Cycad Focus Focus Focus Focus Focus

Encephalartos kisambo

Taxonomic History, Conservation Status & Morphologic Affinities of *Encephalartos kisambo* Faden & Beentje

Jody Haynes

INTRODUCTION

Encephalartos kisambo Faden & Beentje, the 'Voi cycad,' is a large, stately plant from the Voi region of Kenya (and possibly Tanzania [see below and the article on pp. 6-14, this issue]). Even though it is not typically suitable for small gardens due to its imposing size (Fig. 1), it has become a fairly common species in both private and public collections worldwide. While it is now fairly well-known in cultivation, many collectors and enthusiasts may not be familiar with the intricacies of its taxonomic history, conservation status, or morphologic affinities. This article will provide information from early records of the species (before it was formally described), from its formal description in 1989 (and its synonym, *E. voiensis* Moretti, D.W. Stev. & Sclavo from later the same year), and from the recent description of *E. kanga* from northeastern Tanzania that is considered by some to be nothing more than a reddish-coned population of *E. kisambo*.

THE DISCOVERY

Whitelock (2002) reported that *Encephalartos kisambo* was discovered in 1970 near Voi, Kenya, by Robert Archer, who was an American working in the East African Herbarium in Nairobi. Jones (1993) had earlier given the date as 1973 and ascribed no one in particular to the discovery, while Goode (1989) suggested that the species was discovered during one of Heenan's expeditions into central and eastern Africa in 1973-74. If one examines the list of specimens provided in the original description (Faden & Beentje, 1989), it becomes clear that Archer had, indeed, discovered (and collected specimens of) *E. kisambo* in 1970—prior to Heenan's expeditions—as had Robert Faden the following year.

Regardless of which of the above dates is correct, it should be no surprise that the species was not mentioned in Melville's (1957) comprehensive treatment of the cycads of central Africa, in Melville's contribution to Turrill and Milne-Redhead's (1958) *Flora of Tropical East Africa*, or in Lewis's (1960) contribution to *Flora Zambesiaca*. In fact, the first known published information on the species was in Heenan's (1977) revision of the central and eastern African cycads nearly two decades later. Using data and specimens collected by his son (Heenan, 1977; Dave Heenan, pers. comm.), Heenan reported the following about the "imperfectly known" species that he referred to simply as "*Encephalartos* sp. 'B' ('Voi')":

> Trunk up to 2.2 m high, 0.35-0.6 m diameter, with a tendency to taper towards the top. Leaf scars very irregular in size and shape varying from horizontally distended triangles 30 by 60 mm to parallelograms 60 by 80 mm. The most noticeable feature of this species is the unusually swollen base of the rachis with the subsequent distinctive leaf scars on the caudex. Leaves mainly oblong, rounded at apex and narrowing gradually to the base, up to 3.7 m long by 0.65 m wide. Leaflets linear lanceolate, pungent, coriaceous, 250-350 mm long by 30-40 mm wide, overlapping and mainly subopposite, becoming trifurcate, bifurcate and finally with up to 15 pairs of spines terminating about 80 mm from the base of the greatly swollen rachis, which is not grooved. Median leaflets usually with 4-6 distinct spines on the upper margin, usually with 3-4 of these spines close to the basal attachment; lower margin entire, sometimes with up to two smaller spines; under-surface clearly striate with 30-45 parallel nerves.
>
> Th[is] species occur[s] ... S.E. of Voi ..., Kenya in the Maunga Mountains at an altitude of about 1000 m [specific locality information intentionally removed]. The colonies are to be found ... growing in partial shade and in open country. It is worth noting that all specimens growing in the open reached only two-thirds the size of those in partial shade with regard to both trunk and leaf development, probably indicative of the more favourable humid conditions under the forest canopy.

Heenan (1977) also provided a sketch (Fig. 2) of a median leaflet of "*Encephalartos* sp. 'B' ('Voi')" next to leaflets of his "*Encephalartos* sp. 'A'" (which would later be described as *E. sclavoi* De Luca, D.W. Stev. & A. Moretti) and a "form" of *E. laurentianus* De Wild. from Mpanga, Uganda (which would later be described as *E. whitelockii* P.J.H. Hurter).

