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Commiphora omundomba (Burseraceae), a new species from Angola and Namibia

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Abstract

Commiphora omundomba, described here as a new species, is known only from the Kaokoveld Centre of Endemism, a biogeographical region in southwestern Angola and Northwestern Namibia. It has hitherto been confused with C. *dinteri* from west-central Namibia, but both morphological and molecular evidence support a distinction between the two species. Phylogenetic analysis of DNA sequence data indicates that *C. omundomba* shares most-recent common ancestry with *C. buruxa*, a species limited to the Gariep Centre of Endemism in southwestern Namibia. Diagnostic morphological characters for *C. omundomba* include the white, viscous exudate, smooth bark and glabrous, trifoliolate leaves. Photographs of the plant and a distribution map are provided. The new species is mainly confined to near the Atlantic coast of the northern Namib Desert, and is widespread and locally common between Santa Maria in Angola and Puros in Namibia.

Keywords: *Commiphora buruxa*, *Commiphora dinteri,* Iona National Park, Kaokoveld Centre of Endemism, Namib Desert, phylogeny, Sapindales, systematics, taxonomy

Introduction

At present 14 described species of *Commiphora* Jacquin (1797: 66) are known from Angola and 28 from Namibia. Sixteen of these species are endemic to the Kaokoveld Centre of Endemism, a biogeographical region with many restricted-range plants and animals in southwestern Angola and adjacent northwestern Namibia (Mendes 1964, 1967, Van Wyk & Smith 2001, Curtis & Mannheimer 2005, Figueiredo & Smith 2008, Swanepoel 2014, 2015). The Kaokoveld Centre is the principal focal point of diversity and endemism for *Commiphora* in southern Africa (Van Wyk & Smith 2001) and new members of the genus continue to be discovered in this biologically diverse but botanically poorly explored region.

In the present contribution, yet another new species of *Commiphora* confined to the Kaokoveld Centre is described. During botanical exploration in southwestern Angola and northwestern Namibia, the first author encountered a *Commiphora* with smooth, non-peeling bark and glabrous, trifoliolate leaves, initially identified as *C. dinteri* Engler (1910: 151). However, this entity differed from typical *C. dinteri* in that the leaflets were narrower and the margins entire or with only a few serrations. Plants were sterile at the time. During a follow-up visit in May 2010, the plants were again sterile and it was only in May 2015 that flowers and fruit were collected and the plants realised to belong to a different taxon. Subsequent analysis of DNA sequence data by one of us (AW) has confirmed that this taxon represents a still undescribed species. In Angola plants of the new species were found in several localities on the coastal plain between Santa Maria in the north and Iona in the south. Apart from the coastal plain in Namibia, the new species was also recorded more inland on the adjacent mountains of the Great Escarpment.

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FIGURE 1. *Commiphora omundomba*, habitat and habit. **A.** Ascending, leafless shrub-like trees in foreground, ca. 70 km from the Atlantic Coast. **B.** Prostrate shrub on top of sandstone cliffs along the coast. Photographs by W. Swanepoel.

FIGURE 2. *Commiphora omundomba*, variation in leaf morphology (A, B) and trunk with thicker branches showing smooth, non-peeling bark (C). **A.** Leaves with lamina entire. **B.** Leaves with lamina crenate to crenate-serrate. **C.** Plant with short trunk (partly hollowed out), about 200 mm in diameter; note some branches with prominent almost parallel longitudinal ridges. Scale bar = 5 mm. Photographs by W. Swanepoel.

