

Commiphora kaokoensis (Burseraceae), a new species from Namibia, with notes on *C. dinteri* and *C. namaensis*

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ABSTRACT

Commiphora kaokoensis W.Swanepoel, here described as a new species, is known only from the Kaokoveld Centre of Endemism, an arid region in northwestern Namibia. Illustrations of the plant and a distribution map are provided. Diagnostic characters include the petiolate or subsessile, all-simple and relatively large leaves with the lamina obovate or elliptic. New information is provided on the leaf morphology and geographical distribution of *C. namaensis* Schinz and *C. dinteri* Engl., species with which the new species shares some similarities. When without leaves or fruit, the three species can easily be confused. A comprehensive table with diagnostic morphological features to distinguish between the three species is presented.

INTRODUCTION

A new species, *Commiphora kaokoensis* W.Swanepoel, is described. Apart from one specimen (*Giess 9427* in WIND) collected in 1966, the new species remained uncollected until recently. This can be attributed to its limited range in remote parts of the Kaokoveld, northwestern Namibia. In addition, when without leaves or fruit, the plants are virtually indistinguishable from *C. namaensis* Schinz (Van der Walt 1973) and *C. dinteri* Engl. (Van der Walt 1974), species for which it could have been mistaken in the past.

New information is provided on the leaf characteristics of *C. namaensis* and *C. dinteri*. Diagnostic morphological features to differentiate between these two species and *C. kaokoensis* are presented. Previous misidentifications of *C. dinteri* are corrected and apparently wrongly indicated localities, including quarter-degree grids, of two herbarium specimens are rectified.

Apart from examining the herbarium collections of *C. kaokoensis*, *C. dinteri* and *C. namaensis* in WIND and PRE, numerous populations of the three species were studied all over their respective ranges in Namibia during two years of extensive field work. Morphological characters were all determined from fresh material.

1. *Commiphora kaokoensis* W.Swanepoel, sp. nov., *C. namaensis* Schinz habitu foliisque simplicibus similis sed cortice in ramis caulibusque senioribus plerumque longitudinaliter subcristato, foliis semper simplicibus, plerumque maioribus, obovatis vel ellipticis, margine plerumque crenato-serrato cum dentibus pluribus usque ad duplo numero, raro subintegro, petiolatis vel subsessilibus; petiolo elliptico vel lunato, in sectione transversali maiore; floribus minoribus, solitariis vel fasciculatis, parte distali loborum disci non ad hypanthium adnata, in floribus masculis lobis distincte bifidis, filamentis staminum infra plerumque nec appianatis nec incrassatis; fructu ovoideo, ellipsoideo vel obovoideo,

loculo fertili saepe ad loculum sterilem flexo, apiculato, plerumque maiori, exocarpio valde glutinoso; angulo inter loculos in apice putaminis plerumque valde minori, putaminis sutura loculum fertilem versus convexa, loculo sterili aspectu suturali variabili, subconcavo, paene plano, triangulari, convexo vel e basi convexo ad concavum apicem versus varianti; brachiis commissurae pseudarilli plerumque longioribus, aliquando putaminis apicem attingentes, differt.

TYPE.—Namibia, 1913 (Sesfontein): Kharokhaobvlakte, (–BC), 1 030 m, 10-05-2002, *Swanepoel 1* (WIND, holo.!, PRE, iso.!).

Illustrations: Steyn: 43, 44 & 87 (2003).

Diocious, shrub-like tree, 0.3–3.0 m tall, 0.3–6.5 m diam. *Trunk* branching repeatedly just above or below soil level into many stems, rarely with a single trunk up to 200 mm high, up to 180 mm diam.; stems relatively thick, with many thinner side branches (Figure 1). *Bark* pale grey to reddish grey or yellowish cream to brown with small, dark spots, with slightly raised, almost parallel longitudinal ridges on stems and older branches, not peeling, trunk rarely corky and irregularly cracked from soil level up to 150 mm. *Branches and branchlets* glabrous with scattered small lenticels, not spine-tipped; branchlets relatively short, stout, often scarred (Figure 2). *Exudate* milky, glutinous, aromatic, producing a hard, colourless to pale greenish transparent resin, often cracked or disintegrated into small glass-like pieces. *Leaves* simple, clustered on dwarf lateral branchlets, spirally on shoots, glabrous, green; lamina obovate to broadly obovate or elliptic to broadly elliptic, (6–)15–34(–58) × (4–)12–20(–32) mm, apex obtuse, retuse or truncate, base cuneate or cuneate and abruptly attenuate onto the petiole, rarely obtuse; margin finely crenate-serrate or rarely serrate-dentate with (7–)14–20(–25) teeth on each side, rarely subentire, entire near base; midrib yellowish green, conspicuous abaxially towards lamina base, prominently raised ab- and adaxially, especially towards lamina base (Figure 3); petiolate or subsessile, petiole from less than 1 mm up to 21 mm long, elliptic to crescent-shaped in *t/s* with 5–12 vascular bundles, dimensions in *t/s* (0.8–)1.1–1.6(–1.9) × (0.7–)1.0–1.2(–1.4) mm.

