



Morphometric and taxonomic studies of *Senna* ser. *Coriaceae* (Leguminosae, Caesalpinioideae, Cassieae), including a new species from Chapada Diamantina, Bahia, Brazil

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Abstract

Senna sect. *Chamaefistula* ser. *Coriaceae* is restricted to Brazil and is predominantly distributed in savanna habitat. The species are morphologically characterized by their shrub or treelet habit, usually reniform stipules, extrafloral nectaries usually positioned on the middle or distal part of the petiole, zygomorphic corolla and laterally compressed fruits with the seeds parallel to the fruit valves. Previous taxonomic studies have recognized only three species and one variety, nevertheless, they provided the groundwork for a more comprehensive treatment, presented here. Based on fieldwork and on the analysis of herbarium specimens, we recognize five species belonging to *Senna* ser. *Coriaceae* including one new species from the seasonally dry areas in the Chapada Diamantina, *Senna diamantinensis*. We carried out a morphometric analyses and here recognize *S. caesia* as a distinct species rather than a variety of *S. corifolia*. We propose a new combination for *Cassia kuhlmannii* and recognize it under the genus *Senna*. In addition, we propose two first-step lectotypifications and one second-step lectotypification. The taxonomic treatment provided here includes an identification key, morphological descriptions, taxonomic notes, illustrations, preliminary conservation assessments, and habitat and phenology data for each species.

Keywords Brazilian flora · Caatinga · *Cassia* · Cerrado · Endemic · Fabaceae · Savannas · Species delimitation · Taxonomy

1 Introduction

Senna Mill. (Leguminosae, Caesalpinioideae, Cassieae) comprises approximately 300 species distributed mainly in the American continent (80%), while the remaining species are distributed in Africa, Asia and Oceania (Irwin and Barneby 1982; Lewis et al. 2005; Rando et al. 2024). Currently, six sections and 38 series are recognized within *Senna*, based on morphological data (Irwin and Barneby 1982; Randell 1988, 1989, 1990; Randell and Barlow 1998;

Singh 2001). Although molecular phylogenetic analyses support *Senna* as a monophyletic genus, some sections and series were not recovered as monophyletic or have yet to be sampled (Marazzi et al. 2006; Marazzi and Sandersson 2010).

Senna sect. *Chamaefistula* ser. *Coriaceae* (Benth.) H.S.Irwin & Barneby was first described as *Cassia* ser. *Coriaceae* by Bentham (1871) and comprised two species, *C. corifolia* Benth. and *C. gardneri* Benth., morphologically characterized by the two pairs of coriaceous leaflets. In addition to transferring the species from *Cassia* L. to *Senna*, Irwin and Barneby (1982) proposed a new circumscription for *Senna* ser. *Coriaceae* by removing *S. gardneri* (Benth.) H.S.Irwin & Barneby [currently positioned in *Senna* sect. *Chamaefistula* ser. *Bacillares* (Benth.) H.S.Irwin & Barneby] and recognizing only three species [*S. corifolia* (Benth.) H.S.Irwin & Barneby, *S. kuhlmannii* (Hoehne) A.G.Lima & Mansano and *S. reniformis* (G.Don) H.S.Irwin & Barneby] characterized by the shrub or treelet habit, usually reniform stipules, extrafloral nectaries usually positioned on the middle or distal part of the petiole,

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zygomorphic corolla, laterally compressed fruits, and valves without accessory nerves parallel to the sutures.

Irwin and Barneby (1982) highlighted the morphological affinity between *Senna* ser. *Coriaceae* and *Senna* sect. *Chamaefistula* ser. *Laxiflorae* (Benth.) H.S. Irwin & Barneby, only distinguished by the extrafloral nectaries positioned at the middle or distal part of the pedicel in the former (versus extrafloral nectaries placed in the base of the pedicel in the latter), and the fruit valves without accessory nerves in the former (versus fruit valves with accessory nerves in the latter). Although the authors placed *S. kuhlmannii* within *Senna* ser. *Coriaceae*, they recognized its dubious position due to its intermediate morphology which can also be grouped within *Senna* ser. *Laxiflorae*. No molecular phylogenetic analysis has sampled the taxa of *Senna* ser. *Coriaceae* and therefore, its relationship with other series within *Senna* is still unclear.

Since Irwin and Barneby (1982), few taxonomic studies have addressed *Senna*, and our current research projects have focused on several of the series within *Senna*, addressing species complexes and revealing new species (e.g., Lima et al. 2021, 2023, 2024), and also Floristic studies (e.g., Bortoluzzi et al. 2020). In this context, the present taxonomic study of *Senna* ser. *Coriaceae* is part of our efforts to overcome gaps in the taxonomic knowledge of *Senna*.

2 Materials and methods

This study is based on fieldwork and an analysis of specimens housed in the following herbaria: B, BM, BR, CEN, COL, E, ESA, F, G, GB, HDJF, HUEFS, HUFU, IAN, INPA, K, M, MBM, MG, MO, NY, P, R, RB, RON, S, SP, SPF, UB, UEC and US (acronyms according to Thiers 2023, continuously updated). We obtained a list of all names related to *Senna* ser. *Coriaceae* and protologues from Tropicos (www.mobot.org), International Plant Names Index (www.ipni.org), Plants of the World Online (<https://powo.science.kew.org/>) and the taxonomic treatment of *Senna* by Irwin and Barneby (1982).

Morphological terms follow Irwin and Barneby (1982), and Harris and Harris (2001), and Endress (2010) for inflorescences. The preliminary species conservation statuses were evaluated following the IUCN criteria (IUCN 2019). The Area of Occupancy (AOO) and Extent of Occurrence (EOO) were calculated using the Geospatial Conservation Assessment Tool (Bachman et al. 2011). The geographical distribution maps were made using SimpleMapp (Short-house 2010).

Of the five species recognized here, we measured specimens from 35 populations of four species for morphometric

analyses, covering all the morphological variation and geographical distribution of these taxa, due to their complex delimitation. In comparison, *S. kuhlmannii* was not measured in our morphometric studies, as its morphological characteristics and geographical disjunction were enough to recognize it as a remarkably distinct species from other species of *Senna* ser. *Coriaceae*.

Specimens from six populations of *Senna corifolia* var. *corifolia* endemic to Goiás and specimens of *S. corifolia* var. *caesia* (Taub. ex Harms) H.S. Irwin & Barneby from 10 different populations from Goiás and Minas Gerais, comprising the entire geographical distribution and morphological variation within the taxa were measured. A total of 21 continuous characters (15 vegetative and six reproductive) for all specimens. For each specimen, we measured: 1) height; 2) one stipule (length and width); 3) one petiole (length); 4) one rachis (length); 5) number of extrafloral nectaries per leaf rachis; 6) number of pairs of leaflets per leaf; 7) one proximal leaflet (length, basal width, median width, apex width); 8) one distal leaflet (length, basal width, median width, apex width); 9) one adaxial petal (length and width); 10) one lateral petal (length and width); and 11) one abaxial petal (length and width).

We measured specimens from 15 different populations of *Senna reniformis* from Minas Gerais and Bahia, comprising the entire geographical distribution and morphological variation within the species. In this context, we found four additional populations with morphologically distinct specimens that had been identified as *S. reniformis* from the Chapada Diamantina, Bahia. We measured these specimens in order to evaluate if the morphometric analyses supported our decision to describe them as a new species, *Senna diamantinensis* A.G.Lima & Mansano.

We measured 14 continuous characters (12 vegetative and two reproductive) for all specimens. For each specimen, we measured: 1) one petiole (length); 2) one rachis (length); 3) number of extrafloral nectary per leaf rachis; 4) number of pairs of leaflets per leaf; 5) one proximal leaflet (length, basal width, median width, apex width); 6) one distal leaflet (length, basal width, median width, apex width); and 7) one fruit (length and width).

To illustrate the variation within the characters, scatterplot graphs and dendrograms were produced using PAST ver. 4.14 software (Hammer et al. 2001). Each specimen was treated as the Operational Taxonomic Units (OTUs) for all the specimens in the multivariate analysis. Also, for the Principal Component Analysis (PCA) and Unweighted Pair Group Method with Arithmetic (UPGMA), we log-transformed the original measurements in order to avoid scale distortions and normality issues.

3 Results

Based on morphological, morphometric, and habitat data, we recognized five species within *Senna* ser. *Coriaceae*, instead of the three species accepted by Irwin and Barneby (1982). We recognized *S. caesia* as a distinct species rather than a variety of *S. corifolia*, and described *S. diamantinensis* from the seasonally dry areas in the Chapada Diamantina, Bahia, as a new species morphologically distinct from *S. reniformis*. In addition, we propose two first-step lectotypes, one second-step lectotype, and one new combination for *S. kuhlmannii*.

4 Morphometric analyses

Concerning the *Senna corifolia* complex, the dendrogram (Fig. 1) and the scatterplots (Fig. 2) recovered by the UPGMA and the PCA analyses, respectively, revealed two major clusters. Cluster A comprises only specimens of *S. corifolia* var. *corifolia*, endemic to the Chapada dos Veadeiros and surroundings. Cluster A can be mainly morphologically distinguished by the lower stature, two extrafloral nectaries positioned at the base of each leaflet pair, and leaves with two pairs of broad leaflets 4.0–8.0 cm wide.

Cluster B comprises only specimens of *S. corifolia* var. *caesia*, from populations located in Goiás and Minas Gerais. The cluster B is mainly differentiated by the taller stature,

(3–) 4–5 extrafloral nectaries positioned at the base of each leaflet pair, and leaves with (3–) 4–5 pairs of narrow leaflets 1.5–4.0 cm wide. Specimens from Goiás and Minas Gerais were recovered mixed in cluster B and no significant morphological variation related to geographical distribution was observed. The two distinct clusters recovered in the morphometric analysis support our decision to recognize *S. corifolia* var. *caesia* as a distinct species rather than a variety of *S. corifolia*.

Concerning the *Senna reniformis* complex, the dendrogram (Fig. 3) and the scatterplots (Fig. 4) recovered by the UPGMA and the PCA analyses, respectively, revealed two major clusters. Cluster A comprises only specimens of the new species *Senna diamantinensis*. Cluster A can be mainly morphologically distinguished by the leaves with three pairs of broadly elliptic-oblong, ovate or orbicular leaflets, leaflet base usually cordate, three extrafloral nectaries positioned at the base of each leaflet pair, and fruits with thin margin (see diagnosis).