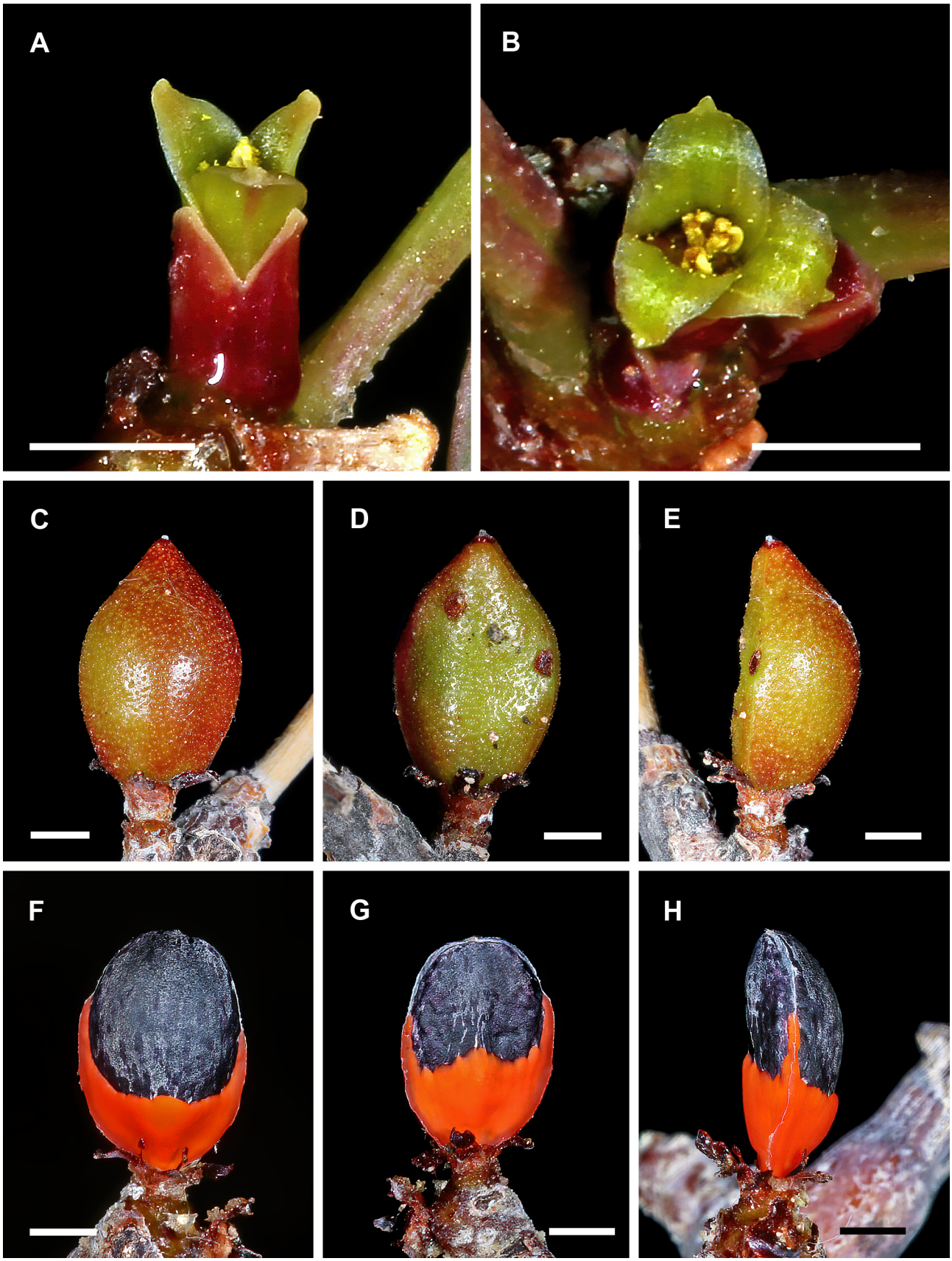

FIGURE 3. *Commiphora omundomba*, flower (A, B), fruit (C–E) and stone (F–H) morphology. **A & B.** Male flower with three petals and three stamens, viewed from the side (A) and from above (B). **C–E.** Fruit in posterior (C), anterior (D), and side (E) view. **F–H.** Stone with pseudo-aril, view of fertile locule (F), sterile locule (G), and as seen from the side (H). Scale bar = 2 mm. Photographs by W. Swanepoel.

Materials and methods

Field observations, comparative morphology, and mapping

Live material of the new species was studied in habitat and throughout its known distribution range. Morphological descriptions are based on mature leaves, fresh flowering material, and ripe fruit. Diagnostic features for *C. dinteri* were determined through examination of plants in the field in Namibia. Additional information for *C. dinteri* was sourced from the literature (Van der Walt & Van der Schijff 1973, Van der Walt 1986, Steyn 2003, Swanepoel 2005, 2006). Diagnostic features for *C. buruxa* Swanepoel (2011: 609), *C. capensis* Engler (1883: 18), and *C. oblanceolata* Schinz (1908: 633) were determined through examination of plants in the field in Namibia. Descriptive terminology follows Beentje (2016).

The following herbaria were consulted for possible collections of the new species: LISC, LISU, PRE, PRU, and WIND (herbarium abbreviations follow Thiers 2019). Locality information for specimens cited also provides the particular quarter degree grid squares following the degree reference system of Edwards & Leistner (1971). The distribution map was compiled from specimen data using ArcView 3.1 software.

