
Boswellia socotrana: One or Two Taxa?

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ABSTRACT. There are seven endemic species of *Boswellia* Roxb. ex Colebr. on Socotra Island, Yemen. *Boswellia socotrana* Balf. f. is a culturally, economically, and ecologically important species on the island. The name *Odina aspleniifolia* Balf. f. has been considered as a synonym, but there are morphological differences between the two taxa sufficient to justify their distinction at subspecific rank. Therefore, *O. aspleniifolia* is transferred to *Boswellia* as *B. socotrana* subsp. *aspleniifolia* (Balf. f.) Lvončik. A lectotype is designated for *O. aspleniifolia*. The distribution and ecology of both subspecies are discussed, as is their conservation status.

Key words: *Boswellia*, Burseraceae, endemism, lectotypification, new combination, *Odina*, Socotra.

The genus *Boswellia* Roxb. ex Colebr. (Burseraceae) includes 19 to 30 described species distributed in dry tropical habitats (Thulin et al., 2008; Daly et al., 2011). Seven endemic species of this genus from Socotra Island have been described: *B. ameero* Balf. f., *B. bullata* Thulin, *B. dioscoridis* Thulin, *B. elongata* Balf. f., *B. nana* Hepper, *B. popoviana* Hepper, and *B. socotrana* Balf. f. (Miller & Morris, 2004). All *Boswellia* species produce an oleoresin containing aromatic terpenes, and several have been widely known since antiquity as “frankincense.” Like other genera of Burseraceae throughout the tropics, their resin has been used for many religious, medicinal, and practical purposes (Miller & Morris, 1988; Van Bergen et al., 1997; Basar, 2005; Shen & Lou, 2008; Mothana et al., 2011; Maděra et al., 2017).

More recently, *Boswellia* species have been commercially applied in medicinal and beauty products around the world (Maděra et al., 2017). They are fundamental species on Socotra Island, as they have affected the cultural life of local people and the island’s economy for centuries (Miller & Morris, 2004; Brown & Mies, 2012). They are also important as anti-erosion plantings and umbrella species (De Sanctis et al., 2013). *Boswellia socotrana* is an important endemic and endangered tree species of Socotra Island. Although the endemic taxa of *Boswellia* are so significant and much attention has been paid to their study, there are still taxonomic uncertainties concerning some of them (Miller & Morris, 2004).

The name *Boswellia socotrana* was published by I. B. Balfour (1882: 505) based on the collections “B.C.S. No. 466” (*Balfour, Cockburn & Scott 466*) and “Schweinf. No. 530” (*Schweinfurth 530*). Balfour simultaneously published the name *Odina aspleniifolia* Balf. f. for a taxon considered to be in the neighboring family Anacardiaceae (Balfour, 1882: 508), based on herbarium specimen “B. C. S. No. 710.” Updated descriptions of both taxa were later published (Balfour, 1888). Due to insufficient study material, some characters in the protologue of *O. aspleniifolia* were stated inaccurately (Balfour, 1888), explaining why the collection was placed in *Odina* Roxb.

Kuntze (1891) synonymized *Odina*, *Lannea* A. Rich., *Calesiam* Adans., and “*Haberlia* Dennst.” (the last being a nomen nudum, not validly published). Believing that *Calesiam* was the generic name with priority, he created a new combination, *C. aspleniifolium* (Balf. f.) Kuntze. Engler (1898: 449) believed that neither *Calesiam* nor “*Haberlia*” were validly published (see Adanson, 1763), and because *Lannea* (published in 1831) had priority over *Odina* (published in 1832), he published the new combination *L. aspleniifolia* (Balf. f.) Engl. The combinations in *Calesiam* and *Lannea* have usually been attributed respectively to Kuntze and Engler alone, but this was erroneous, as both publications directly referred to Balfour. Finally, Kokwaro and Gillett (1980), while studying type material of *O. aspleniifolia*, arrived at the conclusion that this species had pentamerous flowers (not tetramerous as Balfour stated) and therefore could not be a species of *Lannea*, which is tetramerous. Kokwaro and Gillett (1980) concluded that *O. aspleniifolia* was a synonym of *Boswellia socotrana*.