THE SPECIES GETS A NAME (OR TWO)

Encephalartos kisambo

Faden and Beentje (1989) published their description nearly 20 years after its discovery and a dozen years after Heenan first wrote about it. They credited Heenan (1977) for the first report of this species in the literature and explained that 'kisambo' is the local name for the plant in the Taita language. They also stated that the plants typically grow in evergreen mist forest and occasionally on exposed slopes in dry bushland at altitudes of 800-1050 m. According to the authors, this species was, at that time, known with certainty only from a very small area—approximately 160 ha in size—in the Maungu Hills. While Heenan (1977) had reported it from two other locations, Faden and Beentje warned that these additional reports would require confirmation.

Faden and Beentje (1989) went on to say that *Encephalartos kisambo* is "perhaps most closely related to *E. hildebrandtii*," which they reported differs from the latter in having falcate leaflets with fewer marginal serrations, larger male cones with less sharply

Fig. 1. Three large plants of **Encephalartos kisambo** *in a private garden in Homestead, Florida.*

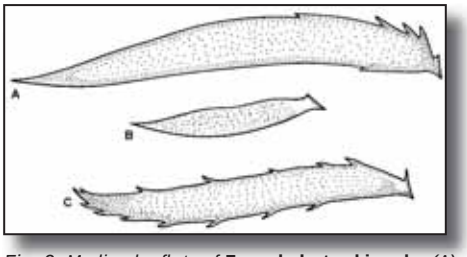

Fig. 2. Median leaflets of **Encephalartos kisambo** *(A),* **E. sclavoi** *(B), and* **E. whitelockii** *(C) (modified from Fig. 1 of Heenan [1977]).*

deflexed bullae, female cones with shallower bullae and trapezoidal rather than rectangular median facets, and orange-yellow rather than red seeds (Fig. 3). It also reportedly differs from *E. tegulaneus* Melville in having larger, more closely spaced leaflets that lack serrations on the lower margin, male cones with shorter median sporophylls and bullae that are more deflexed, and female cones with narrower and shallower bullae on the median sporophylls. It differs from *E. bubalinus* Melville, then, by having larger leaves and leaflets, larger male cones bearing median sporophylls that are larger and proportionately narrower, and female cones with narrower bullae. Finally, the authors reported that *E. kisambo* differs from *E. sclavoi* (which had not yet been described), with the latter having much smaller leaves and leaflets that either lack serrations entirely or have only one or two on the lower margin.

Interestingly, Faden and Beentje (1989) also mentioned that the only other specimen that they had seen that may belong to *Encephalartos kisambo* was collected by Tamas Pócs from the Kanga Mountains of Tanzania. Although they believed that the Kanga plant was not *E. kisambo* based on differences in leaflet morphology, they withheld final judgment until cones could be examined.

Encephalartos voiensis

The synonymous description of *Encephalartos voiensis* later in 1989 (Moretti *et al*., 1989) was based on collections made by Jean Pierre Sclavo and seems to have been published with no apparent knowledge of the earlier description of the same species. The authors mentioned Heenan's (1977) brief report on the species and provided a useful set of diagnostic keys to distinguish their *E. voiensis* from four other east-central African species (see below).

CONSERVATION STATUS

Encephalartos kisambo has long been considered Vulnerable or Endangered because of its restricted distribution in an area prone to habitat destruction and over-collection (Beentje, 1988; Faden & Beentje, 1989). Golding and Hurter (2003) confirmed the Endangered assessment and gave the global status as EN A1cd; B1+2ce based on the 1994 IUCN Red List categories and criteria (IUCN, 1994). In the 'Cycad Action Plan', Donaldson (2003) listed the species as Endangered (EN A2cd; B1ab(ii, iii,v)+2ab(ii,iii,v)) based on the revised IUCN categories and criteria (IUCN, 2001) and reported 5,200 plants in the wild with the population exhibiting a high rate of decline due to over-collecting, habitat destruction, and traditional use. Donaldson also stated that this species did not, at that time, occur in any protected reserves. In a later chapter of the Cycad Action Plan, Walters (2003) stated that *E. kisambo* was then represented in general collections but not in any private or genebank collections. The *CITES Significant Trade Review of Cycads* (TRAFFIC, 2003) also listed the species as Endangered and reiterated that there were 5,200 plants in habitat and that it was being impacted by wild trade. Finally, the 2008 IUCN Red List (IUCN, 2008) listed the species as Endangered, provided the same global assessment as Donaldson (2003), and verified that the population trend was still decreasing.