Phylogenetic analysis

DNA was extracted from leaf material of *Commiphora omundomba* (*Swanepoel 341* [LUBA, PRU], Angola, 25 km on Bentiaba road from Namibe-Caruculo junction, 414 m, 16 April 2010), as well as three species recently described from southwestern Africa: *C. benguelensis* Swanepoel (2015: 191) (*Swanepoel 326* [PRU], Angola, Namibe Province: 9 km from main road on track to Chicambi, 583 m, 18 April 2010), *C. buruxa* (*Weeks 07-I-15-16E* [GMUF]; *Swanepoel 282* [WIND, PRE], Namibia, Karas Region, Haib River Gorge, 28 km ENE of Noordoewer, 370 m a.s.l., 3 February 2004), and *C. namibensis* Swanepoel (2014: 211) (*Swanepoel 329* [LUBA, PRU], Angola, Namibe Province: 13 km west of Caraculo along main road to Namibe, 1526 m, 14 April 2010) using FastPrep FastDNA spin kits (Bio101 Systems, La Jolla, California USA). PCR amplification and sequencing of the nuclear ribosomal external spacer (ETS) and the chloroplast *psbA-trnH* intergenic spacer followed Gostel *et al.* (2016). DNA sequences were deposited in GenBank (MZ998741–MZ998748; https://www.ncbi.nlm.nih.gov/genbank/).

DNA sequences of the four species were aligned against the four-gene, 4378 bp matrix from Gostel *et al.* (2016), which sampled 104 *Commiphora* species and 12 outgroup *Bursera* Jacquin ex Linnaeus (1762: 471) species. Phylogenetic analysis of the dataset was conducted using maximum likelihood inference as implemented by IQ-Tree (Minh *et al.* 2020) using default tree search parameters. The data were analysed together, partitioned by gene region (Hoang *et al.* 2018) and using the best fitting model of evolution for each as determined by ModelFinder (Kalyaanamoorthy *et al.* 2017). Branch support was assessed using the ultrafast bootstrap algorithm (Hoang *et al.* 2018) across 1000 dataset replicates.

Taxonomic treatment

Commiphora omundomba Swanepoel & Weeks, *sp. nov*. (Figs 1–3)

Diagnosis:—Differs from *C. dinteri* in the terminal leaflets being oblanceolate or narrowly obovate (*vs.* obovate); lateral leaflets oblanceolate, narrowly obovate, obovate, elliptic, oblong, or suborbicular (*vs.* broadly elliptic or suborbicular); ratio length of terminal leaflets to width being 1.9–3.2:1 (*vs.*1–2:1); ratio length of terminal leaflets to lateral leaflets being 1.1–1.4:1 (*vs.* 1.5–2.9:1); leaflet margins often entire (*vs.* always toothed); calyx eglandular (*vs*. glandular); number of calyx lobes and petals 3 or rarely 4 (*vs.* 4); number of disc lobes 3 or rarely 4 (*vs.* 4); in male flowers distal part of disc lobes adnate to hypanthium, obscurely bifid at apex (*vs*. distal part not adnate to hypanthium, distinctly bifid at apex); pseudo-aril with commissural arms shorter, extending 25–65% the length of putamen (*vs.* longer, 75–95%).

Type:—NAMIBIA. Kunene Region: Kunene River Valley opposite Hartmann Mountains, (–AB), 170 m, 2 May 2017, *Swanepoel 347* (holotype WIND!; isotype PRU!).

Deciduous, dioecious shrub-like tree, up to 2.5 m tall, 0.5–3.5 m diam. (Fig. 1A), sometimes prostrate (Fig. 1B). *Trunk* simple and short (Fig. 2C), up to 0.2 m long, 0.3 m diam., or branching repeatedly above ground level, appearing succulent; stems relatively thick, with many thinner side branches. *Bark* pale grey or reddish grey, brown, grey-brown or reddish brown, with slightly raised, almost parallel longitudinal ridges on stems and older branches, not