Miller and Morris (2004) regarded *Odina aspleniifolia* as a synonym of *Lannea transulta* (Balf. f.) Radcl. Sm. (syn. *Elaeocarpus transultus* Balf. f.). *Lannea transulta* was described by Balfour (1882) based on the syntypes *Balfour et al. 267* and *409* (K-000423332 and K-000423333). However, after checking the type specimens, we must say that *Balfour et al. 710* is not the same species as *Balfour et al. 267* and *409*, and even the study of Radcliffe-Smith (1971) did not succeed in finding a justification for this claim.

Our research was motivated by the following statements of some authors: Kokwaro and Gillett (1980) stated that leaf characters of the type collection of *Odina aspleniifolia* were not completely identical to those of the type collection of *Boswellia socotrana*. Brown and Mies (2012) mentioned that the form of *B. socotrana* growing in the broad Qalansiyah wadi is different from that found in low-elevation woodlands, and Thulin and Al Gifri (1998) stated that plants from the western part of the island have glabrous leaves and more-lobed leaflets than eastern populations.

The results of our study are based on the comparison of the protologues of *Boswellia socotrana* and *Odina aspleniifolia* with morphological characters of the type material in the K and W herbaria and morphological data collected in 2012–2018 from all the known populations of *B. socotrana*, as now defined, in the field (50 samples, equally divided between *B. socotrana* s. str. and the taxon first named as *O. aspleniifolia*). We conclude that *B. socotrana* and *O. aspleniifolia* are distinct enough to be separated at the rank of subspecies and are not synonyms. Therefore, we publish the new combination *B. socotrana* subsp. *aspleniifolia* (Balf. f.) Lvončík. The diagnostic morphological characters of the two subspecies are presented in Table 1.

Distributions were acquired from herbaria and collected in the field on the island of Socotra by the first author and presented in Figure 1. Literary data were excluded due to their ambiguity.

TAXONOMIC TREATMENT

1. *Boswellia socotrana* Balf. f., Proc. Roy. Soc. Edinburgh 11: 505. 1882. TYPE: Yemen. Socotra: s. loc., Balfour, Cockburn & Scott 466 (lectotype, designated by Kokwaro & Gillett [1980: 759], K-000743721!; isotypes, E-00239350!, E-00239354!).

Tree 3–9 m tall; crown narrow, branches straight, infrequently branched; as a result of pruning often thickened, umbrella-shaped, branches crooked. Bark on trunk and branches smooth, mostly gray except brown on new shoots, young branches with nodes and corky strips, flaking in irregular patches when old; leaf scars crowded on brachyblasts. Leaves on annual shoots arranged in a sparse spiral and crowded at the tips, on older branches crowded on distinctive brachyblasts; imparipinnate, (27–)28–100(–120) × 7–20(–25) mm, 3 to 6× as long as wide, oblong; petiole and rachis conspicuously winged. Leaflets (7 to)10 to 25(to 27), opposite at base, to opposite to alternate near apex, green or gray-waxy with whitish veins, coriaceous, glabrous or finely puberulent on the adaxial surface and especially on upper side of petiole, with thin short