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FIGURE 1.—*C. kaokoensis* in its natural habitat, \pm 1.2 m tall.

Inflorescence: flowers borne in clusters or solitary, axillary. **Flowers** sessile or subsessile, unisexual, perigynous, appearing before or with leaves or occasionally flowering continuously until leaves have been shed. **Bracteoles** ovate, apex acute, glandular, up to 1.2 mm long. **Calyx** green to maroon or cherry, continuous with hypanthium, usually sparsely glandular otherwise glabrous; lobes ovate to triangular, apex acute. **Petals** greenish yellow to yellow, glabrous, narrowly elliptic to oblanceolate, recurved towards apex, but minute tip inflexed, inserted on hypanthium. **Disk** cylindrical with 4 fleshy lobes, adnate to hypanthium but distal part of lobes free. **Male flowers** 2.8–4.9 mm long; calyx 1.6–3.4 mm long, lobes 0.8–1.4 mm long; petals 2.4–4.0 mm long; disk lobes distinctly bifid at apex; stamens 8, 4 long sta-

mens with filaments 1.6–2.8 mm long, inserted on margin of disk lobes, 4 short stamens with filaments 0.8–2.1 mm long, inserted on margin of disk between lobes; anthers 0.7–1.0 mm long, equal in length on short and long stamens; filaments subterete, rarely flattened and broadened over lower part; gynoecium rudimentary (Figure 4A–C). **Female flowers** 2.0–2.7 mm long; calyx 1.6–2.0 mm long, lobes 0.5–0.9 mm long; petals 1.7–2.5 mm long; disk lobes obscurely bifid; staminodes 8, 4 long and 4 short; ovary half inferior, sparsely glandular; style relatively long, sparsely glandular, sutures deeply grooved; stigma obscurely lobed; pistil 1.0–1.6 mm long (Figure 4D–F). **Fruit** a drupe, ovoid, ellipsoid or obovoid, apiculate, flattened, asymmetrical (Figure 5), fertile locule often bent over towards the sterile locule, appearing



FIGURE 2.—*C. kaokoensis*. Close up of branches.

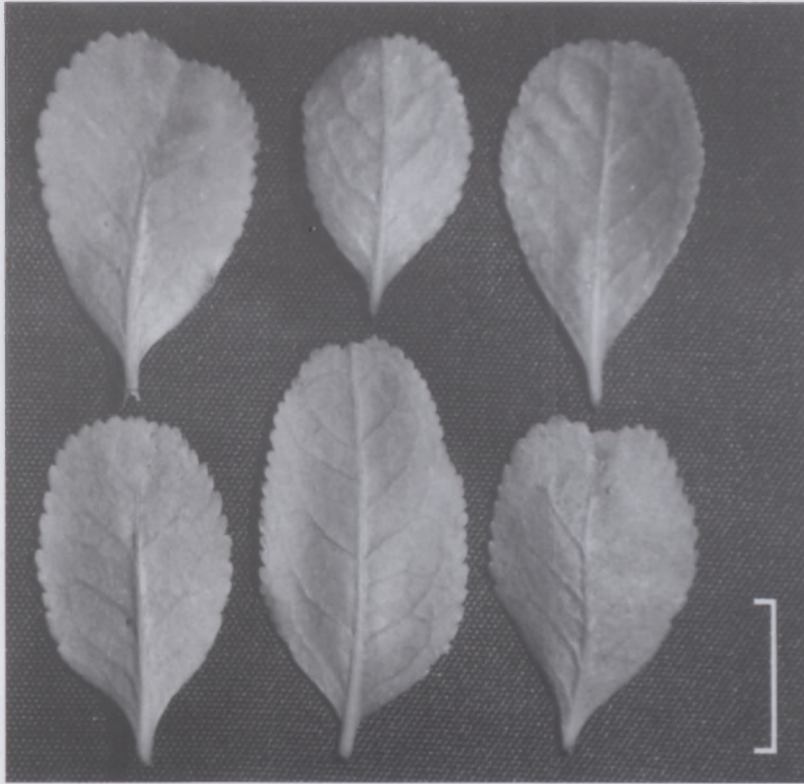


FIGURE 3.—*C. kaokoensis*. Leaves, as seen from below. Scale bar: 10 mm.