peeling (Fig. 2C). *Branches and branchlets* glabrous with few small, prominent lenticels, not spine-tipped; dwarf lateral branchlets scarred. *Exudate* white, viscous, scanty, drying to form a hard, pale yellow, translucent resin. *Leaves* trifoliolate, clustered distally on branches and on dwarf lateral shoots but spirally arranged on actively elongating shoots, subsessile or petiolate, glabrous, pale green, not or slightly glossy; lamina of terminal leaflets oblanceolate or narrowly obovate, apex obtuse or rounded, base cuneate or attenuate, 5–27 × 3–11 mm, length to width ratio 1.9–3.2:1; lamina of lateral leaflets oblanceolate, narrowly obovate, obovate, elliptic, oblong or suborbicular, often asymmetric, apex obtuse, base obtuse or cuneate, 4–10 × 2–6 mm; leaflet margins entire, crenate or crenate-serrate towards apex with up to 5 teeth each side, midrib conspicuous abaxially, prominent towards base on both sides, leaflets sessile, length of terminal to length of lateral leaflets ratio 1.1–1.4:1; petiole usually grooved adaxially, 0.5–34 mm long, obcordate or reniform, rarely obovate in transverse section, vascular bundles 3 or 4, sectional dimensions 0.5–0.7 × 0.6–0.8 mm. *Inflorescences* flowers axillary, solitary or clustered. *Flowers* sessile, unisexual, perigynous, appearing before or with new leaves or occasionally flowering continuously until leaves have been shed. *Bracts* obovate, succulent, ± 0.9 × 0.6 × 0.4 mm, glabrous. *Calyx* maroon or maroon-green, eglandular, glabrous, lobes 3(4), ovate, acute. *Petals* 3(4), spreading-ascending or spreading-recurved, tip minute and inflexed, yellow-green, glabrous. *Disc* cylindrical with 3(4) lobes. *Male flowers* 2.5–4.1 mm long, calyx 1.7–2.6 mm long, calyx lobes 0.6–1.0 mm long, petals oblanceolate or narrowly elliptic, 2.2–4.2 × 1.0–1.8 mm; disc fleshy, folded and glandular on inside, lobes obscurely bifid at apex, distal part adnate to hypanthium; stamens 6(8), filaments subterete, flattened and broadened over lower part, 3(4) long stamens with filaments 1.4–2.1 mm long, inserted on margin of disc lobes, 3(4) short stamens with filaments 0.5–1.4 mm long, inserted between lobes on margin of disc, anthers ± 0.8 mm long, equal in length on short and long stamens; gynoecium rudimentary. *Female flowers* 2.4–3.0 mm long, calyx 1.7–2.3 mm long, calyx lobes ± 0.8 mm long, petals broadly oblanceolate, 2.2–2.6 × 1.1–1.4 mm; staminodes 6(8), alternately long and short, inserted on disc margin, disc lobes not bifid; ovary ovoid, half-inferior, style relatively short, ovary and style glabrous, style sparsely glandular, stigma obscurely 3(4)-lobed, 1.3–1.8 mm long, 0.5–0.6 mm diam. *Fruit* a drupe, ovoid, obovoid or ellipsoid, apiculate, slightly flattened, asymmetrical, fertile locule often bent over towards sterile locule, 9.4–11.4 × 6.7–7.3 × 4.9–5.6 mm; pericarp 2-valved; exocarp glabrous, glandular, glutinous, maroon in ripe fruit; mesocarp not very fleshy; stone flattened, asymmetrically ovoid, obovoid or subglobose with one fertile and one sterile locule, slightly rugose; 5.5–8.1 × 4.8–5.5 × 3.1–3.8 mm; fertile locule convex in sutural and apical view; sterile locule dorsally ridged, slightly convex or varying from convex at base to concave towards apex in sutural view, ± triangular in apical view; suture rectilinear but curved towards sterile locule at apex; angle between locules at apex ± 35°–72°; pseudo-aril orange or red, fleshy, cupular, covering 15–40% of fertile locule and 20–45% of sterile locule, with 2 commissural arms and two short facial lobes, extent of commissural arms (relative to length of stone with pseudo-aril removed) 25–65%, facial lobes convex or triangular, 0.4–1.0 mm on fertile locule, 0.9–1.2 mm on sterile locule, lobe on fertile locule sometimes absent; apical pits small.

Phylogeny:—*Commiphora omundomba* is part of the 'Gariepensis' clade of *Commiphora* (Gostel *et al.* 2016), which comprises a group of 15 unarmed and largely pachycaulescent species endemic to southwestern Africa (Fig. 4). The nested relationships among these species are mostly well supported (90–100% bootstrap support) except for the three nodes subtending *C. omundomba,* including its sister-relationship with *C. buruxa,* which are only moderately supported (80–82%). Both *C. omundomba* and *C. buruxa* share morphological traits that may reflect a close or most-recent common ancestry, despite their disjunct ranges in the Kaokoveld and Gariep Centres of Endemism, respectively. Both are dioecious, shrub-like trees bearing viscous and opaque white to cream coloured exudate and glabrous trifoliolate leaves with variably toothed to entire margins, as well as petioles that can have reniform cross sections. However, flower and fruit structure are more divergent, including differences in the number of petals and the sculpturing of the pseudaril, which suggests that the current molecular phylogenetic hypothesis of a sister relationship between *C. omundomba* and *C. buruxa* may be provisional, pending future and more extensive phylogenomic investigations of this clade. Notably, species of the 'Gariepensis' clade have radiated over the last ca. 16 Ma (Gostel *et al.* 2016), most likely under extreme environmental selection pressures that have resulted in convergent, water-conserving morphologies.

