Plant diversity in tropical East Africa and the project of *Flora of Kenya*

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OUTLINE

- 1. Geological character of East Africa
- 2. Main vegetation types in tropical East Africa
- 3. Plant richness in tropical East Africa
- 4. Inventory incompleteness & priority collecting in tropical East Africa
- 5. Risk of plant diversity in tropical East Africa
- 6. Plant diversity surveys in Africa
- 7. Project of *Flora of Kenya*

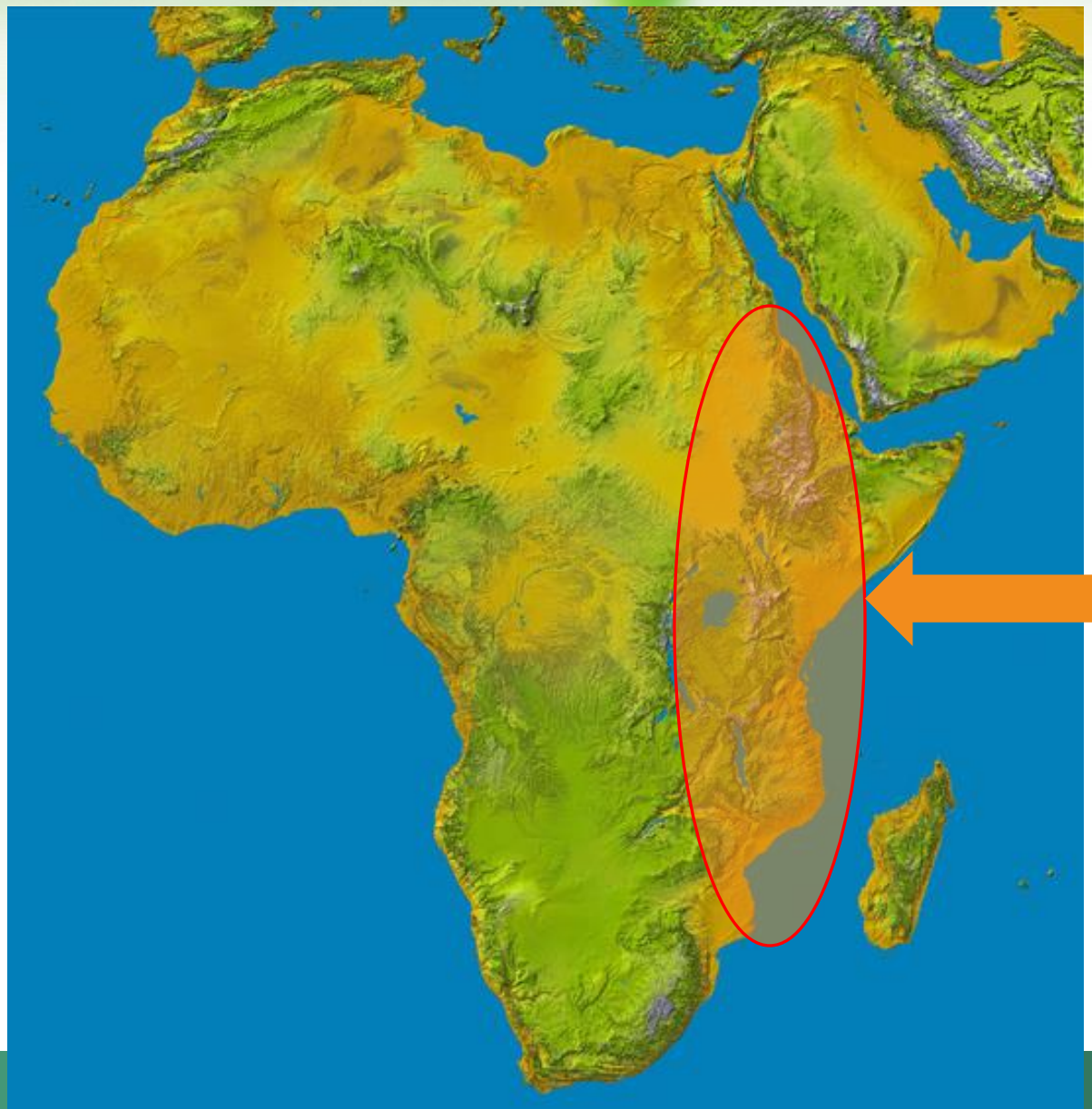
1. Geological Character of East Africa

(1).The geological history of Africa

- Africa is the largest fragment of Gondwanaland. After nearly 200 million years of stability, between 270 and 200 million years ago, it started to drift apart.
- Unlike other parts of Gondwana, Africa maintained a relatively stable position on the globe and hence had a relatively stable climate.
- Main geomorphic features are vast alluvial basins and plains and complex system of rivers and streams – Nile, Zaïre, Niger, Zambezi – and the Great Rift Valleys.

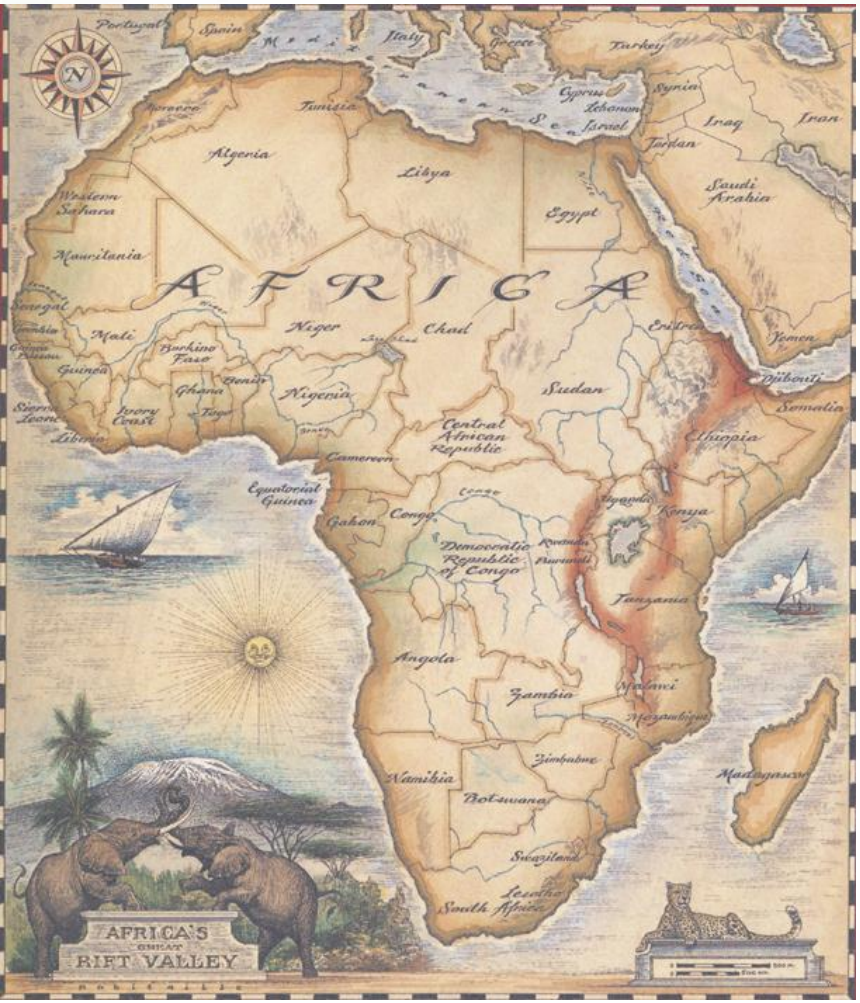
TRIASSIC
200 million years ago

(2). East Africa Great Rift Valley



The Great Rift Valley
in East Africa

(2). Great Rift Valley – the largest, longest, and most conspicuous feature of their kind on Earth.



