

The family Zingiberaceae in Rwanda with description of two new species of *Renealmia*

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Abstract

Background and aims – The Zingiberaceae of Rwanda are revised, and three new records of *Aframomum* species (*A. corrorima*, *A. daniellii*, *A. zambesiaceum*) are provided. One previously recorded species, *A. alboviolaceum*, has to be excluded from the Flora of Rwanda. Two new species of *Renealmia* are described from Rwanda and Burundi in connection with the preparation of the family treatment for the Flore d'Afrique centrale.

Material and methods – Field work and standard herbarium practices were applied.

Key results – *Renealmia timmiorum* sp. nov. is similar to *R. cinninata* and *R. cabrae*, and *R. susannae-katziae* sp. nov. is similar to *R. africana* and *R. dewevrei*. The differences with these species are discussed and distribution maps for the new taxa are presented. *Renealmia timmiorum* is assessed as Least Concern (LC), while *R. susannae-katziae* is assessed as Endangered (EN).

Keywords

Albertine Rift, Flora, *Renealmia*, Rwanda, taxonomy, Zingiberaceae

INTRODUCTION

The Zingiberaceae of tropical Africa consist of taxonomically very difficult genera like *Aframomum* K.Schum., *Renealmia* L.f., and *Siphonochilus* J.M.Wood & Franks. To fully understand these genera and their species delimitation, fieldwork is mandatory. The only treatments presently available are those of the Flora of West Tropical Africa (Hutchinson et al. 1968), the Flora of Tropical East Africa (Lock 1985), the Flora Zambesiaca (Lock 2010), and the Flore du Rwanda (Champluvier 1988). The PhD thesis of the last author (Dhetchuvi 1996) containing a revision of *Siphonochilus*, *Renealmia*, and *Aframomum* in Central Africa (Gabon, Congo, D.R. Congo, Rwanda, Burundi) has not been published up to now. For *Aframomum*, several floristic papers (Lock 1978a, 1978b, 1978c; Lock and Hall 1975; Dhetchuvi 1993, 1995) and a modern revision (Harris and Wortley 2018) are available. The present paper is a precursor to the treatment of Zingiberaceae for the Flore d'Afrique

centrale (D.R. Congo, Rwanda, Burundi) and contains a revision of this family for Rwanda.

MATERIAL AND METHODS

This revision is mainly based on fieldwork in Rwanda between 2000 and 2022, supplemented by herbarium studies from the following herbaria: BR, K, NHR, P, WAG (acronyms after Thiers 2023). The IUCN Red List Categories and Criteria (IUCN 2012, 2022) were applied to evaluate the conservation status of the new species.

TAXONOMIC TREATMENT

1. *Aframomum* K.Schum. (Schumann 1904: 201)

Notes. Champluvier (1988) lists three species for Rwanda, of which only *Aframomum angustifolium* is correctly identified. The specimens assigned to *Aframomum*

mildbraedii Loes. are probably *Aframomum spirologulatum* A.D.Poulsen & Lock (Poulsen and Lock 1997: 608), but we could not retrieve any of the cited specimens. The specimen *Bouxin 1146*, identified as *Aframomum zambesiaceum* (Baker) K.Schum. (Schumann 1904: 206) represents the recently described *Aframomum wuerthii* Dhetchuvi & Eb.Fisch. (Dhetchuvi and Fischer 2006: 241). The highest diversity of *Aframomum* in Rwanda is found in Nyungwe National Park where numerous endemic species occur (e.g. *Impatiens nyungwensis* Eb.Fisch., Dhetchuvi & Ntaganda; Fischer et al. 2003: 91).

Aframomum angustifolium (Sonn.) K.Schum.
(Schumann 1904: 218)

Material examined. RWANDA – **Northern Province** • along road between Gakenke and Bushwati; 01°38'37.40"S, 29°46'34.77"E; 1760 m; 26 Oct. 2004; *Fischer & Dhetchuvi 559/2004*; KOBL. – **Southern Province** • Butare, Arboretum Ruhande; 2°36'48.74"S, 29°45'00.79"E; 1714 m; 29 Nov. 2006; *Fischer 1344/2006*; KOBL. – **Eastern Province** • Ibanda-Makera gallery forest; 02°06'37.17"S, 30°50'59.76"E; 1311 m; 24 Sep. 2021; *Fischer 656/2021*; KOBL.

Notes. For further localities in Rwanda see Harris and Wortley (2018).

Aframomum corrorima (A.Braun) P.C.M.Jansen (Jansen 1981: 10)

Fig. 1

Distribution. New record for Rwanda.

Material examined. RWANDA – **Western Province** • Nyungwe National Park, Cyamudongo Forest; 02°32'27.45"S, 28°59'20.20"E; 1945 m; 19 Oct. 2004; *Fischer 495/2004*; KOBL • *ibid.*; 26 Mar. 2006; *Fischer 571/2006*; KOBL • Forest edge close to WCS-guesthouse at Gisakura; 02°26'25.33"S, 29°05'36.44"E; 1906 m; 15 Oct. 2004; *Fischer 411/2004*; KOBL.

Notes. The species was already illustrated by Fischer and Killmann (2008).

Aframomum daniellii (Hook.f.) K.Schum. (Schumann 1904: 218)

Fig. 2

Aframomum mala auct. non (K.Schum.) K.Schum.: Poulsen and Lock (1997); Fischer and Killmann (2008: 462).

Distribution. New record for Rwanda.

Material examined. RWANDA – **Western Province** • Nyungwe National Park, Cyamudongo Forest; 02°33'31.44"S, 28°59'02.36"E; 1993 m; 20 Dec. 2007; *Fischer 986/2007*; KOBL • Kamiranzovu Swamp, 2000 m; 02°29'04.08"S, 29°09'56.42"E; 2114 m; 15 Oct. 2004; *Fischer 401/2004*; KOBL • Road Pindura–Bweyeye km 7; 02°32'15.56"S, 29°14'23.15"E; 1860 m; 14 Oct. 2004; *Fischer 389/2004*; KOBL • Road Pindura–Bweyeye km

25; 02°36'21.75"S, 29°19'56.71"E; 1768 m; 14 Oct. 2004; *Fischer 395/2004*; KOBL.

Notes. The species was confused with *Aframomum mala* (K.Schum.) K.Schum. by Poulsen and Lock (1997) and Fischer and Killmann (2008). The identification of some East African collections was corrected by Harris and Wortley (2018).

Aframomum spirologulatum A.D.Poulsen & Lock
(Poulsen and Lock 1997: 608)

Material examined. RWANDA – **Western Province** • Nyungwe National Park, between Karamba and Gisakura; 02°28'20.65"S, 29°06'24.39"E; 1941 m; 19 Oct. 2004; *Fischer 475/2004*; KOBL.

Notes. This is the second known locality of this species in Rwanda. Rangiro, which is also situated in Nyungwe National Park, was already cited in the protologue. The species has been illustrated by Fischer and Killmann (2008).

Aframomum wuerthii Dhetchuvi & Eb.Fisch.
(Dhetchuvi and Fischer 2006: 241)

Material examined. RWANDA – **Western Province** • Nyungwe National Park, edge of Kamiranzovu swamp; 02°29'04.75"S, 29°09'04.68"E; 1952 m; 11 Dec. 2018; *Fischer 1143/2018*; KOBL, NHR.

Notes. Only known from the type locality where it was most recently observed in December 2021. The specimen *Bouxin 1146* (BR0000024589918), also collected at this locality, was misidentified as *Aframomum zambesiaceum* by Champluvier (1988) (see also Bouxin 1974).