Phenology:—*Commiphora omundomba* flowers from April to June. Fruits were encountered on plants from April to July.

Distribution and habitat:—*Commiphora omundomba* is presently known from various localities in the coastal zone of southwestern Angola, from Santa Maria and ± 15 km inland southwards to the Kunene River in the Iona National Park and east of the dune belt, to ± 90 km inland. In the vicinity of Moçamedes it occurs on top of the coastal sandstone cliffs (Figs 1B, 5). In Namibia the new species is found from the Kunene River southwards to near Puros and eastwards to the Hartmann and Etendeka Mountains, which form part of the Great Escarpment. The range of *C. omundomba* in Angola and Namibia falls within the Kaokoveld Centre of Plant Endemism (Van Wyk & Smith, 2001);

this extremely arid (average annual rainfall <50–150 mm) area is part of the Namib Desert. *Commiphora omundomba* is rare to locally common and occurs with several other species of *Commiphora* on mountain slopes and level areas, in arid savanna and desert shrubland at elevations of 5–1300 m.

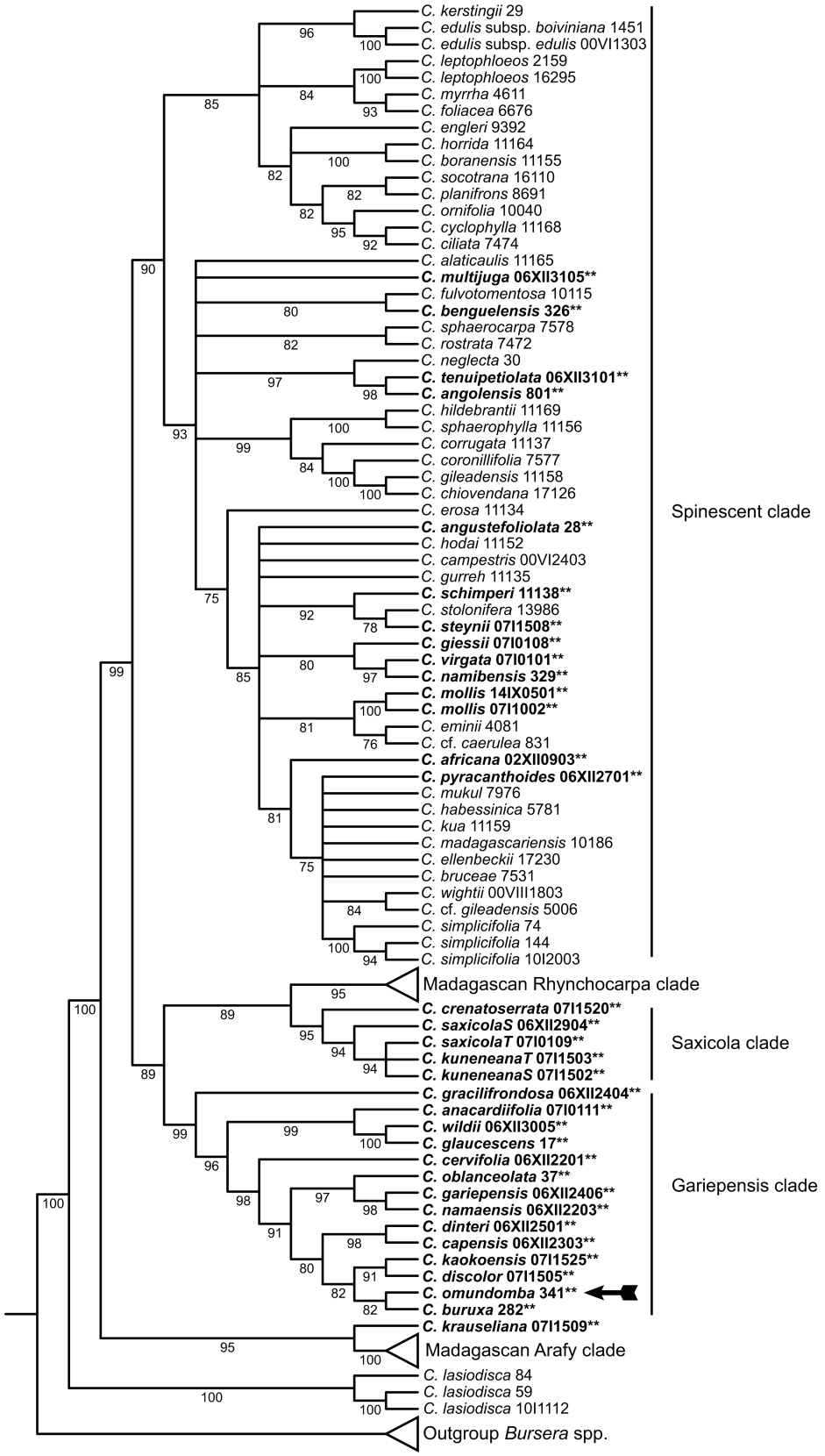

FIGURE 4. Phylogeny of *Commiphora* showing placement of *Commiphora omundomba* (arrow), based on the four-gene matrix of Gostel *et al.* (2016). The topology represents the 75% consensus of 1000 ultrafast bootstrap replicates using maximum likelihood inference; bootstrap percentages are shown below branches. Bolded and marked with double asterisk taxon names are species native to southwestern Africa (excluding the Caprivi Strip).

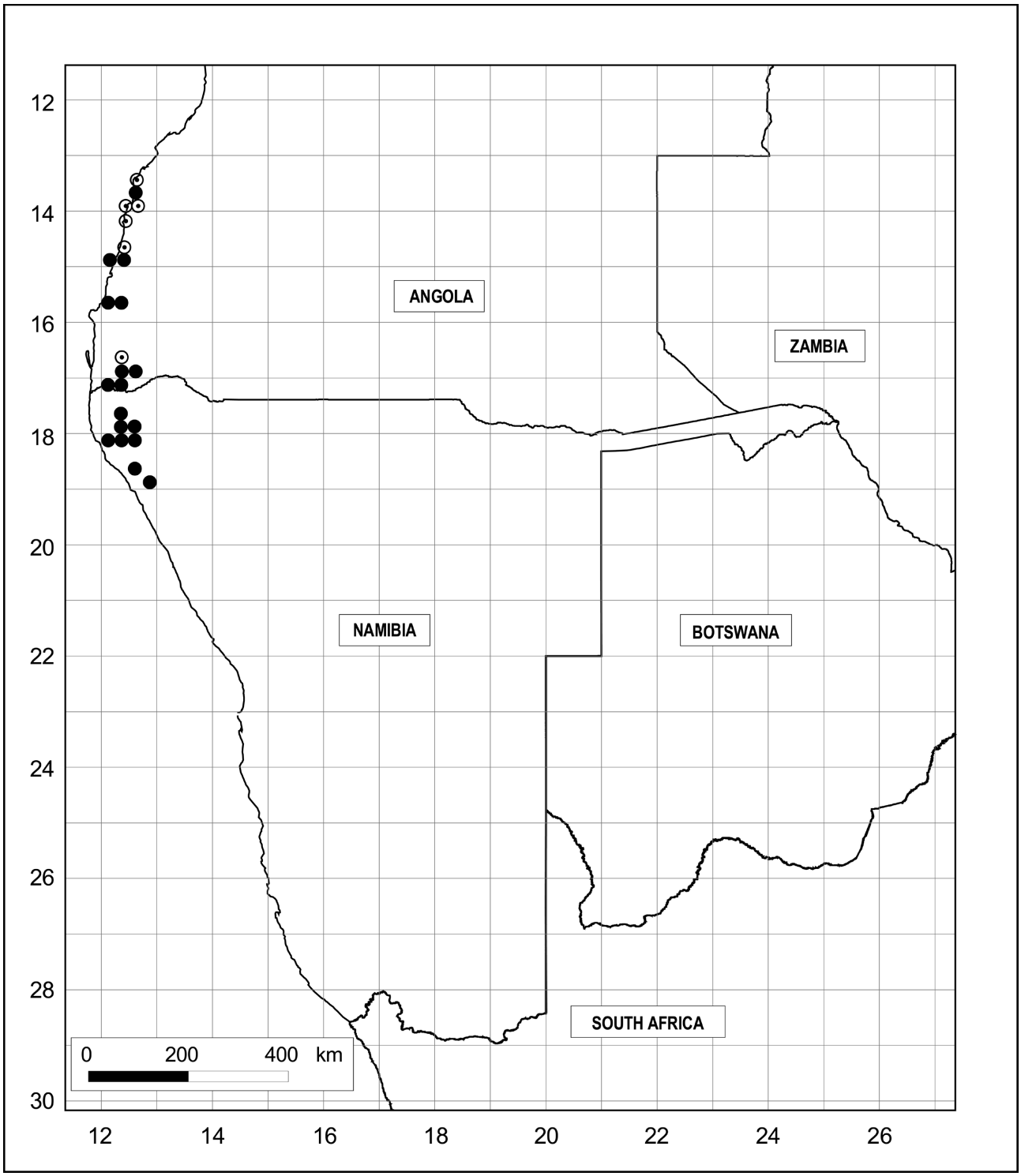

FIGURE 5. Known distribution of *Commiphora omundomba*. Solid circles indicate localities supported by herbarium specimens; open circles with small central dots depict sight records only.