3700 miles (ca. 6000 Km) long from the Afar Depression in the Horn of Africa to the mouth of the Zambezi river in Mozambique

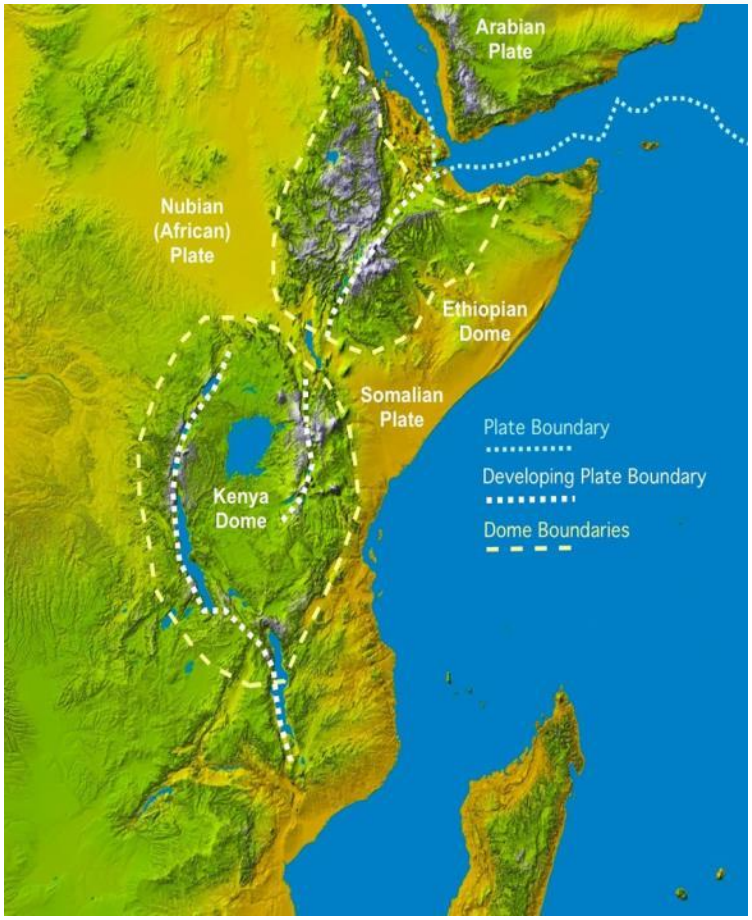
Ranges from salt flats at 175 m below sea-level to 5895 m (Kilimanjaro)

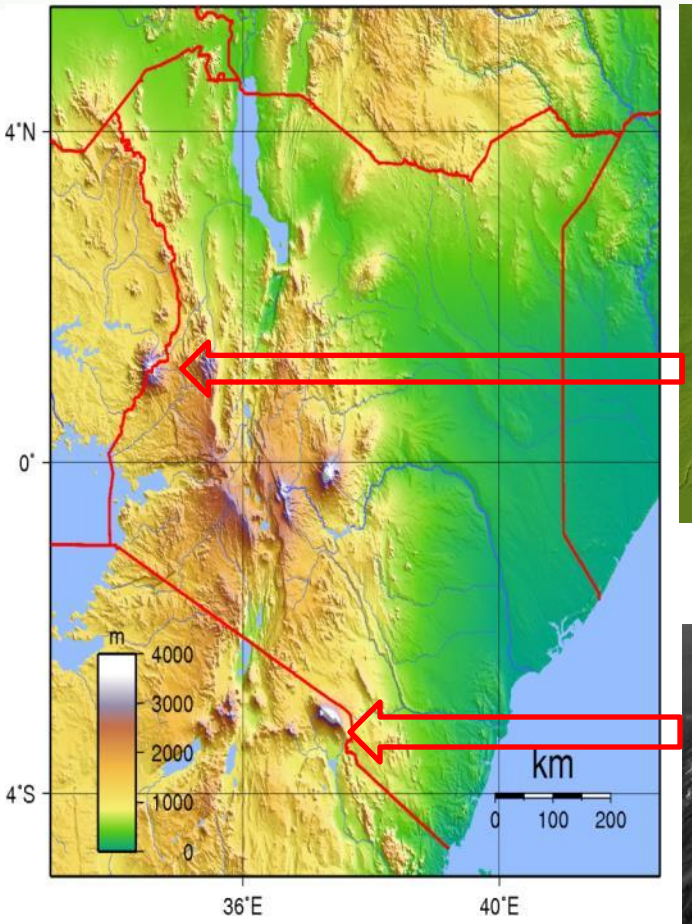
Great Rift Valleys are visible from outer space.

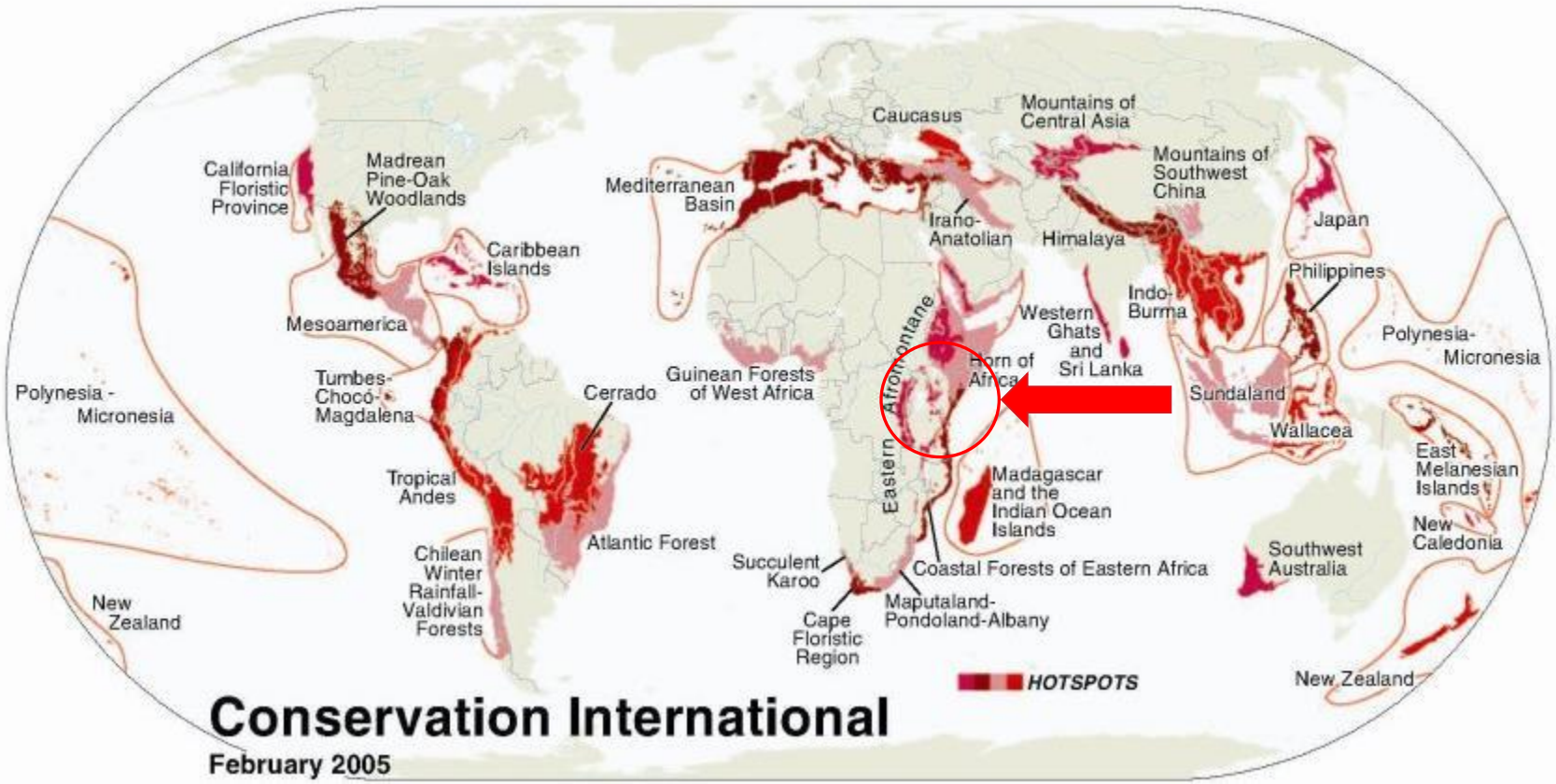
Along the rifts, there are many volcanoes – Elgon, Aberdare, Kenya, Kilimanjaro, Meru.