The cluster B comprises only specimens of *Senna reniformis*, from populations located in Minas Gerais and the only known population in Bahia (municipality of Vitória da Conquista). The cluster B is mainly differentiated by the (3–) 4–5 extrafloral nectaries positioned at the base of each leaflet pair, (3–) 4–5 pairs of elliptic or oblanceolate leaflets, leaflet base cuneate or obtuse, and fruits with thickened valve margins. The two distinct clusters recovered in the morphometric analysis support our decision to recognize *S.*

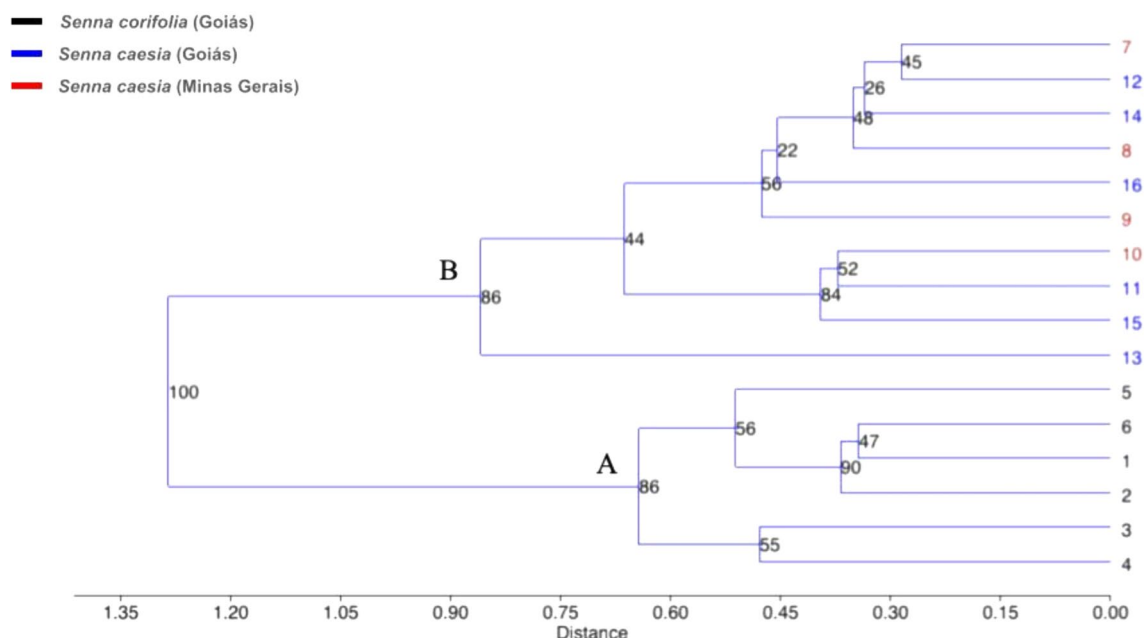


Fig. 1 Dendrogram recovered using the UPGMA method and based on the Euclidean Distance Coefficient with bootstrap (1000 replicates) for the morphometric data of six populations of *S. corifolia* (A) and 10 populations of *S. caesia* (B)

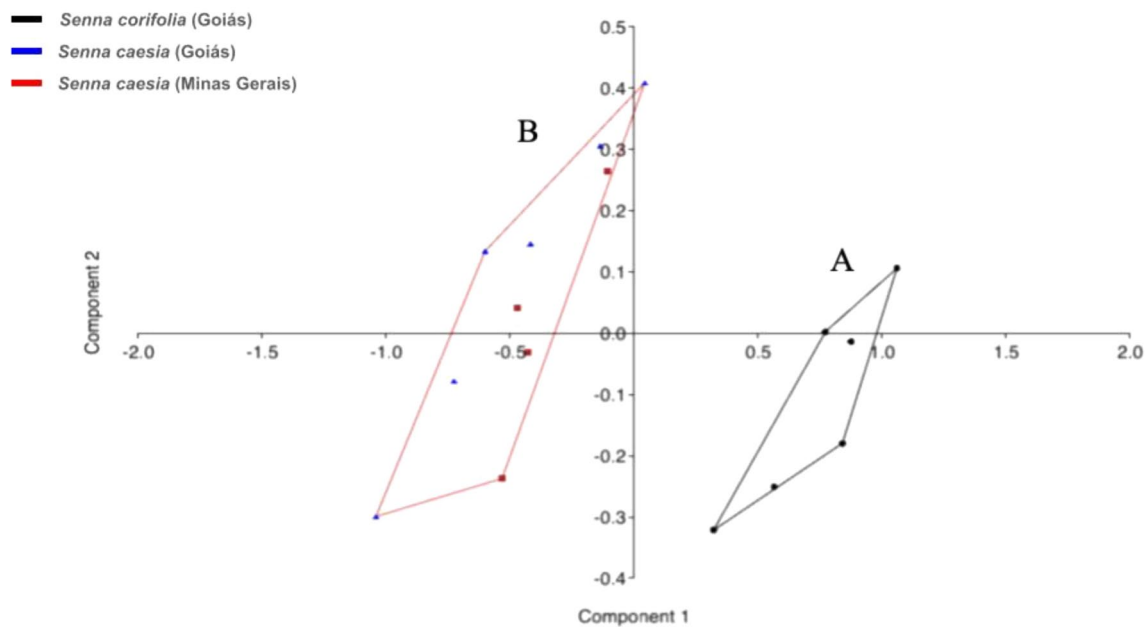


Fig. 2 Scatterplots derived from Principal Component Analysis of six populations of *S. corifolia* (A) and 10 populations of *S. caesia* (B)

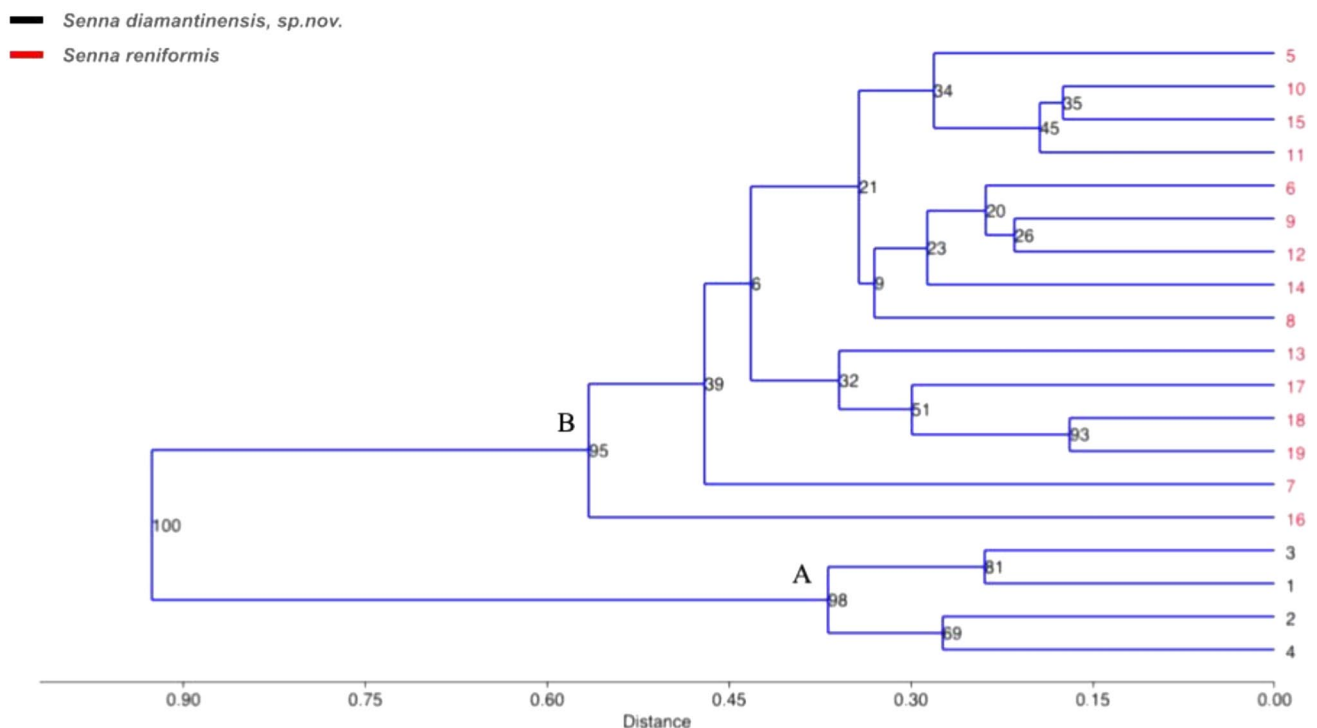


Fig. 3 Dendrogram recovered using the UPGMA method and based on the Euclidean Distance Coefficient with bootstrap (1000 replicates) for the morphometric data of four populations of *S. diamantinensis* (A) and 15 populations of *S. reniformis* (B)

diamantinensis as a new species morphologically distinct and geographically disjunct from *S. reniformis*.

In addition, *Senna kuhlmannii* was not included in the morphometric analyses, since its morphological features

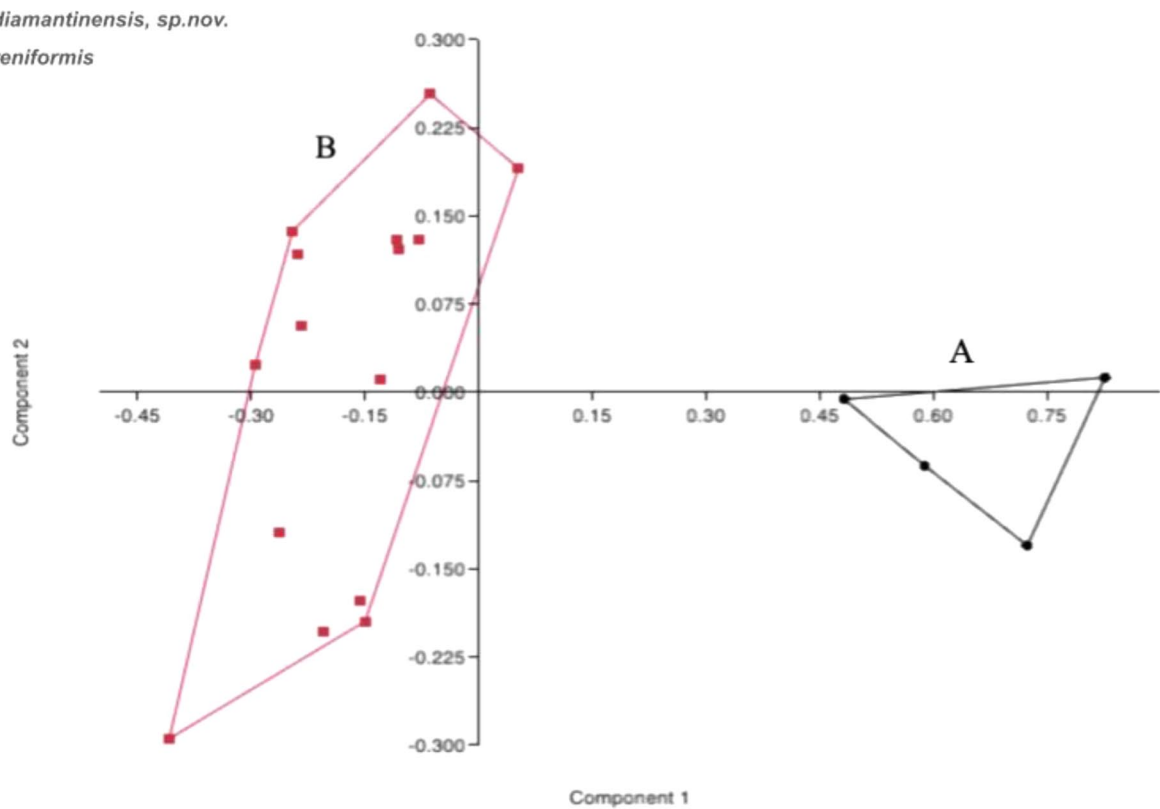


Fig. 4 Scatterplots derived from Principal Component Analysis of four populations of *S. diamantinensis* (A) and 15 populations of *S. reniformis* (B)

were sufficient to distinguish it as a remarkably distinct species within *Senna* ser. *Coriaceae*.