Conservation status:—*Commiphora omundomba* is not under any threat as the plants are located in remote, sparsely populated areas.

Etymology and common names:—The specific epithet is the local Ovahimba vernacular name (a dialect of Otjiherero) for the new species. As vernacular names in English and Afrikaans we propose Iona corkwood and *ionakanniedood*.

Notes:—*Commiphora omundomba* has hitherto escaped recognition as a distinct species because of its superficial similarly to *C. dinteri*. Some of the more prominent morphological features to differentiate *C. omundomba* from *C. dinteri* are compared in Table 1. In the *Tree Atlas of Namibia* (Curtis & Mannheimer 2005) the distribution range of

C. dinteri is mapped as two disjunct regions, namely a core area to the south of latitude 20˚S in central Namibia, and an outlier to the north of latitude 19˚S in the Kaokoveld, up to the Kunene River. However, these northern records in the Kaokoveld refer to the new species, previously misidentified as *C. dinteri* due to similarities in habit and leaf morphology. There is a gap of ± 200 km in distribution of the two species, with *C. omundomba* occurring to the north of 19˚S and *C. dinteri* to the south of 20˚S.

TABLE 1. Comparative table of the more prominent differences between *Commiphora omundomba* and *C. dinteri.*

Character	*C. omundomba*	*C. dinteri*
Leaves	Subsessile or petiolate; pale green, not glossy	Petiolate; green to dark green, often somewhat glossy
Lamina shape (terminal leaflets)	Oblanceolate or narrowly obovate	Obovate
Lamina shape (lateral leaflets)	Oblanceolate, narrowly obovate, obovate, elliptic, oblong, or suborbicular	Broadly elliptic or suborbicular
Length of terminal leaflets to width (ratio)	1.9–3.2:1	1.0–2.0:1
Length of terminal leaflets to lateral leaflets (ratio)	1.1–1.4:1	1.5–2.9:1
Leaflet margins	Entire, crenate or crenate-serrate towards apex; up to 8 teeth each side	Crenate-serrate, serrate-dentate or serrate, often dentate at apex; 5–16 and 5–10 teeth each side on terminal and lateral leaflets respectively
Petiole		
Shape in t/s	Obcordate or reniform, rarely obovate	Pentagonal, rarely triangular or reniform
Dimensions	0.5–34.0 mm long; 0.5–0.7 × 0.6–0.8 mm in t/s	2–26 mm long; 0.7–0.8 × 0.6–0.7 mm in t/s
Number of vascular bundles	3–5	3–7
Flowers	Sessile	Subsessile
Calyx		
Glands	Absent	Present
Number of lobes	3, rarely 4	4
Number of petals	3, rarely 4	4
Disc lobes (male flowers)	3 or 4; distal part adnate to hypanthium, obscurely bifid at apex	4; distal part not adnate to hypanthium, distinctly bifid at apex
Stamens (number)	6, rarely 8	8
Pistil (glands)	Eglandular except for style	Glandular
Stone (angle between locules at apex)	(35–)40–60(–72) degrees	(51–)80–105(–120) degrees
Pseudo-aril (extent of commissural arms)	25–65%	75–95%
Distribution	Southwestern Angola and northwestern Namibia; confined to Kaokoveld Centre of Endemism	Namibia, from the Central Namib Desert eastwards to the Khomas Hochland and southwards to Maltahöhe; absent from Kaokoveld Centre of Endemism