(Pavitt, 2001)

Great Rift Valley



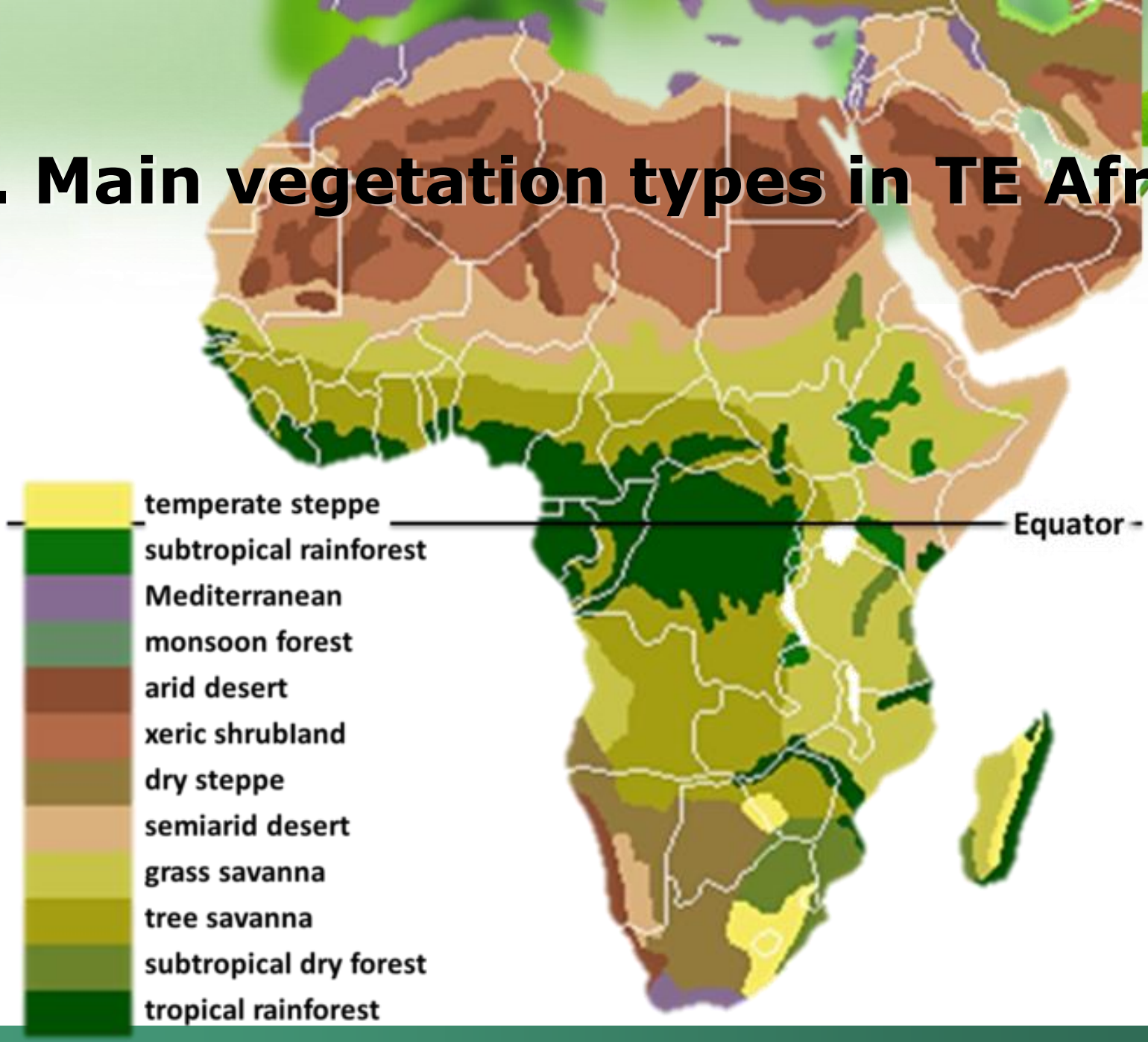




- 34 hot spots of biodiversity in the world

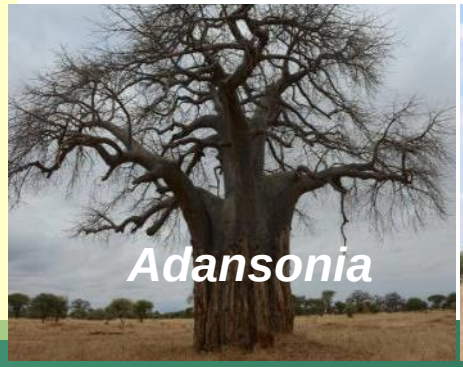
- Three of them are in tropical East Africa：
  - The Eastern Afromontane
  - The Coastal Forests of Eastern Africa
  - The Horn of Africa

2. Main vegetation types in TE Africa



Vegetations in TE Africa

- **Savanna**
  - Grass Savanna
  - Tree Savanna
- **Seasonal tropical rainforest**
- **Montane forest**
  - Evergreen forest
  - Deciduous forest
- **Alpine bush**
- **Alpine grassland (Moorland)**
- **Swamp**
- **Mangroves**



