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**Abstract**

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## A NEW SPECIES OF *ENCEPHALARTOS* (ZAMIACEAE) FROM TANZANIA

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### ABSTRACT

*Encephalartos kanga* sp. nov. is described from Mount Kanga, an isolated hill of the Nguru Mountains within the crystalline, Precambrian Eastern Arc Mountains of Tanzania. The new species is distinguished by its spinose distal leaflet-shoulders with otherwise entire median leaflet margins and by the sharply tuberculate-dentate proximal side of the seminal ridge of the female cone scales.

**Keywords:** Cycads, Eastern Arc Mountains, endemism, Mount Kanga, Nguru Mountains

### INTRODUCTION

Mount Kanga is a satellite of the Nguru Mountains, a steep rocky hill reaching a height of 2018 m (figure 1), a member of the Precambrian Eastern Arc Mountains of Tanzania and southern Kenya, notorious for its richness in endemics, new species and relic species in common with Madagascar or related to Malagasy taxa, like many bryophytes and even a few phanerogams (Pócs 1975, 2000, 2007; Pócs *et al.*, 1990; Luke & Beentje, 2003; Knox *et al.*, 2004; Deroin & Luke, 2005). Kanga, itself, has been shown to hold many rare and endemic plant species (Lovett & Thomas, 1988).

The first author (then senior lecturer at the Morogoro Agricultural Faculty of Dar es Salaam University) first visited Kanga on 27 February 1970, during a day trip, and reached an altitude of 1370 m on its southern ridge. Between 1000 m and 1100 m, on this sharp granitic ridge, the wild date palm, *Phoenix reclinata* Jacq. formed an open stand 4–6 m high, intermixed with an *Encephalartos* species with 1 m, barrel shaped stems, but in sterile condition. Due to the spiny leaflet shoulders, it could not be matched to the widespread coastal species *E. hildebrandtii* A. Braun & C.D. Bouché (Melville, 1958; Heenan, 1976; Beentje, 1994). Duplicates were sent to the East African Herbarium (EA) in Nairobi and it was determined that the plant was probably a new species. For a long time thereafter, the locality was seldom revisited and no new material collected.