slightly falcate in sutural view, 9–13 × 7–8 × 5–7 mm; pericarp 2-valved; exocarp glabrous, glutinous, maroon in ripe fruit; mesocarp not very fleshy; putamen flattened,

asymmetrically ovoid, ellipsoid or rarely subglobose with one fertile and one sterile locule, slightly rugose, 5.0–8.7 × 4.0–5.8 × 3.0–4.2 mm; fertile locule convex in sutural and apical view; sterile locule dorsally ridged, variable in sutural view: either slightly concave, almost flat, triangular, convex or varying from convex at base to concave towards apex, ± triangular in apical view; suture convex towards fertile locule; angle between locules at apex (42°–)53°–73°(–91°); pseudo-aril orange to red, fleshy, cupular, covering (15–)20–25(–34)% of fertile locule and (15–)25–40(–48)% of sterile locule, with 2 commissural arms and 2(1) short facial lobes, extent of commissural arms (relative to length of putamen with pseudo-aril removed) (46–)60–80(–100)%, facial lobes convex or triangular, 0.5–1.1 mm on fertile locule, 0.3–2.1 mm on sterile locule, lobe on fertile locule often undeveloped and completely absent; apical pits small, often absent (Figure 4G–I). *Flowering time*: August to March, occasionally throughout the year. *Pollination*: probably by small ants, often observed on flowers.

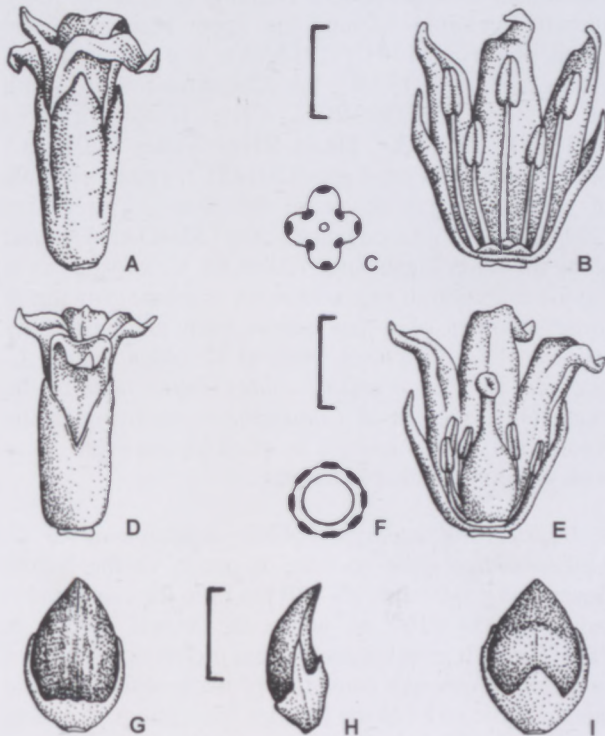


FIGURE 4.—*C. kaokoensis*. A–C, male flower: B, calyx and corolla partly removed; C, disc as seen from above to depict position of stamens (black) and rudimentary ovary (circle). D–F, female flower: E, calyx and corolla partly removed; F, disc as seen from above to depict position of stamens (black). G–I, putamen with pseudo-aril: G, side with fertile locule; H, lateral view, fertile locule (convex side) left, sterile locule (concave side) right; I, side with sterile locule. A, B, Swanepoel 52; D, E, Swanepoel 73; G–I, Swanepoel 1. Scale bars: A, B, D, E, 1 mm; G–I, 5 mm. Artist: Anne Stadler.



FIGURE 5.—*C. kaokoensis*. Dwarf lateral branchlet with leaves and fruit. Scale bar: 10 mm.