Grass Savanna near Mt. Kenya

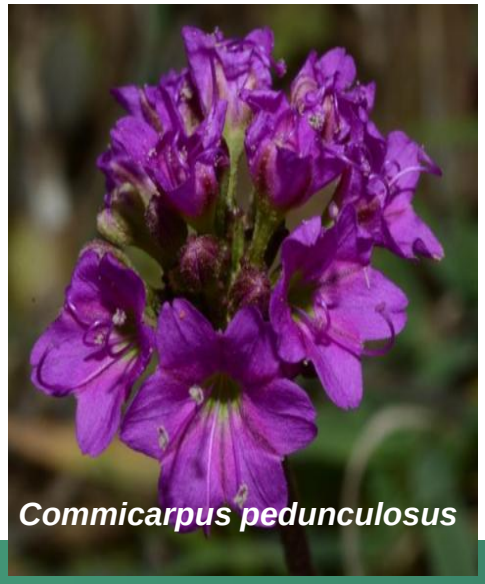

Monadenium stapelioide

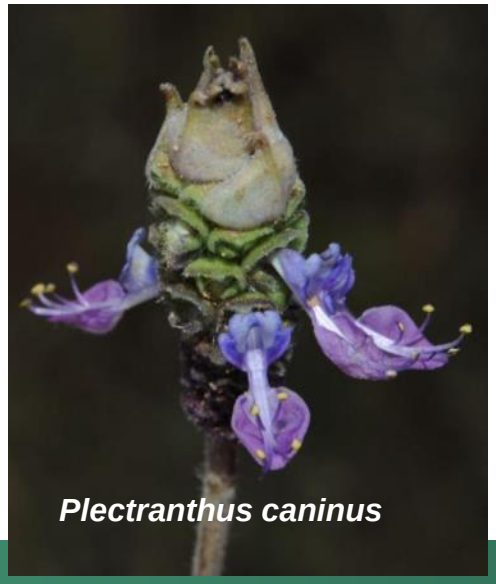

Gomphocarpus stenophyllus


Trachyandra saltii

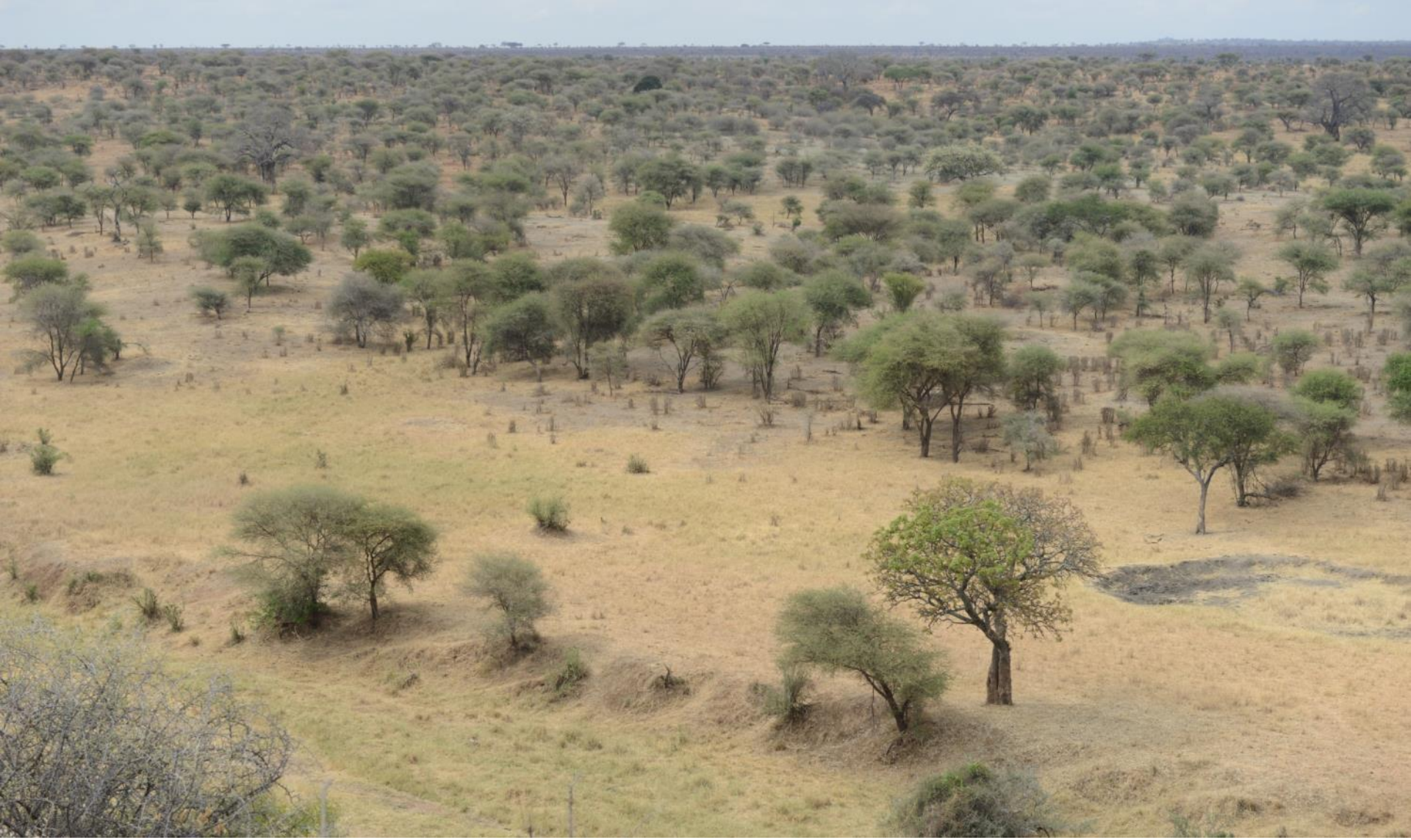

Pavonia urens


Ornithogalum gracillium


Commicarpus pedunculosus


Plectranthus caninus

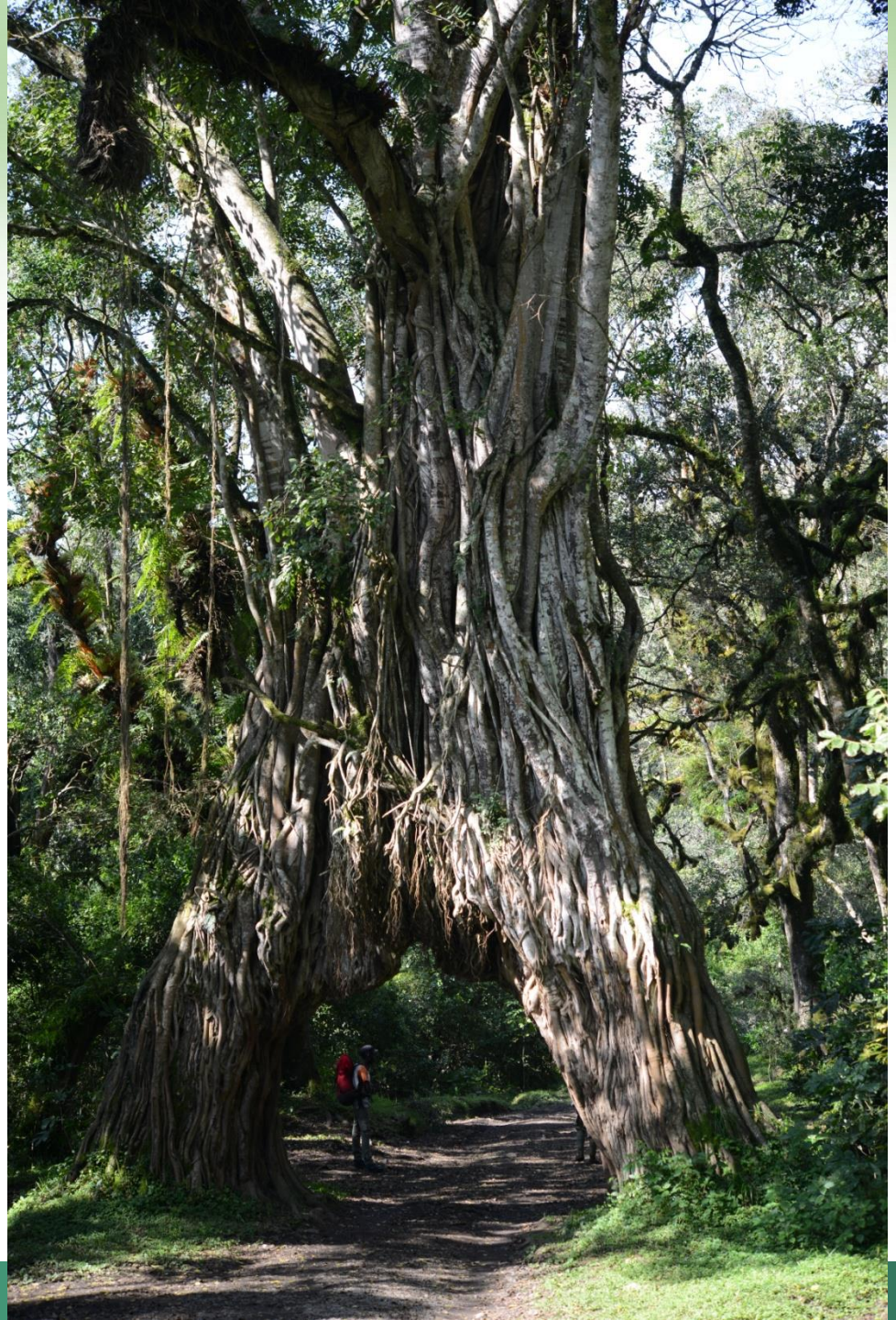

Sparmannia ricinocarpa



Tree Savanna in Tarangire National Park

Savanna is the home of many big animals

Seasonal rainforest (Cherangani, Kenya)



- Gaint *Ficus* tree in seasonal tropical rainforest at the low altitude of Mt. Meru

The road condition in the seasonal rainforest is usually terrible

Montane forest (Mt Kenya 1200-2800 m)

Evergreen forest

Afrocarpus gracilior

Podocarpus latifolius

***Hagenia* forest on Mt. Meru（2500-3800 m）**

- ***Hagenia abyssinica*, the main tree of the temperate forest on the high mountains**

Umbilicus botryoides(Crassulaceae)

Disperis kilimanjarica (Orchidaceae)

Moist condition under *Hagenia* forest

Epiphytic plants on *Hagenia* trees

Alpine bush zone (Mt Kilimanjaro, 3000-4000 m)