Specimens examined of *Senna corifolia* – Goiás. (1) A. Lima, M. Trovó, W. Picanço-Leite 582 (CEN, RB); (2) S. Romaniuc et al. 436 (SP); (3) G. Pereira-Silva et al. 6451 (CEN); (4) V.C. Souza et al. 23,971 (ESA, HUEFS); (5) A. Fidelis et al. 111 (HRCB, HUEFS); (6) B.M.T. Walter et al. 4363 (CEN, HUEFS).

Specimens examined of *Senna caesia* – Minas Gerais. (7) V.C. Souza et al. 32,933 (ESA); (8) R. Simão-Bianchini et al. CFCR12883 (HUEFS, SPF); (9) R. Romero et al. 9105 (HUFU); (10) E.B. Miranda 672 (HUEFS). **Goiás.** (11) W. R. Anderson et al. 10,007 (MO, NY, US); (12) Hatschbach et al. 59,513 (MBM); (13) A. Lima, M. Trovó, W. Picanço-Leite. 575 (CEN, RB); (14) C.F.S Silva et al. 798B (UB); (15) H.S. Irwin et al. 28,595 (NY); (16) Fonseca et al. 5371 (EAC).

Specimens examined of *Senna diamantinensis* – Bahia. (1) H.C. Lima 3974 (RB); (2) J. Costa et al. 764 (HUEFS); (3) N. Roque et al. 1369 (ALCB); (4) Mori & Boom 14,302 (NY).

Specimens examined of *Senna reniformis* – Bahia. (5) S. Mori 9468 (NY). **Minas Gerais.** (6) I. Cordeiro s.n. (SPF); (7) F.F. Mazine 838 (ESA); (8) A.M. Giuliatti et al. CFCR4537 (SPF); (9) J.E.Q. Faria 6102 (RB); (10) J. Lombardi 1890 (BHCB); (11) L.P. Queiroz 14,992 (HUEFS); (12) W. Anderson et al. 11,598 (NY); (13) H.S. Irwin 2510 (NY); (14) H.S. Irwin 23,735 (NY); (15) J. Nakajima 1721 (HUFU); (16) Landrum 4278 (NY); (17) M.M. Arbo 4957 (NY); (18) W. Anderson 35,921 (NY); (19) G. Hatschbach 54,185 (MBM).

Taxonomic treatment – *Senna* sect. *Chamaefistula* ser. *Coriaceae* (Benth.) H.S.Irwin & Barneby, Mem. New York Bot. Gard. 35: 220. 1982, emend. Irwin and Barneby (1982). *Cassia* sect. *Prososperma* ser. *Coriaceae* Benth., Trans. Linn. Soc. London 27: 537. 1871. Type: *Senna corifolia* (Benth.) Irwin & Barneby ($\equiv$ *Cassia corifolia* Benth.).

Shrubs or treelets; young branches straight or curved, cylindrical or subcylindrical, vinaceous, brown or gray, glabrous, glabrescent, pubescent, puberulous, or tomentose. **Stipules** reniform or rarely setaceous, usually persistent. **Leaves** alternate; petiole glabrescent, glabrous, pubescent, puberulous, tomentose or tomentulose; rachis

glabrescent, glabrous, pubescent, puberulous, tomentose or tomentulose; extrafloral nectaries 2–5 placed at the base of all leaflet pairs, sessile, subsessile or stipitate, discoid, fusiform, lanceolate or ovate; leaflets 2–5 pairs per leaf, lamina elliptic, obovate, oblanceolate, oblong, orbicular or ovate, base cordate, cuneate, oblique, obtuse or rounded, apex acuminate, acute, emarginate, mucronate or rounded; adaxial surface glabrescent, glabrous or pubescent, abaxial surface glabrescent, glabrous, pubescent or puberulous, concolorous or discolorous, coriaceous or carthaceus, secondary venation brochidodromous or eucamptodromous, tertiary venation percurrent or reticulate. Inflorescences racemes or panicles, axillary or terminal. **Flowers** with pedicel glabrous or pubescent; extrafloral nectary positioned at the base, middle or distal part of the pedicel; bracts lanceolate or ovate, usually caducous; calyx heteromorphic, sepals cymbiform, obovate, oblong or ovate, glabrous or pubescent externally; corolla zygomorphic, petals glabrous or sparsely pubescent externally, one central-adaxial petal obovate or oblong, base unguiculate, apex emarginate or rounded, two latero-abaxial petals oblong or obovate, base unguiculate, apex emarginate or rounded, two abaxial petals cucullate, obovate or cucullate, base unguiculate, apex rounded; androecium organized in three adaxial staminodes, four median stamens, two latero-abaxial stamens, one central-abaxial stamen. **Fruits** a legume, dehiscent or late dehiscent, body laterally compressed, linear or sometimes falcate, valves chartaceous or papery, surface venulose, straight or elevated over the seeds, brown or blackish, accessory nerves parallel to the sutures absent, valve margins thickened or thin, wavy or straight. **Seeds** oblong, laterally compressed, smooth.

Key to the species of *Senna* sect. *Chamaefistula* ser. *Coriacea* – 1. Stipules filiform or setaceous; leaf rachis extrafloral nectaries discoid, secretory surface usually concave; extrafloral nectary positioned at the base of the pedicel...
.....*S. kuhlmannii*.

1. Stipules reniform; leaf rachis extrafloral nectaries fusiform, lanceolate or ovate, secretory surface convex; extrafloral nectary positioned at the middle or distal part of the pedicel.....2.

2. Stipule apices rounded; leaflet apices emarginate or rounded.....3.

2. Stipules apices acute or caudate; leaflet apices usually acute, acuminate or mucronate.....4.

3. Leaves with two pairs of leaflets; leaflets broadly oblong-obovate or orbicular, distal leaflets 4–8 cm wide; leaf rachis extrafloral nectaries 2.....*S. corifolia*.

3. Leaves with (3–) 4–5 pairs of leaflets; leaflets elliptic, oblong or narrowly oblong-obovate; distal leaflets

1.5–4.0 cm wide; leaf rachis extrafloral nectaries (3–) 4–5...
.....*S. caesia*.

4. Leaves with (3–) 4 (–5) pairs of leaflets; leaflet bases cuneate or obtuse; leaflets elliptic or oblanceolate; fruits brown with margin thickened.....*S. reniformis*.

4. Leaves with 3 pairs of leaflets; leaflet bases cordate; leaflets broadly elliptic-oblong, ovate or orbicular; fruits blackish with margin thin.....*S. diamantinensis*.

***Senna corifolia* (Benth.) H.S. Irwin & Barneby**, Mem. New York Bot. Gard. 35: 221. 1982. Basionym: *Cassia corifolia* Benth., Fl. Bras. 15(2): 120. 1870. Lectotype (designated here) – BRAZIL. Goiás, referred as “Habitat inter Cocal et Trahiras” (probably Cocalzinho and Niquelândia areas), s.d., *Pohl s.n.* (M – barcode number M02117289; isolectotypes: M – barcode number M02117290, NY – barcode number NY00381826).

Shrub or subshrubby 0.7–1.5 (–2.5) m tall; young branches straight or slightly curved, subcylindric, brown or vinaceous, glabrous or rarely sparsely pubescent. **Stipules** 20–45 × 35–80 mm, reniform, apex rounded, persistent. **Leaves** with petiole 2.5–3.8 cm long, glabrous or sometimes sparsely pubescent; rachis 3.0–4.0 (–5.0) cm long, glabrous or sometimes sparsely pubescent; extrafloral nectaries 2, placed at the base of all leaflet pairs, sessile, ovate; leaflets 2 pairs, leaflets of the proximal pair 3.0–7.0 × 3.0–6.5 cm, broadly oblong-obovate or orbicular, base oblique, slightly oblique or rounded, apex emarginate, leaflets of the distal pair 4.0–8.3 × 4.0–8.0 cm, broadly oblong-ovate or orbicular, base oblique, slightly oblique or rounded, apex emarginate, leaflets with margins revolute, adaxial surface glabrous, abaxial surface glabrous or sometimes sparsely pubescent, venation prominent on the abaxial surface, secondary venation brochidodromous, tertiary venation reticulate. Inflorescences racemes or panicles. **Flowers** with pedicel 2.5–4.0 cm long, glabrous, extrafloral nectary positioned at the middle or distal part of the pedicel, 1, sessile or subsessile, ovate or fusiform; bracts 3.0–6.0 × 1.5–3.8 mm, ovate or lanceolate, apex acute or acuminate, usually caducous before the anthesis; calyx heteromorphic, sepals cymbiform, obovate, oblong, glabrous or sparsely pubescent, outermost sepals 3.0–8.0 × 1.5–3.0 mm, innermost sepal 12–18 × 7.0–12 mm; corolla zygomorphic, glabrous, central-adaxial petal 2.2–3.0 × 1.7–2.4 cm, obovate-oblong, base unguiculate, apex emarginate or rounded, two lateral-adaxial petals 2.2–3.0 × 1.7–2.4 cm, obovate, base unguiculate, apex rounded, two abaxial petals 2.6–3.2 × 2–2.5 cm, obovate and slightly cucullate, base unguiculate, apex rounded; three adaxial staminodes 4.0–5.5 mm long, four median stamens with filaments 1.5–2.5 mm long and

anthers 3.5–5.0 mm long, two lateral-abaxial stamens with filaments 10–14 mm long, and anthers 7.0–9.0 mm long, and one central-abaxial stamen with filaments 5.0–7.0 mm long, and anther 4.0–5.0 mm long; ovary 14–20 mm long; style 1.0–2.0 mm long. **Fruits** with stipes 5.0–12 mm long, body 5.0–15 × 1.0–1.5 cm, laterally compressed, linear, valves chartaceous, venulose, straight or slightly elevated over the seeds, brown or blackish, valve margins thickened, and wavy or slightly wavy. **Seeds** oblong-elliptic, laterally compressed, smooth.