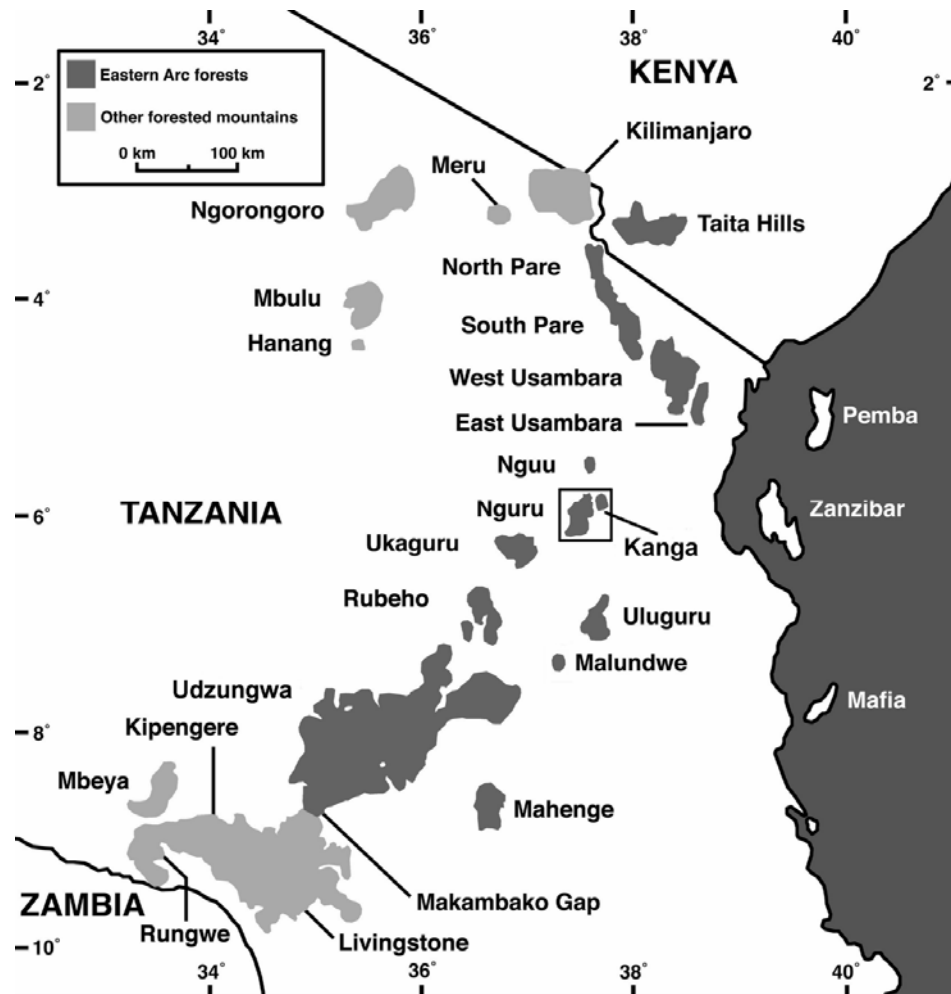


Figure 1. Map of Eastern Arc Mountains, including the Nguru Mountains and Mount Kanga.

During the second phase of the Swedish-Tanzanian Integrated Usambara Rain Forest Project (initiated by Prof. Olov Hedberg), the first author and R-A.P.C. Temu, from the Forest Biology Department of the Sokoine Agricultural University, Morogoro, revisited Mt. Kanga on 2 December 1987 in an attempt to gather more information about this plant. They approached Mount Kanga from the south-eastern side, from the Mkange Valley, and reaching 1250–1300 m on the south face of the main peak, where they found more than 10 specimens of the same *Encephalartos* with half meter tall barrel-shaped stems, intermixed in a 2–4 m tall *Xerophyta spekei* Baker- Ericaceae heath (Lovett & Thomas, 1988) on the steep, rocky slope. This time they managed to collect specimens with young female cones. On the 21 March 2006, Y.S. Abeid and the Frontier Tanzania Team of the Society for Environmental Exploration of UK collected young, sterile plants at 1160 m altitude, also from the south-eastern slopes of Mount Kanga. The fourth attempt to obtain good specimens of this new species was the most successful, when a small expedition was organised as part

of the fieldwork for the Critical Ecosystems Partnership Fund (CEPF) “Redlisting” project. At last W.R.Q. & P.A. Luke, L. Festo & G. Laizer, with local guide, Juma Mohammed, were able to locate a fertile specimen, 1.5 m tall and with fully ripe female cones in a submontane evergreen forest of the south-eastern slopes, at 1140–1160 m altitude (figure 2). The description below is based on these specimens.



Figure 2. Trish Luke and Juma Mohammed with a female *E. kanga*.. Photo by Q.Luke.

## DESCRIPTION

***Encephalartos kanga* Pócs & Q.Luke sp. nov.**, *E. kisambo* Faden & Beentje affinis sed differt truncis doliiformibus, foliis rhachidibus teretibus, foliolis non imbricatis et ad bases abaxiales longiore spinoso-dentatis spina prima, secunda et tertia et saepe quarta rhachim tegens, bullis squamarum medianis strobilorum feminarum latioribus (ad 7 cm), fimbriis seminalibus acute tuberculato-dentatis et seminibus maioribus (ad 4.3 x 2.4 cm). Typus: Tanzania, Kanga Mountain, *Luke W.R.Q. & P.A., Festo L. & Laizer G. 12015 A* (holotypus: NHT; isotypi: EA, K, MO) (figure 3).