MORPHOLOGIC AFFINITIES

As mentioned above, Faden and Beentje (1989) suggested that their new species had a morphological affinity to *Encephalartos hildebrandtii*. Although Moretti *et al*. (1989) admitted that the relationship of their synonymous *E. voiensis* was not completely clear, they also believed that it was most closely related to *E. hildebrandtii* based on vegetative morphology. The latter authors also indicated that the species shares characters with *E. bubalinus*, *E. gratus* Prain, and *E. tegulaneus* and used the most obvious differences to create separate diagnostic keys for vegetative, male cone, and female cone traits (see below).

Vorster (2004) later created 18 subgroups within *Encephalartos* based on shared morphology and geographic proximity. His 'Group 13' included *E. bubalinus*, *E. equatorialis* P.J.H. Hurter, *E. hildebrandtii*, *E. ituriensis* Bamps & Lisowski, *E. kisambo*, *E. sclavoi*, *E. tegulaneus*, and *E. whitelockii* based on their east-central African distributions and the presence of several unique morphological traits.

A recent molecular study confirmed that the species that are genetically most closely related to *Encephalartos kisambo* are those that are also closest geographically and morphologically (Fig. 4; Treutlein *et al*., 2005).

Diagnostic Key

The following vegetative key (adapted from Moretti *et al*. [1989]) should help collectors and enthusiasts better identify the various species in Vorster's (2004) Group 13. Also included in the key is *Encephalartos laurentianus*—which Vorster (2004) placed in its own Group 15—because it is a large, arborescent species from central Africa that is becoming more common in collections and bears certain vegetative similarities to the members of Group 13.

Comments on *Encephalartos kanga*

Two years ago another large, narrowly endemic *Encephalartos* species was described from Mt. Kanga in northeastern Tanzania (Pócs & Luke, 2007). The authors of the new species—which they named *E. kanga* Pócs & Q. Luke after its restricted region of endemicity—admitted a close morphologic resemblance to *E. kisambo* but believed that the Kanga plant differed in having leaflets with a prominent "leaflet shoulder" bearing serrations that protrude across the rachis, dark green rather than "soapy green" leaves, a smooth and terete rather than somewhat flattened and ridged rachis, and several characters of the female cone. The authors also stated that, while P. Vorster

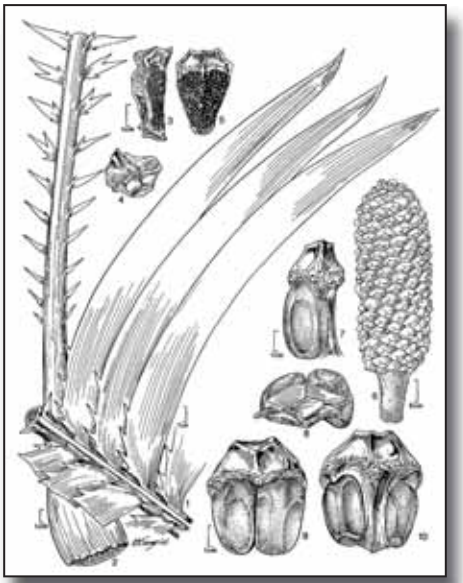

Fig. 3. Illustration of **Encephalartos kisambo** *from the original species description (Fig. 1 of Faden & Beentje [1989]; reprinted with permission).*