Aframomum zambesiaceum (Baker) K.Schum.
(Schumann 1904: 206)

Fig. 2

Distribution. New record for Rwanda.

Material examined. RWANDA – **Western Province** • Nyungwe National Park, Cyamudongo Forest; 02°33'29.90"S, 28°59'13.23"E; 1954 m; 26 Sep. 2011; *Fischer 644/2011*; KOBL • Forest edge close to WCS-guesthouse at Gisakura; 02°26'25.33"S, 29°05'36.44"E; 1906 m; 20 Oct. 2004; *Fischer 521/2004*; KOBL • Road Pindura–Bweyeye km 6; 02°31'45.81"S, 29°18'53.82"E; 1987 m; 16 Oct. 2004; *Fischer 463/2004*; KOBL.

Notes. The species has already been illustrated by Fischer and Killmann (2008). Dhetchuvi (1996) cites a specimen of *Aframomum zambesiaceum* from Rwanda, Eastern Province, Parc National de la Kagera, colline Rurama, 3 Nov. 1958, *Troupin 8698* (BR0000024588621) but this proved to be *Aframomum angustifolium*.

Excluded species

Harris and Wortley (2018) cite *Aframomum albobviolaceum* (Ridl.) K.Schum. from Rwanda with the specimen

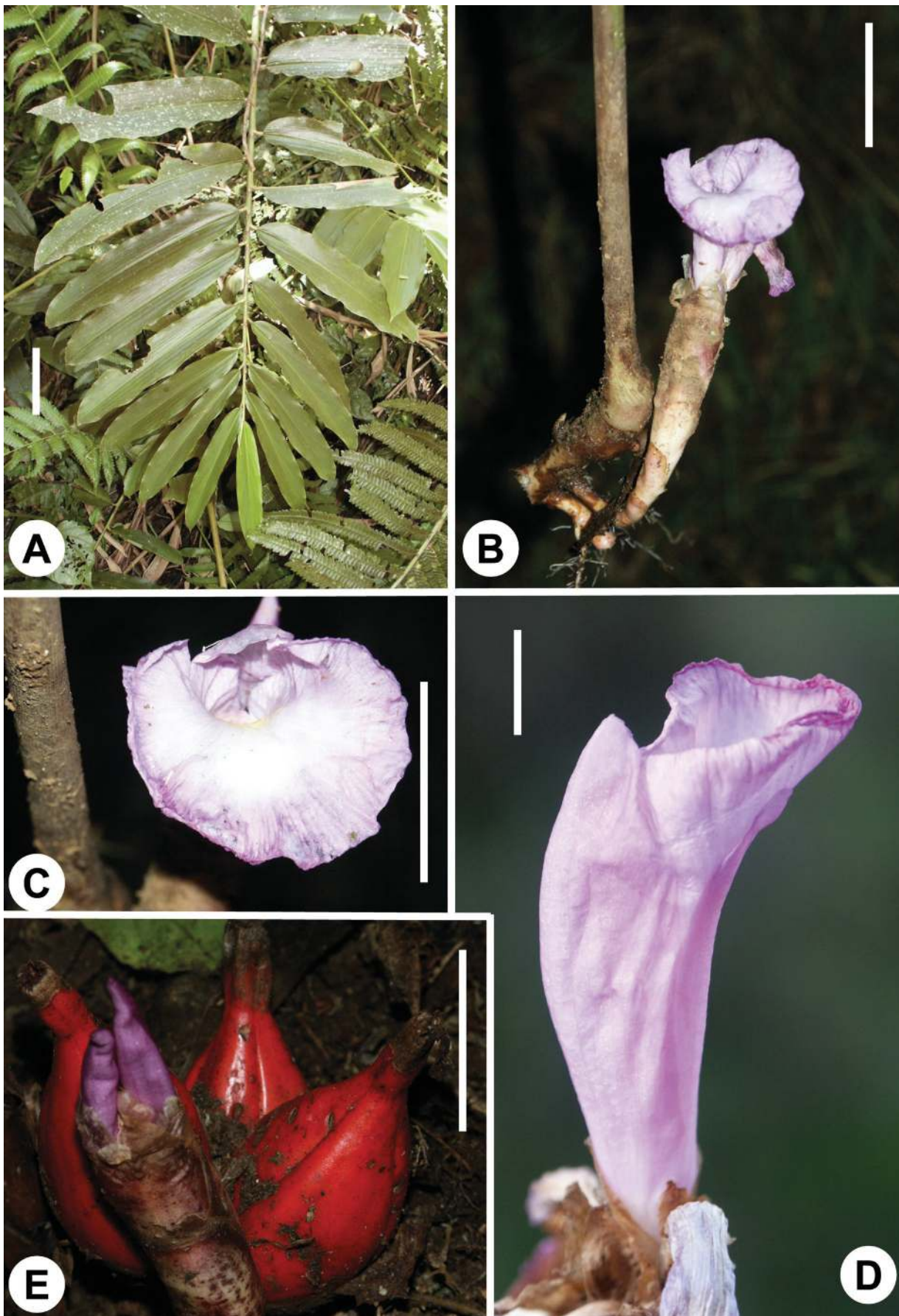


Figure 1. *Aframomum corrorima*. A–B. Flowers. C–D. Flowers. E. Fruits. Scale bars: 5 cm. Photographs taken at Gisakura on 10 Dec. 2018 by Eberhard Fischer.

