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Encephalartos voiensis (Zamiaceae), a New East Central African Species in the *E. Hildebrandtii* Complex

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ENCEPHALARTOS VOIENSIS
(ZAMIACEAE), A NEW
EAST CENTRAL AFRICAN
SPECIES IN THE
E. HILDEBRANDTII COMPLEX

In the past 30 years, several locally endemic species of *Encephalartos* have been described for Central Africa. Most are from Mozambique (Dyer & Verdoorn, 1969; Lavranos & Goode, 1985), Zimbabwe (Dyer & Verdoorn, 1969), and, to a lesser extent, Zaire (Devred, 1959; Malaisse, 1969). All of these taxa are located west and southwest of a line connecting Lake Victoria, Lake Tanganyika, and Lake Niassa (Fig. 1). Little work has taken place on *Encephalartos* east of this line. In fact, the distribution map in the most thorough and

recent work on African *Encephalartos* (Melville, 1957) shows no collections between the line and the east coast of Africa other than two locally endemic species he described: *E. bubalinus* Melville and *E. tegulaneus* Melville. Heenan (1977) repeated Melville's (1957) descriptions and included a discussion of three undescribed and imperfectly known, presumably new taxa from this area.

One of us (JPS) has recently collected material of *Encephalartos* in the central border region of Kenya and Tanzania. In these collections there is

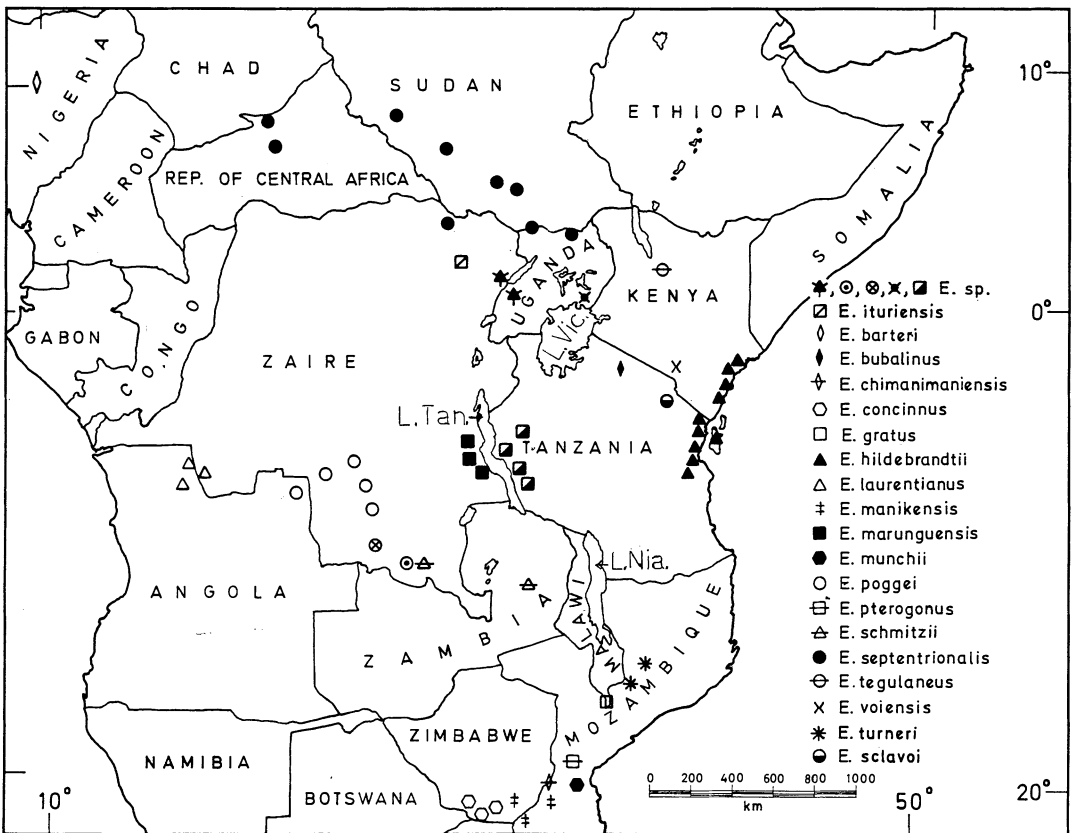


FIGURE 1. Distribution map of *Encephalartos* species in Central Africa. Derived, in part, from Melville (1957) and Devred (1959). L. Nia. = Lake Niassa, L. Vic. = Lake Victoria, L. Tan. = Lake Tanganyika.

