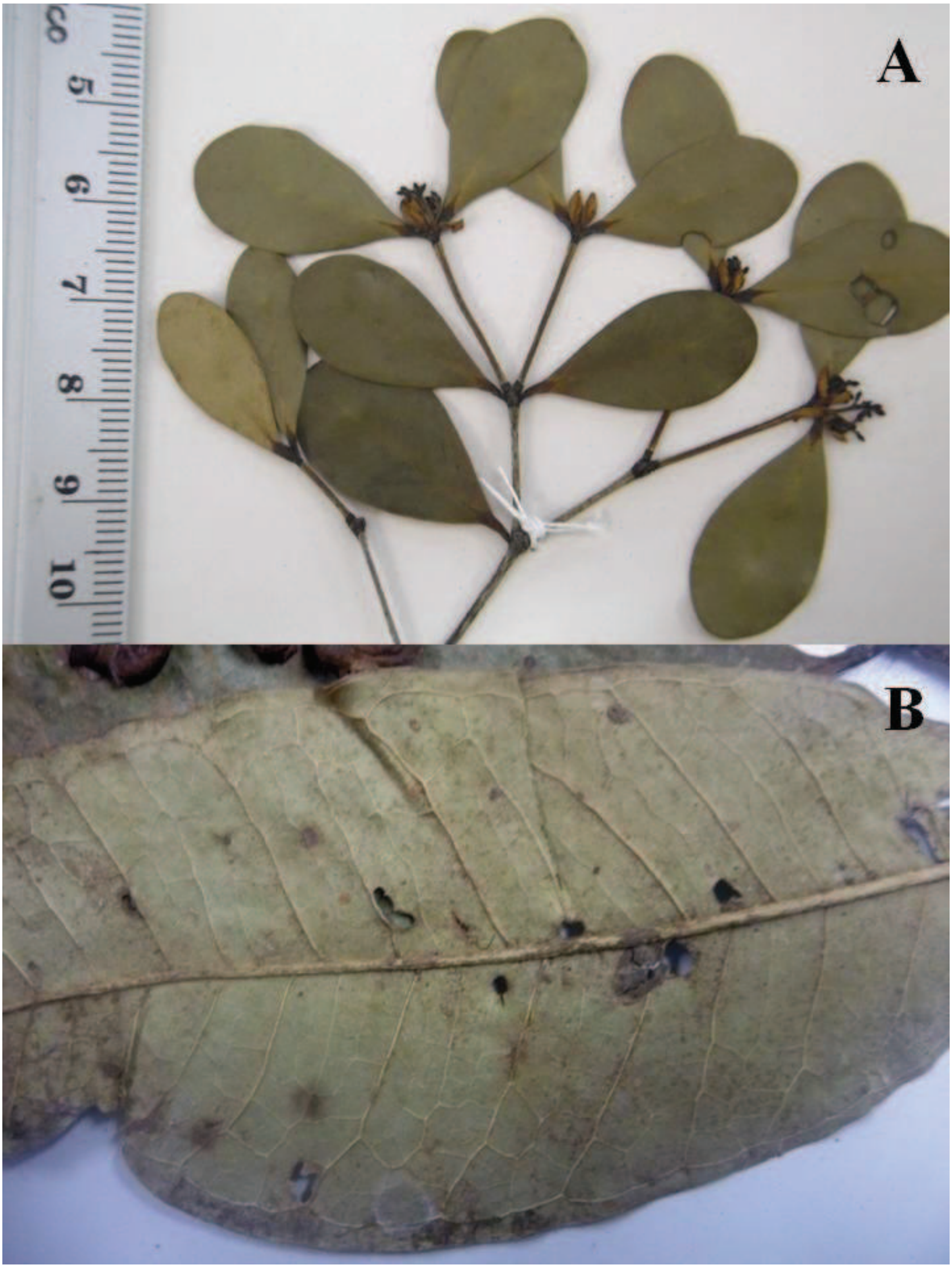


Figura 4. A: Nervuras secundárias inconspícuas em *C. pulchella*; **B**: Nervura central e secundárias proeminentes na face abaxial em *C. concinna*.

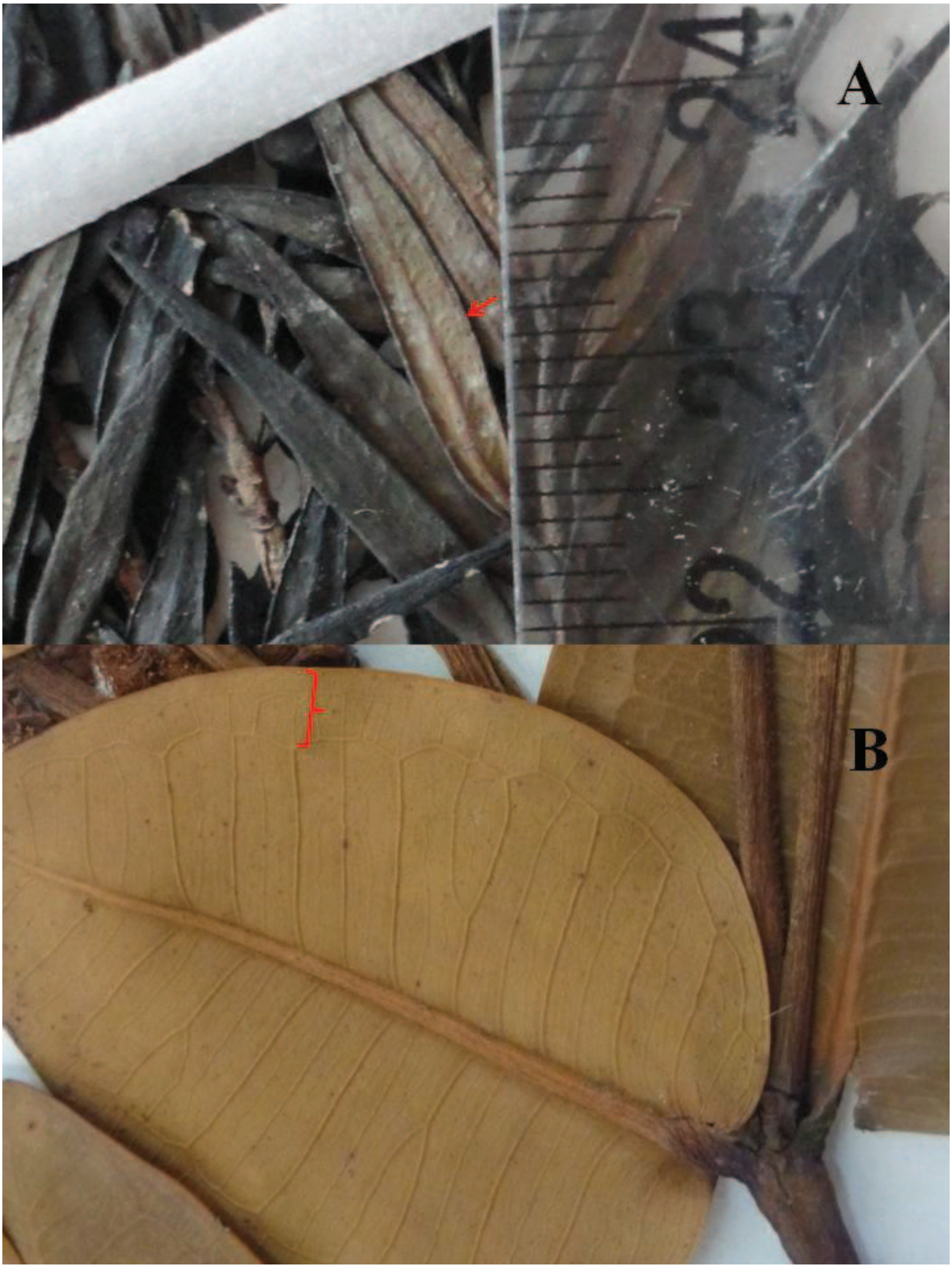


Figura 5. A: Nervura marginal inconspícua, a ca. de 0.1 mm do bordo foliar em *C. angustifolia*; **B**: Nervura marginal visível a olho nu, distando até 11 mm do bordo foliar.

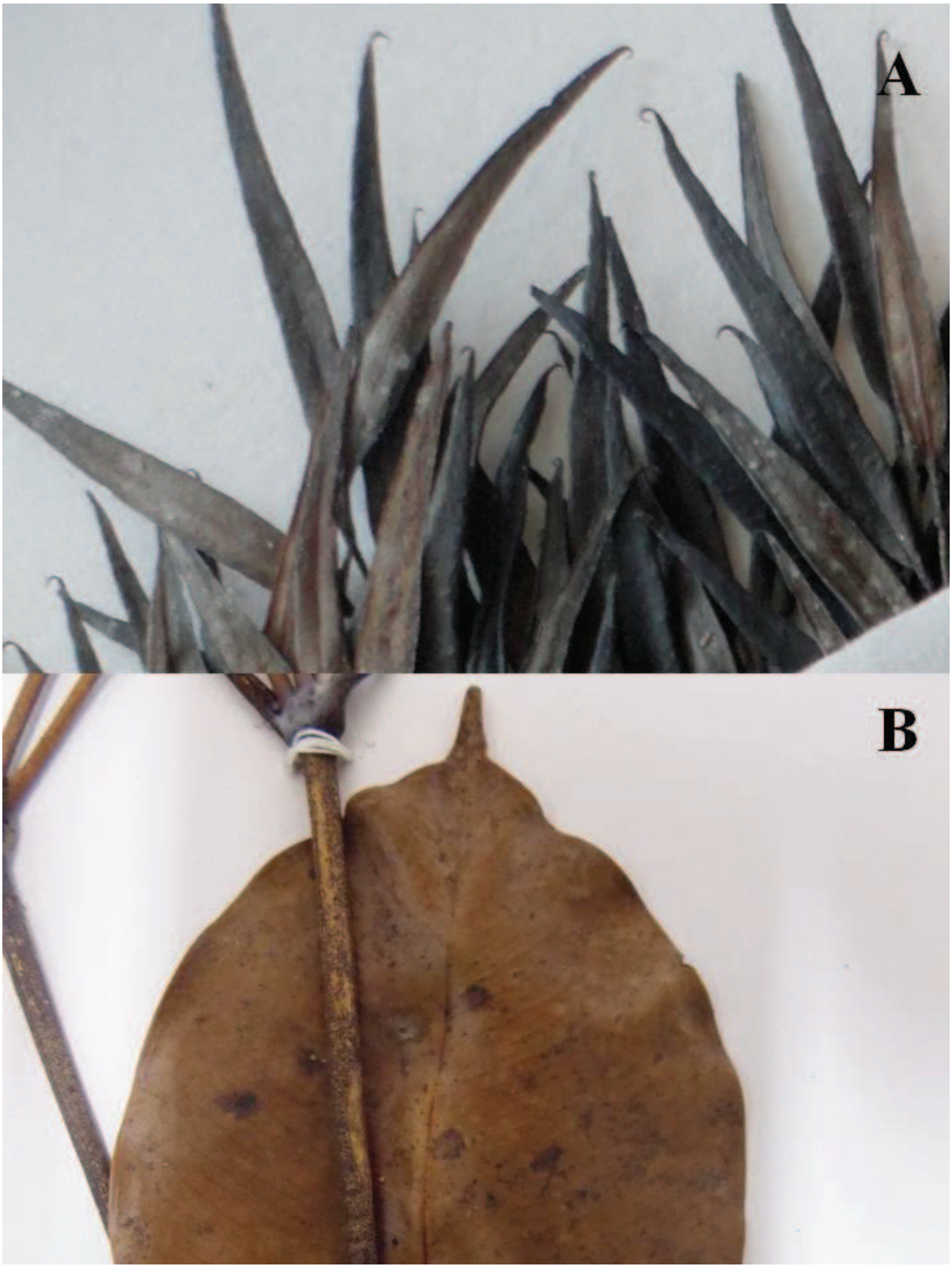


Figura 6. A: Ápices uncinados em *C. angustifolia*; **B**: Ápice abrupto-acuminado em *C. serrana*.

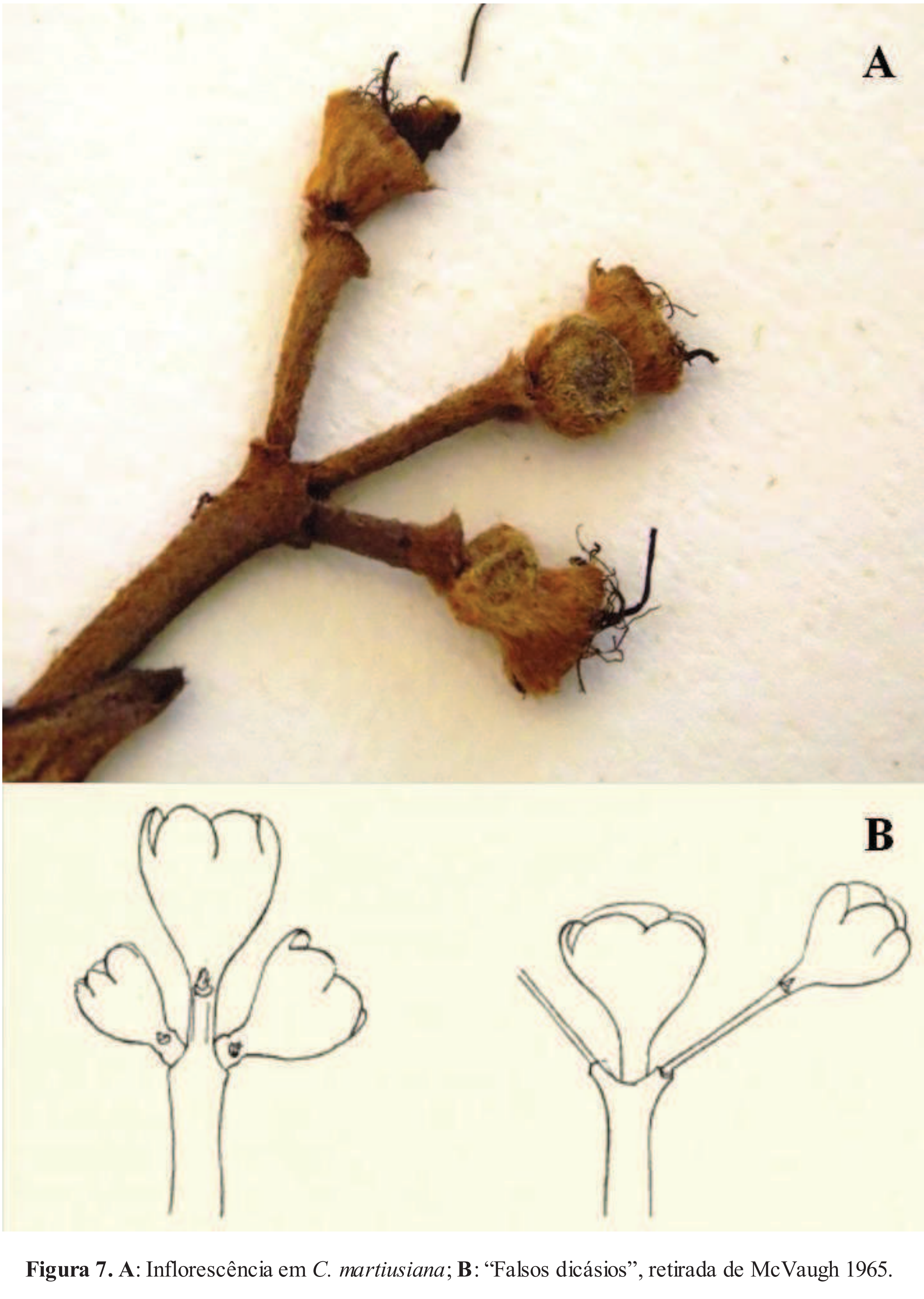


Figura 7. A: Inflorescência em *C. martiusiana*; **B**: "Falsos dicásios", retirada de McVaugh 1965.

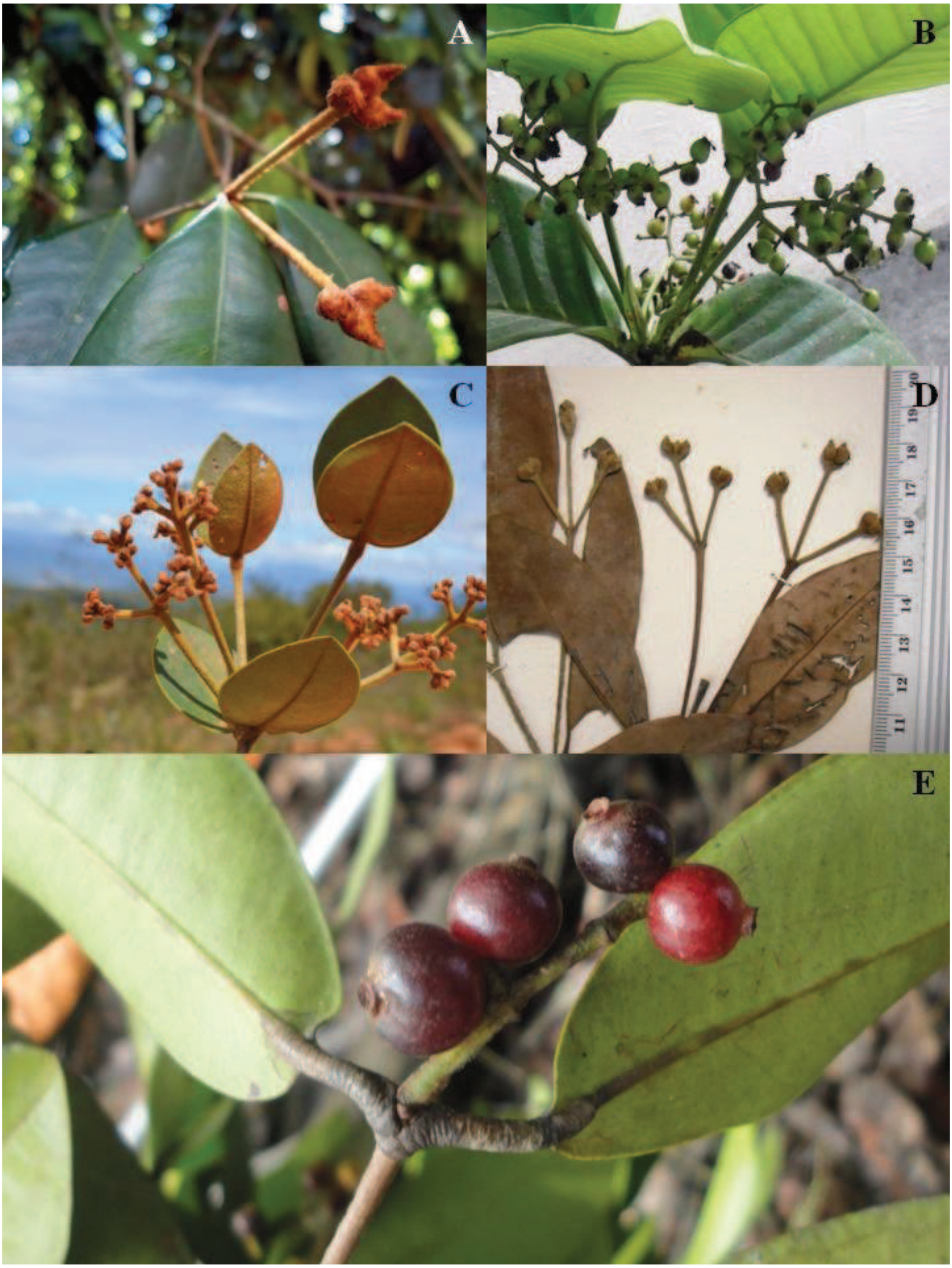


Figura 8. **A**: Panículas reduzidas, não ramificadas, terminando em três flores apicais em *C. tricona*; **B-C**: Panículas ramificadas em um a cinco ramos laterais em *C. aromatica* (**B**) e *C. ouropretensis* (**C**); **D**: Panículas com um ramo lateral com aparência de cruz em *C. concinna*; **E**: Frutos desenvolvidos em uma inflorescência que possuía flores sésseis, emergindo na lateral do eixo principal ao longo do seu comprimento, apresentando uma aparência de espiga em *C. brasiliensis*.

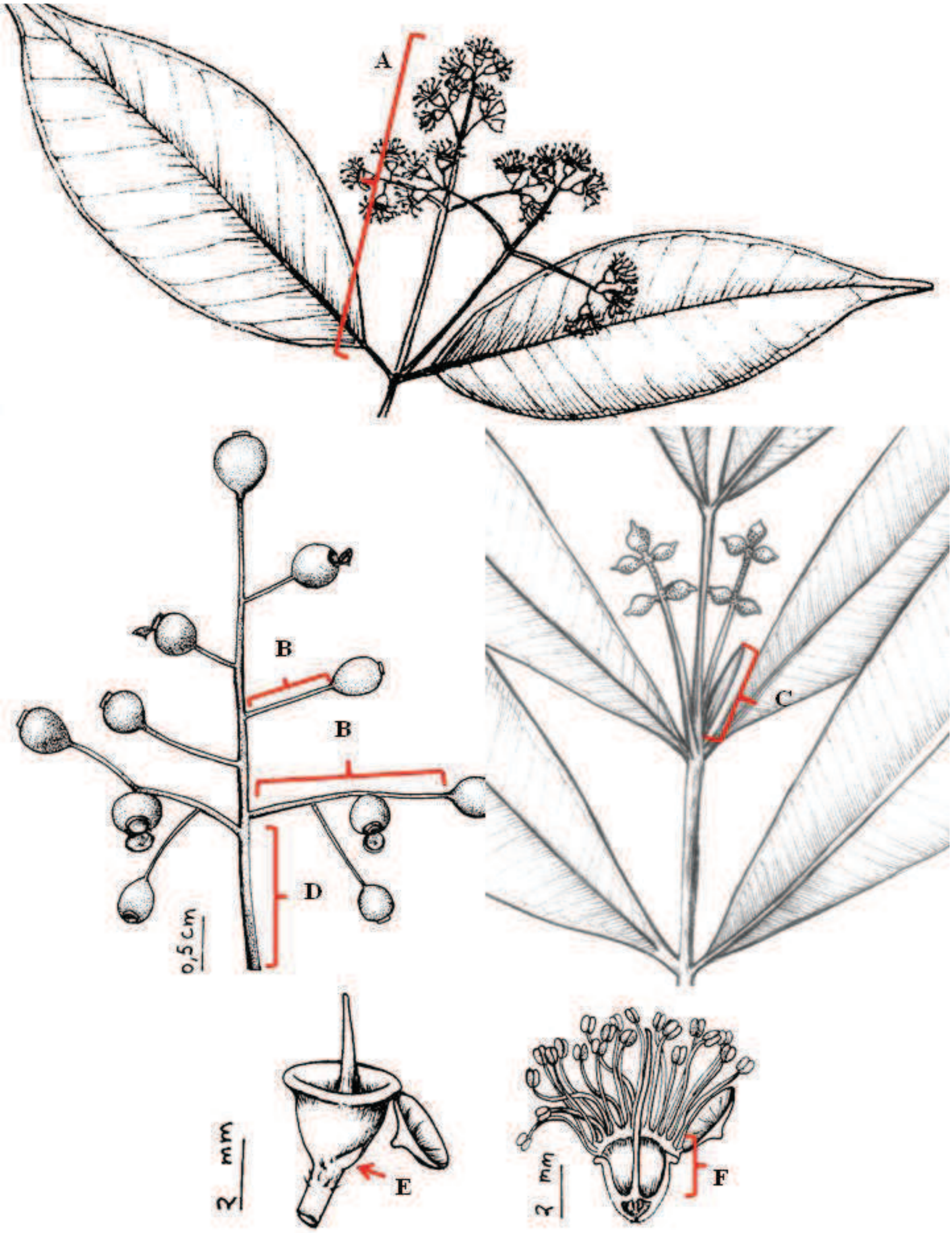


Figura 9. **A**: Eixo principal da inflorescência; **B**: Ramos laterais da inflorescência; **C**: Bráctea basal; **D**: Pedúnculo; **E**: Bractéola; **F**: Hipanto prolongado acima do ovário.

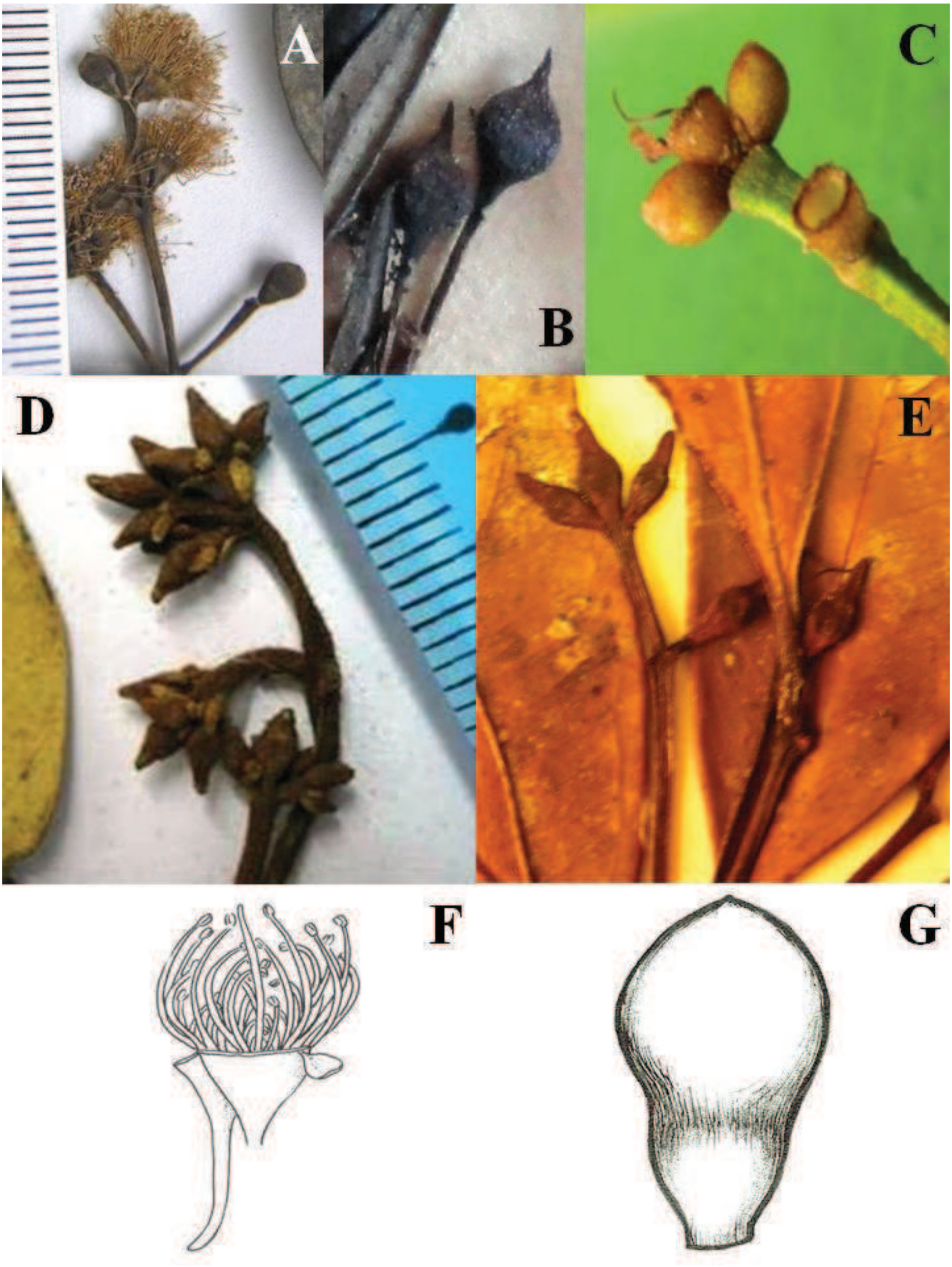


Figura 10. **A**: Botões obovados, caliptra arredondada e ligeiramente apiculada em *C. obovata*; **B**: Botões arredondados a ligeiramente piriformes, caliptra acuminada em *C. angustifolia*; **C**: Botões prolados e caliptra obtusa em *C. brasiliensis*; **D**: Botões fusiformes e caliptra fusiforme a rostrada em *C. restingae*; **E**: Botões rostrados a rostrado-obovados, caliptra rostrada em *C. pileata*; **F**: Botões fusiformes, caliptra longo rostrada em *C. fusiformis*; **G**: Botões obovados a piriformes, caliptra curto-acuminada em *C. serrana*.

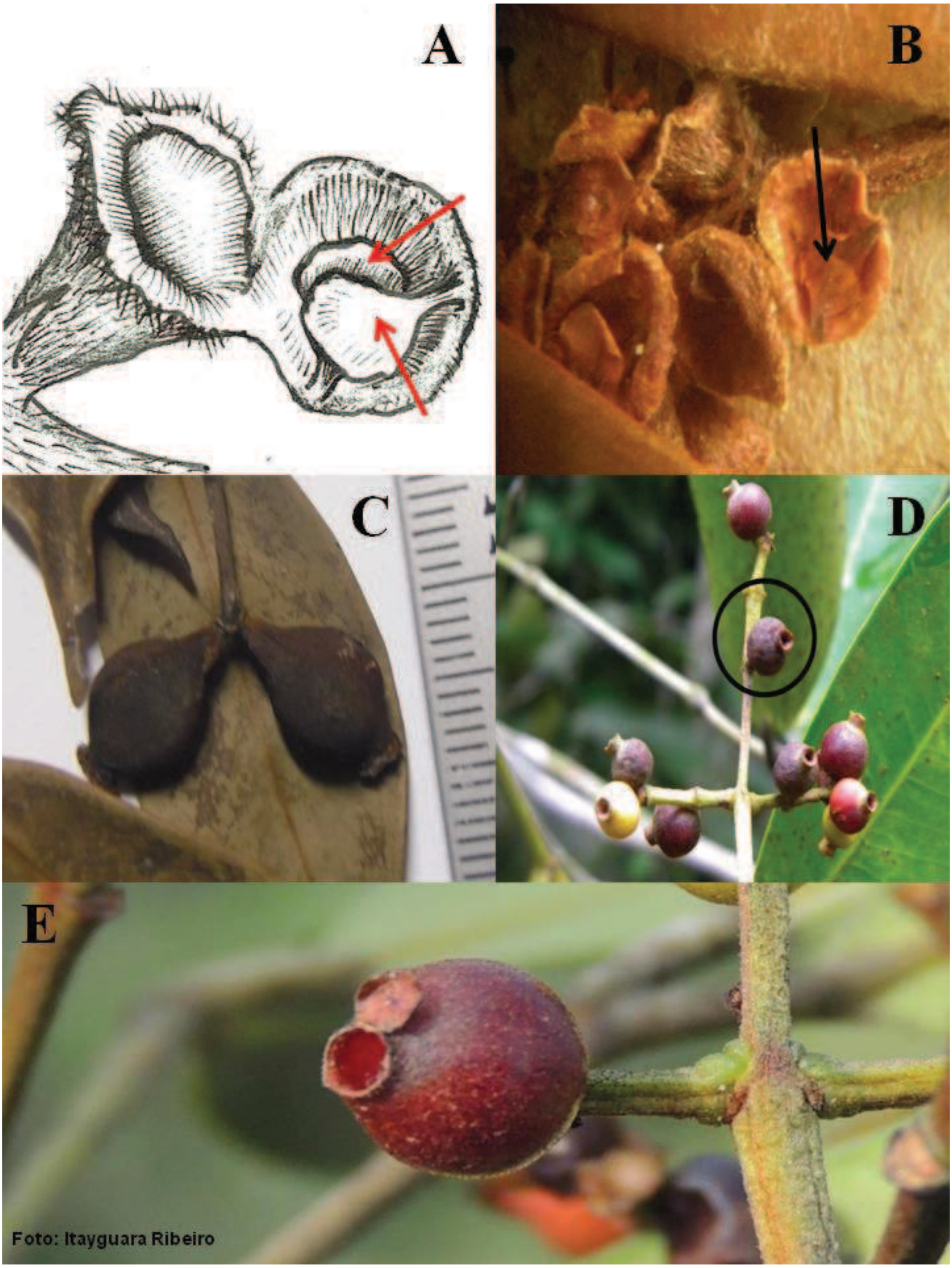


Figura 11. **A**: Pétalas espatuladas aderidas à caliptra na flor em *C. ouropretensis*; **B**: Pétala aderida à caliptra na flor em *C. concinna*; **C**: Frutos piriformes em *C. pileata*; **D**: Frutos globosos a subglobosos, com cicatriz circular apical em *C. brasiliensis*; **E**: Detalhe da caliptra e da cicatriz circular no fruto em *C. brasiliensis*.

Capítulo 2

Calyptranthes Sw. (Myrtaceae) from the Atlantic Forest Domain, Brazil.

Ana Raquel Lourenço & Marccus Alves

Manuscrito a ser submetido ao periódico *Phytotaxa*

Calyptranthes Sw. (Myrtaceae) from the Atlantic Forest Domain, Brazil.

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6.1 Abstract. *Calyptranthes* (*Myrcia s.l.*) is a Neotropical genus growing from Mexico and Caribbean to northern Argentina, with approximately 280 currently known species. In Brazil, 74 species are known, of which 49 are endemic, occurring mainly in the Atlantic and Amazon domains, with few species in the Caatinga and Cerrado. This paper is a taxonomic survey of 32 species, including an identification key, descriptions, phenology and geographic distribution information, nomenclatural updates, new synonyms and illustrations of the main morphological characters. The main character with which the species can be separated is the inflorescence pattern, but often only a combination of characters as well as leaf size and shape, flower buds and indument can lead to a more effective differentiation. Out of the 32 species recognized, 23 are endemic from the Atlantic Forest Domain, and 9 occur in the Amazon Forest, Cerrado and/or other countries of South and Central America as well. According to IUCN red list criteria here adopted, 23 species are included in some threatened. 17 new synonyms are proposed, as well as 7 lectotypifications.

Keywords—Biodiversity, Myrtaceae, Myrteae, *Myrcia* s.l.

6.2 Resumo. *Calyptranthes* (*Myrcia s.l.*) é um gênero Neotropical ocorrendo desde o México e Caribe até o Norte da Argentina, com aproximadamente 280 espécies reconhecidas atualmente. No Brasil, 74 espécies são reconhecidas, das quais 49 são endêmicas, ocorrendo principalmente no Domínio da Mata Atlântica e Amazônico, com poucas espécies na Caatinga e no Cerrado. O presente trabalho é uma revisão taxonômica das 32 espécies, incluindo descrições, dados fenológicos e de distribuição geográfica, atualizações nomenclaturais, novos sinônimos, uma chave de identificação e ilustrações dos principais caracteres morfológicos. As espécies podem ser separadas principalmente pelo padrão da inflorescência, mas muitas vezes, somente um conjunto de caracteres como tamanho e forma da folha, botões florais e indumento podem levar a uma diferenciação mais efetiva. Das 32 espécies reconhecidas, 23 são endêmicas da Floresta Atlântica e 9 ocorrem na Floresta Amazônica, Cerrado e/ou outros países da América do Sul e Central. De acordo com os critérios da Lista Vermelha da IUCN aqui adotados, 23 espécies estão incluídas em alguma categoria de ameaça. 17 novos sinônimos são propostos, bem como 7 lectotipificações.

Keywords—Biodiversity, Myrtaceae, Myrteae, *Myrcia* s.l.

6.3 Introduction

Myrtaceae Juss. consists of 132 genera and 5.671 species (Govaerts 2008) with pantropical distribution, the main centres of diversity being South America and Australia, with low diversity in African and Asian (Lughadha & Snow 2000). A high diversity of Myrtaceae occurs in South America, particularly along the east coast of Brazil, Guiana highlands and the Caribbean (McVaugh 1968). In Brazil, there are 1028 species and 23 genera of Myrtaceae (Flora of Brazil 2020 under contruction), occurring in different Brazilian vegetation, appearing as one of the richest families of woody plants in number of species in different natural formations, particularly in the Atlantic Forest and Cerrado (Barroso & Perón 1994, Oliveira-Filho and Fontes 2000, Holst et al. 2003).

The Atlantic Forest in Brazil represents a mosaic of vegetal communities occurring along the mountain range and lowlands that flank the Atlantic Ocean, from Rio Grande do Sul to Rio Grande do Norte states. It is one of the most devastated and threatened biome on the planet, and the "hot spot" in which the pace of change is among the fastest and in the need of actions for its conservation. Although original area of the Atlantic Forest coverage is estimated between 1 to 1.5 million km², there are only 7-12% of the original forest remaining (Myers et al. 2000, Galindo-Leal & Hall 2005 Stehmann et al. 2009).

It is estimated that about half of the remnant areas of long extension in the Atlantic Forest are protected as Conservation Units (UCs). Most of these fragments are in the mountain regions, especially in the "Serra do Mar" (Colombo & Joly 2010). In the Brazilian Northeast, the major vegetal influences come from the Amazon Forest and Atlantic Forest of South and Southeast of Brazil, representing 6.4% of the Brazilian vegetation universe. However, it is in this region that this ecosystem has one of the worst conservation status, due to deforestation for monoculture and training pastures (Myers et al. 2000, Stehmann et al. 2009).

Calyptranthes Swartz (1788: 79) is a Neotropical genus, occurring from the South of Florida state, Mexico and the Caribbean to the North of Argentina (Lucas & Sobral 2011, Landrum & Kawasaki 1997), having approximately 280 species recognized thus far (Lucas et al. in press.). Its main diversity centre is the Caribbean (Lucas & Sobral 2011). In Brazil, 74 species are known, of which 49 are endemic. The species of Brazilian *Calyptranthes* are basically Atlantic or Amazon, with a few species occurring in the Cerrado and Caatinga (Flora of Brazil 2020 under construction). Despite the possible historical relations between the Atlantic Forest and Amazon being known, it is observed that most species of the genus have a restricted distribution, with just a few disjunct species. Most species of *Calyptranthes* occur preferentially on well conserved areas, near humid ecosystems such as rivers (Oliveira-Filho & Carvalho 1993), and thus being a potential indicator of preservation of these areas.

This study follow the morphological concept of the most recent published works for the genus *Calyptranthes* (Lucas et al. 2011, Rosário et al. 2005, 2014; Rosário & Secco 2006, 2013; Ferreira et al. 2013), which is the same as McVaugh's and Berg's classical concepts: calyx closed, opening by the means of a calyptra, regularly or slightly irregular, the calyptra can be deciduous or persistent and attached to the hypanthium apex after anthesis, sometimes persisting in the fruit, and inflorescence a panicle with cymose branches, with the main axis aborted; the panicle sometimes developed and branched, sometimes reduced to a single unbranched axis bearing one to three flowers at the tip.

Although the group has been emerging as monophyletic in the few existing phylogenetic analyses, the calyptra is not always obvious as to its regular opening. Some species in the Caribbean and Amazon have an intermediate calyptra between regular and irregular form shown by the *Marlierea* species. Lucas et al. (2011) state that the inclusion of species in the future phylogenetic analysis can indicate whether the calyptra continue proving to be a distinctive character, and *Calyptranthes* continue emerging as monophyletic. *Myrcia*, though, appear as paraphyletic. Lucas et al. (2011) proposed the conservation of *Myrcia* over *Calyptranthes*, since the later is an older name, proposing the creation of a large *Myrcia* s.l. genus, but until a nomenclatural decision is made by the International Association for Plant Taxonomy, we maintain the use of *Calyptranthes*.

The main goal of this study is to provide a taxonomic survey of the species of *Calyptranthes* from the Brazilian Atlantic Forest Domain, to better characterize its taxa, contribute to its taxonomy and evaluate the status of threat of those species.

6.4 Materials and methods

The concept adopted for the Brazilian Atlantic Forest Domain, in the present work, is the "broad sense" concept (IBGE 2008, Colombo & Joly 2010), in which it occurs in 17 Brazilian states, comprising three basic types of forests – Dense Ombrophilous Forest, Semideciduous Seasonal Forest, and the mixed Ombrophilous Forest, also known as Araucaria Forests in the south of Brazil, together with their associated ecosystems, such as “salt marshes” (restingas), alluvial areas, the coastal “tabuleiros”, Cerrado enclaves, the high wet forests known as “brejos de altitude” (isolated forest fragments that occur above 600 m of altitude, from the state of Ceará to

Alagoas) and seasonal forests of the Espinhaço Range (Minas Gerais and Bahia states) (**Figure 1**).

