Cola dorrii sp. nov. (Sterculiaceae), a threatened Maputaland Forest endemic of South Africa

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Summary. *Cola dorrii* Cheek sp. nov. is described from Maputaland Sand and Northern Coastal Forest types in KwaZulu-Natal of South Africa. Formerly treated as *Cola greenwayi* Brenan, it differs in much shorter leaf-blades and petioles, and in the fruitlets which are stipitate, with apices that are rounded and forward-facing. The indumentum has stellate hairs which are soft, with sinuate arms, rather than subscabrid with stiff arms. The species is assessed as Vulnerable using the IUCN 2012 standard due to habitat modification and loss due to humans, elephants and due to the invasive shrub *Chromolaena odorata*.

Key Words. Conservation, dioecy, elephants, monograph, sand forest.

Introduction

Cola Schott. & Endl. was included in tribe Sterculieae of Sterculiaceae *sensu lato* of the core Malvales for most of the twentieth century. Phylogenetic investigation of Malvales showed that in place of the traditional four families recognised (Malvaceae, Bombacaceae, Sterculiaceae, Tiliaceae) there is a choice of either recognising nine subfamilies in a super-Malvaceae (Bayer *et al.* 1999; Bayer & Kubitzki 2003) or recognising the same units as the families, Bombacaceae, Brownlowiaceae, Byttneriaceae, Dombeyaceae, Durionaceae, Helicteraceae, Malvaceae *sensu stricto*, Sparrmanniaceae, Sterculiaceae, and Tiliaceae (Baum *et al.* 1998; Cheek & Dorr 2007; Cheek 2007a – j). *Cola* can therefore now be placed either in Malvaceae-Sterculoideae or Sterculiaceae s.s. The second approach is preferred since it is less cumbersome and creates less taxonomic instability (Cheek & Dorr 2007).

The Sterculiaceae *sensu stricto* are characterised within Malvales by unisexual flowers with a single perianth whorl which lack an epicalyx. The male flowers have an androgynophore bearing the anthers in a terminal capitulum or ring, the gynoecium vestigial and inconspicuous. Female flowers usually have a sessile or subsessile gynoecium developing into an apocarpous fruit of (1 –) 4 – 5 (– 15) fruitlets or mericarps, the base surrounded by indehiscent anthers. The family is pantropical, with c. 415 species arranged in 13 genera (Cheek 2007j).

Pterygota Schott & Endl., a pantropical genus, with dehiscent, woody mericarps containing dry, winged

seeds, is in a sister relationship with *Cola*, while *Octolobus* Welw., confined to tropical Africa, with numerous spirally inserted indehiscent mericarps, is sister to *Pterygota-Cola* combined (Wilkie *et al.* 2006). The remaining genera of the *Cola* clade, *Hildegardia* Schott & Endl., *Firmiana* Marsili, *Pterocymbium* R. Br. and *Scaphium* Schott & Endl. all have winged fruitlets and are wind-dispersed, and all but the first are confined to SE Asia and adjoining areas. In comparison, the pantropical genus *Sterculia* L., sometimes confused with *Cola*, is in an entirely different subclade, and always has dehiscent fruit with the seeds with radicle directed away from the hilum and hard-coated, borne on a placenta with irritant hairs.

The genus *Cola* with 100 – 125 species of trees and shrubs, the most species-diverse genus in the Sterculiaceae, is characterised by indehiscent (rarely at length dehiscent) mericarps containing seeds with a soft, fleshy seedcoat, the radicle directed towards the hilum. The endocarp is glabrous. *Cola* is mostly confined to evergreen lowland and submontane forest in continental subsaharan Africa, with only two species in deciduous forest or woodland. While some of the species are widespread, many are extremely local, and some are known from few or single forest patches and so are vulnerable to extinction. Eight species of *Cola* in Cameroon alone have been assessed as threatened (Onana & Cheek 2011). *Cola nitida* (Vent.) Schott. & Endl. and *C. acuminata* (P. Beauv.) Schott. & Endl. are planted throughout the tropics for their seeds which act as stimulants

when chewed and are an ingredient of the eponymous and ubiquitous ‘Cola’ soft drinks. Two other species also have stimulant seeds, but are only locally cultivated (Cheek 2002a; Cheek & Dorr 2007).

Most species of *Cola* occur in Tropical Africa, with only two species, *C. natalensis* Oliv. and *C. greenwayi* Brenan in South Africa (Verdoorn 1981). In East Africa (Uganda, Kenya and Tanzania), 21 species are native (Cheek & Dorr 2007). However, West and Central Africa are the heartland of *Cola*. The largest number for any flora region is that in the *Flora of West Tropical Africa* (FWTA), with 42 species, and with an additional nine imperfectly-known species (Keay & Brenan 1958). Thirty-three species are recorded from Gabon (Hallé 1961) and 32 from Congo-Kinshasa (Germain 1963). The *Flore du Cameroun* account awaits completion. The genus was last monographed by Schumann (1900) when 33 species were recognised. Although Brenan did much research on the genus throughout its range, he confined himself, largely, to publishing accounts of new species (e.g. Brenan & Keay 1955). This paper renews an attempt to monograph the genus afresh that began 16 years ago (Cheek 2002a, b).