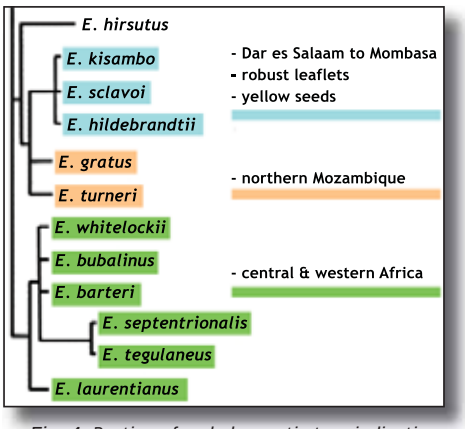

Fig. 4. Portion of a phylogenetic tree indicating purported genetic relationships among several eastern and central African Encephalartos *species based on ITS 1&2 molecular markers (adapted from Fig. 2 of Treutlein* et al. *[2005]). (Note: Morphological characters and geographic distributions are superimposed on the three primary phylogenetic groupings [= clades], and the taxa within each clade that share these characters and distributions are highlighted with the same color.)*

believed that these features suggested a close, perhaps conspecific relationship with *E. kisambo*, they felt the differences were significant enough to warrant specific status. Please refer to the article on pp. 6-14 in this issue (Haynes, 2009) for a more in-depth discussion of *E. kanga*.

LITERATURE CITED

Beentje, H.J. 1988. Atlas of the rare trees of Kenya. *Utafiti* 1:71-123.

Donaldson, J.S. 2003. Regional overview: Africa. Pp. 9–19, *In*: J.S. Donaldson (ed.), *Cycads: Status Survey and Conservation Action Plan*. IUCN/SSC Cycad Specialist Group. IUCN, Gland, Switzerland.

Faden, R.B. & H.J. Beentje. 1989. *Encephalartos kisambo*, a new cycad from Kenya, with a note on *E. tegulaneus*. *Utafiti* 2:7–10.

Golding, J.S. & P.J.H. Hurter. 2003. A Red List account of Africa's cycads and implications of considering life-history and threats. *Biodiv. & Conserv.* 12:507–528.

Goode, D. 1989. *Cycads of Africa*. Tien Wah Press, Singapore.

Haynes, J. 2009. *Encephalartos kanga* Pócs & Q. Luke — A Newly Described 'Red Cone Cycad' from Tanzania. *The Cycad Newsletter* 32(1):6-14.

Heenan, D. 1977. Some observations on the cycads of Central Africa. *Bot. J. Linn. Soc.* 74:279–288.

IUCN. 1994. IUCN Red List categories. Prepared by the Species Survival Commission. IUCN, Gland, Switzerland.

_____ 2001. *IUCN Categories and Criteria, Ver. 3.1*. IUCN Species Survival Commission, Gland, Switzerland. <http://www.redlist.org/info/categories_criteria2001.html>. Accessed Jan. 2008.

_____ 2008. *2008 IUCN Red List of Threatened Species*. <http://www.iucnredlist.org>. Downloaded 26 Jan. 2009.

Jones, D.L. 1993. Cycads of the World: Ancient Plants in Today's Landscape. Smithsonian Institution Press, Washington, DC.

Lewis, J. 1960. Gymnospermae: Cycadaceae. *Flora Zambesiaca* 1(1):79–83.

Melville, R. 1957. *Encephalartos* in Central Africa. *Kew Bulletin* 12:237–257.

Moretti, A., P. De Luca, J.P. Sclavo & D.W. Stevenson. 1989. *Encephalartos voiensis* (Zamiaceae), a new east central African species in the *E. hildebrandtii* complex. *Ann. Miss. Bot. Gard.* 76:934–938.

Pócs, T. & Q. Luke. 2007. A new species of *Encephalartos* (Zamiaceae) from Tanzania. *J. E. Afr. Nat. Hist.* 96:193–201.

TRAFFIC East/Southern Africa. 2003. *Review of Significant Trade: Cycads*. Report PC14 Doc. 9.2.2, submitted to CITES Nov. 2003.

Treutlein, J., P. Vorster & M. Wink. 2005. Molecular relationships in *Encephalartos* (Zamiaceae, Cycadales) based on nucleotide sequences of nuclear ITS 1&2, Rbcl, and genomic ISSR fingerprinting. *Pl. Biol.* 7:79-90.

Turrill, W.B. & E. Milne-Redhead. 1958. *Flora of Tropical East Africa*. Crown Agents, London, UK.

