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South African Journal of Botany 75 (2009) 497 – 504
SOUTH AFRICAN JOURNAL OF BOTANY
www.elsevier.com/locate/sajb

Euphorbia otjingandu (Euphorbiaceae), a new species from the Kaokoveld, Namibia

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Received 22 December 2008; received in revised form 22 March 2009; accepted 1 April 2009

Abstract

Euphorbia otjingandu Swanepoel, here described as a new species, is a robust succulent tree only known from the Namibian part of the Kaokoveld Centre of Endemism. Its range is likely to extend into adjacent mountainous regions of southwestern Angola. Illustrations of the plant and a distribution map are provided. Diagnostic characters of the new species include the short trunk, the succulent, spiny, 4–8-winged, conspicuously segmented branches and the flat-topped candelabriform habit. A table with diagnostic morphological features to distinguish among the new species, its suggested nearest relative *E. fortissima* Leach, and several other species with which it can be confused, is provided.

Keywords: Endemism; *Euphorbia*; Euphorbiaceae; Kaokoveld; Morphology; Taxonomy

1. Introduction

Hitherto only two large, succulent tree species of *Euphorbia* L. with ±candelabriform habit have been recognized from the Kaokoveld in northwestern Namibia. *E. eduardoi* Leach (1968) occurs in the Kaokoveld and southwestern Angola whereas *E. virosa* Willd. (Leach, 1971) occurs throughout western Namibia, in southern Angola and on both sides of the Orange River Valley in southern Namibia and the Northern Cape, South Africa (Craven, 1999; Germishuizen and Meyer, 2003; Curtis and Mannheimer, 2005). In this contribution, a third candelabriform species of *Euphorbia* is described for the Kaokoveld.

In January 2004, during fieldwork for the Namibian Tree Atlas Project, the author encountered an unusual, succulent, candelabriform *Euphorbia*, with a short, stout stem and a ±flat-topped crown in the Van Zyl's Pass area of the Otjihipa Mountains. Subsequently similar plants were found in the Kunene River Valley, downstream from the Ruacana Falls and on the Otjihipu Peak between the Kunene River and Van Zyl's Pass. A study of the *Euphorbia* holdings in PRE and WIND revealed no earlier collections resembling these plants. This taxon is here proposed as a distinct new species.

Live material of the new species from all the known populations in Namibia was studied in the field. Morphological characters in the description that follows were determined from live specimens and from fresh flowering and fruiting material. For *E. fortissima* Leach, the possible closest relative of the new species, as well as the related *E. ingenticapsa* Leach, diagnostic characters were sourced mainly from literature (Leach, 1964; Carter and Leach, 2001). Morphological features for other superficially similar taxa, notably *E. cooperi* N.E.Br. ex A. Berger, *E. eduardoi* Leach, *E. virosa* subsp. *virosa*, *E. avasmontana* Dinter and *E. hottentota* Marl. are from field observations, herbarium specimens and the literature (Marloth, 1930; White et al., 1941; Leach, 1968, 1970, 1971; Carter and Leach, 2001; Coates Palgrave, 2002). Populations of *E. eduardoi*, *E. virosa* subsp. *virosa* and *E. avasmontana* were studied in the field in Namibia, whilst *E. cooperi* was studied in Limpopo (Polokwane and Wolkberg areas) and Mpumalanga (Loskop Dam area). Comparative data for *E. hottentota* are from plants in southern Namibia and the Northern Cape (Richtersveld).

2. Taxonomy

2.1. Description

Euphorbia otjingandu Swanepoel, sp. nov., similissima *E. fortissimae* Leach, optime congruens, haec arbori succulentae candelabriformae, trunco distincto brevi crasso; ramis alatis,

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doi:10.1016/j.sajb.2009.04.003

segmentatis, binatis spinis; inflorescentiis bibracteatis pedunculatis cymis; cyma media mascula caduca; duabus lateralibus hermaphroditis. Differt ab *E. fortissima* distributione geographica diversa, habutu angusto candelabriformi; ramis 4–8 alatis, plerumque brevibus, saepe crassis, usque ad 76 segmenta, marginibus ± planis, sinuatis vel sinuato-dentatis; ramis secundariis efferentibus ad ⅔ apicem; maculis florentibus efferentibus 1–5 cymas; pedunculatis vulgo paulo brevibus; cyathis involucro obconico, glandibus elliptico-oblongatis; capsula plerumque paulo parvula.

TYPE.— Namibia, Kunene Region, along Van Zyl's Pass, 1 km west of Otjihende, 1 305 m, 01-05-2007, *Swanepoel 268* (WIND, holo.!; PRU, iso.!).