Cola natalensis Oliv. (Oliver 1882) was one of the first described species of the genus, and was until the 1970s the only *Cola* known from South Africa. It occurs from the eastern Cape to southern Zululand (Palmer & Pitman 1972). Palmer & Pitman (1972) seem to be the first to mention a second species of South African *Cola* which they identified as *C. microcarpa* Brenan. The earliest herbarium record of this second species so far known dates from 1934 (Forester 52, K, PRE). Palmer & Pitman (1972) state that this species is fairly common in the short sand forests of Zululand and in the high forest around Lake Sibayi. They give an extensive description and illustrations. In South Africa the species is easily distinguished from *C. natalensis* even when sterile because the pulvini below the leaf-blades are densely and persistently shortly hairy (not rapidly glabrescent). Locally it is known as the “Hairy Cola” (Moll 1981; Boon 2010).

Drummond in his checklist of Rhodesian woody plants (1975) lists *Cola microcarpa* as a synonym of *C. greenwayi* Brenan without comment. This is surprising since Wild (1961) in the *Flora Zambesiaca* account does not mention *C. microcarpa* from that region and it may be that Drummond was referring to *C. mossambicensis* Wild, material of which was once referred to as *C. microcarpa*, to which it is similar. Coates Palgrave (1977: 598) in *Trees of Southern Africa* and Verdoorn in her paper ‘The genus *Cola* in southern Africa’ (1981) and later authors, follow and support Drummond’s synonymy. However in this paper we intend to show that *C. microcarpa* sensu Palmer & Pitman (*Cola greenwayi* sensu Verdoorn pro parte) is a similar but distinct

and unnamed species as stated in Cheek & Dorr (2007: 41), which is described below as *Cola dorrri* Cheek.

Materials and Methods

Names of species and authors follow IPNI (continuously updated). Herbarium material was examined with a Leica Wild M8 dissecting binocular microscope fitted with an eyepiece graticule measuring in units of 0.025 mm at maximum magnification. The drawing was made with the same equipment with a Leica 308700 camera lucida attachment. Specimens were inspected from the following herbaria: BM, BNRH, FHO, K, NU. The format of the description follows those in other papers describing new species in *Cola*, e.g. Cheek *et al.* (2002a, b).

All specimens seen are indicated “!” Information on duplicates cited at PRE but not seen derive from the BRAHMS data <http://newposa.sanbi.org/sanbi/Explore>. These specimens are included since they occur within the range of *Cola dorrri* based on specimens seen, and because the only other species of *Cola* in Natal, *C. natalensis*, does not overlap in its range with *C. dorrri*. Points were georeferenced using locality information from herbarium specimens. The map was made using ArcMap version 10.5, with additional layers showing protected areas (UNEP-WCMC 2017) and lakes (ESRI 1992).

The conservation assessment follows the IUCN (2012) standard. Herbarium codes follow Index Herbariorum (Thiers continuously updated).

Zulu names are standardised according to the current method, which capitalises the first letter.

Results

Whilst in South Africa only two species of *Cola* have been recorded (Verdoorn 1981), in the *Flora of Tropical East Africa* (FTEA) region of Uganda, Kenya and Tanzania, 21 species are found (Cheek & Dorr 2007). Underpinning that Flora account was Brenan’s (1956) account of *Cola* in Kenya, Uganda and Tanzania, in which both *C. greenwayi* and *C. microcarpa* were described for the first time, together with several other new species. The reassessment of East African *Cola* species for the FTEA account was based on many more specimens than those available to Brenan (1956). However *C. greenwayi* and *C. microcarpa* were maintained as they had previously been defined by Brenan (Cheek & Dorr 2007), and both are separated from *C. dorrri* by numerous characters. The features that separate these three species are set out in Table 1 below.

Vegetatively the “hairy cola” of Kwazulu-Natal is indeed strikingly similar to both *Cola microcarpa* and *C. greenwayi*. But since sterile specimens of *Cola* species

Table 1. Characters distinguishing *Cola microcarpa*, *Cola greenwayi* var. *greenwayi* (data from Cheek & Dorr 2007) and *Cola dorrii*.