hairs < 0.3 mm; all or main veins clearly visible or prominent, greenish or whitish. Lateral leaflets sessile or with short petiolules to 0.5 mm, elliptic, obovate, broadly ovate, rhombic, or trullate (rhomboid-ovate), 3–10(–12) × (2–)3–7(–8) mm; apex rounded or acute; margin entire or with 1 to 4 blunt serrations or teeth, sometimes revolute or involute. Terminal leaflet obovate or orbiculate, sometimes irregularly shaped, (2–)3.5–13.5(–18) × 2–9(–10) mm, smaller to larger than largest lateral leaflets; apex rounded, sometimes 2-lobed, or acute; margin entire or lacinate with 1 to 4 blunt teeth. Inflorescences (3 to)4 to 11(to 12) panicles clustered at tips of brachyblasts or rarely also at tips of annual shoots; panicles (8–)10–34(–40) mm, with 3 to 8(to 11) flowers; peduncles (4–)5–25(–28) mm; pedicels 3–7(–8) mm, longer or shorter than flowers; flower buds round, oblong shortly before opening, up to 1 cm diam.; bracts at base of pedicel inconspicuous, up to 1 mm, green with brown apex or reddish brown, deciduous. Flowers with receptacle 3–4 mm wide, green; sepals 5, green, broadly triangular, 1/5 of length of petals; petals ovoid, 2–4(–5) × 1.5–3 mm, white; stamens 10, filaments distinctively widened (flattened) in lower 2/3; style greenish white, 2 mm, stigma capitate, bright green; annular disk greenish, distinctly convex. Fruit a capsule, ovoid, (5–)6–9 × 4–8(–9) mm, with persistent stigma, with 3(to 4) single-pyrene locules; unripe fruits green or red, ripe fruits deciduous, brown and dry, sometimes waxy on surface, valves dehiscent along their whole length.

Notes. Published data on the ecology and distribution of *Boswellia socotrana* remain fairly scarce. Interpretation is complicated also by different concepts and classifications of plant communities on Socotra (Miller, 2004; Brown & Mies, 2012; De Sanctis et al., 2013; Habrová & Buček, 2014). Brown and Mies (2012) mentioned that *B. socotrana* grows in coastal plain vegetation and that the form growing there is somewhat different from that found in low-elevation woodlands. De Sanctis et al. (2013) stated *B. socotrana* occurs in arid coastal plains, mainly on alluvial soils in inner non-saline areas at 0–200 m, in *Croton socotranus* Balf. f. shrublands, *Pulicaria stephanocarpa* Balf. f. dwarf shrublands, and *Aristida adscensionis* L., *Tephrosia apollinea* (Delile) Hosni & El Karemy, and *Dactyloctenium robecchii* Chiov. grasslands. Miller (2004) mentioned that *B. socotrana* is widely distributed in dry, semi-deciduous woodlands and is less common in *C. socotranus* shrublands at 50–600 m.s.m. *Boswellia socotrana* is also mentioned as part of the vegetation of wadis at lower and middle altitudes, vegetation of low-altitude rocky slopes, and vegetation of middle-elevation plateaus and gentle slopes (Brown & Mies, 2012; De Sanctis et al., 2013). Its occurrence in

Table 1. Comparison of *Boswellia socotrana* Balf. f. subspecies based on morphological characters of herbarium and fresh material.

	<i>B. socotrana</i> Balf. f. subsp. <i>socotrana</i>	<i>B. socotrana</i> subsp. <i>aspleniifolia</i> (Engl.) Lvončík
Leaf size	(38–)45–100(–120) × (8–)10–20(–25) mm	(27–)28–70(–80) × 7–16.8(–20) mm
Leaf color	green	gray-waxy, whitish veins
Indument of adaxial leaf surface	thin short hairs < 0.3 mm, especially on petiole	glabrous, very rarely with sparse short hairs < 0.2 mm on petiole
Number of leaflets per leaf	(9 to)15 to 25(to 27)	(7 to)10 to 17(to 21)
Size of lateral leaflets	(4–)5–10(–12) × (3–)4–7(–8) mm	3–8(–10) × (2–)3–5 mm
Shape of lateral leaflets	obovate, broadly ovate, or elliptic; apex rounded	rhombic or rhombic-ovate (trullate), ovate, or broadly elliptic; apex acute
Lateral leaflet margins	entire or rarely with 1 to 3 blunt serrations or teeth; sometimes revolute	entire or with 1 to 4 serrations, teeth, or lobes; often involute
Size of terminal leaflet	6–13.5(–18) × 4–9(–10) mm, larger than or as large as the largest lateral leaflet	(2–)3.5–7(–8) × 2–5(–6) mm, smaller than or as large as the largest lateral leaflet
Shape of terminal leaflet	often irregular; apex rounded or 2-lobed	symmetric; apex rounded or acute
Leaflet venation	only main vein clearly prominent	primary and secondary veins raised, whitish
Inflorescence length	(9–)10–34(–40) mm	(8–)12–27(–30) mm
Peduncle length	10–25(–28) mm	(4–)5–11(–15) mm
Petal size	3–4(–5) × 2–3 mm	2–3 × 1.5–2 mm
Bracts at base of pedicel	green with brown apex, up to 1 mm	reddish brown, < 0.5 mm
Capsule size	(6–)7–9 × (4–)7–8(–9) mm	(5–)6–8 × 4–6(–7) mm
Fruit color	green when unripe, brown when ripe	green or red when unripe, brown and waxy when ripe