Succulent, candelabriform, ± flat-topped, spiny, small tree up to 4 m tall, height usually exceeding diam. of crown. *Trunk* single, short, stout, cylindric, 0.3–1.0 m long, 0.20–0.33 m diam., nude or with persistent spine pairs and/or indented circular scars of deciduous branches, often spirally twisted in young plants. *Bark* on trunk dark grey, occasionally pale green or dark brown in places, on branches and central stem pale green to yellowish green with a thin, white waxy coating, on older branches and central stem often dark grey towards base. *Central stem* terete, 5–9 winged towards apex, wings becoming obsolescent with age. *Branches* numerous, rarely lax, arcuate-ascending, ± whorled on central stem, persistent, constricted into segments, 4–8-winged, up to 2.8(–3.7) m long, usually much exceeding central stem, rarely equal, circular in t/s at base, occasionally rebranched on apical two thirds; segments on branches 15–76, elliptic, ovate or suborbicular, rarely oblong, 20–110 mm long, 65–190 mm diam. over broadest part, 45–140 mm diam. over narrowest part; wing-like angles stout, with continuous, ± even, sinuate or sinuate-dentate horny margin; margin maroon when young, eventually white, greyish white or blackish grey, 4–8 mm wide, armed with spines at apex of crenations, slightly humped just above spines. *Spines* paired, stout, alternating with flowering eyes, (1–)6–12 (–22) mm long, longest on broadest part of wings, spaced at (4–) 6–12(–20) mm intervals, diverging at (65–)85–95(–120) degrees, ± perpendicular to margin or slightly pointing upwards, occasionally few pairs curved downwards, wings 22–45 mm over broadest part, 8–20 mm over narrowest part. *Secondary branches* produced from wing margin at broadest part of segment, single or whorled. *Leaves* sessile, ovate to broadly ovate, concave adaxially, thick, fleshy, flanked by pair of fleshy prickles 0.4–0.6 mm long, soon caducous, leaving often a conspicuous, obtuse-triangular leaf scar shortly above spine pairs, 2.5–4.5 × 3.6–5.6 mm long, margin entire or irregularly finely denticulate. *Inflorescences* cymose, glabrous, (1–)3(–5) horizontally arranged cymes produced in flowering eyes, solitary cymes often arranged obliquely or horizontally; on new growth a pair of suppressed, rectangular, leaf-like caducuous prickles at base of flowering eye, up to 0.9 × 0.8 mm long; flowering eyes above spine pairs at quarter to half the distance between adjacent pairs. *Cymes* pedunculate, glabrous, each with 3 vertically arranged cyathia, central initial cyathium male marcescent, sessile, laterally compressed by bisexual lateral cyathia, laterals borne on cyme branches, sometimes only one lateral developed. *Peduncle* bibracteate, stout, laterally compressed when more than one cyme at flowering eye, tapering to base, vertically grooved on one or both flattened sides, light green, 2.8–6.8 mm long, greater diam. 1.9–5.5 mm at base, 5.3–8.2 mm at apex; bracts triangular or crescent-shaped, clasping peduncle, slightly keeled, soon withering, thin and papery towards irregularly denticulate–fimbriate margin, 2.1–3.4 × 4.5–6.0 mm. *Cyme branches* bibracteate, stout, vertically grooved adjacent to central cyme, light green, 3.5–6.1 × 4.8–6.3 mm diam.; bracts ovate or pentagonal, clasping involucre, slightly keeled, soon withering, leaving conspicuous broad v-shaped scar on cyme branch, thin and papery towards irregularly denticulate–fimbriate margin, 3.6–4.2 × 4.3–5.3 mm. *Involucre* obconic, glabrous, light green, in male cyathium usually laterally compressed by laterals, 2.9–4.5 mm long, 6.5–8.6 mm diam. including glands, bisexual cyathia 2.7–4.3 mm long, 7.2–10.1 mm diam. including glands; *glands* (4–)5(–6), elliptic-oblong, spreading, thick, coriaceous, contiguous, often slightly overlapping, obscurely peltate, green becoming yellow, finely rugolose adaxially, margin entire; in male cyathium concave to flat adaxially, 3.9–4.7 × 1.9–2.5 mm., in female cyathia convex adaxially, 2.3–4.4 mm × 1.9–2.3 mm; *lobes* 5, erect, glabrous, transversely rectangular or subquadrate, prominently longitudinally ridged abaxially, apex irregularly fimbriate, ±1.0 × 1.2 mm in male cyathia, ±1.5 × 1.4 mm in bisexual cyathia. *Male flowers* 35–50, well exserted from involucre, subtended by numerous bracteoles, arranged opposite lobes in 5 bracteate fascicles of 7–10 flowers each, usually 2 flowers rudimentary or not fully developed, glabrous; *fascicular bracts* broad, laciniate–fimbriate, ±3.6 mm long, ±1.5 mm wide at base; *bracteoles* filiform-laciniate, ±3 mm long; *pedicels* filiform, pale green, apices exserted beyond glands, when fully developed 4.6–5.0 mm long, 0.4–0.5 mm diam.; *filaments* terete, pale green, 1.5–1.9 mm long; *anther thecae* orbicular, flattened, pale green, 0.5–0.6 mm diam., pollen yellow. *Female flowers* erect, glabrous; *ovary* ovoid, obscurely trigonous, three-locular, green, ±2.5 mm high, ±2 mm between corners, included in involucre; *perianth* pentagonal, fleshy, margin irregularly dentate, 1.1–1.3 mm long, ± 2 mm diam.; female flower rudimentary in male cyathium; *styles* 3, horizontally spreading, recurved at apex, ± equal to apex of pedicels, ±2 mm long, united into a column for ±0.8 mm; *stigmas* capitate. *Capsule* pale green to reddish green when fully developed, glabrous, 3-locular, obtusely trigonous, 11–15 mm between corners, 8–9 mm high, held erect, exerted from involucre on a stout pedicel, ±5 × 5 mm diam.; *perianth* ± triangular or orbicular, margin irregularly dentate to denticulate; *seed* not seen (Figs. 1 and 2).