5 Distribution, habitat, and conservation

Senna corifolia is endemic to the Chapada dos Veadeiros and surroundings in the state of Goiás, Brazil, in the Cerrado domain (Fig. 5). *Senna corifolia* grows on sandy and rocky soils rich in quartz, and occurs in *campo sujo* (herbaceous and shrubby savannas), savannas, rupestrian grasslands and rocky outcrops, from 450 to 1000 m a.s.l. It has been collected inside and outside conservation units. During extensive fieldwork in Chapada dos Veadeiros and surroundings in 2022, we found only one population with a few individuals, suggesting *S. corifolia* is a rare species. Following IUCN (2019) criteria B1ab(i,iii) + 2ab(ii,iii) *S. corifolia* is suggested as Vulnerable (VU) based on its extent of occurrence (EOO = 16,708.160 km²) and area of occupancy (AOO = 44 km²).

Phenology – Collected with flowers from December to July and with fruits from January to July.

Notes –*Senna corifolia* is a shrub or subshrub morphologically characterized by the reniform stipules with rounded apex, leaves with two pairs of leaflets, broadly oblong-obovate or orbicular leaflets, coriaceous leaflets, two extrafloral nectaries on the leaf rachis, and one extrafloral nectary positioned at the middle or distal part of pedicel (Fig. 6). The specimen Azevedo et al. 1018 (NY) has a single anomalous leaf with three pairs of leaflets while the other leaves of the same specimen and its duplicates have only two pairs of leaflets, and therefore we interpret this anomalous leaf as having no taxonomic significance.

Senna corifolia was described under the genus *Cassia* by Benthham (1870) and later transferred to *Senna* by Irwin and Barneby (1982). During our study we found two specimens of *S. corifolia* collected by Pohl in “Inter Cocal et Trahiras” (likely between Cocalzinho and Niquelândia, surroundings of Chapada dos Veadeiros) and housed in M. The two specimens are morphologically similar, and therefore we assume they are duplicates and propose a lectotypification here.

According to the circumscription adopted by Irwin and Barneby (1982), *Senna corifolia* is a polymorphic species with strong morphological variation in the shape, size, and number of leaflets and extrafloral nectaries. Irwin and Barneby (1982) distinguished the specimens with (3–) 4–5 pairs of leaflets, narrower leaflets and (3–) 4–5 extrafloral

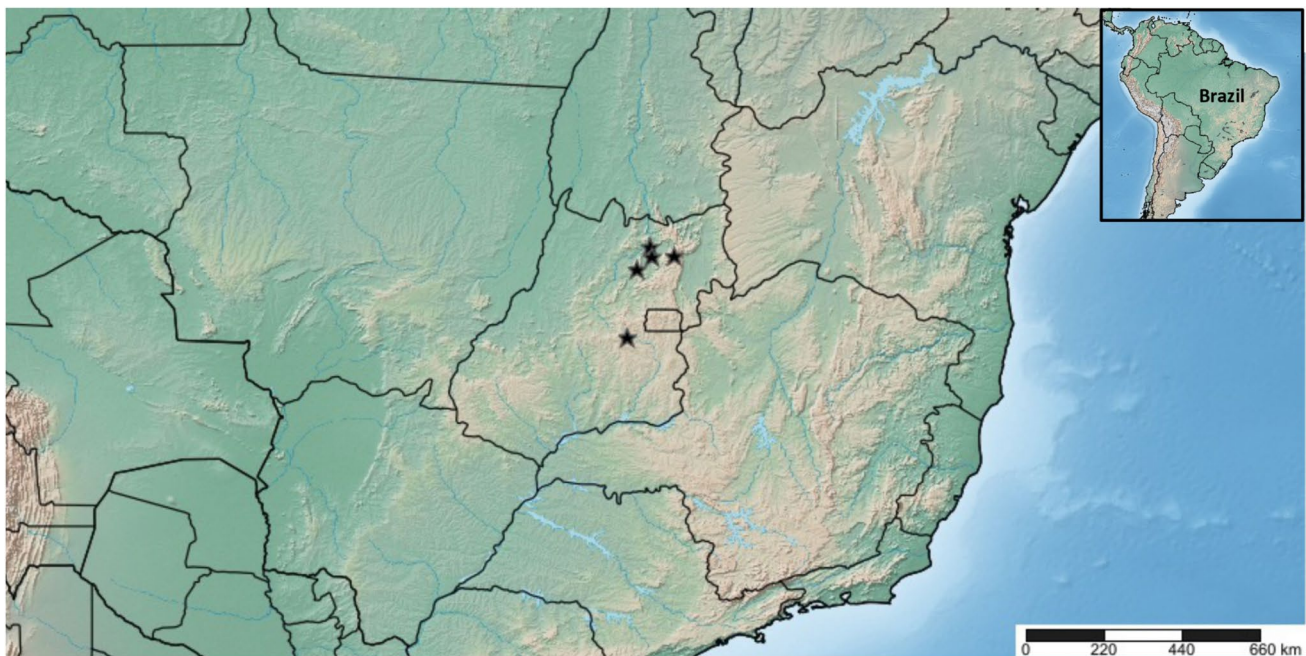


Fig. 5 Geographical distribution of *Senna corifolia*



Fig. 6 *Senna corifolia*. **A** Flower, **B** habit, **C** leaves, **D** habitat in Cerrado, Chapada dos Veadeiros, Alto Paraíso, Goiás, Brazil. Image credits: Alexandre Gibau de Lima

nectaries on leaf rachis and described them under the name *S. corifolia* var. *caesia*. Based on our observation of the two taxa in their habitat and supported by our morphometric analysis we recognize *S. caesia* as a distinct species, rather than as a variety of *S. corifolia*.

Specimens examined – **BRAZIL**. Goiás. Alto Paraíso, cerrado pedregoso, solo rico em quartzo, 22 May 2022, fl., A. Lima, M. Trovó, W. Picanço-Leite. 582 (CEN, RB). Alto Paraíso, Chapada dos Veadeiros, Parque Nacional, arredores da Sede do IBDF, próximo do rio José Jacó, 14 May 1986, fl., S. Romaniuc et al. 436 (SP). Cavalcante, cerrado, solo argilo-arenoso, estrada obra—Rio do Carmo, km 10, 21 May 2002, fl., G. Pereira-Silva et al. 6451 (CEN). Cavalcante, campo sujo, Reserva Natural da Serra do Tombador, 04 Apr 2012, fl., E. Gorgone-Barbosa et al. 101 (CEN. UEC). Cavalcante, campo sujo, Reserva Natural da Serra do Tombador, 05 Dec 2011, fl., A. Fidelis et al. 111 (HRCB, HUEFS). Colinas do Sul, cerrado ralo próximo a grandes áreas rupestres, estrada de terra Colinas—Serra da Mesa. A 41 km de Colinas, cerca de 7 km após a Vila Borba, 24 Jun 1999, fr., B.M.T. Walter

et al. 4363 (CEN, HUEFS). Colinas do Sul, campo cerrado, 15 Jun 1993, fl., fr., G. Hatschbach 59,557 (MBM, HUEFS). Niquelândia, cerrado, 8 km da cidade, Fazenda Traíras, 29 May 1996, fl., M.A. Silva et al. 2947 (EAC). Niquelândia, campo sujo, estrada de acesso à Ponte da Bagagem (relocada)- Nossa Senhora Abadia do Moquém, 22 May 1996, fl., S.P. Cordovil-Silva 462 (CEN, HUEFS). Niquelândia, estrada que sai da Rodovia Uruaçu—Niquelândia (cerca de 60 km de Uruaçu) em direção a Barro Alto, 15 Jul 2000, fl., V.C. Souza et al. 23,971 (ESA, HUEFS).

***Senna caesia* (Taub. ex Harms) A.G.Lima & Mansano**, comb. nov. $\equiv$ *Senna corifolia* var. *caesia* (Taub. ex Harms) H.S. Irwin & Barneby, Mem. New York Bot. Gard. 35: 222. 1982. Basionym: *Cassia caesia* Taub. ex Harms, Repert. Spec. Nov. Regni Veg. 24: 123. 1924. Lectotype (**first-step lectotype designated by Irwin and Barneby 1982:222; second-step lectotype designated here**) – BRAZIL. Minas Gerais, “Rio das Pedras au Valu”, 1892 [fl.], Glaziov 19,078 [P! – barcode number P02436038; isolectotypes: K! – barcode number K000555345, P! (two sheets) – barcode numbers P02436036, P02436037; holotype: B (destroyed) = negative photos F! – F0BN001666].

Shrub 1.0–3.0 m tall; young branches straight or slightly curved, subcylindric, brown or vinaceous, glabrous or rarely sparsely pubescent. **Stipules** 15–25 $\times$ 25–45 mm, reniform, apex rounded, persistent. **Leaves** with petiole 2.5–3.8 cm long, glabrous or sometimes sparsely pubescent; rachis 7.0–9.5 cm long, glabrous or sometimes sparsely pubescent; extrafloral nectaries (3–) 4–5, placed at the base of all leaflet pairs, sessile, ovate; leaflets (3–) 4–5 pairs, leaflets of the proximal pair 2.5–6.0 $\times$ 1.0–3.2 cm, elliptic, oblong or oblong-obovate, base cordate, oblique or slightly oblique, apex emarginate or rounded, leaflets of the distal pair 3.0–8.0 $\times$ 1.5–4.0 cm, elliptic, oblong or oblong-obovate, base cordate, oblique or slightly oblique, apex emarginate or rounded, leaflets with margins plane, adaxial surface glabrous, abaxial surface glabrous or sometimes sparsely pubescent, venation prominent on the abaxial surface, secondary venation brochidodromous, tertiary venation reticulate. Inflorescences racemes or panicles. **Flowers** with pedicel 2.5–4.0 cm long, glabrous, extrafloral nectary positioned at the distal part of the pedicel, 1, sessile or subsessile, ovate or fusiform; bracts 2.0–5.0 $\times$ 1.5–3.0 mm, ovate or lanceolate, apex acute or acuminate, usually caducous before the anthesis; calyx heteromorphic, sepals cymbiform, obovate or oblong, glabrous or sparsely pubescent, outermost sepals 3.5–8.0 $\times$ 1.5–3.5 mm, innermost sepal 12–18 $\times$ 7.0–12 mm; corolla zygomorphic, glabrous, central-adaxial petal 2.0–2.3 $\times$ 1.5–2.0 cm, obovate-oblong, base unguiculate, apex emarginate or rounded, two lateral-adaxial petals 2.0–2.7 $\times$ 1.5–2.0 cm, obovate, base unguiculate, apex rounded, two abaxial petals 2.7–3.4 $\times$ 2.0–2.5 cm, obovate and slightly cucullate, base unguiculate, apex

rounded; three adaxial staminodes 4.0–5.0 mm long, four median stamens with filaments 1.5–2.5 mm long and anthers 3.5–5.2 mm long, two lateral-abaxial stamens with filaments 10–13.5 mm long, and anthers 7.0–9.0 mm long, and one central-abaxial stamen with filaments 5.0–7.0 mm long, and anther 4.0–5.0 mm long; ovary 15–20 mm long; style 1.0–2.0 mm long. **Fruits** with stipes 8.0–15 mm long, body 5.0–16 × 1.0–1.5 cm, laterally compressed, linear, valves chartaceous, venulose, straight or slightly elevated over the seeds, brown or blackish, valve margins thickened, and wavy or slightly wavy. **Seeds** oblong-elliptic, laterally compressed, smooth.