Diagnostic characters and affinities: *Commiphora kaokoensis* differs from *C. dinteri* and *C. namaensis* mainly in leaf and fruit characters, apart from minor differences in the flowers, as well as in geographical distribution. *C. kaokoensis* can be readily distinguished from these and all other southern African succulent-appearing *Commiphora* species, by its all-simple, relatively large leaves, (6–)15–34(–58) × (4–)12–20(–32) mm, that are petiolate or sessile, with the lamina obovate or elliptic. The midrib is conspicuous abaxially towards the lamina base and prominently raised ab- and adaxially, especially towards lamina base. The petiole in *t/s* is relatively thick, (0.8–)1.1–1.6(–1.9) × (0.7–)1.0–1.2(–1.4) mm, crescent-shaped or elliptic, with 5–12 vascular bundles.

C. namaensis also has simple leaves, but rarely develops a few additional trifoliolate leaves. The leaves are rotund, orbicular, ovate or cordate, usually much smaller than in *C. kaokoensis*, (5–)7–12(–15) × (4–)5–11(–14) mm and always petiolate; the midrib is inconspicuous and not, or only slightly raised ab- and adaxially towards the lamina base; the petiole in *t/s* is smaller, 0.5–0.7 × 0.5–0.7 mm, always crescent-shaped and with 3–7 vascular bundles only.

C. dinteri usually has predominantly trifoliolate leaves with a few additional simple leaves. Only rarely, in a few restricted localities, does it either have only simple leaves, or predominantly simple leaves with a few additional trifoliolate leaves, or simple and trifoliolate leaves together in equal numbers on the same plant. Simple leaves in *C. dinteri* are variable in shape, and on individual plants may vary between obovate, elliptic, ovate, cordate, oblate or slightly oblong. Unlike *C. kaokoensis*, the simple leaves of *C. dinteri* are always petiolate, with the lamina usually much smaller, about half the size, (3–)7–18(–27) × (3–)6–15 (–25) mm; the midrib is inconspicuous and not, or only slightly raised, ab- and adaxially towards the lamina base; the petiole in *t/s* differs from *C. kaokoensis* by being triangular, pentagonal or reniform in shape, usually smaller, 0.7–0.8 × 0.6–0.7 mm, and with only 3–7 vascular bundles. For comparable lamina size, the petioles of both *C. namaensis* and *C. dinteri* are slender when compared to those of *C. kaokoensis*. Petioles of *C. kaokoensis* with *t/s* dimensions similar to those of *C. namaensis* and *C. dinteri*, are only found on exceptionally small leaves, occasionally present amongst the usually larger leaves.

Additional differences between these three taxa are provided by fruit morphology: the suture of the putamen in *C. kaokoensis* is convex towards the fertile locule and the angle between locules at the apex is 42°–91°. In *C. namaensis* the suture is rectilinear and the apical angle between locules is 80°–150°, whereas in *C. dinteri* the suture is rectilinear but curved towards the sterile locule at the apex and the apical angle is 51°–120°. Through examination of herbarium specimens and plants in the field, a comprehensive comparative table of diagnostic characters to differentiate between the three taxa was compiled (Table 1).

Etymology: the specific epithet refers to the Kaokoveld of northwestern Namibia. The distribution of *C.*

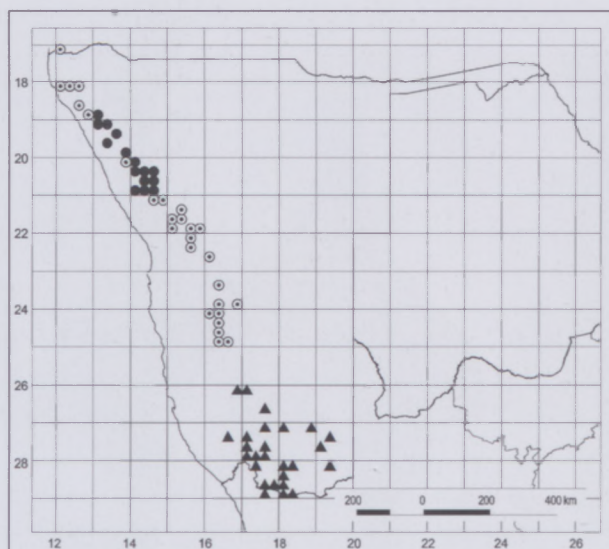


FIGURE 6.—Known distribution of *C. kaokoensis*, ●; *C. dinteri*, ○; and *C. namaensis*, ▲.

kaokoensis partly falls in the previous politically demarcated Kaokoland and Damaraland, now called the Kunene Region. Both these regions are included in the broader biogeographical concept of 'Kaokoveld' as a centre of plant endemism (Van Wyk & Smith 2001).

