



Original Paper

Synopsis of *Pentacalia* (Compositae: Senecioneae) in Brazil

Aristônio Magalhães Teles^{1,5}, Geovana Vieira da Fonseca^{2,3} & Lidyanne Yuriko Saleme Aona^{2,4}

Abstract

The genus *Pentacalia* belongs to the tribe Senecioneae. It is represented by approximately 160 species predominantly distributed in the Andes. Species of *Pentacalia* are characterized by having a scandent habit, usually alternate leaves, axillary or terminal capitulescence, homogamous or heterogamous capitula, commonly yellow ray-florets, yellowish, creamy, or whitish disc-florets, sagittate to caudate anther-bases, and cypselae with five to ten ribs. The aim of the present study was to perform a taxonomic treatment of *Pentacalia* in Brazil, where it is represented by two species, *P. desiderabilis* and *P. tropicalis*, from the Atlantic Forest Domain. Detailed descriptions, taxonomic discussions, geographical distributions, an identification key, illustrations and a new record of *P. tropicalis* for the Northeast Region are presented. Moreover, three names (*Senecio desiderabilis*, *S. ellipticus*, and *S. tropicalis*) are lectotypified.

Key words: Asteraceae, Atlantic Forest, *Florae Fluminensis*, lectotypification, Senecioneae.

Resumo

O gênero *Pentacalia* pertence à tribo Senecioneae. É representado por aproximadamente 160 espécies distribuídas, predominantemente, nos Andes. As espécies de *Pentacalia* são caracterizadas pelo hábito escandente, folhas normalmente alternas, capitulescência axilar ou terminal, capítulos homogamos ou heterogamos, flores do raio comumente amarelas, flores do disco amareladas, creme ou esbranquiçadas, base das anteras sagitadas ou caudadas e cipselas com cinco a dez costelas. O objetivo do presente estudo foi o de realizar o tratamento taxonômico de *Pentacalia* no Brasil, onde o gênero está representado por duas espécies, *P. desiderabilis* e *P. tropicalis*, oriundas do Domínio Floresta Atlântica. São apresentadas descrições detalhadas, discussões taxonômicas, distribuição geográfica, uma chave de identificação, ilustrações e um novo registro de *P. tropicalis* para a região Nordeste. Além disso, três nomes (*Senecio desiderabilis*, *S. ellipticus* e *S. tropicalis*) são lectotipificados.

Palavras-chave: Asteraceae, Floresta Atlântica, *Florae Fluminensis*, lectotipificação, Senecioneae.

Introduction

The genus *Pentacalia* Cass. is one of the largest genera belonging to the subtribe Senecionineae of the tribe Senecioneae, family Compositae (Nordenstam *et al.* 2009). *Pentacalia* was described by Cassini (1827) on the basis of a single species of the genus *Cacalia* with five-ribbed cypselae, previously described by Kunth as

Cacalia arborea. However, Cassini did not validly publish the combination “*Pentacalia arborea*” (Flann *et al.* 2010); the combination was made 151 years later by Robinson & Cuatrecasas (1978). Although the genus was validly published, it was treated for a long time as a synonym of *Cacalia* (e.g., Bentham 1873; Hoffmann 1894) or *Senecio* L. (e.g., Nordenstam 1977; Barkley 1985).

¹ Universidade Federal de Goiás, Instituto Ciências Biológicas, Depto. Botânica, câmpus Samambaia, Vila Itatiaia, Goiânia, GO, Brazil. ORCID: <<https://orcid.org/0000-0002-1370-044X>>.

² Universidade Federal do Recôncavo da Bahia, Centro de Ciências Agrárias, Ambientais e Biológicas, Centro, Cruz das Almas, BA, Brazil.

³ ORCID: <<https://orcid.org/0000-0003-2496-6187>>.

⁴ ORCID: <<https://orcid.org/0000-0001-8477-5791>>.

⁵ Author for correspondence: teles@ufg.br

Greenman (1902) described *Senecio* sect. *Streptothamnus* (as *Streptothamni*) for a group of scandent species from Mexico and Central America. In this section he included the following species, all of them are currently treated within in *Pentacalia*: *S. candelariae* Benth., *S. durandii* Klatt, *S. parasiticus* Hemsl., *S. streptothamnus* Greenm., and *S. tonduzii* Greenm. This taxonomic treatment was adopted by Cabrera (1957) when working on species from Brazil, Paraguay, and Uruguay.