Fieldwork was performed from March 2011 to December 2012 in 10 states in which the Atlantic Forest occurs, plus some areas of the Espinhaço Range (Minas Gerais), in different vegetation fragments along the study area. Vouchers were deposited at UFP. In addition, most of the main herbaria with holdings of Myrtaceae and the Atlantic Forest were visited and/or consulted on-line (*): ALCB, ASE, BHCB, B*, BM, BR*, CEN, CEPEC, CVRD, EAC, EAN, G*, HB, HBR, HRB, HUEFS, HUESB, HVASF*, INPA, IPA, JPB, K, LE*, M*, MAC, MBM, MBML, NY*, OUPR, P, PEUFR, R, RB, S*, SP, SPF, UB, UFP, UFRN, VIES, W* (acronyms following Thiers 2015). Type specimens, herbarium vouchers, and literature were also consulted in order to confirm species identifications. The conservation status of individual species was estimated according to the IUCN Red List criteria (2010).

Morphological terms follow mostly Barroso (1991), Font Quer (1979), Beentje 2012 and McVaugh (1968, 1969). In addition, special terminology was adopted to the following characters: the bracts and bracteoles concept follow Sobral (2003), in which the "bracts" are situated at the base of the lateral branches and "bracteoles" are situated at the base of the flowers; "lateral branch" is used to describe the ramification of the inflorescences; "few flowers" was used to describe the inflorescences when they have less than 20 flowers, and "many flowered" to describe inflorescences with more than 20 flowers; the number of stamens was not cited, varying between 50 to 100 per flower, not being considered an informative character for the Atlantic Forest species, as well as the size and shape of style and stigma. Illustrations are provided for some species.

6.5 Results

Thirty-two species of *Calyptranthes* were documented for the Brazilian Atlantic Forest Domain, after a detailed analysis of herbaria and type collections. Out of the 32 species recognized, 23 are endemic from the Atlantic Forest, while 9 are not endemic, occurring in other Brazilian ecosystems (like Cerrado and Amazon Forest) and/or other vegetal formations in countries of South and Central America. Seventeen new synonyms and seven lectotypes are proposed. According to IUCN red list criteria here adopted, 23 species are included in some threatened category.

6.5.1 KEY TO *CALYPTRANTHES* SPECIES FROM THE ATLANTIC FOREST DOMAIN, BRAZIL

1. Inflorescences reduced panicles, not branched………...……………………………...2

2. Plants glabrous or essentially so, with puberulent indument restricted to the young twigs or the abaxial surface of young leaves only..………………………….….……….3

3. Leaf blade 3.5–8.5×1.5–4.4 cm, inflorescences 2.4–4.9 cm long….……...…...……4

4. Leaf blades coriaceous, orbicular, apex rounded…………..…………........*C. tetraptera*

4’. Leaf blade cartaceous or membranaceous, lanceolate, elliptic, rarely obovate, apex long acuminate, sometimes long caudate……………………...……….......*C. bipennis*

3’. Leaf blade ≤ 3.3×1.5 cm, inflorescences ≤ 2 cm long……………………………….5

5. Leaf blade linear to narrow lanceolate, apex uncinate, rarely acute (together with uncinate apices in the same individuals), petals lacking.....……..……....*C. angustifolia*

5’. Leaf blade not linear or narrow-lanceolate, apex not uncinate neither uncinate together with rarely acute, petals present..6

6. Leaf blade elliptic, rarely elliptic-lanceolate, apex long caudate...*C. caudata*

6’. Leaf blade spatulate to narrow spatulate, rarely narrow-elliptic, apex obtuse, sometimes slightly acute (often the young leaves)..*C. grammica*

2’. Plants with indumentum pubescent, scattered pubescent, appressed pubescent, tomentose, lanate, villose, velutinous or arachnoid...7

7. Inflorescences axis alate...*C. pteropoda*

7’. Inflorescences axis not alate...8

8. Leaves coriaceous, abaxial surface strongly densely covered with appressed pubescent indument..*C. santalucia*

8’. Leaves chartaceous, abaxial surface glabrous or villose to pubescent, never strongly densely appressed pubescent...9

9. Inflorescences ≤ 1 cm long..*C. curta*

9’. Inflorescences ≥ 2.5 cm long...10

10. Inflorescences scattered pubescent, petals lacking……..…………….....*C. pauciflora*

10’. Inflorescences densely covered with villose, tomentose to pubescent indument, petals present………………………………………………………….…………………..11

11. Leaves chartaceous, abaxial surface villose to pubescent, sometimes restricted to the midvein, flowers clustered in three at the tips of inflorescences...*C. tricona*

11’. Leaves coriaceous, abaxial surface glabrous, one flower at the tip of inflorescence...*C. solitaria*

1’. Inflorescences branched panicles, one to six lateral branches……………….……12

12. Plants glabrous or essentially so, except for the abaxial leaves surface, base of the flower buds or the inflorescences rarely puberulent……………………………………13

13. Flower buds rostrate, rostrate-obovoid or fusiform ……..…..…………………….……14

14. Flower buds rostrate to rostrate-obovoid, calyptra long rostrate, mostly membranaceous, fruits globose……………..……………….……..……......*C. fusiformis*

14’. Flower buds fusiform, calyptra rostrate, coriaceous to chartaceous, fruits pyriform………………………………………………………………….......*C. pileata*

13’. Flower buds globose, prolate, obovoid or pyriform.........………………………...15

15. Leaves ≥ 25 cm long, sessile or with a reduced petiole < 2 mm long, inflorescences ≥ 13 cm long…………………………..*C. aromatica*

15’. Leaves < 25 cm long, petiole > 2 mm long, inflorescences < 13 cm long……………………………………………………………………………………..16

16. Leaf apex rounded or obtuse…………………………………………......*C. pulchella*

16’. Leaf apex acute, attenuate, acuminate to long acuminate……………...……….17

17. Leaves sessile or subsessile, petiole up to 1 mm long when present………..*C. boanova*

17’. Leaves petiolate, petiole ≥ 4 mm long……………………………………………18

18. Inflorescences 1.5–2.5 cm long, one lateral branch, reduced, alternate, few flowered, flower buds 5–6×3–4 mm……………………………………......*C. reginae*

18’. Inflorescences 4–5.6 cm long, one to four lateral branches, opposite or alternate, many flowered, flower buds 1–3×1–2 mm……………………………......*C. lucida*

12’ Plants with indumentum pubescent, pubescent to puberulent, appressed pubescent (strongly or densely), tomentose, strongly tomentose, lanate, floccose, villose, densely villose……………………………………………………………….…….……19

19. Leaves sessile or subsessile, petiole up to 1 mm long when present………..*C. boanova*

19’. Leaves petiolate, petiole ≥ 4 mm long...20

20. Flower buds fusiform, hairs dendritic...*C. restingae*

20’. Flower buds obovoid, rounded, prolate, globose or pyriform, hairs simple or dibrachiate...21

21. Leaf blade cordate to orbicular-cordate...*C. ouropretensis*

21’. Leaf blade elliptic, widely elliptic, elliptic-oblong, elliptic-ovate, elliptic-lanceolate, narrow-elliptic, narrow-spatulate, spatulate, ovate, obovate, oblong, narrow-oblong, rhomboid, lanceolate, orbicular to elliptic-orbicular...22

22. Inflorescence pattern mainly with one lateral branch, when having a second one it is reduced and often rare (in some *C. concinna* it can eventually appear a very reduced third one)...23

23. Flower buds 6–8 mm long, apex apiculate...*C. dryadica*

23'. Flower buds 2–3 mm long, apex obtuse, obtuse to rounded, rounded to acuminate, slightly obtuse or rounded...24

24. Leaf blades mostly lanceolate, sometimes narrow-elliptic; inflorescences densely villose interspaced with appressed pubescent indument (the midvein of the abaxial surface of the young leaves totally covered by this densely villose indument); hairs mostly long and easily distinctive by disarmed eyes, simple, mostly ochre, sometimes mixed between whitish and brownish…………………………......……......*C. strigipes*

24'. Leaf blades mostly elliptic, narrow-elliptic, narrow-oblong, narrow-spatulate, obovate to ovate; inflorescences with other types of indument, (the midvein of the abaxial surface of young leaves pubescent to appressed pubescent, sometimes interspaced with lanate and dense indument in *C. concinna*, scarcely pubescent to glabrous in *C. rubella* and floccose in *C. martiusiana*); hairs not always distinct by disarmed eye, lanate, dibrachiate or simple, brownish, ferruginous or light brown, the lanate whitish or yellowish, sometimes ferruginous…………………………………...25

25. Bracteoles rounded, evolving the flower bud; flower buds 4–5 mm wide……………………………………………..…………….……......*C. martiusiana*

25'. Bracteoles ovate, deltoid, navicular when evolving the flower buds, sometimes slightly lanceolate; flower buds 2–2.5 mm wide………………………………………26

26. Peduncles much longer than the leaves, arched, reaching 3 mm wide, with a reduced lateral branch, about 6 to 7 times shorter than the total inflorescence length…………………………………………………………………......*C. rubella*

26’. Peduncles smaller than the leaves, not arched, up to 2 mm wide, lateral branches less shorter than the total inflorescence length……………………………....*C. concinna*

22’. Inflorescence pattern mainly with two to five developed lateral branches, (the fourth or the fifth ones can be reduced)..27

27. Leaf blades spatulate, oblong, sometimes rhomboid, apex rounded to obtuse, abaxial surface of leaves and inflorescences strongly covered with a ochraceous to light yellow brown tomentose indument……..……………………..………………..........*C. clusiifolia*

27’. Leaf blades with other shapes, apex never rounded to obtuse, abaxial surface of leaves and inflorescences covered with other types of brownish, ferruginous or sometimes whitish indument...28

28. Leaf blades orbicular to orbicular-elliptic, apex abruptly acuminate, inflorescences with branches slightly arched and sub opposite to alternate...*C. serrana*

28’. Leaf blades, with other shapes, apex never abruptly acuminate, inflorescences with branches straight, opposite to sub opposite...29

29. Flower buds ≥ 5 mm compr……………………………..…………................30

30. Leaf blades elliptic, coriaceous, flower buds with calyptra apiculate to fusiform, basal bracts lanceolate, 1.7–2 cm long……………..……........................*C. blanchetiana*

30’. Leaf blades oblong to lanceolate, chartaceous, flower buds with calyptra apiculate or slightly rostrate, basal bracts lanceolate, 1.2–8 cm long……………………………………………………...…...……......*C. lanceolata*

29’. Flower buds < 5 mm compr…………………………………………………….31

31. Leaf blades obovate to rhomboid, apex acuminate to apiculate...………….......*C. obovata*

31’. Leaf blades elliptic, elliptic-oblong, elliptic-ovate or ovate, sometimes elliptic-lanceolate or lanceolate-obovate, apex acute, acuminate to obtuse-acuminate...............32

32. Secondary veins visible on both surfaces, marginal vein 3.5–5 mm from margin; petiole 14–19 mm long, flower buds with apex acute…..........………….........*C. maritima*

32’. Secondary veins slightly or barely visible on both surfaces, marginal vein 1–4 mm from margin; petiole (2)5–13 mm long, flower buds with calyptra obtuse, apiculate, shortly apiculate to slightly rostrate…………………………………………………33

33. Leaf blade elliptic, elliptic-oblong, elliptic-ovate or ovate, sometimes elliptic-lanceolate, apex acute, acuminate to obtuse-acuminate; base rounded, cuneate, obtuse or acute; Inflorescences 5.2–14.5 cm long, basal bracts often present, 1–1.5 cm long, navicular to lanceolate; peduncle 2.5–5 cm long, bracts ovate to rounded, 1–5 long; flower buds obovoid, globose, sometimes prolate... … … ....*C. brasiliensis*

33’. Leaf blade obovate to rhomboid, apex acuminate to apiculate; base attenuate; Inflorescences 5–6 cm long, basal bracts lacking or very reduced; peduncle 1–3.5 cm long; flower buds obovoid, sometimes pyriform…………………..……........*C. obovata*

Calyptranthes Sw. (1788: 79). *nom. cons.*

Type species: *C. chytraculia* (L.) Sw. (1788: 79).

Myrtus chytraculia L. *Syst. Nat., ed.* 10: 1056 (1759).

Trees or shrubs with brown or red, sometimes pale yellow, simple or t-shaped trichomes; branchlets compressed or flattened to terete, sometimes two to four-winged with distal ends of wings between the leaf-bases at opposite sides of a node,; branching sympodial; bracteoles linear, rounded or triangular and acute, usually deciduous or caducous; inflorescence paniculate, often with an abortive, congested terminal primary axis or occasionally reduced with terminal flowers in groups of three; buds apiculate, rounded, prolate or sometimes contricted; petals 0–2(–5), small, calyx fused and calyptrate, circumscissile and falling as a calyptra at anthesis, or remaining attached by a small piece of tissue at one side of the hypanthium; floral disc glabrous; staminal ring narrow, hypanthium glabrous internally, extending into a turbinate tube beyond the ovary; ovary bi-locular (rarely 3–4), with 2 ovules per locule; fruits globose with persistent apical hypanthium tube, calyptra generally falling or occasionally still attached at one side of the rim.

6.5.1.1 *Calyptranthes angustifolia* Kiaerskou (1893: 42). Type:—BRAZIL. Rio de Janeiro: Serra dos Órgãos, 15 Mar 1888, *Glaziou 16997* (Lectotype K!, designated here; isolectotypes: R!, P!, NY- Image!, F-Image!). Remaining syntypes: Brazil, *Glaziou* 2869, 3984 (P!).

Shrubs, twigs mainly terete, young ones sub compressed; essentially glabrous, except for the young twigs puberulent; hairs simple, whitish. Leaf blade linear to narrow-lanceolate, 1–2.8×0.1–0.4 cm, chartaceous to coriaceous, drying dark green adaxially, pale green to green adaxially, slightly discolorous; apex uncinate, rarely acute (together with uncinate apices in the same individual); base cuneate to attenuate; midvein impressed above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein slightly visible, ca. 0.1 mm from margin; intramarginal vein not seen; petiole 2–4×0.5–1 mm. Axillary solitaire or paired reduced panicles, 1–2 cm long, axis terete, not branched, few flowered, flowers clustered in one to three at the tips; basal bracts caducous, not seen; peduncle 0.4–1.4×0.3–0.5 mm; bracts caducous, not seen; flowers sessile; bracteoles linear, very reduced, up to 0.5 mm long, caducous; buds rounded to pyriform, 5–6×2.5 –3 mm, apex rounded to obtuse, calyptra acuminate, chartaceous; hypanthium not seen; petals lacking. Fruits not seen. **Figs. 2B–D.**

Phenology:— Flowers in September.

Distribution, habitat and conservation:— Endemic to Rio de Janeiro state. The Serra dos Órgãos, as indicated at the specimen label, is part of the larger “Serra do Mar” chain of mountains where several species of *Calyptranthes* occur and considered “micro-endemic”. It is known by a few and old herbarium samples and probably very rare in nature, therefore, is here considered Critically Endangered (CR).

Representative specimens examined:—BRAZIL: **Rio de Janeiro**, Teresópolis, Serra dos Órgãos, 4 Sep 1949, *Barbosa 267* (R!).

Sobral *et al.* (2015) cited the species to Minas Gerais (Campos Rupestres vegetation), but the sample was not physically located at herbarium CESJ, only its register at speciesLink site (K. Antunes 332). However, other samples from Minas

Gerais state identified as *C. angustifolia* were found in different herbaria, but in fact, it is a not known species of the genus *Eugenia.*

Calyptranthes angustifolia can be distinguished from this *Eugenia* species in the vegetative gestalt by the uncinate apex of the leaves. From other species of *Calyptranthes*, by the small and narrow leaves (1–2.8×0.1–0.4 cm) with the uncinate apex.

When Kiaerskou described the species, he listed three syntypes: *Glaziou* 2869, 3984 and 16997. Those specimens were distributed in several herbaria. All the specimens of *C. angustifolia* analysed that had the same collect numbers and Glaziou's handwriting, were tagged as "isosyntypes", which indicates that none of the collections was ever lectotypified. We decided to designate the K material as the lectotype, since it was a species described by Kiaerskou and the most preserved specimen.

6.5.1.2 *Calyptranthes aromatica* A. Saint-Hilaire (1824:1), [non *C. aromatica* Blume (1826:1092) *nom. illeg.* = *Syzygium antisepticum* (Blume) Merr. ex Perry]. *Chytraculia aromatica* (A. Saint-Hilaire) Kuntze (1891:238). Type:—BRAZIL. Rio de Janeiro: A. *Saint-Hilaire s.n.* (Holotype P!).

Trees or shrubs 2–7m high, twigs terete; essentially glabrous, inflorescences and flowers glabrescent to puberulent; hair simple and dibrachiate, white or yellowish when dried. Leaf blade elliptic to oblong-elliptic, 25–38×9.5–26 cm, chartaceous to coriaceous, drying brownish to pale green, discolorous; apex acute; base subcordate to rounded, rare obtuse; midvein sulcate above, prominent bellow; secondary veins visible on both surfaces, impressed adaxially, prominent abaxially; marginal vein 0.6–1.2 cm from margin; intramarginal vein 0.2–0.5 cm from margin; sessile or with a reduced petiole, shorter than 2 mm. Axillary or terminal, solitaire or paired panicles, 13–27 cm long, axis terete, sometimes slightly compressed, three to six lateral branches, opposite to alternate, many flowered, flowers clustered in three at the tips; basal bracts lanceolate to elliptic, 1.6–4.8cm, foliaceous, persistent; peduncle 6–18 cm long, up to 5 mm wide; bracts caducous, not seen; flowers sessile; bracteoles caducous, not seen; buds prolate to globose, 3.5–5×2–4 mm, apex rounded to obtuse, calyptra rounded or shortly apiculate, coriaceous to chartaceous; hypanthium prolonged ca. 2 mm beyond ovary, internally glabrous; petals 3–4, rounded to obovate. Fruits globose, 8×9–10mm, yellow to black when mature.

Phenology:—Flower and buds from December to April, fruits from November to June.

Distribution, habitat and conservation:—Endemic to Rio de Janeiro state. The species is referred to the Atlantic forest, known for a few collections, besides being cultivated in Rio de Janeiro Botanical Garden for many years. Therefore, it can be considered a "micro-endemic" species, Critically Endangered (CR).

Representative specimens examined:—BRAZIL: **Rio de Janeiro**, Silva Jardim, Rebio Poço das Antas, 22º30/22º33S 42º15/42º19W, 15 Apr 1995, *D.S. Faria et al. 377* (RB!, K!); Jardim Botânico do Rio de Janeiro, *A.R. Lourenço & M.C. Sousa 445* (UFP!); Guanabara, Serra do Lameirão, Pico da Pedra do Ponto, 5 Mar 1966, *Z.A. Trinta* 1250 (R!).

Calyptranthes aromatica is easily distinct among the other Atlantic Forest species, due its long and wide leaves (25–38×9.5–26 cm), three to six lateral branched panicles and the presence of a foliaceous bract at the base of the inflorescence. Sometimes, smaller individuals can be confused with *C. lanceolata*, especially due to the presence of a basal bract in the inflorescence, but the leaves in *C. lanceolata* are smaller (14.5–36×4.5–8.2 cm) and petiolate, besides the presence of buds with a rostrate calyptra and often a less branched inflorescence. The species have a strong aromatic smell, similar to guava, especially in the leaves and opened flowers, from where the epithet derived.

6.5.1.3 *Calyptranthes bipennis* O. Berg (1861: 248); *Chytraculia bipennis* (Berg) Kuntze (1891: 238); Type:—PERU. "*Habitat ad cataracta Huallayae in Peruvia*", *Spruce 4596* (lectotype: BR-Image!, selected here; isolectypes: BM!, G-Image!, K!, W-Image!).

Calyptranthes hylobates Standl. ex Amshoff (1958: 169). Type:—PANAMÁ. Bocas Del Toro, region of El Almirante, *Cooper 366* (type: F-Image!; isotypes: A-Image!, GH-Image!, US- Image!).

Shrubs to treelets 1m high, twigs alate; glabrous. Leaf blade lanceolate, elliptic, rarely obovate, 3.5–8.5×1.5–2.9 cm, chartaceous or membranaceous, drying pale green, discolorous; apex long acuminate, sometimes long caudate; base cuneate; midvein impressed above, prominent bellow; secondary veins slightly visible on both surfaces; marginal vein 0.5–0.9 mm from margin; intramarginal vein not seen; petiole 2–2.8 mm long, up to 1 mm wide. Axillary or terminal, solitaire or paired panicles, 2.4–3 cm long, axis terete, not branched, few flowered, flowers clustered in one at the tips; basal bracts absent; peduncle 1.7–3.2 cm long, less than 0.5 mm wide; bracts absent; flowers sessile; bracteoles linear, up to 2 mm long, caducous; buds obconic, 3×1–2 mm, apex acute, calyptra shortly apiculate to apiculate, chartaceous; hypanthium prolonged ca. 1 mm beyond ovary, internally glabrous; petals absent. Fruits subglobose, 6×7–10 mm, vinaceous when mature. **Figures 5A–C.**

Phenology:— Flowers in February; fruits from march to June.

Distribution, habitat and conservation:—The species was known to occur only in Bolívia, Ecuador, Peru, in the Amazon Forest, and in Brazil, in the Amazon and Acre states. Here, we state here a new occurrence for Pará and Espírito Santo states, having thus, a disjunct distribution between Amazon and the Atlantic Forest. Andrade-Lima (1966) gave the name Hiléia Bahiana to the forests of northern Espírito Santo and southern Bahia, pointing out floristic similarities with the Amazon forest. Considered Vulnerable (VU).

Representative specimens examined:—BRAZIL: **Espírito Santo**, Conceição da Barra, Reserva Biológica de Córrego Grande, 4 Jun 2011, *M. Ribeiro 533, 453* (VIES!); **Amazonas**, near Rio Embira, 7º30'S, 7º15'W, 21 Jun 1933, *Krukoff 4949* (SPF!); *Krukoff 5203* (K!); **Pará**, Parauapebas, Floresta Nacional de Carajás, 6º8'58''S, 50º95'49''W, 10 May 2009, *Vidal 648* (BHCB!); BOLÍVIA: Morona-Santiago, Tiwintza, ; EQUADOR; PERÚ;

Calyptranthes bipennis is here cited as a new occurrence for the Atlantic forest, since the species was previously known only for the Amazon forest in Brazil. The species is characterized by its slender inflorescences, flowers and fruits, that often break when herborized.

6.5.1.4 *Calyptranthes blanchetiana* O. Berg (1857: 40); *Chytraculia blanchetiana* (O. Berg) Kuntze (1891:238). Type:—BRAZIL. Bahia: *Blanchet 3114* (holotype P!: isotype: W-Image!).

Trees or shrubs up to 6m high, young twigs alate; young twigs pubescent, abaxial leaves surface pubescent to glabrescent, inflorescence pubescent to glabrescent; hairs simple or dibrachiate, whitish to ferruginous. Leaf blade elliptic, 19–22×7–8.5 cm, coriaceous, drying brownish to pale green, discolorous; apex attenuate to acute; base cuneate to slightly cuneate; midvein sulcate above, prominent bellow; secondary veins visible adaxially, slightly prominent to impressed, barely visible abaxially; marginal vein 3 mm from margin; intramarginal veins up to 1 mm from margin, when present; petiole 1.4–2 mm long, ca. 5 mm wide. Axillary paired panicles, 6–12 cm long, axis compressed, alate, two to three lateral branches, rarely four, opposite, few flowered, flowers clustered in three at the tips; basal bracts lanceolate, 1.7–2 cm long, up to 5 mm wide, foliaceous, persistent to caducous; peduncle 4–4.5 cm long, 2 mm wide; bracts navicular, 2.5–5 mm long, caducous; flowers sessile; bracteoles deltoid to slightly lanceolate, 1–2 mm long, caducous; buds obovoid to fusiform, 5–7×3–4 mm, apex acute, calyptra apiculate to fusiform, mostly coriaceous; hypanthium prolonged ca. 2 mm beyond ovary, internally glabrous; petals 0–1, spatulate; stamens not seen. Fruits globose, ca. 1.5 cm diam., green, not seen mature.

Phenology:—Fruits in May, flower buds in September.

Distribution, habitat and conservation:— The species was restricted to the Atlantic forest of Bahia, occurring as a shrub or a small tree in the interior of forests. However, Rosario et. al. (2014) registered a new occurrence for the Amazon. Even so, due to its clear rarity in the nature and the state of conservation of the ecosystems, many of them considered under threat, we here assign *C. blanchetiana* as Endangered (EN).

Representative specimens examined:—BRAZIL: **Bahia**, Jussari, Serra do Teimoso, , 12 Dec 2013, *B.S. Amorim et al. 1892* (UFP!); Serra Grande, on road to Itacaré, 14º25’S, 39º01'W, 7 May 1992, fr., *W.W. Thomas et al. 9180* (K!, CEPEC!, NY- Image!); Uruçua, Distrito de Serra Grande, Fazenda Lagoa do Conjunto Fazenda Santa Cruz, 14º25'S, 39º01'W, 7 Sep 1991, *A.M. Carvalho et al. 3658* (CEPEC!, K!): **Pará**, Oriximiná, Rio Paru do Oeste, cachoeira Chuvisco, 7 September 1980, *C.A. Cid Ferreira et al. 2259* (INPA, MG).

It can be recognized by its fusiform and pubescent buds, differing from *C. restingae*, also an species known for the southern Bahia state, mainly by the type of indument (dendritic in *C. restingae*) and the size and base of its leaves (smaller leaves with mostly rounded or subcordate base in *C. restingae*). The species was found in Bahia state only twice recently, despite this area being intensively collected, and this fact shows the rarity of it in the field. However, Rosario et al. (2014) pointed out a new occurrence for the species in the Brazilian Amazon, which shows a disjunct distribution, but only a unique collection was found and analyzed, in fruit.

6.5.1.5 *Calyptranthes boanova* Sobral (2012: 20). Type:—BRAZIL. Bahia: Boa Nova, Fazenda São José, 14°23,630´S, 40°08,722´W, 25 Oct 2001, *W.W. Thomas et al. s.n.* (holotype: CEPEC- Image!; isotypes: BHCB, NY, RB).

Shrub to trees 1.8–12 m high, twigs pubescent to glabrous, leaves glabrous adaxially, puberulent abaxially, especially in the midvein, inflorescence pubescent to glabrous; hairs dibrachiate, brownish. Leaf blade ovate-lanceolate to oblong, 7–13×4.1–5 cm, coriaceous, drying deep green or greenish adaxially, pale yellow-green or greenish abaxially, concolorous or discolorous; apex acute or acuminate; base obtuse; midvein sulcate above, prominent bellow; secondary veins barely visible adaxially, impressed, visible and prominent abaxially; marginal vein 1.5–2 mm from margin; intramarginal vein absent; leaves sessile or subsessile, petiole up to 1×2 mm when present. Terminal paired panicles, 6–9 cm long, axis slightly compressed, one to three lateral branches, rarely a reduced fourth one, sub opposite, few flowered, flowers clustered in three at the tips; basal bracts triangular, 4–7×2.5–3 mm, persistent; peduncle 3.7–4 cm long, 1–1.8 mm wide; bracts probably caducous, not seen; flowers sessile; bracteoles not seen, probably caducous; buds obovoid, 3–5×3 mm, apex rounded, calyptra rounded, coriaceous; hypanthium not seen; petals not seen; stamens not seen. Fruits immature, up to 10 mm diam., green when immature, color when mature not seen.

Phenology:—Immature fruits and old flowers collected in October, buds in November.

Distribution, habitat and conservation:—The species is restricted to Southern and Eastern Bahia state thus far, occurring in the "Ombrófila" forest, at 600–900m elevation. Sobral *et al.* (2012) inferred a Data Deficient (DD) conservation status for *C. boanova*, since the surroundings of Boa Nova municipality can be considered a still scarcely sampled area. The species was found in more localities nearby, in a disturbed area by the logging of timber species. Therefore, we consider the species Endangered (EN).

Representative specimen examined:—BRAZIL: **Bahia**, Apuarema, Conceição do Rio Tinto, 13º52'47''S 39º41'20''W, 22 Nov 2013, *E. Lucas et al. 1208* (RB!, K!, HURB!).

Calyptranthes boanova is easily distinct from the other Atlantic Forest species mainly by its sessile or subsessile and ovate-lanceolate to oblong leaves, which together with the obovoid buds separate it from *C. blanchetiana* (with petiolate, elliptic leaves and fusiform flower buds).

6.5.1.6 *Calyptranthes brasiliensis* Sprengel (1825: 499); *Calyptranthes brasiliensis* Sprengel var. *brasiliensis* (1857:41); *Chytraculia brasiliensis* (O. Berg) Kuntze (1891:238). Type:— BRAZIL. *Sellow 367* (Lectotype designated by A.C. Araújo & Lucas 2013, P!).

Calyptranthes eriopoda De Candolle (1828: 257); *Chytraculia eriopoda* (O. Berg) Kuntze (1891:238). Type:— BRAZIL. "*in Brasilia*", *Martius s.n.* (Holotype M-Image!, isotype NY- Image!).

Calyptranthes loranthifolia De Candolle (1828: 258); *Chytraculia loranthifolia* (O. Berg) Kuntze (1891: 238). Type:—BRAZIL. [São Paulo]: "*In Brasiliae campis prov. S. Pauli*", *Martius s.n.* (M- Image!).

Calyptranthes brasiliensis Sprengel var. *densa* Berg (1857:41). Type:—BRAZIL. [Rio de Janeiro]: "*Type in subturfosis prope Botafogo ad Rio de Janeiro*" *s.n.* (B – probably destroyed).

Calyptranthes brasiliensis Sprengel var. *laxa* Berg (1857:42). Type:—BRAZIL. [Espírito Santo]: "*In campis ad urbem Vittoria*", *Sellow s.n.* (B – probably destroyed).

Calyptranthes cephalantha Berg (1857: 46); *Chytraculia cephalantha* (Berg) Kuntze (1891:238). Type:—BRAZIL. "*Habitat in Brasilia*", *Franke.*

Calyptranthes fastigiata Berg (1857: 50), [non *C. Fastigiata* Blume (1826:1090) *nom. illeg.* = *Syzygium fastigiatum* (Blume) Merr. & L.M. Perry]; *Chytraculia fastigiata* (Berg) Kuntze (1891:238). Type:—BRAZIL. [Minas Gerais]: "*Habitat in prov. Rio de Janeiro*", *Martius 1237* (Lectotype K!, isolectotypes P!, M-Image!, HAL-Image!).

Calyptranthes melanoclada Berg (1857: 50). Type:—BRAZIL: "*Habitat in pascuis ad Venda Cural falso, prope Real Fazenda S. Cruz, in prov. Rio de Janeiro*", *Pohl 1028* (Holotype K!).

Calyptranthes grandifolia Berg (1857: 48); *Calyptranthes grandifolia* Berg var. *grandifolia*. Type:—BRAZIL. [Rio de Janeiro]: "*Habitat in prov. Rio de Janeiro*", *Sellow 67* (Holotype B - probably destroyed, isotype P!). *syn. nov.*

Calyptranthes mutabilis Berg (1859: 540). *Chytraculia mutabilis* (Berg) Kuntze (1891:238); *Calyptranthes brasiliensis* Spreng. var. *mutabilis* (O. Berg) Legrand (1971: 515). Type:—BRAZIL: [Bahia], "*in collibus siccis prope Ilheos*", *Riedel s.n.* (Holotype K!; isotype P!).

Calyptranthes rufa Berg (1859:541); *Calyptranthes grandifolia* var. *rufa* Legrand (1971: 515). Type:—BRAZIL. *Riedel, s.n.* (Holotype K!). *syn. nov.*

Calyptranthes glazioviana Kiaerskou (1893: 35). Type:—BRAZIL. Rio de Janeiro, *Glaziou 11991* (Holotype: K!, isotype: R!). *syn. nov.*

Calyptranthes grandifolia var. macrantha Legrand (1962: 196). Type:—BRAZIL. Santa Catarina, Itajaí, Cunhas, *Klein 1538* (Holotype MVM- Image!).

Calyptranthes dardanoi Mattos, Loefgrenia (1990:1). Type:— BRAZIL. Pernambuco: Goiana, road Recife-Goiana, *Andrade-Lima 65-4346* (Holotype IPA!). *syn. nov.*

Calyptranthes ovata Berg (1858: 50); *Chytraculia ovata* (Berg) Kuntze (1891: 238). Type:— BRAZIL. *Pohl 1088* (Holotype W; isotype K!). *syn. nov.*

Trees or shrubs up to 15m high, twigs terete to compressed; adaxial leaves surface, abaxial leaves surface, inflorescences, flowers and fruits pubescent to puberulent; hairs simple or dibrachiate, ferruginous, rarely yellowish. Leaf blade elliptic, elliptic-oblong, elliptic-ovate or ovate, sometimes elliptic-lanceolate, 5–17.5×2.5–10.5 cm, chartaceous to coriaceous, drying dark brown adaxially, brownish to ferruginous abaxially, discolorous; apex acute, acuminate to obtuse-acuminate; base rounded, cuneate, obtuse or acute; midvein sulcate to prominent above, prominent bellow; secondary veins slightly visible on both surfaces, impressed adaxially, slightly prominent abaxially; marginal vein 1–4 mm from margin; intramarginal vein often present, 0.3–1.5 mm from margin; petiole (2)5–13 mm long, up to 2 mm wide. Axillary or terminal paired or solitaire panicles, 5.2–14.5 cm long, axis compressed to terete, two to five lateral branches, opposite, many flowered, flowers clustered in three to five, rarely nine near the tips; basal bracts often present, 1–1.5 cm long, navicular to lanceolate, persistent or caducous; peduncle 2.5–5 cm long; bracts ovate to rounded, 1–5 long, caducous, sometimes persistent; flowers sessile; bracteoles deltoid to ovate, sometimes linear, 0.5–2 mm long, caducous or persistent; buds obovoid, globose, sometimes prolate, 2–3×2–2.5 mm, apex rounded to obtuse, calyptra obtuse to shortly apiculate, chartaceous to coriaceous; hypanthium prolonged 1–2 mm beyond ovary, internally glabrous; petals (0)2–3, spatulate. Fruits globose or subglobose, 3–5.5×2.5–3 mm, red to black when mature.

Phenology:— Flowers from December to April, fruits from March to July.

Distribution, habitat and conservation:—The species widespread in Brazil, occurring in the Atlantic Forest, Cerrado and caatinga. Considered Least Concern (LC).

Representative specimens examined:— **Paraíba**, Mataraca, *Millennium Inorganic Chemicals* LDTA, 25 mar 2009, *A.R. Lourenço* 257 (JPB!); **Rio Grande do Norte**, Baía Formosa, Mata Estrela, 19 Jul 2010, *A.R. Lourenço* 301 (JPB!); **Alagoas**, Maceió, s.d., *Garder* 1302 (IPA!); **Sergipe**, Santo Amaro das Brotas, 15 Nov 1991, C. *Farney & A.C. Beaumond 2825* (UB!); **Bahia**, Abaíra, 13º19'S 41º51'W, 12 Nov 1992, *W. Ganev* 1412 (UB!); **Espírito Santo**, Linhares, Reserva Natural da Vale, 8 Feb 1999, *E.N. Lughadha 172* (CVRD!, UB!); **Minas Gerais**, Conceição do Mato Adentro, 5 Jul 1996, *V.C. Souza et al.* 11769 (SP!); **Rio de Janeiro**, Rio de Janeiro, Restinga de Jacarepaguá, 9 Jun 1969, *D. Sucre et al.* 5236 (RB!); **São Paulo**, Salesópolis, 29 Nov 1967, J. Mattos & N. Mattos 14262 (SP!); **Santa Catarina**, Itajaí, 8 Feb 1955, R.M. Klein 1146 (HBR!); **Distrito Federal**, Brasília, 30 Out 2011, *J.E.Q. Faria & M.R.V. Zanata* 2108 (UB!).

The bracts and bracteoles are one of the most variable features in *C. brasiliensis* – they can be present or absent, caducous or persistent - together with the leaf shape. Some specimens of *C. concinna* can be confused to *C. brasiliensis*, mainly in relation to the leaf shape and the color when dry. Some specimens of *C. brasiliensis* have a shorter inflorescence, especially in individuals that were collected in its early stage of development, with an immature inflorescence. The features that can used to separate specimens like that can be difficult, being necessary more than one collection to identify the species. The lanate indument appearing like tuffs in young leaves and inflorescences of *C. concinna*, can be a very characteristic feature - when present though. Sometimes the specimens can be near glabrescent and those individuals also can be confused with *C. brasiliensis*.

Individuals from drier areas, like Cerrado, Campo rupestres and Restinga, normally have smaller and coriaceous leaves, obovate, with ferruginous hairs abaxially, and rounded base. Meanwhile, the wet areas specimens normally have a longer and sometimes lanceolate leaves. However, in some regions (especially Restingas in Espírito Santo and Rio de Janeiro), both foliar patterns can be found in the same individual – a clue of its variation and fragility as a character to separate different species.

Calyptranthes brasiliensis, as treated here, could be regarded as an "ochloespecies" – a widespread species occurring in a wide range of habitats, following complex patterns related to geographical and ecological traits presented in the different populations (White 1998). *Calyptranthes lucida* and *C. concinna* (see descriptions and discussions later) can also fit this concept. Those species, very common in the Neotropical Myrtaceae, often do not easily fit well in formal taxonomic treatments, and the description of different species and varieties by different authors in different periods of time and geographical regions are expected. Additional approaches are strongly recommended to try to clarify the boundaries in ochloespecies, as genetic of populations and morphometric analysis. Thus far, we here propose a wider species concept for *Calyptranthes brasiliensis*, with the synonimization of some species and varieties described mainly by Berg and Legrand, since the boundaries between them are not well established to separate in a traditional dichotomous key until the present moment.

6.5.1.7 *Calyptranthes caudata* Gardner (1845: 102); *Chytraculia caudata* (Gardner) Kuntze (1891: 238). Type:—BRAZIL. [Rio de Janeiro]: "*Habitat in montibus Serra dos órgãos, in prov. Rio de Janeiro*", *Gardner 5715*. (lectotype K!, designated here).

Trees 0.9–m high, twigs compressed; glabrous. Leaf blade elliptic, rarely elliptic-lanceolate, 2.4–3.3×0.8–1 cm, chartaceous to coriaceous, drying green adaxially, pale green abaxially, discolorous; apex long caudate; base attenuate; midvein impressed to sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein not seen; intramarginal vein absent; petiole 1.5–2 mm long, up to 1 mm wide. Axillary solitaire reduced panicles, 1–1.5 cm long, axis terete, not branched, few flowered, bearing one flower at the tip; basal bracts lacking; peduncle 0.8–1.2 cm long, up to 0.5 mm wide; bracts probably lacking, not seen; flowers sessile; bracteoles probably lacking, not seen; buds obovoid, 3×2 mm, apex obtuse, calyptra apiculate, chartaceous; hypanthium not seen; petals 1, linear. Fruits not seen.

Phenology:—Not known.

Distribution, habitat and conservation:— Endemic to the montane region of Rio de Janeiro, as well as *Calyptranthes angustifolia*, and considered “micro-endemic”. Known for few collections, is here assigned as Critically Endangered (CR).

Representative specimens examined:—BRAZIL: **Rio de Janeiro**, Teresópolis, Serra dos órgãos, *M.C. Souza 1076* (RB); Jan 1838, *Miers s.n.* (BM!); *Miers s.n.* (P!); *Glaziou 3986* (P!).

The main morphological feature of *C. caudata* is the leaf with a long acuminate to caudate apex and the solitaire reduced panicle bearing one flower at the tip. As well as *C. angustifolia*, its known occurrence area is very restricted thus far, and this can be mainly explained by two factors - both species occurs in wet forests of montane regions, having small leaves and very small and fragile inflorescences, making it difficult to see and collect. Another morphologically related species is *C. grammica*, which also occurs in the Forests of Rio de Janeiro, having small leaves and small and fragile inflorescences, but with a wider geographical distribution. The three species can be distinct mainly by the shape of the leaves: elliptic-lanceolate with long acuminate to caudate apex in *C. caudata*; linear to narrow-lanceolate with uncinate, rarely acute apex in *C. angustifolia* and spatulate to lanceolate leaf blades with obtuse, sometimes acute apex in *C. grammica*.