	<i>Cola microcarpa</i>	<i>Cola greenwayi</i> var. <i>greenwayi</i>	<i>Cola dorrii</i>
Ecology & geography	riverine forest; 100–700 m alt. SE Tanzania (FTEA regions T6–8)	submontane forest; 1100–1850 m alt. Tanzania, Mozambique, Malawi	low altitude sand forest and coastal forest; 10–70 m alt. KwaZulu Natal
Indumentum of distalmost internode	softly hairy, pale brown	subscabrid, hairs rusty-red	softly hairy, pale brown
Leafblade length (on a single flowering stem, cm)	2–15 (–17.5)	3–16 (–18)	(1.2–) 3.5–8.5 (–10.4)
Petiole length range (on a single flowering stem, cm)	0.1–6.7	0.3–4 (–5.6)	0.2–2 (–3.7)
Stipule	ligulate, c. 6 mm long, puberulous	narrowly triangular 3–6 mm long, with brown scurfy hairs	filiform 3–4 × 0.6 mm, glabrous
Male inflorescences			
Number perianth lobes (male flowers)	fascicles	fascicles	single flowers per axil
Anther No. (male flowers)	5 (–7)	5 (–6)	(5–) 6
Stigmas of female flowers	5–6	4–6	8
Style position in mature fruitlet	(3–) 4	(3–) 4 (–5)	5
Fruitlet base	obscure	lateral	apical
Fruitlet apex	rounded to obtuse	obtuse to acute	shortly stipitate
	rounded	apiculus ± 1 mm long	rounded

are often impossible to identify to species even by the specialist (Cheek & Dorr 2007) this is not unusual. However the leaf-blades of the “hairy cola” have a smaller median length than those of *C. greenwayi* (Table 1), and the thickened blade margin is revolute, not flat at the base of the blade. While the young leaves and stem apex of *C. greenwayi* have dense, rusty-red, stiff, subscabrid stellate hairs, those of the ‘hairy Cola’ are sparse, pale brown-pink or translucent and have longer sinuous arms, giving a shaggy appearance. The stipules are dissimilar (Table 1) but since they are caducous, they are or can be, difficult to find.

In flower the ‘hairy Cola’ produces but a single flower per axil and each male stem has usually 5–6 (–10) flowers of which 1–2 are at anthesis at any one moment, while in *C. greenwayi* the male flowers are produced in fascicles and each stem can have many tens to more than 100 flowers.

The tepal indumentum of *Cola greenwayi* is also characterised by the stiff, rusty-red stellate hairs seen at the stem apex, separating it from the pale brown-pink, soft, sinuate hairs of *C. dorrii*.

While the anther heads of *Cola greenwayi* have 4–6 anthers, those of *C. dorrii* have 8. The fruitlets of the two species differ very greatly. Those of *C. dorrii* have a neck or stipe at the base (Fig. 1C; Palmer & Pitman 1972, as *C. microcarpa*) and the apex, the stylar area, is rounded, with the styles apical since the fruitlets are erect. In *C. greenwayi*, as depicted in Wild (1961: tab. 105–5) there is no basal neck (or stipe) and the stylar area is both beaked (rostrate) and lateral.

***Cola dorrii* Cheek sp. nov.** Type: South Africa, “Natal, Ingwavuma distr., near Sihangwane Store, in *Newtonia-Cleistanthus* forest on pallid sands”, fr., 25 Jan. 1964, Tinley 883 (holotype K!; isotype NU).

<http://www.ipni.org/urn:lsid:ipni.org:names:60476373-2>

Cola microcarpa non Brenan, sensu Palmer & Pitman (1972)

Cola greenwayi var. *greenwayi* non Brenan, sensu Verdoorn (1981); Moll (1981); Boon (2010), van Wyk & van Wyk (2013).

Dioecious, evergreen, small tree 3.5–8 (–18) m tall, up to 20 cm diam. at 1.5 m from ground; bark light-brown, flaking (Palmer & Pitman 1972); *Terminalia*-branching; bud-scales c. 10–12, lanceolate, 3–3.5 × 1 mm, grey, densely and minutely puberulent. Indumentum dimorphic, stellate, c. 90% of hairs white, persistent, 0.025–0.03 mm diam., 7–8-armed, arms appressed; c. 10% of hairs pale brown, caducous, 0.75–1.25 mm diam., 6–9-armed arms erect, sinuate, indumentum covering current season’s growth (larger, pale brown hairs falling first) previous season’s stems glabrous,

Fig. 1. *Cola dorrii*. A habit, stem with female flowers; B hairs from young leaf surface from A; C habit, stem with fruits; D hairs from surface of fruit; E male flower; F hairs from pedicels of male and female flowers; G dimorphic hairs from exterior sepal surface; H anther-head, plan view, note vestigial gynoeceum; J stellate hair from androgynophore base; K female flower, one tepal removed; L external sepal surface female flowers: dimorphic hairs; M stigmas, side view; N stigmatic lobe, transverse section. A & B, E, J – M from Moll 4388; C from Tinley 883; D, F – H from Pooley 867. DRAWN BY ANDREW BROWN.