Robinson & Cuatrecasas (1978) retrieved the generic name *Pentacalia* adopting Cassini's concept of the genus. They emphasized the pentagonal shape of the cypselae and considered *Senecio* sect. *Streptothamnus* Greenm. as a synonym of *Pentacalia*.

Cuatrecasas (1981) proposed a broader circumscription of *Pentacalia* with the addition of the species previously treated by Bentham (1845) in the genus *Microchaete*, considering it a subgenus of *Pentacalia*. Hence, in line with Cuatrecasas (1981), *Pentacalia* has two subgenera, the typical subgenus and *P.* subgen. *Microchaete* (Benth.) Cuatrec., with the former encompassing the scandent species and the latter the erect and shrubby species. Jeffrey (1992) proposed a more restrictive concept of *Pentacalia* including only the species with a scandent habit. To this effect, Jeffrey (1992) reestablished the genus *Microchaete* Benth. under the new required name *Monticalia* C. Jeffrey; however, there has not been consensus about the circumscription of *Pentacalia*. Some authors, such as Díaz-Piedrahita & Cuatrecasas (1999), Badillo *et al.* (2008), Lapp *et al.* (2013), and Ávila *et al.* (2016) treated the genus in the broader sense, while Nordenstam (1999, 2007), Nordenstam *et al.* (2009), Beck & Ibáñez (2014), Calvo & Beltrán (2018), and Calvo & Buirra (2018) treated the genus *Pentacalia* in a narrow sense following Jeffrey's concept, as herein treated.

During the study of the tribe Senecioneae of the Brazilian flora, a need for three lectotypifications and a new record for the Northeast Region became apparent. Herein, a synopsis of the species of *Pentacalia* occurring in Brazil is presented, along with detailed descriptions, taxonomic discussions, geographical distributions, an identification key, and illustrations.

Material and Methods

The study was carried out on the basis of herbarium specimens from the following herbaria: BHCB, CESJ, FURB, G-DC, HRB, HUEFS,

HUESB, HUESC, HURB, K, MBM, P, R, RB, RFA, SPF, UEC, and UFG (acronyms according to Thiers, continuously updated). The terminologies used in the descriptions are in accordance with Jeffrey (1987), Roque *et al.* (2009), and Beentje (2012). The genus description was adapted from Bremer (1994) and Nordenstam (2007).

Only one representative specimen from each federative unit (state) was cited as selected material. Helpful previously published illustrations were cited as iconography.

The lectotypifications proposed herein follows the guidelines and rules presented by Turland (2019) and Turland *et al.* (2018). Abbreviations of original publications and their authors were based on IPNI (2020).

Results and Discussion

Taxonomic treatment

Pentacalia Cass., Dict. Sci. Nat. (ed. 2)48: 461. 1827. *Senecio* sect. *Triana* Cuatrec., Fieldiana, Bot. 27(2): 71. 1951. Type: *Pentacalia arborea* (Kunth) H. Rob. & Cuatrec. (= *Cacalia arborea* Kunth). *Senecio* sect. *Streptothamnus* Greenm., Bot. Jahrb. Syst. 32(1): 19. 1902. Type: *Pentacalia streptothamna* (Greenm.) H. Rob. & Cuatrec. (= *Senecio streptothamnus* Greenm.).

Macrophyllous, lianas. Stems terete, more or less uniformly leafy, glabrous or pubescent, always with eglandular trichomes. Leaves petiolate, alternate or very rarely opposite (three species from Peru); lamina oblong, ovate to elliptic-ovate, entire to dentate or serrate, often coriaceous to fleshy, venation pinnate. Capitulescence few to many capitula, in several arrangements, terminal or lateral; capitula heterogamous or homogamous, radiate, disciform or discoid, yellow or rarely white florets, pedicels bracteolate; involucre uniseriate, calyculate; anther-bases sagittate to caudate, anther-collars balusterform; style-branches with two separated stigmatic areas, apex truncate to rhomboid crowned by divergent trichomes. Cypselae cylindrical to slightly fusiform, erostrate, 5–10-ribbed, glabrous or sometimes pubescent; pappus capillary, composed of barbellate bristles, white or pink to rufous, persistent.

The genus *Pentacalia* in the narrow sense [excluding the subgenus *Microchaete* (= *Monticalia* C. Jeffrey)] comprises approximately 160 species (Calvo & Buirra 2018) found in tropical Americas (Jeffrey 1992), distributed from southern Mexico to northwestern Argentina, besides two disjunct species found in Brazil (Nordenstam 2007; Calvo

& Buira 2018). According to Calvo & Buira (2018), the center of diversity for the genus is in the Andean region, especially in Colombia, Ecuador, and Peru, where about 80% of the species are found.