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at least one new species, which is known to us from two localities near Voi, Kenya. This species appears in many respects, including locality, to correspond to Heenan's (1977) *Encephalartos* "sp. B." This species is described below and is followed by a discussion of its relationships and affinities to neighboring congeners.

***Encephalartos voiensis* Moretti, D. Stevenson & Sclavo, sp. nov.** TYPE: Kenya: Voi, 2 Jan. 1986 (♀), *Sclavo 1* (holotype, K). Figure 2.

Truncus erectus, ad 2.5 m altus, 35–70 cm diam. Cataphylla acuminato-lanceolata vel linearia, dense tomentosa. Folia 2–4 m longa, oblonga, ad basin abrupte attenuata; rachis glabra duobus sulcis superne praedita. Foliola mediana alternata vel subopposita, oblanceolata, subfalcata, sensim acuminata, pungentia, marginibus calloso-dentatis, dentibus 1–5, basi abrupte cuneata superne 1–5 infereque 0–1 spinosa, 25–40 cm longa, 4 cm lata; foliola inferiora abrupte diminuta, bifurcata; foliola infima in spinas mutata. Strobilus ♂ lineare-cylindricus, 45–50 cm longus, 10 cm diam.; pedunculus ebracteatus, 5–7 cm longus, 3–5 cm diam.; microsporophylla ad axin perpendicularia, deltoideo-cuneata, 35–40 mm longa, 22–25 mm lata, bulla deflexa praedita. Strobilus ♀ cylindricus vel ovoideo-cylindricus, 50–60 cm longus, 15–20 cm diam.; pedunculus ebracteatus, 5–7 cm longus, 3–5 cm diam.; megasporophylla mediana rhomboidea, 35 mm longa, 40 mm lata; pedicellus 10 mm longus, tribus abaxialibus faciebus praeditus; bulla rhomboidea, 40 mm lata, 18 mm alta, 24 mm profunda; bullae terminalis facies hexagona atque vulticulo praedita; adaxialis facies ex tribus trapezoidis partibus constituta atque tuberculata crista tuberculatoque margine praedita; lateralis bullae lobi 7–9 mm longi, 2–4 mm lati, ad latera complanati.