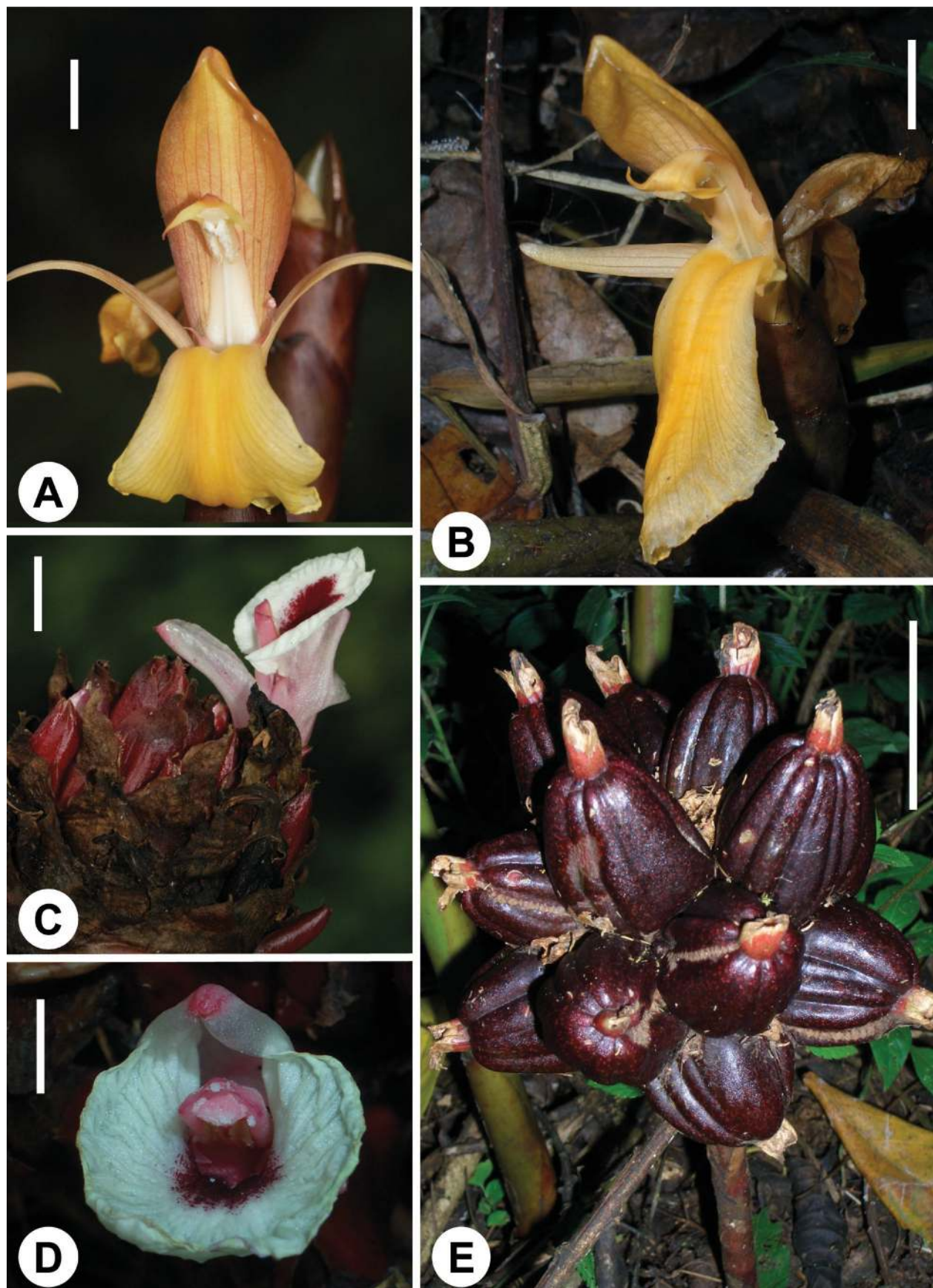


Figure 2. A–B. Flowers of *Aframomum daniellii*. C–D. Flowers of *A. zambesiacum*. E. Fruits of *A. zambesiacum*. Scale bars: 1 cm (A–D), 5 cm (E). Photographs taken at Gisakura on 10 Dec. 2018 by Eberhard Fischer.

Froment 525 from Kibali (BR0000021390890). However, this specimen was collected at Kibali (Mahagi) by D. Froment on 11 June 1959 in a *Loudetia* savanna in the Democratic Republic of the Congo, phytogeographical district Lac Albert, and has thus to be excluded from the Flora of Rwanda.

2. *Renealmia* L.f. (Linnaeus 1781: 79)

Notes. The genus *Renealmia* comprises 82 species (POWO 2023), 26 of which are found in tropical Africa. While a modern treatment for tropical America (Maas 1977) and subsequent descriptions of new taxa (Maas 1979; Maas and Maas 1987, 1990; Ospina and Pozner 2013) and revisions of critical groups (Lima et al. 2018) are available, the African species are still in need of a revision (Lock 1985). Important contributions have been the treatments for Flore du Cameroun (Koechlin 1965) and Flore du Gabon (Koechlin 1964). Dhetchuvi (1996) proposes six new species of *Renealmia* in his PhD thesis, which will be validated in a paper on the genus in Central Africa (Fischer and Dhetchuvi unpubl. data). Another six new species have subsequently been discovered during intensive research in the field and in major herbaria. One of these taxa, *R. timmiorum*, was collected on a joint field trip by the first author and the last author in Rwanda and thus the description could be written in more detail. A second new species was collected by the first author in the isolated Cyamudongo Forest. The four remaining species will be described in a forthcoming paper. Champluvier (1988) only lists *R. congolana* De Wild. & T.Durand (De Wildeman and Durand 1899: 144) from Rwanda. However, this species differs from *Renealmia susannae-katziae* and *R. timmiorum* in the partial inflorescences (cincinni) with at least 4–8 flowers and the distinctly pubescent rachis. *Renealmia congolana* is now considered as a synonym of *R. africana* Benth. ex Hook.f. (Hooker 1883: 24) (Fischer and Dhetchuvi unpubl. data). This taxon has not yet been recorded for Rwanda and the specimens cited by Champluvier (1988) represent mostly *R. timmiorum*. The majority of collections available consists of fruiting material, including the majority of species already proposed by Dhetchuvi (1996). However, their description will point out the existence of these taxa and may help to collect further material and to assess the conservation status. Important characters used in the description of *Renealmia* species are the leaves, the number of flowers in a cincinnus, the shape of the bracteole, the shape of the calyx and the fruit (including number of seeds). Generally, the flowers are rarely available and flower characters are therefore difficult to apply for comparison with other species. The two new species proposed in the present paper have fortunately been observed with flowers and their characters are included in the descriptions. The majority of *Renealmia* species in Africa is restricted to lowland rainforest. The two new taxa from Rwanda represent species of the genus

that are occurring at the highest known elevations of up to 2003 and 2267 m.

Renealmia susannae-katziae Eb.Fisch., Killmann & Dhetchuvi, **sp. nov.**

urn:lsid:ipni.org:names:77320403-1

Figs 3–5, 9

Renealmia congolana auct. non De Wild. & T.Durand: Champluvier (1988: 498), pro parte.

Type. BURUNDI – **Bubanza Province** • Mugomero (Rugazi); 03°13'33.65"S, 29°31'21.89"E; 2167 m; 2 May 1981; *Reekmans 10045*; holotype: BR [BR0000020218539].

Diagnosis. The new species resembles *Renealmia africana* and *R. dewevrei* De Wild. & T.Durand. It differs, however, in the partial inflorescences (cincinni) with 1–2(–4) flowers (vs 1–7 in *R. africana* and 4–8 in *R. dewevrei*), the glabrous calyx and fruit (vs pubescent in *R. africana* and *R. dewevrei*), the subglobose capsules, and the 2–3 seeds per locule (vs 11–13 in *R. africana* and 9 in *R. dewevrei*).

Description. Perennial herb forming a dense clump. Leafy shoots 100 to 200 cm tall, covered at base with imbricate leafless sheaths. Leaves with sulcate sheaths surrounding the stem, with reticulately anastomosing venation and numerous brownish glands between the reticulations. Ligule obtuse, up to 2 mm long. Petiole 4–6(–10) cm long. Lamina narrowly obovate, attenuate at base and decurrent along petiole, caudate-acuminate at apex, about 60 cm long and 10 cm wide, greyish-green at lower surface, lateral veins visible at both surfaces. Inflorescence thyrsic, arising at base of leafy shoots, 20–40 cm long. Peduncle about 30 cm long, with up to 5 leafless glabrescent sheaths of about 5–10 cm length, ciliate near margin, internodes glabrous; rachis about 1/2 of inflorescence, glabrous, red. Bracts caducous, membranaceous, pubescent with persistent hairs, ciliate at margin, about 1 cm long. Bracteoles caducous, membranaceous, tubular, abaxially shortly incised, pubescent with persistent hairs, ciliate at margin, about 5 mm long. Partial inflorescences (cincinni) subsessile, with 1 to 2(–4) flowers. Pedicels red-orange, sparsely pubescent, with minute hairs, about 3–15 mm long, regularly enlarged at apex. Calyx persistent, accrescent in fruit, tubular apex with acuminate lobes, glabrous except for ciliate margin, purple, about 6 mm, 1 cm long in fruit. Corolla yellowish with purplish to violaceous marks; dorsal lobe rounded, 5 mm long, tinged with mauve; lateral lobes purplish 5 mm long; labellum yellowish with purple; claw 3.7 mm long; limb about 8 mm in diameter, the free portion 3-lobed. Stamen with 1 bilocular theca, about 2 mm long; lateral staminodes ovate, acuminate, 1 mm long. Ovary 2–3 × 1–2 mm, glabrescent, greenish-yellowish tinged with purple; epigynous glands rectangular, 1 mm long; style 8 mm long; stigma bilobed, 0.7 × 1.1 mm. Fruits subglobose, glabrous, shining black at maturity, 10 × 5–8 mm. Seeds globose-polygonal to irregular, 3 mm in diameter, 2–3 per locule.