similarly defined communities has been described also by Habrová and Buček (2014). Kürschner et al. (2006) established *B. socotrana* as a diagnostic species for the *Boswellietum socotranae* plant sub-association of the *Adenio socotranum–Sterculietum socotranae* association. This subassociation occurs at altitudes of (50–)150–400 m. In the light of our research on *B. socotrana* subspecies distribution (depicted in Fig. 1), we can presume that some of these authors were observing only one of the subspecies but others both of them, then presumed to represent a single taxon.

The populations of *Boswellia* on the island of Socotra are limited geographically and in size (Lvončík et al., 2013) and are therefore very vulnerable. According to the IUCN categorization (Miller, 2004), *B. socotrana* is listed in the category Vulnerable D2 on the grounds of being a rare species with a very limited distribution area; several populations show no sign of regeneration, suggesting a decline in habitat quality. On the other hand, Attorre et al. (2011) state that *B. socotrana* shows a medium rate of regeneration. Dissimilar claims made by authors can be explained by different methods and area of field data collection.

KEY TO SUBSPECIES OF *BOSWELLIA SOCOTRANA*

1. Leaves green, 45–100 × 10–20 mm; leaflets 15 to 25; lateral leaflets obovate to broadly ovate or elliptic, 5–10 × 4–7 mm, apex rounded, margin sometimes revolute, only main veins visible, greenish, adaxial surface and petiole short-pubescent; terminal leaflet larger than or as large as the largest lateral, often irregular in shape, apex rounded or 2-lobed; peduncles 10–25 mm; bracts green with brown apex; capsule not waxy when ripe *Boswellia socotrana* Balf. f. subsp. *socotrana*
- 1'. Leaves gray-waxy, 28–70 × 7–17 mm; leaflets 10 to 17; lateral leaflets rhombic to trullate (rhomboid-ovate), ovate, or broadly elliptic, 3–8 × 3–5 mm, apex acute, margin often involute, with whitish prominent venation, glabrous (rarely sparse short hairs on petiole); terminal leaflet smaller than or as large as the largest lateral, symmetric, apex rounded or acute; peduncles 5–11 mm; bracts reddish brown; capsule waxy when ripe *Boswellia socotrana* subsp. *aspleniifolia* (Engl.) Lvončík