Gardner cited in the protologue one collection (Gardner *5715*) but even if we did not find any other duplicate in the visited herbaria, we could not assume that it was the only material he used to describe the species. Therefore, here we choose to designate it as the lectotype.

6.5.1.8 *Calyptranthes clusiifolia* Berg (1857:39); *Myrcia clusiaefolia* Miquel (1849: 533) *nom. illeg.*, [non *Myrcia clusiaefolia* (Kunth) De Candolle (1828:255) = *Myrcia clusiifolia* (Kunth) De Candolle]; *Chytraculia clusiaefolia* (Miquel) Kuntze (1891:238). Type:—BRAZIL. Minas Gerais, *Widgren 536* (Lectotype designated by A.C. Araújo & E. Lucas 2013, K!).

Calyptranthes clusiifolia Berg var. *cordifolia* Legrand (1962: 193). Type:—BRAZIL. Minas Gerais, Lima Duarte, Pilar, Serra de Ibitipoca, *Mendes Magalhães 423* (Holotype MVM).

Threes 6–15 m high, twigs terete; young twigs, abaxial surface of leaves and inflorescences strongly covered with a tomentose indument, sometimes interspaced with lanate hairs, the adaxial surface of leaves with a lanate indument when young and middle age, puberulent to glabrescent when old; hairs simple, dibrachiate or lanate, mostly very tangled, ochraceous to light yellow brown. Leaf blade spatulate, oblong, sometimes rhomboid, 11–19.5×5–9.5 cm, chartaceous to coriaceous, drying brownish adaxially, ochraceous to brownish abaxially, discolorous; apex rounded to obtuse; base rounded to cuneate; midvein sulcate above, prominent bellow; secondary veins visible on both surfaces, when not covered by the indument, impressed to slightly prominent adaxially and abaxially; marginal vein 3.5–8 mm from margin; intramarginal vein up to 2 mm from margin; petiole 9–12×2–4 mm. Axillary, paired or solitaire panicles, 7–10.5 cm long, axis compressed, two to four lateral branches, rarely a reduced fifth order one, sometimes more than one coming from the same point, mostly opposite, sometimes sub opposite to alternate, many flowered, flowers clustered in three to five at the tips; basal bracts rarely present, lanceolate, 2–3 cm long, caducous; peduncle 3–5 cm long, 2–3 mm wide; bracts lanceolate, 2–3 mm long, caducous; flowers sessile; bracteoles lanceolate to linear, ca. 1.5 mm long, caducous; buds prolate to obovoid, 2–4×2–3 mm, apex apiculate to obtuse, calyptra apiculate, chartaceous; hypanthium prolonged ca. 1 mm beyond ovary, internally glabrous; petals 0–3, obovate. Fruits globose, 5–6 mm diam., red when mature. **Figure 3A.**

Phenology:— Buds and flowers from December to January, fruits from July to November.

Distribution, habitat and conservation:— *Calyptranthes clusiifolia* occurs in different types of habitats, from the Brazilian Cerrado of Distrito Federal, Campos rupestres with iron-rich soil of Minas Gerais, the Restinga vegetation in Bahia state and the montane forests of São Paulo, seeming to prefer the forest formations of those ecosystems. Sobral *et al.* (2015) cite the species for Pernambuco, Alagoas and Sergipe states (northern of the São Francisco river) but the studied samples are clearly under the morphological concept here adopted for *Calyptranthes brasiliensis*. Holst et al. (2003) cite the species for the Venezuelan Guyana, but affirm that, despite the specimens are similar in leaf size and shape to the type specimen from Minas Gerais, mature flowers and fruits are not known from the two known flora area populations. They also cite a difference in the indumentum: the Venezuelan collections are rust-colored (ferruginous) versus yellow-tan (ochraceous to yellow) in the Brazilians. Therefore, we do not consider it in the present work, until the specimens are possible to be analised. According to its distribution, it is considered here Least Concern (LC).

Representative specimens examined:—BRAZIL: **Bahia**, Una, Reserva Biológica de Una, 15º9’0’’S 39º4’9’’W, 19 Feb 2006, *J.L. Paixão et al.* 694 (CEPEC!); **Minas Gerais**, Lima Duarte, Parque Estadual do Ibitipoca, 23 Jan 2007, *R.C. Forzza et al. 4398* (BHCB!, SPF!, K!); Barroso, Mata do Baú, 15 Jun 2002, *L.C.S. Assis et al. 508* (SPF!, CESJ!); s.loc., Serra do Espinhaço, 19 Jan 1971, *H.S. Irwin et al.28736* (UB!); **São Paulo**, Campinas, s.d., *C. Novaes 1431* (SPF!); Gália, Estação Ecológica dos Caetetus, 8 Jul 2000, *P. Fiaschi & A.V. Christianini 352* (SPF!); **Distrito Federal**, bacia do rio São Bartolomeu, 17 Feb 1981, *E.P. Heringer et al.6213* (IBGE, MAC!); 5 Feb 1966, *H.S. Irwin et al. 12295* (NY- Image!,UB!).

Calyptranthes clusiifolia can be mainly characterized by its spatulate, oblong to orbicular, sometimes rhomboid leaves, with rounded to obtuse apex and its one to four lateral branched inflorescences (sometimes with a reduced fifth one), with a ochraceous to light yellow brown tomentose indument. The young leaves in *C. clusiifolia* are mostly totally covered by this kind of indumentum, and are often spatulate. It can be confused with *C. brasiliensis*, especially the individuals that have puberulent indument when young, are glabrescent when old, and the task of separating them can be very difficult. However, the young leaves in *C. brasiliensis* have a ferruginous indumentum, or are completely glabrous, never spatulate. Also, some adult individuals of *C. brasiliensis* with oblong leaves can be confused with *C. clusiifolia*, but the characters like the indumentum ferruginous or glabrous, elliptic or obovate leaves, with the apex mostly acute, can separate them.

6.5.1.9 *Calyptranthes concinna* De Candolle (1828: 258); *Chytraculia concinna* (De Candolle) Kuntze (1891: 238); *Calyptranthes concinna* De Candolle var. *concinna* (1962: 538). Type:—BRAZIL. *Martius s.n.* (Holotype M- Image!).

Calyptranthes glomerata Cambessèdes (1833: 371); *Chytraculia glomerata* (Cambessèdes) Kuntze (1891: 238). Type:—BRAZIL. [Minas Gerais] "*In prov. Minas Geraes*" *Saint-Hilaire 41* (Holotype P!). *syn. nov.*

Calyptranthes variabilis var. *riparia* Berg (1857: 49). Type:—BRAZIL. [São Paulo]: "*In prov. S. Pauli, inter Carambey et Castro*", *Sellow 5376* (holotype M-image!; isotypes K!, P!, B- probably destroyed).

Calyptranthes variabilis var. *oblongata* Berg (1857: 49). Type:—BRAZIL. [São Paulo]: "*In prov. S. Pauli, inter Carambey et Castro*", *Sellow s.n.* (holotype M-image!; isotypes K!, P!, M, B).

Calyptranthes variabilis var. *stricta* Berg (1857: 49).Type:—BRAZIL. [São Paulo]: "*In prov. S. Pauli, inter Carambey et Castro*", *Sellow s.n.* (holotype M-image!; isotypes K!, P!, B).

Calyptranthes variabilis var. *pulchella* Berg (1857: 49). Type:—BRAZIL. [Minas Gerais]. "*In prov. Minas Geraes*", *Widgren 1185* (Holotype S- Image!).

Calyptranthes obversa Berg (1857: 51). Type:—BRAZIL. [São Paulo]: "*Habitat ad Mato de Peracicaba in prov. S. Pauli*", *Martius 287* (holotype M-image!, isotypes: BR-image!) *syn. nov.*

Calyptranthes widgreniana Berg (1859: 39); *Chytraculia widgreniana* (Berg) Kuntze (1891:238). Type:—BRAZIL. [Minas Gerais] "*In prov. Minas Geraes*", *Widgren 537* (Holotype S-Image!, isotypes SP!, US- Image!). *syn. nov.*

Calyptranthes paraguayensis Barbosa-Rodrigues (1907:804). Type:—PARAGUAY. "*Ad ripas rivulorum in valle fluminensis Y-aca*", Dec, *6729* (holotype Paraguay, not localized, isotype P!)

Calyptranthes kleinii Legrand (1962: 197). Type:—BRAZIL. Santa Catarina, Ibirama, *R.M. Klein 2186* (holotypus MVM- Image!, isotypus HBR!).

Calyptranthes reitziana Legrand (1962: 202). Type:—BRAZIL. Santa Catarina, Concordia, Estreito do Uruguai, *L.B.Smith & P.R. Reitz 9919* (holotype MVM; isotype HBR!, US- Image!).

Calyptranthes concinna var. *paulistana* Legrand (1971: 543). Type:—BRAZIL. São Paulo, Sapucahu, *St. Hilaire 1286* (Holotype P!)

Trees or treelets 3–15 m high, twigs terete to compressed; young twigs, abaxial surface of leaves, especially the midvein of the abaxial surface of young leaves and inflorescences pubescent to appressed pubescent, interspaced with lanate and dense indument, completely covering the surfaces or appearing like tuffs, formed by very thin wooly hairs, sometimes interspaced with long hairs often visible by disarmed eye, or rarely pubescent to puberulent; hairs simple, lanate or dibrachiate, brownish, ferruginous or light brown, the lanate whitish or yellowish. Leaf blade narrow-elliptic, elliptic, narrow-oblong, narrow-spatulate, rarely ovate, 3–16×0.8–8.5 cm, chartaceous to sometimes coriaceous, drying pale, dark brown or pale green adaxially, light brown, yellowish to ferruginous abaxially, discolorous; apex obtuse, shortly-acuminate, obtuse acuminate to sometimes acute; base cuneate to attenuate; midvein impressed to sulcate above, prominent bellow; secondary veins slightly visible to visible on both surfaces, impressed to slightly prominent above and below; marginal vein 1–8 mm from margin; intramarginal vein 0.5–3 mm when present; petiole 7–12 mm long, up to 2 mm wide. Axillary or terminal, solitaire or paired panicles, 1.4–9 cm long, axis terete to compressed, one lateral branch, rarely a reduced second or third one, opposite, few flowered, rarely many flowered, flowers clustered in three to eight at the tips; basal bracts caducous, not seen; peduncle 2.5–5 cm long, 1–2 mm wide; bracts ovate to deltoid, 2–4×2–3 mm, caducous, sometimes persistent; flowers sessile; bracteoles ovate, deltoid, to navicular, when so, evolving the flower buds, sometimes slightly lanceolate, 1–6×2–5 mm, caducous, sometimes persistent; buds obovoid, globose to slightly prolate, 2–4×2–2.5 mm, apex obtuse to rounded, calyptra obtuse, sometimes slightly apiculate, cartaceous; hypanthium prolonged 1–1.8 mm beyond ovary, internally glabrous; petals 0–2, spatulate. Fruits globose to subglobose, 5–7×5–6 mm diam., red to vinaceous when mature. **Figures 3B–C.**

Phenology:—Flowers from September to March, fruits all over the year.

Distribution, habitat and conservation:—*Calyptranthes concinna* occurs in the states of the Southeastern and Southern regions of Brazil, in the Atlantic Forest domain. However, the species also occurs in the Cerrado (Sobral 2015). Outside Brazil, *C. concinna* occurs in Bolivia, Argentina, Paraguay and Uruguay (WCSP 2014). Assigned here as Least Concern (LC).

Representative specimens examined:—BRAZIL: **Rio de Janeiro**, Silva Jardim, Reserva Biológica Poço das Antas, 22º30'S, 42º19' W, 30 Oct 1992, *M. Peron et al. 976* (RB!); **Espírito Santo**, Santa Teresa, Estação Biológica de Santa Lucia, 24 Feb 2003, R.R. Vervloet et al. 1902 (MBML!, BHCB); **São Paulo**, Jeriquara, 17 Mar 1964, *J. Mattos &H. Bicalho 11553* (MAC!); Itararé, Fazenda Pisa, Poço do encanto, 24º12'09''S, 49º24'15''W, 18 Dec 1997, *S.L. Elias et al. 311* (BHCB!, ESA); **Minas Gerais**, Lima Duarte, 25 Feb 1999, E.N. Lughadha et al. 226 (K!). **Paraná**, Jaguariaiva, 19 Dec 1961. *G.Hatschbach 8736* (PEUFR!);Itaperuçu, Rio Açungui, 7 Dec 1995, *J. Cordeiro & J.M. Cruz 1266* (SPF!, MBM!, UB!); **Santa Catarina**, Rancho Queimado, Serra da Boa Vista, 25 Jan 1961, *P.R.Reitz &R.M. Klein 10762* (MBM!); Rio Grande do Sul, Cachoeira do Sul, 23 Apr 1983, *M. Sobral & D. Falkenberg 1821* (SP!, SPF!).

Calyptranthes variabilis and three of its varieties - *C. variabilis* var. *stricta*, *C. variabilis* var. *riparia*, *C. variabilis* var. *oblongata*, were described based in materials from the same place "*In prov. S. Pauli*" collected by Sellow. The type material of *C. variabilis* var. *stricta* is in the same sheet as *C. variabilis* var. *riparia* at the herbarium K, but with different tags and clearly based in different collections; the first one without a number and the last one numbered 5376. The type of *C. variabilis* var. *oblongata* bears no number. Those three varieties are clearly part of the same taxonomic entity, and are here treated under the synonymy of *C. concinna*. The variety *C. variabilis var. pulchella* was described by Berg based in a material connected by Widgren (1185) from Minas Gerais, the same locality and collector of the type of the species *Calyptranthes widgreniana*, which Berg himself described in *Flora Brasiliensis*. This fact clearly shows the similarity between the materials and the doubts about the boundaries of both species registered in the flora.

In 1962, Legrand considered *C. glomerata*, a species descbribed by Cambessèdes in 1833 based in a type material from Minas Gerais, under the synonym of *C. concinna* var. *glomerata*, a new variety described by him in the same work, based on materials from São Paulo, Santa Catarina, Rio Grande do Sul and Argentina, but with no type assigned, therefore we here assign a lecotype. However, in 1971, he describes a new variety, *C. concinna* var. *paulistana*, and included *C. glomerata*, *C. concinna* var. *glomerata* and two varieties of *C. variabilis* ("*riparia*" and "*pulchella*") under its synonym. Again, we see a lack of consensus between both authors (Berg and Legrand), and that the descriptions of new varieties and species along the years had led to a confused taxonomy.

Calyptranthes concinna and *C. widgreniana* are here treated as synonyms, *C. concinna* having the priority according to the nomenclatural code. Along many years, both names were used in identifications in Brazilian herbaria for the taxonomic entity that we here consider the same, and this is mainly due to the extent of its geographical distribution and differences in the habitat. These differences had led to morphological variations, sometimes very extreme, especially concerning the leaf shape, size, color and consistence (**fig. 3B**). The most preserved character observed, in all specimens analyzed, is the inflorescence pattern, which consists in a reduced panicle with one lateral branch, rarely a reduced second one, opposite, that gives it a "cross" appearance (**fig. 3C**). In a few specimens from Minas Gerais state, the inflorescence rarely have two or one reduced third lateral branch, but this variation do not support a separation in a different species. Specimens from northern limit of its geographical distribution, like Rio de Janeiro, Minas Gerais, Espírito Santo and São Paulo, tend to have longer leaves, chartaceous, drying pale green, longer inflorescences and a bigger quantity of flowers (up to eight agglomerated at their tips). By the time they reach the south of Brazil, Paraná and Santa Catarina, they tend to have smaller leaves, coriaceous, drying brown, smaller inflorescences and a lower quantity of flowers (up to three agglomerated at their tips). However, these characters were not enough to separate them as two different taxonomic entities. This morphological plasticity pattern occurs in other species that have a wide latitudinal distribution, and is described by other specialists (Nic Lughadha 1997) as a known difficulty when studying Neotropical Myrtaceae. One clear example is the species *Blepharocalyx salicifolius* (Kunth) O. Berg, which treatment in the Flora Neotropica (Landrum 1968) include 65 synonyms. This species has a very similar latitudinal distribution as *C. concinna* and the leaf variation had led to numerous species descriptions.

The characters used by Berg to describe *Calyptranthes obversa*, as well as the type image analyzed, were also not enough to separate it from *C. concinna*, therefore it is a new synonym here established. On the other hand, Legrand (1971) described the species *C. rubella* and compared it with *C. concinna var. paulistana*. However, the type material and the set of samples located in the visited herbaria have led us to recognize *C. rubella* as a distinct species, as described by Legrand. The variety "*paulistana*" is different from *C. rubella* and is here treated as a synonym of *C. concinna* as explained before. *Calyptranthes rubella* can be distinct from *C. concinna* by its longer and arched peduncles, much longer than the leaves, reaching 3 mm wide, with a much reduced lateral branch, about 6 or 7 times shorter than the total inflorescence length. Legrand pointed out that *C. rubella* occurs only in Santa Catarina state, however, the species also occurs in São Paulo and Paraná (see further description).

The species *C. paraguayensis*, here considered a synonym of *C. concinna*, is referred as a "*nomen nudum*" by the Tropicos site. However, the analysis of the protologue showed that the name has a very brief description, as well as an examined material. Therefore, we here do not consider it as a "*nomen nudum*" and the material is here cited, but no photos of any Paraguay herbarium were found. Isotypes with herbarium tags of the Paraguay flora at Paris Herbarium were found though, and according to the morphological anaylsis of this material, it is a synonym of *C. concinna*.

6.5.1.10 *Calyptranthes curta* Sobral & Aguiar (2012: 22). Type:—BRAZIL. São Paulo: Salesópolis, Casa Grande, Reserva Florestal Guaratuba, 4 Feb 1988, 23°39´S, 45°52´W, *G. Franco & A. Custódio Filho 437* (holotype BHCB- Image!; isotype SPF).

Trees up to 3 m high; twigs terete; young twigs and inflorescences appressed pubescent, leaves puberulent adaxially; hair simple or dibrachiate, greyish or brownish. Leaf blade elliptic, 0.5–1.1×0.2–0.6 cm, chartaceous, drying brownish adaxially, light brownish abaxially, discolorous; apex acute; base acute to cuneate; midvein sulcate above, prominent bellow; secondary veins slightly visible on both surfaces, slightly prominent on both sides; marginal vein 1.5–2 mm from margin; intramarginal vein absent; petiole 4–9×2–2.5 mm. Axillary solitaire reduced panicles, 0.7–1×0.12–0.15 cm, axis compressed, not branched, few flowered, flowers clustered in three at the tips; basal bracts absent; peduncle 0.5–0.7×0.12–0.15 cm; bracts cordiform, 3×4 mm, apparently caducous; flowers sessile; bracteoles elliptic, 2×1 mm, persistent; buds globose or ovate, 4–5×3 mm, apex acute, calyptra apiculate, apparently chartaceous; hypanthium prolonged up to 2 mm beyond ovary, not seen internally; petals one or two, spatulate; stamens up to 80. Fruits not seen.

Phenology:—Flowers collected in January.

Distribution, habitat and conservation:—It is known only for the type collection, from the Atlantic Forest at high altitudes (890–950 m) in São Paulo. The area also houses two species of *Calyptranthes* known for a few samples: *C. fusiformis* and *C. serrana*, both micro-endemic. The area is considered by Sobral *et al.* (2013) as well collected, therefore, *C. curta* must be a rare species and here it is assigned under Critically Endangered (CR), considering we did not found more samples of the species in the visited herbaria or in field trips.

The very short inflorescence length (peduncle 5–7 mm long) makes *C. curta* easy to be distinguished from all other species of *Calyptranthes* occurring in the Atlantic forest. The lack of more samples and the variability of inflorescence length in *Calyptranthes* are value tasks to believe that this species needs further studies to confirm its validity.

6.5.1.11 *Calyptranthes dryadica* Kawasaki (1998: 386). Type:—BRAZIL. São Paulo: Iguape, Ecological Reserve of Juréia-Itatins, trail of the fig tree, 14 Mar 1990, *L. Rossi et al. 542* (holotype: SP!; isotypes: MBM, MO, RB!).

Treelets 1.5–4m high, twigs terete; twigs puberulent, adaxial leaves surface glabrous, abaxial puberulous to glabrous, inflorescence and buds tomentose; hairs dibrachiate, ferruginous to yellowish brown. Leaf blade widely elliptic to elliptic, 10–17×5–9 cm, chartaceous, drying pale green to olive green adaxially, yellowish to greenish abaxially, discolorous; apex acute to acuminate; base cuneate; midvein sulcate above, prominent bellow; secondary veins barely visible adaxially, visible and prominent abaxially; marginal vein 2–3 mm from margin; intramarginal vein 1–3 mm from margin; petiole 8–15×2 mm. Terminal paired panicles, 3–8 cm long, axis terete, one to two lateral branches, opposite, few flowered, flowers clustered in one to three at the tips; basal bracts lanceolate, 8–10 mm long, 2–3 mm wide, caducous; bracts caducous, not seen; peduncle 2–3 cm long, 1–1.5 mm wide; flowers sessile; bracteoles linear, ca. 2 mm long, caducous; buds obovoid, 6–8×3 mm, apex apiculate, calyptra apiculate, chartaceous; hypanthium prolonged ca. 2 mm beyond ovary, internally glabrous; petals lacking. Fruits globose, 1.5–2 cm diam., wine-red to black when mature.

Phenology:—Flowers in March and April, fruits from June to December.

Distribution, habitat and conservation:—*Calyptranthes dryadica* occurs in the coastal forests of Brazil, in the states of Espírito Santo and São Paulo. It is consider Endangered (EN), due to its rarity and the conservation conditions of the habitat where it occurs.

Representative specimens examined:—BRAZIL: **Espírito Santo**, Castelo, Parque Estadual do Forno Grande, 20º30’58’’S 41º05’01’’W, 17 July 2008, *R. Goldenberg et al.1161* (MBML!); **São Paulo**, Iguape, Reserva Biológica Juréia-Martins, *M.P. Costa et al. 52* (SP!).

The species can be distinguished from the others *Calyptranthes* from Atlantic Forest by its few flowered inflorescence, with first to second-order branches, together with its large (6–8×3 mm) and tomentose flower buds, pyriform with apiculate apex, and large fruits (1.5–2 cm diam.).

6.5.1.12 *Calyptranthes fusiformis* Kawasaki (1996: 508). Type:—BRAZIL. São Paulo: Salesópolis, Reserva Biológica de Boracéia, 20 Dec 1993, *W. Wilms 424* (Holotype SP!).

Trees 2–4m high, twigs terete; essentially glabrous, young twigs, abaxial leaves surface and flower buds puberulent; hairs dibrachiate, greyish. Leaf blades narrowly elliptic or lanceolate, 13–18×3.5–5.5 cm, chartaceous, drying green to dark brown adaxially, pale green to greenish brown abaxially, discolorous; apex acuminate; base cuneate; midvein sulcate above, prominent bellow; secondary veins barely visible adaxially, impressed, visible and prominent abaxially; marginal vein 2–5 mm from the margin; intramarginal vein up to 1 mm from margin; petiole 10–15 mm long, up to 1 mm wide. Axillary paired panicles, 8–9 cm long, axis terete, one to two lateral branches, opposite, few flowered; basal bracts lanceolate, 1.5–3.5×0.3–0.5 cm, caducous; peduncle 3–4 cm long, 0.5–1 mm wide; bracts not seen; flowers sessile; bracteoles linear, ca. 1 mm long, caducous; buds fusiform, ca. 1 cm long, ca. 3 mm wide, apex acute, calyptra long rostrate, mostly membranaceous; hypanthium prolonged ca. 2 mm beyond ovary, internally glabrous; petals 3, spatulate; Fruits globose, 1–1.5 cm diam., dark wine-red when mature.

Phenology:—Flowers in December and January, fruits in September.

Distribution, habitat and conservation:—*Calyptranthes fusiformis* is endemic of the Atlantic forest of São Paulo, from which only three collections are known. It is considered Critically Endangered (CR).

Representative specimens examined:—BRAZIL: **São Paulo**, Biritiba, Estação Ecológica de Boracéia, 16 Jan 1990, *G.A.D.C. Franco & A. Custódio 1001* (CEN!, SPF!); Salesópolis, Biological Reserve of Boracéia, 7 Sep 1994, *R. Simão-Bianchini 536* (SP!).

Calyptranthes fusiformis resembles *C. lanceolata* (see description later), a species endemic from the Atlantic Forest of Brazil, from Bahia to Santa Catarina state, especially due to its lanceolate basal bracts (Kawasaki 1996). However, in *C. fusiformis* the buds are fusiform (as the epithet suggests), with a conspicuously rostrate calyptra, while in *C. lanceolata* the buds are obovoid, with an apiculate apex (rarely rounded) and apiculate calyptra, which sometimes can be slightly rostrate, but never as conspicuous as in *C. fusiformis*. Although some individuals of *C. lanceolata* are glabrous or puberulent, most of them have floccose indument, interspersed with puberulent, a type of indumentum not present in *C. fusiformis*. The size of the leaves used by Kawasaki (1996) to recognize both species clearly overlaps.

6.5.1.13 *Calyptranthes grammica* (Sprengel) Legrand (1962: 196); *Calyptranthes grammica* Legrand var. *grammica*; Basionym: *Myrtus grammica* Sprengel (1825: 480); *Chytraculia grammica* (Sprengel) Kuntze (1891:238). Type:—BRAZIL. *Sellow, s.n.* (lectotype K!, here designated).

Calyptranthes uniflora Sprengel (1837: 87), [non *C. uniflora* Proctor (1982: 272) *nom. illeg.* = *Calyptranthes proctorii* Acevedo-Rodrigues]. Type:—BRAZIL. *Martius 58* (type K!, isotype P!).

Calyptranthes musciflora var. *obscura* Berg (1857: 54). Type:—BRAZIL. [Rio de Janeiro]: "*ad littora fluvii prope Sumidouro in Montibus Serra dos Órgaos*", *Sellow s.n.* (type P!).

Calyptranthes musciflora var. *angustifolia* Berg (1857: 54).Type:—BRAZIL. [Minas Gerais]: "*in acumemontis Itacolomi prov. Minas Geraes*", *Sellow s.n.* (not found).

Calyptranthes musciflora var. *spathulata* Berg (1857: 54).Type:—BRAZIL. [Minas Gerais]: "*prope Cachoeiro do campo, prov. Minarum*", *Martius 58* (isotype P!, M-Image!)

Calyptranthes musciflora var. *triflora* Berg (1857: 54). Type: not known and not found.

Calyptranthes musciflora var. *glauca* Berg (1859: 543).Type:—BRAZIL. [São Paulo]: "*habitat ripas rivulorum montium Serra da Lapa*", *Riedel s.n.* (not found).

Shrubs to trees 1.5–2m high, twigs terete, sometimes alate; essentially glabrous, young twigs and abaxial surface of young leaves sometimes puberulent; hairs simple, whitish. Leaf blade spatulate to narrow-spatulate, rarely narrow elliptic (often the young leaves), 1.4–2.6×0.4–1.5 cm, chartaceous, drying green adaxially, pale green abaxially, discolorous; apex obtuse, sometimes slightly acute; base attenuate; midvein impressed above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein up to 0.5 mm from margin; intramarginal vein not seen; petiole 1.5–2 up to 1 mm wide. Axillary solitaire or paired reduced panicles, 1.2–2 cm long, axis terete, not branched, few flowered, flowers clustered in one to three at the tips; basal bracts not seen; peduncle 0.9–1.7 cm long, ca. 0.2 mm wide; bracts not seen; flowers sessile; bracteoles lanceolate to linear, 1 mm long, caducous; buds obovoid, 4–5×2–3 mm, apex obtuse, calyptra apiculate to acuminate, chartaceous; hypanthium prolonged ca. 1–1.5 mm beyond ovary, internally glabrous; petals 1–4, spatulate. Fruits subglobose, up to 5 mm diam.

Phenology:— Buds and flowers from November to February, fruits collected in February.

Distribution, habitat and conservation:— The species is scattered distributed in the pluvial forests at high altitudes in the states of Minas Gerais, Rio de Janeiro and São

Paulo. It is a relatively common species but with few collections available. Therefore, it is here assigned as Near Threatened (NT).

Representative specimens examined:—BRAZIL: **Minas Gerais**, Santana do Pirapama, 18º58'40"S 43º46'35"W, 18 Fev 2007, *V.C. Souza et al. 32636* (RB!, ESA); Caraça, Cachoeira do Belchior, 12 Dec 1986, M.B. *Horta et al. 13* (BHCB, RB!); **Rio de Janeiro**, Itatiaia, Parque Nacional de Itatiaia, 22º15'S 22º28W, Ponte do Maromba, 21 Nov 1994, *J.M.A. Braga et al. 1554* (RB!, CEPEC!, K!); **São Paulo**, Cunha, Parque Estadual da Serra do Mar, 11 Fev 2005, *N.M. Ivanauskas et al. 5182* (SP!); Salesópolis, Estação Biológica Boracéia, 29 Nov 1967, *J. Mattos & N. Mattos* (SP!).

Berg (1957, 1959) described and recognized *Calyptranthes musciflora* and six varieties by the leaves shape and number of flowers, as well as *C. uniflora* which is based on having a single flower. However, the characters used showed a wide variability among the studied samples showing no support for the names published by him. *Calyptranthes grammica* is morphologically similar to *C. caudata* and *C. angustifolia*, and its affinities were already discussed (see *C. caudata*).A specimen with the tag "*Myrtus grammica*" by Sprengel was found at K herbarium marked as "type", and we here choose this material as the lectotype.

6.5.1.14 *Calyptranthes lanceolata* Berg (1857:51). *Chytraculia lanceolata* (Berg) Kuntze (1891:238). Type:—BRAZIL. Rio de Janeiro: *Glaziou 2588* (Neotype designated by Araújo & Lucas 2013, K!: isoneotype P!).

Calyptranthes anceps Berg (1857:40). *Chytraculia anceps* (Berg) Kuntze (1891:238). Type:—BRAZIL. [Rio de Janeiro]: *Martius s.n.* (Lectotype designated by A.C. Araújo & E. Lucas 2013, BR- Image!). *syn. nov.*

Calyptranthes lanceolata Berg *var. latifolia* Berg (1859: 540). Type:—BRAZIL. [Rio de Janeiro]: *Habitat in montibus Serra de Boa Vista et Corcovado prov. Rio de Janeiro: Riedel.* (Holotype not found).

Calyptranthes lanceolata Berg *var. catharinensis* Legrand (1962: 198). Type:—BRAZIL. Santa Catarina: *Reitz & Klein 2000* (Holotype MVM: isotypes HBR!,US-Image!).

Calyptranthes ubatubana Sobral & Rochelle (2014: 500). Type:—BRAZIL. São Paulo: Ubatuba, Picinguaba, fazenda Capricórnio, Jul 2007, *A. Rochelle 228* (Holotype UEC-Image!, isotypes: HUFSJ, RB). *syn.nov.*

Trees, treelets or shrubs 3–10m high, twigs terete; old branches and adaxial surface of leaves glabrous, young branches, abaxial surface of young leaves, inflorescences and flowers with floccose indument, interspersed with puberulent, some individuals pubescent to glabrescent; hairs simple, floccose or dibrachiate, brownish, the floccose whitish. Leaf blade oblong to lanceolate, 14.5–36×3.2–8.2 cm, chartaceous, drying brownish, sometimes greenish, discolorous; apex acuminate, shortly acuminate, attenuate or acute; base obtuse to cuneate, rarely attenuate; midvein prominent above in the majority of the individuals, but sometimes impressed or sulcate, prominent bellow; secondary veins barely visible on both surfaces; marginal vein 1–4 mm from margin; intramarginal vein 0.2–2 mm from margin; petiole 8–17 mm long, up to 2 mm wide. Terminal paired or solitaire panicles, (–6)10–31 cm long, axis compressed, two to five lateral branches, sometimes more than one coming from the same point, opposite, few or many flowered, flowers clustered in three to five at the tips; basal bracts lanceolate, 1.2–8 cm long, persistent; peduncle (–3.8)6–15 cm long, 0.2–2.5 mm wide, sometimes alate; bracts linear, up to 2 mm long, caducous; flowers sessile; bracteoles linear, up to 1 mm long, caducous; buds obovoid, 5–9×4 mm, apex apiculate, rarely rounded, calyptra apiculate or slightly rostrate, chartaceous to coriaceous; hypanthium prolonged 1–3 mm beyond ovary, internally glabrous; petals lacking. Fruits globose, 5–8 mm diam. green when immature, color when mature not seen. **Figures 7A–D.**

Phenology:—Flowers from November to July, fruits from August to November.

Distribution, habitat and conservation:—The species is endemic to the Atlantic Forest of Brazil from southern Bahia to Santa Catarina state. Despite being found in a considerable large extension area, it is still a threatened ecosystem, thus, the species is here considered Vulnerable (VU).

Representative specimens examined:—BRAZIL: **Bahia**, Camamu, 15 Jun 1979, *L.A. Mattos Silva et al. 492* (CEPEC!, K!); Itacaré, 20 Nov 1991, *A. Amorim et al. 457* (CEPEC!, K!); Uruçua, 14º29'59''S 39º6'54''W, 18 Mar 2004, *P. Fiaschi et al. 2028* (CEPEC!, SPF!). **Espírito Santo**: Mimoso do Sul, Fazenda Pratinha, 21º5'20.7''S 41º21'02.2''W, 24 Jan 2011, *P. Fiaschi et al. 3575* (RB!, MBML!, SPF!). Rio de Janeiro: Rio das Ostras, 11 Mar 1999, *P. Oliveira 199* (BHCB!). **São Paulo**: Pariquera-Açu, Estação Experimental do Instituto Agronômico, 24º36'S 47º52'W, 24 Apr 1996, *N.M. Ivanauskas et al. 970* (HUEFS!). **Paraná**: Paranaguá, Morro do Tabaquara, 22 Apr 1967, *G. Hatschbach 16357* (HB!).

Calyptranthes anceps was described in the same *obra princeps* as *C. lanceolata*, in a previous page. The nomenclatural code does not specify which name should be used if two species published in the same work are synonymized, therefore, we here chose the most used name, *Calyptranthes lanceolata*, as the valid name for the species.

Calyptranthes ubatubana is a recently described species, and the main features to distinguish it from *C. lanceolata* are the densely pilose inflorescence with crowded flowers at their apices. But those characters were not enough to separate both species, because they overlap when you compare with a bigger sample of *C. lanceolata*. Some individuals of *C. lanceolata* can have congested flowers at the tips of the inflorescences, and the type of indument is something that vary in the species. Many other characters such shape and size of leafs, size, type and shape of basal bracts, peduncle and total inflorescence length, shape and size of the flower buds and the petals lacking also overlaps – it was not possible to find characters to separate them. Therefore, we consider here *C. ubatubana* as a new synonym. Even with this variation, *C. lanceolata* can be recognized mainly by its lanceolate leaves together with the lanceolate, long and persistent basal bracts.

None Riedel collections of *C. lanceolata var. latifolia* Berg were found in the visited herbaria, but enough material from Rio de Janeiro, Corcovado, with Berg's handwriting "*C. lanceolata*" was analyzed. Therefore, according to the data available in the protologue description, *C. lanceolata var. latifolia* is a synonym of *C. lanceolata*. Legrand (1971) described *C. lanceolata* Berg *var. catharinensis*, as a variety with longer leaves occurring in Santa Catarina state, southern Brazil. He also pointed out that the variety previously described by Berg (*latifolia*) was an intermediate between the typical one and *catharinensis*. As the main features used to distinguish the varieties are the leafs size and shape, features known to be widely plastic in some species of *Calyptranthes*, and in this species this can be observed, we do not agree in considering the different morphotypes as distinct taxonomic entities. *Calyptranthes lanceolata* resembles *C. fusiformis* and its affinities were already discussed before (see *C. fusiformis*).

6.5.1.15 *Calyptranthes lucida* Martius ex De Candolle (1828: 258); *Chytraculia lucida* (Martius) Kuntze (1891: 238). *Calyptranthes lucida* Martius ex De Candolle *var. lucida* (1971:526). Type:—BRAZIL. Bahia: *Martius 2124* (Lectotype designated here M).

Calyptranthes pohliana Berg (1859:42); *Chytraculia pohliana* (Berg) Kuntze (1891: 238); Type:—BRAZIL. [Goiás]: "*Habitat ad Engenho da Donna Feliciana in prov. Goyaz*", *Pohl 1076* (holotype W-image!, isotypes: K!, M-image!, BR-image!).

Calyptranthes affinis Berg (1859: 43); *Chytraculia affinis* (Berg) Kuntze (1891: 238).Type:—BRAZIL. [Rio de Janeiro]: "*Habitat in montibus Serra dos Orgàos*", *Martius 57* (type M, isotype NY-image!).

Calyptranthes polyantha Berg (1859: 541); *Chytraculia polyantha* (Berg) Kuntze (1891: 238); *Calyptranthes lucida* Martius ex De Candolle var. *polyantha* Legrand (1971:531). *syn. nov*. Type:—BRAZIL. Rio de Janeiro: *Riedel 1832* (holotype G-Image!; isotypes K!, P!, M-Image!).

Calyptranthes luetzelburgii Burret ex Luetzelburg (1923: 200), *nom. nud.* Type:—BRAZIL. Paraíba: *Luetzelburg 1222* (holotype M!). *syn. nov*.

Calyptranthes lucida Mart. ex De Candolle. var. *lucida* forma *hilariana* Legrand (1971:530). Type:—BRAZIL. Goiás: "Rancho do Guarda-Mor", *St. Hilaire*. (holotype not found) *syn. nov*.

Trees 4–7m high, twigs mainly terete, sometimes alate; essentially glabrous, abaxial surface of the leaves, inflorescences and base of the flower buds sometimes puberulent, rarely sparsely pubescent; hairs simple, greyish, rarely yellowish. Leaf blade elliptic, elliptic-ovate, narrow-elliptic to lanceolate, 4–11×1.8–4.5 cm, chartaceous to coriaceous, sometimes slightly membranaceous, drying pale greenish, concolorous; apex acute, attenuate, acuminate to long acuminate; base cuneate, attenuate, rarely rounded; midvein sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein 0.5–1 mm from margin; intramarginal vein absent; petiole 4–7 mm long, up to 1 mm wide. Terminal or axillary paired or solitaire panicles, 4–5.6 cm long, axis terete to compressed, sometimes alate, one to four lateral branches, opposite or alternate, many flowered, flowers clustered in three at the tips; basal bracts rarely present, lanceolate, ca. 1 cm long, caducous; peduncle 1.4–2.2 cm long ,0.5–1 mm wide; bracts linear, up to 1 mm long, caducous, sometimes persistent; flowers sessile; bracteoles linear, up to 0.5 mm long, caducous, rarely persistent; buds obovoid to globose, 1–3×1–2 mm, apex rounded, calyptra shortly apiculate, mostly membranaceous; hypanthium prolonged 1–1.5 mm beyond ovary, internally glabrous; petals lacking. Fruits globose or subglobose, 4–8×6–9 mm, yellow to red when mature. **Figures 8A–F.**

Phenology:— Flower and buds from august to april, fruits all over the year.

Distribution, habitat and conservation:— The species is widespread from the north of South America (Venezuela, Bolivia, Colombia, Suriname and French Guiana) reaching Brazil, where is widespread. Thus is here considered Least Concern (LC).