Commiphora omundomba can, in addition to *C. dinteri*, also be confused with *C. capensis* and *C. oblanceolata*, with which it shares a similar habit and non-peeling bark, trifoliolate leaves, and perigynous flowers. The three species have, however, different distributions: *C. oblanceolata* is distributed from just north of the Kunene River Valley in southwestern Angola south to Swakopmund in the central Namib (thus partly overlapping with the range of the new species), whereas *C. capensis* has a southerly distribution in the Gariep Centre of Endemism (Van Wyk & Smith, 2001) in Namibia and South Africa. In addition to distribution, *C. omundomba*, differs from these two species in several characters of the exudate, leaves, flowers, and fruit. *Commiphora capensis* and *C. oblanceolata* have clear, squirting (when branchlets are damaged) exudate, whereas the exudate in *C. omundomba* is white and not squirting. The lamina of the terminal leaflets in *C. omundomba* is oblanceolate or narrowly obovate and the lateral leaflet lamina is oblanceolate, narrowly obovate, obovate, elliptic, oblong, or suborbicular. All leaflets in *C. oblanceolata* are narrowly oblanceolate to oblanceolate, and in *C. capensis* they are rotund, obovate or cordate. The flowers in *C. omundomba* are borne solitary or clustered and usually have three sepals and petals (rarely four) in comparison with the consistently four sepals and petals of *C. oblanceolata* and *C. capensis*. The flowers in *C. oblanceolata* and *C. capensis* are borne solitary or in simple dichasial cymes. The putamen in *C. omundomba* and *C. oblanceolata* has a pseudo-aril, whereas in *C. capensis* the pseudo-aril is lacking.

Hiern (1896) mentions an extremely resinous low shrub with trifoliolate leaves from the Namib Desert in Angola (*Welwitsch 1253*). An image of this specimen (labelled *C. virgata* Engler [1894: 139]) has been examined and although sterile, proofed to belong to *C. omundomba*. In *Conspectus Florae Angolensis* (Exell & Mendonça 1951) *C. omundomba* keys out as *C. virgata* Engler (1894: 139). The latter, however, has papery bark that conspicuously peels transversely (*vs*. bark not papery nor peeling).

Additional specimens examined (paratypes):—ANGOLA. Namibe Province: 37 km from Lucira on road to Dombe Grande, 1312DA, 294 m, 10 May 2015, *Swanepoel 345* (LUBA!, PRU!); Mucuio, 1412CC, 21 m, 10 May 2015, *Swanepoel 344* (LUBA!, PRU!); 25 km on Bentiaba road from Namibe-Caruculo junction, 1412CD, 414 m, 16 April 2010, *Swanepoel 341* (LUBA!, PRU!); 22 km south of Namibe on road to Tombua, 1512CA, 100 m, 9 May 2015, *Swanepoel 343* (LUBA!, PRU!); Flamingo River between coast and Namibe-Tombua road, 1512CA, 89 m, 14 May 2016, *Swanepoel 346* (LUBA!, PRU!); 5 km north of Curoca River on Iona-Namibe road, 1512CB, 295 m, 8 May 2015, *Swanepoel 342* (LUBA!, PRU!); 18 km northwest of Iona on road to Curoca River, 1612CD, 581 m, 27 May 2019, *Swanepoel 565*, *567* (LUBA!, PRU!); 10 km northeast of Iona on road from Oncocua, 1612DC, 738 m, 27 May 2019, *Swanepoel 566* (LUBA!, PRU!); Mossamedes. By the red-sandy rocks at the base of Serra de Montes Negros, 10 August 1859, Welwitsch 1253 (LISU!).

—NAMIBIA. Kunene Region: 400 m due south of Kunene River, 2 km east of Wilderness Safari Lodge, 1712AA, 200 m, 21 April 2003, *Swanepoel 33*, *54* (WIND!); Kunene River Valley opposite Hartmann Mountains, 1712AB, 170 m, 2 May 2017, *Swanepoel 348* (WIND!); Between Hartmann Valley and Rooidrom, 1712CB, 850 m, 21 April 2003, *Swanepoel 53* (WIND!); Engo Valley near Oranjedrom, 1712CD, 729 m, 3 May 2017, *Swanepoel 564* (WIND!); Onjuva, 1712DC, 28 November 2004, *Curtis BC2185*, *BC2181* (WIND!); 40 km NW Orupembe, 1812AA, 18 July 1973, *Robinson & Knouwds 63* (WIND!); 32 km NW Orupembe, 1812AB, 24 April 1966, *Giess 9402* (WIND!); Orupembe waterhole, 1812BA, 5 May 1957, *De Winter & Leistner 5737* (PRE!, WIND!); 13 km nördlich Sarusas, 1812DA, 10 June 1963, *Giess & Leippert 7466* (WIND!); Rocky hill slope on plains just north of Purros, 1812DA, 620 m, 27 November 2004, *Curtis BC2177*, *BC2179* (WIND!); 25 km NW of Purros, 1812DA, 500 m, 12 April 1985, *Jacobsen & Moss K154* (PRE, WIND!); Purros-Orupembe Road D3707, 1812DA, 584 m, 18 April 2003, *Swanepoel 26*, *27*, *28*, *30* (WIND!); Purros-Orupembe Road D3707, 1812DD, 604 m, 18 April 2003, *Swanepoel 29* (WIND!).

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