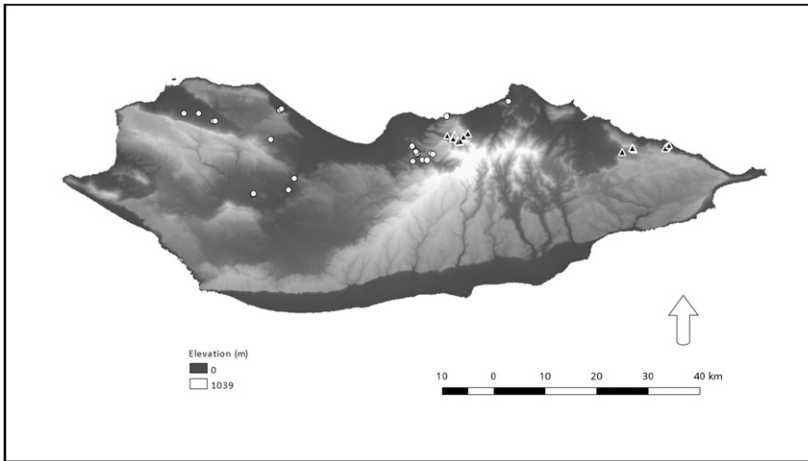


Figure 1. Distribution map of *Boswellia socotrana* Balf. f.: subsp. *socotrana* (triangles) and subspecies *aspleniifolia* (Engl.) Lvončík (circles).

1a. *Boswellia socotrana* Balf. f. subsp. *socotrana*.

Leaves on annual shoots (38–)45–100(–120) × (8–)10–20(–25) mm. Leaflets (9 to)15 to 25(to 27), at base always opposite, sometimes scattered or alternate toward apex, green, on adaxial surface pubescent, especially on petiole, with hairs < 0.3 mm. Lateral leaflets obovate to broadly ovate or elliptic, gradually smaller toward leaf apex; middle leaflets (4–)5–10(–12) × (3–)4–7(–8) mm; apex rounded, margins mostly entire, rarely with 1 to 3 blunt serrations or teeth, sometimes revolute. Terminal leaflet 6–13.5(–18) × 4–9(–10) mm, often irregular in shape, larger than or as large as the largest lateral leaflet; apex rounded or 2-lobed; only main vein clearly visible, greenish. Panicles 3- to 7(to 11)-flowered, (9–)10–34(–40) mm; peduncle 10–25(–28) mm; pedicels 4–7(–8) mm; bracts green with brown apex, to 1 mm. Petals 3–4(–5) × 2–3 mm. Fruits (6–)7–9 × (4–)7–8(–9) mm, green when unripe, brown when ripe, surface not waxy.

Notes. Balfour's (1882) original protologue contains some mistakes and inaccuracies. He was wrong in recording the length of the inflorescence as shorter than 12.7 mm; the flower pedicel is not always shorter than the flower but can be longer; the capsules are not only trilateral, but sometimes also quadrilateral; and the inflorescences are not axillary but rather terminal and pseudoterminal.

Distribution and ecology. The distribution of subspecies *socotrana* is depicted in Figure 1. The occurrence of the typical subspecies was recorded only on steep rocky slopes at altitudes of 150–550 m in the northeastern part of the island, in the upper part of Aiheft Valley, in the Mugadrihon Saddle, and on the

northern slopes of Reyged Hill. It also grows on the southern and southeastern slopes of the Hamadero Massif and the northern slopes of the Pequadion Massif, especially near Hog Cave (site names by Miller & Morris, 2004). We estimate that there are only hundreds of individuals of subspecies *socotrana* in two populations.

In the course of our field research from 2012 to 2018, successful regeneration of *Boswellia socotrana* subsp. *socotrana* was found only in the upper part of the Aiheft Valley, in the Mugadrihon Pass, and on the northern slopes of Reyged Hill; those populations seem to be quite stable for now. In the other populations we repeatedly found only annual seedlings that did not survive the intense pressure of herbivores during droughts. We also recorded quite a sharp drop in the number of mature individuals. This raises concern that this subspecies may be more threatened than the prior assessment of the species' conservation status would indicate.

Selected specimens examined. YEMEN. **Socotra:** s. loc., 1880, *Balfour et al. s.n.* (E); Wadi Dilal, 1881, *Balfour et al. 530* (W); Wadi Ayheft, 2002, *Kilian et al. YP2588* (W); Mt. Hamadero, S slope, 2000, *Koblížek 130901* (BRNL); Mt. Hamadero, 2001, *Koblížek 211100* (BRNL); Mt. Hamadero, S slope, 2000, *Koblížek s.n.* (BRNL); Hog Cave, 2016, *Lvončík s.n.* (BRNL); s. loc., *Miller 11240* (E); s. loc., *Miller 12653* (E); Magadrihon Pass, 1996, *Miller 14129* (E); s. loc., 1898, *Ogilvie, Grant & Forbes 139* (E).