Distribution. Only known from Nyungwe National Park, Rwanda, and western Burundi (Fig. 9).

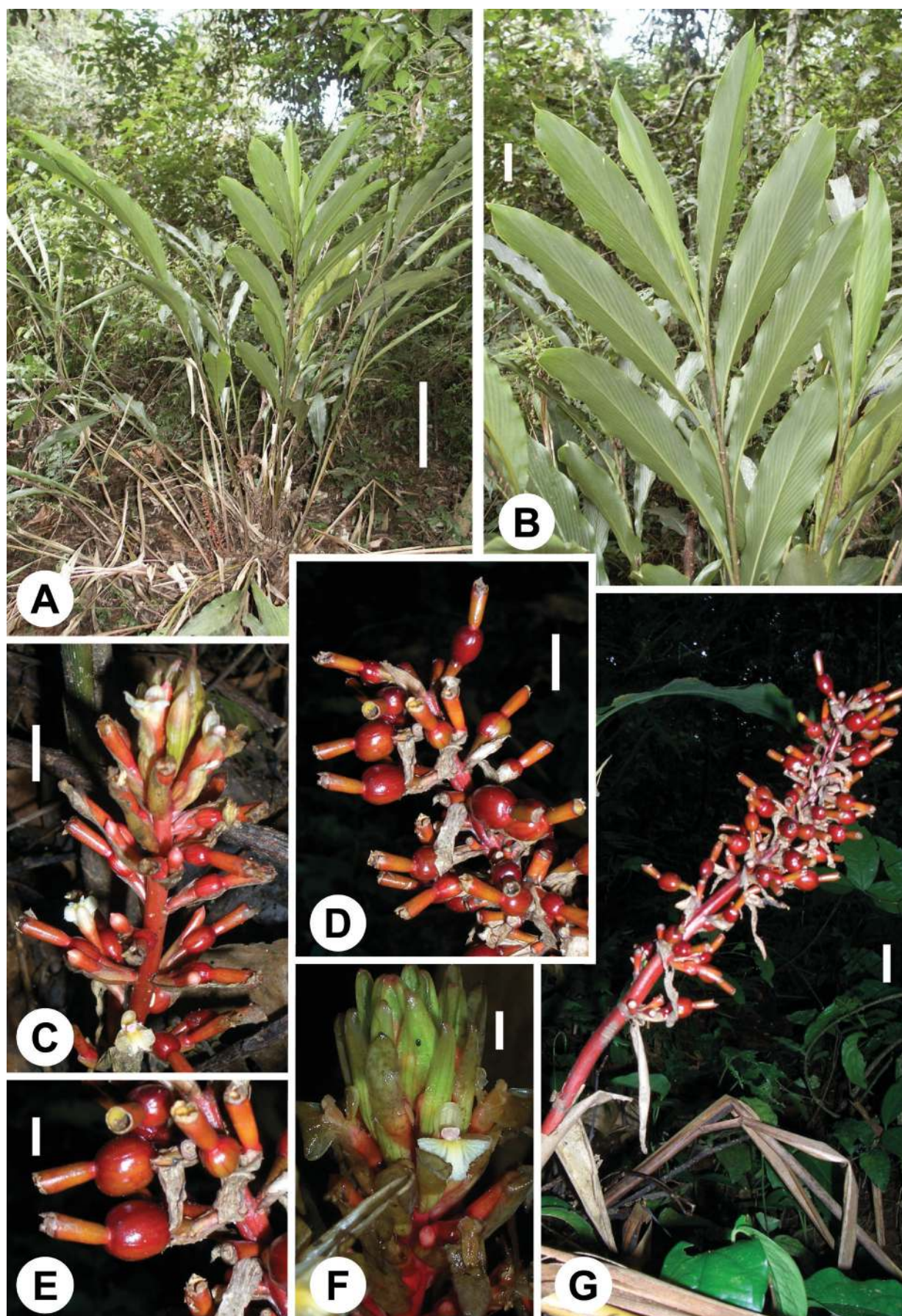


Figure 3. *Renealmia susannae-katziae*. A–B. Habit. C–E, G. Infructescence. F. Inflorescence. Scale bars: 50 cm (A), 10 cm (B), 1 cm (C–D, G), 5 mm (E–F). Photographs taken in Cyamudongo Forest from Fischer 1137/2018 on 10 Dec. 2018 by Eberhard Fischer.

Habitat. The new species grows close to a small stream with *Carapa grandiflora*, *Tabernaemontana stapfiana*, *Lepidotrichilia volkensii*, *Alangium chinense*, *Myrianthus holstii* in the tree layer, *Scepcarpus hypselodendron* and *Illigera vespertilio* as lianas, and *Fagopyrum snowdenii*, *Uvariopsis congensis* (juvenile), *Ptisana africana*,

Blotiella bouxiniana, *Impatiens erecticornis*, *Antrophyum mannianum*, *Culcasia falcifolia*, and *Polystachya cultriformis* in the herb layer or as stem epiphytes. A specimen was collected near the road passing through Cyamudongo Forest to Nyakabuye in a forest with *Newtonia buchananii*, *Entandrophragma excelsum*,