Dioecious, pachycaul tree, trunk to 1.5 m tall, more or less barrel shaped, with diameter to 50 cm, leaf scars rhomboidal, c.12 x 5 cm. **Cataphylls** lanceolate, 11–15 x 0.65–1.34 cm, densely brown woolly. **Leaves** dark green, shiny, many, to 400 x 70 cm, young leaves with dense light brown woolly indumentum, later glabrous, petiole and rachis terete, leaflets alternate, not overlapping, slightly angled to the plane of the leaf. **Median leaflets**, falcate, parallel sided for much of their length, 30.3–35.3 cm (including apical spine to 3 mm), width 3.0–3.6 cm, attached (3.0) 3.4–3.6 (4.2) cm apart, margin revolute (artefact of drying?), distal margin with 3–7 spines 4–7 mm long within the first 2.5–5 cm, often the first three extending across the leaf rachis on the basal curve of the leaflet, proximal margin spineless, petiole width 9–11 mm. Leaflets towards apex more elliptic and with more marginal spines *e.g.* 5<sup>th</sup> to 7<sup>th</sup> leaflet from apex 19.0–23.5 x 2.2–2.8 cm, spaced 2.5–2.8 cm, distal margin with 2–5 spines in the first 3–8cm with 3–4 spines evenly distributed along the lower margin, petiole width 4–7 mm. **Female cones** several together (5 seen), oblong, cylindrical about