2.2. Flowering time

E. otjingandu produces cyathia from June to August. Several species of fly, blowfly, bee and wasp were seen visiting the fully developed cyathia.

2.3. Diagnostic characters

E. otjingandu clearly belongs to subg. *Euphorbia* sect. *Euphorbia* (Bruyns et al., 2006) and is probably most closely related to *E. fortissima* from which it differs conspicuously in

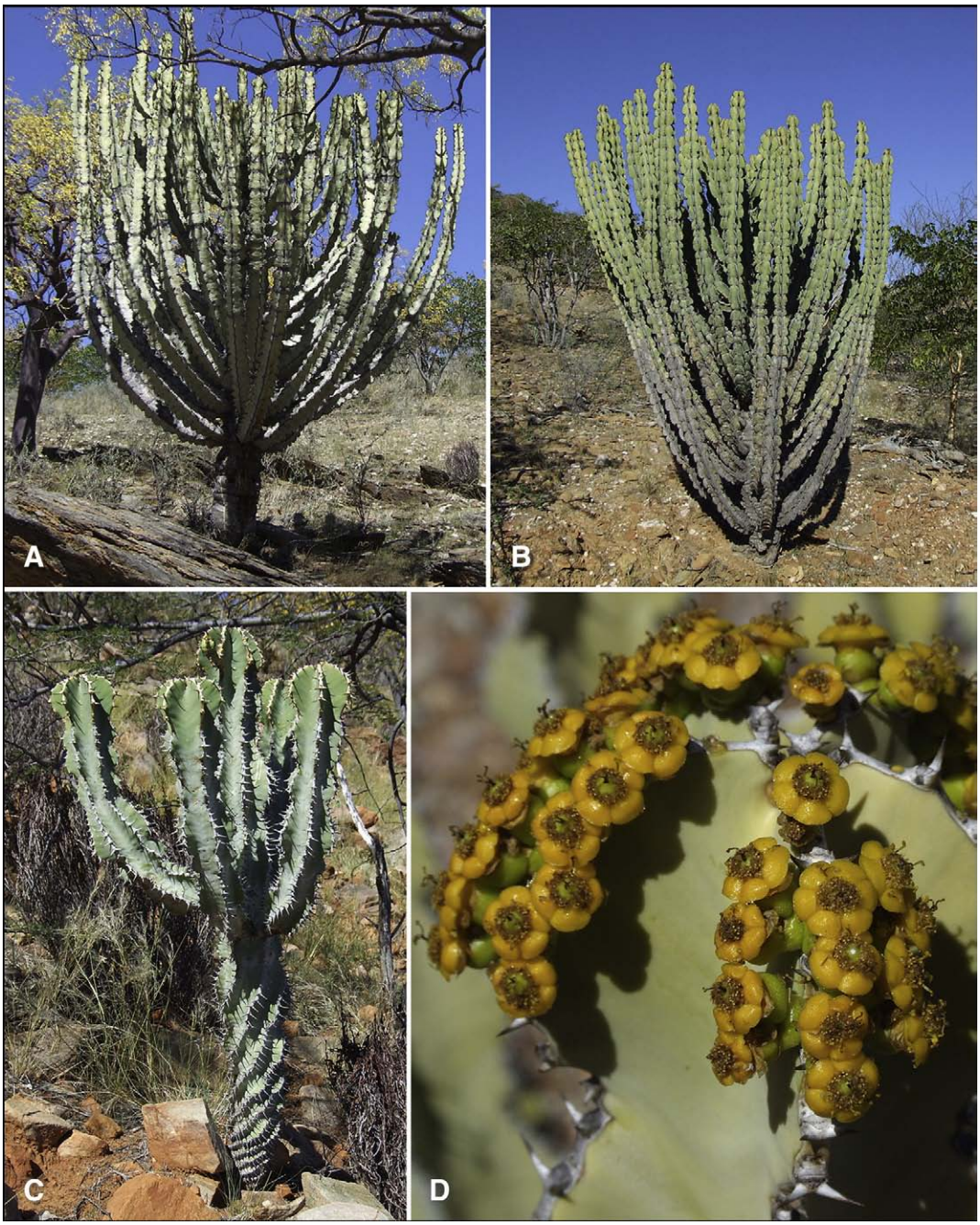

Fig. 1. *Euphorbia otjingandu*: (A) tree in natural habitat, ±4 m tall; (B) tree in natural habitat, ±3 m tall; (C) young plant showing spirally twisted stem, ±1 m tall; (D) inflorescences, each cyathium ±10 mm in diameter.

the branches and inflorescences. Branches in *E. otjingandu* are arcuate-ascending, up to 3.7 m long with up to 76 segments per branch, often thicker (65–190 mm diam.) than in *E. fortissima*, 4–8-winged with the margins ±even, sinuate or sinuate–dentate. Secondary branches are produced along the apical two-thirds. Branches in *E. fortissima* are often longer (up to 5 m), spreading ascending, thus resulting in a wider crown. In addition, the branches often have fewer segments (only up to 40), the diameter is often smaller (45–90 mm diam.), they are only 3- or 4-winged and the margins are ±even. Secondary branching occur ±halfway from the base.

E. otjingandu produces 1–5 cymes per flowering eye, the bracts clasp the obconical involucre and the glands are elliptic-oblong. 35–50 male flowers are produced per cyathium. The ovary in *E. otjingandu* is ovoid and the capsule is 11–15 × 8–9 mm in size. In *E. fortissima*, only 1–3 cymes are produced per flowering eye, the bracts are usually spreading and the glands are reniform. Approximately 60 male flowers are produced per cyathium. The ovary in *E. fortissima* is narrowly obovoid and the capsules are usually larger than in *E. otjingandu*, 15–24 × 9–18 mm.

Apart from the morphological differences, the two species have different geographical distributions with *E. otjingandu*