1b. *Boswellia socotrana* subsp. *aspleniifolia* (Engl.)

Lvončík, comb. et stat. nov. Basionym: *Odina aspleniifolia* Balf. f., as "*asplenifolia*," Proc. Roy. Soc. Edinburgh 11: 508. 1882. *Calesium aspleniifolium* Kuntze, as "*asplenifolium*," Revis. Gen. Pl. 1: 151. 1891. *Lannea aspleniifolia* (Balf. f.) Engl., Bot. Jahrb. Syst. 24: 499. 1898. TYPE:



Figure 2. Overall habit of *Boswellia socotrana* Balf. f. subsp. *socotrana*. —A. Unpruned tree with straight branches and thin crown. —B. Pruned tree with crooked and thickened branches. Photos: A by P. Maděra; B by S. Lvončik.

Yemen. Socotra: s. loc., *Balfour, Cockburn & Scott 710* (lectotype, designated here, K-000199635!; isolectotype, E-00436149!).

Leaves on annual shoots (27–)28–70(–80) × 7–17(–20) mm. Leaflets (7 to)10 to 17(to 21), opposite, gradually alternate toward apex, gray-waxy, on adaxial surface glabrous, rarely finely puberulent at petiole (< 1 trichome per mm²) with trichomes up to 0.2 mm. Lateral leaflets rhomboid-ovate (trullate) to broadly elliptic, smaller toward leaf apex, middle leaflets 3–8(–10) × (2–)3–5 mm; apex acute; margin with 1 to 4 serrations or teeth often involute. Terminal leaflet (2–)3.5–7(–8) × 2–5(–6) mm, smaller than or as large as larger lateral leaflets; apex rounded or acute; veins conspicuous, prominent, whitish, main and lateral veins clearly visible especially on upper side. Panicles 3- to 7(to 8)-flowered, (8–)12–27(–30) mm; peduncle (4–)5–11(–15) mm; pedicels 4–7(–8) mm; bracts reddish brown, up to 0.5 mm. Petals 2–3 × 1.5–2 mm. Fruits (5–)6–8 × 4–6(–7) mm, green or red when unripe, brown when ripe, surface waxy.

Distribution and ecology. The distribution of *Boswellia socotrana* subsp. *aspleniifolia* is restricted to the western part of Socotra, except for one individual

growing on the southern sandy slope of Hawari Hill. The distribution of subspecies *aspleniifolia* is depicted in Figure 1. Subspecies *aspleniifolia* grows on plains or gentle slopes at 20–250 m.s.m., which makes it ecologically very different from subspecies *socotrana*.

During our field observations from 2012 to 2018, successful regeneration was not observed. We repeatedly found only annual seedlings that did not survive the dry season. We recorded a sharp drop in the number of individuals during our repeated visits. Thulin and Al Gifri (1998) mentioned 640 individuals for the most numerous populations of *Boswellia socotrana* subsp. *aspleniifolia* (Qalansiyah wadi), while Mies et al. (2000) stated 620 adult individuals at the same locality. The total number of adult individuals of *B. socotrana* subsp. *aspleniifolia* in the whole area can be estimated at 1000 to 1500.