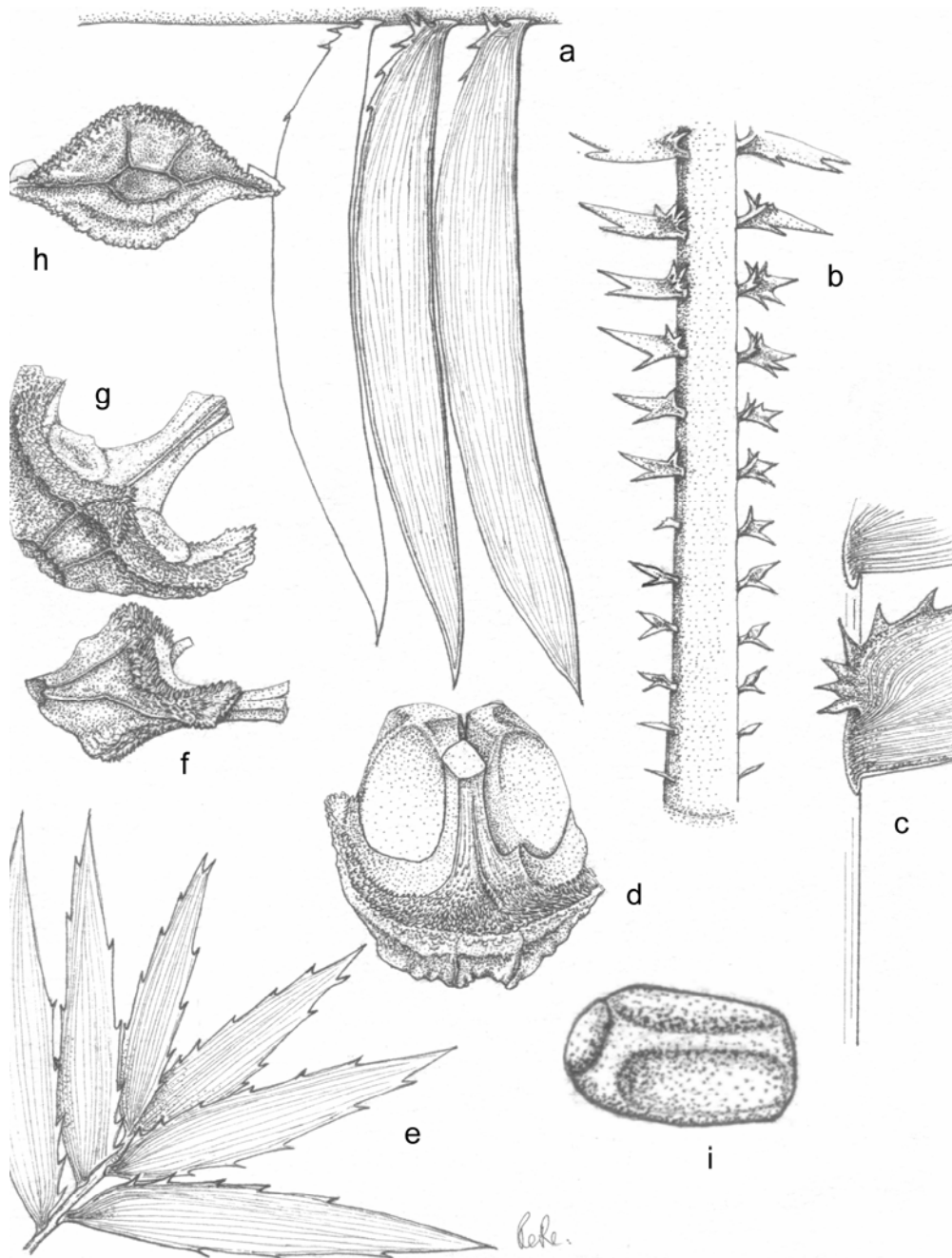


Figure 3: *Encephalartos kanga* Pócs & Luke. a) Median leaflets  $\times 1/3$ ; b) Lower leaf rachis  $\times 1/3$ ; c) Detail of leaflet basal spines  $\times 2/3$ ; d) Abaxial view of female cone scale  $\times 2/3$ ; e) Leaf apex  $\times 1/3$ ; f) Side view of bulla  $\times 2.31$ ; g) Adaxial view of bulla showing seed chalazas  $\times 2/3$ ; h) End view of bulla showing terminal facet  $\times 2/3$ ; i) Seed  $\times 2/3$ . Drawing by Rawana Pye from the type.

60–66 cm long, 17–19.5 cm diameter, yellowish orange; **peduncle** 12 cm, 8 cm diameter, glabrous; **median scales** (megasporophylls) with bulla 6.6–7.0 cm wide, 3.1–3.6 cm high, rhomboidal, glabrous,  $\pm$  smooth; **adaxial face** angled to the peduncle at (40) 42–43 (49) degrees, with 3 broad facets, the one medial, almost rectangular, and the two lateral, trapezoidal; latero-sagittal ridges not very prominent,  $\pm$  straight, lateral ridges sharp, straight to slightly arched; **terminal facet** compressed elliptical, 1.5–1.9 x 0.5–0.8 cm, with upper side 3-angled and lower side shallowly curved, the face itself concave; **seminal fringe** ca. 7 mm wide, rounded-tuberculate towards the terminal facet becoming sharp, irregular-tuberculate/dentate towards the seed chalaza, median lobe hardly developed, ca. 5 mm, lateral lobes triangular (adaxial view), 11–14 x 13–15 mm, 3–4-angled in cross section; **abaxial face** partly exposed, depression running from side to side roughly midway between terminal facet and seminal ridge (*i.e.* marks the start of the seminal ridge), almost lacking in divisions, though very faint lines observed from left corner and centre of bottom curve of terminal facet in a few bulla; **seminal ridge** ca. 7 mm wide, sparsely verrucose, becoming sharply tuberculate/dentate inside of the ridge and on the sagittal crest; **chalaza** 7–15 x 15–18 mm, peduncle 4-angled, 3 acute, 1 obtuse or 3-angled and then rounded. **Male cones** and microsporophylls not known as fertile male specimens were not seen in either population. **Seeds** with orange sarcotesta, sclerotesta ellipsoid, irregularly angled, 3.8–4.3 cm x 2.1–2.5 cm x 2.4–2.7 cm.

### DIAGNOSTIC CHARACTERS AND AFFINITIES

The new species, by its peculiar spiny distal leaflet shoulder and otherwise entire leaflet margin and single spiny apex shows close resemblance to the similar *E. kisambo* Faden & Beentje (March, 1989), which is native to a few hills in southern Kenya (later also described as *E. voiensis*, by Moretti, De Luca, Sclavo & Stevenson in August 1989). *E. kisambo*'s authors already noted the differences between it and the Kanga plant (specifically Pócs 6137/B), as the leaflets of the latter "*are more widely spaced (do not overlap); the leaflets are oblong (not lanceolate-oblong); and they are not at all falcate*". In actual fact, *E. kanga*'s leaflets are falcate, but less so than those of *E. kisambo*. The colour of *E. kisambo* leaves is a peculiar "soapy green" (Vorster, pers. comm.) while those of *E. kanga* is dark vivid green. In addition, the somewhat flattened rachis of *E. kisambo* has an emergent ridge on its adaxial side, while the rachis (and petiole) of *E. kanga* is totally smooth and terete. The teeth on the median leaflet distal margin shoulder of *E. kisambo* are less spiny and are mostly directed parallel to the leaf axis whilst the innermost spiny teeth on those of *E. kanga* are often perpendicular to, and at least the first three of them always extending across, the leaf rachis (it should be noted that the spines in *E. kisambo* do sometimes overlap the leaf rachis but obliquely) Other character differences are: the median scales in the female cone of *E. kanga* are broader with the bulla up to 7 cm wide as opposed to 4.8 cm in *E. kisambo*; the seminal fringe is sharply tuberculate towards the seed chalaza as opposed to merely rugose-verrucose to smooth in *E. kisambo*, and finally the well defined angle lines between the lateral facets of *E. kanga* are four, giving four lateral facets, whereas in *E. kisambo* there are six.