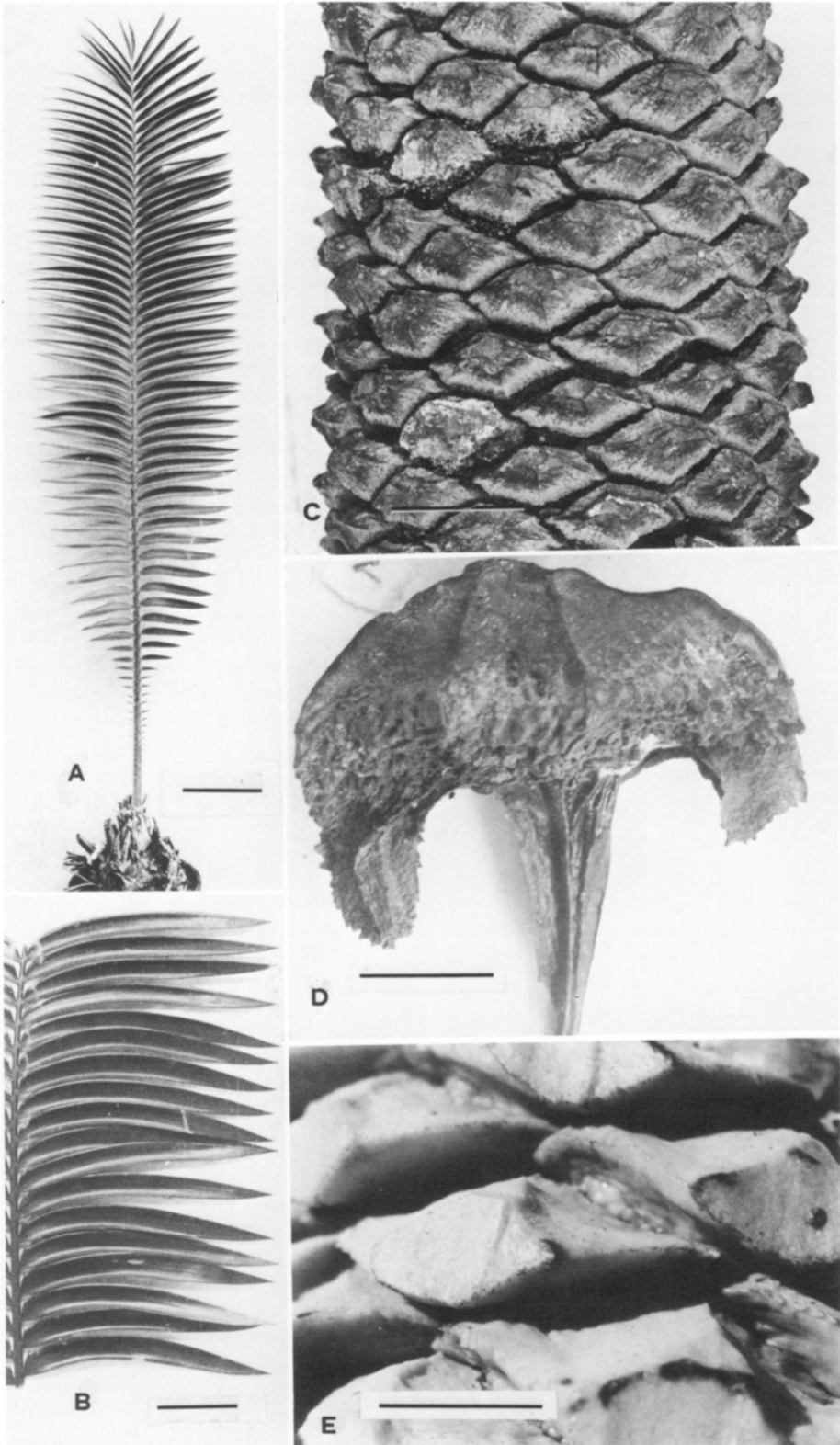
Trunk erect, to 2.5 m tall, 35–70 cm diam., straight to slightly tapering towards apex, leaf bases persistent. Leaves 2–4 m long, oblong, gradually tapered basally and becoming abruptly spinose in the lower 1/4. Petiole bulbous and tomentose. Rachis glabrous and with 2 shallow longitudinal adaxial grooves between leaflet insertions. Median leaflets alternate to subopposite, coriaceous, adaxially concave, blue-green, inserted at a right angle to the rachis and slightly oblique in the ab-adaxial plane, oblanceolate, subfalcate, 25–40 cm long, 4 cm wide, gradually acuminate apically and pungent, abruptly attenuate and strongly inequilateral basally, superior margin with 1–5 strong spinose teeth on the basal curve and with 1–5 barely discernible callose teeth along the rest, inferior margin with 0–1 small teeth basally and 1–5 barely discernible callose teeth along with the rest. Lower leaflets exhibiting an abrupt transition from those with 1 basal spinose tooth on the superior margin to those with bifurcate apices to completely reduced and pungent lower leaflets. Microsporangiate strobilus

long-cylindric, greenish yellow when young, yellow to tan when shedding pollen, 45–50 cm long, 10 cm diam.; peduncle without bracts, glabrous, 5–7 cm long, 3–5 cm diam. Median microsporophylls, 35–40 mm long, 22–25 mm wide, perpendicular to the strobilus axis, cuneate to deltoid, bulla deflexed, terminal facet triangular to pentagonal. Megasporangiate strobilus cylindrical to ovoid-cylindrical, green to yellow when young, yellow to tan when mature, 50–60 cm long, 15–20 cm diam.; peduncle ebracteate and glabrous, 5–7 cm long, 3–5 cm diam. Median megasporophylls pedicellate with rhomboid bulla, 35 mm long, 40 mm wide; pedicel with 3 abaxial facets, the median facet inconspicuous and triangular, 10 mm long. Bulla of megasporophyll rhomboidal, 40 mm wide, 18 mm high, 24 mm deep; the terminal facet slightly concave and hexagonal, 15–17 mm wide, 6–8 mm tall; adaxial face with 2 lateral trapezoidal facets, a median rectangular to trapezoidal facet, and a short median lobe 2–4 mm wide and long, the margin and seminal fringe tuberculate; abaxial face with 2 lateral trapezoidal facets and a median rectangular to trapezoidal facet with obtuse lateral sagittal ridges, the inferior ridge and sagittal crest tuberculate; lateral lobes 7–9 mm long, 2–4 mm wide, flattened laterally.

Additional specimens examined. KENYA: near Voi, Mlilonyi Hill, 4 Jan. 1986 (♂), *Sclavo 2* (EA, K, MO, NAP).