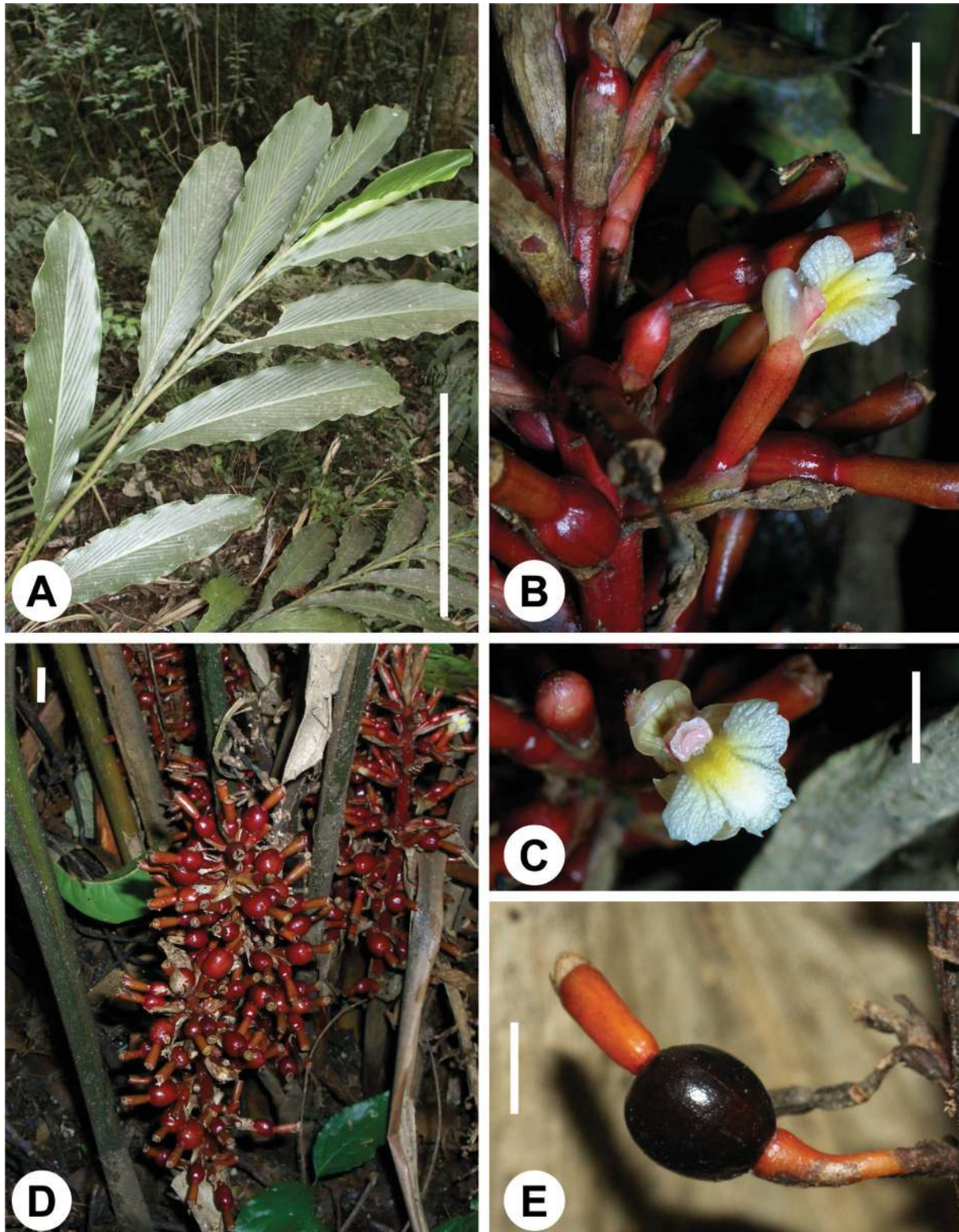


Figure 4. *Renealmia susannae-katziae*. A. Leaves. B–C. Flowers. D. Inflorescence. E. Fruit. Scale bars: 50 cm (A), 5 mm (B–C, E), 1 cm (D). Photographs taken in Cyamudongo Forest from Fischer 1137/2018 on 10 Dec. 2018 by Eberhard Fischer.



Figure 5. *Renealmia susannae-katziae*. **A.** Detail of infructescence. **B.** Fruit. **C–E.** Flowers. **F.** Labellum with stamens showing lateral staminodes. From Dhetchuvi & Fischer 1991, drawn by Eberhard Fischer. Scale bars: 1 cm (A), 5 mm (B), 1 mm (C–F).

Myrianthus holstii, *Polyscias fulva*, *Maesa latifolia*, *Neoboutonia macrocalyx*, *Xymalos monospora*, *Astropanax abyssinicus*, and *Tabernaemontana stapfiana* in the tree layer. The species occurs from 1240 to 2267 m.

Etymology. Dedicated to Mrs Susanne Katz on the occasion of her 50th birthday for her generous financial support of taxonomic research.

Preliminary IUCN conservation assessment. Karuzi and Mabayi are now densely and heavily populated area. The location of Kihofi is likely lost due to a large sugarcane plantation and a factory which are installed there. The collecting sites in Burundi are located outside protected areas where the species' habitat is rapidly degrading due to agriculture and urbanization expansion. By considering the loss of habitat, the number of locations is 4 or 5. Two are located within protected areas (Nyungwe National Park). Several adverse factors are affecting the extent and quality of habitat of this species like logging and agriculture. The calculated EOO is 6680 km² and the AOO is 54 km². Based on the above observations, it is assessed as Endangered: EN B1 ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v).

Additional material examined. RWANDA – **Western Province** • Nyungwe National Park, Cyamudongo Forest, near Riv. Nyamabuye: 02°33'10.015"S, 28°59'31.46"E; 1755 m; 1 Apr. 2004; *Fischer 156/2004*, KOBL, NHR • Cyamudongo Forest, along road to Nyakabuye: 02°33'30"S, 28°59'01"E; 1978 m; 18 Oct. 2004; *Dhetchuvi & Fischer 1990*; KOBL • *ibid.*; 10 Dec. 2018; *Fischer 1137/2018*; KOBL • 23 km on road Pindura–frontière Burundi; 02°34'45.38"S, 29°12'13.35"E; 1720 m; 13 Aug. 1974; *Auquier 3742*; BR [BR0000020218010].

BURUNDI – **Bubanza Province** • Bubanza; 19 Dec. 1970; *Lewalle 5101*; BR [BR0000014516139] • Bubanza, Mabayi, route vers Cibitoke; 02°42'36.15"S, 29°17'20.15"E; 2267 m; 22 Jun. 1969; *Lewalle 3799*; BR [BR0000020218003] • Bubanza, Muyebe, Rugazi; 03°12'54.72"S, 29°31'10.34"E; 1845 m; 16 Oct. 1974; *Reekmans 3839*; BR [BR0000020218591] • Bubanza, Cibitoke-Mabayi, vallée Nyamagana; 2 Mar. 1969; *Lewalle 3285*; BR [BR0000020218607]. – **Rutana Province** • Kiofi, Mosso; 04°02'S, 30°07'E; 1240 m; 15 Mar. 1952; *Michel & Reed 1371*; BR [BR0000020218546]. – **Karuzi Province** • Kitega, Chefferie Bweru, environs de Karuzi; 03°08'33.22"S, 30°05'38.16"E; 1758 m; 21 Jan. 1959; *Van der Ben 2446*; BR [BR0000020218027].

Renealmia timmiorum Eb.Fisch., Killmann & Dhetchuvi, **sp. nov.**

urn:lsid:ipni.org:names:77320404-1

Figs 6–9

Renealmia congolana auct. non De Wild. & T.Durand: Champluvier (1988: 498), pro parte.

Type. RWANDA – **Western Province** • Nyungwe National Park, crête au Sud-Ouest du Kamiranzovu; 02°28'27.11"S, 29°07'36.31"E; 2003 m; 5 Aug. 1976; *Troupin 15842*; holotype: BR [BR0000020217891].

Diagnosis. The new species resembles *Renealmia cinnamata* and *R. cabrae* in the lax inflorescence but differs in the hyaline bracts, the elliptic lamina that is decurrent on the petiole, the pubescent and much shorter inflorescence with partial inflorescences (cincinni) bearing 1–3 flowers, and the fruits with 2–3 seeds per locule.