epidermis white, often with deep longitudinal ridges. Leafy stems terete 1.5 – 2 (– 3) mm diam., with (2 –) 6 (– 8) alternate, spirally arranged leaves (at anthesis) inserted over the distal 1 – 2 cm of stem in a rosette, the distalmost leaves subsessile, with the smallest blades, the most proximal leaves with the longest blades and longest petioles. *Leafblades* glossy, dark green, oblanceolate (the smallest elliptic) (1.2 –) 3.5 – 8.5 (– 10.4) × (0.7 –) 1.2 – 3.6 (– 4.3) cm, apex shortly acuminate, acumen as broad as long, c. 0.5 cm long, base cuneate, abruptly rounded or obtuse, secondary nerves (4 –) 5 – 9 (– 11) on each side of the midrib, arising at c. 60° from the midrib, arching gradually up towards the margin and apex, connecting with the secondary nerve above, forming a looping infra-marginal nerve 1.5 – 2 mm from the margin, domatia absent; tertiary and quaternary nerves inconspicuous; glabrescent, young leaves with dense, overlapping 7 – 9-armed stellate hairs 0.5 – 0.7 mm diam., the arms slender, sinuous. Stipules highly caducous, sub filiform, 3 – 4 × 0.6 mm, twisted, subglabrous. Petioles, terete, 2 – 20 mm long, 0.5 – 1 mm wide pulvinus 3 – 6 mm long, 1 mm wide, at apex of petiole, persistently densely pale brown hairy; indumentum as stem. Inflorescence buds globose, 1.75 – 2 mm diam., 1 (– 2) per axil at (usually) leafy nodes, flower single, enclosed in c. 6 variously-shaped bracts; proximal bract pair semi-circular, about 5× broader than long, c. 0.2 × 1 mm; middle bract pair concave, bifurcate, 2 – 3× broader than long, c. 0.5 × 1.5 mm, persistent post-anthesis and becoming flat, exposing the glabrous glossy mid brown adaxial surface; distal bract pair caducous, naviculate, about 3× longer than broad, constricted midlength, c. 1.75 – 3 × 0.8 – 1.5 mm, outer surface of bracts densely and minutely dull brown puberulent. *Inflorescences* 1-flowered, bracts caducous or nil, in axils of the previous season's leaves (borne immediately below the leaves, 1 – 4 per leafy stem; pedicels 1 – 1.5 mm long. Flowers pale green, divided into lobes for $\frac{5}{6}$ their radius. *Male flowers* 12 – 14 mm across, pedicels 10 – 15 × 0.1 mm, terete, c. 50% covered by 4 – 8-armed stellate hairs, arms 0.2 – 0.5 mm long, articulated 7 – 8 mm below the flower. *Tepals* 6 patent (to slightly campanulate); oblanceolate to lanceolate 5.5 × 2.2 mm; apex acute, abruptly rounded, base 1 – 1.5 mm wide, inner surface glabrous in proximal two-thirds, distal third with 30 – 50% cover of 3 – 5-armed stellate hairs 0.2 – 0.35 mm diam.; outer surface moderately densely stellate-hairy, hairs overlapping, dimorphic, smaller hairs 5 – 10-armed, 0.1 – 0.15 mm diam., larger hairs 6 – 8-armed, 0.25 – 0.35 mm diam. Androphore 2 × 0.5 mm, base densely stellate hairy, hairs c. 8-armed, 0.6 mm diam., otherwise glabrous. Staminal head c. 2 mm diam., 1 mm long, stamens c. 8; gynoecium vestigial, concealed within apex, styles 4. *Female flowers* 13 – 14 mm diam. with pedicels 10 – 12 mm long at anthesis,

indumentum as male. *Tepals* 6, patent to ascending, lanceolate, 7.5 – 8 × 2.5 – 3 mm, apex acute to subacuminate, base 1.8 – 2.2 mm wide, inner surface glabrous, outer surface 60% covered in a mixture of dimorphic stellate hairs (Fig. 1K): 1) 5 – 7-armed hairs 0.15 – 0.2 mm diam. 2) 6 – 9-armed hairs 0.4 – 0.7 mm diam. *Stamens* 5, alternating with carpels, each 1 mm long, indehiscent. *Gynoecium*: ovary 4 – 5-lobed, 1.75 × 3.2 mm, densely patent hairy, style c. 1 × 1 mm, densely patent hairy, hairs extending to the dorsal surfaces of the style-arms, hairs 0.2 mm long, patent. Style arms (4 –) 5, spreading, 3.5 – 4 mm diam., each blade-like laterally flattened 1.5 × 0.6 – 0.7 × 0.2 – 0.3 mm, the apex recurved, the ventral edge lacerate. *Fruit* pedicels accrescent 1.5 – 2.2 cm long, articulation 0.4 – 0.6 cm below the apex; perianth persistent; carpels (1 –) 4 (– 5), each globose 1 – 1.5 cm diam., apex rounded, base stipitate, stipe slender 2 – 3 mm long; orange, with a slight ventral groove, stigmas persistent, indumentum of scattered 5 – 9-armed stellate hairs, each 0.4 – 0.7 mm across. Fig. 1