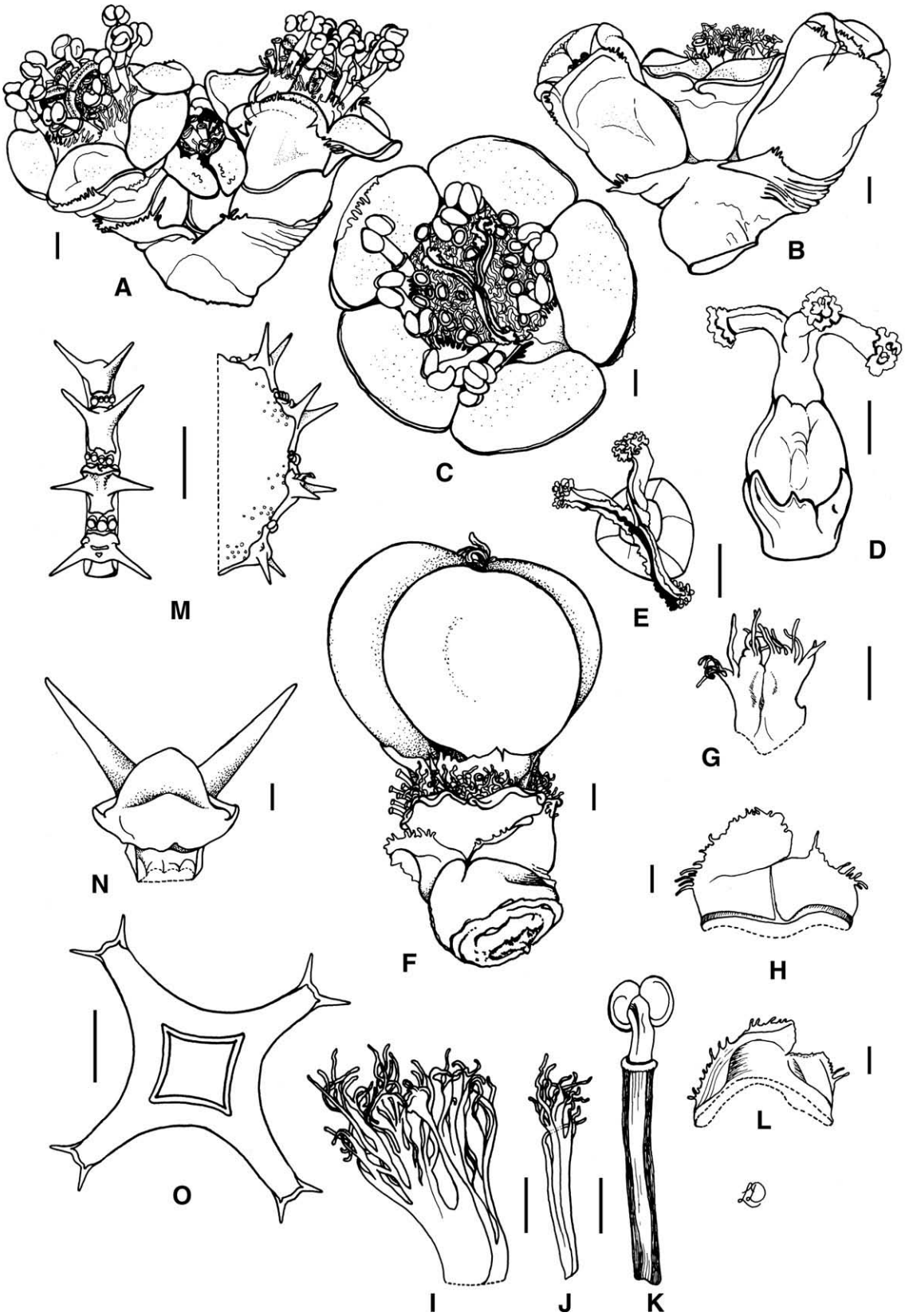

Fig. 2. *Euphorbia otjingandu*: (A) cyme with old central male cyathium and two open bisexual cyathia; (B) young cyme with open central male cyathium and two bisexual cyathia in bud; (C) bisexual cyathium from above; (D) female flower; (E) pistil from above; (F) developing fruit; (G) lobe; (H) involucral bract; (I) fascicular bract; (J) bracteole; (K) male flower; (L) peduncular bract; (M) wing margin with spines; (N) spine-pair with leaf; leaf prickles in young growth often more pronounced than in illustration; (O) stem in transverse section (schematic). Vouchers: A–E, G–L, O, *Swanepoel 269*; F, M, N, *Swanepoel 268*. Scale bar 1 mm (A–L and N), or 10 mm (M and O).

occurring in the northern Kaokoveld in Namibia and *E. fortissima* in Zambia and Zimbabwe. Also a species of restricted range, *E. fortissima* is known only from the gorges below Victoria Falls and the area between Hwange and Victoria Falls.

In the Kaokoveld, *E. otjingandu* is easily confused with *E. virosa* subsp. *virosa*, even by the local Ovahimba. In habit both species are rather similar at times with the trunk often spirally twisted in young plants. *E. otjingandu*, however, always has a distinctive trunk, up to 1 m long, the branches are pale green to yellowish green, 1–5 cymes are produced per flowering eye, the cyathia are 6.5–10.1 mm broad with usually 