Distribution: *C. kaokoensis* is known from several isolated localities, all within the Kaokoveld Centre of Endemism in northwestern Namibia (Figure 6). More specific localities include the upper reaches of the Obias River (1813CC; 1913AA); just south of the Giribesvlakte (1913AB); the Kharakhaobvlakte south of Sesfontein (1913BC; –CB); Grootberg area (1913DD; 2014AA); Huab River Valley (2014AC; –AD); Petrified Forest area (2014BC); catchment area of the Goantagab River in the Doros Crater area (2014CB; –CD); Goedgenoeg area (2014DA; –DC) and along the lower Ugab River (2014CC). *C. kaokoensis* is locally common to rare within these areas, growing in loose colonies of a few plants each amongst other species of *Commiphora*, such as *C. oblanceolata*, *C. saxicola*, *C. virgata* and *C. wildii*. Unlike most of the many other species of *Commiphora* occurring in the Kaokoveld, *C. kaokoensis* is often absent from areas with seemingly suitable habitat.

Habitat and ecology: habitat requirements of *C. kaokoensis* are quite specific. It occurs in the Namib Desert and pro-Namib, 45–130 km from the coast at altitudes of 200–1 100 m, where the annual rainfall is 75–150 mm. It grows in rocky areas preferring terraces of calcrete and outcrops consisting of metasedimentary and metamorphic rocks of the Damara Supergroup, including marble, marble-conglomerate, quartzite, gneiss and inclined strata of schist (Mendelsohn *et al.* 2002). It is restricted to calcrete formations, wherever it occurs within the extensive areas of Etendeka Group basalt, e.g. at Palm near Palmwag. In spite of extensive searching, nowhere could it be found on formations from the Karoo Supergroup and associated lavas of the Etendeka Group, not even in areas where these occur within only a few metres of *C. kaokoensis* specimens growing on rocks of the Damara Supergroup.

TABLE 1.—Salient morphological differences between *Commiphora kaokoensis*, *C. namaensis*, *C. dinteri* and *C. dinteri* (form: Uis area)