Vorster, P. 2004. Classification concepts in *Encephalartos* (Zamiaceae). Pp. 69–83, *In*: T. Walters & R. Osborne (eds.), *Cycad Classification: Concepts and Recommendations*. CABI Publishing, Oxfordshire, UK, and Cambridge, MA.

Walters, T. 2003. Off-site collections. Pp. 48–53, *In*: J.S. Donaldson (ed.), *Cycads: Status Survey and Conservation Action Plan*. IUCN/SSC Cycad Specialist Group. IUCN, Gland, Switzerland & Cambridge, UK.

Whitelock, L.M. 2002. *The Cycads*. Timber Press, Portland, OR.

Table I. Vegetative key to *Encephalartos kisambo* and related species

1a. Median leaflet apices typically bi- or trifurcate 2
  2a. Leaflets soft-textured or leathery.....3
    3a. Leaflets to 25 cm long and 3 cm wide, petiole ≤ 5 cm.....*E. ituriensis*
    3b. Leaflets 35-50 cm long and 4-7 cm wide, petiole to 30-40 cm .....*E. laurentianus*
  2b. Leaflets rigid.....4
    4a. Leaves strongly keeled, median leaflets succubously overlapping.....*E. equatorialis*
    4b. Leaves relatively flat in cross section, median leaflets not overlapping.....5
      5a. Leaflet apices oriented apically, leaves green-emergent.....*E. whitelockii*
      5b. Leaflet apices not oriented apically, leaves red-emergent.....*E. hildebrandtii*
1b. Median leaflet apices ending in a single pungent tip 6
  6a. Leaves 1.7-2 m long, petiole to 20 cm long, leaflet apices recurved/hooked .....*E. sclavoi*
  6b. Leaves > 2 m long, petiole short or absent, leaflet apices not recurved 7
    7a. Median leaflets subfalcate to falcate, 24-37 cm long.....*E. kisambo*
    7b. Median leaflets linear to oblanceolate, < 24 cm long.....8
      8a. Leaflets linear, ≤ 2 cm wide, margins flat or slightly revolute .....*E. bubalinus*
      8b. Leaflets (ob)lanceolate, > 2 cm wide, margins strongly revolute .....*E. tegulaneus*

Encephalartos kisambo in cultivation - Athi River, Kenya

Andrew Cameron

In the years leading up to 2002, the Kenya National Museum in Nairobi was in the process of trying to establish a national botanic garden. In an effort to conserve species and educate the public, a large number of endangered plants (mostly trees and shrubs) had been collected and grown from seed. These plants were grown for several years on the museum grounds until February 2002, when it was decided that some of the extra plants should be distributed to various individuals who were capable of responsibly planting them out and preserving them. Of the thirteen species collected as being suitable for this location, we were extremely fortunate to receive fifteen *Encephalartos kisambo* plants.

Encephalartos kisambo is only found in small, remote locations on the slopes of some isolated hills situated in southeastern Kenya. Its natural habitat has been increasingly destroyed due to population pressure resulting in the clearance of bushland for subsistence farming and the never-ending destruction of forest for charcoal burning—thus resulting in its endangered status.

This area of Kenya, located around 30 km (20 miles) south of Nairobi, has proven to be very suitable for the cultivation of cycads, especially *Encephalarto*s. At an altitude of 1,450 m above sea level (4,750 feet), our normal diurnal temperature ranges from around 28ºC (82ºF) during the day to 12ºC (53ºF) at night. Our average annual rainfall is 600 mm (23 in.), approximately 55% of which falls during the "long rains" of March, April, and May, and 35% falling over the "short rains" of October and November. Daytime humidity generally ranges between 20-30%, with a nighttime humidity of 80-100%.

The donated cycads were planted out during the long rains of April/May 2002 next to an area already planted with several *Cycas* species and other

Kenyan *Encephalartos* the previous year. Some were planted out in mostly full sun and others in a shady location with only patchy sunlight. This mixed planting has resulted in some marked differences in plant physiology, which would normally be expected in such circumstances. Apart from the speed of growth—which seems much better in the sunny location—the main difference is the spacing of the leaflets on the rachis. Plants grown in shade have leaflets spaced farther apart than those in sunny areas. In addition, plants growing in the sun generally produce nine to 11 new leaves per flush, whereas those in the shade only produce three to seven leaves.