Description. Perennial herb usually with few single shoots closely adjacent. Leafy shoots 40 to 100 cm tall, covered at base with imbricate leafless sheaths, the upper sheath sometimes with a reduced lamina. Leaves with sulcate sheaths surrounding the stem, with reticulately anastomosing venation and densely pubescent between the reticulations, with numerous simple and bifid hairs, margin membranaceous, reddish. Ligule very short, up to 2 mm long. Petiole 3–7 cm long, with reticulation and hairs within the furrows. Lamina elliptic, distinctly and progressively attenuate at base and decurrent at apex of petiole, acuminate to acute at apex, 19–25 cm long and 3.5–4 cm wide, median vein reticulate and glabrous, dark green at upper surface, greyish-green at lower surface, lateral veins visible only at lower surface, acumen at apex about 1 cm long. Inflorescence thyrsic, arising at base of leafy shoots, 14–25 cm long, entirely pubescent, with flowers and fruits horizontally arranged or bent upwards, in spiral arrangement. Peduncle about 10–20 cm long, up to 7 internodes reaching 8.5 cm of length, longer than the sheaths, with basal leafless sheaths short and dense, upper sheaths longer, of about 7 cm length, with bifid and caducous hairs at outer surface; rachis 5–10 cm long, entirely purple, with minute simple and caducous hairs, glabrescent. Bracts coriaceous to membranaceous, persistent, lanceolate, basal bract 2.5–3 cm long, the upper bracts shorter, glabrous with membranaceous ciliate margin, bracts of secondary axes lanceolate, with membranaceous ciliate margin, 1–2 cm long. Bracteoles tubular, with short abaxial slit, membranaceous, about 6–8 mm long, glabrescent. Partial inflorescences (cincinni) subsessile, with 1 to 3 flowers; peduncle about 2 mm long. Pedicels purple, becoming orange in fruit, glabrescent, about 5–20 mm long. Calyx persistent, accrescent in fruit, tubular, apex with acuminate lobes, glabrous except for ciliate margin, purple, about 6 mm, 1 cm long in fruit. Corolla white with purplish to violaceous marks; dorsal lobe rounded, 4.5–5 mm long, tinged with mauve; lateral lobes purplish, 4.5–5.1 mm long; labellum white with purple; claw 3.8 mm long; limb 6.3 × 7 mm, obtusely 3-lobed, mid-lobe deeply emarginate. Stamen with 1 bilocular theca, about 3.8 × 2 mm; lateral staminodes acuminate, ovate-lanceolate, 1 mm long. Ovary 2–3 × 1–2 mm, glabrescent, greenish-yellowish tinged with purple; epigynous glands rectangular, 1 mm long; style 8 mm long; stigma bilobed. Fruits elliptic, glabrous, about 1.5 cm long and 5 mm wide, red-orange, shining black at maturity. Seeds red-orange, surrounded by a yellowish aril, 2–3 per locule.

Distribution. Montane forests of western Rwanda (Fig. 9).

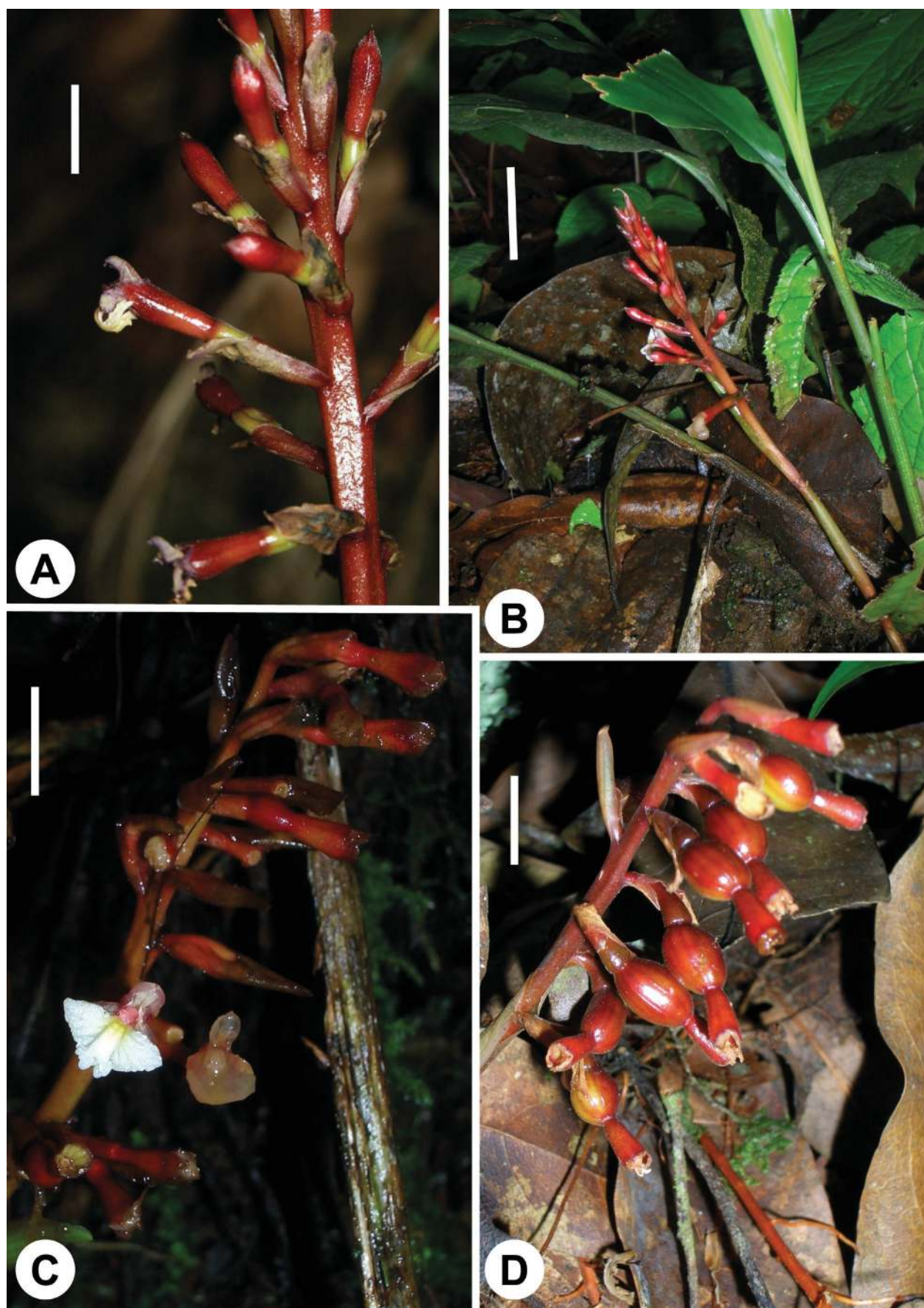


Figure 6. *Renealmia timmiorum*. A–C. Inflorescence. D. Infructescence. Scale bars: 1 cm (A), 2 cm (B), 1 cm (C–D). Photographs taken at Gisakura from Fischer 1125/2018 on 10 Dec. 2018 by Eberhard Fischer.