Pentacalia along with *Pseudogynoxys* are the only genera of Senecioneae from Brazil with scandent habit. However, they can easily be differentiated from each other by the ray-floret corolla color and by the style-branch apex. The corolla of *Pentacalia* is yellow or white and the apex of the style-branches is truncate to rhomboid and crowned by divergent trichomes, whereas in *Pseudogynoxys* the corolla is orange or reddish and the apex of the style-branches is truncate.

Pentacalia is represented by two species in Brazil, *P. desiderabilis* (Vell.) Cuatrec. and *P.*

tropicalis (Cabrera) C. Jeffrey, which are endemic to the Atlantic Forest Domain and possess distributions disjunct from the rest of the genus (Teles & Stehmann 2008).

According to Pelsner *et al.* (2007) and Nordenstam *et al.* (2009), as presently circumscribed, *Pentacalia* is doubtlessly polyphyletic. The phylogenetic analysis based on ITS sequences by Pelsner *et al.* (2007) revealed the Brazilian species *P. desiderabilis* to be in a clade distinct from that of the type species of the genus (*P. arborea*). Perhaps this explains the disjunct distribution of the Brazilian species.

The Brazilian species of *Pentacalia* can be differentiated by the characters presented in the following key:

Key to the species of *Pentacalia* from Brazil

1. Capitulescence thyrsoid-paniculiform; corolla of ray-florets yellow, limb 4–7 mm long; corolla of disc-florets 5–6 mm long; style-base cylindrical; cypselae 2–3.5 mm long 1. *Pentacalia desiderabilis*
- 1'. Capitulescence cymose-corymbiform; corolla of ray-florets white, limb 12–22 mm long; corolla of disc-florets 11–13 mm long; style-base swollen; cypselae 6–6.5 mm long 2. *Pentacalia tropicalis*

1. *Pentacalia desiderabilis* (Vell.) Cuatrec., *Phytologia* 52: 164. 1982. *Senecio desiderabilis* Vell., *Fl. Flumin.* Icon. 8: t. 108. 1831. Lectotype (designated here): [Illustration] Original parchment plate of *Florae Fluminensis* in the Manuscript Division of the Biblioteca Nacional, Rio de Janeiro [cat. no.: mss1198657_112], digital image available at <http://objdigital.bn.br/acervo_digital/div_manuscritos/mss1198657/mss1198657_112.jpg> and later published in Vellozo (1831).

Senecio ellipticus DC., *Prodr.* 6: 420. 1837. Lectotype (designated here): BRAZIL. RIO DE JANEIRO: Serra dos Orgaos, “*ad marg. sylvar.*”, IX.1831, *Lhotsky 149* (G-DC, barcode: G00487077, digital image available at <<https://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=337986&base=img&lang=en>>). Fig. 1a-d

Iconography: Cabrera (1957: p. 239, Figure VIII); Cabrera & Klein (1975: p. 169, Figure 47); Moraes & Monteiro (2006: p. 45, Figures 7, 9, and 10).

Lianas. Stem terete, multisulcate, pithy, glabrescent. Leaves alternate, spirally arranged, petiolate; lamina 2–10 cm long, 0.7–5.5 cm wide, elliptic to ovate, base acute to obtuse, apex acuminate, margins entire, plane, penninerved, subfleshy, glabrous on both faces; petioles

0.4–2.5 cm long, glabrescent. Capitulescence thyrsoid-paniculiform, many capitula; capitula heterogamous, radiate; pedicels 2–20 mm long, glabrous or sparsely lanate, bracteolate; bracteoles 2–5 mm long, lanceolate, glabrous or sparsely lanate; involucre 5–19 mm long, 4–10 mm wide, campanulate, calyculate; calycular bracts 3–6, 1.5–4 mm long, lanceolate; involucral bracts 6–9, lanceolate, apex acute and penicillate, margins scarious, glabrous dorsally; receptacle plane to slightly convex, alveolate. Ray-florets 5–8, pistillate, corolla liguliform, yellow, corolla-tube 3.5–5 mm long, corolla-limb 4–7 mm long, 1–1.2 mm wide, 4-nervate, apex 3-dentate; style 6.5–7 mm long, style-branches ca. 1 mm long, symmetric. Disc-florets 6–16, bisexual, corolla tubulose, yellow, 5–6 mm long, 5-lobed, corolla-lobes 1–1.5 mm long, anthers 2–2.3 mm long, anther-bases sagittate, anther-appendages ca. 0.2 mm long, oblong; style ca. 6 mm long, style-base cylindrical, style-branches 1–1.5 mm long, symmetric, apex rhomboid, crowned by divergent trichomes. Cypselae 2–3.5 mm long, cylindrical, 5-ribbed, glabrous, carpodium annuliform, symmetric; pappus 3–9 mm long, capillary, composed of barbellate bristles, whitish, persistent.