5 glands and the capsule is obtusely trigonous, 11–15 mm wide and dehisces explosively when mature. *E. virosa* branches from ground level and only very rarely has a distinctive trunk and then only up to 0.3 m tall, the branches are glaucous and only one cyme per flowering eye is produced, the cyathia are relatively large, 8–12 mm broad with usually 8–12 glands, the capsule is globose, usually 4-locular, 10–24 mm in diam. and dehisces by falling apart, simply dropping the seeds. Plants of *E. otjingandu* are also often mistaken for young specimens of *E. eduardoi*. Young plants of the latter, however, have tall, brightly mottled, unbranched trunks which exceed the maximum trunk length of old specimens of *E. otjingandu* by far. Branches of *E. otjingandu* are regularly, conspicuously constricted into segments and winged, whereas the branches of *E. eduardoi* are irregularly, usually inconspicuously constricted and scarcely winged, producing only one cyme per flowering eye. In *E. otjingandu* the peduncle and cyme branches are relatively short, 2.8–6.8 mm and 3.5–6.1 mm long respectively, the involucre is obconic with spreading glands and the capsule is 8–9 mm high. In *E. eduardoi* the peduncle and cyme branches are relatively long, 12–28 mm and 14–18 mm respectively, the involucre is cup-shaped with the glands suberect and the capsule is higher (at least 16 mm).