Character	States	<i>C. kaokoensis</i>	<i>C. namaensis</i>	<i>C. dinteri</i>	<i>C. dinteri</i> (Uis area)
Bark					
Older branches & stems	Fissured longitudinally (narrow & deeply); usually not parallel	Never	Always	Often	Often
	Ridged longitudinally, usually \pm parallel	Always	Never	Often	Often
Leaves	Simple only	Always	Usually	Never	Rarely
	Trifoliolate only	Never	Never	Rarely	Never
	Simple with few trifoliolate	Never	Rarely	Never	Usually
	Trifoliolate with few simple	Never	Never	Usually	Never
	Simple and trifoliolate in \pm equal numbers	Never	Never	Rarely	Never
Lamina shape					
Simple leaves	Obovate or elliptic to broadly so	Always	Never	Never	Never
	Orbicular, rotund rarely ovate or cordate	Never	Always	Never	Never
	Variable: obovate to elliptic, ovate, cordate, oblate or slightly oblong	Never	Never	Always	Always
Trifoliolate leaves	Obovate or broadly elliptic	Never	Always	Always	Always
Lamina margin					
Teeth on lamina margin	Crenate-serrate	Usually	Rarely	Usually	Usually
	Serrate-dentate	Rarely	Usually	Rarely	Rarely
	Subentire	Rarely	Never	Rarely	Never
Teeth on lamina margin					
Simple leaves	No. per side	(7-)14-20(-25)	(6-)9-11(-13)	(5-)10-18(-21)	(7-)11-16 (-21)
Terminal leaflets	No. per side	Never	7*	(3-)7-12(-16)	(5-)7-9(-11)
Lateral leaflets	No. per side	Never	7*	(4-)6-8(-10)	(5-)6-7(-8)
Lamina					
Simple leaves	Size (mm)	6-58 \times 4-32	5-15 \times 4-14	3-27 \times 3-25	3-27 \times 3-20
Terminal leaflets	Size (mm)	Never	5-7 \times 4-5*	6-22 \times 4-15	6-15 \times 4-12
Lateral leaflets	Size (mm)	Never	3-5 \times 2-4*	3-12 \times 2-9	3-9 \times 2-7
Petiole	Petiolate	Often	Always	Always	Always
	Subsessile	Often	Never	Never	Never
Petiole in t/s					
Shape	Elliptic	Rarely	Never	Never	Never
	Crescent-shaped	Usually	Always	Never	Never
	Triangular	Never	Never	Rarely	Rarely
	Pentagonal	Never	Never	Usually	Usually
	Reniform	Never	Never	Rarely	Never
Vascular bundles	No.	5-12	3-7	3-7	3-7
Dimensions	mm	0.8-1.9 \times 0.7-1.4	0.5-0.7 \times 0.5-0.7	0.7-0.8 \times 0.6-0.7	0.7-0.8 \times 0.6-0.7
Petiole					
Simple leaves	Length (mm)	1-21	1-9	2-26	2-15
Trifoliolate leaves	Length (mm)	Never	4*	2-26	2-15
Inflorescence					
Flowers solitary	Flowers solitary	Often	Never	Often	Often
	Clusters	Often	Always	Often	Often
Calyx glands					
Absent	Absent	Rarely	Rarely	Never	Never
	Sparsely glandular	Usually	Rarely	Never	Never
	Profusely glandular	Never	Usually	Always	Always
Disc lobes					
Male flowers	Distal part not adnate to hypanthium	Always	Never	Always	Always
Male flowers	Distinctly bifid at apex	Always	Never	Always	Always
Male flowers	Obscurely bifid at apex	Never	Always	Never	Never
Fruit					
Shape	Ovoid	Often	Never	Often	Often
	Ellipsoid	Often	Rarely	Often	Often
	Obovoid	Rarely	Never	Rarely	Rarely
	Subglobose	Never	Usually	Rarely	Rarely
	Globose	Never	Rarely	Never	Never
	Fertile locule bent over towards sterile locule	Often	Never	Never	Never
Apex	Apiculate	Always	Never	Usually	Usually
Exocarp					
Distinctly glutinous	Distinctly glutinous	Always	Never	Usually	Usually
	Slightly glutinous to non-glutinous	Never	Always	Rarely	Rarely
Dimensions	mm	9-13 \times 7-8 \times 5-7	5-10 \times 5-8 \times 5-7	8-11 \times 7-9 \times 6-8	8-11 \times 7-9 \times 6-8
Putamen					
Apex	Angle between locules (degrees)	(42-)53-73(-91)	(80-)90-115(-150)	(51-)80-105(-120)	(61-)80-100(-118)
	Convex towards fertile locule	Always	Never	Never	Never
	A straight line	Never	Always	Never	Never
	A straight line but curved towards sterile locule at apex of putamen	Never	Never	Always	Always
Dimensions	mm	5.0-8.7 \times 4.0-5.8 \times 3.0-4.2	3.5-7.2 \times 3.4-5.6 \times 2.8-4.9	4.8-7.1 \times 4.2-5.6 \times 3.1-4.2	4.9-7.1 \times 4.3-6.2 \times 3.2-4.5

* Giess & Müller 14284 (WIND).

2. *C. dinteri* Engl.

Hitherto *C. dinteri* was regarded as having trifoliolate leaves only, with no mention of simple leaves (Van der Walt 1986). However, thorough investigation revealed that many herbarium specimens of *C. dinteri* in PRE and WIND have in addition to trifoliolate leaves, a small percentage of simple leaves, variable in shape, including ovate, obovate, elliptic, cordate, oblate, slightly oblong, or orbicular. During field work throughout the range of *C. dinteri*, both simple and trifoliolate leaves were found to a varying extent on virtually all individual plants examined. The presence of the occasional simple leaf on plants was probably overlooked (or at least not sampled) when several specimens were collected. For example, *Van der Walt 201, 207* in WIND and PRE respectively, have trifoliolate leaves only, whereas the duplicates in PRE and WIND respectively, each have a few additional simple leaves. Moving north, between the Khan and Omaruru Rivers in central-western Namibia, a gradual increase in the percentage of simple leaves on specimens of *C. dinteri* was observed. Specimens from the south of this area (Stingbank and Ebony areas, 2215AB), have a small percentage of simple leaves, similar to those observed further afield in south-central Namibia at Maltahöhe (2416DD) and in the Tsaris Mountains (2416CD). To the east of the Schwarze Kuppen (2115CA; -CB), the percentage simple versus trifoliolate leaves is \pm equal, whereas in the vicinity of the Omaruru River (Nai-nais & Okombahe areas, 2115AC; -AD), the majority of leaves are simple with only a few trifoliolate leaves, both on dwarf lateral branches and on long shoots. This is likewise the case with plants from the Uis area (2114BD), which were previously considered as an isolated population of *C. namaensis* (Van der Walt 1986), probably on account of the simple leaves, which resemble those of *C. namaensis* to a certain extent. In addition to both the simple and trifoliolate leaves resembling those of *C. dinteri*, the floral structure and fruit of the plants in the Uis area resemble those of *C. dinteri* as well (Table 1). Therefore, it is concluded that all these specimens belong to *C. dinteri* and that all specimens from the Uis area (predominantly simple-leaved) were previously misidentified as being *C. namaensis*.