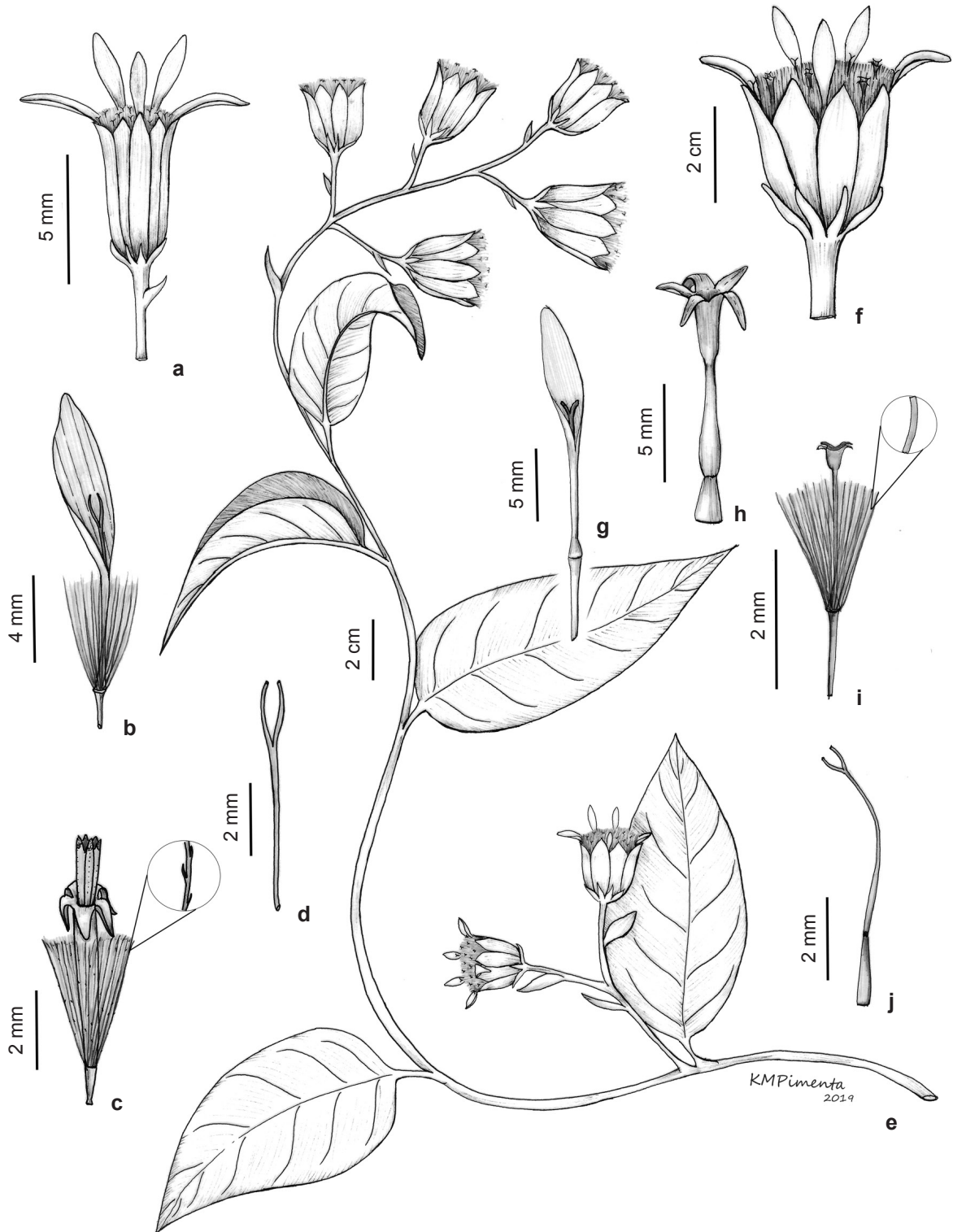


Figure 1 – a-d. *Pentacalia desiderabilis* – a. capitulum; b. ray-floret; c. disc-floret showing a detail of the barbellate bristle; d. style with cylindrical base. e-j. *Pentacalia tropicalis* – e. flowering branch showing the scandent habit; f. capitulum; g. ray-floret without pappus; h. disc-floret corolla; i. disc-floret showing detail of the barbellate bristle; j. style with swollen base.