Representative specimens examined:—BRAZIL: **Paraíba**, Cacimba de Areia, Serra de Teixeira, Pico do Jabre, 7º11'10"S, 37º08'22"W, 25 Feb 1994, bt., fl., *M.F. Agra, et al.*

2635 (JPB!); **Pernambuco**, Arcoverde, Serra das Varas, 8°25'48"S, 37°02'61"W, alt. 970m, 21 Feb 2006, *R. Pereira* et al. *2613* (HUEFS!, IPA!); **Bahia**, Cachoeira, vale dos rios Paraguaçu e Jacuípe, 12º32'S 39º05'W, Nov 1980, bt., *Gr. Fl. Ped. Cavalo 886* (ALCB!); **Maranhão**, Carolina, margem esquerda do Rio Sereno, 07º36'11''S 47º18'40''W, 30 Aug 2008, *G. Pereira-Silva et al. 13657* (CEN!). **Espírito Santo**, Linhares, Reserva Natural da CVRD, 23 Dec 2005, D.A. Folli 4722 (CVDR!); **Rio de Janeiro**, Nova Friburgo, Reserva Ecológica de Macaé de Cima, 22º00'S 42º03'W, 20 April 1989, *Lima et al. 3568* (SP!); **Paraná**, Guaraqueçaba, 11 Jan 1968, *Hatschbach 18261* (R!, RB!, MBM!); **Santa Catarina**, Itajaí, Morro da Ressacada, *Reitz & Klein 1523* (HBR!, MVM); **Mato Grosso**, margem do Rio Casca, 19 Sep 1988, *M. Pereira 391* (RB!); **Amapá**, *M. Bastos 97* (RB!); **Pará**, Canaã dos Carajás, Mata baixa. 700 m. 4 Aug 2010. *L.C.V. Silva et al.* 1018. (BHCB!, RB!); **Amazonas**, Carauari, Rio Juruá, 15 Oct 1980, *P. Lisboa 1960* (INPA!); VENEZUELA: Slope of Mount Duida, Aguita, 1928, *G.H.H. Tate* (NY- Image!); SURINAME: Tafelberg, Grace Falls, 26 Aug 1944, *Maguire 24491* (RB!, NY-Image!, F!-Image).

Calyptranthes lucida was described with the type collection locality assigned "*Brasilia, Bahia*" and "*in herb. Mart.*". Berg (1859) cited three materials, one of them from Bahia state. The material here assigned as the lectotype is located at the Martius herbarium (M), has Berg's handwriting identification as *C. lucida*, as well as the locality "*Brasilia prov. Bahia*", and matches both previous descriptions. Despite being before annotated by Lucas and Araújo (herbarium tag) as a *C. lucida* isotype, we do not consider it the holotype, since we are not sure it was the only sample used to describe the species, or if it is the only existing sample of the same collection. We here designate it as a lectotype.

Berg (1859) had already pointed out the weakness in the delimitation of some species described by him, here recognized as synonyms. *Calyptranthes affinis* is a clear example, as one of the collections analyzed by Berg (*Martius 57*) was previously recognized by Martius as *C. lucida*, in his field notebook. Legrand (1971) considered *C. polyantha* as a variety under *C. lucida*, *C. pohliana* being a synonym of the typical variety. We here believe that, due to the wide distribution of the species, the features used by him to recognize the varieties do not reflect its real variability, since the samples used in his work were mostly restricted to the south of Brazil. Still concerning the species described by Berg, *C. polyantha* appears under the synonym of *C. grandifolia* (Sobral 2003), with a reference to Legrand's work, but that was a mistake committed by the author because in Legrand's work this synonym is not cited.

Calyptranthes luetzelburgii is a *nomen nudum*, but the type collection is clearly indicated in the protologue (Luetzelburg 1923). The type analysis, together with other samples that match the type and the distribution area in the Caatinga of Pernambuco and Paraíba states, overlap with the *C. lucida* description, so the name was considered a synonym and first recorded for the Caatinga vegetation of Brazil (Lourenço & Alves in prep.), in the same publication of the synonimization of *C. grandiflora*.

McVaugh (1958) believed that *C. lucida* has a disjunct distribution interrupted by the Amazon River, and that probably more than one species could exist. But him, like the previous authors, did not analyze a big set of samples, and according to all the data collected and morphological analysis carried out, we here recognize that the species is widely distributed, with remarkable morphological plasticity, especially the leaves length and shape, in a similar way to *C. brasiliensis*. *Calyptranthes lucida* can be recognized by drying pale green, fragile and many flowered panicles, linear bracts and bracteoles and flowers with a mostly membranaceous calyptra, differing from *C.*

pulchella, its closely related species, basically by its leaves shape and apex. But a revision of the Amazonian species is much needed for a further understanding of the boundaries of the likely existence of more than one species.

6.5.1.16 *Calyptranthes maritima* Sobral & Bertoncello (2012: 26). Type:—BRAZIL. São Paulo: Ubatuba, Parque Estadual Serra do Mar, 9 Dec 1989, *A. Furlan 1078* (holotype: BHCB; isotype: HRCB).

Trees 4–21 m high, twigs terete; young twigs densely villose, leaves puberulent to glabrous, inflorescences villose to pubescent; hairs simple to dibrachiate, ferruginous. Leaf blade elliptic to lanceolate, sometimes lanceolate-obovate, 14.5–24×6.2–10.6 cm, chartaceous, drying dark green or brown adaxially, brownish abaxially, discolorous; apex acuminate; base cuneate; midvein sulcate above, prominent bellow; secondary veins visible on both surfaces, impressed or slightly sulcate abaxially, prominent abaxially; marginal vein 3.5–5 mm from margin; intramarginal vein 0.5–1 mm from margin; petiole 14–19×1.7–2.2 mm. Axillary solitaire panicles, 10.5–14 cm long, axis terete, three to five lateral branches, sometimes more than one coming from the same point, opposite, many flowered, flowers clustered in three at the tips; basal bracts narrowly lanceolate, 2–2.5×0.4–0.6 cm, caducous; peduncle 4.5–5 cm long, 1.8–2 mm wide; bracts triangular-lanceolate to linear, 2–2.2 mm long, caducous; flowers sessile; bracteoles linear to narrowly triangular, 1 mm long, caducous; buds prolate to obovoid, 2.8–3×2–2.5 mm, apex acute, calyptra acute, consistency not observed; hypanthium prolonged 1 mm beyond ovary, internally not seen; petals lacking. Fruits not seen.

Phenology:—Flowers collected in November and December.

Distribution, habitat and conservation:— Restricted to São Paulo state in the northeastern slopes of the Serra do Mar mountain range, as well as another species like *C. serrana* and *C. fusiformis*. Assigned here as Critically endangered (CR).

The type specimen is not available in the cited herbaria. *Calyptranthes maritima* is cited as morphologically related to *C. strigipes* (a sympatric species, despite a wider distribution), differing by longer petioles, blades and inflorescences (petioles 4–8 mm, blades 8–9×2.5–4 cm and inflorescences 4–7 cm long in *C. strigipes*), as well as the quantity of flowers, less than 100 in *C. strigipes* vs. more than 100 in *C. maritima* (Sobral et al. 2012). Secondary veins visible on both surfaces (in dried specimens at least) in *C. maritima* is also a distinctive character to separate them.

6.5.1.17 *Calyptranthes martiusiana* De Candolle (1828: 257); *Chytraculia martiusiana* (De Candolle) Kuntze (1891: 238).Type:—BRAZIL. Rio de Janeiro: "*Habitat in silvis primaevis adviam Felisberti*" (lectotype M, here designated).

Calyptranthes dichotoma Casaretto (1843: 47).; *Chytraculia dichotoma* (Casaretto) Kuntze (1891: 238). Type:—BRAZIL. [São Paulo] "*Habitat in prov. São Paulo", Riedel s.n.* (holotype LE- Image!). *syn. nov.*

Trees or shrubs 2–6m high, twigs glabrous, abaxial surface of young leaves with a floccose indument, old ones puberulous to glabrous, inflorescence axis appressed pubescent to puberulent, flower buds, flowers, bracts and bracteoles strongly appressed pubescent; hairs simple, dibrachiate or floccose, whitish to ferruginous. Leaf blade elliptic to obovate, 10–12×4.5–5.5 cm, chartaceous, drying brownish, concolorous; apex obtuse, rarely acute; base cuneate, rarely rounded; midvein sulcate above, prominent bellow; secondary veins visible on both surfaces, slightly prominent or impressed adaxially, prominent abaxially; marginal vein 2–4 mm from margin; intramarginal vein up to 1 mm; petiole 8–11 mm long, 1.5–2 mm wide. Axillary paired or solitaire panicles, 5–10 cm long, axis compressed, one lateral branch, rarely a second one, opposite, few flowered, flowers clustered in one to three at the tips; basal bracts, caducous not seen; peduncle 3.5–9 cm long, 1–1.5 mm wide; bracts not seen; flowers sessile; bracteoles rounded, ca. 5 mm long, caducous, evolving the flower bud; buds prolate, 3×4–5 mm, apex rounded to acuminate, calyptra apiculate, cartaceous; hypanthium prolonged ca. 2 mm beyond ovary, internally pilose; petals not seen; stamens not seen. Fruits not seen.

Phenology:—Flowers and buds collected in November and January.

Distribution, habitat and conservation:— The species can be considered rare, since it is known for only a few historical samples, analised hundreds of years ago by De Candolle and Berg. Apart from those old collections, it was found only two more collections made in the 20th century, occurring in disturbed areas, restricted to Bahia and Rio de Janeiro states. Therefore, we consider *C. martiusiana* Endangered (EN).

Representative specimens examined:—BRAZIL: “*in Brasilia*”, *Pohl s.n.* (BR-Image!); *Menke 91* (BR-Image!); **Bahia**: Itapebí, rod. Ventania-Itapebí, 8 november 1967, bt., *Pinheiro & Santos* 381 (CEPEC!, K!); Rio de Janeiro: *“ad Tocaia”* , *Schott n. 1039* (K!); *Riedel 538* (R!); **Rio de Janeiro**: Silva Jardim, Reserva Biológica Poço das Antas, entre a BR-101 e a ponte da linha férrea, 24 Jan 1994, *Farias et al. 120* (CEPEC!, RB!, K!); *Riedel 558* (R!).

Calyptranthes martiusiana can be distinguished from the other Atlantic Forest species, mainly due its compound cyme inflorescence pattern, few flowered, peduncle 3.5–9 cm long, together with pubescent flower buds, covered by a long (ca. 5 mm long) rounded bracteole, which can be easily seen in the first stages of the inflorescence development. The designation of the lectotype here follows the same concept adopted in previous species (*C. lucida* and *C. grammica* for example).

6.5.1.18 *Calyptranthes obovata* Kiaerskou (1893: 38), [non *C. obovata* Krug & Urban (1895: 600) *nom. illeg.* = *Calyptranthes kiaerskovii* Krug & Urban]. Type:—BRAZIL. Rio de Janeiro: *Glaziou 17662* (lectotype: C, designated by Araújo & Lucas 2014, isolectotypes: P!, R!, K!, G, F, NY, US)

Calyptranthes hatschbachii Legrand (1958: 1). Type:—BRAZIL. Paraná: "*Campiña Grande do Sur, Campininha*", *Hatschbach 3466* (MBM- Image!). *syn. nov.*

Trees or treelets 4–15 m high, twigs terete, rarely alate; twigs and adaxial surface of leaves glabrous, young twigs, abaxial surface of leaves and inflorescences densely appressed pubescent to puberulent; hairs simple or dibrachiate, ochre to ferruginous. Leaf blade obovate to rhomboid, 2.5–5.5 (–7.5)×1.1–4 cm, coriaceous to chartaceous, the adaxial surface drying green, the abaxial surface drying ferruginous or pale green, discolor; apex acuminate to apiculate; base attenuate; midvein impressed to slightly sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein up to 1.5 mm from margin; intramarginal vein inconspicuous when present, ca. 0.5 mm; petiole 2–5 mm long, up to 2 mm wide. Axillary paired panicles, 5–6 cm long, axis terete, one to three lateral branches, opposite to alternate, few flowered; basal bracts lacking; peduncle 1–3.5 cm long up to 1.5 mm wide, sometimes alate; bracts lacking or very reduced, linear; flowers sessile; bracteoles not seen; buds obovoid, sometimes pyriform, 3–4×2 mm, apex rounded to obtuse, calyptra apiculate to slightly rostrate, cartaceous to coriaceous; hypanthium prolonged ca. 1.5 mm beyond ovary, internally glabrous; petals lacking. Fruits globose, ca. 5 mm diam., vinaceous when mature. **Figure 6D.**

Phenology:— Flower and buds from October to February, fruits from March to August.

Distribution, habitat and conservation:— *Calyptranthes obovata* is endemic of the Atlantic forest of Brazil, occurring mostly in the pluvial forests with high altitudes in the states of Minas Gerais, Espírito Santo, Rio de Janeiro, Paraná and Santa Catarina, seeming to be a species restricted to well conserved and wet areas. As well as another species of *Calyptranthes* endemic to the Brazilian Atlantic Forest, we here consider it Vulnerable (VU).

Representative specimens examined:— **Minas Gerais**: Lima Duarte, Mata Grande, 25 Jan 2007, *R.C. Forzza et al. 4454* (BHCB!, RB!, SPF!). **Rio de Janeiro**: Nova Friburgo, Reserva Ecológica Municipal de Macaé de Cima, 22º00'S 42º03'W, 18 Aug 1989, *M. Peron et al. 859* (BHCB!, RB!). **Santa Catarina**: Florianópolis, Morro do Ribeirão, 16 May 1967, *R.M. Klein 7396* (MVM!). **Paraná**: Bocaiúva do Sul, trilha da borda do Rio Capivari, 30 Oct 2003, *E. Lucas et al. 147* (K!); Quatro Barras, 26 Jan 1994, *C.V. Roberjan 1127* (MBM!, SPF!, UB!); Morretes, 11 Nov 1965, *G. Hatschbach 13127* (R!).

Regarding its morphology and geographical distribution, *Calyptranthes obovata* is very similar to *C. pulchella*, and Kiaerskou pointed it out in the species protologue. He used the apex of the leaves as the main character to separate both species, abruptly short acuminate to acuminate in *C. obovata*, versus rounded or obtuse in *C. pulchella*. We here analised a bigger set of samples, and we agree with this separation, despite some individuals having dimorph young leaves in the apex of the branches, sometimes elliptic or lanceolate. But it is important to stress that when the leaves are fully developed, this character is distinctive. This dimorphism can be observed in *C. pulchella* as well (see the comments), and it was also observed by Legrand in the *C. hatschbachii* protologue, a species here considered as a synonym of *C. obovata*. Legrand used the indument to separate *C. hatschbachii* from *C. obovata* in its protologue, together with the alate branches, but it was observed that these characters do not sustain two different species, since it varies along its geographical distribution.

6.5.1.19 *Calyptranthes ouropretensis* A.R. Lourenço *sp. nov*. Type:—BRAZIL. Minas Gerais: Ouro Preto, Serra of Antônio Pereira, Campo rupestre on ferruginous "canga", 20º10'S, 43º31'W, 21 Nov 2007, *M.C.T.B. Messias et al. 1544* (holotype: BHCB!; isotype: OUPR!).

Shrubs up to 3m high, twigs mostly sulcate, rarely terete; twigs pubescent, adaxial surface of young leaves glabrous to slightly puberulous, abaxial surface strongly tomentose, the old ones tomentose, sometimes glabrescent, inflorescences, buds and flowers tomentose to pubescent; hairs simple or dibrachiate, ferruginous. Leaf blade cordate, sometimes orbicular-cordate, decussate, 8.5–15.5×6–11.5 cm, coriaceous, drying brownish, slightly discolorous; apex acute to obtuse; base cordate to subcordate, sometimes amplexicaul; midvein sulcate to impressed above, prominent bellow; secondary veins slightly visible on both surfaces, slightly prominent adaxially, prominent abaxially; marginal vein 5–11 mm from the margin; intramarginal vein 2–3 cm from margin; sessile, or subsessile, petiole up to 2×2 mm. Axillary paired or solitaire panicles, 8.5–15 cm long, axis extremely compressed and angular, striate, one to four lateral branches, opposite, many flowered, flowers clustered in three at the tips; basal bracts naviculiform, up to 5 mm long, caducous; peduncle 6.5–7.5 cm long, ca. 3

mm wide; bracts lanceolate, up to 2 mm long, caducous; flowers sessile; bracteoles linear to lanceolate, up to 3 mm long, caducous; buds prolate to obovoid, 4–6×2–3 mm, apex rounded, calyptra shortly apiculate, coriaceous; hypanthium prolonged 1.5–2 mm beyond ovary, internally glabrous; petals 1–2, spatulate. Fruits globose, ca. 5 mm diam., yellow to red when mature. **Figures 9F–I.**

Phenology:—Flowers from November to March, fruits in July.

Distribution, habitat and conservation:—*Calyptranthes ouropretensis* is endemic from the ironstone outcrops of Minas Gerais thus far. Therefore, the species is here considered Vulnerable (VU).

Representative specimens examined:—BRAZIL: **Minas Gerais**, Barão de Cocais, Mina de Brucutu, 9 feb 1999, *M.R.S.M. Marques-Leitão et al., s.n.* (BHCB!); Mariana, Córrego do macaco barbado, Samarco Mineração, 4 dec 1996, *M. Ronhel & J. Craig, s.n.* (OUPR!).

Among *Calyptranthes* species, it can resemble to *C. brasiliensis*, especially some morphotypes with coriaceous leaves and ferruginous indumentum that occurs in the coastal forests and opened habitats including Campos rupestres (Lourenço & Barbosa 2012, Sobral et al. 2015) but differs by having the twigs mostly sulcate (vs. mainly terete, sometimes compressed in *C. brasiliensis*), sessile to subsessile leaves (vs. petiolate) with cordate to subcordate base (vs. cuneate or rounded).

6.5.1.20 *Calyptranthes pauciflora* Berg (1859: 543); *Chytraculia pauciflora* (Berg) Kuntze (1891: 238). Type:—BRAZIL. [Rio de Janeiro]: "*Habitat in silvis prope Mandiocca*", *Riedel s.n.* (holotype: LE- Image!).

Shrubs to trees 2–4.5m high, twigs terete; young twigs and inflorescence scattered pubescent; type of hair not seen. Leaf blade elliptic, 5.8–8.1×2.7–3.6 cm, chartaceous, drying green adaxially, pale green abaxially, discolorous; apex acuminate; base cuneate; midvein impressed above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein ca. 1 mm from margin; intramarginal vein not seen; petiole 2.2–4 mm long, up to 2 mm wide. Axillary or terminal solitaire reduced panicles, 2.5–3.7 cm long, axis terete, not branched, few flowered, flowers clustered in one to three at the tips; basal bract not seen; peduncle 2–3.1 cm long, 1–2.5 mm wide; bracts not seen; flowers sessile; bracteoles not seen; buds obovoid 4×6.7 mm long, apex acute, calyptra apiculate, membranaceous; hypanthium not seen; petals lacking. Fruits subglobose, 1 cm diam., color when mature not seen.

Phenology:—Fruits from June to August.

Distribution, habitat and conservation:— The species in endemic of Rio de Janeiro state thus far, occurring in the pluvial forests at high altitudes. It is here considered as Endangered (EN).

Representative specimens examined:—BRAZIL: **Rio de Janeiro**, Teresópolis, Posse, 22º22’18’’S 43º01’35’’W, 25 Aug 2002, *R. Marquete et al. 3379* (RB!); Petrópolis, 19 Jun 2002, *L.C. Giordano et al.* 2229 (RB!).

Calyptranthes pauciflora can be mainly characterized by being essentially glabrous with acuminate leaves, fusiform flower buds and inflorescence not branched.

6.5.1.21 *Calyptranthes pileata* Legrand (1962: 199).Type:—BRAZIL. Santa Catarina, Blumenau, morro Spitzkopf, *Reitz & Klein 4159* (holotype MBM, isotype HBR-image!, K!).

Calyptranthes dusenii Kausel (1972: 98). Type:—BRAZIL. Paraná, "*Banhado in silva prim*.", 30 Dec 1908, *Dusén 7411* (Holotype HBR, isotype P!, K!, S- Image!).

Calyptranthes pileata Legrand var. *riograndense* (1962: 201) Type:—BRAZIL. Rio Grande do Sul, São Leopoldo, *s.d., S.J. Theissen* 7730 (holotype ICN).

Trees up to 9 m high, twigs terete; essentially glabrous, base of the flower buds sometimes puberulent; hairs simple, greyish. Leaf blade elliptic to elliptic-lanceolate, 5.6–7×2–5.5 cm, coriaceous, drying brownish adaxially, brownish to ferruginous abaxially, discolorous; apex acuminate; base acute to attenuate; midvein impressed above, prominent bellow; secondary veins barely visible on both surfaces, sometimes slightly prominent abaxially; marginal vein 1–2 mm from margin; intramarginal vein not seen; petiole 5–9 mm long, ca. 2 mm wide. Axillary solitaire panicles, 5–6.5 cm long, axis slightly compressed, one to two lateral branches, opposite, few flowered, flowers clustered in one to three at the tips; basal bracts not seen; peduncle 3.5–4.5 cm long, ca. 1–2 mm wide; bracts probably lacking, not seen; flowers sessile; bracteoles probably lacking, not seen; buds rostrate to rostrate-obovoid, 4–8×3–3.5 mm, apex acuminate, calyptra rostrate, coriaceous to chartaceous; hypanthium prolonged 3–4.5 mm beyond ovary, internally glabrous; petals 1–2, spatulate to rounded. Fruits pyriform, up to 1.5 cm diam., vinaceous to black when mature. **Figures 4C–D.**

Phenology:— Flowers from December to January, fruits from August to October.

Distribution, habitat and conservation:— Legrand (1971) stated that *C. pileata* is characteristic from the pluvial Forest of the south of Brazil, found only in Santa

Catarina state, but possibly with a wider distribution. It is here presented that the species also occurs in Paraná and Rio Grande do Sul. A specimen from Espírito Santo state also matches the description given by Legrand, but with slightly differences in the leaf, so, we here consider that the species probably has a wider distribution, but further collections need to be made. Assigned as Vulnerable (VU).

Representative specimens examined:—BRAZIL: **Paraná**, Morretes, Estrada Graciosa, Alto da Serra, 30 Jul 1968, *Hatschbach 19758* (R!, RB!, MBM!); Quatro Barras, Serra da Baitaca, 24 Dec 1996, J. Cordeiro & E. Barbosa 1343 (MBM!, SP!, HUEFS!); **Santa Catarina**, Serra da Boa Vista, Rancho Queimado, 11 Aug 1960, *Reitz & Klein 9726* (R!, RB!); **Espírito Santo**: Vila Velha, Morro do convento da Penha, 11 Sep 2009, *D.A. Foli 6410* (CVRD!).

The occurrence of the species in Rio Grande do Sul is referred as the variety *C. pileata* var. *riograndensis*, but the type was not found in the visited herbaria. However, we here assign the variety as a synonym, based on its description and on the discussion in Legrand (1971).The most striking feature of *C. pileata* is its pyriform fruits, up to 1.5 cm diam., and it can be distinct among another species of *Calyptranthes* together with the glabrous and acuminate leaves and fusiform buds, forming a false compound cyme.

6.5.1.22 *Calyptranthes pteropoda* O. Berg (1857: 47); *Chytraculia pteropoda* (Berg) Kuntze (1891: 238). Type:—BRAZIL. [Minas Gerais], "*Habitat in prov. Minas Geraes*", *Widgren 549* (Lectotype: S, isolectotypes: BR- Image!, HUEFS!, SP!, US-Image!)

Shrubs to trees 2–8m high, twigs terete, sometimes sulcate; young twigs, abaxial surface of leaves puberulent to glabrescent, the inflorescences and buds covered by tomentose to lanate hairs; hairs simple, lanate, greyish to yellowish. Leaf blade lanceolate-oblong, lanceolate to elliptic, 6.5–12×2.7–3.8 cm, chartaceous, drying pale green abaxially, pale green to yellowish green abaxially, discolorous, sometimes concolorous; apex acuminate; base attenuate to cuneate; midvein impressed above, prominent bellow; secondary veins slightly visible on both surfaces, impressed to slightly prominent adaxially and abaxially; marginal vein 1–2 mm from margin; intramarginal vein up to 1 mm from margin; petiole 5–10 mm long, up to 1.5 mm wide. Axillary or sub terminal solitaire or paired reduced panicles, 1.8–4.3 cm long, axis alate, not branched, few flowered, flowers clustered in one to six at the tips; basal bracts caducous, not seen; peduncle 1.7–3.5 cm long, ca. 2 mm wide, alate; bracts caducous, not seen; flowers sessile; bracteoles lanceolate, 2 mm long, caducous; buds obovoid, 3–4×2 mm, apex obtuse, calyptra apiculate to rostrate, chartaceous; hypanthium prolonged ca. 1.5 beyond ovary, internally glabrous; petals 1, spatulate. Fruits globose, ca. 6 mm diam., color when mature not seen. **Figures 4A–B.**

Phenology:—Flower buds and flowers from December to February, immature fruits in July.

Distribution, habitat and conservation:—Referred as endemic from Brazil by Sobral *et al.* (2014), occurring in the Atlantic Forest of Espírito Santo, Rio de Janeiro and Minas Gerais. However, some samples of *C. pteropoda* from Bolivia were found at K herbarium, occurring in the forests of Cochabamba. The disjunction distribution of some species between the Bolivian Chaco and the Brazilian Semi-arid and Cerrado dry forests was already discussed by the light of the Pleistocenic arcs theory by some authors (Oliveira *et al.* 2013). The disjunct distribution Brazil/Bolivia of *C. pteropoda* is clear; however, this work does not intend to discuss the biogeographic theories to explain this pattern, especially in wet forests. Considered here as Vulnerable (VU), since the samples found in the herbaria were not abundant, which reflects just a few populations of this species existing in nature.

Representative specimens examined:—BRAZIL: **Espírito Santo**, Alegre, Parque Nacional do Caparaó, 20º26'45''S, 41º44'07''W, 20 Feb 2000, *V.C. Souza et al. 23755* (ESA- Image!); **Minas Gerais**, Carandaí, 20º52'40''S, 43º49'01''W, 28 Dec 2005, *N.F.O. Mota & P.L. Viana 456* (BHCB!); Entre Rios de Minas, Dec 1991, *E. Tameirão Neto & M. Batitticci 673* (BHCB!). BOLIVIA: **Cochabamba**, Carrasco, 18º29'S, 65º15'W, 29 Dec 1995, *J.R.I. Wood* 10290 (K!); Sep 1990, *A.M.B. Lectae 511* (K!)

The main character to recognize *C. pteropoda* is the peduncle alate, with 3–6 flowers clustered at the tip, and this was pointed out by Berg in the protologue. The species is referred for Rio de Janeiro state at RB herbarium, but the specimens analyzed are not *C. pteropoda*, but *C. pauciflora*.

6.5.1.23 *Calyptranthes pulchella* De Candolle (1828: 257); *Chytraculia pulchella* (De Candolle) Kuntze (1891: 238). Type:—BRAZIL. [Minas Gerais] "*In prov. Minarum*" *Martius s.n.* (lectotype M, designated here).

Calyptranthes pulchella De Candolle var. *latifolia* Berg (1857: 43). Type:—Locality uncertain: *Richard 387* (lectotype P!, designated here).

Calyptranthes pulchella De Candolle var. *grandiflora* Berg (1857: 44). Type:— Not known, not found.

Calyptranthes pulchella De Candolle var. *parviflora* Berg (1858: 516). Type:— BRAZIL. [Amazonas] "*Prope Panurê ad Rio Uaués in prov. do Alto Amazonas*" *Spruce 2729* (holotype: M-Image, isotypes K!, P!, BR- image!).

Trees or shrubs 1–9 m high, twigs terete, sometimes alate; essentially glabrous, midveins in the abaxial surface of leaves and base of the flower buds sometimes puberulent; hairs simple, white or yellowish. Leaf blade obovate, 1.5–4.5×1.3–3 cm, chartaceous to coriaceous, drying pale green to green adaxially, pale green to yellowish abaxially, discolorous; apex rounded or obtuse; base cuneate or attenuate; midvein impressed to slightly sulcate above, slightly prominent bellow; secondary veins barely visible on both surfaces; marginal vein up to 1 mm from margin; intramarginal vein not seen; petiole 2–4.9 mm long, up to 1 mm wide. Terminal, rarely axillary solitaire or paired panicles, 1.4–3.6 (–6) cm long, axis terete, one to three lateral branches, mainly sub opposite, few flowered, flowers clustered in one to three at the tips; basal bracts lacking; peduncle 1–3.4 (–5) cm long, up to 1 mm wide; bracts lacking or very reduced, linear; flowers sessile; bracteoles lacking or very reduced; buds pyriform to obovoid, 2–5×1.5–2 mm, apex rounded to obtuse, calyptra rounded or shortly apiculate, membranaceous to chartaceous; hypanthium prolonged ca. 1 mm beyond ovary, internally glabrous; petals lacking. Fruits globose or subglobose, ca. 5 mm diam., yellow to red when mature. **Figure 6C.**

Phenology:—Flowers collected from September to February, fruits collected from November to April.

Distribution, habitat and conservation:—The WCSP (2014) cites the occurrence for Guyana, Suriname, Venezuela, Ecuador and Peru. However, due to the uncertain of the identity of the material for the North of South American (see discussion below), we here prefer to assume the occurrence of the species according to the material analyzed in the present work from Colombia, Peru and the northern, southeastern and northeastern of

Brazil, in the Amazon, Cerrado, Caatinga and Atlantic Forest. Therefore, we here consider it Least Concern (LC).

Representative specimens examined:—BRAZIL: **Amazonas**: São Gabriel da Cachoeira, Rio Cubate, 4 Nov 1987, *Farney et al.* 1886 (K!). **Bahia**: Rio de Contas, Campo do Queiroz, 13º33'44''S 41º56'41''W, 11 Dec 2012, *Costa-Lima et al. 841* (UFP!); 13º31'S 41º58'W, 28 Nov 1988, *Harley et al. 26646* (SP!). **Espírito Santo**: Santa Teresa, Reserva Biológica Santa Lúcia, Trilha do Sagui, 4 Feb 1999, *Kollmann et al. 1823* (MBML!). **Minas Gerais**: Cunha Magalhães, Rio Jequitinhonha, 16 Nov 1971, *Hatschbach 28070* (R!, RB!, MBM!); Morro do Pilar, Serra do Cipó, 26 Out 1993, *Campos et al. 13489* (SP!). PERU: Loreto,1 Sep 1972, *Croat 19886* (RB!).

Calyptranthes pulchella var. *cuneata* was described by Berg based in the same type material as De Candolle used to describe *C. pulchella*, as well as *C. pulchella* var. *grandifolia* was probably described based on the same material of *C. pulchella* var. *parviflora*, as it can be understood by the protologue and herbarium samples. We here agree with the WCSP (20014) approach, in which all the varieties described by Berg are synonyms of *C. pulchella*.

Holst *et al.* (2003) mentioned that the Guayana Highland material may represent another species, and the description of *C. pulchella* for the Flora of Venezuelan Guayana do not match the delimitation adopted here, concerning the inflorescence pattern (not branched, (1)-3 flowered and buds abruptly apiculate), as well as some specimens analyzed in the visited herbaria, for example, the specimen from Acre state, identified by McVaugh (*E. Forero et al.6353*, K!, R!, NY- Image!) and Amazonas state by Krukoff (*Krukoff 49 49*, BM!) which has elliptic leaves and similar inflorescence pattern. Based on those information, it can be thought that *C. pulchella* occurs together with closely related species, forming a complex in the Guyana highland and other Amazon Domain regions.

The material classified by Berg as *Calyptranthes pulchella* var. *latifolia*, here designated as the lectotype for the variety, matches the description of the type material of *C. pulchella* from Minas Gerais, originally described by De Candolle, and it is here included as a synonym. The material was found at P herbarium, with Berg's handwriting, and the tag has the indication of Louis Claud Richard collection from the "Herbarium Guyanensi-Antillanum", but with no locality specified. This does not match the protologue for the variety in the *Flora Brasiliensis*, in which Berg cites the locality "*ad montes Serra de Antonio Pereira ejusdem provinciae*", corresponding to Minas Gerais state.

Therefore, we here believe that the species does occur from the northern South America to the Southeastern of Brazil, but further studies are needed to understand the boundaries between probably other species.

Regarding the species distribution in the Northeastern Brazil, it seems the species does not reach the vegetation further Bahia state, occurring up to the northern limit of the Espinhaço range, in the Chapada Diamantina. The material referred to the Maranhão state (Turiaçu, Rio Maracaçumé, 4 Apr 1981, *Santos 697*, SP!) seems to be another taxon in the need of further studies.

Despite the uncertainty in the delimitation of species in the northern region of South America, it is important to stress that the specimens treated in this monograph, occurring in the Atlantic Forest (*s.s.*) of Brazil and in the Espinhaço Range, do have a morphological uniformity, matching the type and the De Candolle description. It can be mainly characterized by its obovate leaves, with rounded to obtuse apex, glabrescent to glabrous, panicles with one to three lateral branches and obovate (sometimes pyriform) flower buds, with rounded to obtuse calyptra. Sometimes, the leaf apex can be somehow acute, as could be observed in some specimens from Bahia state, Rio de Contas (Nascimento 127, HUEFS!, BHCB!) but this character is often found in immature leaves, turning into obovate shape with rounded or obtuse apex when fully developed.

6.5.1.24 *Calyptranthes reginae* A.R. Lourenço *sp. nov.* Type:—BRAZIL. Espírito Santo, Santa Teresa, São Lourenço, Mata Fria de Clerio Ross, 25 Jun 1998, *L. Kolmann et al. 138* (holotype: MBML!, isotype: RB!)

Trees 13–15m high, twigs terete; essentially glabrous, except for the abaxial surface of leaves rarely slightly puberulent; hairs simple, whitish. Leaf blade lanceolate to narrow-elliptic, sometimes elliptic, 5–6.8×2–2.5 cm, chartaceous, drying pale green adaxially, pale green to yellowish abaxially, discolor; apex long acuminate; base cuneate; midvein sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein 1 mm from margin; intramarginal vein absent, or very reduced and barely visible; petiole 4–5 mm long, up to 1 mm wide. Axillary reduced panicles, 1.5–2.5 cm long, axis terete, one lateral branch, reduced, alternate, few flowered, one to three flowers clustered at the tips; basal bracts not seen; peduncle 8–14 mm long, up to 1mm wide; bracts not seen; flowers sessile; bracteoles not seen; buds obovoid, 5–6×3–4 mm, apex rounded, calyptra rounded, mostly cartaceous; hypanthium prolonged 2 mm beyond ovary, internally glabrous; petals lacking. Fruits globose, ca. 4 mm diam.

Phenology:—Buds and flowers collected in June. Fruits not known.

Distribution, habitat and conservation:—*Calyptranthes reginae* is endemic of the Espírito Santo state thus far, known for a few collections, occurring in the montane Atlantic forest. Considered here as Endangered (EN).

Representative specimens examined:—BRAZIL: **Espírito Santo**, Estação Biológica Santa Lucia, 18 Aug 1993, *L.D. Thomaz 1440* (MBML!); 18 Aug 1993, *L.D. Thomaz 1403* (MBML!); 23 Nov 1998, *L. Kolmann et al. 1097* (MBML!).

The species occurs together with *C. santalucia* in the Estação Biológica Santa Lucia, and can be distinguished by being glabrous and by having leaves with long acuminate apex.

6.5.1.25 *Calyptranthes restingae* Sobral (1988: 11). Type:—BRAZIL. Bahia: Belmonte, 30 Jan 1967, *Belém & Pinheiro 3212* (Holotype: CEPEC!; isotypes: IUCN, UB!).

Shrubs to trees up to 7m high, twigs terete; young twigs, inflorescences and abaxial surface of young leaves pubescent to puberulent; hairs dendritic, ferruginous. Leaf blade elliptic, elliptic-ovate, oblong-ovate to ovate, 8–11×3.1–7 cm, chartaceous to coriaceous, drying pale green to greyish adaxially, yellowish abaxially, discolorous; apex acuminate, sometimes acute; base rounded, subcordate, sometimes slightly cuneate; midvein sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein 1–4 mm from margin; intramarginal vein up to 1 mm from margin, when present; petiole 12–15 mm long, 1–2 mm wide. Terminal paired panicles, 5.5–8.5 cm long, axis compressed, two to three lateral branches, opposite, few to many flowered, flowers clustered in three at the tips; basal bracts lanceolate, up to 5 mm long, caducous; peduncle 3–4.5 cm long, 1.5–2 mm wide; bracts oblong, up to 2 mm long, caducous; flowers sessile; bracteoles oblong, caducous, up to 2 mm long; buds fusiform, 6–7×3–3.5 mm, apex acute, calyptra fusiform to rostrate, mostly coriaceous; hypanthium prolonged 1–2 mm beyond ovary, internally glabrous; petals lacking. Fruits globose, 5–8×5–7 mm, green when immature, color when mature not seen. **Figures 6A–B.**

Phenology:— Flower and buds in January, fruits in February.

Distribution, habitat and conservation:— Endemic from the Restinga vegetation of Bahia and Sergipe states, where a few populations can be observed, so we here assign it as Near Threatened (NT).

Representative specimens examined:—BRAZIL: **Sergipe**, Santo Amaro das Brotas, 10º47'20''S, 36º58'34''W, Nov 1991, *C. Farney 2913* (RB!, UB!); **Bahia**, Ilhéus, Cana Brava, 11 Fev 1983, *A.M. Carvalho & T. Plowman 1610* (CEPEC!); Porto Seguro, RPPN Manona, 10 Oct 2005, *L.J. Alves 12* (ALCB!).

Calyptranthes restingae is the unique species of *Calyptranthes* from the Atlantic forest that have dendritic hairs. This character, together with the lustrous adaxial surface of leaves and the fusiform buds with fusiform to rostrate calyptra can distinct the species from its closely related ones, *C. blanchetiana* and *C. brasiliensis*.

6.5.1.26 *Calyptranthes rubella* (Berg) Legrand (1971: 535); Basionym: *Calyptranthes variabilis* var. *rubella* Berg (1857:49). Type:—BRAZIL. [Rio Grande do Sul], "*Ad Itararé in prov. Rio Grande do Sul*", *Sellow s.n.* (B- destroyed, neotype designated by Araújo & Lucas (2014), *R. Klein & A. Bresolin 6590* FLOR!, isolectotypes HBR, MBM).

Trees 5–12m high, twigs terete; inflorescences tomentose, young twigs, abaxial surface of leaves scarcely pubescent to glabrous; hairs simple or dibrachiate, whitish to yellowish, sometimes ferruginous. Leaf blade obovate, 3–5.3×2–2.5 cm, coriaceous to chartaceous, drying dark green or dark brownish adaxially, light green or ferruginous abaxially, discolorous; apex obtuse to shortly-acuminate; base cuneate; midvein impressed above, sulcate bellow; secondary veins barely visible on both surfaces; marginal vein up to 2 mm from margin; intramarginal vein up to 0.5 mm when present; petiole 2–3 mm long, up to 1.5 wide. Axillary or terminal paired panicles, 5.5–11 cm long, axis slightly compressed, one lateral branch, opposite, few flowered, four to six flowers clustered at the tips, rarely one; basal bracts not seen; peduncle 4–9 cm long, up to 3 mm wide, arched; bract deltoids to navicular, 2–3×2 mm, caducous, sometimes persistent; flowers sessile; bracteoles ovate to lanceolate, 1.5–2 mm long, caducous, sometimes persistent; buds prolate to obovoid, 2–2.5×2 mm, apex obtuse, calyptra obtuse, sometimes slightly apiculate, cartaceous; hypanthium prolonged 1 mm beyond ovary, internally glabrous; petals not seen. Fruits globose, ca. 5 mm diam., color when mature not seen.

Phenology:—Flowers from December to May, fruits in February.

Distribution, habitat and conservation:— Restricted to the pluvial forests in the South of Brazil and São Paulo state, predominately in Santa Catarina quaternary plain wet forests. Although occurring in a considered extension, the individuals of *C. rubella* are not frequently in the habitats in which it occurs (Legrand 1971). Assigned here as Vulnerable (VU).

Representative specimens examined:—BRAZIL: **São Paulo**, Biritiba-Mirim, 8 Feb 2001, *S.A. Nicolau et al.* 2785, (SP!, BHCB!); Iguape, Peropava, Fazenda Boa Vista, 24º34’–36’ S, 47º37’–40’W, 24 Jan 1986, *E.L.M. Catharino 654* (SPF!, UB!, ESA); **Paraná**, Guaraqueçaba, Rio do Costa, 4 Feb 1971, *Hatschbach 26265* (R!, RB!, MBM!); **Santa Catarina**, Palhoça, 5 Feb 1953, *Reitz 5621* (HBR!).

