# Encephalartos successibus (Zamiaceae): a new species from Uganda

### P. Vorster\* and P. Heibloem1

Botany Department, University of Stellenbosch, Private Bag X1, Matieland, 7602 Republic of South Africa

¹Present address: P.O. Box 700, Nambour, Queensland 4560, Australia.

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Encephalartos successibus, a new species from Uganda, is described, illustrated and circumscribed in terms of other tropical African arborescent species of Encephalartos. It is a large arborescent plant, with mostly non-overlapping leaflets. The strobili are green and glabrous; the megastrobilus is ovoid, shortly pedunculate but with peduncle buried in cataphylls so that the megastrobilus appears to be sessile, with the exposed faces of the megastrobilus more or less smooth; the microstrobili emerge in succession, being narrowly ovoid, long-pedunculate, with the exposed faces of the microsporophylls smooth.

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\*To whom correspondence should be addressed.

The genus *Encephalartos* is widespread in the eastern parts of Africa, from the Eastern Cape Province of South Africa to southern Sudan; extending westwards through equatorial Africa to Ghana and Nigeria (Figure 6). Nowhere is it common, occurring mostly as relic populations of which a considerable percentage must be considered as being in danger of extinction. The description of *E. successibus* brings the number of described and recognised taxa to 58.

### Encephalartos successibus Vorster, sp. nov.

Planta magna arborescens. Foliola bene disposita, recta vel minime leviter S-formia, dentibus in marginibus ambobus ad spationibus 25-50 mm. Strobili virides, glabri, bullarum porcis mediolateralibus integris et faciebus laevigatis; megastrobili ovoidei, sessiles; microstrobili in successione emergentes, anguste ovoidei, longe pedunculati.

TYPUS.— Western Uganda: Mpanga River falls, P. Heibloem sub P. Vorster 3033 (K, holotypus; MO, isotype).

Plant large, arborescent, unbranched (rarely with aerial branching after sustaining damage); suckering profusely from base. Stem up to 8 m long, reclining when exceeding 2 or 3 m, up to 450(-750) mm in diameter, covered with old leaf bases, with little or no woolly indumentum at the apex. Leaves numerous, spreading-ascending, straight and rigid, emerging fresh milky green and turning glossy green with age, 2.5-4.0 m long, sessile, slightly pubescent when emerging but glabrous at maturity, leaflets gradually reduced to prickles towards proximal part of frond; median leaflets orientated at angle of about 30° towards apex of frond, opposing leaflets 180° towards each other, very narrowly ovate and very slightly falcate or S-shaped, with teeth 20-70 mm apart on both margins, not or only slightly overlapping, hard and rigid, 180-260 mm long and 20-30 mm wide. Megastrobili 2-4, ovoid, sessile, milky green, glabrous, 300-400 mm long and 150-170 mm across; exposed faces of megasporophylls moderately projecting, terminal facet centrally situated and about 40-50% of the horizontal diameter of exposed face of megasporophyll, median facet differentiated in most sporophylls, ridges separating facets clearly differentiated and simple, facets more or less smooth. Microstrobili 4-8, emerging and maturing in succession, each carried on a stout peduncle up to 300 mm long; microstrobili milky green, glabrous, up to 350 mm long and 85-95 mm across at anthesis; exposed faces of microsporophylls

moderately projecting, slightly drooping at anthesis, only terminal facet differentiated and about  $V_3$  to  $V_2$  the horizontal diameter of exposed face of microsporophyll, smooth. Seed with red sarcotesta, about 38 mm long and 25 mm across; with sarcotesta removed about 32 mm long and 22 mm wide. (Figures 1–5).

#### Variation

Plants growing in more open situations (cf. Figures 4 & 5) have a very different general appearance from plants growing within the evergreen montane forest (see below). Understandably they are more compact with straighter and more rigid leaves than the etiolated forest plants, but they are also considerably smaller. Within the forest the plants attain stupendous dimensions with trunks up to 750 mm in diameter and up to 8 m long. The cones collected for study, including microstrobili at the pollen-shedding stage, retained their glaucous green pigmentation, but field reports indicate that they may sometimes turn pale yellow when maturing.