Vorster (pers. comm.) believes these features put our new taxon very close to *E. kisambo*, but we feel the differences are enough to warrant a separate status as species. Probably the comparison of the two species by DNA investigation can more elucidate their relationship.

The other related species, *Encephalartos sclavoi* Moretti, D. Stevenson & De Luca [= *E. sp. A* of Melville (1958)], is native to the Usambara Mountains, another member of Eastern Arc Mountains in north eastern Tanzania (Jones, 1993). Whitelock (2002) gives dimensions for its leaves that are shorter and narrower with more crowded, overlapping median leaflets and with margins that have no spines on both sides or, at most, “three short spiny teeth, often reduced to mere bumps of callus in the basal half”. The apex is said to be curved backward and downward to form a recurved hook. The female cones would appear to be shorter and fatter with a shorter, more delicate peduncle. The megasporophylls are more squat, being 3.8–4.0 cm high by 5.5–6.5 cm wide as opposed to *E. kanga*’s 3.1–3.6 x 6.6–7.0 cm and have a six sided terminal facet rather than the three sides and one curve of *E. kanga*.

## DISTRIBUTION AND SPECIMENS EXAMINED

TANZANIA (T6). Morogoro Region, Mvomero District, Kanga Mountain Forest Reserve, only known from here; on the southern ridge of Mount Kanga above Kibwende settlement, at 1000–1100 m, sterile, 27 Feb. 1970, Pócs T. 6137/B (EA, DSM, SUA); on the southern, rocky face of Kanga peak at 1250–1300 m, female with young cones, 2 Dec. 1987, Pócs T. & Temu R-A.P.C. 87228/Z (NHT, SUA, UPS, EGR); on the southern slopes of Mount Kanga, 1160 m, young sterile plant, 21 Mar. 2006, Abeid Y.S. & Frontier Team 2658 (DSM, MO, EA, NHT?); south eastern slope of Mount Kanga at 1140 m, female plant with mature cones (A) & sterile flushing plant (B), 9 May 2007, Luke W.R.Q & P.A., Festo L. & Laizer G. 12015 A&B (NHT (holotype), EA, K, MO (isotypes)).

## HABITAT

Sub-montane dry evergreen and mesic evergreen forest and *Xerophyta* - *Erica* heath on steep slopes of Precambrian crystalline (mostly gneissic) bedrock with shallow soil; alt. 1000–1300 m.

Pócs T. 6137/B on the southern ridge of Mount Kanga, on steep rocky slope, dry evergreen forest on granitic boulders dominated by *Phoenix reclinata* Jacq., trunks barrel shaped, up to 1 m height. Associate species: *Dracaena afromontana* Mildbr., *Maytenus undata* (Thunb.) Blakelock, *Psychotria lauracea* (K.Schum.) E.M.A.Petit, *P. tanganyikensis* Verdc., *Schizozygia coffaeoides* Baill., *Saintpaulia ionantha* H.Wendl. subsp. *velutina* (B.L.Burtt) I.Darbysh., *Dorstenia tayloriana* Rendle var. *laikipiensis* (Rendle) Hijman, *Asparagus racemosus* Willd., *Cynorkis uncata* (Rolfe) Kraenzl., *Carex spicato-paniculata* C.B.Clarke, *Arthropteris orientalis* (J.F.Gmel.) Posth., *Asplenium buettneri* Hieron., *A. rutifolium* (Bergius) Kunze, *A. pellucidum* Lam., *Belvisia spicata* (L.f.) Mirb., *Phymatosorus scolopendria* (Burm.f.) Pic.Serm., *Nephrolepis biserrata* (Sw.) Schott, *Crepidomanes melanotrichum* (Schltdl.) J.P.Roux.