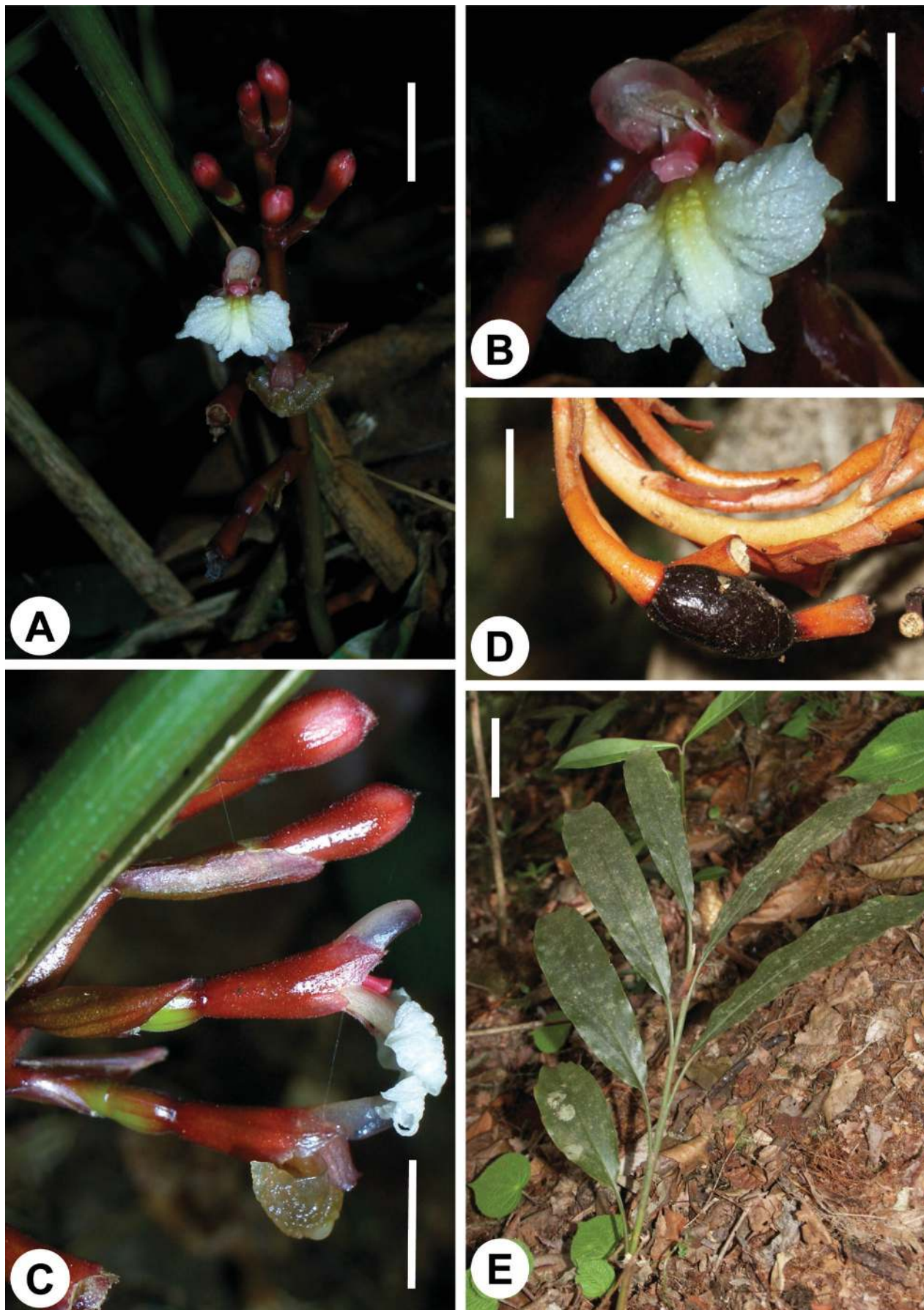


Figure 7. *Renealmia timmiorum*. **A.** Inflorescence. **B–C.** Flowers. **D.** Fruits. **E.** Habit. Scale bars: 5 mm (A), 5 mm (B–D), 5 cm (E). Photographs taken at Gisakura from *Fischer 1125/2018* on 10 Dec. 2018 by Eberhard Fischer.



Figure 8. *Renealmia timmiorum*. **A.** Inflorescence. **B.** Leaves with enlarged ligule. **C.** Calyx and ovary. **D.** Flower. **E.** Labellum and stamens showing lateral staminodes. **F.** Fruit. **G–H.** Flower. From Dhetchuvi & Fischer 1990, drawn by Eberhard Fischer. Scale bars: 1 cm (A–B), 1 mm (B, E), 5 mm (C–D, F), 1 mm (G–H).

Habitat. The new species is found at the type locality in a montane rainforest with *Pentadesma reyndersii*, *Newtonia buchananii*, *Carapa wohllebenii*, *Parinari excelsa*, and *Strombosia scheffleri* dominant in the tree layer. Other abundant species in the shrub and herb layer are *Mimulopsis arborescens*, *Alchornea hirtella*, *Blotiella bouxiniana*, *Cinnobotrys speciosum*, *Selaginella lewalleana*, *Saintpauliopsis lebrunii*, and *Scadoxus multiflorus*. Other habitats mentioned on the specimens studied include *Parinari excelsa*-forest, forest with *Pentadesma lebrunii*, and relict transition forest. It occurs from 1580 to 2003 m.

Etymology. Dedicated to the family Timm from Germany for their generous financial support of taxonomic research.

Preliminary IUCN conservation assessment. Using a 3 × 3 km² grid cell size, the EOO is estimated at 41.3 km² which falls within the limits for the Vulnerable category; the AOO is estimated at 27 km² which falls within the limits for the Endangered category. As all locations are situated in a protected area (Nyungwe National Park), the species is assessed as Least Concern (LC).

Additional material examined. RWANDA – Western Province • Nyungwe National Park, Ntendezi; 02°27'07.43"S, 29°03'27.43"E; 1580 m; *Habiyaremye s.n.*; BRLU, NHR • Rangiro; 02°27'36.41"S, 29°10'51.50"E; *Bridson* 379; BR [BR0000020217877], K • Rangiro, forêt dense près pépinière de Rutabanzogera; 02°27'13.61"S,

29°11'44.52"E; 1967 m; 12 Jun. 1978; *Raynal* 20486; P [P00072226], WAG [WAG0364620] • Rangiro; 02°27'36.41"S, 29°10'51.50"E; *Troupin* 16051; BR [BR0000020217884] • Gisakura, near waterfalls; 02°25'51.95"S, 29°07'02.92"E; 1933 m; 19 Oct. 2004; *Dhetchuvi & Fischer* 1991; KOBL, NHR • *ibid.*; 10 Dec. 2018; *Fischer* 1125/2018; KOBL, NHR • Site Gisakura/Karamba; 6 Jul. 1999; *Liengola* IBL 406; GIS • Gisakura; 6 Jul. 1999; *Liengola* IBL 407; GIS • Forêt de Nyungwe, village Gasumo, sous-bois de la forêt primaire de montagne; 02°31'00.09"S, 29°04'28.19"E; 1680 m; 6 Jul. 1999; *Liengola* IBL 412; GIS • Cyangugu, commune de Kagano, forêt de Gisakura, forêt à *Pentadesma reyndersii* et *Syzygium guineense*; 02°27'06.31"S, 29°06'46.86"E; 1966 m; 10 Apr. 2000; *Ewango & Boniface* 2247; BR [BR0000009718661].

Notes. *Renelalmia montana* sensu *Dhetchuvi* (1996) comprises *R. timmiorum* and another undescribed taxon from eastern D.R. Congo found at lower elevations (850–1000 m) that will be validated in a future paper.

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REFERENCES

- Bouxin G (1974) Etude phytogéographique des plantes vasculaires du marais de Kamiranzovu (forêt de Rugege, Rwanda). Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België 44: 149–159. <https://doi.org/10.2307/3667431>
- Champluvier D (1988) 176. Zingiberaceae. In: Troupin G (Ed.) Flore du Rwanda. Spermatophytes. Vol. 4. Royal Museum for Central Africa, Brussels, 490–498.
- De Wildeman E, Durand T (1899) Matériaux pour la Flore du Congo, cinquième fascicule. Bulletin de la Société Royale de Botanique de Belgique 38(2): 120–152.
- Dhetchuvi J-B (1996) Taxonomie et Phytogéographie des Marantaceae et des Zingiberaceae de l'Afrique Centrale (Gabon, Congo, Zaïre, Rwanda et Burundi). PhD Thesis, Université Libre de Bruxelles, Belgium.