In the Purros area of the Kaokoveld (1812DA), predominantly simple-leaved plants (*Swanepoel 26 & 27*) were found alongside plants with predominantly trifoliolate leaves (*Swanepoel 28, 29 & 30*). The leaves were relatively large, especially on the predominantly simple-leaved plants and the petioles were long and slender, similar to those in some *C. dinteri* specimens from the Okombahe area (2115AD) in central-western Namibia. In the *Flora of southern Africa* (Van der Walt 1986), *C. dinteri* specimens with large leaves are also mentioned for plants from the Orupembe area, 60 km to the north. A specimen with predominantly trifoliolate leaves, *Jacobsen & Moss K154*, displays the same characteristics typical of *C. dinteri* from the Orupembe area. A specimen with simple leaves, *Moss & Jacobsen K195* and from the same locality as *Jacobsen & Moss K154*, was previously identified as *C. cf. namaensis*, probably on account of the simple leaves, which resemble those of *C. namaensis* superficially. This specimen displays the same characteristics as *Swanepoel 26, 27* with leaves large and petioles relatively slender. It lacks, however,

the presence of a few typical *C. dinteri* trifoliolate leaves as found on *Swanepoel 26, 27* (only discovered on these plants upon thorough examination). The presence of the occasional trifoliolate leaf on plants was probably overlooked (or at least not sampled) when *Moss & Jacobsen K195* was collected. Therefore, it is concluded that both *Swanepoel 26, 27* and *Moss & Jacobsen K195* belong to *C. dinteri*, and are similar to specimens from the Uis area. In all the examples mentioned above, simple and trifoliolate leaves occur on both short lateral branchlets and on long shoots. Lateral leaflets are smaller than terminal leaflets to a variable extent. Hence *C. dinteri* is considered a heterophyllous species as it usually develops both simple and trifoliolate leaves on the same plant.

3. *C. namaensis* Schinz

According to Van der Walt (1986), *C. namaensis* occurs as an isolated outlier population in the Uis area of north-western Namibia, in addition to being widespread in southern Namibia and the adjacent parts of South Africa. As explained above, all the plants from the Uis area should be reclassified as *C. dinteri*. Trifoliolate leaves and transitional forms of simple to trifoliolate leaves on plants under cultivation are mentioned by Van der Walt (1986) and were found on many *C. dinteri* plants during the present study, whereas only simple leaves were found on *C. namaensis* during extensive field work in southern Namibia. Trifoliolate and intermediate leaves, however, are present on a single herbarium specimen of *C. namaensis* (*Giess & Müller 14284*) from southern Namibia (2717AC). It is concluded that *C. namaensis* is confined to southern Namibia and adjacent areas in South Africa and that it only very rarely develops a few trifoliolate leaves in addition to the usually simple leaves.

SPECIMENS EXAMINED

The location given for the previously unidentified specimen of *C. kaokoensis*, *Giess 9427* (WIND), namely Spaarwater 711, is from a locality underlain by Etendeka lava (basalt) associated with the Karoo Supergroup. This is in stark contrast with the geological formations at all the other known localities for this species which are situated on formations of the Damara Supergroup. As expected, extensive searching for *C. kaokoensis* on the Farm Spaarwater 711 produced no specimens, nor could any suitable habitat be found. However, on the Farm Palm 708, 20 km to the northwest of Spaarwater, a few small specimens of *C. kaokoensis* were found growing on an isolated formation of calcrete within the otherwise homogeneous Etendeka basalt area. Twelve kilometres to the south of Spaarwater, on the Farm Fontaine 717, also in the basalt area, *C. kaokoensis* was found growing on an isolated outcrop of dolomite. Further explorations on Spaarwater for any calcrete formation outcrops would in all probability produce some *C. kaokoensis* specimens at that locality.