As discussed before, the main feature to separate *C. rubella* from the closely related *C. concinna* is the long and arched peduncles. Although some species of *C. concinna* have longer peduncles, the important feature to separate them is the proportion of the peduncle in relation to the whole inflorescence: in *C. rubella*, the peduncle is about 6 or 7 times longer than the rest of the inflorescence, and also arched. In the others, this proportion is mainly smaller and the peduncles are straight. Also, the leaves in *C. rubella* are obovate and mostly glabrous.

According to Araújo & Lucas (2014) no Sellow collection of *C. variabilis* var. *rubella* was found in any herbarium that could be expected to hold it. In elevating the name to species level, Legrand & Klein (1971) cited several specimens seen and one of this material was chosen to be the neotype.

6.5.1.27 *Calyptranthes santalucia* Sobral (2013: 44). Type:—BRAZIL. Espírito Santo: Santa Teresa, Estação biológica de Santa Lúcia, 2 Mar 1993, *L.D. Thomaz 1113* (holotype MBML!, isotypes UFP!, HRCB, HUFSJ).

Trees up to 16 m, twigs, abaxial surface of leaves, inflorescences and fruits strongly densely covered by an appressed pubescent indument; hairs dibrachiate, brownish. Leaf blade elliptic to elliptic-lanceolate, 6–8.7 × 2–4.5 cm, coriaceous, drying brownish, discolorous; apex acuminate; base cuneate or obtuse; midvein sulcate above, prominent bellow; secondary veins visible on adaxial surface, rarely on abaxial surface; marginal vein 2–3.5 mm from margin; intramarginal vein 0.7–0.8 mm from margin; petiole 7.5–

11 mm long, up to 2 mm wide. Axillary solitaire reduced panicles, 0.3–1.5 cm long, axis terete, not branched, few flowered, one to three flowers clustered at the tips; basal bracts lacking; peduncle 0.3–1.2 cm long; bracts lacking; flowers sessile; bracteoles lacking; buds not seen, calyptra not seen; hypanthium not seen; petals not seen; stamens not seen. Fruits globose, up to 7 mm diam., color not seen.

Phenology:— Fruits in march and april.

Distribution, habitat and conservation:—The species is known only from two collections from the same locality, the Estação Biológica de Santa Lúcia, in the Santa Teresa municipality, occurring in the montane Atlantic Forest (up to 800 m). Sobral (2013) applied the IUCN criteria B1 ab(iii), considering the species Endangered (EN), since the extension area in which the species occurs is smaller than 5.000 km^2, severely fragmented and presents a constant decline of its extent.

Examined species:—BRAZIL: **Espírito Santo**: Santa Teresa, Estação biológica de Santa Lúcia, 650–800 m, 20 Abr 1993, *L.D. Thomaz 1424* (MBML!).

Calyptranthes santalucia is part of the morphological group that presents a reduced and not branched inflorescence, together with *C. angustifolia, C. biflora*, *C. caudata*, *C. curta*, *C. grammica* and *C. pauciflora*, for example. *Calyptranthes reginae* occurs with *C. santalucia* in the same montane area in Santa Teresa municipality, both sharing the inflorescence pattern and the elliptic leaves with apiculate apex, but they differ by the glabrous leaves, drying green in *C. reginae* (*vs.* densely appressed pubescent, drying brown in *C. santalucia*). Sobral (2013) also pointed out the similarity between *C. santalucia* and *C. brasiliensis* in the vegetative gestalt, differing them by the branched inflorescences and acute or obtuse-acuminate apex of the leaves in *C. brasiliensis*.

6.5.1.28 *Calyptranthes serrana* A.R. Lourenço (2014: 275). Type:—Brazil. São Paulo, Santo André: Alto da Serra, Estação Biológica, [Reserva Biológica Alto da Serra de Paranapiacaba, 23º46'00''–23º47'10''S and 46º18'20''–46º20'40''W], 12 December 1928, *Lemos s.n.* (Holotype SPF!; isotype: SPF!, BHCB- Image!).

Trees, abaxial surface of leaves with midvein pubescent to puberulent, inflorescences and flower buds pubescent; hairs simple, ferruginous. Leaf blade orbicular to elliptic-orbicular, 9–12×6–7 cm, coriaceous, drying brownish, discolorous; apex abruptly acuminate; base rounded to attenuate; midvein sulcate above, prominent bellow; secondary veins barely visible on both surfaces; marginal vein 3–4 mm from margin; petiole 15–20 mm long, 2.5–3 mm wide. Terminal paired panicles, 10–11 cm long., axis compressed, three to four lateral branches, sub opposite, sometimes clearly alternate, few flowered, flowers clustered in three at the tips; basal bracts deltoid, 1×1 mm, caducous; peduncle 4–6×0.2–0.3 cm long; bracts probably lacking, not seen; flowers sessile; bracteoles deltoid to linear, up to 1 mm long, caducous; buds pyriform to obovoid, 6–7×3–6 mm, apex rounded, calyptra shortly apiculate, coriaceous; hypanthium prolonged up to 1 mm beyond ovary, internally glabrous; petals lacking. Fruits not seen. **Figures 9A–E.**

Phenology:— Buds and flowers collected in December.

Distribution, habitat and conservation:—The species is endemic from the "Floresta Ombrófila Densa Montana" (Veloso 1991) of the "Reserva Biológica Alto da Serra de Paranapiacaba", a conservation unit (UC) located in Santo André municipality, and the Estação Biológica de Boracéia (EBB), located near the city of Salesópolis, both in São Paulo state, in Montane Atlantic Forest (Ferro & Diniz 2007).This region suffers with the continuous action of pollutants because of its proximity with the Cubatão chemical pole and is also disturbed with the presence of numerous invasive plants and logging of timber species (Pastore et al. 2012). Therefore, according to the distribution and habitat information available, and following the IUCN red list criteria (IUCN 2010), we here assign *C. serrana* as Critically Endangered (CR) (see Lourenço & Alves 2014).

Examined species:—Brazil. **São Paulo**, Salesópolis: Estação Biológica de Boracéia [23º37'59''S–45º31'59''WS], perto do Rio Corujá, 29 November 1967, bt., fl., *J. Mattos & N. Mattos 14272* (SP!).

The species is closely related to *C. grandifolia*, but differs by having orbicular leaf blades, with abruptly acuminate apex, and 6–7 mm long buds.

6.5.1.29 *Calyptranthes strigipes* Berg (1959: 540). *Chytraculia strigipes* (Berg) Kuntze (1891:238). Type:—BRAZIL. Rio de Janeiro: "*Habitat in silvis arenosis própe Porto d'Estrela, et fluv. inhumerim prov. Rio de Janeiro*", *Riedel s.n.* (holotype G- Image!, isotype P!).

Treelets to trees 6–20 m high, twigs terete; young twigs densely villose, the old ones sometimes villose, but getting pubescent to glabrescent, adaxial surface of leaves glabrous to puberulent, abaxial surface extremely villose, specially the midveins, becoming less when older, inflorescence densely villose interspaced with appressed pubescent indument; hairs simple, mostly long and easily distinctive by disarmed eyes, mostly ochre, sometimes mixed between whitish and brownish. Leaf blade lanceolate, sometimes narrow-elliptic, 8–19 ×2.5–4 cm, chartaceous, drying pale green to brownish adaxially, pale green, light brown or sometimes ochre due to the indumentum abaxially, discolorous; apex attenuate, sometimes acuminate; base attenuate; midvein impressed above, prominent bellow; secondary veins slightly visible on both surfaces, impressed adaxially, slightly prominent abaxially; marginal vein 1.5–3 from margin; intramarginal vein up to 1 mm from margin, when present; petiole 4–8 mm long, ca. 1.5 mm wide. Terminal or axillary paired panicles, 4–7 cm long, axis mainly compressed, rarely slightly terete, one lateral branch, rarely a reduced second one, opposite, few to many flowered, flowers clustered in three at the tips; basal bracts caducous, not seen; peduncle 2.6–6 cm long, 2–2.5 mm wide; bracts deltoid, 2 mm long, caducous; flowers sessile; bracteoles probably lacking, not seen; buds obovoid to globose, 2–2.5×2–2.5 mm, apex slightly obtuse or rounded, calyptra slightly apiculate, cartaceous to slightly coriaceous; hypanthium prolonged up to 1 mm beyond ovary, internally glabrous; petals lacking. Fruits subglobose to globose, 5–10 mm diam., red when mature.

Phenology:— Flowers from December to January, fruits from September to November.

Distribution, habitat and conservation:— It occurs from Espírito Santo to Santa Catarina state, being characteristic of the high pluvial forests, occurring specially in closed and humid valleys and depressions, absent in more open forests like Restingas. Considered here as Vulnerable (VU).

Representative specimens examined:—BRAZIL: **Espírito Santo**, Cariacica, 20º17'29"S 40'31'10"W, 20 Jul 2008, *A.M.A. Amorim et al.7581* (RB!, MBML!, CEPEC, UPCB, BHCB); Santa Teresa, Estação Biológica da Caixa D’água, 21 Mar 1988, *H.Q.B. Fernande 2521* (MBML!); **Rio de Janeiro**, Nova Iguaçu, 30 Sep 2002, *G.V. Somner & M.L.V. Pereira 1041* (RB!); **São Paulo**, Pariquera-açú, 24º40’33’’W 47º52’37’’S, 28 Apr 1995, *N.M. Ivanauskas 425* (SP!, ESA); Ubatuba, Picinguaba, 23º18’09’’S 44º48’61’’W, 29 May 1997, *M. Sanchez et al. 1339* (SP!, UEC); **Paraná**, Morretes, 23

Jan 1969, *Hatschbach 41780* (R!, MBM!); **Santa Catarina**, Pilões, Palhoça, 7 Sep 1956, *Reitz & Klein 3659* (K!).

6.5.1.30 *Calyptranthes solitaria* Sobral, Aguiar & Antunes (2014: 498). Type:—BRAZIL. São Paulo, Salesópolis, Parque Estadual da Serra do Mar, trilha da torre, 23 Feb 2005, *F.M. Souza, M.T.Z. Toniato & D. Souza 495* (holotype: SPSF, isotype: HUFSJ-Image!).

Trees 2–14 m high, twigs terete; young twigs velutinous, young leaves with scattered trichomes adaxially, densely covered with an arachnoid indumentum abaxially, the older ones glabrous or puberulent only adaxially, inflorescences tomentose or pubescent. Hairs simple, brown. Leaf blade elliptic, narrowly elliptic or ovate, 4–9×1.6–3.5 cm, coriaceous, drying green or dark brown adaxially, light, dull green, discolorous; apex acuminate; base cuneate; midvein slightly sulcate above, prominent bellow, secondary veins slightly visible on both surfaces, impressed or slightly sulcate adaxially, slightly prominent abaxially; marginal vein 1–2 mm from margin; intramarginal vein 0.2–0.3 mm from the margin, when present; petiole 4–10×1–2 mm. Solitaire axillary reduced panicles, 2.6–3.3×0.5–0.5 cm long, axis terete, not branched, few flowered, one flower at the tip; basal bracts not seen; peduncle 20–25×1–1.5 mm bracts not seen, probably caducous; flowers sessile; bracteoles not seen, probably caducous; buds ovate slightly rostrate, 6–8×4 mm, apex acute, calyptra acute to rostrate, consistency not seen; hypanthium prolonged 1–2 mm beyond ovary, internally glabrous; petals 1–2, rounded. Fruits elliptic, 1×0.8 cm diam., immature.

Phenology:—Flowers collected in February and April, fruits in May.

Distribution, habitat and conservation:—According to the authors (Sobral et al. 2015) the species occurs in four municipalities of Minas Gerais, Rio de Janeiro and São Paulo, which has already been intensively surveyed. Therefore it is a rare species and they consider the species as vulnerable (VU). The geographical distribution overlaps with *C. tricona*, which occurs as well in Minas Gerais and it is pointed out by the authors as the most similar species. They can be separated by the coriaceous leaf blades in *C. solitaria* (versus chartaceous in *C. tricona*), visible pilose (versus almost glabrous) and mainly, the uniflorous inflorescence in *C. solitaria* (versus up to three at the tips of *C. tricona*). It is reasonable to think, however, that some specimens of *C. tricona* do have only one flower at the tip of the inflorescence, and that those individuals might be confused with *C. solitaria*. However, other populations of *C. solitaria* were not available in the visited herbaria to assure that the other characters pointed out by the authors are strong enough to distinguish them in these cases. Even though, we here prefer to maintain them as different taxonomic entities while new populations are not observed.

6.5.1.31 *Calyptranthes tetraptera* Berg (1857: 53). Type:—BRAZIL. [Minas Gerais]: "*in prov. Minas Geraes*", *Sellow s.n.* (holotype B, destroyed. Lectotype designated by Araújo & E. Lucas 2013, K!, isotype BM!).

Shrubs 1.8–2m high, twigs strongly alate; glabrous. Leaf blade orbicular, decussate, 4.2–5.2×3.9–4.4 cm, coriaceous, drying light green adaxially, yellowish green abaxially, discolorous; apex rounded, rarely obtuse; base subcordate to rounded; midvein sulcate above, prominent bellow; secondary veins slightly visible on both surfaces, impressed adaxially, prominent abaxially; marginal vein 2.5–3 mm from margin; intramarginal vein up to 1 mm from margin; sessile or with a very small petiole, up to 1 mm long.

Terminal paired reduced panicles, 4.9–3.3 cm long, axis terete, not branched, few flowered, flowers clustered in three at the tips; basal bracts probably lacking, not seen; peduncle 3.9–28. cm long, 0.5–1 mm wide; bracts linear, up to 1 mm long, caducous; flowers sessile; bracteoles probably lacking, not seen; buds obovoid to slightly fusiform, 4–5×2 mm, apex acute, calyptra fusiform, cartaceous to slightly coriaceous; hypanthium not seen; petals not seen; stamens not seen. Fruits subglobose, 5–5 mm diam., color not seen. **Figure 2A**.

Phenology:—Flower buds in June, fruits with no date.

Distribution, habitat and conservation:—The specimen *D. Sucre 3671*, at RB herbarium, contains a notemade by Dr^{a} Graziella Maciel Barroso saying: “very important plant, perhaps already extinct in Rio de Janeiro”. Along this study, we found only three samples of the species, which lead us to think that it can be considered Critically Endangered (CR).

Adicional specimens examined:—BRAZIL: **Rio de Janeiro**, Cabo Frio, Morro da Piaçava, 6 Jun 2002, *C. Farney & A. Terra 4469* (RB!, BHCB!); Restinga de Cabo Frio, 16 Nov 1968, *D. Sucre 3671* (CEPEC!RB!, K!); Sep 1851, *Glaziou s.n.* (R!).

The lectotypification of *C. tetraptera* was made by Araújo & Lucas (2013), in which it was chosen the *Sellow s.n.* collection from Minas Gerais, cited by Berg in the protologue (1857), remaining the syntype *Widgren s.n.*, since no collection bearing his name was found in MEL. The species lectotype is referred to occur in Minas Gerais state, but the few collections found in the Brazilian herbaria are all from the same area, the Restinga of Cabo Frio, Rio de Janeiro state. There might be two explanations for this: mistakes about the type locality of the plants described by Berg in *Flora Brasiliensis* are usually common, and according to Stafleu & Cowan (1988), Sellow had been collecting in many states like Minas Gerais, São Paulo and Rio de Janeiro. Also, mistakes regarding the type locality of the species here described as *C. ouropretensis* (see discussion before) was already observed. Therefore, since no sample of *C. tetraptera* was yet found in any Minas Gerais area, it is very likely that this is not the correct location. The second option is that the species is very rare in nature, therefore it was not found again in Minas Gerais state, due to deforestation of its natural habitat.

Calyptranthes tetraptera is a species that stands out for its unique features. The combination of the orbicular, sessile and coriaceous leaves, together with the strongly alate young twigs and the not branched inflorescence, bearing three flowers at the tips, makes easy to recognize it. However, apart from the type collection, the samples available for analysis are restricted to a very small area. Thus, is not possible to observe any morphological variation due to the geographical distribution pattern, often common in *Calyptranthes* species. *Calyptranthes ovalifolia* Cambessédes (1929: 372) a species found in some localities along the Espinhaço Range, in Campos rupestres, mainly in the Cerrado and Caatinga Domains (Harley 1995) share with *C. tetraptera* the orbicular, sessile and coriaceous leaves, but strongly differ in the indumentum pattern (*C. ovalifolia* it is strongly pubescent, while *C. tetraptera* is glabrous) and in the inflorescence pattern (well branched, with up to three, sometimes four-order branches, *vs.* not branched), as well as the quantity of flowers (many flowered, *vs.* three flowers) and the shape of the buds (rounded, *vs.* fusiform). It was not possible to observe, due to the quantity of indumentum, if the young twigs are alate or not in *C. ovalifolia*. Additional studies must be conducted to understand the identity of this taxon and its relationship with *C. tetraptera*.

6.5.1.32 *Calyptranthes tricona* Legrand (1962: 204). Type:—BRAZIL. Santa Catarina, Rio do Sul, Matador, Mata de várzea, 23 Nov 1958, *Reitz & Klein 7565* (holotype MBM, isotype HBR!).

Calyptranthes iraiensis Mattos (1963: 2). Type:—BRAZIL. Rio Grande do Sul, *A. Schultz 964* (holotype PAHN).

Calyptranthes ursina Barroso & Peixoto (1996: 69). Type:—BRAZIL. Rio de Janeiro, Nova Iguaçú, Reserva Biológica de Tinguá, caminho de Barrelão à Reunião, 14 Dec 1991, *S.J. Silva Neto 04* (Holotype: RBR; isotype: RB!). *syn. nov.*

Calyptranthes detecta Sobral & M. Souza (2012: 24). Type:—BRAZIL. Minas Gerais: Descoberto, Reserva Biológica da represa do Grama, 27 Jan 2002, *R.C. Forzza & B.K.S. Franco 2065* (holotype RB- Image!; isotypes BHCB, CESJ). *syn. nov.*

Trees, treelets or shrubs, 2.5–10 (–15) m high, twigs mainly terete; young twigs, abaxial surface of leaves villose to pubescent, sometimes restricted to the midvein, inflorescences densely covered with villose to pubescent indument; hairs simple, brownish, ferruginous to ochre. Leaf blade elliptic, elliptic-oblong or lanceolate, 4–17×1.9–6 cm, chartaceous, drying green adaxially, pale green abaxially, discolorous; apex acuminate; base cuneate to acute; midvein impressed to slightly sulcate above, prominent bellow; secondary veins barely visible on both surfaces, sometimes slightly prominent; marginal vein 1.5–6 mm from margin; intramarginal vein 1–1.5 mm from margin; petiole 4–10×1.5–2 mm. Terminal or axillary, solitaire or paired reduced panicles, 2.5–3 cm long, axis terete to compressed, not branched, few flowered, flowers clustered in three at the tips; basal bracts lanceolate to triangular, 0.8–2.5×0.2–0.5 cm, caducous; peduncle 1–3 cm long, ca. 1.5 mm wide; bracts linear, lanceolate to elliptic, up to 12 mm long, caducous, rarely persistent; flowers sessile; bracteoles navicular, elliptic to lanceolate, 3–4 mm long, caducous; buds obovoid to slightly fusiform, 3–8×3–6 mm, apex acute, sometimes obtuse, calyptra fusiform, sometimes obtuse, cartaceous to slightly coriaceous; hypanthium prolonged 2–5 mm beyond ovary, internally glabrous; petals 0-2, linear. Fruits subglobose, 1–1.5 cm diam., vinaceous to black when mature. **Figure 5D.**

Phenology:—Flower buds and flowers from October to March, fruits collected in June.

Distribution, habitat and conservation:— Legrand (1971) pointed out that *C. tricona* is a species characteristically from the subtropical forests of the Paraná and Uruguay river basin, where we can find the majority of the specimens occurring dispersedly along Santa Catarina state, reaching the northern Argentina, as well as *C. concinna* (Tressens & Rodrigues 1996). However, the species also occur in the municipality of Belmiro Braga, Minas Gerais, in the riparian zone of the "Peixe river", and in Rio de Janeiro state, also in riparian zones of Nova Iguaçu municipality. Probably due to the situation of the riparian habitats along the Brazilian Atlantic Forest domain, the species occurs scattered throughout its occupation area, and we here assign the species as Near Threatened (NT).

Adicional specimens examined:—BRAZIL: **Minas Gerais**, Belmiro Braga, Fazenda Nossa Senhora, borda do Rio do Peixe, 21º52'58''W 43º25'33''S, 7 Mar 2007, *M.C. Souza et al. 619* (RB!); **Rio de Janeiro**, Nova Iguaçú, Reserva Biológica de Tinguá, 9 Nov 1993, *A. L. Peixoto & S. J. Silva Neto* 1988 (RBR, RB!), 14 Nov 1994, *S. J. Silva Neto 474*; Santa Catarina, Nova Teutônia, 23 Dec 1943, *F. Plaumann 269* (RB!); **Santa Catarina**, Luiz Alves, Braço Joaquim, 24 May 1956, *R.M. Klein 2049* (HBR!).

In the protologue of *Calyptranthes ursina*, a species described as endemic of Rio de Janeiro state, the authors point out the morphological similarity with *C. strigipes*, *C. concinna* and *C. pileata*, but interestingly not with *C. tricona*. In the present work, the description of the analyzed material of *C. tricona* overlaps in many characters which the ones from *C. ursina*, like the type of indument, the size of the leaves, the flower buds, and the inflorescence pattern. The most variable characters is the presence of a basal bract, not seen by Legrand (1962, 1971) in his descriptions, but referred by Barroso and Peixoto (1996), and the difference in the leaf shape, described as elliptic-oblong by Legrand, versus lanceolate by Barroso & Peixoto. The presence/absence of the basal bract can be expected, since they are caducous, like many species in *Calyptranthes*, thus, they can be observed or not depending on the sample analyzed. But regarding the leaf shape, some species from Santa Catarina state can have a more lanceolate than elliptic shape, similar to the samples found in Rio de Janeiro. Therefore, we here consider *C. ursina* a new synonym of *C. tricona*. Between the others similar species compared by Barroso and Peixoto, we can add that *C. tricona* can be distinct from *C. strigipes* and *C. concinna* mainly by its different kind of indument and inflorescence branch pattern, and from *C. pileata* by the lack of indument of this one, especially in the flower buds, and by the pyriform fruits.

Calyptranthes detecta was described as distinct from *C. tricona* (Sobral et al. 2012) based in the size of petioles, leaves, inflorescences and flower buds. In addition to the indument in the abaxial surface of the leaves, pointing out that in *C. tricona* the indument in the abaxial surface of the leaves was entirely densely covered by trichomes, while in *C. detecta*, it was restricted to the midvein. It was also pointed out that the distribution of *C. tricona* also occurs in Minas Gerais state. A carefully analysis of the characters like petiole, leaf shape, size, inflorescence size and type, using a big set of samples of *C. tricona*, of a wider range of distribution, shows that the species overlaps in almost all the characters, especially because the only sample used in the protologue of *C. detecta* does not show a good image of the inflorescence and flower buds. Therefore, we here propose the two species as synonyms.

6.6 Acknowledgements

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Figure 1. Vegetation physiognomies of the Atlantic Forest Domain: Floresta Ombrófila densa (Dense ombrophilous forest), Floresta Ombrófila mista (Mixed ombrophilous forest), Floresta estacional decidual (Deciduous Seasonal Forest) , Floresta estacional semidecidual (Semideciduous seasonal forest), formações pioneiras ("salt marshes", mangrooves, alluvial areas), Campos de altitude, encraves de Cerrado, zonas de tensão ecológica (Altitude fields, Cerrado enclaves, ecological tension zones). Adapted from Colombo & Joly (2010).

Figure 2 A–D. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A. *C. tetraptera***, fertile branch with reduced non branched panicles with three flower buds at the tips. **B–D. *C. angustifolia***. B. fertile branch with reduced non branched panicle with one flower buds at the tip. C. Flower bud, showing acuminate calyptra. D. Linear to lanceolate leaves with uncinate apices.

Drawings from C. Farney & A. Terra 4469 (A), Barbosa 267 (B–D).

Figure 3 A–C. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A. *C. clusiifolia,*** fertile branch with oblong leaf blades, panicles with four lateral branches, the first one sub opposite, many flowered, flower buds prolate to obovoid, calyptra apiculate. **B–C. *C. concinna*.** B. fertile branch with one lateral branched panicle, few flowered, navicular bracts covering the flower buds. **C.** inflorescence detail, showing the pubescent indument and the navicular bracts covering the flower buds with obtuse apex.

Drawings from J.E.Q. Faria et al. 2365 (A), M. Peron et al. 976 (B–C).

Figure 4 A–D. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–B.** ***C. pteropoda***. A. fertile branch with reduced non branched panicles with three flowers buds at the tips. B. inflorescence detail, showing the alate peduncles and the obovate flower buds. **C–D.** ***C. pileata***. C. inflorescence detail, showing the rostrate flower buds with rostrate calyptra. D. Pyriform fruits.

Drawings from E. Tameirão Neto & M. Batitticci 673 (A–B), Dusén 7411 (C–D).

Figure 5 A–D. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–C.** ***C. bipennis.*** A. Branch with elliptic-lanceolate leaves and long acuminate apices. B. Detail of the leaf blades, showing the secondary veins and the non branched inflorescences with a globose fruit at the tip. C. Detail of the globose fruit, with a remnant calyptra. **D.** ***C. tricona***. Detail of the reduced non branched panicles with villose indument, three flowers buds at the tips, fusiform, calyptra fusiform.

Drawings from M. Ribeiro 533 (A–C), Márcio Verdi, s.n. (D).

Figure 6 A–D. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–B.** ***C. restingae.*** **A.** fertile branch with obovate to elliptic-obovate leaf blades, panicles with two to three lateral branches, opposite, many flowered, flower buds fusiform, calyptra fusiform to rostrate. **B.** Detail of the inflorescence. **C.** ***C. pulchella.*** fertile branch with obovate leaf blades, panicles with one to three lateral branches, mainly sub opposite, few flowered, flower buds pyriform to obovoid, calyptra rounded or shortly apiculate. **D.** ***C. obovata.*** fertile branch with obovate leaf blades, panicles with one to two lateral branches, opposite, few flowered, flower buds obovoid to pyriform, calyptra apiculate to slightly rostrate.

Drawings from J.L. Alves 12 (A–B), M. Peron 367 (C), R.C. Forzza et al. 4454 (D).

Figure 7 A–D. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–D.** ***C. lanceolata.*** **A.** fertile branch with lanceolate leaf blades, panicles not well developed, with a reduced lateral branch, opposite. **B.** Detail of the floccose indument, interspersed with puberulent, showing some glandular dots and secondary veins. **C.** Detail of the lanceolate basal bract. **D.** Detail of the obovoid flower bud, with floccose indument, calyptra apiculate. **Drawings from P. Fiaschi et al. 3575 (A–D).**

Figure 8 A–F. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–F.** ***C. lucida.*** **A.** fertile branch with elliptic leaf blades, panicles with one to two lateral branches, opposite or alternate, many flowered, flower buds obovoid to globose, calyptra shortly apiculate. **B.** detail of the leaf blade, adaxial surface. **C.** flower, transversal cut showing the hypanthium prolonged above the ovary, the opened calyptra and stamens. **D.** ovary, transversal cut showing the two locules with two ovules each. **E.** opened flower without stamens, showing the style and stigma and the apiculate calyptra. **F.** detail of the inflorescence, with globose to subglobose fruits.

Drawings from W. Ganev 2224 (A–F).

Figure 9 A–I. *Calyptranthes* species from the Brazilian Atlantic forest domain. **A–E.** ***C. serrana.*** **A.** fertile branch with orbicular to orbicular-elliptic leaf blades, panicles with three to four lateral branches, sub opposite to alternate, slightly arched, few flowered. **B.** detail of the flower bud obovoid to pyriform, calyptra shortly apiculate. **C.** detail of the inflorescence, with the slightly arched inflorescences. **D.** opened flower. **E.** detail of the leaf blade, adaxial surface. **F–I.** ***C. ouropretensis.*** **F.** fertile branch with **cordate leaf blades, panicles with two to three lateral branches, opposite, many** flowered. **G.**

detail of opened flowers with a remnant shortly apiculate calyptra, stamens and spatulate petals attached to the calyptra. **H.** detail of the obovoid flower bud. I. detail of the striate inflorescence axis.

Drawings from the holotypes.

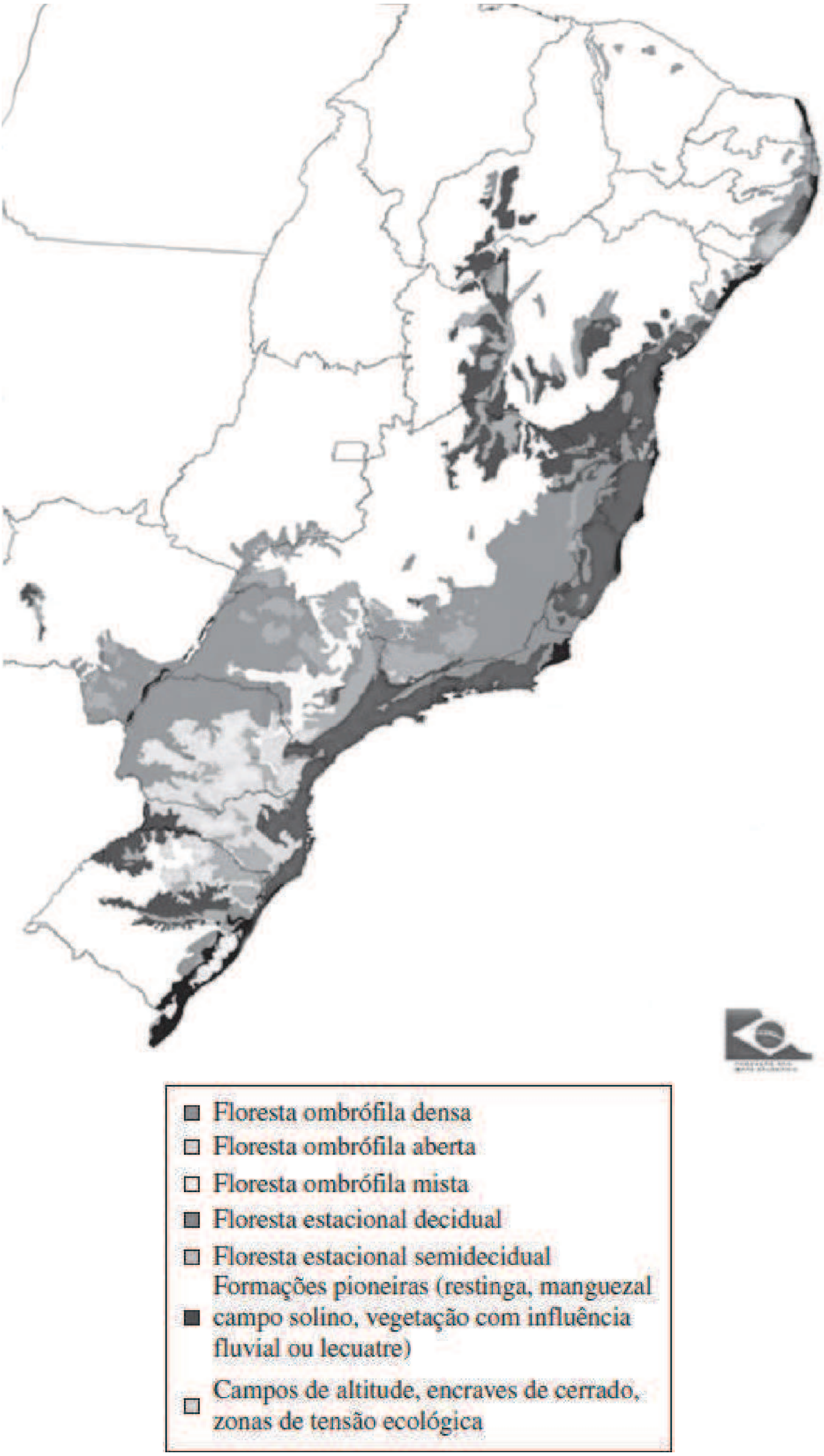
Floresta ombrófila densa
Floresta ombrófila aberta
Floresta ombrófila mista
Floresta estacional decidual
Floresta estacional semidecidual
Formações pioneiras (restinga, manguezal campo solino, vegetação com influência fluvial ou lecuatre)
Campos de altitude, encraves de cerrado, zonas de tensão ecológica