# Phenology

During July as well as September, the plants had fresh male and female cones. The megastrobilus collected for study (Figure 2e) proved to be not entirely mature but there were no megastrobili from the previous season left, suggesting that the seeds mature and are dispersed in less than a year, probably in about July. Seeds from the previous season were observed germinating in September. Like several tropical species of Encephalartos, including E. ferox Bertoloni f. (1851), E. gratus Prain (1916), E. hildebrandtii A. Braun & Bouché (1874), and E. imbricans Vorster (Vorster & Heibloem 1995), the extended period of pollen release manifested by the microstrobili maturing in gradual succession suggests a pollination syndrome different from the South African species where the microstrobili mature more or less simultaneously. Could it be that, close to the equator, the timing of maturation of the megastrobili by changing day length is less accurate than further from the equator, accessitating an extended period of pollen availability?

# Geographical distribution and habitat

It is known only from one vigorous population around the Mpanga River falls in western Uganda, at altitudes of 1 000 to 1 300 m (Figure 6), but there are unconfirmed reports of other populations along the Mpanga River, which debouches into Lake

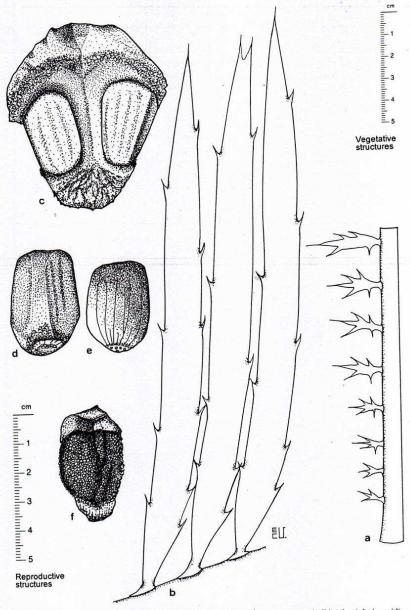


Figure 1 Encephalartos successibus: (a) proximal part of leaf; (b) median leaflets; (c) megasporophyll in abaxial view; (d) seed with sarcotesta; (e) seed with sarcotesta removed; (f) microsporophyll in abaxial view. Del. E.C. Vorster.

George. Plants occur for 1 to 2 km upstream as well as below the falls, but were not seen further than about 250 m from the shore. They grow on almost sheer granite faces and on rocky slopes, in association with *Euphorbia dawei* N.E. Br. amongst tall grass in savanna where the foliage is annually destroyed by fires (Figure 4), but also within dense evergreen montane forest. The forest habitat is so moist that the trunks and even the fronds are covered in lichens and bryophytes.

Baboons or chimpanzees as thought to eat (and possibly dis-

perse) the seeds (cf. Morris & Osmaston 4055), and we found evidence that the seeds are cleaned and dispersed by rodents.

# Conservation status

The population visited was particularly healthy, consisting of at least 5 000 to 10 000 sexually mature individuals. Seedlings and small plants were noticeably absent from open habitats where they are presumably destroyed by the annual grass fires. This

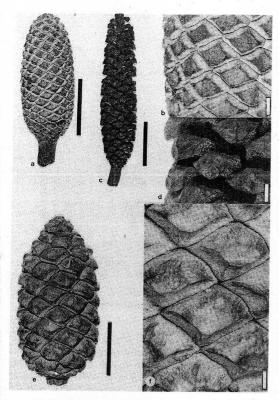


Figure 2 Encephalartos successibus: (a) microstrobilus in immature stage; (b) portion of immature microstrobilus, showing centrally situated terminal facets of exposed faces of microsporophylls; (c) microstrobilus at anthesis; (d) portion of microstrobilus at anthesis, showing drooping terminal facets of exposed faces of microsporophylls; (e) megastrobilus; (f) portion of megastrobilus showing more or less smooth facets of exposed faces of megasporophylls. Scale bars: a, c, e = 100 mm; b, d, f = 10 mm.

raises the question of whether the forest has receded in recent years, leaving the cycads marooned in the open. Underneath the forest canopy, seedling regeneration was found to be prolific, with thousands of seedlings and small plants in evidence, probably because fires do not penetrate into this moist habitat.