Selected material: BAHIA: Camacã, RPPN Serra Bonita, 15°23'30"S, 39°33'55"W, 850 m, 6.VI.2006, fl. and fr., *M.M.M. Lopes et al. 806* (HUEFS). MINAS GERAIS: Ouro Preto, Serra de Capanema, 20°12'35"S, 43°34'27.5"W, 1,904 m, 11.IX.2007, fl. and fr., *F.F. Carmo 1045* (BHCB). ESPÍRITO SANTO: Alfredo Chaves, estrada São Bento de Urânia a Alfredo Chaves, 800 m, 16.VI.1999, fl. and fr., *G. Hatschbach et al. 69096* (MBM). RIO DE JANEIRO: Parque Nacional de Itatiaia, 1,750 m, 9.IX.1988, fl. and fr., *L.C. Giordano et al. 444* (RB). SÃO PAULO: "Province de San-Paolo (Herbier Impérial du Brésil n° 404)", 1833, *C. Gaudichaud* (P). PARANÁ: Morretes, BR-277, Rio dos Padres, 3.VIII.1995, fl. and fr., *J.M. Silva & E.P. Santos 1480* (MBM). SANTA CATARINA: São Joaquim, Chapada Bonita, 28°20'54"S, 50°02'26"W, 1,255 m, 5.III.2012, fl., *M. Verdi & F.E. Carneiro 563* (FURB, HURB). RIO GRANDE DO SUL: Camará do Sul, rodovia para Fortaleza, 15.IV.1993, fl. and fr., *G. Hatschbach et al. 59151* (HUEFS).

The species is endemic to Brazil where it occurs in all states of the Southeast and South Regions (Hind 1993) as well as in Bahia (Northeast Region) (Teles & Stehmann 2008). *Pentacalia desiderabilis* is commonly found at the edges of forests in the Atlantic Forest Domain, at altitudes ranging from 400 to 2,040 m (Cabrera & Klein 1975).

The species was first described by Vellozo (1831) (publication date discussed by Carauta 1973) as *Senecio desiderabilis* through an illustration with analysis, *i.e.*, a ray-floret, a disc-floret, a dissected floret showing the style, and an opened capitula with a cypselia attached to the receptacle were depicted in addition to a flowering branch (Fig. 2). According to Turland *et al.* (2018: ICN Art. 38.8 and 38.9), illustrations with analysis or diagnosis are eligible as type specimens. Thus, Vellozo's illustration is here designated as the lectotype of the name *Senecio desiderabilis*.

Sampaio & Peckolt (1943) were the first to mention *Senecio ellipticus* as a synonymy of *S. desiderabilis*. This opinion was followed by Cabrera (1957), Cabrera & Klein (1975), and Hind (1993). In the protologue of *S. ellipticus* two syntypes are cited, one housed at Candolle's herbarium (G-DC) and the other one deposited at P herbarium. The specimen at G-DC (G00487077) is the most complete, and therefore, it is designated as the lectotype of the name *S. ellipticus*. In the protologue of this species the type locality is cited only as "in *Brasilia ad margines sylvarum, in Serra dos Orgaos (h. DC.), et in prov. Sanct-Pauli (h. Mus. Par. sub. n. 404!)*". However, there is a

hand-written label on the type specimen at G-DC herbarium with the number 149 and the month and year of collection (September 1831); moreover there is the collector name Lhotsky a little strikethrough, and the number 1832, apparently written with another pen.

Vernacular name: catião-trepador (Cabrera & Klein 1975).

2. *Pentacalia tropicalis* (Cabrera) C. Jeffrey, Kew Bulletin 47(1): 64. 1992. *Senecio tropicalis* Cabrera, Rodriguésia 21/23(33/34): 144. 1959. Lectotype (designated here): BRAZIL. RIO DE JANEIRO: D.F. Restinga de Jacarepaguá, 28.VII.1958, *E. Pereira 4039, Liene, Sucre & Duarte* (RB, accession number: 109118, barcode: RB00541928, digital images available at <<http://reflora.jbrj.gov.br/reflora/geral/ExibeFiguraFSIUC/ExibeFiguraFSIUC.do?idFigura=284401560>>). Isolectotypes: RB, accession number: 109118, barcode: RB00542068, digital images available at <<http://reflora.jbrj.gov.br/reflora/geral/ExibeFiguraFSIUC/ExibeFiguraFSIUC.do?idFigura=284401800>>; HB, accession number: 6830, barcode: HB000006830; RFA, accession number: 4238, barcode: RFA24973). Fig. 1e-j

Iconography: Barroso (1959, Figure VI).