Alchemilla argyrophylla

Erica arborea

Hypericum revolutum

Alpine bush zone

Anthospermum usambarense-Rubiaceae

Stoebe kilimandscharica-Asteraceae

Cliffortia nitidula-Rosaceae

Struthiola thomsonni-Thymelaeaceae

Alpine grassland (Moorland) (Mt Kenya, 3400-4600 m)

Alpine grassland (Moorland) on Mt. Kenya (3200-4600m)

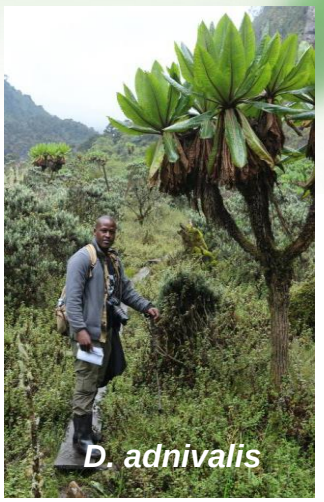
Alpine grassland on Mt. Kenya (3200-4600m)

Alpine grassland


D. brassiciformis


D. keniodendron


D. cheranganiensis


D. adnivalis


D. kilimanjari


D. johnstonii


D. battiscombei


D. keniensis

Fig 1. The appearance of the same patch of afroalpine vegetation in July 1948 (*A*) and November 1967 (*B*) on Mt Kenya, Teleki Valley, on the shore of Teleki Tarn, altitude 4,200 m. Photographed by myself (*A*) and I. Grawé (*B*).

Growth speed is very low, it took *Dendrosenecio keniodendron* 19 years to grow up for 45 cm, average growth rate is 2.5cm/year.(Herdberg, 1969)

- How old are them？ About 250 years old.

***Lobelia deckenii* on Mt. Kenya**

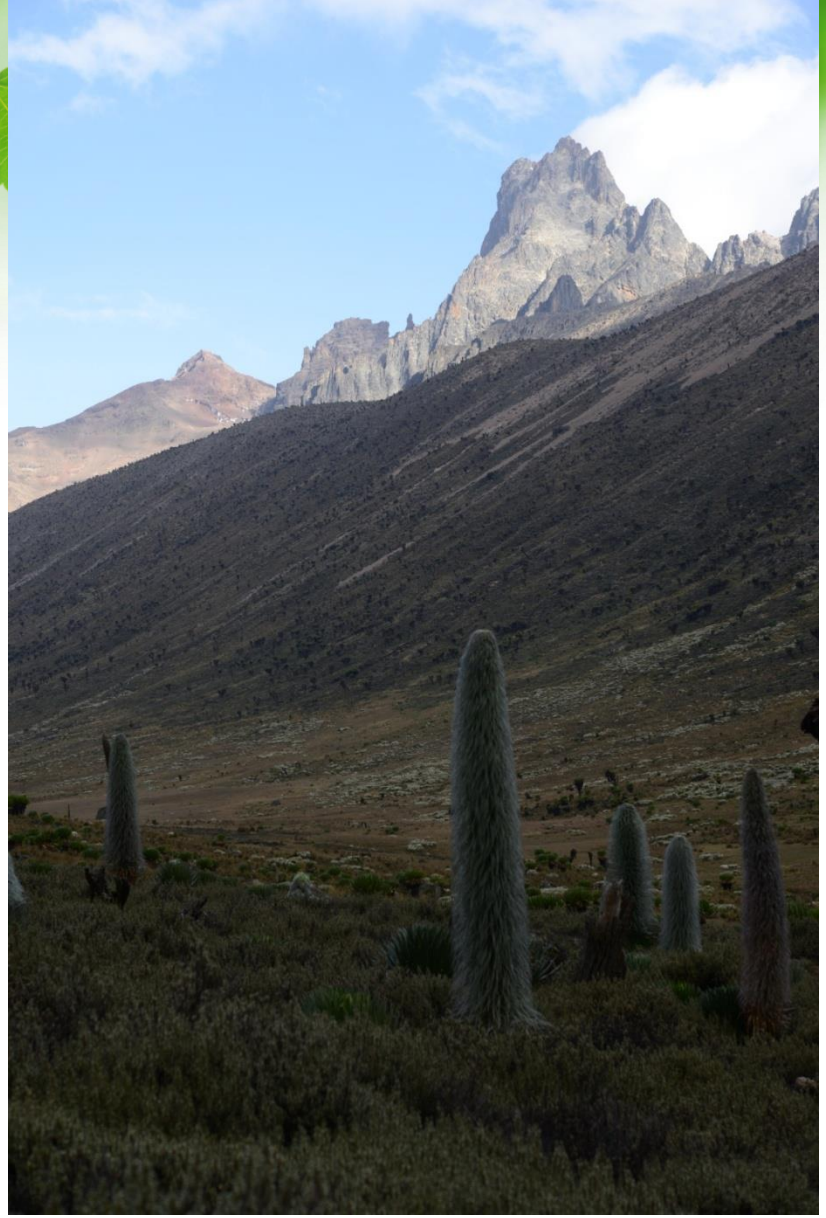
Lobelia deckenii
(Campanulaceae)