Figure 1

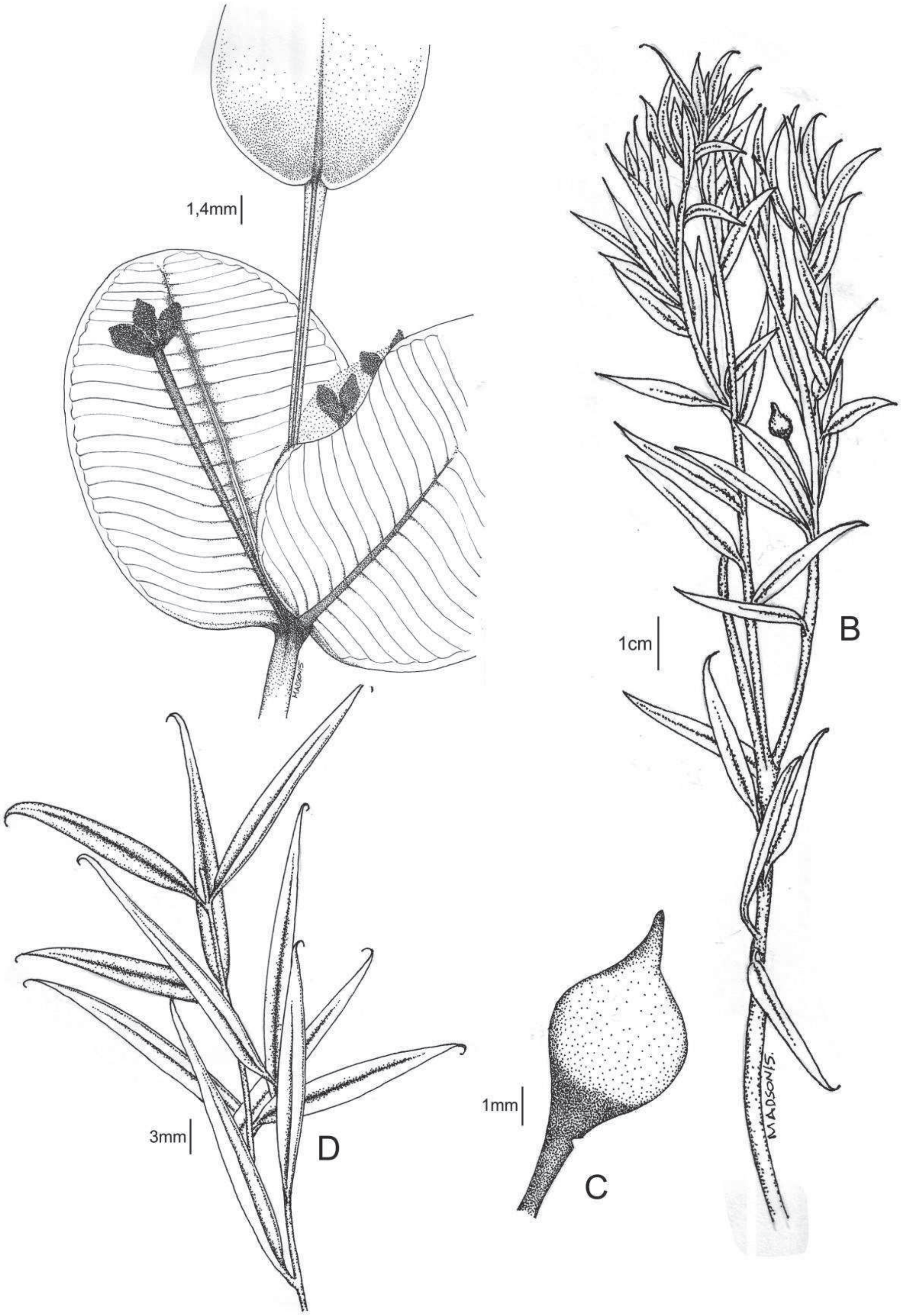

Figure 2

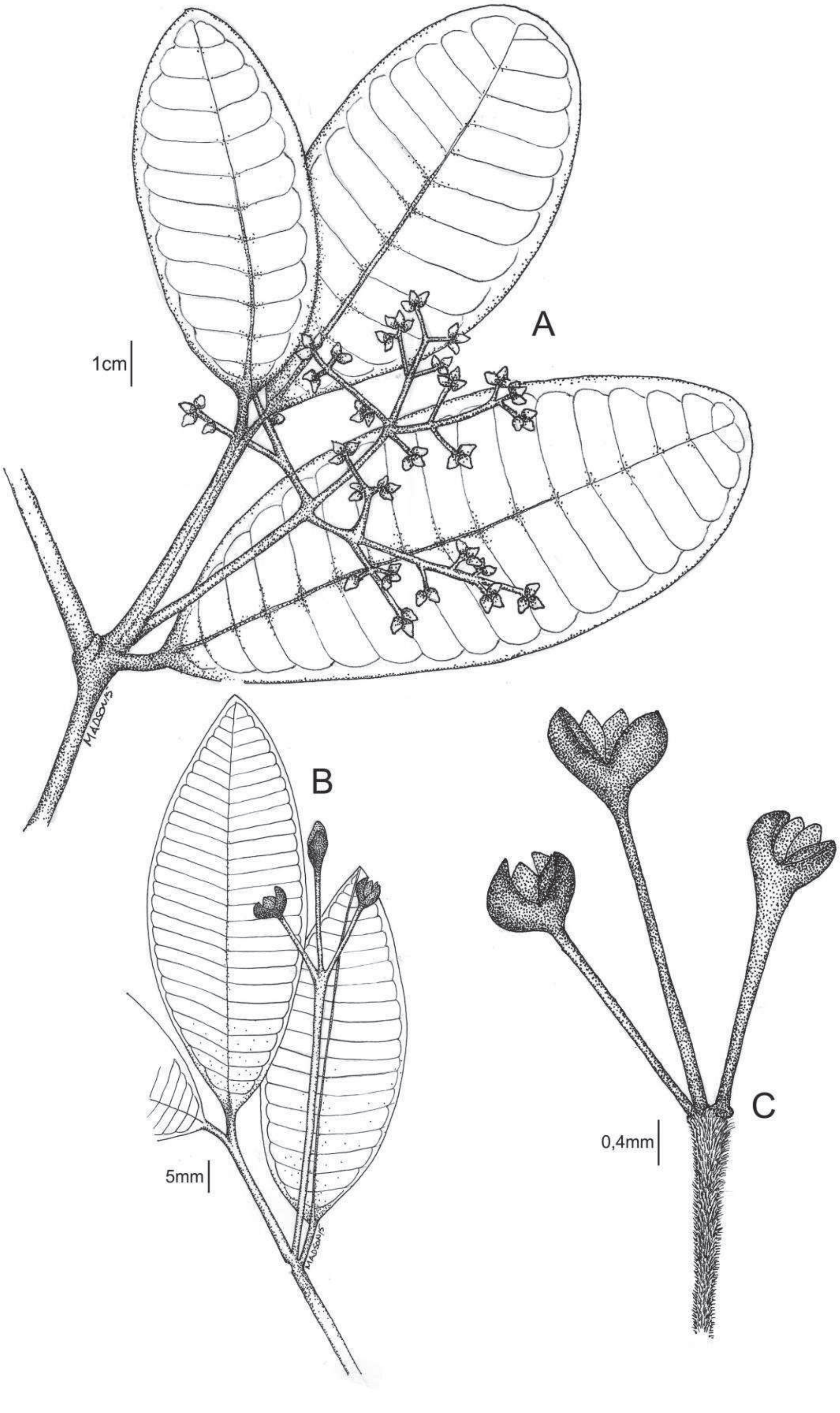

Figure 3

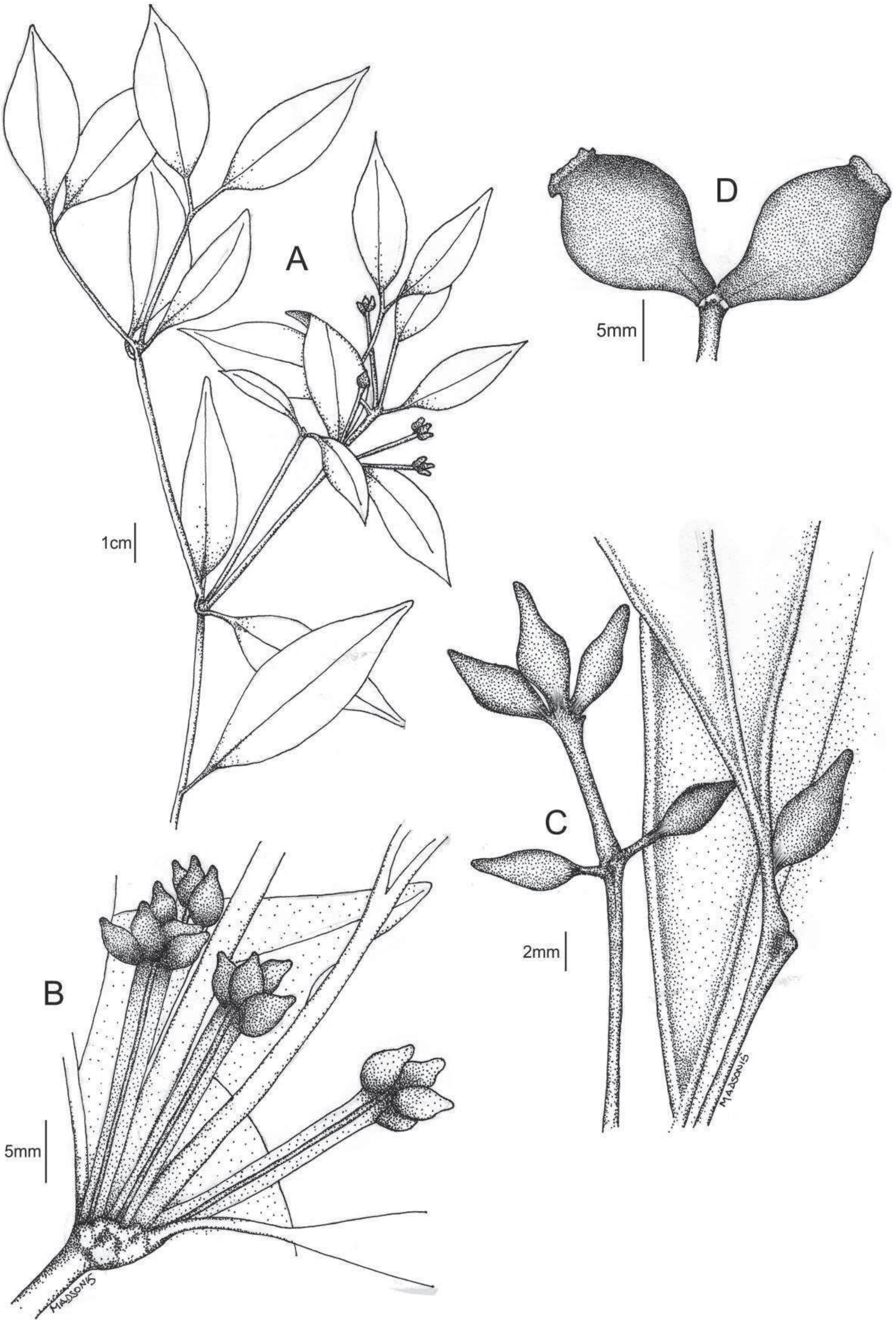

Figure 4

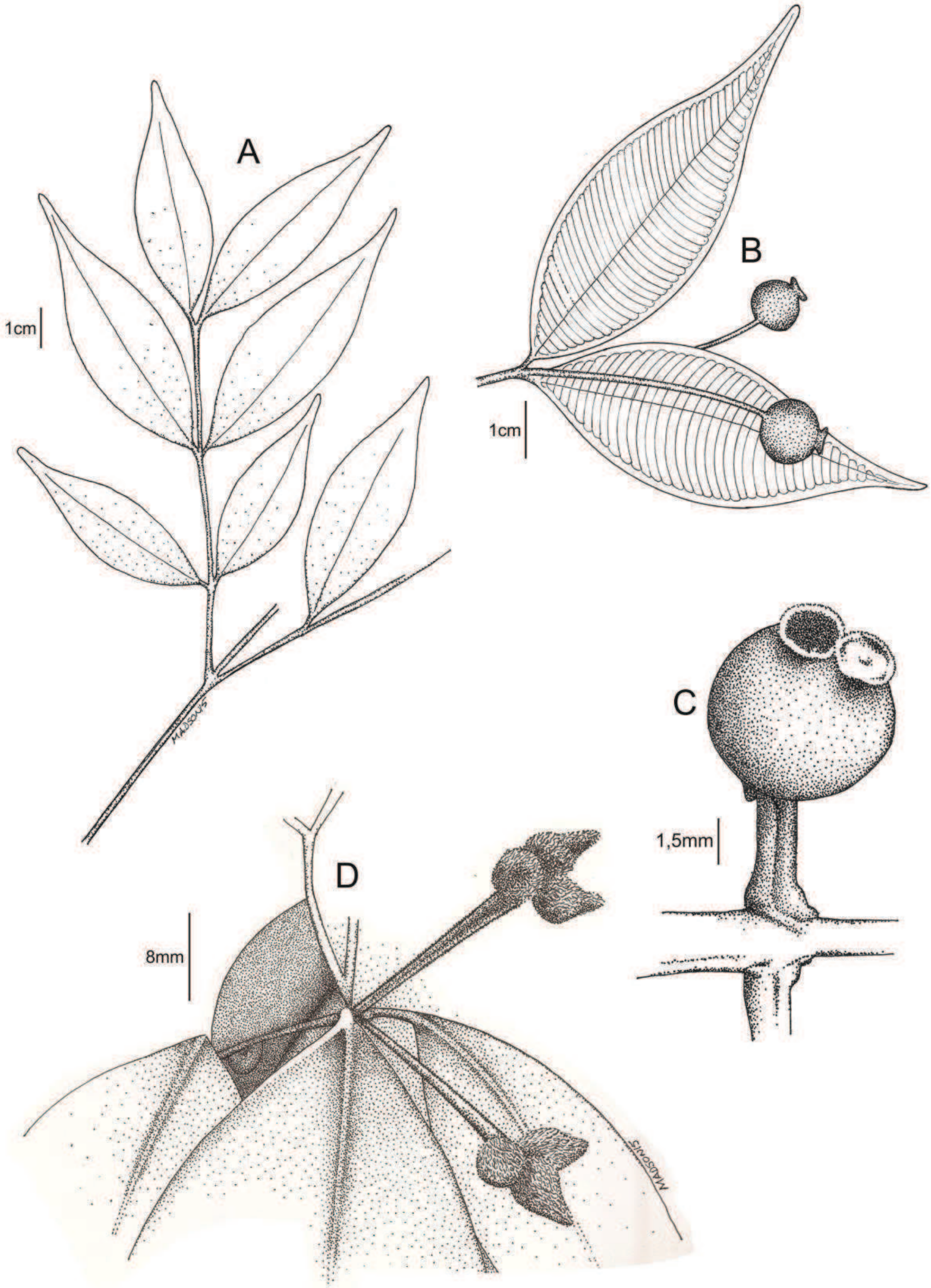

Figure 5

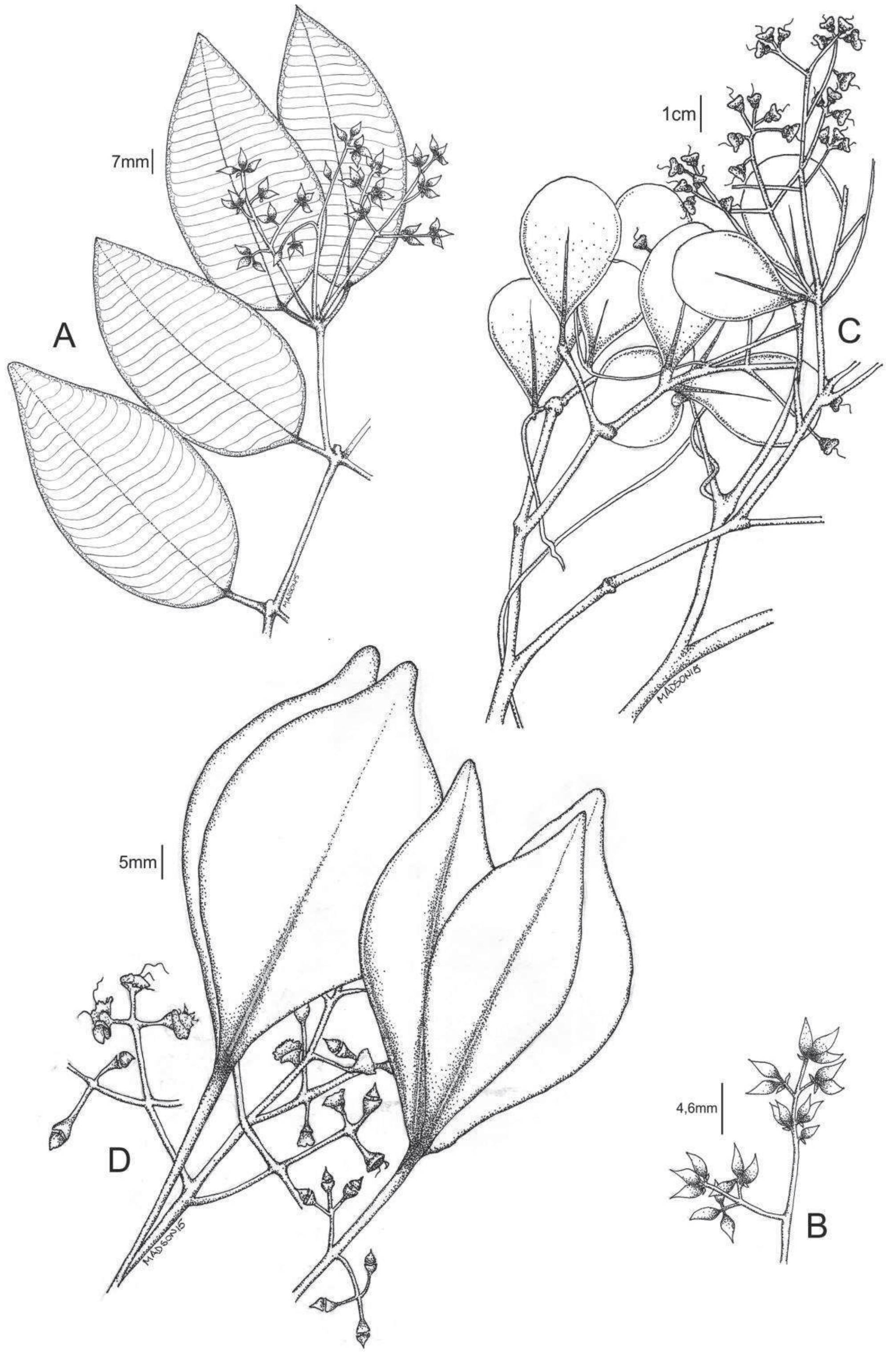

Figure 6

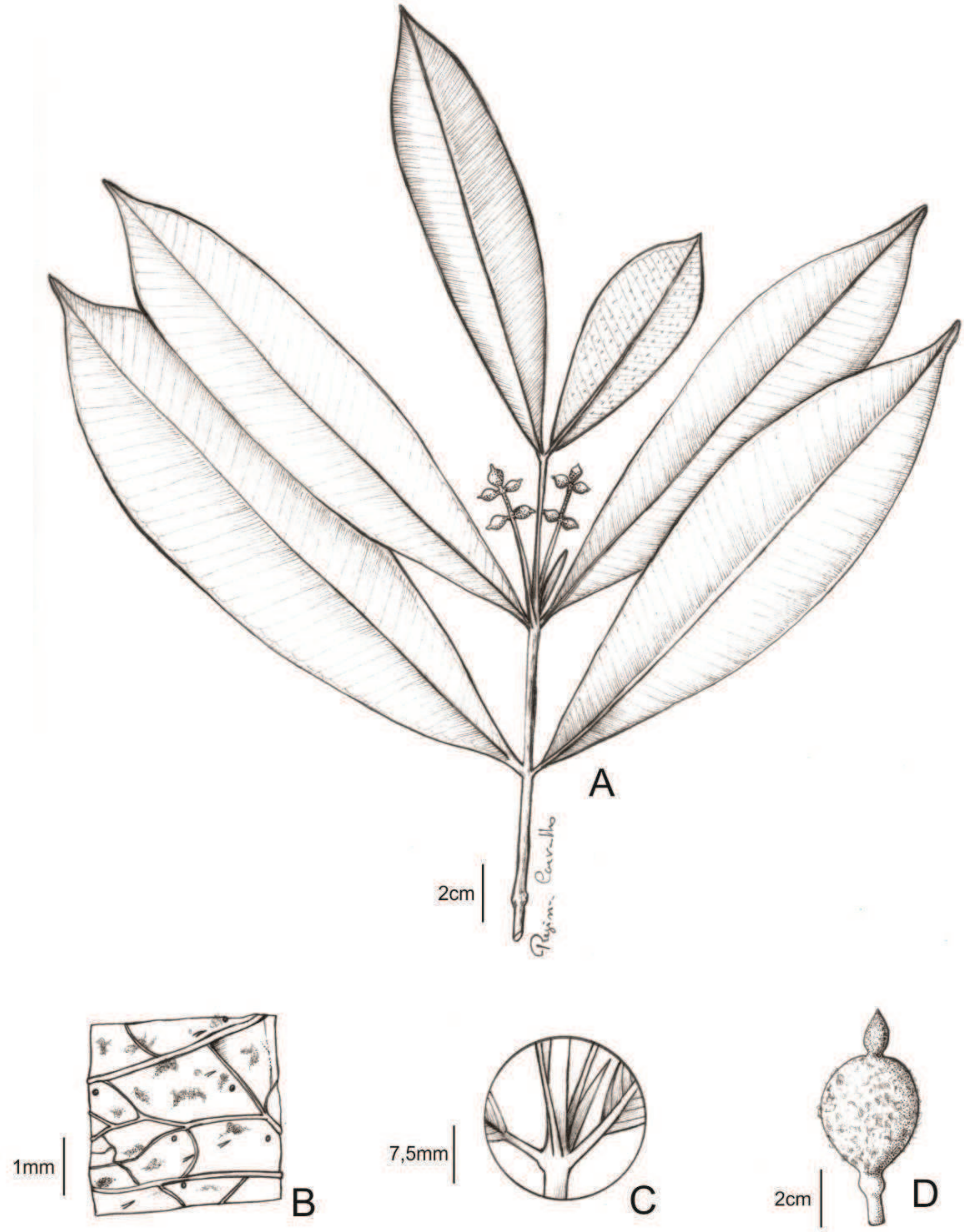

Figure 7

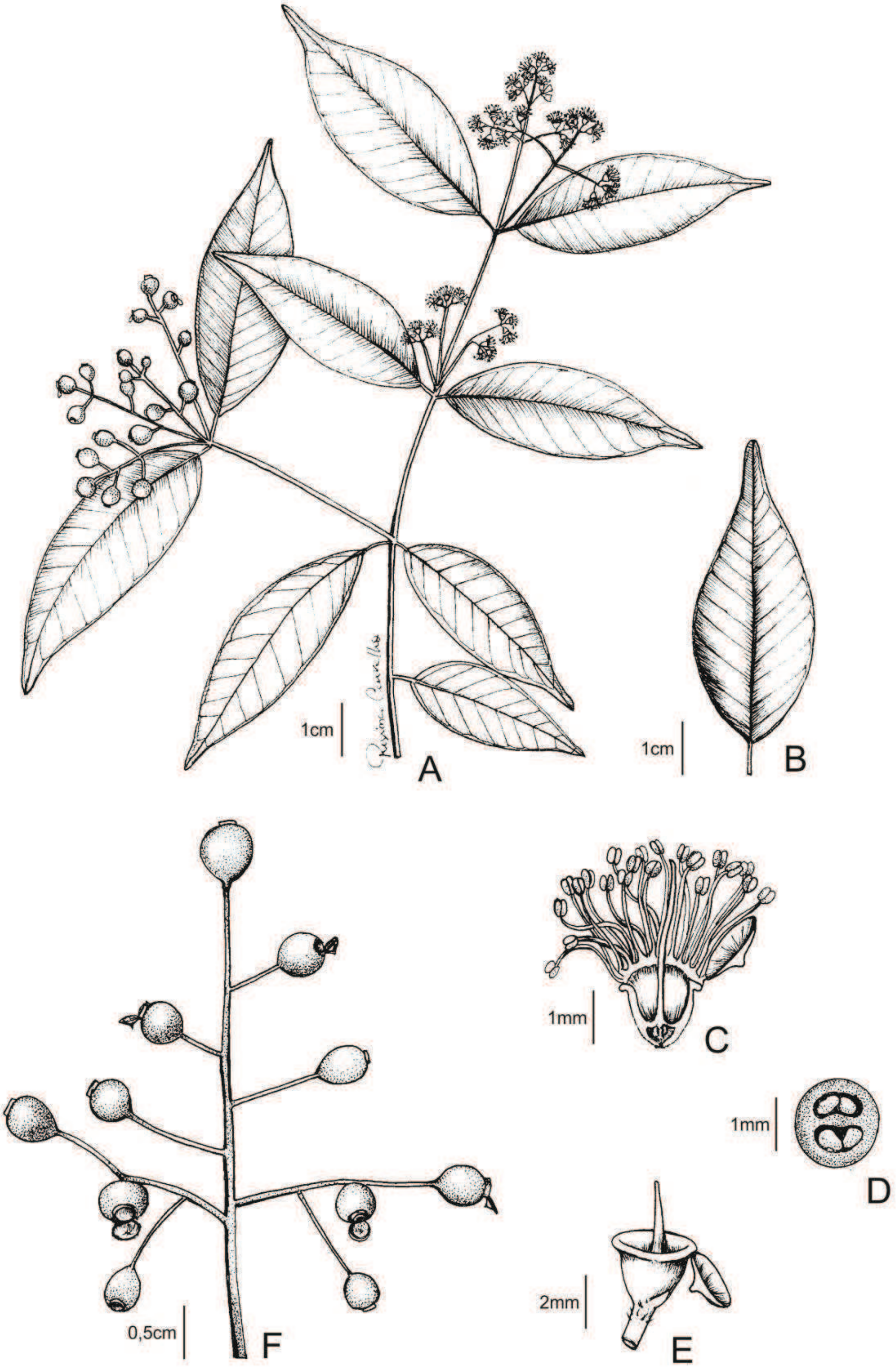

Figure 8

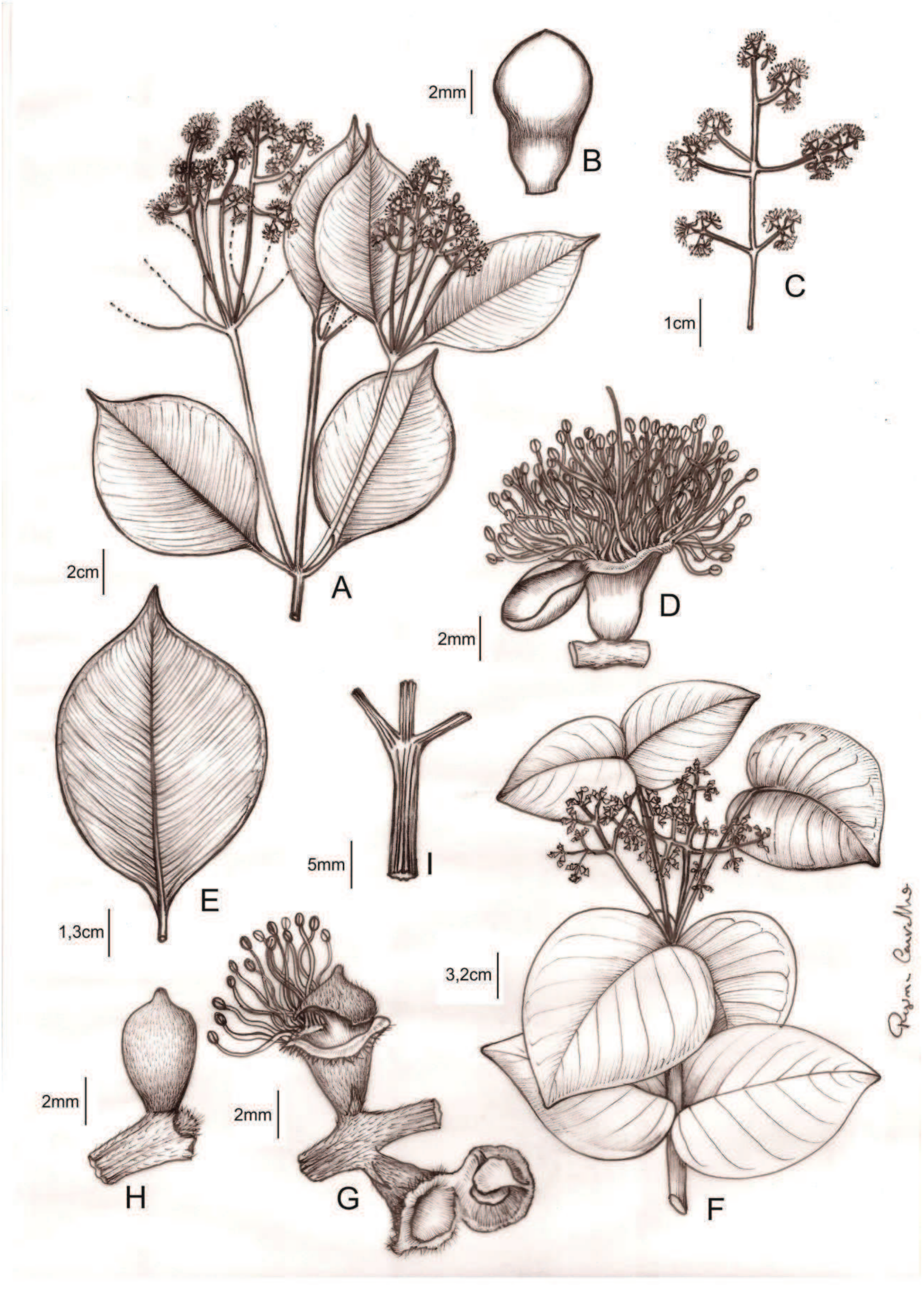

Figure 9

6.8 APENDIX A – LIST OF EXAMINED MATERIAL IN ALPHABETICAL ORDER OF COLLECTOR, THE NUMBERS CORRESPONDING TO THE SPECIES LIST

1. *Calyptranthes angustifolia*
2. *Calyptranthes aromatica*
3. *Calyptranthes bipennis*
4. *Calyptranthes blanchetiana*
5. *Calyptranthes boanova*
6. *Calyptranthes brasiliensis*
7. *Calyptranthes caudata*
8. *Calyptranthes clusiifolia*
9. *Calyptranthes concinna*
10. *Calyptranthes curta*
11. *Calyptranthes dryadica*
12. *Calyptranthes fusiformis*
13. *Calyptranthes grammica*
14. *Calyptranthes lanceolata*
15. *Calyptranthes lucida*
16. *Calyptranthes maritima*
17. *Calyptranthes martiusiana*
18. *Calyptranthes obovata*
19. *Calyptranthes ouropretensis*
20. *Calyptranthes pauciflora*
21. *Calyptranthes pileata*
22. *Calyptranthes pteropoda*
23. *Calyptranthes pulchella*
24. *Calyptranthes reginae*
25. *Calyptranthes restingae*
26. *Calyptranthes rubella*
27. *Calyptranthes santalucia*
28. *Calyptranthes serrana*
29. *Calyptranthes strigipes*
30. *Calyptranthes solitaria*
31. *Calyptranthes tetraptera*
32. *Calyptranthes tricona*

Specimens examined

Acevedo-Rodríguez, P 8779 (7) **Acildo** 626 (9) **Agra, MF** 2635 (15); 4883 (15) **Aguiar, OT** 406 (6); 612 (6); 733 (9) **Almeida Rocha, RF** 195 (6) **Almeida, J** 1267 (6); 1301 (6) **Almeida, K** 73 (15) **Almeida, TE** 1878 (9) **Alves-Araújo, A** 314 (6); 635 (6); 779 (6); 819 (6) **Alves, E** 13 (9) **Alves, LJ** 12 (23) **Alves, M** 1265 (6); 1834 (6) **Alves, RJV** 1321 (8) **Amaral, IL** 3387 (22); 3764 (15) **Amorim, AA** 7192 (6); 7581 (27) **Amorim, AM** 457 (14); 6525 (3); 7192 (6); 7581 (27) **Amorim,**

RA 15 (6) **Colletta, GD** 262 (6) **Conceição, AA** 512 (22) **Constantino, R** 28 (9) **Cooper, GP** 366 (7) **Cordeiro, I** 598 (22); 643 (9); 1383 (9); 1390 (6); 6509 (13) **Cordeiro, J** 688 (9); 1266 (9); 1343 (20) **Correa, MA** 12 (9) **Corrêa, MA**12 (9) **Costa, IR** 557 (8); 620 (6) **Costa, RA** 16 (6) **Coura Neto, AB** 43 (9) **Cribari, RS** 105 (3) **Croat, TB** 18466 (3); 19886 (22) **Cunha, MCL** 214 (15) **Daly, DC** 6692 (3) **Damasceno Jr, GA** 2616 (15) **de Lima, HC** 3568 (15) **de Oliveira, CAM** 42 (6) **Demuner, V** 882 (6) **Dias, E** 128 (27)**Dias, HM** 214 (6); 381 (6) **Dombrowski, LT** 5365 (9); 12436 (9); 12683 (9) **Domingos, QD** 561 (8) **Duarte, AP** 9152 (6) **Dunaiski Jr** 1128 (9) **Dusén, PKH** 7411 (20) **Echternacht, LA** 210 (8); 484 (21) **Ekman, EL** 13896 (6) **Elias, SI** 311 (9) **Elisaro, S** 36 (13) **Engels, ME** 1513 (15); 1636 (9) **Erbesdobler, E** 14 (15) **Estevan, DA** 400 (9); 824 (9) **Esteves, GL** 2158 (6) **Eupunino, A** 139 (6) **Falcão, M** 76 (6) **Falkenberg, DB** 2241 (9) **Faria, JEQ** 526 (13); 956 (22); 974 (13); 986 (13); 989 (13); 992 (22); 2365 (8); 2387 (8); 2400 (8); 2426 (13); 2429 (22); 2452 (8); 2497 (6)**Farias, DS** 120 (9); 368 (9); 377 (2) **Farias, GL** 99 (6); 589 (6) **Farney, C** 1312 (6); 1991 (23); 2627 (6); 2824 (23); 2825 (6); 2906 (6); 2912 (6); 2913 (23); 3087 (15); 3873 (22); 4469 (28); 4554 (6) **Fazza, LFA** 28 (9) **Felitto, G** 792 (9) **Fernande, HQB** 2521 (27) **Fernandes, GD** 33388 (9)**Ferreira, CAC** 4142 (22); 9295 (15); 10067 (3); 10077 (3) **Ferreira, PSS** 2 (6) **Ferreira, VBR** 9 (6); 117 (6) **Ferreira, VF** 277 (14); 4154 (9) **Fiaschi, P** 352 (8); 710 (6); 2028 (14); 2703 (19); 3575 (14) **Fiebrig, K** 6277 (9) **Flora da E.E. Panga** 266 (15) **Flores, TB** 287 (6) **Foli, DA** 622 (15); 644 (15); 697 (6); 1392 (6); 2223 (15); 3346 (15); 4167 (6); 4301 (6); 4722 (15); 6262 (6) **Folli, DA** 443 (15); 622 (15); 644 (15); 697 (6); 1392 (6); 2223 (15); 3346 (15); 4167 (6); 4301 (6); 4722 (15); 6262 (6); 6304 (6); 6410 (6) **Fonseca, ML** 2879 (28) **Forero, E** 6353 (22); 6424 (3); 8758 (6)**Forest Department of British Guiana** 7926 (22) **Forzza, RC** 4398 (8); 4454 (18); 4736 (9) **Foster, RB** 3364 (7); 12057 (3) **Fraga, CN de** 2137 (9); 2186 (27) **Fraga, CN** 2137 (9); 2186 (27) **França, F** 2735 (6); 2737 (6); 4032 (6); 4061 (6) **Franco, GADC** 437 (10); 1101 (12) **Franco, GDAC**1101 (12) **Franzen, R** 19 (1) **Freire, CG** 59 (15) **Freire, E** 10 (6) **Freire, GQ** 59 (15) **Freire, L** 112 (6) **Freire, SG** 73 (6) **Freitas, L** 897 (13) **Fróes, RL** 30950 (15) **Funch, LS** 716 (22) **Furlan, A** 1078 (16) **G,** 56971 (6) **Gadelha Neto, PC** 1982 (6) **Gadelha Neto, PC** 1982 (6); 2252 (15) **Gandolfi, S** 2722 (9) **Ganev, W** 782 (6); 1156 (6); 1412 (6); 1453 (6); 1454 (22); 2224 (15); 2547 (6); 2591 (6) **Garcia, RJF** 66 (6); 119 (6); 321 (6); 360 (6); 740 (6) **Garder,** 1302 (6) **Gardner, G** 1302 (8); 3187 (15); 4667 (6); 5715 (7) **Gasson, P** 5973 (6) **Giordano,**

(6) **Vieira, AOS** 534 (9) **Vieira, FCS** 1882 (24); 1885 (9); 1908 (24); 1910 (20); 1925 (27) **Vieira, MCW** 281 (8) **Vinha, PC** 1253 (6) **Volpi, RL** 779 (15) **Walter, BMT** 4258 (6) **Wasum, R** 655 (9); 829 (9); 845 (15); 848 (9); 870 (9); 948 (9); 958 (9); 1126 (9); 1239 (15); 1273 (9); 1664 (9); 1681 (9); 1738 (9); 1739 (9); 1921 (9); 1922 (9); 2275 (9); 3412 (9); 4766 (9); 12360 (9) **Weiler Juniro, I** 148 (6) **Weyland Vieira, MC** 33 (8); 281 (8); 536 (8); 561 (8) **Widgren** 536 (8) **Wood, JRI** 10290 (21); 25178 (7); 25179 (15) **Woodgyer, E** 2838 (6); 2840 (6) **Yoland, C** 6678 (6) **Záchia, R** 735 (9)**Zanotto, M** 108 (9); 110 (9) **Zappi, DC** 752 (6); 1597 (6); 2473 (6); 2496 (22); 2771 (6); 9298 (6) **Zardini, EM** 2775 (9) **Zarucchi, JL** 2992 (22) **Ziller, SR** 427 (9); 1489 (9); 1571 (9)

Unknown collector and/or collector number:

ALCB 34135 (6); 36574 (6); 36611 (6); 75109 (6) ASE 20299 (6) BHCB 3677 (22); 8682 (13); 13094 (13); 16786 (22); 17160 (22); 20487 (8); 20491 (6); 32035 (13); 43667 (15); 45763 (6); 47318 (14); 47936 (6); 52846 (22); 91778 (8); 109894 (26); 125354 (9); 153535 (6); 156292 (6); 157239 (6) CEPEC 86051 (6); 86070 (6); 105751 (6) INPA 237626 (9) IPA 13712 (6); 13787 (6); 15256 (6); 44524 (6) K NA (NA); (NA); (NA); MBM 65786 (6); 81798 (9); 85158 (9); 129218 (6); 139771 (6); 161268 (15); 167028 (9); 167456 (9); 173321 (15); 258043 (8); 276914 (6); 319495 (15); 322534 (9); 345114 (27); 346080 (6); 385545 (6); 391490 (9); 391803 (9); 397402 (6); 397569 (6) P NA (NA); (NA); (NA); PEUFR 2240 (6) RB 63328 (9); 75139 (6); 75150 (6); 85204 (2); 146213 (2); 148552 (15); 236044 (8); 247757 (13); 247874 (6); 255698 (15); 262628 (6); 273720 (27); 290857 (2); 294321 (9); 298713 (17); 362415 (2); 368983 (6); 389197 (6); 415752 (27); 415761 (15); 423096 (9); 437126 (9); 479769 (8); 502764 (9) SP 26969 (9); 26975 (9); 35085 (6); 44254 (9); 47002 (9); 80773 (6); 81593 (15); 138151 (6); 138836 (9); 246452 (9); 270824 (9); 292884 (9); 305388 (6); 310367 (9); 315598 (6); 316802 (9); 316807 (9); 339000 (6); 350038 (9); 382673 (6) SPF 13597 (9); 19523 (13); 20843 (13); 36072 (6); 41256 (6); 41689 (6); 44001 (6); 44612 (6); 46586 (6); 67597 (6); 69384 (6); 69718 (6); 71694 (9); 71695 (8); 82080 (14); 91077 (6); 96500 (6); 100925 (22); 116162 (6); 117194 (6); 122570 (15); 127118 (6); 134274 (9); 166855 (6); 203802 (22) UB; UFP 5390 (6) VIES CEUNES 24661 (6); 24761 (6).

Capítulo 3

A new species and a new geographical record of *Calyptranthes* (*Myrcia s.l.*, Myrtaceae) from Brazil

Ana Raquel Lourenço & Marccus Alves

Manuscrito publicado no periódico *Phytotaxa*, 188 (5): 275–281, 2014.

A new species and a new geographical record of *Calyptranthes* (*Myrcia s.l.*, Myrtaceae) from Brazil

7.1 Abstract. Taxonomic studies on *Calyptranthes* have led to the identification and proposal of a new species, *Calyptranthes serrana*, endemic to the Atlantic rainforest. It is mainly characterized by its orbicular to orbicular-elliptic and coriaceous leaf blades, with abruptly acuminate apices, and 6–7 mm long buds. It is here described and illustrated, with comments concerning its distribution and habitat of occurrence. Considering the data available, the species is recognized as Endangered (EN) according to the IUCN criteria. *Calyptranthes dryadica*, a species previously considered as endemic to the state of São Paulo, is here registered for the state of Espírito Santo.

7.2 Resumo. Estudos com *Calyptranthes* levaram à identificação e proposta de uma nova espécie, *Calyptranthes serrana*, endêmica da Mata Atlântica. É caracterizada principalmente pelas folhas orbiculadas a orbiculado-elípticas e coriáceas, com ápice abruptamente acuminado e botões florais com 6–7 mm compr. A espécie é aqui descrita e ilustrada, com comentários acerca da sua distribuição e habitat de ocorrência. Considerando os dados disponíveis, a espécie é reconhecida como "Endangered" (EN), de acordo com os critérios da IUCN. *Calyptranthes dryadica*, uma espécie conhecida previamente como endêmica do estado de São Paulo, é aqui registrada para o estado de Espírito Santo.

7.3 Introduction

Calyptranthes Swartz (1788: 79) is a Neotropical genus growing from Mexico and the Caribbean to northern Argentina (Landrum & Kawasaki 1997), with approximately 260 currently known species (WCSP 2013). In Brazil, 72 species are known, of which 47 are endemic, occurring mainly in the Atlantic and Amazon domains, with few species in the Caatinga and Cerrado (Sobral *et al.* 2014).

Calyptranthes is thus far recognized as monophyletic, nested within a large *Myrcia s.l.* clade, thus far recognized as monophyletic, *Myrcia s.s.* (De Candolle 1827: 406) being paraphyletic (Lucas *et al.* 2011). *Calyptranthes* is an older name than *Myrcia*; to maintain nomenclatural stability, the latter name has been proposed for conservation over the former (Lucas & Sobral 2011). Until a nomenclatural decision is made by the International Association for Plant Taxonomy, we maintain the use of *Calyptranthes*. The main diagnostic morphological feature of *Calyptranthes* is the calyx opening by the dehiscence of a calyptra. However, this character is still subject to discussion since McVaugh (1968) raised concerns about lack of consistency in using calyx opening as a diagnostic character for a genus in the Myrcioid group (species with the "myrcioid embryo" according to Barroso 1999). Even so, anthesis by means of a calyptra has been shown to be an important feature for recognition of the sub-generic clade 1 as defined by Lucas *et al.* (2011), which includes the species sampled in that analysis, presently named in *Calyptranthes*.

Taxonomic studies on Myrtaceae have increased in Brazil in recent years, including an increase in new records and new species described, as well as a taxonomic deflation due to synonymization (Souza & Morim 2008; Amorim & Alves 2012a, b; Sobral *et al.* 2012; Faria & Proença 2012; Lourenço *et al.* 2013; Amorim *et al.* 2013; Sobral 2014). This fact demonstrates the importance of monographic work in a diverse but still poorly understood family like Myrtaceae (Thomas *et al.* 1998). Species in *Calyptranthes,* as in most of the American genera of Myrtaceae, are morphologically very similar to each other. Diagnostic features that separate them can be very obscure and only an accurate analysis of herbarium and field material, allied with an understanding of the group over a wide geographical range, can help to understand boundaries among the species involved. A taxonomic review of *Calyptranthes* for the Atlantic rainforest domain is in progress by the authors, and has led us to identify and propose here a new species, occurring in the Atlantic rainforest of São Paulo state, Brazil, as well as to report a new occurrence record for an additional species in the state of Espírito Santo.

7.4 New species

Calyptranthes serrana *sp. nov*. (Fig. 1)

Type:—Brazil. São Paulo, [Santo André]: Alto da Serra, Estação Biológica, [Reserva Biológica Alto da Serra de Paranapiacaba, 23º46’00’’–23º47’10’’S and 46º18’20’’S–46º20’40’’W], 12 December 1928, bt., fl., *C. Lemos s.n.* (holotype: SPF! 67445; isotypes: RB! 71687; BHCB- Image!: 109894).

Related to *C. grandifolia*, but differs by having orbicular leaf blades, with abruptly acuminate apices, and 6–7 mm long buds; to *C. dryadica* but differs by having coriaceous leaf blades, inflorescences 10–11 cm long, three to four lateral branches, and flower buds with rounded apices; and to C. *lucida*, differing by the inflorescences and buds length, as well as the brownish color of the leaves when dried.

Trees essentially glabrous except for pubescent and ferruginous flower buds; hairs simple, ferruginous. Leaf blade orbicular to orbicular-elliptic, 9–10.5×6.5–7 cm, coriaceous, brownish when dried, concolorous; apex abruptly acuminate; base rounded and attenuate; margin slightly revolute; midvein sulcate above, prominent below; secondary veins barely visible on both surfaces, impressed above, slightly prominent below; marginal vein 3–4 mm from margin; intramarginal vein up to 1 mm from margin; glandular dots not visible on both surfaces; petiole 1.5–2 cm long, 2.5–3 mm wide. Inflorescence of terminal paired panicles 10–11 cm long, axes compressed to terete, three to four lateral branches, these subopposite to alternate, slightly arched, ca. 15–25 flowers per panicle; basal bracts deltoid, 1×1 mm, caducous; peduncle 5.5–6 cm long; bracts caducous, not seen; flowers sessile; bracteoles deltoid to linear, up to 1 mm long, caducous; flower buds obovoid, slightly constricted between the hypanthium and calyptra, slightly pyriform, 6–7×3–6 mm, apex rounded, with a very shortly apiculate calyptra; hypanthium prolonged up to 1 mm beyond ovary, internally glabrous; petals absent; stamens ca. 120, filaments 6–8 mm long, anthers up to 0.5 mm long, ellipsoid; style 6–8 mm long, stigma punctiform; ovary bilocular to trilocular, with two to four ovules per locule. Fruits not seen.