The combination of distance, bearing and quarter-degree square given for *Moss & Jacobsen K195* and *Jacobson & Moss K154*, both *C. dinteri*, is incorrect. Investigation revealed that a point 25 km to the northwest of Purros is situated within quarter-degree square 1812DB

and not within 1812DD as given for the locality of these specimens. In addition, none of the plants in question could be found during field work in 1812DD, nor could any be found in a wide area around a point situated 25 km to the northwest of Purros. At a point, west-northwest, 25 km from Purros on the Purros-Orupembe District road (D3707), situated within 1812DA, many plants were found in habitat similar to that given for the two specimens. Therefore it seems appropriate to consider the locality for both *Moss & Jacobsen K195* and *Jacobsen & Moss K154* to be as follows: 25 km from Purros on road D3707, in quarter-degree square 1812DA.

Acocks 15665, 18168 (3) PRE.

Basson 204 (2a) PRE. *Biggs 209* (2a) PRE. *Botha 683* (3) PRE. *Bührman BUH 1/32, BUH 1-104* (2a) WIND. *Burgoyne 3527* (2a) PRE. *Burke 9759* (3) WIND.

Craven 2254 (2f) WIND. *Curtis 1/9* (2a) WIND; *CUR 1/172* (2b) WIND.

De Winter 3563 (3) PRE. WIND; *6035* (2b) PRE. *De Winter & Leistner 5737* (2a) PRE. WIND. *Dinter 958, 5148* (3) PRE. *Dreyer 480* (2a) PRE.

Friedrich FR 12/112 (2a) WIND.

Gerstner 6343 (3) PRE. *Giess 9427* (1) WIND; *13490A* (2a) PRE; *14520* (3) PRE; *14525, 14561* (3) WIND. *Giess & Leipert 7466* (2a) WIND. *Giess & Müller 11717* (2a) WIND; *11709* (2b) PRE. WIND; *11739* (2f) PRE. WIND; *12267* (3) PRE. WIND; *14284* (3) WIND; *14323* (3) PRE. WIND. *Giess, Volk & Bleisner 5325, 6908, 6931* (3) WIND.

Jacobsen & Moss K154 (2b) WIND. *Jankowitz 90/813* (3) WIND.

Mannheimer CM2317 (3) WIND. *Mannheimer & Mannheimer CM1380* (2b) WIND. *Merxmüller & Giess 935* (2b) PRE. WIND; *1688* (2f) PRE. WIND; *2703* (3) PRE. *Moss & Jacobsen K154* (2a) PRE; *K195* (2e) PRE. *Müller 1339* (2b) PRE. WIND. *Müller & Giess 361* (2g) PRE. WIND.

Oliver & Müller 6401 (3) PRE. *Örtendahl 204* (3) PRE.

Robinson & Knowlts 63 (2a) WIND.

Strey 2296, 2612 (2a) PRE. *Strobach 3445* (3) WIND. *Strobach & Dauth 3752* (3) WIND. *Strobach & Kubirske 3031* (3) WIND. *Swanepoel I* (1) PRE. WIND; *13-25, 31, 32, 40, 42-52, 72-74, 126* (1) WIND; *30, 33, 34* (2b) WIND; *28, 29, 35, 38, 41* (2c) WIND; *26, 27, 36, 37, 39* (2d) WIND.

Van der Walt 201 (2a) WIND; *207* (2a) PRE. WIND; *267* (2a) PRE; *201* (2b) PRE; *267* (2b) WIND; *263, 305* (3) PRE. WIND; *307* (3) WIND. *Volk 11493* (2a) WIND.

Walter 1514, 11821 (2a) WIND; *1719* (2b) WIND; *2173* (3) WIND. *Walter & Walter 2258* (3) WIND. *Ward 10805, 10889* (2b) PRE.

WIND. *Wendt 48* (3) WIND. *Wiss 1852* (3) WIND. *Werger 1507* (3) PRE.

2a. trifoliolate leaves only.

2b. predominantly trifoliolate with few simple leaves.

2c. ± equal number of trifoliolate & simple leaves.

2d. predominantly simple with few trifoliolate leaves, excluding specimens from the Uis area.

2e. simple leaves only.

2f. specimens from the Uis area with predominantly simple & few trifoliolate leaves.

2g. specimens from Uis area with simple leaves only.

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