Lobelia telekii on Mt. Kenya

Malachite sunbird is visiting the inflorescence of *Lobelia telekii*

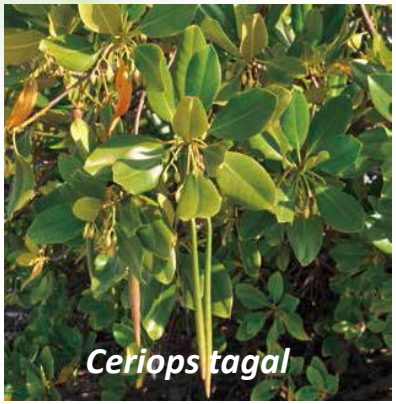
***Lobelia telekii* on Mt. Kenya**

Lobelia rhynchopetalum Hemsl. On **Mt. Bale**

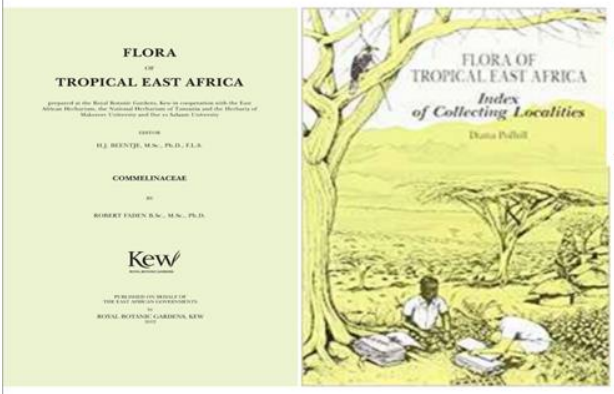


Mt. Kenya

Swamp & Mangroves



3. Plant richness in Tropical East Africa



RAINBIO

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Un centre créé et développé par la FRB
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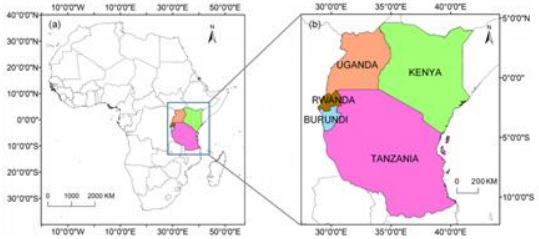
Naturalis Biodiversity Center
CNRS
Botanic Garden Meise
Royal Botanic Garden Edinburgh
AARHUS UNIVERSITY
MISSOURI BOTANICAL GARDEN

P D E A

Plants Database of Tropical East Africa

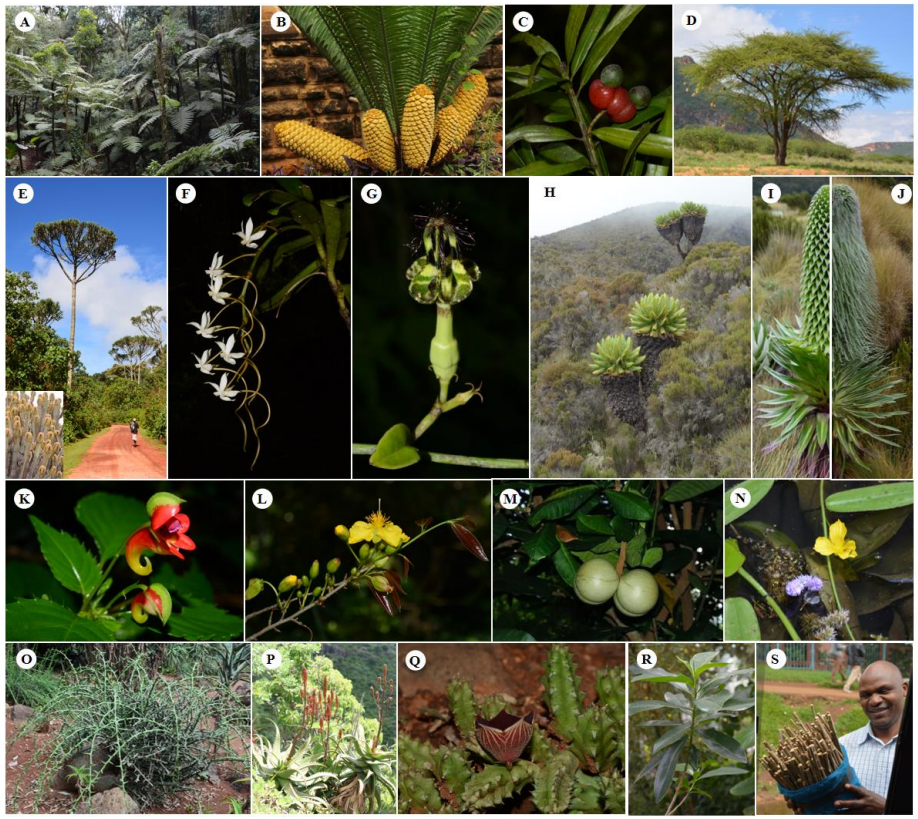
- Species
- Habitat
- Life form
- Location
- Functional traits