Notes. The populations of *Boswellia socotrana* subsp. *aspleniifolia* are consistent in their diagnostic characters (waxy leaves and capsules, and prominent leaf venation). Table 1 highlights diagnostic characters for the two subspecies of *B. socotrana*. These diagnostic characters are consistent even for material cultivated artificially under identical conditions. All the material assigned to subspecies *aspleniifolia* has a glabrous

adaxial leaflet surface, with one exception (*Maděra* 29/2014, BRNL), while all specimens of subspecies *socotrana* have a pubescent abaxial leaflet surface and petiole. Some specimens of *B. socotrana* in K appear to have been treated with a coating that has covered the trichomes on most leaves so that they look glabrous at first sight (*Balfour et al.* 466, K-000743721). Conversely, the leaflet surfaces of the lectotype of *Odina aspleniifolia* have structures resembling branched trichomes. However, neither the leaves of this specimen stored in an envelope nor the leaves of other specimens have these characters; we conclude that they are most likely crystals of a substance of unknown origin, perhaps used to disinfect the herbarium specimen.

Balfour's (1888) claim that young branches of subspecies *aspleniifolia* are strigillose was probably the result of erroneous interpretation of their waxy surface. Balfour (1888) also recorded the flowers of subspecies *aspleniifolia* (syn. *Odina aspleniifolia*) as tetramerous, but they are, in fact, pentamerous, as Kokwaro and Gillett (1980) mentioned. The branches are never thorny; in fact, they possess brachyblasts.

The leaves of both subspecies vary little in their size and shape, much less than in other Socotran *Boswellia* species. We did not find any simple leaves on adult plants of either taxon (unlike *B. elongata*, *B. nana*, and *B. popoviana*, in which both simple and compound leaves are common). Miller and Morris (2004) found a few individuals showing characters intermediate between *B. nana* and *B. socotrana* (Miller & Alexander 17045); whether this is due to variation or to hybridization can be ascertained only through genetic/molecular study.

The habit of adult plants of the two taxa does not differ, as all the trees on the island are frequently pruned to make fodder for goats, with the exception of Ayheft Valley and neighboring Mugadrihoh Pass, where subspecies *socotrana* forms trees with a sparse crown and long, straight, infrequently branched branches, reaching a height of 3–6 m, which may be the result of the lack of pruning and/or the influence of microclimatic factors. Since we have not found a single unpruned adult plant of subspecies *aspleniifolia* on the island of Socotra, the natural habit of this taxon remains unknown (Fig. 2A, B).

The type collection of *Odina aspleniifolia* is *Balfour et al.* 710. There are known duplicates at K (K-000199635) and E (E-00436149). The K duplicate is an intact specimen with several fragments and many leaves. The E duplicate consists of a leafless twig and a small fragment packet, which contains crushed samples of leaflets belonging to at least four taxa. It is not at all clear what parts of the plant belong to each species; in sum, it is inadequate for identification. Balfour did not indicate a single duplicate to be the type, so they are

syntypes and one should be selected as lectotype. In an appendix regarding species misplaced in *Lansea*, Kokwaro and Gillett (1980) mentioned *Balfour* 710 as the type and referred (Kokwaro & Gillett, 1980: 759) to a “packet on the isotype at Kew.” This cannot be interpreted as a formal designation of the inferior duplicate at E as lectotype, since the E duplicate was actually not mentioned at all. We therefore herein select the K duplicate as lectotype.

Selected material examined. YEMEN. **Socotra:** Quare, 2016, *Ehrenbergerová E1* (BRNL); Qalansiyah plain, 2016, *Ehrenbergerová E2* (BRNL); Qalansiyah plain, 2016, *Ehrenbergerová E3* (BRNL); Qalansiyah plain, *Croton socotranus* shrubland, 2016, *Ehrenbergerová E4* (BRNL); Qalansiyah plain, 2000, *Koblížek 071100* (BRNL); rd. to Dixam, 2016, *Koblížek 161100* (BRNL); Qalansiyah plain, 2000, *Koblížek 271000* (BRNL); Hawari, 2014, *Maděra 29/2014* (BRNL); Wadi Trubah, 1990, *Miller et al. 10325* (E); Zahr Basin, 1996, *Miller & Alexander 14044* (E); Qalansiyah plain, 1996, *Miller & Alexander 14242* (E); Wadi Trubah 1996, *Miller & Alexander 14294d* (E).

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