Lianas. Stems terete, multisulcate, pithy, glabrous. Leaves alternate, spirally arranged, petiolate; lamina 7–11.5 cm long, 4–6 cm wide, ovate, base rounded, apex acute, margins entire, plane, penninerved, fleshy, glabrescent on both faces; petioles 2–3 cm long, glabrous. Capitulescence cymose-corymbiform, few capitula; capitula heterogamous, radiate; pedicels 1.5–4 cm long, glabrescent, bracteolate; bracteoles 5–10 mm long, lanceolate, glabrous; involucre 11–15 mm long, 12 mm wide, campanulate, calyculate; calycular bracts 3–5, 2–4 mm long, lanceolate; involucral bracts 8, oblong-lanceolate, apex acute, margins scarious, glabrous dorsally; receptacle plane, alveolate. Ray-florets 5–8, pistillate, corolla liguliform, white, corolla-tube 5–7 mm long, corolla-limb 12–22 mm long, 1–3 mm wide, 4-nervate, apex 3-dentate, style 13–14 mm long, style-branches 3.5–4.5 mm long, asymmetric. Disc-florets ca. 15, bisexual, corolla tubulose, white, 11–13 mm long, 5-lobed, corolla-lobes 2–2.5 mm long, anthers ca. 5 mm long, anther-bases shortly sagittate, anthers-appendages ca. 0.6 mm long, oblong; style ca. 14 mm long, style-base swollen, style-branches 2–2.5 mm long, apex rhomboid, crowned by divergent trichomes.

Syng. Polyg. Superf.
 SENECIO *desiderabilis*



Figure 2 – Original parchment plate of Vellozo, here designated as lectotype of *Senecio desiderabilis*, from *Florae Fluminensis* in the Manuscript Division of Biblioteca Nacional, Rio de Janeiro (cat. no.: mss1198657_112), showing a flowering branch with details of a ray-floret, a disc-floret, a dissected floret showing the style, and an opened capitulum with a cypsela attached to the receptacle. (Courtesy of Biblioteca Nacional, Rio de Janeiro).

Cypselae 6–6.5 mm long, cylindrical to slightly fusiform, 10-ribbed, glabrous, carpopodium annuliform, symmetric; pappus 10–13 mm long, capillary, composed of barbellate bristles, whitish, persistent.

Selected material: BAHIA: Boa Nova, Parque Nacional de Boa Nova, 22.IX.2013, fl. and fr., *G.S. Brandão 131* (HUESB; HURB). Potiraguá, rodovia que liga a BR-101 com Itapetinga, ca. de 15 km de Itaibé, Fazenda Independência, 15°12'12"S, 39°34'30"W, 18.VIII.2006, fl. and fr., *J.L. Paixão et al. 1068* (HUEFS; HUESC). ESPÍRITO SANTO: Itaguaçu, Jatiboca, 17.V.1946, *Brade 18308, Altamiro & Apparício* (RB). RIO DE JANEIRO: Cabo Frio, Arraial do Cabo, Praia do Pontal, 3.VIII.1953, fl. and fr., *F. Segadas et al. 648* (R, US).

The species is endemic to Brazil, where it is known from the states of Espírito Santo and Rio de Janeiro (Barroso 1959; Hind 1993) and, now reported for the first time, from the state of Bahia, which is the first record for the species in the Northeast Region. *Pentacalia tropicalis* has the same habitat as its Brazilian congener, but with a more restricted distribution.

The species was described by Cabrera in Barroso (1959) based on two collections, one from Rio de Janeiro State (*Pereira et al. 4039*) and another one from Espírito Santo state (*Brade et al. 18308*). Cabrera (*apud* in Barroso 1959) indicated the collection from Rio de Janeiro as the type specimen, probably based on a specimen from RB herbarium. However, Cabrera did not state that there were four duplicates of Pereira's collection, two in RB, one in HB, and one in RFA. Despite having the same accession number, the two specimens from RB herbarium have different barcode numbers, and are not clearly labelled as being part of the same specimen. Therefore, as there are duplicate specimens belonging to the same collection, the specimen RB (barcode: 00541928) is designated as the lectotype of the name *S. tropicalis*, and the remaining duplicates become isolectotypes.