RECOGNITION. Differing from *Cola greenwayi* in that leaf-blades (1.2 –) 3.5 – 8.5 (– 10.4) cm long on a single stem, petioles 0.2 – 2 (– 3.7) cm long, (not 3 – 16 (– 18) cm long and 0.3 – 4 (– 5.6) cm long respectively), flowers single per node (not in fascicles); fruitlet apex rounded, positioned apically, base stipitate (not rostrate, lateral and obtuse to acute).

DISTRIBUTION. South Africa: KwaZulu Natal (Map 1).

SPECIMENS EXAMINED. SOUTH AFRICA. KwaZulu-Natal, uMkhanyakude Distr. (specimens grouped according to the 1:50 000 quarter-degree mapping grid used in South Africa). **2632CC.** Tembe Elephant Park, Western Boundary in corridor area, 28 Oct. 1993, *P. van Wyk* BSA1312 (PRE); *ibid.*, Tembi, male fl., 17 Jan. 1999, *Schmidt* 2111 (BRNH! image); Ulukondo Ndumu Game Reserve, Ingwavuma Distr., male fl., 26 Oct. 1970, *Pooley* 867 (K!, NU); Ndumu Game Reserve, st., 21 Nov. 1967, *Strey & Moll* 3757 (K! PRE); Ndumu Game Reserve, Khondo Sand Forest, March 1968, *de Moor* 34 (PRE); *ibid.*, 17 Oct. 1968, *Garland* S301, 302, 303, 304, 305, 306 (all PRE); *ibid.*, Oct. 1968, *Garland* 47574 (PRE); *ibid.*, 19 Jan. 1968, *Garland* 47576 (PRE). **2632DC.** Manguzi, Mabibi-Bos, wes van Manguzi, 3 Oct. 1984, *D. J. Botha* 3485 (PRE). **2732AB.** 10 miles Pongola Bridge/Maputa, Ubombo, female fl., 8 Nov. 1969, *Moll* (4388 (K!, NH; PRE); Ingwavuma Distr., 1 mile E of Makane's Drift, female fl., 22 Nov 1967, *Moll & Strey* 3773 (K!, PRE); *ibid.*, 1 mile E of Pongola Pont, 23 Nov. 1967, *Strey & Moll* 3774 (PRE); *ibid.*, E of Pongola R., Jan. 1968, *Garland* 47580 (PRE); *ibid.*, 2 km E of Makane's Drift, 30 May 1972, *Stephen* 733 (PRE); Makane's Pont; Pongola R., 10 Nov. 1983, *Poynton* PRF17953 (PRE); Mengu, Pongola R., Makane's Pont near Jobe's Kraal, 13 Oct. 1969, *Garland* 434 (PRE); E of Pongola R., Jan. 1968, *Garland* 47565 (PRE); E side of Pongola R., Ndumo sandveld, road Ndumo-Jozini, 30

Map 1. Global distribution of *Cola dorrii*. Grey diamonds indicate specimens that have been seen, black diamonds indicate specimens that have not been verified (unseen). Green areas are formally protected. DESIGNED BY POPPY LAWRENCE.