Pócs T. & Temu R-A.P.C. 87228/Z: *Xerophyta spekei* Baker - *Erica* heath on steep rocky slope and cliff of South face of main Kanga peak at 1250–1300 m. Associate species: *Lefebvrea droopii* C.C.Towns., *Pentas longituba* K.Schum., *Sacleuxia newii* (Benth.) Bullock, *Urologia ulugurica* Gilg & Gilg-Ben., *Aloe brachystachys* Baker, *Neobenthamia gracilis* Rolfe, *Coleochloa microcephala* Nelm.

Luke *et al.* 12015A & B: Submontane rainforest at 1140 m altitude, in the canopy with *Nuxia floribunda* Benth., *Harungana madagascariensis* Poir., *Phoenix reclinata* Jacq., *Heteromorpha arborescens* (Spreng.) Cham. & Schltdl., *Macaranga capensis* (Baill.) Sim,



*Solanecio kangae* sp. nov. ined., *Gynura valeriana* Oliv., *Maytenus acuminata* (L.f.) Loes., *Parinari excelsa* Sabine subsp. *holstii* (Engl.) R.A.Graham, *Trema orientalis* (L.) Blume, *Trimeria grandifolia* (Hochst.) Warb. subsp. *tropica* (Burkill) Sleumer and *Cussonia spicata* Thunb. In the shrub and ground layer with *Ipomoea shupangensis* Baker, *Cissampelos truncata* Engl., *Agarista salicifolia* (Lam.) G.Don, *Pentas* sp., *Bothryocline* sp., *Phaulopsis imbricata* (Forssk.) Sweet, *Carex echinocloe* Kunze, *Smilax anceps* Willd., *Myrsine melanophloeos* (L.) R.Br., *Asparagus* sp., *Ficus ottonifolia* (Miq.) Miq. subsp. *ulugurensis* (Mildbr. & Burret) C.C.Berg, *Pittosporum* sp.

## CONSERVATION STATUS

The Eastern Arc Mountains are known for their high diversity within a relatively small area and extreme human pressure and have thus been placed in one of the world's biodiversity "hotspots" (Meyers *et al.*, 2000; Mittermeier *et al.*, 2004). The Critical Ecosystems Partnership Fund (CEPF), mentioned above, was set up to offer help to all the world's hotspots and in 2004 released funding for projects within this area (CEPF, 2003). One such project, the "Redlisting" project, set out to assess all the endemic and threatened plants of the hotspot (Gereau & Luke, 2003). This resulted in the junior author's visit to Kanga, the fortuitous collection of suitable material for description of this taxon and its conservation assessment.

*Encephalartos kanga* is a rare species with a few scattered populations on Mount Kanga. The total area known to be occupied by this plant is less than 10 km<sup>2</sup> and the total number of mature specimens in all known populations together is estimated to be not more than 50. As access to the area is difficult, *E. kanga* is not endangered by deforestation (although a part of the southern slopes was severely burnt a few years ago) and it appears to have no problem reproducing. The most serious threat to this plant is its horticultural value, indeed the last collecting team received reports that some foreign collectors had visited the area on two occasions and organised the removal of 100–200 seedlings each time. If a concerted effort is not made to give this ancient species strong protection, the small population could be easily eradicated in a short space of time. Thus this cycad is assessed under the IUCN 2001 criteria as **Critically Endangered. CR B2ab and C2a(i).**

## ETYMOLOGY

The new species is named after its locality, Mount Kanga. The word "kanga" otherwise means in local languages 'guinea-fowl', which probably refers to the shape of the steep rocky peak.

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allowing the material of this CITES Appendix I listed species to be moved to Nairobi for study. He also thanks his fellow team members from the National Herbarium in Arusha (NHT), his wife and the people of Kanga for making the last collection possible. We would like to thank P. Vorster (Botany and Zoology Department, Stellenbosch University) and a second anonymous reviewer for their critical comments.

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