Other species from the southwestern parts of the subcontinent with which *E. otjingandu* may be confused are *E. avasmontana*, *E. hottentota* and *E. ingenticapsa*. However, *E. otjingandu* may at once be distinguished from these by being a small tree up to 4 m high, with a distinctive trunk and the conspicuously winged, relatively large in diameter branches (65–190 mm over the broadest part), deeply constricted into usually elliptic, ovate, or suborbicular segments. *E. avasmontana*, *E. hottentota* and *E. ingenticapsa* are shrubs up to 2.5 m high which branch from ground level and with the branches usually much thinner, the diameter over the broadest part 40–70 mm, 20–50 mm and 90–120 mm respectively. The wings in *E. ingenticapsa* are conspicuous as in *E. otjingandu*, whereas in *E. hottentota* they are inconspicuous and in *E. avasmontana* vary from conspicuous to inconspicuous on different plants. Stem segments in *E. avasmontana* are elliptic, ovate, oblong or oblong–lanceolate but considerably less constricted than in *E. otjingandu*, or the branches are of nearly uniform thickness. In *E. hottentota* the branches are of uniform thickness or only slightly constricted into elliptic, ovate or oblong segments. Although the branches in *E. ingenticapsa* are also deeply constricted into segments as in *E. otjingandu*, the segments are in addition to being elliptic or suborbicular also trullate (ovate in *E. otjingandu*). Capsules of *E. otjingandu* differ from the other species in both size and in some instances also in shape and the position relative to the involucre, by being obtusely trigonous, 11–15 mm across the angles and held erect. The capsule in *E. avasmontana* often is much smaller (4–10 mm across the angles), trigonous or obtusely trigonous and exserted sideways, in *E. hottentota* it is also much smaller (±7 mm across the angles), triquetrous and exserted sideways, whereas in *E. ingenticapsa* it is much larger (26–28 mm across the angles) and triquetrous.

E. otjingandu can also be confused with *E. cooperi* (from the eastern parts of the subcontinent), in both of which the trunk is sometimes scarred by fallen branches. In addition, young plants of both species may have a twisted trunk. *E. otjingandu*, however, usually has much thicker branches (65–190 mm) which lack any conic-ovate or cordate segments and secondary spines (one relative short spine each side of the flowering eyes) on the wing margins. Secondary spines were observed on all *E. cooperi* plants examined. Cymes in *E. otjingandu* consist of three cyathia and the capsules have only three lobes whereas in *E. cooperi* plants with cymes bearing secondary cyathia and capsules with four lobes in addition to cymes with the typical three lobes were recorded in the Polokwane area. Some of the more prominent morphological features to differentiate *E. otjingandu* from *E. fortissima*, *E. virosa* subsp. *virosa*, *E. eduardoi* and *E. cooperi* are compared in Table 1.

2.4. Distribution and habitat

At present *E. otjingandu* is known only from three localities in the arid, northern parts of the Kaokoveld in northwestern Namibia (Fig. 3), a region forming part of the biogeographically well-defined Kaokoveld Center of Endemism (Van Wyk and Smith, 2001). Two populations of the species occur in the Otjihipa Mountains in the escarpment zone: one on the plateau of the Otjihipu Peak and the other at the top of Van Zyl's Pass near the village of Otjihende. A third population is found 150 km to the east, in the Kunene River Valley downstream of the Ruacana Falls. The two western and the eastern localities are respectively at 100 and 250 km from the coast at altitudes of 1300 to 1725 m and ±750 m, with average annual rainfall of ±150 and 250 mm (Mendelsohn et al., 2002). *E. otjingandu* is locally uncommon to rare and grows on rocky substrate on hillsides and mountain plateaus/summits, in shrubland and open woodland.