Encephalartos voiensis lives in isolated mountains surrounded by dry savanna in which species of *Encephalartos* do not occur. The new species occurs on steep rocky slopes in cloud forest at 1,500–1,800 m elevation as an understory plant. It also grows in partial shade and full sun areas of forest clearings.

Encephalartos voiensis shares some characters with *E. bubalinus*, *E. gratus* Prain, *E. hildebrandtii* A. Br. & Bouché, and *E. tegulaneus*, which are all found in the same general vicinity (Fig. 1); and, to a lesser extent, it resembles *E. manikensis* (Gilliland) Gilliland and its allies in Central Mozambique and in Zimbabwe. *Encephalartos voiensis* shares different features with each of these taxa. For example, foliage characteristics are closest to *E. bubalinus* and (especially) *E. hildebrandtii* in that 1–5 spinose teeth are present on the basal curve of the superior margin of the median pinnae, and at least one spinose tooth is present near the basal portion of the inferior margin. *Encephalartos voiensis* differs from these two species by having subfalcate, very abruptly cuneate basally, very dark green to blue-green leaflets, and the transition to



reduced leaflets in the lower $\frac{1}{2}$ of the rachis is abrupt rather than gradual. *Encephalartos voiensis* can be distinguished further from *E. bubalinus* because the former has median leaflets 4 (vs. 1–2) cm wide, 25–40 (vs. 10–20) cm long, and gradually acuminate (vs. acute) apices. In general, in *E. hildebrandtii*, the median leaflet apices are either bifurcate or trifurcate; in *E. voiensis*, by contrast, they are always pungent. Moreover, the median leaflets of *E. hildebrandtii* have up to nine spinose teeth along each margin; in *E. voiensis* these teeth are reduced to barely discernible callose bumps.

The mega- and microsporangiote strobili of *E. voiensis* resemble those of *E. bubalinus*, *E. gratus*, *E. hildebrandtii*, and *E. tegulaneus* with respect to overall size, shape, and color. There are, however, significant differences in mega- and microsporophyll characters. As in vegetative characters, *E. voiensis* shares individual characters with each of the aforementioned species, but none that is common to all except perhaps the presence of inferior and sagittal crest tubercles. For example, only *E. gratus* and *E. voiensis* have a rectangular, not trapezoidal adaxial median lobe. This median lobe is 5–12 mm long in *E. gratus* but only 2–4 mm long in *E. voiensis*. *Encephalartos tegulaneus* has a unique abaxial tuberculate facet that replaces the abaxial angle of the pedicel of its megasporophylls. This feature also occurs in *E. voiensis*, but here the facet is narrower, usually does not extend the full length of the pedicel, is barely discernible in herbarium material, and is nontuberculate. The ab- and adaxial margins of the bulla of the megasporophylls of *E. voiensis* and *E. hildebrandtii* are tuberculate and without ridges, whereas those of *E. bubalinus*, *E. gratus*, and *E. tegulaneus* always have some distinct ridges. The overall appearance of the megasporophylls of *E. voiensis* in shape and arrangement of the bulla facets is most similar to those of *E. hildebrandtii*. Compared with the previously discussed taxa, the lateral lobes of the bulla of *E. voiensis* are uniquely smaller and thinner and appear laterally compressed in the ab-adaxial plane.

The deltoid to cuneate microsporophylls of *E. voiensis* are more similar to those of *E. bubalinus* than to the oblong microsporophylls of *E. gratus*,

E. hildebrandtii, and *E. tegulaneus*. In addition, only *E. voiensis* and *E. bubalinus* have their microsporophylls inserted at a right angle to the strobilus axis at pollen shedding, whereas in the other species they are either ascendant as in *E. gratus* and *E. hildebrandtii* or descendant as in *E. tegulaneus*. *Encephalartos voiensis* has a median facet on the ab- and adaxial bulla faces; these median facets are not present in *E. gratus*.

Encephalartos voiensis exhibits little variability except that some leaflet characters appear to be associated with habitat differences. The leaflets of plants growing in deep shade are thinner in texture and barely subfalcate, and they generally have fewer and smaller marginal spinose teeth. Only shade plants exhibit these features, and they would most likely change under exposure to higher light intensities, as Stevenson et al. (1986) observed in *Ceratozamia latifolia* under otherwise similar conditions.