Oct. 1993, *P. van Wyk* 1342 (PRE); Makanes Pont; Mengwu Sand Forest, 13 Nov. 1968, *H. J. T. Venter* 5153 (PRE); nr Sihangwane Store, fr., 25 Jan. 1964, *Tinley* 883 (K!, NU); Sihangwana, 24 Feb. 1982, *Retief* 803 (PRE). **2732BA.** 50 km from Mbazwana to Kosi Bay, 28 Jan. 1967, *Schuhardt* DSO1021 (PRE). **2732BC.** Ubombo Distr. 2732BC (Ubombo) Mondozi Lake Forest, Lake Sibayi, male fl., 13 Feb. 1976, *Brenan* 14225(K!); *ibid.*, Lake Sibayi, st., 29 March 1965, *Vahrmeijer* 720 (K!, PRE); *ibid.*, 14 Sept. 1965, *Vahrmeijer* 1080 (PRE); E Shores of Lake Sibayi on old rd, 12 Sept. 1971, *Stephens* 381 (PRE); Lake Sibayi, Ubombo, fl. buds, Oct. 1968, *Garland* s.n. (K!, NH); Lake Sibayi, 16 Sept. 1971, *Stephens* 411 (PRE); at Mandozi, on E Shore Lake Sibayi Mbazwana, 24 Oct. 1966, *De Winter* 8524 (PRE); Lake Sibayi, Drum Island Forest, 26 Oct. 1994, *Lubbe* 383 (PRE). **2732CD.** Hlabisa Distr., False Bay, 16 Jan. 1968, *Garland* 26 (PRE); False Bay Park, Mpophomeni Trail, 27 Jan. 1981, *Ankiewicz* 10 (PRE); False Bay Park, 28 Jan. 1967, *Strey* 7342 (PRE); *ibid.*, Nov. 1967, *Garland* 47563 (PRE); *ibid.*, 12 Jan. 1968, *Garland* 47575 (PRE); *ibid.*, False Bay, Bird Sanctuary Bushveld Reserve, Near Mr Redman's Camp, 27 June 1944, *Gerstener* 4757 (PRE); *ibid.*, 17 Feb. 1986, *Venter* 11509 (PRE); *ibid.*, 9 July 1961, *Ward* 3664 (PRE); *ibid.*, *Ward* 3676 (PRE). **2832AB.** Charter's Creek E of Ndhlozi pan, 11 Oct. 1958, *Rochet* 14 (PRE); *ibid.*, *Rochet* 15 (PRE). **2832AD.** Dukuduku forest, fr., 23 Nov. 1964, *Strey* 5593 (K!, PRE); *ibid.*, Dukuduku Forest, st., 1934, F.D. Herb 8676, *Forester* 52 (K!, PRE).

HABITAT. Sand Forest and Northern Coastal Forest; 5 – 150 m asl.

CONSERVATION STATUS. *Cola dorrii* has not been previously assessed for its conservation status, since it was formerly included within a broadly delimited *C. greenwayii* var. *greenwayii*. The latter taxon was treated as Least Concern by Foden & Potter (2005) accessed at <http://redlist.sanbi.org/genus.php?genus=1854>, and by Raimondo *et al.* (2009). This was because of the very large extent of occurrence of that taxon as previously delimited by authors such as Verdoorn (1981).

As delimited in this paper, and using the georeferenced specimens cited above, *Cola dorrii* has an EOO of 4787 km² and an AOO of 72 km². This was calculated using Geocat (Bachman *et al.* 2011) set to the IUCN preferred cell size of 4 km².

Cola dorrii currently appears to survive at nine locations, most of which are designated as protected but at which it is threatened. These, with threats are as follows, listed from north to south:

1. Tembe Elephant Park (TEP) where sand forests are threatened by trampling and browsing by unsustainably high elephant populations (Stone & Ntetha 2013; Potgieter 2013).
2. Ndumo Game Reserve. The sand forest habitat in Ndumo is threatened by land invasions from surrounding communities seeking arable land for cultivation.
3. The site on the road between Mbazwana and Kosi Bay (Schuhardt DSO1021), inside or on the boundary of Kosi Bay protected area. Here the sand forest has been heavily impacted by subsistence agriculture. So we could consider this a site that potentially still has the species but is significantly threatened by further habitat loss.
4. Sileza Nature Reserve. This appears to be well protected.
5. Lake Sibayi (also known as Sibhayi and Sibaya). All sites appear to be within the protected area between lake and coast and to be well-protected.
6. False Bay Park section of iSimangaliso Wetland Park. The forest habitat for the species at this location appears well-protected.
- 7 – 9. Dukuduku Forest, Mtubatuba, and Hluhluwe. Such forests are threatened by habitat alteration through the invasion of the alien shrub *Chromolaena odorata* (L.) R. H. King & H. Rob. and habitat loss through informal settlement (Ntombela 2003).

At four locations *Cola dorrii* appears likely to have been lost altogether due to habitat loss (W. McClelland pers. comm. 2017; observations on Google Earth). These are at Charter's Creek, and at three locations along the Pongola River at Makane's Drift. Most of the habitat in the vicinity of the drift has been transformed through subsistence agriculture (up to at least 3 km east of the drift, which is the area that Moll & Strey 3773, Moll & Strey 3774, Stephen 733, Poynton

PRF17953 and *Garland* 434 were collected in: W. McClelland pers. comm. 2017).

As a consequence, gaps have widened in the distribution. So, between the southernmost locations (Mtubatuba and Dukuduku forest), and the next extant locations to the North, at Hluhlwe and False Bay, a gap has opened up due to apparent loss of habitat at Charter's Creek.

A further gap of 80 km occurs between False Bay and Lake Sibayi, locations. However, we consider this is insufficient to rate as severely fragmented due to habitat loss. Equally, although four of the former 13 locations have been lost, equating to a 30% loss over the last 50 years since the specimens evidencing these locations were collected, we consider this too unreliable to invoke Criterion A.

Instead we here assess *Cola dorrii* as Vulnerable VU B1+B2 ab(i-v) since we count nine locations where *Cola dorrii* it is still extant, most of which are in formal protected areas, yet at six of which it is threatened as documented above.