Acknowledgments

We are grateful to the curators and technicians of the herbaria HUESB, HUESC, and HUEFS, for loans of exsiccates; and to Marcelo Trovó Lopes de Oliveira (Universidade Federal Fluminense), for sending the digital photographs of the type of *Pentacalia tropicalis*. AM Teles thanks INCT - Virtual Herbarium of Plants and Fungi of Brazil, supported by CNPq (process n. 573.883/2008-4), for the financial support granted to visit the herbaria BHCBL, MBML, and R. The authors are thankful

to KM Pimenta, for the line drawings; and to the anonymous reviewers, whose comments helped us to improve the article considerably.

References

- Ávila F, Funk VA, Diazgranados M, Díaz-Piedrahita S & Vargas O (2016) *Pentacalia* Cass. In: Bernal R, Gradstein SR & Celis M (eds.) Catalogue of the plants and lichens of Colombia. Vol. 1. Panamericana Formas e Impresos S.A., Bogotá. Pp. 878-887.
- Badillo VM, Díaz-Piedrahita S & Benítez CE (2008) Asteraceae. In: Hokche O, Berry PE & Huber O (eds.) Nuevo catálogo de la flora vascular de Venezuela. Fundación Instituto Botánico de Venezuela "Dr. Tobías Lasser", Caracas. Pp. 230-265.
- Barkley TM (1985) Infrageneric groups in *Senecio s.l.*, and *Cacalia s.l.* (Asteraceae: Senecioneae) in Mexico and Central America. Brittonia 37: 211-218.
- Barroso GM (1959) Flora da cidade do Rio de Janeiro - Compositae. Rodriguésia 21/22: 69-155.
- Beck SG & Ibáñez D (2014) *Pentacalia* Cass. In: Jørgensen PM, Nee MH & Beck SG (eds.) Catálogo de las Plantas Vasculares de Bolivia. Monographs in Systematic Botany from the Missouri Botanical Garden. Vol. 127. MGB Press, Saint Louis. Pp. 317-318.
- Beentje H (2012) The Kew plant glossary: an illustrated dictionary of plant terms. Revised edition. Kew Publishing, Royal Botanic Gardens, Kew. 164p.
- Bentham G (1845) Plantas hartwegianas: *imprimis mexicanas adjectis nonnullis grahamianis enumerat novasque describit*. Londini, London. Pp. 209-216.
- Bentham G (1873) Compositae. In: Bentham G & Hooker JD (eds.) Genera Plantarum. Vol. 2(1). Reeve, London. Pp. 163-533.
- Bremer K (1994) Asteraceae: Cladistics & Classification. Timber Press, Portland. 752p.
- Cabrera AL (1957) El género *Senecio* (Compositae) en Brasil, Paraguay y Uruguay. Archivos do Jardim Botânico do Rio de Janeiro 15: 163-264.
- Cabrera AL & Klein RM (1975) Compostas - Tribo: Senecioneae. In: Reitz R (ed.) Flora Ilustrada Catarinense. Vol. 2. Herbário Barbosa Rodrigues, Itajaí. Pp. 126-222.
- Calvo J & Beltrán H (2018) Two new species of *Pentacalia* (Senecioneae, Compositae) from Peru. Phytotaxa 357: 284-290.
- Calvo J & Buira A (2018) Two new species of *Pentacalia* (Compositae, Senecioneae) from northern Andes. Phytotaxa 364: 193-201.
- Carauta JPP (1973) The text of Vellozo's *Flora Fluminensis* and its effective date of publication. Taxon 22: 281-284.
- Cassini H (1827) XIV. Tribu. Les Sénécionées (Senecioneae). In: Cuvier G (ed.) Dictionnaire des