6 Distribution, habitat, and conservation

Senna caesia is endemic to the Brazilian Cerrado, and it occurs disjunctly in the Chapada dos Veadeiros and Espinhaço range regions, in the states of Goiás and Minas Gerais respectively (Fig. 7). *Senna caesia* grows on sandy and rocky soils rich in quartz, and it occurs in the *campo sujo* (herbaceous and shrubby savannas), savannas, rup-estrian grassland, riparian forests, edge of semideciduous forests, wet shrubby grassland, and anthropic areas, from 700 to 1600 m a.s.l. It has been collected inside and outside of conservation units. During fieldwork in the Chapada dos Veadeiros and surroundings we found several populations of *S. caesia* growing in different vegetation types of Cerrado and anthropized areas. Following IUCN

(2019) criteria B1ab(i,iii) + 2ab(ii,iii), *S. caesia* is suggested as Least Concern (LC) based on its extent of occurrence (EOO = 246,696.423 km²) and area of occupancy (AOO = 160 km²).

Phenology – Collected with flowers from February to July and with fruits from January to October.

Notes – *Senna caesia* is a shrub that is morphologically characterized by the reniform stipules with rounded apices, leaves with (3–) 4–5 pairs of leaflets, elliptic, oblong or oblong-obovate, and coriaceous leaflets, (3–) 4–5 extrafloral nectaries on the leaf rachis, and 1 extrafloral nectary positioned at the middle or distal part of pedicel (Fig. 8).

Irwin and Barneby (1982) considered *S. caesia* as a variety of *S. corifolia*, but it can be differentiated by its leaf rachis extrafloral nectaries (3–) 4–5 (versus 2 in *S. corifolia*), pairs of leaflets (3–) 4–5 (versus 2), and distal leaflets 1.5–4.0 cm wide (versus 4.0–8.0 cm wide). During our fieldwork, collections-based research and our morphometric analysis we have observed remarkable morphological discontinuity supporting the new status, recognizing *S. caesia* as distinct from *S. corifolia*.

Senna caesia was described under the genus *Cassia* by Harms (1924) and later transferred to *Senna* by Irwin and Barneby (1982). The holotype collected by Glaziou and seen by the German botanist Harms was housed in B and destroyed during World War II. Duplicates of the holotype

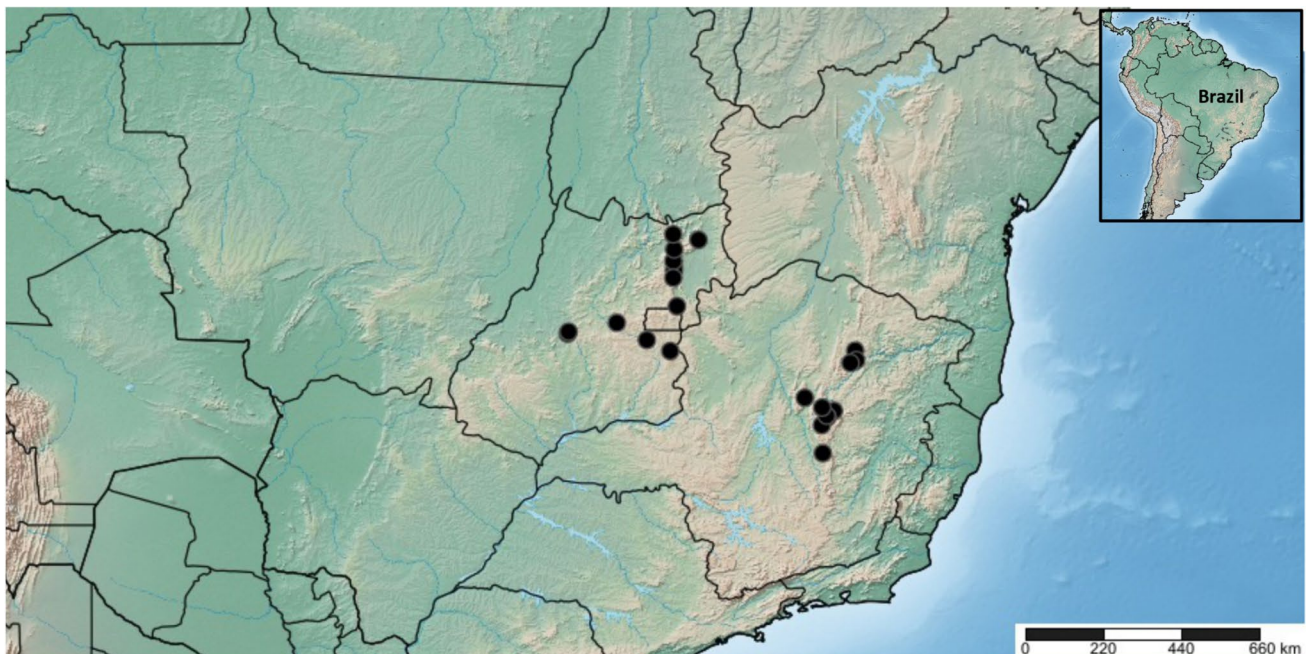


Fig. 7 Geographical distribution of *Senna caesia*



Fig. 8 *Senna caesia*. **A** Flower, **B** pedicel extrafloral nectary, **C** stipules, **D** leaves, **E** habit, **F** habitat in Cerrado, Chapada dos Veadeiros, Alto Paraíso, Goiás, Brazil. Image credits: Alexandre Gibau de Lima

were seen by Irwin and Barneby (1982), who interpreted the three sheets housed in P as a single specimen and lectotypified it. During our studies, we analyzed the specimens in P, and all of the three sheets have complete branches with flowers and, in addition, have different barcode numbers. Therefore we interpret them as three duplicates (not sheets) and propose a second-step lectotypification.

The name *Cassia caesia* Taub ex Glaz. cited by Harms (1924) was only found in the work “Plantae Brasiliae centralis a Glazou lectae” by Glazou (1905). Nevertheless, Glazou’s work is listed in the suppressed works (Appendix I) of the Code (Turland et al. 2018), and the name is considered not validly published. Therefore, the authority of the name is credited to Harms (1924) who provided a complete description for *C. caesia*.

Specimens examined – Brazil. Minas Gerais. Diamantina, campo rupestre, Parque Estadual do Biribiri, Cachoeira Sentinela. Próximo à cachoeira, 24 Apr 2019, fl., R. Romero et al. 9105 (HUFU). Diamantina, campo rupestre, área de

campo rupestre após a ponte, na estrada entre Diamantina e Biribiri, 20 Sep 2004, fr., E.B. Miranda 672 (HUEFS). Diamantina, Rod. Guinda-Conselheiro Mata, km 20, 21 May 1989, fl., G. Hatschbach 53,044 (MBM, NY). Diamantina, campo rupestre, 6 km de Diamantina em direção a Mendanha, 07 Jun 1996, fl., fr., V.C. Souza et al. 11,930 (ESA). Grão Mogol, campo rupestre, Serra de Grão Mogol, 08 Jan 2003, fr., L.P. Queiroz et al. 7543 (HUEFS). Grão Mogol, transição cerrado e campo rupestre, vale do Corrego Escurona, 13 Jun 1990, fl., fr., R. Simão-Bianchini et al. s.n. (HUEFS, SPF). Santana do Riacho, campo rupestre, RPPN Brumas do Espinhaço e Ermo do Gerais, 15 May 2012, fl., I.R. Andrade et al. 336 (BHQB, HUEFS). Santana do Riacho, campo rupestre, Serra do Cipó (Serra da Lapa). Distrito de São José da Cachoeira. Estrada Santana do Riacho—Santana do Pirapama, trilha do Cruzeiro, 21 Feb 2007, fl., V.C. Souza et al. 32,933 (ESA). **Goiás.** Alto Paraíso, cerrado alterado, beira de estrada, 20 May 2022, fl., A. Lima, M. Trovó, W. Picanço-Leite 575 (CEN, RB). Alto Paraíso, campo pedregoso com arbustos, Chapada dos Veadeiros. Ao longo da GO—118, 31 Mar 2019, fl., M.F. Simon et al. 3701 (CEN). Alto Paraíso, Chapada dos Veadeiros, ca. 12 km N.W. of Alto Paraíso de Goiás, 19 Oct 1965, fr., H.S. Irwin et al. 9277 (NY). Alto Paraíso, wet campo, Chapada dos Veadeiros, ca. 15 km W. of Alto Paraíso de Goiás, 12 Feb 1966, fr., H.S. Irwin et al. 12,710 (NY). Alto Paraíso, campo sujo com afloramento rochoso, Instituto Biorregional de Cerrado. RPPN Murundu. Trilha de acesso ao rio dos Couros, 10 May 2021, fl., C.F.S. Silva et al. 798B (CEN, UB). Cavalcante, campo sujo, estrada entre Cavalcante e Araújo, Solo cascalhento, 13 Apr 2004, fl., R.C. Mendonça et al. 5536 (EAC). Formosa, cerrado, Fazenda J. Teles, ca. 10 km. N.W. of Formosa, Goiás, near source of Rio Paraná, 29 Apr 1966, fl., R. Souza et al. 15,445 (K). Goiás (Goiás Velho), rock outcrops with cerrado, Ca 15 km s de Goiás velho; serra dourada Goiás, 10 May 1973, fl., W. R. Anderson et al. 10,007 (MO, NY, US). São João da Aliança, region of the Chapada dos Veadeiros at 16 km north of São João da Aliança, 19 Apr 1956, fl., E.Y. Dawson et al. 14,446 (NY). São João da Aliança, cerrado, Rod. GO-12, 23 May 1975, fl., G. Hatschbach 36,721 (MBM, NY).

***Senna reniformis* (G.Don) H.S.Irwin & Barneby**, Mem. New York Bot. Gard. 35: 223. 1982. Basionym: *Cassia reniformis* G.Don, Gen. Hist. 2: 440. 1832. Lectotype [designated by Irwin and Barneby (1982)] – BRAZIL, s.d., Sellow s.n. (K! – barcode number K000056180; isolectotypes: E! – barcode number E00296849, P! – barcode number P00798421).

= *Cassia reniformis* var. *glabrata* Vogel, Gen. Cass. Syn.: 26. 1837. **Lectotype (designated here)** – BRAZIL, Minas Gerais. In the protologue indicated as “Rio das

Pedras, prop. Vill. Rica", s.d., *Sellow s.n.* [P! – barcode number P00798421; holotype: B (destroyed)].