At Lake Sibayi, some sites were not traced with certainty and were considered as possibly being outside of the protected area, these being Drum Island and Mondozi (or Mandozi) Forest. Neither of these appear on old topographical maps. However, Mandozi is indicated as being on the eastern lake shore, so would therefore be in the protected part of the forest. A lookout point near the south-eastern part of the lake is called "Dumile" which means "to thunder or drum", so we assume that Drum Island may refer to this, which would also place it in the eastern part of the lake and in protected forest.

It is possible that this species may yet be found at additional locations. There is a near-continuous strip of coastal forest from Lake Sibayi to Bhanga Nek (about 22 km long) and much coastal forest between Cape Vidal and Sodwana Bay (about 45 km of coastline) that has not been intensively floristically studied but which resembles the Lake Sibayi forest. The gap along the coast between Dukuduku and Lake Sibayi may be more a function of undersampling than true fragmentation.

ETYMOLOGY. named for Dr Laurence ('Larry') Dorr (1953 –) who with the first author wrote the Sterculiaceae account for *Flora of Tropical East Africa* in which this species was first mooted as distinct (Cheek & Dorr 2007). A leading specialist in Malvales globally and with floristic expertise in Madagascar, Africa and the New World, Dr Dorr is Chair of the Botany Department, Smithsonian Institution (US), USA, having previously initiated Missouri Botanical Garden's (MO) research and exploration programme in Madagascar (1983 – 1986) before conducting floristic survey work in the Andes of S America for New York Botanical Garden (NY) in the Bronx (1988 – 1991).

LOCAL NAMES. Hairy Cola (English); Harige Kola (Afrikaans) (Boon 2010); Baster knoppel-hout (Afrikaans) (Moll 1981); Umqhosho, Umthenenende, Intandothi (isiZulu) (Boon 2010); Mqobo (*Forester* 52, K) Zulu; Umbidzane (siSwati) (Loffler & Loffler 2005) **LOCAL USES.** "fruit sometimes chewed by the Zulus, but never swallowed. They are eaten by Livingstone's antelope (Suni), Red Duiker, and rodents. Zulus use the tree medicinally. They value it most for its wood which — together with that of *Cola natalensis* — makes the best of all sticks (hence the name Umqhosho, meaning "the Vanquisher"). It is also used for upright house poles." (Palmer & Pitman 1972: 1491; Boon 2010: 354).

The ecology & distribution of *Cola dorrii*

Cola dorrii is endemic to the Maputaland coastal plain in northern KwaZulu-Natal, South Africa (Map 1). It has not yet been discovered over the border in southern Mozambique despite being found at the border fence in South Africa, so its presence in Mozambique is to be expected so long as suitable habitat remains intact there. *Cola dorrii* occurs in two distinctly different forest types, namely Sand Forest and Northern Coastal Forest (Mucina & Rutherford 2006). Sand Forest is described by Pooley (1993: 16) as being restricted to deep sands on inland fossil dunes that define a former coastline. This forest type occurs in a fragmented belt from 12 to 55 km inland and extends over 200 km in length from the False Bay Park section of the iSimangaliso Wetland Park in the south to the Licuati Forest in southern Mozambique in the north. It is present in a number of formal conservation areas, most notably Tembe Elephant Park (TEP). Matthews *et al.* (2001) described eight vegetation communities in TEP, one of which refers to Sand Forest, namely the *Drypetes arguta* – *Uvaria lucida* community. Two subcommunities were recognised, the first of which is "*Cola greenwayi* – *Balanites maughamii* tall Sand Forest", in which the "diagnostic consistent species are the tall tree *Balanites maughamii* and the understory shrub *Cola greenwayii*." This subcommunity is associated with dune slopes and depressions on orange brown arenosols and dystic regosols (largely sands with very little clay) at pH 5.6. *Cola greenwayi* (i.e. *C. dorrii*) is recorded as being almost entirely restricted to this subcommunity within the eight Maputaland communities at TEP (Matthews *et al.* 2001).