In cultivation, *Encephalartos kisambo* has proven to be a pleasure to grow, and in fact seems to compete with *E. tegulaneus* in vigor and growth rate. These plants receive a heavy mulching of compost and manure during drier periods, which provides plentiful nutrients during the rainy seasons and times of new leaf development. New leaves normally emerge in October/November, after a prolonged dry period of four to five months, and continue developing into December. These plants have yet to cone, but it is expected that they will cone at the same time as *E. hildebrandtii*—which in this location is generally in November and December. No specific susceptibility to any particular pests or diseases has been noted so far. And in this climate, it is apparent that planting in full sun is the better option for optimal growth.

Fig. 2. Encephalartos kisambo *growing in full sun (A) and shade (B) seven years after planting out. The caudex width on the largest plant in the sun is 40 cm (16 in.) in diameter, with a leaf height of 250 cm (100 in.).*

Fig. 1. Leaves of Encephalartos kisambo *from full sun (A) and shady (B) locations in Athi River, Kenya.*

Upcoming "Cycad Focus" Articles

Caribbean *Zamia* (Part II) . Jun. 2009
Zamia skinneri **complex** . Sep. 2009
Lepidozamia hopei ..... Dec. 2009

Growing Kisambos in Hawaii

Greg Holzman

Encephalartos kisambo has been one of the greatest discoveries in cycad cultivation I have ever experienced. I first saw it at Fairchild Botanical Garden in 1991. The thing that struck me most about this plant was how neat and tidy it appeared to be. Leaflets stack up with such perfect, symmetrical form that it needs nothing else to complement it. It can just be placed in the middle of a nice lawn, and it would catch everyone's eye. This cycad is large and is not for the small garden collection. On the other hand, I have a few that I have had in pots for 15 years that have stayed small and have not really outgrown their space. But if the roots get out of the pot…look out!

This cycad has leaves that are very erect when they first flush and spread to a 60º angle within the year. This is a cycad that, when mature, does not need to hold more than one flush of leaves at a time because the leaf flush is massive: 30-70 leaves are known to be produced in some plants. The leaves range from 8-12 feet long and seem to become more striking with a little shade, but the plants flush more often and produce more leaves at a time in a sunny location. Male plants seem to cone every year, while the females seem to take a year off every other year. We have had trouble with rotting cones that can turn black before they are receptive. We have also noticed that if the leaves are cut back too close to the caudex it can create crown rot. The leaf bases are huge, so this might be the reason. I cut the leaves back 3/4 of the way at first, allowing some time to let the plant adjust before cutting the leaves back further when they are older.

Besides these few issues, I have experienced no other adverse problems that have caused me to consider *Encephalartos kisambo* anything but the perfect feature cycad for just about any condition or soil type. I have it growing well in very dry conditions, and it looks great. I also have it in very wet soil conditions. Deep shade creates a

Fig. 2. Encephalartos kisambo *immature male cones.*

Fig. 2. Encephalartos kisambo *immature female cone.*

completely different look to the plant, with longer, arching leaves and amazing, long, perfect, dark green leaflets. In a sunny location, the plants are very compact and can be a bit paler green color, but with extra nitrogen in the fertilizer this can be changed to a nice dark green.

I have put these in the front yard of homes with pure sand lined with a circle of rocks. This cycad needs no mounding and seems to have no problem handling extra water. I have not experienced anything but "shock and awe" over this species, as the years just make it more beautiful if it is given enough room to show itself off. It's symmetry is really stunning as a perfect feature plant.

One thing I have observed in *Encephalartos kisambo* over the years is that it rarely ever suckers, which keeps it very clean and easy to maintain. The female cones are very easy to pollinate, and seedlings can look a lot like *E. hildebrandtii* when they are young but have a little glaucous color to the new leaves when they are soft. The plants take a bit longer to mature than some Central African cycads probably because of the very large size that the caudex gets before maturity. The plants have no special needs other than a lot of room for the roots and leaves. I think that this plant will become a commercially accepted African cycad in the years to come.

Fig. 2. Encephalartos kisambo *growing under nursery conditions*