



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/000-0003-2496-6187>>.

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.

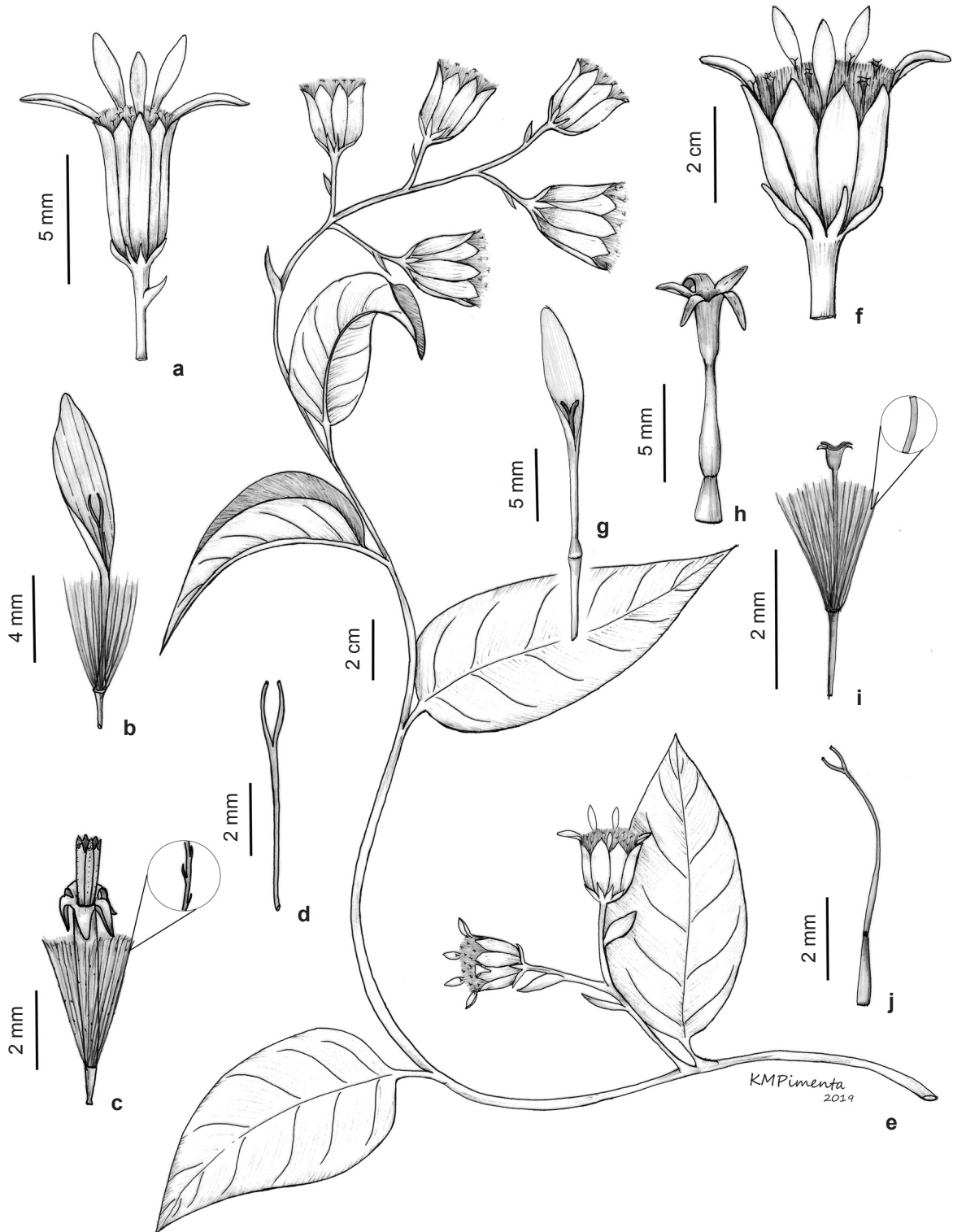


Figure 1 – a-d. *Pentacalia desiderabilis* – a. capitulum; b. ray-floret; c. disc-floret showing a detail of the barbellate bristle; d. style with cylindrical base. e-j. *Pentacalia tropicalis* – e. flowering branch showing the scandent habit; f. capitulum; g. ray-floret without pappus; h. disc-floret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

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