16143 species, 248 families, 2306 genera

Fabaceae, Asteraceae, Rubiaceae, Poaceae and Orchidaceae

3. Plant richness in Tropical East Africa



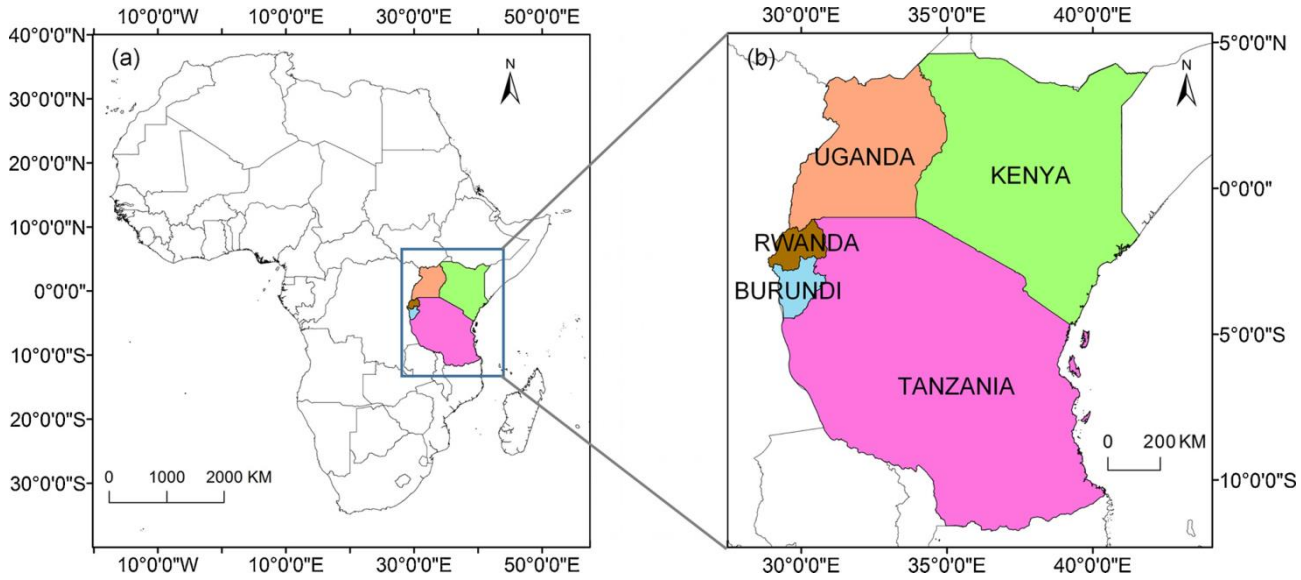
3,000 species are endemic (in 104 families, 626 genera):

Euphorbia (Euphorbiaceae)
Crotalaria (Fabaceae)
Impatiens (Balsaminaceae)
Aloe (Asphodelaceae)
Polystachya (Orchidaceae).

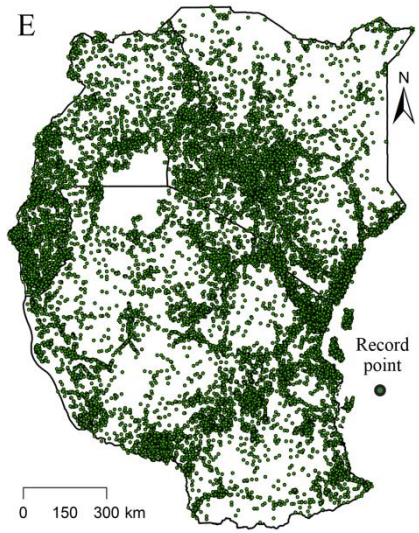
700 species are succulent

Euphorbia (Euphorbiaceae)
Aloe (Asphodelaceae)
Ceropegia (Apocynaceae)
Sansevieria (Asparagaceae)
Kalanchoe (Crassulaceae)

4. Inventory Incompleteness & Priority Collecting in tropical East Africa

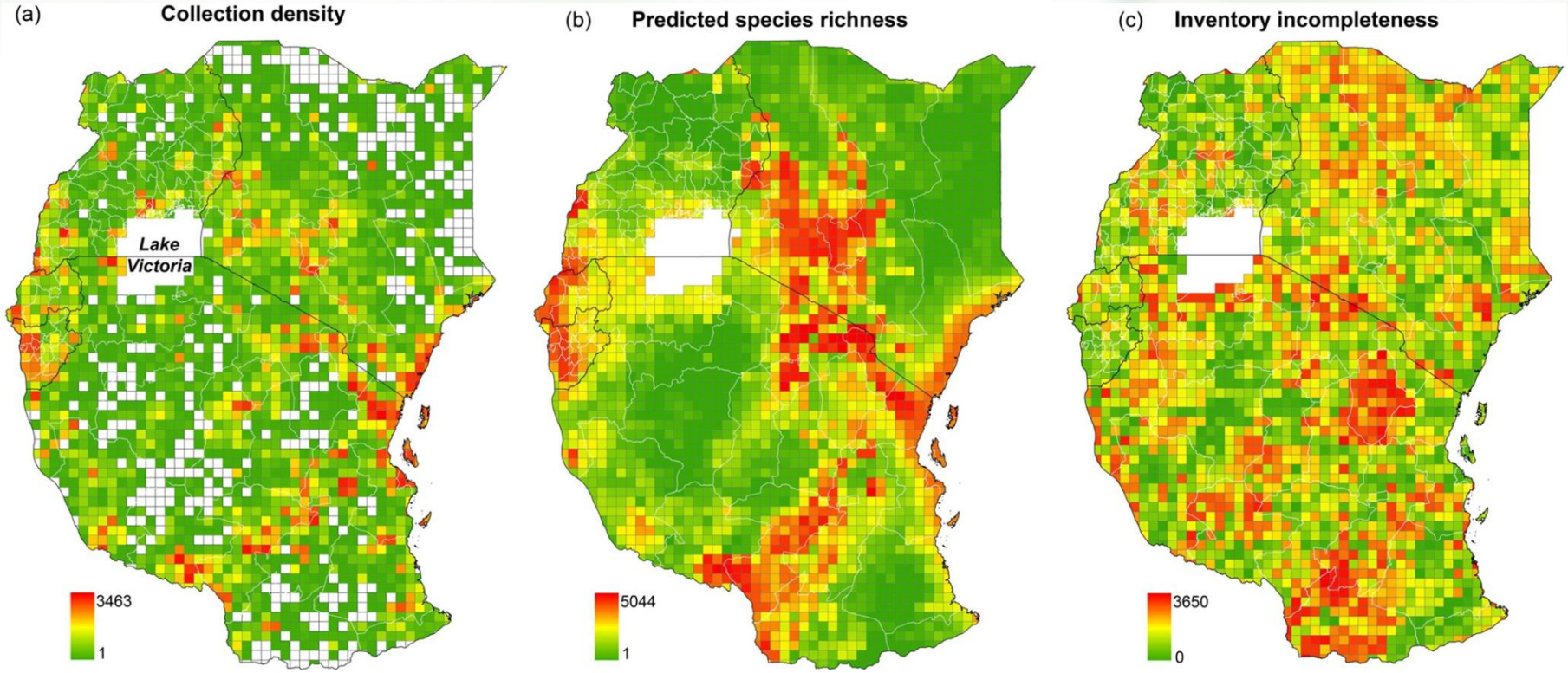


Location of research area. (a) Geographical location of tropical east Africa in Africa. (b) Five countries in tropical east Africa.