In the Otjihipa Mountains, *E. otjingandu* grows on mica schist, shale and quartzite of the Okapuka Formation from the Khoabendus Group of Oldest Rocks (Miller and Schalk, 1980; Mendelsohn et al., 2002). The vegetation is arid mopane-acacia-commiphora savanna. The new species grows among plants such as *Acacia ataxacantha*, *A. nilotica*, *A. senegal*, *Adenium boehmianum*, *Catophractes alexandrii*, *Colophospermum mopane*, *Cyphostemma currorii*, *Commiphora africana*, *C. glaucescens*, *C. kuneneana*, *C. mollis*, *C. multijuga*, *C. tenuipetiolata*, *Elephantorrhiza suffruticosa*, *Euphorbia guerichiana*, *Myrothamnus flabellifolius* and *Pachypodium lealii*. *Euphorbia virosa* subsp. *virosa* also occurs along Van Zyl's

Table 1
Prominent differences between *Euphorbia otjingandu*, *E. fortissima*, *E. virosa* subsp. *virosa*, *E. eduardoi* and *E. cooperi*.

Character	*E. otjingandu*	*E. fortissima*	*E. virosa* subsp. *virosa*	*E. eduardoi*	*E. cooperi*
Habit	Tree, up to 4 m high, usually taller than broad	Tree, up to 7 m high	Shrub, usually broader than tall, rarely a tree up to 3 m high	Tree, up to 10 m high	Shrub or tree, 2–9 m high
Trunk (length)	Short, 0.3–1.0 m	Short, rarely up to 3 m or more	Branching from ground level, rarely up to 0.3 m	Up to 9 m	Up to 3 m
Branches					
Orientation	Arcuate-ascending	Spreading ascending	Ascending erect, often descending at base, rarely arcuate-ascending	Ascending around crown, ±horizontal lower down	Arcuate-ascending
Diameter (over broadest part)	65–190 mm	45–90 mm	80–140 mm	±75 mm	37–120 mm
Segments	Up to 76; conspicuous; elliptic, ovate or suborbicular, rarely oblong	Up to 40; conspicuous; elliptic, broadly ovate, suborbicular or trullate; lengthening towards base	Conspicuous; elliptic, ovate or suborbicular	Inconspicuous; elliptic or oblong	Conspicuous; conic-ovate, suborbicular or ±cordate
Wings (no.) (primary branches)	Conspicuous; 4–8	Conspicuous; 3–4	Conspicuous; 5–8	Scarcely; 4 or 5	Conspicuous; 2–9
Margin	±even, sinuate or sinuate-dentate	±even	Sinuate-tubercled	Slightly wavy	Shallowly sinuate-undulate
Spines (length)	1–22 mm	2–10 mm	10–13 mm	Up to 15 mm	5–15 mm
Secondary spines	Absent	Absent	Absent	Absent	Present on either side of flowering eye; up to 6 mm long, or vestigial
Secondary branching	Occasional, along apical two-thirds	Occasional, ±halfway from base	Occasional, over apical part	Absent	Occasional, near apices
Inflorescences					
No. of cymes per flowering eye	1–5	1–3	1	1	1–3
Position of flowering eye relative to spine pairs	Quarter to halfway above lower pair	±5 mm above lower pair	±halfway	±5 mm above lower pair	±halfway
Involucre (shape)	Obconic	Cup-shaped	Cup-shaped	Shallowly cup-shaped	Cup-shaped
Glands	(4)5(6) spreading; elliptic-oblong	5, spreading; reniform	5–10, spreading; crescent-shaped	5, suberect; oblong-elliptic	5; transversely oblong
Capsules					
No. of locules	3	3	3–6	3	3(4)
Size (mm)	11–15×8–9	15–24×9–18	10–23 (diam.)	±18×16	6–15×8–13.5
Distribution	Kaokoveld, northern Namibia	Zambia and Zimbabwe (Zambezi River Valley)	Southwestern Angola, western Namibia and Northern Cape (South Africa)	Southwestern Angola and northern Kaokoveld, Namibia	Malawi, Zambia, Zimbabwe, Botswana, Mozambique, Swaziland and eastern South Africa

Pass, but is found further to the west and at lower altitudes under even more arid conditions.

Near Ruacana, *E. otjingandu* is found on the slopes of calcrete terraces belonging to the Dwyka Formation of the Ecca Group, Karoo Supergroup (Miller and Schalk, 1980; Mendelsohn et al., 2002). Here it grows in arid mopane shrubland, among plants such as *Colophospermum mopane*, *Commiphora africana*, *C. multijuga*, *C. steynii*, *Euphorbia subsalsa* and *Pachypodium lealii*. Unlike the geographically widespread and relatively common *E. virosa* subsp. *virosa*, the localized and rare *E. otjingandu* probably represents a relic taxon as it is absent from several localities with similar habitat and geology. Although not yet encountered by the author in Angola, it almost certainly occurs in the poorly explored mountainous southwestern parts of that country as well, considering that the Namibian populations are found in close proximity to the Kunene River that forms the border between the two countries.