Shrub or treelet 1.0–6.0 m tall; young branches straight or slightly curved, cylindrical or subcylindrical, brown, glabrescent, pubescent or tomentose. **Stipules** 08–25 × 10–30 (–40) mm, reniform, apex acute or caudate, persistent. **Leaves** with petiole 2.0–5.0 cm long, glabrescent, pubescent or tomentulose; rachis 4.0–10 cm long, glabrescent, pubescent or tomentulose; extrafloral nectaries (3–) 4–5, placed at the base of all leaflet pairs, sessile or shortly stipitate, ovate or fusiform-lanceolate; leaflets (3–) 4 (–5) pairs, leaflets of the proximal pair 2.5–6.0 × 1.0–3.2 cm, elliptic, base cuneate or obtuse, apex acuminate or acute and additionally mucronate, leaflets of the distal pair 4.5–11 (–14) × 3.0–6.0 cm, elliptic or sometimes oblanceolate, base cuneate or obtuse, apex acuminate or acute and additionally mucronate, margin subrevolute, adaxial surface glabrous, abaxial surface glabrous or pubescent at the primary vein, venation prominent on the abaxial surface, secondary venation brochidodromous, sometimes basal secondary veins eucamptodromous, tertiary venation usually percurrent. **Inflorescences** racemes or panicles. **Flowers** with pedicel 2.5–3.5 cm long, glabrous or pubescent, extrafloral nectary positioned at the middle or distal part of the pedicel, 1, subsessile or stipitate, clavate, fusiform or ovate; bracts 3.0–6.5 × 1.5–3.0 mm, lanceolate, apex acute or acuminate, usually caducous before the anthesis; calyx heteromorphic, sepals, obovate, oblong or ovate, glabrous, outermost sepals 4.0–8.0 × 2.0–5.0 mm, innermost sepal 10–16 × 5.0–9.0 mm;

corolla zygomorphic, glabrous or sparsely pubescent, central-adaxial petal 2.0–2.5 × 1.3–2.0 cm, obovate, base unguiculate, apex emarginate or rounded, two lateral-adaxial petals 2.2–2.7 × 1.5–2.0 cm, oblong-obovate, base unguiculate, apex rounded, two abaxial petals 2.7–3.2 × 1.8–2.5 cm, obovate or slightly cucullate, base unguiculate, apex rounded; three adaxial staminodes 3.0–5.0 mm long, four median stamens with filaments 2.0–3.0 mm long and anthers 5.0–8.0 mm long, two lateral-abaxial stamens with filaments 8.0–10 mm long, and anthers 9.0–13 mm long, and one central-abaxial stamen with filaments 5.0–7.0 mm long, and anther 8.0–10 mm long; ovary 15–20 mm long; style 4.0–7.0 mm long. **Fruits** with stipes 2.0–5.0 mm long, body 8.0–20 × 0.9–1.2 cm long, laterally compressed, linear, sometimes slightly falcate, valves chartaceous, venulose elevated over the seeds, brown, valve margins thickened, and wavy or straight. **Seeds** oblong, laterally compressed, smooth.

7 Distribution, habitat, and conservation

Senna reniformis is endemic to Brazil, and it occurs in Bahia and Minas Gerais (Fig. 9). *Senna reniformis* usually grows on sandy or rocky soils, quartz- or iron-rich soils, and it occurs on the edge of semideciduous forests, savannas, rupestrian grassland, riparian forests, wet shrubby grasslands, and anthropic areas, from 800 to 1800 m a.s.l. The species has been collected inside and outside conservation

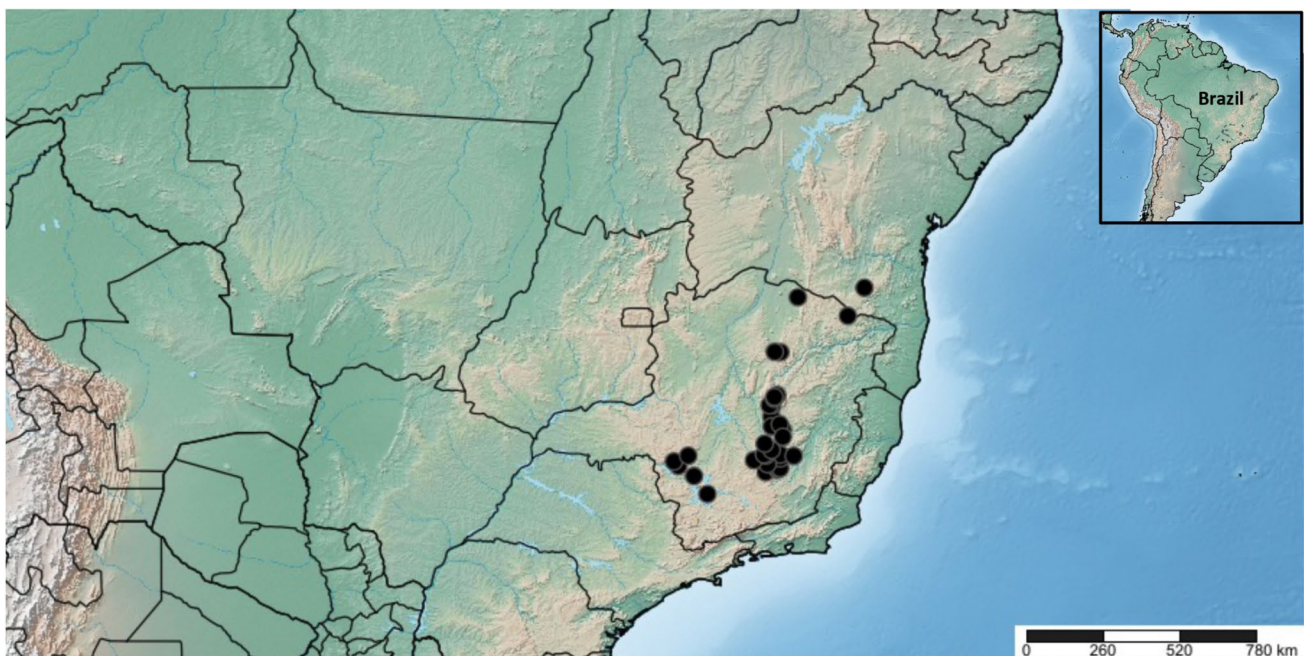


Fig. 9 Geographical distribution of *Senna reniformis*

units. During our fieldwork in Bahia and Minas Gerais, we found no populations of *S. reniformis*. Following IUCN (2019) criteria B1ab(i,iii)+2ab(ii,iii), *S. reniformis* is suggested as Least Concern (LC) based on its extent of occurrence (EOO = 203,518.402 km²) and area of occupancy (AOO = 204 km²).

Phenology – Collected with flowers from December to June and with fruits from January to December.

Notes – *Senna reniformis* is a shrub or a treelet morphologically characterized by reniform stipules with acute or caudate apex, leaves with (3–) 4 (–5) pairs of leaflets, leaflets elliptic or oblanceolate, leaflets base cuneate or obtuse, leaflet apex acuminate or acute and additionally mucronate, fruits brown with thickened margins (Fig. 10). *Senna reniformis* is morphologically similar to *S. diamantinensis*, but distinguished by the leaves with (3–) 4 (–5) pairs of leaflets in the former (versus three pairs in the latter), leaflets

elliptic, narrow elliptic or oblanceolate in the former (versus broadly elliptic-oblong, ovate or orbicular in the latter), leaflet base cuneate or obtuse in the former (versus cordate or sometimes rounded in the latter), fruits brown in the former (versus blackish in the latter), valve margins thickened in the former (versus thin in the latter).

Senna reniformis was described under the genus *Cassia* by George Don (1832) and later transferred to *Senna* by Irwin and Barneby (1982). Vogel (1837) recognized *C. reniformis* as described by George Don, and in addition, described *C. reniformis* var. *glabrata*, probably based on Sellow's collection housed in the herbarium B and destroyed during World War II. Vogel (1837) characterized *C. reniformis* var. *glabrata* as “glabrata, legumine subfalcato-curvato”. We selected a specimen in the herbarium P (barcode number P00798421), which coincides with the protologue and therefore, we propose a lectotypification.

Specimens examined – **Brazil. Bahia.** Vitória da Conquista, mata de cipó, Rodovia BA-265, trecho Vitória da Conquista/ Barra do Choça, a 9 km Leste da primeira, 04 Mar 1978, fl., S.A. Mori et al. 9468 (NY). **Minas Gerais.** Caeté, Serra da Piedade. Km 1–5 on road to top of Serra, 02 Feb 1982, fl., fr., L.R. Landrum 4278 (NY). Claro dos Poções, campo cerrado, rod. BR-365, Claro dos Poções, 11 Jun 1990, fr., G. Hatschbach et al. 54,185 (MBM, NY). Conceição do Mato Dentro, Serra do Cipó, margens do Rio Santo Antônio, Km 174., 28 Apr 1978, H.C. Lima et al. 507 (HUEFS, RB). Conceição do Mato Dentro, Serra do Sapo (atrás do Platô 19), 02 Apr 2014, fl., S.N. Moreira et al. 615 (HDJF). Diamantina, Cerrado, Serra do Espinhaço, Ca. 8 km E. of Diamantina, road to Extração, 16 Mar 1970, fl., fr., H.S. Irwin et al. 27,663 (NY). Diamantina, rocky hillside, districto Diamantina, Cristais, 13 May 1931, fl., Y. E. J. Mexia 5823 (GB, NY). Diamantina, campo rupestre, Parque Estadual do Biribiri, área da cascalheira, 15 Mar 2013, fl., T.J.O. Otoni s.n. (HDJF). Diamantina, rocky slopes, upper slopes of Serra do Espinhaço, 26 Feb 1975, fl., fr. W.R. Anderson 11,598 (MBM). Diamantina, cerrado and gallery forest, Serra do Espinhaço, ca. 7 km N. of São João da Chapada, road to Inhaí, 30 Mar 1970, fl., fr., H.S. Irwin 28,631 (NY). Diamantina, capoeira resultante de cerradão degradado, estrada Turmalina-Diamantina, 13 May 1979, fl., fr., H.C. de Lima et al. 1080 (NY, RB). Joaquim Felício, campo rupestre, margem de córrego, 15 May 2001, fl., Hatschbach, G. et al. 72,031 (ESA). Joaquim Felício, matinha de galeria, rio da Onça, 14 Apr 1996, fl., G. Hatschbach 64,928 (MBM). Monte Azul, mata ciliar, Serra da Formosa em frente ao Pico da Formosa, 27 Oct 2010, fr., L.P. Queiroz, et al. 14,992 (HUEFS). Montes Claros, cerrado, Serra do Espinhaço, Serra dos Três Irmãos, ca. 52 km west of Montes Claros, road to Água Boa, 26 Feb 1969, fl., H.S. Irwin et al. 23,937 (NY). Santana do