- Sciences Naturelles. Ed. 2. Vol. 48. SCA - SERQ. Le Normant, Paris. Pp. 446-477.
- Cuatrecasas J (1981) Studies in Neotropical Senecioneae II. Transfers to genus *Pentacalia* of north Andean species. *Phytologia* 49: 241-260.
- Díaz-Piedrahita S & Cuatrecasas J (1999) Asteráceas de la Flora de Colombia. Senecioneae-I, géneros *Dendrophorbium* y *Pentacalia*. Academia Colombiana de Ciencias Exactas, Físicas y Naturales. Colección Jorge Álvarez Lleras 12: 1-391.
- Flann C, Greuter W & Hind DJN (2010) Cassini's Compositae genera: a nomenclatural and taxonomic assessment. *Taxon* 59: 1206-1244.
- Greenman JM (1902) Monographie der nord- und centralamerikanischen Arten der Gattung *Senecio*. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 32: 1-33.
- Hind DJN (1993) A checklist of the Brazilian Senecioneae (Compositae). *Kew Bulletin* 48: 279-295.
- Hoffmann O (1894) Compositae. In: Engler A & Prantl K (eds.) *Die natürlichen Pflanzenfamilien*. Vol. 4. Engelmann, Leipzig. Pp. 87-391.
- IPNI (2020) The International Plant Names Index. Available at <<http://www.ipni.org>>. Access on 15 January 2020.
- Jeffrey C (1987) Developing descriptors for systematic analyses of Senecioneae (Compositae). *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 108: 201-211.
- Jeffrey C (1992) The tribe Senecioneae (Compositae) in the Mascarene Islands with an annotated world check-list of the genera of the tribe. Notes on Compositae: VI. *Kew Bulletin* 47: 49-109.
- Lapp M, Ruiz-Zapata T & Torrecilla P (2013) Nueva especie de *Pentacalia* Cass. (Senecioneae-Asteraceae). *Ernstia* 23: 15-24.
- Moraes MD & Monteiro R (2006) A família Asteraceae na planície litorânea de Picinguaba, Ubatuba, São Paulo. *Hoehnea* 33: 41-78.
- Nordenstam B (1977) Senecioneae and Liabeae - Systematic review. In: Heywood VH, Harborne JB & Turner BL (eds.) *The Biology and Chemistry of the Compositae*. Vol. 2. Academic Press, London. Pp. 799-830.
- Nordenstam B (1999) *Pentacalia* Cass. In: Jørgensen PM & León-Yáñez S (eds.) *Catalogue of the Vascular Plants of Ecuador*. Monographs in systematic botany from the Missouri Botanical Garden. Vol. 75. MBG Press, Saint Louis. Pp. 303-304.
- Nordenstam B (2007) XII. The tribe Senecioneae Cass. 1819. In: Kadereit JW & Jeffrey C (eds.) *The families and genera of vascular plants. Flowering plants, Eudicots, Asterales*. Vol. 8. Springer, Berlin. Pp. 208-241.
- Nordenstam B, Pelsner PB, Kadereit JW & Watson LE (2009) Senecioneae. In: Funk VA, Susanna A, Stuessy TF & Bayer RJ (eds.) *Systematics, evolution, and biogeography of Compositae*. IAPT, Vienna. Pp. 503-525.
- Pelsner PB, Nordenstam B, Kadereit JW & Watson LE (2007) An ITS phylogeny of tribe Senecioneae (Asteraceae) and a new delimitation of *Senecio* L. *Taxon* 56: 1077-1104.
- Robinson H & Cuatrecasas J (1978) A review of the Central American species of *Pentacalia* (Asteraceae: Senecioneae). *Phytologia* 40: 37-50.
- Roque N, Keil DJ & Susanna A (2009) Illustrated glossary of Compositae. In: Funk VA, Susanna A, Stuessy TF & Bayer RJ (eds.) *Systematics, evolution, and biogeography of Compositae*. IAPT, Vienna. Pp. 781-806.
- Sampaio AJ & Peckolt O (1943) A nomenclatura das espécies na "Flora Fluminensis" de Conceição Veloso e sua correspondência atual. *Arquivos do Museu Nacional do Rio de Janeiro* 43: 333-394.
- Teles AM & Stehmann JR (2008) *Plantae, Magnoliophyta, Asterales, Asteraceae, Senecioneae, Pentacalia desiderabilis* and *Senecio macrotis*: distribution extensions and first records for Bahia, Brazil. *Check List* 4: 62-64.
- Thiers B [continuously updated] *Index Herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Available at <<http://sweetgum.nybg.org/science/ih/>>. Access on 15 January 2020.
- Turland NJ (2019) *The code decoded: a user's guide to the International Code of Nomenclature of algae, fungi, and plants*. Pensoft Publishers, Sofia. 196p.
- Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber W-H, Li D-Z, Marhold K, May TW, McNeill J, Monro AM, Prado J, Price MJ & Smith GF (2018) *International Code of Botanical Nomenclature (Shenzhen Code) adopted by the Nineteenth International Botanical Congress, Shenzhen, China, July 2017*. *Regnum Vegetabile* 159. Koeltz Botanical Books, Glashütten. 254p.
- Vellozo JMC (1831) [1827] *Florae Fluminensis* Icones. Vol. 8. Ex off. lithogr. Senefelder, Parisiis. 165p.

Area Editor: Dr. Gustavo Heiden

Received in January 28, 2020. Accepted in October 22, 2020.



This is an open-access article distributed under the terms of the Creative Commons Attribution License.