Distribution and habitat:— The species is restricted to São Paulo state thus far, where samples from three areas were located in the visited herbaria, all sharing environmental conditions such as vegetation type and altitude. The “Reserva Biológica Alto da Serra de Paranapiacaba" (RBASP) is a Brazilian conservation unit (UC) comprising about 440 ha located in the municipality of Santo André, at 750–900 m elevation (Pastore *et al.* 2012). According to Veloso *et al.* (1991) the predominant vegetation type is "Floresta Ombrófila Densa Montana" (Montane Atlantic Forest) composed of distinct physiognomies; however, lack of information prevents assertion of exactly in which physiognomy this species occurs. The UC Estação Biológica de Boracéia (EBB) is located near the city of Salesópolis, São Paulo state, an area with 96 ha of Montane Atlantic Forest, about 100 km from the RBASP (Ferro & Diniz 2007). Another area where the species was found is part of "Parque Estadual da Serra do Mar", also a UC with ca. 310.000 ha, located at the Serra do Mar corridor, the fourth area with the highest endemic angiosperm richness in the Brazilian Atlantic rainforest (Werneck *et al.* 2011). The three areas are distant 100–200 km from each other, which clearly shows that *C. serrana* has a restricted occurrence area as well as habitat of occurrence.

Conservation status:—In a herbarium based survey on collections made between 1983–1995 to recollect species represented only by very old collections, Kirizawa *et al.* (2009) listed 68 species of Myrtaceae in the RBASP (the second most species-rich family, only preceded by Orchidaceae). Since 1970, the area has been subject to the continuous action of pollutants due to its proximity to the Cubatão chemical pole (Kirizawa *et al.* 2009). The site is also disturbed by the presence of numerous invasive plants and logging of timber species (Pastore *et al.* 2012). After the first collection dated 1928, the species was collected again in 1967, Salesópolis, and subsequently after 34 years, in São Luis do Paraitinga. Although the areas in which the species where be found are inserted in UC's, following the IUCN (2010) red list criteria, we here assign *C. serrana* to the endangered category (EN), based on the criteria: B2ab(ii) (area of occupancy < 500 km^2, number of locations ≤ 5 and a continuing decline in area of occupancy) and D (very small or restricted population).

Etymology:— The epithet refers to the type locality (Alto da Serra de Paranapiacaba).

Affinities and discussion:—Among other species of *Calyptranthes* from the Atlantic rainforest of São Paulo, *C. serrana* could be confused with *C. grandifolia* Berg (1857: 48), *C. dryadica* M.L.Kawasaki (1998: 386) and *C. lucida* Martius ex De Candolle

(1828: 258) (Table 1). *Calyptranthes serrana* can be distinguished from *C. dryadica* mainly by its orbicular and coriaceous leaf blades (vs. widely elliptic to elliptic), flower buds with rounded apex (vs. apiculate) and inflorescences 10–11 cm long (vs. 3–8 cm long). *Calyptranthes grandifolia* is a widely distributed species, with remarkable morphological plasticity. Despite this variation, some features are very distinct from *C. serrana* such as the elliptic to lanceolate-elliptic leaf blades with acute to acuminate (vs. abruptly acuminate in *C. serrana*) apices and 3–5 mm long buds. Another widespread species with remarkable plasticity is *C. lucida*, which can be distinct from *C. serrana* also by the inflorescences size (10–11 cm long vs. 4–5.6 cm), the flowers buds size (6–7 mm long vs. 1–3 mm) and by the colour when dried (brownish vs. greenish).

The ovary in *Calyptranthes* is mainly described in the literature as bilocular with two ovules per locule, with the exception of Landrum & Kawasaki (1997), who state that it can be 2(–3)-locular. In the ongoing taxonomic review for the Atlantic Rainforest domain, several species with trilocular ovary and variable numbers of ovules per locule were observed; *C. serrana* is one of them. The consistency of this character as diagnostic is questionable however, as it appears to vary among individuals of the same species.

Some recently described species of *Calyptranthes* match the observation of Joppa *et al.* (2011), that many species published as new in recent years are described based on just a few herbarium collections, indicating that the remaining species to be described are probably narrow endemics. *Calyptranthes fusiformis* M.L.Kawasaki (Kawasaki 1996), *C. boanova* Sobral, *C. curta* Sobral & O. Aguiar, *C. detecta* Sobral & M. Souza and *C. maritima* Sobral & Bertoncelo (Sobral *et al.* 2012), *C. santalucia* Sobral (Sobral 2013) and now *C. serrana* are some examples. These species are clearly rare and their limited occurrence in the field may explain a lack of samples in herbaria.

There is a considerable lag time between the three known collections of *C. serrana*. This time is even longer, considering the first collection (1927) and its publication as a new species. This time lapse is close to recently published estimates of the average time that species remain undescribed after the first collection (Bebber *et al.* 2010) and suggests global taxonomic capacity to describe new species of flowering plants is stagnant at a time of unprecedented concern for conservation and extinction (Bebber *et al.* 2010; 2013).

Additional specimens examined (paratypes):—Brazil. São Paulo, Salesópolis: Estação Biológica de Boracéia [23º37'59''S–45º31'59''W], perto do Rio Corujá, 29 November 1967, bt., fl., *J. Mattos & N. Mattos 14272* (SP! 157928); São Luis do Paraitinga [23º20'66''S–45º07'30''W], Núcleo Santa Virgínia, trilha do Rio Ipiranga, 21 November 2001, bt., *n.c.*, n.d. (HRCB, BHCB- Image!).

7.5 New geographical record

Calyptranthes dryadica M.L.Kawasaki (1998: 386).
Type:—BRAZIL. São Paulo: Iguape, Ecological Reserve of Juréia-Itatins, trail of the fig tree, 14 Mar 1990, *L. Rossi et al. 542* (Holotype: SP!; Isotypes: RB!, MBM, MO).

This species was thought to be restricted to São Paulo state, but along a survey of specimens of *Calyptranthes* we were able to identify a collection of this species from the state of Espírito Santo. This represents a considerable extension of the known range of this species.

Specimen examined:—Brazil. Espírito Santo: mun. Castelo, Parque Estadual do Forno Grande, Floresta Ombrófila Densa Altomontana com inselbergues, 20º30'58''S 41º05'01''W, elev. 1100–1400 m, *R. Goldenberg et al.* 1161 (MBML!).

7.6 Acknowledgements

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Legends of illustrations:

Figure 1. *Calyptranthes serrana* (A) fertile branch, (B) detail of the inflorescence (panicle) showing the branching pattern, some branches slightly arched (C) Flower bud with a rounded apex, slightly constricted between the hypanthium and calyptra (D)

Flower (E) Leaf blade; adaxial surface. Illustration by Regina Carvalho, drawn from the holotype.

Table 1. Comparison of characters between *Calyptranthes serrana* and closely related species.

	C. serrana	***C. dryadica***	***C. grandifolia***	***C. lucida***
Leaf color when dried	brownish	greenish	brownish	greenish
Leaf consistency	coriaceous	chartaceous	chartaceous to coriaceous	chartaceous to coriaceous, sometimes slightly membranaceous
Leaf shape	orbicular to orbicular-elliptic	widely elliptic to elliptic	elliptic to lanceolate-elliptic	elliptic, elliptic-ovate, narrow-elliptic to lanceolate
Inflorescence size (cm long)	10–11	3–8	8–9	4–5.6
Inflorescence branch pattern (lateral branches)	three to four	one to two	one to four	one to four
Flower bud size (mm long)	6–7	6–8	3–5	1–3
Flower bud apex	rounded	apiculate	rounded, rarely shortly apiculate	rounded
Geographical distribution	Atlantic rainforest of São Paulo state	Atlantic rainforest of São Paulo and Espírito Santo states	Atlantic rainforest from northeastern to southern Brazil	From Central America to North of the South America, widespread in Brazil

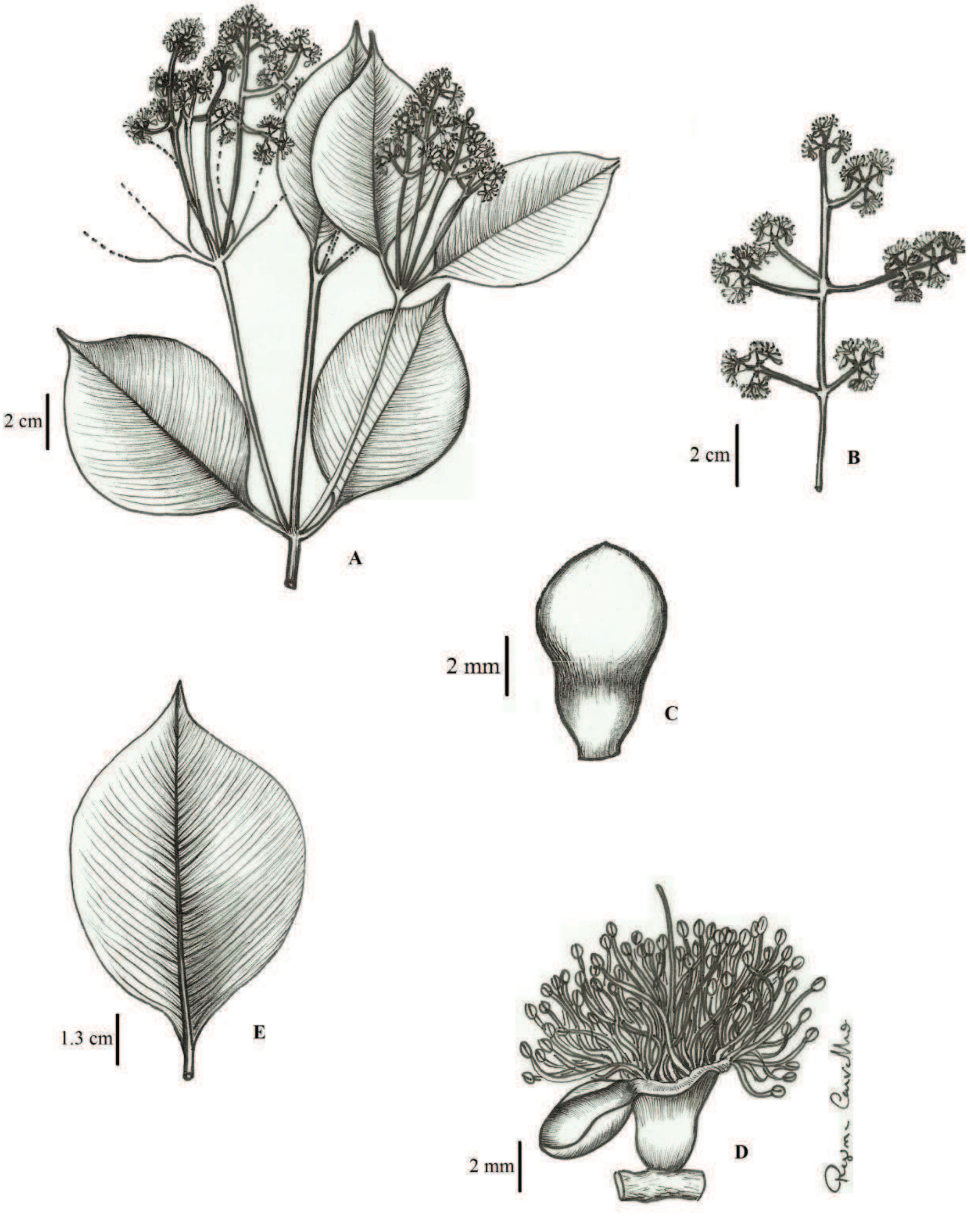

Figure 1

Capítulo 4

Calyptranthes ouropretensis sp. nov. (Myrtaceae, *Myrcia s.l.*) from Minas Gerais, Brazil.

Ana Raquel Lourenço, Matheus Fortes Santos & Marccus Alves

Manuscrito a ser submetido ao periódico *Nordic Journal of Botany*

Calyptranthes ouropretensis spp. nov. (Myrtaceae, *Myrcia s.l.*) from Minas Gerais, Brazil.

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8.1 Abstract

A new species of *Calyptranthes* from the vegetation locally known as “canga” in Minas Gerais state, previously misidentified as *Calyptranthes cordata*, is here described. The paper provides illustrations and explains the main characters to separate it from the morphologically closest related species. Also, an IUCN Red List assessment is proposed; the species is here considered “Vulnerable” (VU).

Kew words—Ironstone outcrops, conservation, new species.

8.2 Introduction

The Espinhaço Range is one of the leading diversity regions in South America (Giulietti et al. 1997), being the second longest mountain formation of Brazil. It extends for over one thousand kilometers from the north-south direction, its northern limit being the "Serra da Jacobina", in Bahia state, and the southern the "Serra do Ouro Branco", in Minas Gerais. The mountain range basically consists in two major "blocks" – the "Serra do Espinhaço" and "Chapada Diamantina", with elevations varying between 700–2000 m (Kamino *et al.* 2008).

A mosaic of different types of vegetation and physiognomies can be observed, under the influence of three phytogeographic domains: Caatinga, Cerrado and Atlantic rainforest. This latter has its influence predominantly on the southern portion, which comprises the surroundings of Belo Horizonte and Ouro Preto region, the Caatinga vegetation influencing predominantly the northern portion (Harley 1995).

A set of variables as the past climatic and geological history, changing rainfall regime, longitudinal and latitudinal gradients, among others, have enabled the unique flora of the region to thrive in the specialized high altitude environment (Harley 1995), with a high species richness and remarkable concentration of species with restricted distribution (Rapini et al. 2008).

The ironstone outcrops, locally known as "cangas", were formed millions of years ago, resulting from the weathering of ironstones, located predominantly in the Iron Quadrangle (IQ) region, interspersed throughout the mountain tops that compose the southern end of the Espinhaço Range, (Carmo et al. 2012, Carmo & Jacobi 2013, Jacobi et al. 2007). Besides the high local diversity in species number, the vegetation in cangas houses dozens of rare species, taxonomic novelties and endemism (Jacobi et al 2007, Carmo & Jacobi 2013).

Myrtaceae is often cited as one of the richest families throughout the Espinhaço range, occurring in outcrops as well as in gallery forests (Nic Lughadha 1995, Giulietti et al. 1997, Zappi et al. 2003, Kawasaki 2004, 1989, Messias et al. 2012, Bünger et al. 2014). *Calyptranthes* is a Neotropical genus with approximately 260 currently species (WCSP 2013), from which 72 species are known for Brazil thus far. They occur mainly in the Atlantic and Amazon domains, with few species in the Caatinga and Cerrado (savanna-like vegetations) (Sobral *et al.* 2014). The genus has been positioned within the large *Myrcia s.l.* clade, and the main morphological feature that separates it from the closely related genera is the calyx opening in a calyptra (Lucas et al. 2011).

During the ongoing revision of *Calyptranthes* for the Brazilian Atlantic rainforest domain, specimens previously misidentified as *Calyptranthes cordata* O. Berg (now a synonym of *Myrcia cordata*, see explanation later) is here proposed as a new species, described and illustrated.

8.3 Taxonomy

Calyptranthes ouropretensis **A.R. Lourenço sp. nov. (Fig. 1)**

Type: Brazil. Minas Gerais: Ouro Preto, Serra of Antônio Pereira, campo rupestre on ferruginous "canga", 20º10'S, 43º31'W, 21 Nov 2007, *M.C.T.B. Messias et al. 1544* (Holotype: RB, Isotype: BHCB 124917, OUPR).

Closely related to *Calyptranthes brasiliensis*, differing by its distal branches striate (versus terete to compressed), leaves cordate to subcordate, sometimes amplexicaul, sessile (versus rounded, cuneate, obtuse, or acute, never amplexicaul, petiolate).

Description

Shrubs up to 3m high, branches, especially the distal ones, striate; branchlets pubescent, mostly in the grooves; adaxial surface of leaves glabrous to slightly puberulous; abaxial surface of young leaves tomentose, the old ones glabrous or sometimes pilose; inflorescences, buds and flowers strongly pubescent; fruits pubescent to puberulent; hairs simple or t-shaped, mainly ferruginous. Leaf blade cordate, sometimes orbicular-cordate, decussate, sessile, 8.5–15.5×6–11.5 cm, coriaceous, slightly discolour, drying brownish, glandular dots not seen by disarmed eye; apex acute to obtuse; base cordate to subcordate, sometimes amplexicaul; midvein adaxially sulcate near the base, impressed towards the apex, abaxially prominent; secondary veins slightly prominent above, prominent bellow; main marginal vein 5–11 mm from the margin; intramarginal vein 2–3 cm from margin. Inflorescences axillary, paired or solitaire branched panicles, 8.5–15 cm long; rachis extremely compressed and angular, striate; first to fourth-order branches, opposite, 12–20 flowers per panicle; peduncles 6.5–7.5 cm long; basal bracts present in the early inflorescence, naviculiform; bracts at the base of the lateral branches lanceolate, up to 2 mm long, caducous; bracteoles at the base of the flower buds linear or lanceolate, up to 3 mm long, caducous; flower bud prolate, 4–6 mm long, sessile, calyptra apiculate, ca. 4 mm diam., chartaceous to coriaceous, tearing slightly irregular, leaving an irregular appearance on the borders of the flowers; petals one or two, spatulate, 1–2 mm long, often attached to the calyptra in the flower; stamens ca. 50, filaments ca. 3 mm long, anthers 0.5 mm long; style and stigma not seen; bilocular ovary, two ovules per locule, basal placentation. Fruits globose, ca. 5 mm diam., yellow to red when mature, crowned by a tube with slightly irregular borders, sometimes holding the remnant calyptra; seeds one or two.

Distribution and conservation status

Calyptranthes ouropretensis is endemic from the ironstone outcrops of Minas Gerais thus far, occurring in areas described as ferruginous “cangas”, where the litolic soil can accumulate, allowing the development of shrubby vegetation, sometimes near water (Messias et al. 2012). According to the IUCN criteria (IUCN 2010), the species is here considered “Vulnerable” (VU) based on the criteria A2(d) (a population reduction estimated in ≥ 50 %, because of actual or potential levels of exploitation that may not have ceased). The ironstone outcrops share most of the characteristics of other rock outcrops, such as isolation and edaphic and climatic harshness, but they are the object of opencast mining, where currently around 50 mines are in operation (Brazil 2006), and thus subjected to irrecoverable degradation (Jacobi et al 2007).

Etymology

The epithet refers to the city of Ouro Preto, in Minas Gerais, the type locality.

Additional specimens examined: Brazil. Minas Gerais, Barão de Cocais, Mina de Brucutu, 9 feb 1999, *M.R.S.M. Marques-Leitão et al. s.n.* (BHCB 45763); Ouro Preto, Serra de Antônio Pereira, 19 mar 2008, *M.C.T.B. Messias et al. 1734* (OUPR 20697, BHCB 124880); 28 jul 2007, *M.C.T.B. Messias et al. 1380* (OUPR 20991); 20 nov 2009, *M.C.T.B. Messias et al. 2373* (OUPR 23354); Mariana, Córrego do macaco barbado, Samarco Mineração, 4 dec 1996, *M. Ronhel & J. Craig s.n.* (OUPR 6298).

Discussion

Specimens of *C. ouropretensis* were previously identified in the consulted herbaria as *C. cordata* O. Berg, a species described in Flora Brasiliensis (Berg 1857). In the protologue of *C. cordata*, Berg cites the type collection information: *Habitat in prov. S. Pauli: Sellow.* (*v. in h. Berol*).

No material collected by Sellow matching the type description was found at B herbarium, but a Sellow collection bearing the number 1090 and handwritten by Berg and named *C. cordata*, was found at LE herbarium. We here assume that this material was used by Berg to describe *C. cordata*. However, the analysis of the LE specimen has led to confirm that, in fact, it is a species of *Myrcia* – *Myrcia cordata* – which is very similar to what was being called *C. cordata*, specially the leaves and branches. The specimen has only fruits and it is very easy to misidentify between the two species and genera. This analysis has leaded us to agree with World Checklist (WCSP 2013) which cites this name as a synonym under *Myrcia subcordata* DC (De Candolle 1828). Therefore, specimen from Minas Gerais, which was being identified as *C. cordata*, is here proposed as a new species.

Affinities

Calyptranthes ouropretensis and *Myrcia subcordata* resemble each other in vegetative gestalt (especially the leaves shape and base), but can differ by the diagnostic character used to separate *Myrcia* from *Calyptranthes* thus far: the calyx lobes (five separated lobes in *Myrcia*, calyx forming a calyptra in *Calyptranthes*). Bunger et al. (2012) provides a well detailed description of *Myrcia subcordata* and also points out that the young leafs can be covered by a villous-ferruginous cataphyll, character that does not occur in *C. ouropretensis*. The geographical distribution of *M. subcordata* somehow overlaps with *C. ouropretensis*, since the *Myrcia* species occurs in the campos rupestres of Minas Gerais state (including the canga vegetation) besides Bahia and Goiás states, in Cerrado and Floresta Ombrófila ecosystems (Sobral et al. 2014).

Among *Calyptranthes* species, it can resemble to *C. brasiliensis* Sprengel, especially some morphotypes of the later, with coriaceous leaves and ferruginous indumentum that occurs in opened habitats, including campos rupestres and the coastal forests (restingas) (Lourenço and Barbosa 2012, Sobral et al. 2014) but differs by the sulcate branches (vs. mainly terete, sometimes compressed in *C. brasiliensis*), sessile to subsessile leaves (vs. petiolate) and base cordate to subcordate, sometimes amplexicaul (vs. cuneate or rounded, never amplexicaul).

8.4 Acknowledgements

The authors would like to thank CNPq (process 140966/2011-7) and CAPES (BEX 1549/12-0) for funding the PhD. research of the first author and Regina Carvalho for the illustrations.

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Figure 1. *Calyptranthes ouropretensis* (A) fertile branch, (B) detail of the flowers showing the petals attached to the calyptra and the stamens (C) Flower bud with a apiculate apex D) Striate branchlet.
Illustration by Regina Carvalho, drawn from the holotype.

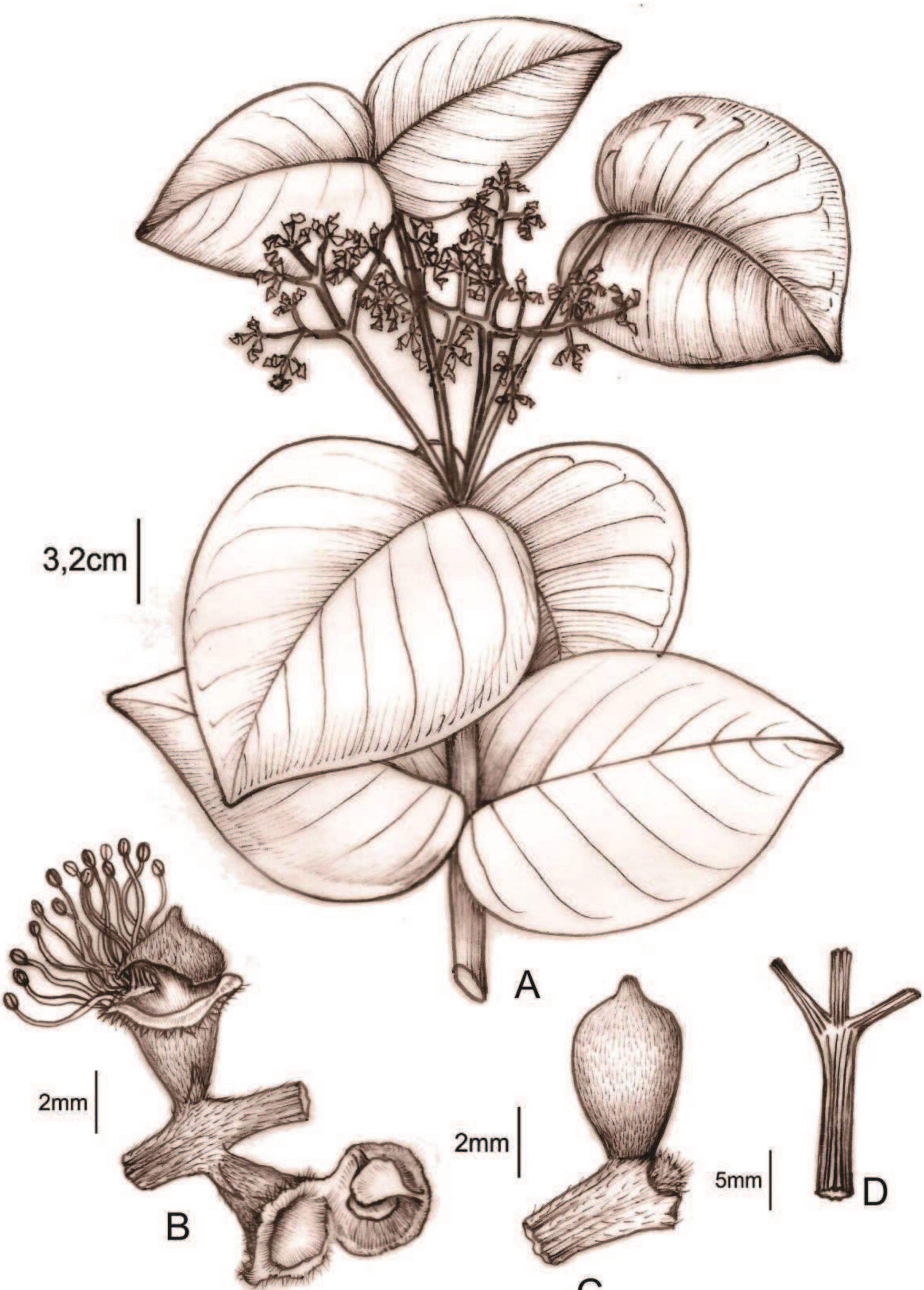

Figure 1

Capítulo 5

Phylogenetic relationships in *Calyptranthes* Sw. (*Myrcia s.l.*) reveal a monophyletic diversification on the Atlantic Forest Domain

Ana Raquel Lourenço, Luiz Gustavo Souza, Marccus Alves & Eve Lucas

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Phylogenetic relationships in *Calyptranthes* Sw. (*Myrcia s.l.*) reveal a monophyletic diversification on the Atlantic Forest Domain

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9.1 Abstract

The Atlantic Forest Domain is one of the most diverse and threatened ecosystems on earth, it is considered one of the main hotspots for biodiversity and conservation in a global context. In this region, Myrtaceae Juss. is a highly species-diverse family in which species concepts are known to be difficult and with taxonomic boundaries in and between many groups still poorly understood. A problematic group within this family is *Myrcia* sensu lato that appear paraphyletic, including the currently accepted genera *Myrcia, Marlierea*, *Gomidesia* and *Calyptranthes*. A phylogenetic analysis of *Myrcia s.l.* with a focus on *Calyptranthes* was carried out using DNA sequence data from plastid spacers (*trn*Q-*rps*16, *psb*A-*trn*H, *trn*L-*trn*F) and ribosomal nuclear ITS loci. The aim was to understand the relationships between these lineages. Bayesian analysis confirmed that *Calyptranthes* is not monophyletic, due to *Calyptranthes multiflora* emerging in a *Myrcia* clade. Based on molecular and morphological data, two species complexes were identified, comprising species with difficult circumscriptions: the *Brasiliensis* and *Lucida* complexes. Haplotype networks were produced to investigate relationships between each complex and reveal that the taxonomy of *Brasiliensis* complex is in need of adjustment while the *Lucida* complex requires further study. Interpretation of the molecular phylogeny in a biogeographical context revealed a clade formed by the Atlantic species and another, including species from the Amazon/Caribbean. The oldest lineages in the phylogeny occurred in the latter clade suggesting a more recent colonization of the Atlantic region by *Calyptranthes*, with recent diversification, contributing to difficulties delimiting many of the species. Nomenclatural notes and general discussion regarding *Calyptranthes* is provided.

9.2 Introduction

The Atlantic Forest Domain is one of the most diverse and threatened ecosystems on earth, considered to be one of the main hotspots for biodiversity and conservation in a global context (Mittermeier et al. 2005). The "Lista de Espécies da Flora do Brasil" (Flora of Brazil 2020 under construction) registered the biodiversity of the Brazilian flora and indicated ca. 15.500 species for the Atlantic Forest, equivalent to almost 50% of the species richness of Brazil's total flora (ca. 32.800 sp.). However, it is believed that this diversity is still poorly understood. Despite major advances in the knowledge of species distribution in Brazil, taxonomic reviews are disperse and incomplete for much of the Brazilian taxa (Werneck et al. 2011).

Taxonomic reviews are the first step to know how many species are in an ecosystem, to understand the geographical distribution and levels of endemism, all of which contribute to conservation of biological diversity. However, concepts of genera and species have been discussed for many years by taxonomists and non-taxonomists, being troublesome in many groups (Lourenço & Alves in prep.). Rieseberg et al. (2006) state that biological entities must correspond to reproductively independent lineages at a species level for a classification to reflect nature, but must be useful at the same time. Morphological methods sometimes do not entirely achieve this, with the result that morphological data are now frequently used together with DNA-based phylogenetic methods, especially by taxonomists working on species-level problems.

Myrtaceae Juss. is a highly species-diverse family with about 5.670 species (Govaerts 2008); of these, 1028 occur in Brazil (Flora of Brazil 2020 under construction). Species concepts in Myrtaceae are known to be difficult, with species boundaries in many groups still poorly understood. A centre of diversity of Myrtaceae is the Brazilian Atlantic

Forest, in which it is the sixth most species-rich family (Stehmann 2009). Within Myrtaceae, several species are widespread, occurring in a wide range of habitats, following complex morphological patterns related to geographical and ecological traits in different populations – so-called "ochloespecies" (White 1998). Unsurprisingly, these biological entities were then described as different species by different taxonomists, resulting in groups of morphologically very similar species, coexisting in the same habitat as "species complexes" (Judd et al. 2009). It is very difficult to solve the resulting taxonomic problems at the morphological level, so population analysis can be a useful tool to clarify species boundaries; these were used in Myrtaceae by Lima et al. (2015) for the *Myrcia laruotteana* complex and have been applied to some species complexes of *Melaleuca* (Broadhurst et al. 2004) and *Eucalyptus* (Whiffin and Ladiges 1992, Steane et al. 1998).

Taxonomic concepts in Myrtaceae evolved very slowly along history, since the beginning of the 19th century, especially with the works of Berg and McVaugh. On the basis of various morphological and molecular works, Wilson et al. (2005), using *mat*K as a molecular marker and including the then widest sample of species and groups, proposed a division of Myrtaceae into subfamilies: Psiloxyloideae and Myrtoideae. The latter subfamily includes the majority of species including tribe Myrteae, in which the South American species form a cohesive phylogenetic group with fleshy fruits, although probably this character has appeared more than once and independently during the evolution of the family. The classification proposed is the currently accepted and is used as a base for the recent studies (Lucas et al. 2005, 2007 and 2011, Mazine et al. 2014 and Staggemeier 2015).

Myrteae is subdivided in subtribes, and within subtribe Myrciinae, *Calyptranthes* Sw. is the genus with the most stable generic classification and clear morphological character boundaries (**Table 1**). The first morphological boundaries defined by Swartz (1788), the "truncated calyx, operculate, missing corolla" remain the same, even after

McVaugh's (1968) concern regarding consistency of characters of the calyx to separate a genus. He observed that some species of *Myrcia* and *Marlierea* could have an "imperfect" calyptra, saying it was difficult to separate the three genera based just on the calyx alone. Multiple studies are underway to investigate the consistency of the morphology of the calyx and its evolution; however, these characters remain the main feature separating *Myrcia s.s.* from *Marlierea* and *Calyptranthes*.

Lucas et al. (2011), in a molecular phylogenetic analysis including six species of *Calyptranthes*, concluded that the group was monophyletic, with a high bootstrap index (100) - but this was not the case for *Myrcia s.l.,* that emerged paraphyletic (bootstrap 61) with *Marlierea*, *Gomidesia* and *Calyptranthes* nested within it. The *Calyptranthes* clade, the only monophyletic group, was so called "clade 1"; the main morphological characters used by Lucas et al. (2011) to distinguish from the other clades in *Myrcia s.l.* are given below:

Branching pattern	Sympodial
Inflorescence	Usually cymosely branched, with an abortive, congested terminal primary axis
Calyx lobes	Fused and calyptrate, circumscissile and falling as a calyptra at anthesis
Floral disk	Glabrous internally
Hypanthium	Glabrous internally, prolonged beyond ovary
Ovary	Bilocular, two ovules per locule
Fruit	Globose, with persistent apical hypanthium tube; calyptra generally falling
Distribution	Mostly forests (Amazon and Atlantic), Central and South America and Caribbean; relatively few species extending to associated drier habitats

Table 1. Clade 1 – *Calyptranthes* morphological characters. From Lucas et al. 2011.

The “Clade 1” in the sense proposed by Lucas et al (2011), raised some questions. If taxonomic treatments, that means, accurate morphological analysis and monography of the group within its main centres of diversity - the Atlantic Forest Domain, Amazonian Forest and Caribbean – are done, the morphological characters proposed to distinguish the genus from the others genera of *Myrcia* s.l., will be maintained? If not, the alternative scenario is that the closed calyptra may have evolved multiple times during the evolution of the group. By adding more samples of *Calyptranthes* in the phylogenetic analysis, is the group still going to emerge as monophyletic? The “Clade 1”, although based on six *Calyptranthes* samples only, showed a tendency that the Atlantic rainforest species are part of a separated lineage from the Caribbean, being formed by derived species, the last ones appearing at the basis of the clade. Are the Atlantic species morphologically very close from each other due to the recent evolution, a fact that caused taxonomic and nomenclatural problems accumulated on years of study?

The genus *Calyptranthes* in the Brazilian Atlantic Forest comprises 32 species distributed from northern of Rio Grande do Norte to southern of Rio Grande do Sul states (Lourenço and Alves in prep.). All of them fit well the concept of the genus described before, including the calyx opening in a regular calyptra. However, it is not always easy to distinguish the species boundaries, since some of them can be included in the concept of ochloespecies, as well as occur in a wide latitudinal range, having a considerable morphological plasticity. This lead to the recognition of a complex, here called “*Brasiliensis* complex”, formed by the species: *Calyptranthes brasiliensis* Spreng., *C. aromatica* St. Hil., *C. clusiifolia* Berg., *C. concinna* De Candolle, *C. dardanoi* Mattos, *C. grandifolia* Berg, *C. lanceolata* Berg, *C. loranthifolia* De Candolle, *C. widgreniana* Berg- all of them overlapping at some point of their geographical distribution.

The aim of this work is to clarify the above questions, using an expanded geographical and taxonomic sample and performing a DNA-based phylogenetic analysis, in addition to the biogeography interpretation found with the parallel taxonomic treatment of the species of the Atlantic Forest Domain. In particular, also investigate the species relationships of the *Brasiliensis* complex, and briefly discuss the *Lucida* complex.

9.3 Materials and methods

Plant material

50 samples of *Myrcia s.l.* were examined, including 38 specimens of *Calyptranthes*. In the Neotropics, these samples were collected in the Atlantic Forest Domain, Caribbean, Central American and Amazon regions – when not, they were obtained cultivated at Kew. Species names, together with the RBG Kew DNA and Tissue Collections numbers, vouchers, provenance and herbaria that hold the samples are presented in **table 2**. Most samples were prepared from field collected leaf material kept in dehydrated in silica-gel until the moment of the DNA extraction. A minority of samples were extracted from herbarium material but generally yielded lower concentrations of DNA.

Phylogenetic analysis

Phylogenetic analysis was based on plastidial spacers *trn*Q-*rps*16, *psb*A-*trn*H and *trn*L-*trn*F as well as the nuclear ITS (ITS1-5.8S-ITS2). Non *Myrcia* s.l. Myrtaceae outgroups were included from the genera *Eugenia*, *Myrceugenia*, *Luma* and *Myrtus* (**Table 2**, indicated with an *). DNA extraction was performed according to Doyle & Doyle (1987).

Total DNA was purified for long-term storage in the Kew DNA and Tissue Collections using centrifugation in caesium chloride-ethidium bromide gradients (1.55 gml-

1) followed by butanol extraction of the ethidium bromide and dialysis to remove caesium chloride.

The ITS region was amplified using primers AB101 (F) and AB102 (R) (Sun et al. 1994). The chloroplast spacers of Hamilton (1999) were used to amplify *psb*A-*trn*H and *trn*L-*trn*F. *trn*Q-*rps*16 was amplified using the primers of Shaw et al. (2007). PCR products were purified using QIAGEN® QIAquick™ Spin Columns according to the manufacturer's protocol; product quality was visually checked in a 1% agarose gel. Cycle sequencing reactions were cleaned using the Promega Magnesil clean up system before sequencing reactions were carried out with the Taq DyeDeoxy Terminator Cycle Sequencing Kit™ (Applied Biosystems, Inc). Sequences were read on an ABI 3100 Genetic Analyzer. DNA sequences were assembled and edited in GENEIOUS 7.1.4 (http://www.geneious.com, Kearse et al. 2012). Alignments were made using the MUSCLE plugin extension in GENEIOUS, with subsequent manual adjustments when necessary. Any doubtful base calls and all phylogenetically informative base changes were compared with the general consensus and individually checked. The molecular datasets obtained from the nuclear and plastid regions were then analyzed independently before being combined.

The Bayesian Inference (BI) analysis was performed with each region and with ITS+*trn*Q-*rps*16+*psb*A-*trn*H+*trn*L-*trn*F combined data. The most appropriate model of sequence evolution for Bayesian Inference (BI) analysis was determined for each region and for the combined data using the Akaike information criterion (AIC) as implemented in the program jModelTest 0.1.1 (Posada 1998). Evolutionary models were determined for each data partition as follows: HKY+G for ITS1 and ITS2, K80+I for 5.8S and GTR for the plastidial spacers. BI search was performed using Mr. Bayes v3.1.2 (Ronquist and Huelsenbeck 2003) under a partitioned model as implemented on CIPRES Science Gateway V.3.1 (Miller et al. 2010) (available at: www.phylo.org). The analysis was conducted for two independent runs and for 5,000,000 generations, sampling every 1,000 trees. The first quarter of sampled trees were discarded as burn-in. Subsequent trees were retained and posterior probabilities (PP) were estimated by constructing a 50% majority-rule consensus tree in PAUP*. Trees were visualized using FigTree v1.3.1 (Rambaut 2009).

Species distribution data were obtained from the site http://www.gbif.org, from which distribution maps were prepared using the software QGIS (QGIS Development Team 2015). Haplotype networks were developed using the samples obtained from the phylogenetic work, using the software DNAsp v5.10.1 (Rozas and Rozas 1995) and Network v4.6.1.1. (Bandelt et al. 1999) and after edited in the CorelDraw Graphic Suits X7.