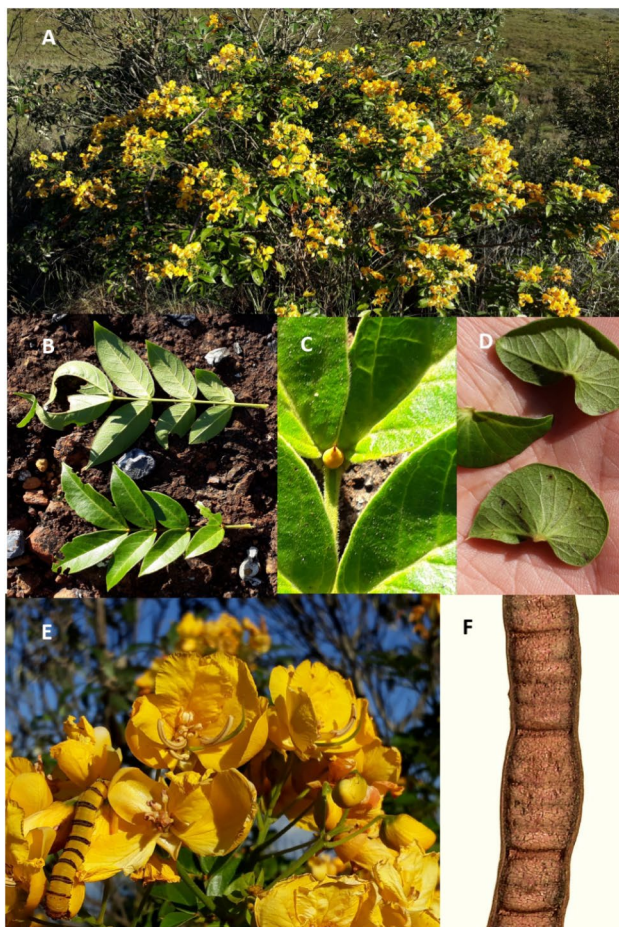


Fig. 10 *Senna reniformis*. **A** Habit, **B** leaves, **C** leaf rachis extrafloral nectary, **D** stipules, **E** flowers, **F** fruit (median portion). Image credits: A–E) Celso Lago-Paiva, Santana do Riacho, Minas Gerais, Brazil. F-) Specimen Rezende, S.G. 9817 (BHCB)

Riacho, em mata ciliar, contrafortes ocidentais da Serra do Cipó, elevações a nordeste da Lapinha, nas nascentes do córrego do boqueirão, 22 Apr 2006, fl., *R. Mello-Silva* et al. 2906 (SPF). Santana do Riacho, mata ciliar do córrego Indequécê, 19 Apr 1981, fl., fr., *A. Furlan* et al. s.n. (ESA). Santana do Riacho, borda de mata ciliar com campo rupestre ao redor, córrego Três Pontinhas, 01 Oct 2006, fl., *J.G. Rando* et al. 133 (ESA). Santa Bárbara, mata de encosta, serra do Caraça, 22 May 1997, fl. *R. Mello-Silva* et al. 1337 (SPF). Santa Bárbara, low secondary forest, rocky iron soil (canga), 16 km SE. of Santa Bárbara on road to Catas Altas, 22 Jan 1959, fr., *H.S. Irwin* et al. 2510 (NY). São Roque de Minas, campo rupestre, Cachoeira da Casca D'Anta, trilha para a guarita de baixo, PARNA Serra da Canastra, 12 May 1995, fl., fr., *J.N. Nakajima* et al. 1081 (HUFU, NY). São Roque de Minas, borda de mata de encosta, Parque Nacional da Serra da Canastra, Trilha para a parte de baixo da Cachoeira Casca D'Anta, 20 Apr 1997, fl., *J.N. Nakajima* et al. 2417 (HUFU). Rio Vermelho, mata, Pedra Menna, Serra do Ambrósio, Morro do Ananazeiro, 31 Mar 1985, fl., *A.M. Giulietti* et al. CFCR4537 (NY). Rio Vermelho, campo rupestre, Serra do Ambrósio, 28 Apr 2013, fl., *M.L. Brotto* et al. 1204 (MBM).

***Senna diamantinensis* A.G.Lima & Mansano**, sp. nov. Holotype – BRAZIL. Bahia, Lençóis. Chapada de Diamantina, road to Recanto, capetinga (capitinga), seasonally dry forest, 12 Sep 1990 [fr.], *H.C. Lima* et al. 3974 (RB) – barcode number RB00147861, herbarium number RB288618; isotype: K! – barcode number K000056053) (Fig. 11)

Senna diamantinensis is morphologically similar to *S. reniformis*, but distinguished by the leaves with three pairs of leaflets in the former [versus (3–) 4 (–5) in the latter], leaflets broadly elliptic-oblong, ovate or orbicular in the former (versus elliptic, narrow elliptic or oblanceolate in the latter), leaflet base cordate or sometimes rounded in the former (versus cuneate or obtuse in the latter), fruits blackish in the former (versus brown in the latter), valve margins thin in the former (versus thickened in the latter).

Scandent or erect shrub 1.5–4.0 m tall; young branches straight or slightly curved, cylindric or subcylindric, dark brown, glabrescent or sparsely pubescent. **Stipules** 10–18 × 10–30 mm, reniform, apex acute or caudate, persistent. **Leaves** with petiole 5.0–7.0 cm long, glabrescent, pubescent or sparsely pubescent; rachis 7–9 cm long, glabrescent, pubescent or sparsely pubescent; extrafloral nectaries 3, placed at the base of all leaflet pairs, sessile or shortly stipitate, ovate or lanceolate; leaflets 3 pairs, leaflets of the proximal pair 3.5–6.5 × 3.5–5.0 cm, oblong, oblong-ovate or orbicular, base cordate or rounded, apex obtuse or rounded and additionally mucronate, leaflets of the distal pair 6.0–8.5 × 4.0–7.5 cm, oblong or oblong-ovate, base cordate, apex acute or obtuse and additionally mucronate,

margin subrevolute, adaxial surface glabrous, abaxial surface glabrous or pubescent at the primary vein, discolor, adaxial surface glossy and blackish (when dry) and abaxial surface opaque and brown (when dry), venation prominent on the both surfaces, secondary venation brochidodromous, sometimes basal secondary veins eucamptodromous, tertiary venation reticulate. **Inflorescences** racemes or panicles. **Flowers** with pedicel 2.8–4.0 cm long, glabrous or pubescent, extra-floral nectary positioned at the middle or distal part of the pedicel, 1, subsessile or stipitate, fusiform or lanceolate; bracts 3.0–6.5 × 1.5–3.0 mm, lanceolate, apex acute or acuminate, usually caducous before the anthesis; calyx heteromorphic, sepals, obovate, oblong or ovate, glabrous or sparsely puberulent, outermost sepals 4.0–6.8 × 2.0–4.0 mm, innermost sepal 10–16 × 9.0–12 mm; corolla zygomorphic, glabrous, central-adaxial petal 2.0–2.5 × 1.4–2.0 cm, obovate, base unguiculate, apex rounded, two lateral-adaxial petals 2.1–2.6 × 1.5–2.0 cm, oblong-obovate, base unguiculate, apex rounded, two abaxial petals 2.7–3.2 × 1.8–2.4 cm, obovate and slightly cucullate, base unguiculate, apex rounded; three adaxial staminodes 5.0–6.0 mm long, four median stamens with filaments 2.0–3.0 mm long and anthers 5.0–7.0 mm long, two lateral-abaxial stamens with filaments 8.0–10 mm long, and anthers 9.0–13 mm long, and one central-abaxial stamen with filaments 6.0–8.0 mm long, and anther 7.0–9.0 mm long; ovary 13–18 mm long; style 4.0–8.0 mm long. **Fruits** with stipes 4.0–8.0 mm long, body 10–23.5 × 0.9–1.2 cm, laterally compressed, linear, sometimes slightly falcate, valves chartaceous, venulose, slightly elevated over the seeds or straight, blackish, valve margins thin, and straight. **Seeds** narrowly oblong, laterally compressed, smooth.

8 Distribution, habitat, and conservation

Senna diamantinensis is endemic to the Chapada Diamantina, in the Caatinga domain (Fig. 12). It grows on sandy or rocky soils, in the *caatinga* (seasonally dry forest), *capit- inga* (sandy herbaceous-shrub grassland), rupestrian grassland and sometimes in the edge of semi-deciduous forests, from 500 to 900 m a.s.l. *Senna diamantinensis* is associated with the seasonally dry environments of the northern part of the Espinhaço range in the Caatinga domain. In contrast, *S. reniformis* is mostly associated with the Atlantic Forest and Cerrado domains in the southern part of the Espinhaço range. It has been collected inside and outside conservation units. During our fieldwork in the Chapada Diamantina we found no populations of *S. diamantinensis*. Following IUCN (2019) criteria B1ab(i,iii) + 2ab(ii,iii), *S. diamantinensis* is suggested as Endangered (EN) based on its extent of occurrence (EOO = 185.095 km²) and area of occupancy (AOO = 16 km²).



Fig. 11 Illustration of *Senna diamantinensis*. **A** Type locality in Lençóis, Chapada Diamantina, Bahia, **B** habit, **C** flowering branch, **D** leaflet base, **E** leaflet venation, **F**, **G** leaf rachis extrafloral nectary, **H** stipules, **I** flower bud, **J** pedicel extrafloral nectary, **K** flower, **L** adaxial petal, **M** innermost sepal, **N** outermost sepal, **O** androecium, **P** pistil, **Q** fruit. Illustrated by Maria Alice de Rezende (Jardim Botânico do Rio de Janeiro)



Fig. 12 Geographical distribution of *Senna diamantinensis*

Phenology – Collected with flowers and fruits from May to July.

Notes – *Senna diamantinensis* is a scandent shrub characterized by reniform stipules with apiculate or caudate apices, leaves with three pairs of leaflets, leaflets broadly elliptic-oblong, ovate or orbicular, leaflet base usually cordate, glossy leaflets, tertiary venation reticulate and prominent on both surfaces, fruits blackish with thin margins.

Irwin and Barneby (1982) recognized only *S. reniformis*, but highlighted the few flowering specimens from the Chapada Diamantina as a potential disjunct distribution. In the last 40 years, new collections of *S. diamantinensis* became available, including specimens with fruits, all endemic to the Chapada Diamantina, allowing us to understand its morphology better and distinguish it as a new species.

Etymology – The specific epithet refers to the new species' habitat in the Chapada Diamantina, Bahia, Brazil.

9 Additional specimens examined (paratype)

Brazil. Bahia. Andaraí, mata de encosta, estrada 2 km de Igatu, 20 May 2004, fl., fr., *J. Costa* et al. 764 (HUEFS). Lençóis, open area on deep sand, ca. 4 km N.E. of Lençóis by old road, 23 May 1980, fl., *R.M. Harley* 22,453 (NY).

Lençóis, campo rupestre, Along BR 242, ca. 15 km NW of Lençóis at km 225, 10 Jun 1981, fl., *S.A. Mori & B.M. Boom* 14,302 (NY). Mucugê, caatinga, Chapada Diamantina, 44 km de Mucugê, em afloramento rochoso, 07 Jul 2006, fl., fr., *N. Roque* et al. 1369 (ALCB).