Even though the relationship of *E. voiensis* is not completely clear, it is our opinion, based on vegetative morphology, that *E. voiensis* is most closely related to *E. hildebrandtii*. This is because in the cycads, in general, vegetative characters are more useful in separating species as, for example, in *Ceratozamia* (Stevenson et al., 1986), *Dioon* (Sabato & De Luca, 1985), and *Macrozamia* (Johnson, 1959). There are several reasons for this. First, vegetative characters are always present and often exhibit more obvious macroscopic diversity than do reproductive characters. Secondly, most data concerning reproductive characters are either fragmentary or nonexistent, and herbarium material is highly unreliable because of the vast amount of distortion of size and shape induced by drying. Thirdly, because all cycads are dioecious, we think it is important to establish vegetative characters that can be correlated with reproductive characters to establish a common denominator. In the case of the species discussed in this work, microsporophyll and megasporophyll characters do help corroborate the species delimitations indicated by vegetative characters. Finally, cycads often exhibit extreme changes in vegetative morphology between species of different habitats and/or localities while at the same time exhibiting only subtle differences in reproductive morphology. These vegetative changes

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FIGURE 2. *Encephalartos voiensis*. A, B. Leaf and leaflet characters. —A. Leaf with characteristic abrupt transition to reduced spinose leaflets in lower portion. Scale bar = 20 cm. —B. Subfalcate leaflets of holotype with spinose teeth. Scale bar = 10 cm. —C. End view of megasporophylls. Scale bar = 5 cm. —D. Adaxial view of megasporophyll of the holotype. Scale bar = 1 cm. —E. End view of a microsporophyll. Scale bar = 1 cm.

are stable and remain so even when the species are brought together and cultivated through successive generations in a uniform environment.

The high incidence of locally endemic species of *Encephalartos* in Central Africa appears to be related to habitat preference and physical geography in this region. That is, in general, *Encephalartos* here prefers steep wooded slopes, and this habitat occurs in isolated areas surrounded by savanna in which this genus does not occur. Even

E. hildebrandtii (Fig. 1) occurs at the top and on the sides near the top of coastal cliffs and on the sides of river valleys. With the appropriate habitats isolated from each other, there is the opportunity for locally endemic taxa to differentiate. *Encephalartos voiensis* fits this pattern because it also occurs on steep slopes of isolated mountains surrounded by savanna. As more areas of Central Africa are explored for *Encephalartos* populations, more new taxa will certainly be discovered.

KEYS TO EAST CENTRAL AFRICAN SPECIES OF *ENCEPHALARTOS*

KEY TO VEGETATIVE PLANTS

- 1a. Median leaflet apices bi- or trifurcate *E. hildebrandtii*
 1b. Median leaflet apices sharply pointed, ending in a spikelike tip.
 2a. Median leaflets subfalcate *E. voiensis*
 2b. Median leaflets linear to oblanceolate.
 3a. Median leaflets linear, narrower than 2 cm *E. bubalinus*
 3b. Median leaflets lanceolate or oblanceolate, wider than 2 cm.
 4a. Median leaflets oblanceolate, margins reflexed, distinctly striate below *E. tegulaneus*
 4b. Median leaflets lanceolate, margins flat, indistinctly striate below *E. gratus*

KEY TO MEGASPORANGIATE PLANTS

- 1a. Microsporophylls oblong, either ascendant or descendant at pollen shedding.
 2a. Bulla puberulent *E. gratus*
 2b. Bulla glabrous.
 3a. Microsporophylls ascendant *E. hildebrandtii*
 3b. Microsporophylls descendant *E. tegulaneus*
 1b. Microsporophylls deltoid to cuneate, at right angles to strobilus axis at pollen shedding.
 4a. Lateral ridges of bulla acute *E. bubalinus*
 4b. Lateral ridges of bulla subacute to obtuse *E. voiensis*

KEY TO MEGASPORANGIATE PLANTS

- 1a. Median lobe of bulla well developed, 7–12 mm long, bulla puberulent *E. gratus*
 1b. Median lobe of bulla absent or if present shorter than 5 mm, bulla glabrous or nearly so.
 2a. Median lobe of bulla 2–4 mm long *E. voiensis*
 2b. Median lobe of bulla absent.
 3a. Bulla subtriangular, abaxial angle of pedicel absent *E. tegulaneus*
 3b. Bulla rhomboid, abaxial angle of pedicel present.
 4a. Adaxial margin of bulla with radiating ridges *E. bubalinus*
 4b. Adaxial margin of bulla with tubercles *E. hildebrandtii*

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