Northern Coastal Forest, as described by Mucina & Rutherford (2006), formerly referred to under other names, such as "Coastal Tropical Forest" or "coastal dune forest" (Breen 1971), occurs along the South African coastline from the Eastern Cape to the border with Mozambique and extraliminally along the entire Mozambique seaboard to southern Tanzania. It differs

significantly from Sand Forest in being confined to deep sands on relatively recent (younger than 10,000 years) coastal dunes, and in having a different suite of dominant tree and shrub species, such as *Mimusops caffra*, *Diospyros natalensis*, *Sideroxylon inerme* and *Psyrax obovata*. A number of *Cola dorrii* specimens have been collected historically from Northern Coastal Forest, specifically in the vicinity of Lake Sibayi, Manguzi and Dukuduku Forest. Breen (1971) gave an account of the Northern Coastal (“Dune Forest”) at Sibayi. *Cola dorrii* (as *C. natalensis*) is one of 86 tree species recorded, and is one of the species occurring at median frequency, at a relative density of 0.6. It is not one of the major components of the canopy. Of the five stems recorded in Breen’s enumeration of this species, two were 7.5 cm girth class, one in the 10 cm, and two in the 15 cm girth classes, these individuals all occurring in the 3 – 6 m height class apart from one in the 2.1 – 3 m height class. Most canopy individuals of this forest type occur in the 3 – 6 m height class, with the highest canopy trees being in a class above 9 m high. Breen (1971) estimates that the annual rainfall of Sibayi is in the order of 1000 mm, falling mostly between September and May.

Maputaland (formerly Tongaland), extending from Kwazulu Natal into southern Mozambique, is considered a regional centre of endemism with at least 230 species and infraspecific taxa of plant documented as being endemic or near endemic (van Wyk 1996). Of these, at least 27 are restricted to Sand Forest (known as Licuati Forest in Mozambique) (Matthews *et al.* 2001).

A similar case of a species recently discovered to be endemic to the Sand Forest of Maputaland is that of *Warneckea parvifolia* R. D. Stone & Ntetha which had previously also been considered conspecific with a species to the north in tropical Africa, and which like *Cola dorrii* has smaller leaves in comparison with those relatives (Stone & Ntetha 2013).

In several parts of tropical Africa and Madagascar, areas of sand, usually coastal, and derived from ancient-dunes have unique assemblages of species including narrowly endemic species and even genera. Examples occur in coastal Cabinda to Gabon (Cheek *et al.* 2014; Gosline *et al.* 2014); in coastal northern Mozambique (Timberlake *et al.* 2011 and Johnson *et al.* 2017) and in North West Madagascar (Stirton & DuPuy 1992).

PHENOLOGY. Flowering occurs in Oct. – Nov., after the rains begin in September, in the southern spring, with out-of-season flowers as late as February (Brenan 14225). Fruits follow in Nov. – Feb. In March – April new shoots and leaves are produced in a flush, after which during the dry season, growth appears to cease until October, during which time axillary inflorescence buds develop, while the dormant stem apex is covered by bud-scales. Leaves persist on the stems for at least 3 seasons.

STEM ARCHITECTURE. The first leaves of the season’s stem growth in March are the largest, with the longest petioles, to 20 (– 37) mm long. A season’s growth can be 4 cm to 8.5 cm long, with (3 –) 5 to 12 leaves. The last leaves of the flush are progressively smaller, with shorter petioles only 2 – 3 mm long, so that the leafy stem resembles a tiled dome, lacking light gaps.

Stems in the first season are covered in stellate hairs, conspicuously so in the first and second internodes when large but caducous pale brown sinuous-armed stellate hairs are present. These soon fall, but more numerous, denser and less conspicuous translucent-white, appressed armed minute stellate hairs persist. In the second season the stems are largely free of hairs, with white epidermis, with shallow longitudinal grooves.

DIOECY. The sexuality of *Cola* species has been given as “Dioecious or monoecious, occasionally with bisexual flowers” (Verdoorn 1981). However, in the case of *Cola dorrii*, all the evidence currently available indicates that the species is dioecious. Of the ten specimens cited in this paper, those in flower had either all male flowers, or all female flowers. One specimen (Moll 4388, K) has notes stating clearly: “female flowers only found on the tree” and another Moll & Strey 3773 “dioecious”.

While female flowers were observed always to have full-sized anthers, these were never seen to be dehiscent, so that functionally the stamens in female flowers appear to be sterile.

Schmidt 3434 (BRNH image!), a fruiting specimen that fits *Cola dorrii*, is atypical in its geography since it occurs further inland than all other verified specimens of *C. dorrii* and not in the coastal forest or sand forest to which *C. dorrii* seems otherwise restricted. If this specimen is not the product of a labelling error, it means that the range of the species may be larger than current data suggests, and may extend to the Lubombo Mts of Swaziland to which it is known that some sand forest species extend, and whence records of “*Cola greenwayi*” have been made but not been seen by us (W. McClelland pers. comm. Nov. 2017). Further investigation is planned to address this question.

The Barberton *Cola*

Verdoorn (1981) refers to the surprising discovery of *Cola* in the Barberton District of Transvaal, now Mpumalanga. She included these specimens in her broad concept of *C. greenwayi* var. *greenwayi*. The specimens seen from this upland area differ greatly in multiple leaf characters from those of *C. dorrii*. In this respect they indeed fit best with *C. greenwayi* var. *greenwayi* as defined in Table 1. Thus South Africa now certainly has three species of *Cola*, not two.

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