***Senna kuhlmannii* (Hoehne) A.G.Lima & Mansano**, comb. nov. Basionym: *Cassia kuhlmannii* Hoehne, Relat. Commiss. Linhas. Telegr. Estrateg. Matto Grosso Amazonas 12(12): pl. 185, f. 1. 1922. Holotype – BRAZIL. Between Mato Grosso and Rondônia, between Barão de Melgaço and Pimenta Bueno, Jun 1918 [fl.], *J.G. Kuhlmann s.n.* (R! – barcode number R000027429).

= *Cassia cachimboensis* H.S.Irwin & Barneby, Brittonia 28(4): 432. 1976. Holotype – BRAZIL. Pará, Ereri, Cururú river, Alto Tapajós, 13 Jul 1959 [fl.], *W.A. Egler* 848 (IAN! – herbarium number IAN102329; isotype NY! – barcode number NY00003741).

Shrub 1.0–3.0 m tall; young branches straight or slightly curved, cylindrical or subcylindrical, gray or vinaceous, glabrous or sometimes sparsely pubescent. **Stipules** 3.0–6.0 × 0.5–1.0 mm, filiform or setaceous, apex acute, usually caducous. **Leaves** with petiole 0.5–2.0 cm long, glabrous or sometimes sparsely puberulous; rachis 1.8–5.0 cm long, glabrous or sometimes sparsely puberulous; extrafloral nectaries 2–3, placed at the base of all leaflet pairs, sessile or rarely subsessile, discoid; leaflets 2–3 pairs, leaflets of the proximal pair 2.5–5.0 × 1.4–2.5 cm, elliptic, oblanceolate or obovate, base cuneate, obtuse or rounded, apex emarginate or rounded, leaflets of the distal pair

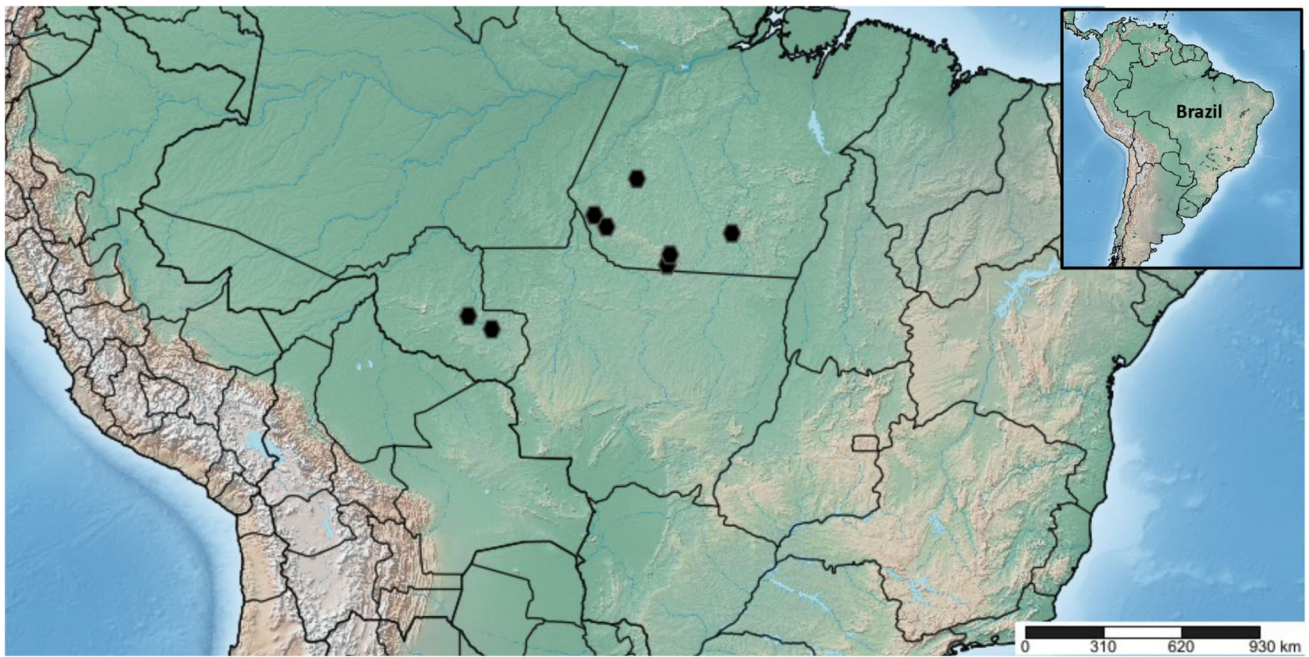


Fig. 13 Geographical distribution of *Senna kuhlmannii*



Fig. 14 *Senna kuhlmannii*. **A, B** Discoid leaf rachis extrafloral nectary, **C, D** Inflorescence with extrafloral nectaries located at the base of the pedicel (indicated by the red arrows)

4.0–8.0 × 2.0–4.0 cm, elliptic, oblanceolate or obovate, base cuneate, obtuse or rounded, apex emarginate or rounded, margin revolute, adaxial surface glabrous, abaxial surface glabrous or sparsely puberulous, venation prominent on the abaxial surface, secondary venation brochidodromous,

basal secondary veins usually eucamptodromous, tertiary venation usually percurrent. **Inflorescences** racemes. **Flowers** with pedicel 2.5–3.5 cm long, glabrous, extrafloral nectary positioned at the base of the pedicel, 1, stipitate, clavate or fusiform; bracts 2–5 × 1.0–2.0 mm, lanceolate,

apex acute or acuminate, caducous before the anthesis; calyx heteromorphic, sepals obovate, oblong or ovate, glabrous, outermost sepals $3.0\text{--}5.0 \times 1.5\text{--}3.0$ mm, innermost sepal $10\text{--}15 \times 5.0\text{--}9.0$ mm; corolla zygomorphic, glabrous, central-axial petal $2.0\text{--}2.5 \times 1.3\text{--}1.8$ cm, obovate, base unguiculate, apex rounded or emarginate, two lateral-axial petals $2.2\text{--}2.5 \times 1.3\text{--}1.8$ cm, obovate, base unguiculate, apex rounded, two abaxial petals $2.5\text{--}3.0 \times 1.6\text{--}2.3$ cm, cucullate or slightly cucullate, base unguiculate, apex rounded; three adaxial staminodes $4.0\text{--}5.0$ mm long, four median stamens with filaments $2.0\text{--}3.0$ mm long and anthers $5.5\text{--}7.0$ mm long, two lateral-abaxial stamens with filaments $7.0\text{--}9.0$ mm long, and anthers $9.0\text{--}15$ mm long, and one central-abaxial stamen with filaments $4.0\text{--}7.0$ mm long, and anther $7.0\text{--}10$ mm long; ovary $13\text{--}20$ mm long; style $7.0\text{--}10$ mm long. **Fruits** with stipes $2.0\text{--}6.0$ mm long, body $8.0\text{--}11 \times 0.9\text{--}1.3$ cm, laterally compressed, linear, valves papery, venulose, elevated over the seeds, dark brown, valve margins slightly thickened, and straight or sometimes wavy. **Seeds** oblong, laterally compressed, smooth.

10 Distribution, habitat, and conservation

Senna kuhlmannii is only known in the states of Pará and Rondônia, Brazil, in the transition between the Amazon and Cerrado domains (Fig. 13). It usually grows on sandy soils and occurs in the savannas, *campinas* (sandy shrub grasslands), and rocky outcrops, from 100 to 500 m a.s.l. It has been collected outside conservation units. *Senna kuhlmannii* occurs disjunctly in the savannas of the states of Pará and Rondônia. Following IUCN (2019) criteria B1ab(i,iii) + 2ab(ii,iii), *S. kuhlmannii* is suggested as Least Concern (LC) based on its extent of occurrence (EOO = $167,822.932$ km²) and area of occupancy (AOO = 44 km²).

Phenology – Collected with flowers from April to October and with fruits from June to February.

Notes – *Senna kuhlmannii* is a shrub characterized by filiform or setaceous and usually caducous stipules, leaves with 2–3 pairs of leaflets, leaf rachis extrafloral nectaries discoid, extrafloral nectaries placed at the base of the peduncle (Fig. 14). The discoid leaf rachis extrafloral nectary of *S. kuhlmannii* is a remarkable feature and unique in the genus. The extrafloral nectary secretory surface in *Senna* is convex, except for the usually concave surface found in *S. kuhlmannii*.

Also notable are the extrafloral nectaries positioned at the base of the pedicel of the flowers of *S. kuhlmannii*, while the other species of *Senna* ser. *Coriaceae* all bear extrafloral

nectaries at the middle or the distal part of the pedicel. Extrafloral nectaries at the base of the pedicel can also be found in the members of *Senna* ser. *Laxiflorae*.

Despite the unique morphological characteristics, we have recognized, as Irwin and Barneby (1982) did, *Senna kuhlmannii* within *Senna* ser. *Coriaceae* because of the same morphological patterns of its corolla, androecium, and fruits with other species of the series. However, we are working on a comprehensive morphological and molecular study in order to understand the relationship among the series within *Senna*, including *Senna* ser. *Coriaceae* and *Senna* ser. *Laxiflorae*.

Senna kuhlmannii was described under the genus *Cassia* by Hoehne (1922) based on a specimen collected by Kuhlmann between Barão de Melgaço and Pimenta Bueno, Mato Grosso and Rondônia respectively. Although Irwin and Barneby (1982) considered *C. kuhlmannii* under the genus *Senna*, they didn't indicate its basionym. Therefore, according to article 41.5 of the International Code of Nomenclature for algae, fungi, and plants, the new combination was not validly published (Turland et al. 2018). Here, we propose a new combination for *C. kuhlmannii* following article 41.5 (Turland et al. 2018).

The collector number “Kuhlmann 2043” on the holotype label is questionable, as this number was also found on a Solanaceae specimen (barcode number RB00467495). Nevertheless, the holotype of *Senna kuhlmannii* fully agrees with the protologue and conclusively confirms its identity.

Specimens examined – **Brazil. Pará.** Alto Tapajós, sandy cerrado, campos near streams SE of Missão Cururú, 08 Feb 1974, fr., W.R. Anderson 10,685 (NY). Itaituba, Estrada Santarém-Cuiabá, Br-163, Km 794, Serra do Cachimbo, Base Aérea, 25 Apr 1983, fl., L. Amaral et al. 942 (INPA, NY, US). Tapajós, rio cururú, campo da Tabua, 13 Jul 1959, fl., W.A. Egler 23,686 (NY). Rio São Manoel, campo natural posto dos índio Caiabí, encontrada em campo natural, 08 Jan 1952, fr., J.M. Pires 3863 (IAN). Pará—Mato Grosso border; on the Cachimbo hills, at and near the Cachimbo airfield, campo cerrado interspersed with rain forest near rivers, Jul 1961, fl., J.H. Hemming 05 (K). **Rondônia.** Pimenta Bueno, Campina, solo quartzarenico, eletrogões, 19 Jun 2017, fl., I. Mendes-Silva et al. 76 (RB, RON). Pimenta Bueno, mancha de cerrado, Área às margens da BR 364, 09 May 2019, fl., K.R.C. Paixão 480 (RB).

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