## Affinities

Within the genus *Encephalartos*, interspecific relationships are still poorly understood. For many years species were separated solely on vegetative characteristics (Vorster 1993). There does indeed seem to be a considerable amount of convergence in cone characteristics, yet these are often useful to circumscribe species, if not always reflecting phylogenetic relationships. It would appear that recurring vegetative characteristics may well be cryptic signposts of evolutionary kinship. The following is therefore intended to identify *E. successibus*, but is certainly not intended to infer phylogenetic relationships.

E. successibus is distinguished by its ovoid, sessile, glabrous, glaucous green megastrobili of which the surfaces of the exposed faces of the megasporophylls are more or less smooth; its multiple and successionally maturing, long-peduncled, glabrous, glaucous green microstrobili with smooth and slighly drooping



Figure 3 Encephalartos successibus: microstrobili in situ, showing well-developed peduncles and successive maturation of strobili. Scale bar = 100 mm.

exposed faces of the microsporophylls; and not- or only slightly overlapping leaflets which lack a concentration of 3 to 4 teeth at the base of the upper margin and instead have teeth at regular intervals along both margins.

It resembles *E. bubalinus* Melville (1957) in its green and ovoid megastrobili (Figure 2e), but differs by the megastrobili being completely sessile instead of peduncled, and by the long-peduncled instead of almost sessile microstrobili. In *E. successibus* the leaflets taper gradually to their apices (Figure 1b) whereas in *E. bubalinus* they are uncinate.

It resembles *E. imbricans* Vorster (Vorster & Heibloem 1995) in its green, ovoid megastrobili, but is readily distinguished by smooth instead of somewhat wrinkled facets of the exposed megastrobilate faces, and the not or only slightly (Figure 1b) instead of strongly overlapping leaflets. It also lacks the concentration of 3-4 teeth near the base of the upper leaflet margin.

It resembles E. laurentianus De Wildeman (De Wildeman 1903a, b, c, 1907; Bois 1907; Gentil 1904a, b; Lebrun 1930), with which it was confused by Prain (1917: 353-254), Robyns (1948: 1-2), Eggeling (1956: 104) and Heenan (1977: 282), mainly by its large stature. It has similar ovoid megastrobili, but these are sessile rather than well-peduncled and the facets of the exposed faces of the megasporophylls are smooth instead of somewhat wrinkled (Figure 2f). Like E. laurentianus it bears a large number of long-pedunculate microstrobili (Figure 3), but is distinguished by the absence of a characteristic thin indumentum of reddish-brown trichomes, and green rather than greenish-yellow pigmentation of the strobili (but see above under Variation). Vegetatively E. laurentianus is a very different species, with much larger (up to 500 mm long and 50 mm wide) and softer textured leaflets.

It resembles *E. septentrionalis* Schweinfurth (1871) by its ovoid megastrobili and long-pedunculate microstrobili, but differs in the sessile instead of very long- (up to 300 mm) peduncled megastrobili (Goode 1989: 239) and the glaucous green instead of greenish-yellow pigmentation of the strobili. It also lacks the concentration of up to 4 teeth near the base of the upper margin of the leaflet. Despite being known for 125 years, *E. septentrionalis* is not well known, and in view of its unusually wide geographical distribution (according to the map in Stevenson *et al.* 1990b: 157) (Figure 6) more than one species may be involved. In this respect it is worth noting that the very long megastrobilate peduncle depicted by Goode (1989: 239) is not mentioned elsewhere in the literature.