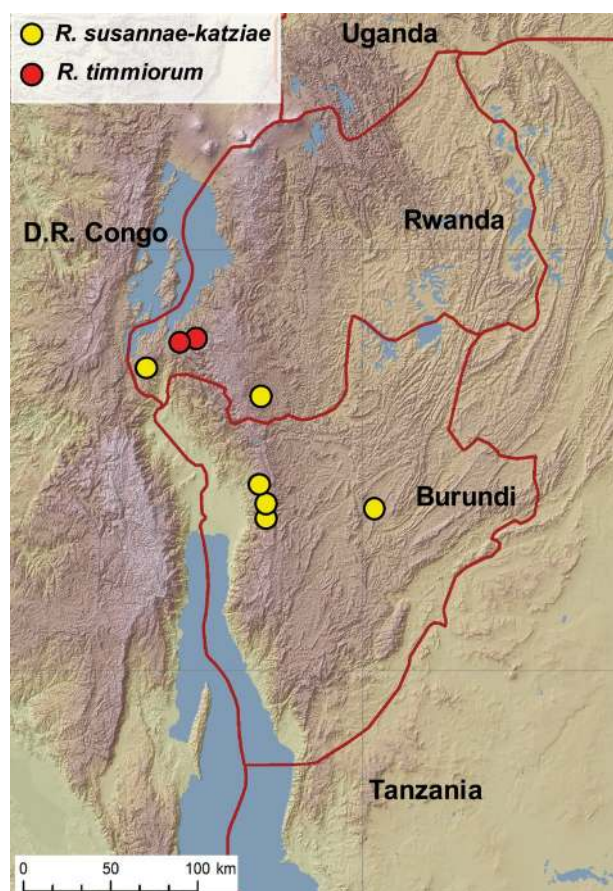


Figure 9. Distribution map of *Renelalmia susannae-katziae* and *R. timmiorum*.

- Dhetchuvi J-B, Fischer E (2006) A new species of *Aframomum* (Zingiberaceae) from Nyungwe National Park/Rwanda. *Systematics and Geography of Plants* 76: 241–245. <https://www.jstor.org/stable/20649717>
- Dhetchuvi MM (1993) Observations sur les Zingiberaceae de l'Afrique centrale. 1. *Aframomum singulariflorum* Dhetchuvi, nouvelle espèce du Zaïre souvent confondue avec *A. melegueta* (Roscoe) K.Schum. *Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België* 62: 181–186. <https://doi.org/10.2307/3668273>
- Dhetchuvi MM (1995) Observations sur les Zingiberaceae de l'Afrique centrale. 2. *Aframomum makandensis* Dhetchuvi, une nouvelle espèce en provenance de la Forêt des Abeilles (Gabon). *Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België* 64: 197–200. <https://doi.org/10.2307/3668378>
- Fischer E, Dhetchuvi J-B, Ntaganda C (2003) A new species of *Impatiens* (Balsaminaceae) from Nyungwe Forest, Rwanda. *Systematics and Geography of Plants* 73: 91–95. <https://www.jstor.org/stable/3668483>
- Fischer E, Killmann D (2008) Illustrated Field Guide to the Plants of Nyungwe National Park, Rwanda. Koblenz Geographical Colloquia, Series Biogeographical Monographs 1, 1–772.
- Harris DJ, Wortley AH (2018) Monograph of *Aframomum* (Zingiberaceae). *Systematic Botany Monographs* 104: 1–204.
- Hooker JD (1883) Plate 1430: *Renealmia africana*, Benth. Scitamineae, Tribe Zingiberaceae. *Hooker's Icones Plantarum*: 24–25.
- Hutchinson J, Dalziel JM, Keay RWJ (1968) *Flora of West Tropical Africa*, Second Edition, vol. 3(1). Crown Agents Publishing, London, 1–276.
- IUCN (2012) IUCN Red List Categories and Criteria. Version 3.1. Second Edition. <https://iucn.org/resources/publication/iucn-red-list-categories-and-criteria-version-31-second-edition> [accessed 30.05.2023]
- IUCN (2022) Guidelines for using the IUCN Red List Categories and Criteria. Version 15. <https://www.iucnredlist.org/resources/redlistguidelines> [accessed 30.10.2022]
- Jansen PCM (1981) Spices, condiments and medicinal plants in Ethiopia, their taxonomy and agricultural significance. PhD Thesis, Wageningen University, the Netherlands. <https://edepot.wur.nl/201964> [accessed 25.05.2023]
- Koechlin J (1964) Scitamineae (Musaceae, Strelitziaceae, Zingiberaceae, Cannaceae, Marantaceae). *Flore du Gabon* 9. Muséum national d'Histoire Naturelle, Paris, 1–172.
- Koechlin J (1965) Scitamineae (Musaceae, Strelitziaceae, Zingiberaceae, Cannaceae, Marantaceae). *Flore du Cameroun*, vol. 4. Muséum national d'Histoire Naturelle, Paris, 1–162.
- Lima HRP, Gevú, KV, Andreatta, RHP, Braga JMA (2018) A reassessment of the *Renealmia chrysotricha* (Zingiberaceae) species complex based on morphological evidence and nomenclatural notes. *Phytotaxa* 130: 50–54. <https://doi.org/10.11646/phytotaxa.367.2.6>
- Linnaeus C (1781) *Supplementum Plantarum Systematis Vegetabilium Editionis Decimae Tertiae Generum Plantarum Editiones Sextae et Specierum Plantarum Editionis Secundae Editum a Carolo a Linné*. *Brunsvigae, Impensis Orphanotropei*, 1–468. <https://doi.org/10.5962/bhl.title.555>
- Lock JM (1978a) Notes on the genus *Aframomum* (Zingiberaceae) 1. The species related to *Aframomum polyanthum* (K.Schum.) K.Schum. *Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België* 48: 129–134. <https://doi.org/10.2307/3667922>
- Lock JM (1978b) Notes on the genus *Aframomum* (Zingiberaceae) 2. The Ethiopian species. *Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België* 48: 387–391. <https://doi.org/10.2307/3667938>
- Lock JM (1978c) Notes on the genus *Aframomum* (Zingiberaceae) 3. Two new species from West Africa. *Bulletin du Jardin Botanique National de Belgique / Bulletin van de Nationale Plantentuin van België* 48: 393–398. <https://doi.org/10.2307/3667939>
- Lock JM (1985) Zingiberaceae. In: Polhill RM (Ed.) *Flora of Tropical East Africa*. A.A. Balkema, Rotterdam, 1–40.
- Lock JM (2010) Zingiberaceae. In: Timberlake J, Martins ES (Eds) *Flora Zambesiaca*, vol. 13(4). Royal Botanic Gardens, Kew, Richmond, 120–140.
- Lock JM, Hall JB (1975) Taxonomic studies in the genus *Aframomum* (Zingiberaceae). *Boissiera* 24: 225–231.
- Maas PJM (1977) *Renealmia* (Zingiberaceae - Zingiberoideae) Costoideae (Additions) (Zingiberaceae). *Flora Neotropica* 18: 1–218. <https://www.jstor.org/stable/4393712>
- Maas PJM (1979) Notes on the New World Zingiberaceae: 2. *Acta Botanica Neerlandica* 24: 469–480.
- Maas PJM, Maas H (1987) Notes on the New World Zingiberaceae: 3. Some new species of *Costus* and *Renealmia*. *Notes from the Royal Botanic Garden, Edinburgh* 46: 237–428.
- Maas PJM, Maas H (1990) Notes on the New World Zingiberaceae: 4. Some new species of *Costus* and *Renealmia*. *Notes from the Royal Botanic Garden, Edinburgh* 46: 307–320.
- Ospina JC, Pozner RE (2013) A new species of *Renealmia* (Zingiberaceae) from Colombia. *Phytotaxa* 130: 50–54. <https://doi.org/10.11646/phytotaxa.130.1.6>
- Poulsen AD, Lock JM (1997) New species and new records of Zingiberaceae from tropical East Africa. *Kew Bulletin* 52: 601–616. <https://doi.org/10.2307/4110289>
- POWO (2023) Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. <https://powo.science.kew.org/> [accessed 21.04.2023]
- Schumann K (1904) Zingiberaceae. In: Engler A (Ed.) *Das Pflanzenreich*. Wilhelm Engelmann, Leipzig, 201–221.
- Thiers B (2023) Index herbariorum. A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <https://sweetgum.nybg.org/science/ih/> [accessed 21.04.2023]