Species	**RBG Kew'sDNA and Tissue Collections numbers**	**Voucher**	**Provenance**	**Herbaria**
Eugenia uniflora L. *	Cultivated RBG Kew	Lucas, 207	Cultivated RBG Kew	K
Luma apiculata (DC.) Burret *	Cultivated RBG Kew	Lucas, 208	Cultivated RBG Kew	K
Myrtus comunis L. *	Cultivated RBG Kew	Lucas, 211	Cultivated RBG Kew	K
Eugenia sp1. *	42894	Amorim, 1016	Brazil -BA	UFP
Calyptranthes bipennis O.Berg.	36258	Holst, 8054	Brazil -AM	K
Calyptranthes brasiliensis Spreng.	42892	Lourenço, 432	Brazil -SE	UFP
Calyptranthes brasiliensis Spreng.	42934	Faria, 2594	Brazil -BA	UB
Calyptranthes brasiliensis Spreng.	42935	Faria, 2597	Brazil -SE	UB
Calyptranthes brasiliensis Spreng.	41397	Araújo, 1828	Brazil -MG	K
Calyptranthes brasiliensis Spreng.	41406	Lucas, 930	Brazil -ES	K
Calyptranthes brasiliensis Spreng.	42920	Lourenço 404	Brazil -SE	UFP
Calyptranthes brasiliensis Spreng.	42932	Faria, 2568	Brazil -BA	UB
Calyptranthes brasiliensis Spreng.	42922	Lourenço 440	Brazil - ES	UFP
Calyptranthes caudata Gardner	42893	Souza, 1076	Brazil - RJ	R
Calyptranthes cf. eriocephala Urb.	41412	Araujo, 1803	Rep. Domi.	K
Calyptranthes cf. lanceolata O. Berg	43052	Fiaschi, 3575	Brazil - ES	RB
Calyptranthes cf. paniculata Ruiz & Pav.	43222	Assunção, 1134	Brazil - AM	INPA
Calyptranthes clusiifolia O. Berg	42895	Faria, 1279	Brazil - GO	UB
Calyptranthes clusiifolia O. Berg	42921	Lourenço, 441	Brazil - ES	UFP
Calyptranthes clusiifolia O. Berg	42931	Faria, 2549	Brazil - BA	UB
Calyptranthes dardanoi Mattos	42896	Lourenço, 444	Brazil - PE	UFP

Calyptranthes fasciculata O.Berg	K000330977	Pendry, 266	Dominica	K
Calyptranthes garciae Alain & M.M.Mejía	41415	Araujo, 1802	Rep. Dom.	K
Calyptranthes grammica (Spreng.) D. Legrand	42898	Souza, 1097	Brazil - RJ	R
Calyptranthes grandifolia O.Berg	41404	Lucas, 122	Brazil - PR	K
Calyptranthes hatschbachii D.Legrand	41398	Lucas, 171	Brazil - PR	K
Calyptranthes laevigata Urb. & Ekman	41403	Araujo, 1793	Rep. Dom.	K
Calyptranthes lanceolata O.Berg	41407	Lucas, 84	Brazil - SP	K
Calyptranthes lucida Mart. ex DC.	41729	Sasaki, 2448	Brazil - MT	SPF, NY, HERBAM
Calyptranthes multiflora Poepp. ex O.Berg.	41410	Araujo, 1885	Brazil - RO	K
Calyptranthes pallens Griseb.	41400	Araujo, 1792	Rep. Domi.	K
Calyptranthes pauciflora O. Berg	42899	Faria, 2572	Brazil - BA	UB
Calyptranthes pulchella DC.	41411	Zappi, 2496	Brazil - MG	K
Calyptranthes restingae Sobral	41416	Lucas, 990	Brazil - BA	K
Calyptranthes sintenisii Kiaersk.	41413	Araujo, 1785	Rep. Dom.	K
Calyptranthes sp.1	42901	Souza, 1092	Brazil - RJ	R
Calyptranthes speciosa Sagot	41394	Holst, 9399	French Guiane	K
Calyptranthes spruceana O.Berg	41396	Araujo, 1874	Brazil - RO	K
Calyptranthes thomasiana O.Berg	19048	Pollard, 1195	British Virgin Islands	K
Calyptranthes widgreniana O.Berg	43223	Santos, 850	Brazil - SP	SP
Calyptranthes widgreniana O.Berg	42900	Bunger 621	Brazil - MG	BHCB
Marierea obscura	42936	Lourenço, 439	Brazil - RJ	UFP
Marlierea caudata McVaugh	42097	Zappi, 1506	Brazil - MT	K
Marlierea eugenisopsoides	43057	Bunger, 571	Brazil - SP	BHCB
Marlierea newiedeana	43055	Lourenço, 442	Brazil - ES	UFP
Marlierea racemosa (Vell.) Kiaersk.	S-727	Lucas, 225	Brazil - RJ	K
Mycia subcordata DC.	42933	Faria, 1231	Brazil - MG	UB
Myrcia anacardiifolia Gardner	9942	Nadruz, 999	Brazil - RJ	K, RB
Myrcia isaiana G.M.Barroso & eixoto	16196	Lucas, 60	Brazil - SP	K, ESA, HUEM
Myrcia mutabilis (O.Berg) N.Silveira	19053	Mazine, 1052	Brazil - MG	ESA, MBM
Myrcia pubipetala Miq.	16203	Lucas, 86	Brazil - SP	K, ESA
Myrcia rufipes DC.	19692	Lucas, 280	Brazil - MG	K, RB
Myrcia splendens (Sw.) DC.	16202	Lucas, 73	Brazil - SP	K, ESA, HUEM
Myrcia subavenia (O. Berg) N. Silveira	42930	Faria, 2426	Brazil - MG	UB, HUFSJ

Table 2. Vouchers for DNA samples used in the phylogenetic analysis of *Calyptranthes*.

Names marked with an asterisk (*) are outgroup taxa.

9.4 Results

Relationships of *Calyptranthes* in *Myrcia s.l.*

The isolated analysis of the individual markers provided had no statistical support for any species relationships and are not presented here. The consensus tree from the combined *trn*Q-*rps*16, *psb*A-*trn*H, *trn*L-*trn*F and ITS Bayesian inference analysis of *Myrcia* s.l. with emphasis on *Calyptranthes*, is shown in **figure 1**. Base pair statistics of each locus are shown in **Table 3** with ITS presenting most variability (23.7% of informative sites) and the three combined plastidial regions providing much less (6.2%).

Most *Calyptranthes* species (the core *Calyptranthes* species) appear as a monophyletic group with a moderate support (Bayesian posterior probability of 0.7), sister to clade formed by *Myrcia anacardifolia* and *M. pubipetala* (**Figure 1**). However, as reported by Wilson et al. (submitted), the Amazonian species *Calyptranthes multiflora* emerged outside of the core *Calyptranthes* clade, related to *Marlierea caudata* (Bayesian posterior probability of 1.0), a species of *Myrcia* sect. *Aulomyrcia* (Staggemeier et al. 2015). *Myrcia* and *Marlierea* appear paraphyletic with respect to each other as reported by previous studies (Lucas et al. 2011, Staggemeier 2015).

	nrITS	*trn*L-*trn*F	*psb*A-*trn*H	*trn*Q-*rps*16	Combined
Number of sequences (including outgroups)	103	90	106	66	59
Alignment length (bp)	594	349	303	629	2.125
No. of variable sites (%)	212 (35.7%)	34 (9.7%)	70 (23.1%)	330 (52.4%)	345 (16.23%)
No. of parsimony informative sites (%)	141 (23.7%)	13 (3,7%)	39 (12.9%)	111 (17.6%)	131 (6.2%)
Autapomorfias	71	21	31	219	213
Gaps	8	3	5	12	45

Table 3. Descriptive statistics of nuclear ITS and plastid spacers (*trn*L-*trn*F, *psb*A-*trn*H and *trn*Q-*rps*16) in *Myrcia s.l.*

Relationships within core *Calyptranthes*

A distinct and well supported clade of Atlantic forest species can be distinguished (Bayesian posterior probability of 0.9), in which all Atlantic forest endemic species emerge. *Calyptranthes pulchella*, a widespread species occurring in the Atlantic and Amazon forests also emerges in this clade. The other species, all of them Amazonian and Caribbean, emerged in four other lineages, two of which form a weakly supported (Bayesian posterior probability of 0.5) polytomy with the Atlantic forest clade. *Calyptranthes lucida* is a widespread species that also occurs in the Atlantic rainforest, and a sample of *C. lucida* from Mato Grosso emerges in one of these clades. The remaining two clades of *Calyptranthes* are sequential sisters to this polytomy. In summary, the main pattern found in the *Calyptranthes* core group is: Atlantic clade and Amazonian + Caribbean basal lineages (**Figure 2**).

The "*Brasiliensis* complex" emerged as a well supported clade (Bayesian posterior probability of 0.9) in which the relationships between the species are shown as very close, with a polytomy at the base. The tree (**Figure 1**, blue highlighted, bayesian posterior probability of 1.0) also reflects another morphology complex, here called *Lucida* complex. McVaugh (1968) already pointed out that *Calyptranthes lucida* was probably "more than one species", but we only inserted one sample of *C. lucida* in the analysis, due to the lack of sequences obtained. *Calyptranthes bipennis* also appears in this clade, and according to the taxonomic analysis, this species has a complex disjunction pattern (Atlantic Forest and Amazon, but also occurring in the transition zones, including a wide range of morphological variation that is sometimes similar to *C. lucida*. Within the *Calyptranthes lucida* clade, *C. bipennis* emerges in a polytomy with no statistical support for relationships. This clade and this group need further investigation.

Haplotype networks – *Brasiliensis* complex

Due to the difficulty on working with a morphological approach to separate or unite species in the *Brasiliensis* complex and to the low internal resolution of the species in the Bayesian tree, two haplotype networks were generated (**Figure 3**) comprising the species that emerged in the monophyletic group (**Figure 1**, yellow highlighted): one with ITS and another with *psb*A-*trn*H sequences. The network using nrITS data (**Figure 3**, a) suggests an early evolution of the species, showing a non-variable haplotype for twelve specimens, the other ones with one or two mutation steps, the distal ones being *Calyptranthes clusiifolia* (that also appears in the central haplotype) and *C. aromatica*, the most morphologically distinct species. The network of *psb*A-*trn*H sequences (**Figure 3**, b) provides slightly different results but is also inconclusive for most species. The *psb*A-*trn*H network indicates three main haplotypes, of which two include samples of *Calyptranthes brasiliensis*, *C. dardanoi*, *C. clusiifolia*, *C. concinna*, *C. lanceolata*, *C loranthifolia* and *Calyptranthes sp.2*, species that cannot be distinguished in this context. Two samples of *Calyptranthes grandiflora* appeared united in one haplotype together with *C. widgreniana*. Two specimens of *Calyptranthes brasiliensis* are separated from the main haplotype and *C. aromatica* is distinguished from all other specimens included in the analysis.

9.5 Discussion

Morphology within core *Calyptranthes* – Inflorescence and calyptra evolution

Species of *Calyptranthes* have remarkably plastic morphology with many species very similar to each other, contributing to difficulties of identification and delimitation. In the taxonomic revision of the group for the Atlantic Forest (Lourenço and Alves in prep.), it has been noted that combinations of characters, rather than single characters, are often required to distinguish one species from another morphologically.

Perhaps the most consistent character to distinguish big groups of species within the *Calyptranthes* core group is the inflorescence pattern. The majority of species have a cymose branched panicle, a pattern found in the species of the Atlantic clade (represented by the upper inset inflorescence in **figure 1**). A second common inflorescence pattern is the cymose non-branched panicle (represented by the middle inset inflorescence in **figure 1**). This pattern was found in four species of the Atlantic clade and one in the Amazon/Caribbean clade (*Calyptranthes bipennis*). It is, therefore, not possible to establish a pattern of the inflorescence supported by the tree topology. The third pattern is the non-cymose branched panicle (represented by the third inset inflorescence in figure 1). The non-cymose branched panicle pattern is common of the Amazonian species – but not Caribbean ones, with species having a cymose branched panicle, as the Atlantic ones. Is also present in *Calyptranthes multiflora*, as well as its sister species, *Marlierea caudata*. Interestingly, Lucas et al. (2011) showed that this last pattern is common in species in *Myrcia* sect. *Aulomyrcia,* the oldest apparent lineages of the general tree presented in their work (there referred to as 'clade 9').

As it is shown, the inflorescence pattern starts to get confused when taken at a narrow level in *Myrcia s.l.*, with species presenting the same inflorescence type emerging in different positions of the clades. Wider samples of *Calyptranthes bipennis* and *C. lucida* might express similar patterns. In some individuals, *Calyptranthes bipennis* develops a somewhat branched inflorescence, different from the predominant pattern of cymose non-branching that at the other extreme can consist of only one thin pedicel with a single flower at the tip. In *Calyptranthes lucida* the opposite arrangement is possible – the species usually has a well developed non-cymose branched panicle but occasionally can appear to have short and non branched inflorescences. It is necessary to bear in mind that these two species are widespread or have distributions disjunct between the Atlantic and Amazon rainforests – different ecosystems with different origins, linked by similar ecological and geographical conditions.

Only accurate analysis of specimens in the field and herbarium as necessary for taxonomic revisionary work, can provide assurance that different 'entities' are not in fact, individuals collected at different stages of development. Therefore, results presented here suggest that inflorescence patterns may be a good taxonomic tool to identify some species, but not to separate internal groups within the *Calyptranthes* core, since it seems to have appeared differently in evolution of the group, and still are evolving. More species should be included in further analysis to corroborate this lack of pattern.

Taxonomic and phylogenetic studies of the clades discussed by Lucas et al. (2011) are currently being conducted by a variety of researchers using different approaches (e.g. anatomy, macro-morphology, DNA-based). These works are expected to provide insights or answers regarding the evolution and development of the calyptra within *Myrcia s.l.* For now it is accepted that the anatomy and origin of the calyptra as described since Berg and McVaugh's works is the same for core *Calyptranthes* species but not for *Calyptranthes multiflora*. All core *Calyptranthes* individuals analysed here possess the synapomorphies for the group listed in **table 1** and emerge as a monophyletic clade, a pattern that, in combination with the morphological characters, particularly from the inflorescence, strongly suggest that the core *Calyptranthes* is a monophyletic group. However, since *Calyptranthes multiflora* also has a calyptra, it is clear that further studies of the group will require inclusion of additional samples of this species. Such future works will further test these phylogenetic patterns and focus with more detail on the relationship between *Calyptranthes multiflora* and the species of *Myrcia* sect. *Aulomyrcia* with which it emerges.

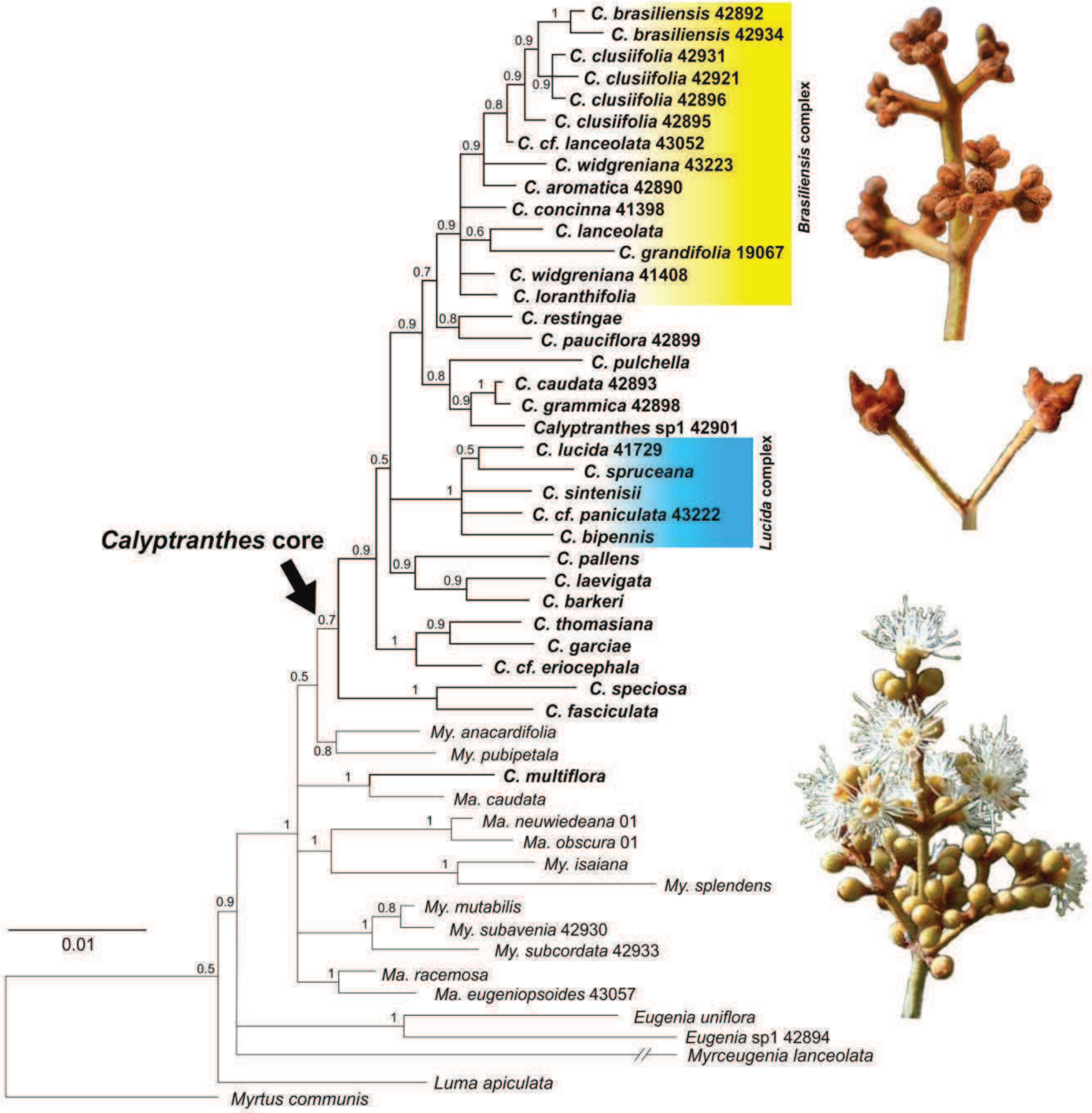

Figure 1. Majority-rule consensus tree derived from the combined *trn*Q-*rps*16+*psb*A-*trn*H+*trn*L-*trn*F+nrITS Bayesian analysis of *Myrcia* s.l. with emphasis on the *Calyptranthes* clade (bold). Numbers on branches are Bayesian posterior probabilities. Inflorescence photos: Ana Raquel De Lima Lourenço [*Calyptranthes ouropretensis* sp. nov. and *C. tricona* D.Legrand] and http://www.plantcreations.com [*Calyptranthes pallens* Griseb.].

Biogeography patterns within core *Calyptranthes*

The tree topology and branch lengths suggest that the Amazonian + Caribbean clade is older than the Atlantic clade, suggesting an Amazonian/Caribbean origin for the group. The main centre of diversity of the group is the Caribbean, with high species diversity occurring in this region.

Therefore, the Atlantic clade appears to be a more recent lineage, and in the map, the species of the Atlantic forest clade occurrence shows a remarkable geographical overlapping (Fig 2, red dots). This overlapping and tree topology agrees well with the concept of "ochloespecies" and "species complexes" cited before, as happen with the species part of the *Brasiliensis* complex.

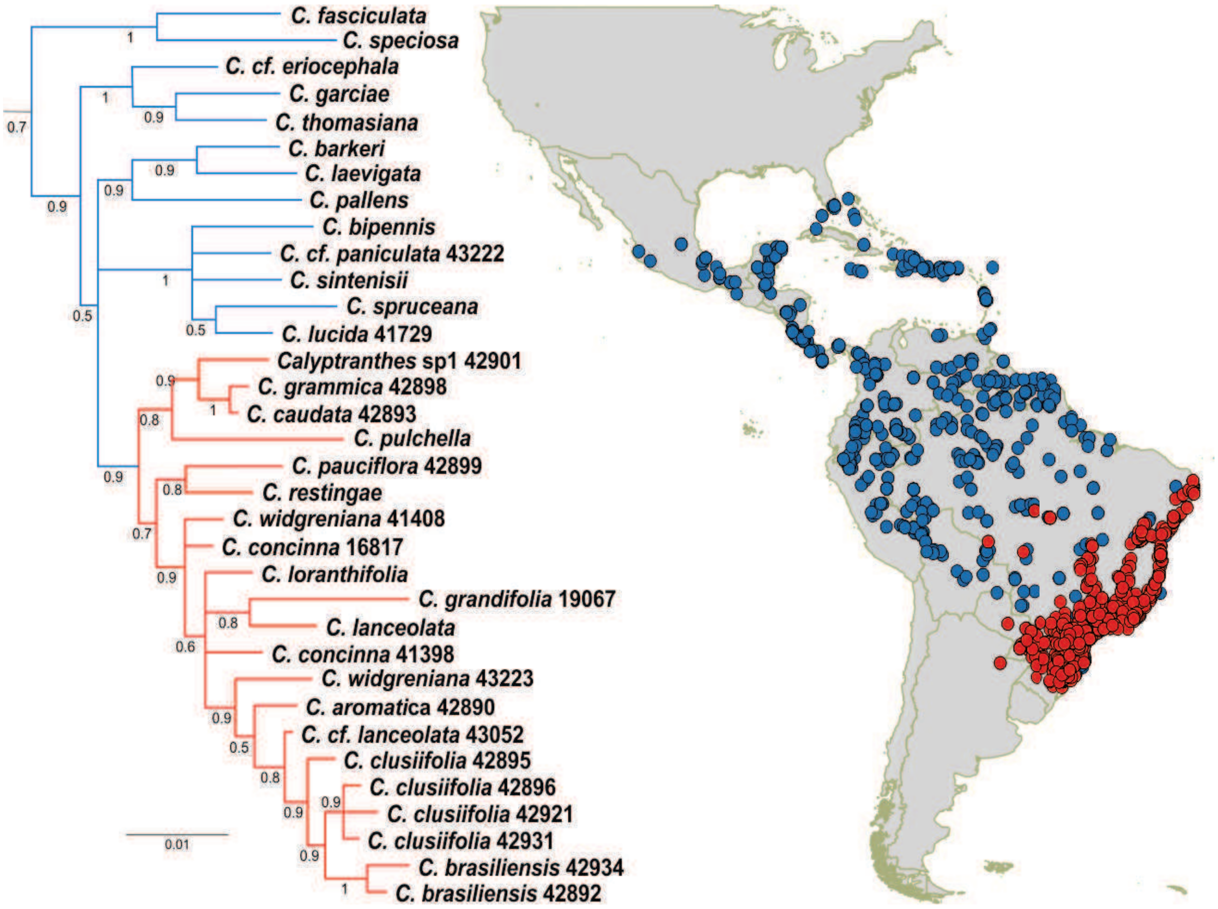

Figure 2. Phylogenetic relationships and biogeography of the genus *Calyptranthes*. Topology derived from the combined *trn*Q-*rps*16+*psb*A-*trn*H+*trn*L-*trn*F+nrITS Bayesian analysis. Numbers on branches are Bayesian posterior probabilities. In *blue* Central American/Amazon/Caribbean lineages and in *red* the Atlantic Forest clade.

McVaugh (1968), based on morphological data, suggested that species from Northeastern Brazil are often distinct from the Southern ones. Recent studies in Myrtaceae conducted in Northeastern Brazil (Lourenço and Barbosa et al. 2012, Amorim and Alves 2011, 2012, 2012a) indicate that this region is not so different from the South, with new occurrences of species previously only recorded from the South, found in the Northeast. McVaugh (1968) however, also suggested that Northeastern and Southern Brazilian species were usually distinct from Amazonian species, with some similarities in the case of disjunct species. The core *Calyptranthes* clade shows a pattern similar to that described by McVaugh. *Calyptranthes pulchella* emerged in the Atlantic clade but also occurs in the Amazon suggesting a previous link between those two ecosystems, probably through the Cerrado, where the species also occurs. The longer branch length of *C. pulchella* in relation to the sister ones (**Figure 2**) suggests an older diversification.

Results presented here corroborate those of the dating analysis of Staggemeier et al. (2015) that found the endemic species of *Myrcia* sect. *Aulomyrcia* from Amazonia and the Guiana shield to be older than those from the Atlantic forests. The latter study used BEAST (Drummond and Rambaut 2007) to calculate the mean age of the endemic species of *Aulomyrcia* from the Amazon to be ca. 21 Mya, while for the Atlantic Forest species, the mean age was more recent, c. 6 Mya. Low phylogenetic signal within the Atlantic Forest subclade may be due to this more recent speciation.

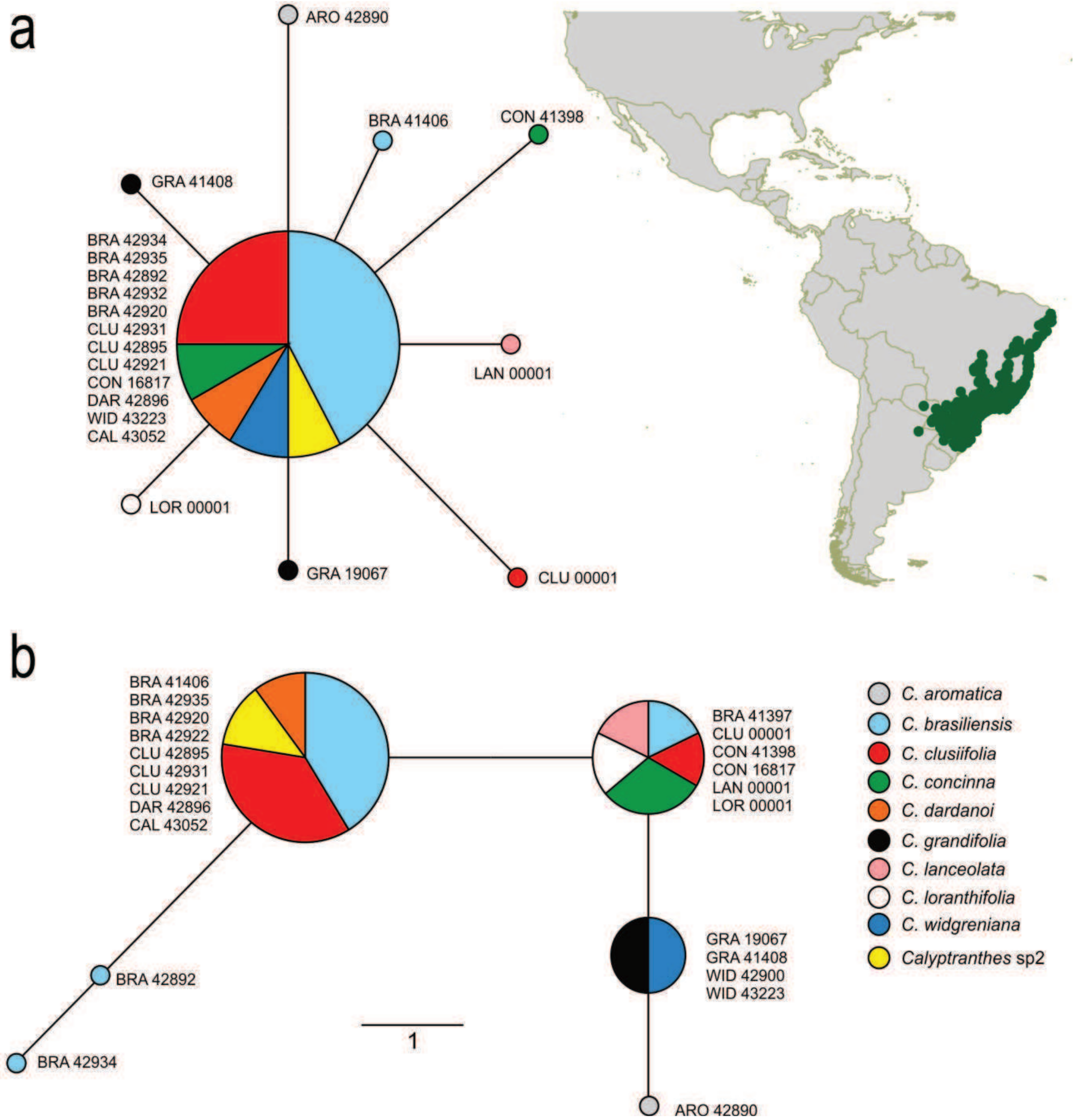

Figure 3. Haplotype networks connecting ITS (a) and psbA-trnH (b) of the *Brasiliensis* complex and their geographic distributions. In each network, each species is indicated by a different color and the circle sizes are proportional to the number of individuals observed for each haplotype.

Taxonomic implications in *Calyptranthes* in relation to *Myrcia s.l.*

Due to the emergence of *Calyptranthes* in the paraphyletic *Myrcia s.l.* clade, and the higher number of species of *Myrcia* in relation to *Calyptranthes*, a proposal to conserve the name *Myrcia* against *Calyptranthes* (which is an older name and therefore has nomenclatural priority) is in submission to the nomenclatural committee and a decision from the International Association for Plant Taxonomy must be awaited at the next International Botany Congress in 2017 (Lucas and Sobral 2011, Applequist 2014). The proposal is a first step towards a subgeneric classification of *Myrcia s.l.* comprising ‘sections’, each one being formed by a monophyletic group with morphological synapomorphies. In this context, core *Calyptranthes* might logically be proposed as *Myrcia* section *Calyptranthes*. However, before this classification can be published, the lack of morphological synapomorphies to distinguish each clade remains problematic. In the case of *Calyptranthes*, *C. multiflora* demonstrates the main morphological character of any “section *Calyptranthes*” – the calyx opening in a calyptra, but at the same time, together with the main type of inflorescence of the section *Aulomyrcia* – asymmetrically branched panicles.

Due to the described uncertainly of future taxonomic changes in the *Myrcia s.l.* group, this work does not propose any nomenclatural changes, maintaining the name *Calyptranthes* for all species analyzed, according to the International Code of Nomenclature (2006).

***Brasiliensis* complex**

During taxonomic revision of the Atlantic Forest species being carried out in parallel to the work presented here, a species complex formed by *Calyptranthes brasiliensis*, *C. grandifolia*, *C. dardanoi*, *C. clusiifolia*, *C. concinna* and *C. widgreniana* was detected. It is here referred to as the “*Brasiliensis* complex”. The Bayesian analysis presented here recovered this complex, including also a sample of *Calyptranthes loranthifolia*, a species already in synonymy with *C. brasiliensis*, but included here as *C. loranthifolia* to test the hypothesis.

The species of the *Brasiliensis* complex, as shown here, do not show molecular support to exist as different "lineages" as proposed by Rieseberg et al. (2006) – except for *Calyptranthes aromatica*. However, following this scenario, the lack of genetic variation between the majority of species is neither necessarily evidence that they represent a single species. The patterns demonstrated by the gene regions used here may not reflect the morphological variation that these species present in nature. Taxonomic adjustments must be made for this complex, and thus far based on both the morphological and genetic analyses, we propose to maintain *Calyptranthes aromatica*, *C. brasiliensis*, *C. concinna* and *C. lanceolata*. In a separate work we will propose *Calyptranthes widgreniana* as a synonym of *C. concinna*, and *C. grandifolia* and *C. dardanoi* as synonyms of *C. brasiliensis*, as well as keep *C. loranthifolia* as a synonym of *C. brasiliensis*. Greater sampling is required to clarify the taxonomic status of *Calyptranthes clusiifolia*, either as a synonym of *C. brasiliensis* or as a species in its own right.

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10 CONCLUSÕES

Com base nas perguntas realizadas no início do trabalho, podemos concluir que:

- Foram reconhecidas 32 espécies de Calyptranthes para o Domínio da Mata Atlântica Brasileira, sendo . A quantidade de atualizações nomenclaturais propostas (17 sinônimos e 7 lectotipificações) e a diferença do número de espécies com relação à atual listagem para a Flora do Brasil é bastante importante, tendo em vista a construção da Flora monografada 2020 para o gênero, que está sendo realizada pela primeira autora do presente trabalho;
- Três novas espécies para a ciência foram reconhecidas e descritas;
- A abordagem filogenética realizada para o grupo corroborou a hipótese de que as espécies da Mata Atlântica fora um clado monofilético, porém, o gênero Calyptranthes como um todo continua não sendo monofilético por uma espécie emergindo dentro do clado *Myrcia* sect. *Aulomyrcia*;
- As espécies da Mata Atlântica forma um clado distinto das demais, de evolução provavelmente recente – o que será mais bem estudado no futuro em estudos de biogeografia;
- De acordo com as espécies amostradas na filogenia até o momento, e também com as espécies de Mata Atlântica estudadas no tratamento taxonômico, a caliptra continua sendo utilizada como caractere diagnóstico do gênero *Calyptranthes*;
- A filogenia também ajudou a elucidar a taxonomia do grupo, corroborando com complexos morfológicos previamente identificados: *Brasiliensis* e *Lucida.* Algumas mudanças taxonômicas para o complexo *Brasiliensis* são sugeridas, embora mais amostras e estudos em outras abordagens (como morfometria e estudos populacionais, por exemplo) sejam necessários para melhor delimitar os taxa.

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ANEXO A – NORMAS PARA PUBLICAÇÃO NO PERIÓDICO PHYTOTAXA

(Disponível em: http://www.mapress.com/phytotaxa/author.htm)

Phytotaxa - A rapid international journal for accelerating the publication of botanical taxonomy

Aim and scope

Phytotaxa is a peer-reviewed, international journal for rapid publication of high quality papers on any aspect of systematic and taxonomic botany, with a preference for large taxonomic works such as monographs, floras, revisions and evolutionary studies and descriptions of new taxa. Phytotaxa covers all groups covered by the International Code for Botanical Nomenclature, ICBN (fungi, lichens, algae, diatoms, mosses, liverworts, hornworts, and vascular plants), both living and fossil. Phytotaxa was founded in 2009 as botanical sister journal to Zootaxa. It has a large editorial board, who are running this journal on a voluntary basis, and it is published by Magnolia Press (Auckland , New Zealand). It is also indexed by SCIE, JCR and Biosis.

All types of taxonomic, floristic and phytogeographic papers are considered, including theoretical papers and methodology, systematics and phylogeny, monographs, revisions and reviews, catalogues, biographies and bibliographies, history of botanical explorations, identification guides, floras, analyses of characters, phylogenetic studies and phytogeography, descriptions of taxa, typification and nomenclatural papers. Monographs and other long manuscripts (of 60 printed pages or more) can be published as books, which will receive an ISBN number as well as being part of the Phytotaxa series.

Checklists and vegetation surveys are only included when the data provided in the checklist or survey are analysed and discussed. Data in checklists should be interpreted to make the study relevant for the international botanical community. Range extensions of single species are generally not considered for publication, although exceptions may be possible. Please contact the chief editor before submitting such articles.

Open Access publishing is strongly encouraged for authors who have funding to do so. For those without grants/funds, accepted manuscripts will be published, but access will be secured for subscribers only. All manuscripts will be subjected to peer review by two or more anonymous.

ANEXO B – NORMAS PARA PUBLICAÇÃO NO PERIÓDICO TAXON

(Disponível em: http://www.iapt-taxon.org/files/guidelines_authors.pdf)

Taxon publishes original papers and reviews dealing with the systematics in its widest sense of all groups of organisms covered by the International Code of Nomenclature for algae, fungi, and plants. Emphasis is on articles reporting new results with implications of general interest beyond the study group. Taxon also publishes papers on nomenclature, and on methodology, botanical history, biography, bibliography, and related subjects if these are of general interest. Preference is given to integrative papers combining the results of modern analysis together with its consequences for classification. Authors are not encouraged to submit manuscripts including new classifications without underlying original (molecular, morphological, etc.) analyses. We discourage submission of monographs, revisions, and description of new species. Papers dealing with single species (e.g., phylogeographic or palaeobotanical studies) can only be published when they contain important new taxonomy or include aspects of particular evolutionary, biogeographic or biological interest. Sampling should be appropriate for the research questions and analytical methods in all cases. Phylogenetic studies should employ multiple, ideally independent, markers and adequately representative taxon sampling (e.g., avoiding unjustified geographic bias). Articles may be rejected without review.

Consult a recent issue of **Taxon** and carefully follow the following instructions. Use Times New Roman font. This font contains most characters, signs, and symbols that might be needed (e.g., Greek and Cyrillic characters, diacritics, arrows, identity sign, primes, etc.). Use other fonts only if a character or symbol is not present in Times New Roman. For original papers, provide an informative abstract and 5–6 keywords in alphabetical order (indicating taxa, methods, main topic, geographic region) and a short title to be used as running head. Try to structure the manuscript into Introduction, Materials and Methods, Results, Discussion, (Acknowledgements) and Literature Cited. Give the full addresses of all authors and the e-mail address of the author who will receive correspondence. Keep title and subheadings short and informative. Only two subheading categories are encouraged: the primary ones standing alone, the secondary ones being followed by a period and a long dash (or triple hyphen), with the subsequent text running on. Authors are requested to check correct spelling and authors of scientific names before submission, and abbreviate authors of scientific plant names in conformity with Brummitt & Powell, Authors of Plant Names (Kew, 1992; also incorporated in International Plant Names Index [IPNI], http://www. ipni.org/ and Index Fungorum, http://www.indexfungorum.org). Author names of all taxa at the rank of genus or below must be provided at first mention in each of the text, the tables and the appendices. A single blank must always follow after a period, colon, semicolon, or comma (except within numerals, standard abbreviations such as e.g., i.e., l.c., s.str., s.l., and authors initials: "Brown, A.J." not "Brown, A. J."; "32: 120--130" not "32:120-130"), and between numerals and units of measure: "2 mm" not "2mm", but "5%" not "5 %"; x = 5 not x=5. Use a double hyphen between page numbers and measurements, "120--130" not "120-130."

Literature citation Verify that all citations in the text are also in the Literature Cited and vice versa. References are cited in the text as follows: … was studied by Miller (1993) and Miller & Smith (1994). Baker & al. (1996) showed that … has frequently been observed (e.g., Miller, 1993, 1998; Miller & Smith, 1994; Baker & al., 1996 [note: sort chronologically, beginning with oldest; within the same year, sort alphabetically]. When there are three or more authors, the name of the first author is cited followed by "& al." If smaller parts of a work or chapter, or single pages shall be referenced, do this in the text: … was given by Parker (2003: 152). Parker (2003: fig. 2) showed that … References should be listed in alphabetical order at the end of the paper, with single-author works preceding two-author works preceding multi-author works. Multi-author works (cited "[first author] &. al." in text) are to be sorted by first author and year of publication. Within the same year of publication sort alphabetically by co-authors. Journal titles and book titles must be italicized and journal titles abbreviated as explained further below. Give names of all authors and add a DOI number if available.

ANEXO C – NORMAS PARA PUBLICAÇÃO NO PERIÓDICO NORDIC JOURNAL OF BOTANY

(Disponível em: http://www.nordicjbotany.org/authors/author-guidelines)

General

Authors submitting a manuscript do so on the understanding that the work has not been published before, is not being considered for publication elsewhere and has been read and approved by all authors. The submission of the manuscript by the authors means that the authors automatically agree to assign exclusive copyright to the journal if and when the manuscript is accepted for publication.

GUIDELINES FOR MANUSCRIPT PREPARATION

Manuscripts can **only be submitted online** at: http://mc.manuscriptcentral.com/njbot and should preferably be submitted as separate text and figure files. Preferred file formats for the main document, including tables and figure legends is .doc or .docx. Pdf-files are accepted during the review process but a doc file is required should the manuscript be accepted. Preferred formats for figure files are: .eps .tif or high-resolution .jpeg

LANGUAGE

Manuscripts should be in English. Linguistic usage should be correct. Avoid the use of the passive voice. Avoid extensive reviews in the Introduction and Discussion. Cite only essential sources of a theory or opinion. Authors for whom English is a second language may choose to have their manuscript professionally edited before submission. We recommend using the service http://wileyeditingservices.com/en/. All services are to be arranged and paid for by the author, and use of a language editing service does not guarantee acceptance.

TITLE

The title should be brief and contain words useful for indexing and information retrieval.

TEXT

The first page should contain only the title and the author's name, address, fax and email-address. Page two contains the abstract, in which the main results of the work should be summarized. The abstract should not contain more than 300 words. Begin the introduction on page three. Avoid right margin justification and hyphenation. Double-check the contents of your manuscript before submitting. Only printer's mistakes in proofs will be changed free of charge. Avoid use of capitals, bold face and foot-notes in the text. Hierarchy of paragraphs should be indicated. Only scientific plant names, Latin diagnoses and longer quotes in Latin should be italizied, **not** phrases of Latin origin that have been incorporated into scientific English (like et al., per se, ad libitum etc).

Manuscripts must be written in English. All text, including tables, figure captions and reference list should be double spaced, with line and page numbers. Manuscripts should follow The Chicago Manual of Style and The CBE Manual for Authors, Editors, and Publishers.

DIAGNOSES AND DESCRIPTIONS OF NEW TAXA

Validating diagnoses and descriptions may be written in English or Latin as stipulated by the the International Code for Nomenclature of algae, fungi and plants. A format with a short diagnosis including only those characters essential for the identification of the taxon followed by a full morphological description is preferred. Descriptions of new taxa of fungi to be published after 1 Jan 2013 have to include an identifier issued by a recognised repository such as MycoBank.

TYPE MATERIAL

Nomenclatural types should be referred to with appropriate terminology in accordance with the International Code of Botanical Nomenclature. Provide bibliographic references for lectotypifications, neotypifications and epitypifications, when appropriate.

REFERENCES

Please refer to a recent issue of Nordic Journal of Botany when making the reference list. If a reference manager software is used, make sure to double-check the references and the reference list before you submit your manuscript. The reference list should be double spaced and arranged alphabetically on authors' names and chronologically per author. If the author's name is also mentioned with co-authors, then publications of the single author, arranged chronologically should be given first, then publications of the same author with one co-author, arranged chronologically. Publications by the same author(s) in the same year should be listed as 2014a, 2014b, etc.