2.5. Conservation status

Although rare with only about 80 plants known in the wild, *E. otjingandu* is not threatened at present. Of concern, however, are the very few young plants seen in the field. The local Ovahimba people do not distinguish between *E. otjingandu* and *E. virosa* and regard both species as extremely poisonous and probably without any use other than for poison. No traces of damage caused by animals or humans could be found on any of the in-situ specimens examined.

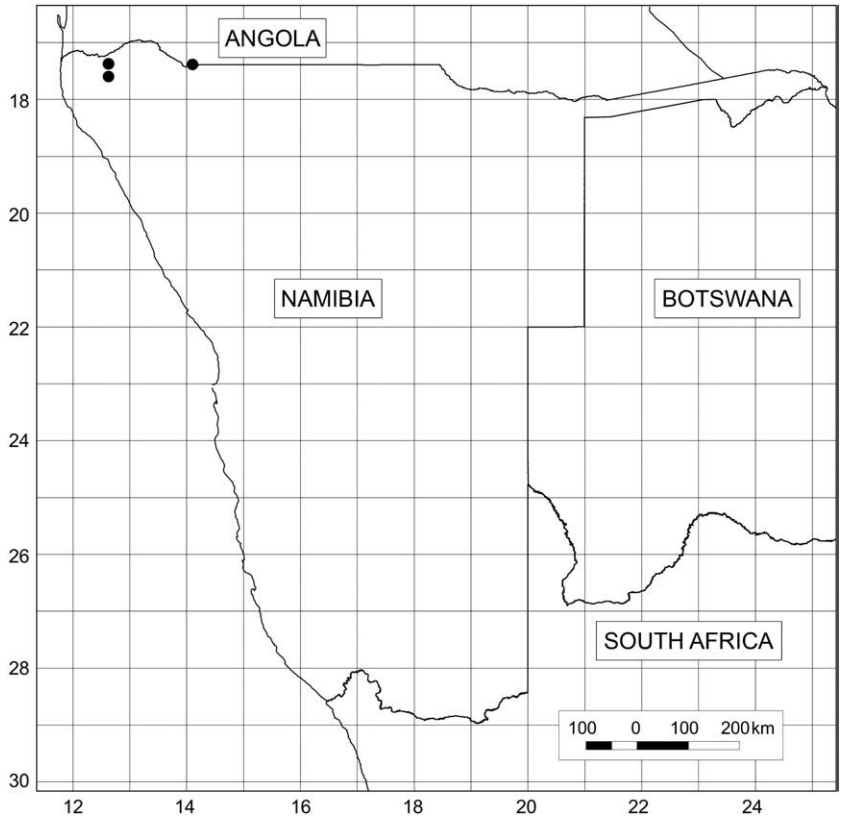

Fig. 3. Known distribution of *Euphorbia otjingandu*.

2.6. Etymology

The specific epithet refers to the vernacular Otjiherero name used by the local Ovahimba for the new species. Note, however, that the name *otjingandu* is also indiscriminately applied by the Ovahimba to *E. virosa* subsp. *virosa*. I would like to propose the names "shortstem candelabratree" and *kortstamnaboom* as English and Afrikaans vernacular names, respectively.

2.7. Specimens examined

Namibia, Kunene Region:

1712 (Posto Velho): Otjihipa Mountains, plateau of Otjihipu Peak (-BC), *Swanepoel 279* (WIND); along Van Zyl's Pass, 1 km W of Otjihende (-DA), *Swanepoel 268* (PRU, WIND).
1714 (Ruacana Falls): Kunene River Valley, 7.5 km WSW of Ruacana Falls, on slopes of calcrete terraces (-AC), *Swanepoel 269* (PRU, WIND).

Acknowledgements

I would like to thank Prof. A.E. Van Wyk, University of Pretoria, for advice and support, Prof. J. Jacobs for translating the diagnoses into Latin, Ms Hester Steyn, SANBI, for preparing the distribution map and Ms Lesley Deysel for the line drawings. The curator and staff of the National Herbarium of Namibia are thanked for their assistance during visits to the herbarium. The curator, National Herbarium, Pretoria, is thanked for access to their collections; the assistance of Ms Marie Jordaan during visits to the herbarium is acknowledged with thanks. I am grateful to the University of Pretoria for financial support. For assistance and companionship during field trips, I am especially grateful to my wife Hannelie and friends Ernst van Jaarsveld, Werner Voigt and Freddie Versfeld.

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Edited by JC Manning