It resembles E. sclavoi De Luca, Stevenson & Moretti (Steven-

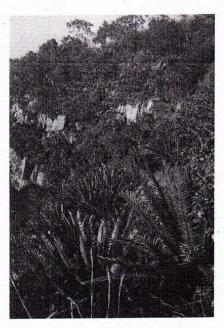


Figure 4 Encephalartos successibus: exposed part of habitat, showing dense concentration of relatively small plants.

son et al. 1990a, b) by the ovoid megastrobili, but differs in that the megastrobilus is sessile, both mega- and microstrobili are green with centrally placed terminal facets on the exposed faces of the megasporophylls (Figure 2b & f) instead of orange-yellow with terminal facets situated towards the proximal margins of the exposed faces of the megasporophylls, the long (up to 300 mm) instead of very short-peduncled (20–40 mm) microstrobili, and the narrower (up to 30 mm against up to 40 mm) leaflets.

Compared to *Encephalartos turneri* Lavranos & Goode (1985), both species have sessile megastrobili but in *E. turneri* the megastrobilus is narrowly ovoid instead of ovoid, the exposed faces of the megasporophylls project more, and it bears fewer microstrobili (up to 3 versus 4–8) on shorter peduncles (up to 120 mm instead of up to 300 mm). In both sexes of *E. turneri* the cones are not green but yellowish with a conspicuous pink bloom (Lavranos & Goode 1985). In *E. successibus* the leaflets are not or only slightly overlapping instead of strongly imbricate, and the apices taper to a fine point instead of being uncinate (Figure 1b).

E. successibus resembles E. ituriensis Bamps & Lisowski (1990) by its long-peduncled microstrobili. However, in E. ituriensis the megastrobilus is shortly cylindrical and the strobili of both sexes are yellow instead of green (Goode 1989). Moreover, the type collection of E. ituriensis (Lisowski 41057, BR) leaves the impression of relatively soft-textured and flaccid leaflets as in E. laurentianus, in marked contrast to the hard and rigid leaflets of E. successibus.

Other east African arborescent species with which we compared E. successibus are E. hildebrandtii A. Braun & Bouché (Braun & Bouché 1874; Stapf 1914; Prain 1915), E. kisambo Faden & Beentje (Faden & Beentje 1989; Moretti et al. 1989), and E. tegulaneus Melville (Melville1957). From all these it differs by its glaucous green instead of yellow cones, and the ovoid instead of cylindrical megastrobili. Yet in various respects it



Figure 5 Encephalartos successibus: a young plant in habitat, showing straight and rigid fronds. Scale bar = 1 m.

resembles these species, which probably indicates a near relationship. Therefore, in all four species the microstrobili are borne on very long peduncles which can be up to 300 mm long. In both E. successibus and E. hildebrandtii, the microstrobili emerge and mature in succession rather than simultaneously. This trait is shared by E. imbricans, E. gratus Prain from Malawi and E. ferox Bertoloni f. from southern Mozambique and South Africa, and is suspected to be present in at least some other tropical

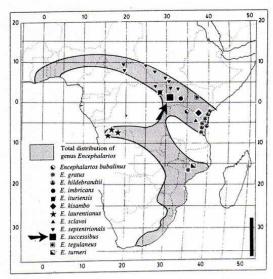


Figure 6 Encephalartos successibus: known geographical distribution in relation to those of other tropical African arborescent species of Encephalartos. Based on Stevenson et al. (1990b). Scale bar = 1 000 km.

African species including E. septentrionalis and E. laurentianus. In the South African species, in the E. manikensis Gilliland (Gilliland) complex (Gilliland 1938, 1939), the E. poggei Ascherson & Graebner group, (Ascherson 1878), and in E. barteri Miquel (1868) the cones emerge simultaneously. Leaflets of Kenyan material of E. hildebrandtii characteristically have 2 to 3 apical teeth; and though not common in E. successibus, occasional leaflets do show this trait which is also present in some (but not all) specimens of E. laurentianus (e.g. Lebrun 121, K).

#### Specimens seen

sub P. Vorster 3033 (K, MO), Doggett sub Johnston s.n. (K), Morris & Osmaston 4055 [K, 3 sheets (also in ENT & EA, not seen)].

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