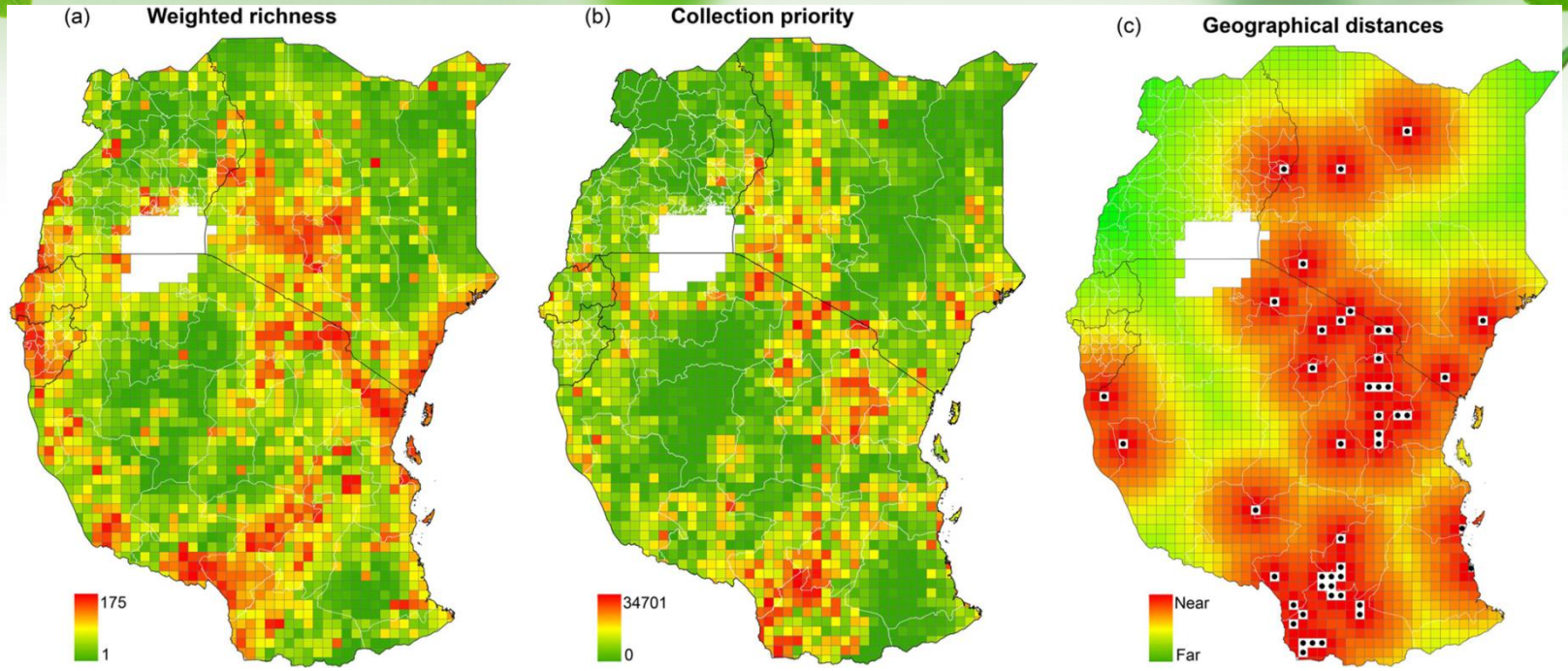
Spatial distribution of Specimen collection

Inventory Incompleteness & Priority Collecting in tropical East Africa



Geographical patterns of collection density (a), where white squares denote no collection data; (b) predicted species richness, including the data predicted by Maxent software and all recorded data (de-duplication); (c) inventory incompleteness of tropical East Africa based on grids of 0.25° ×0.25° .

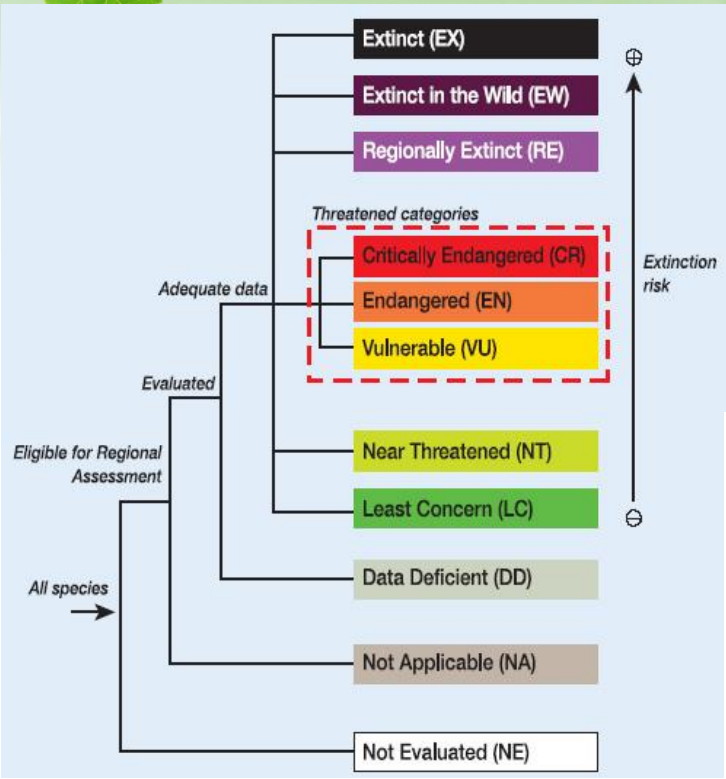
Inventory Incompleteness & Priority Collecting in tropical East Africa



Geographical patterns of weighted species richness (a) and (b) collection priority; (c) Geographical distance of priority collection center (Cpri > 3000)

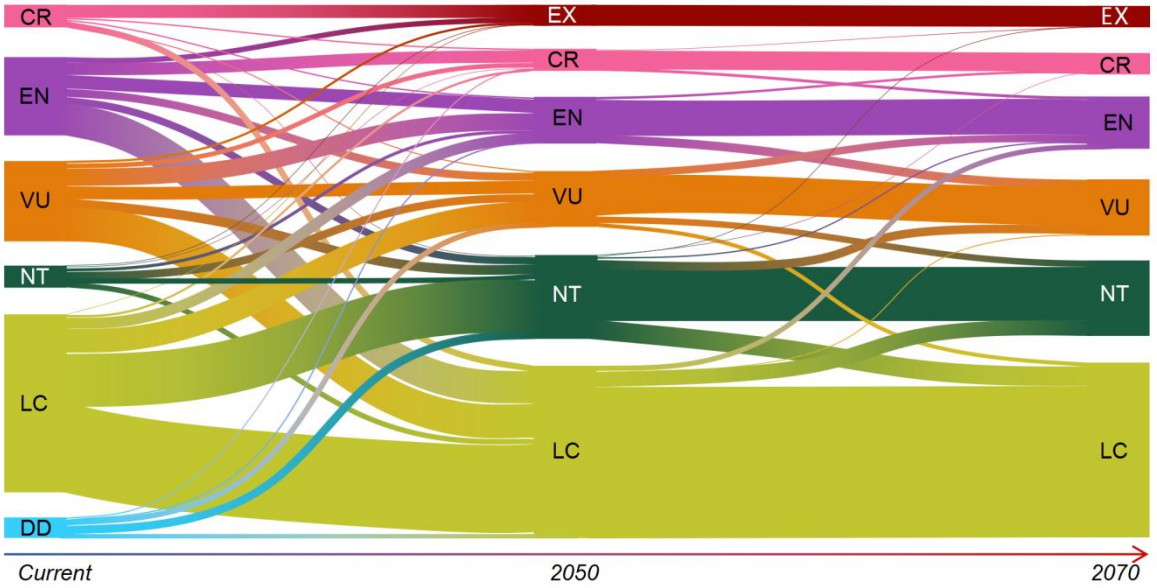
- **The results showed that the spatial distribution pattern of collection density and species richness is very uneven in tropical East Africa, with 16 % of regions having zero-collection, and more than half of the regions having inventory incompleteness.**

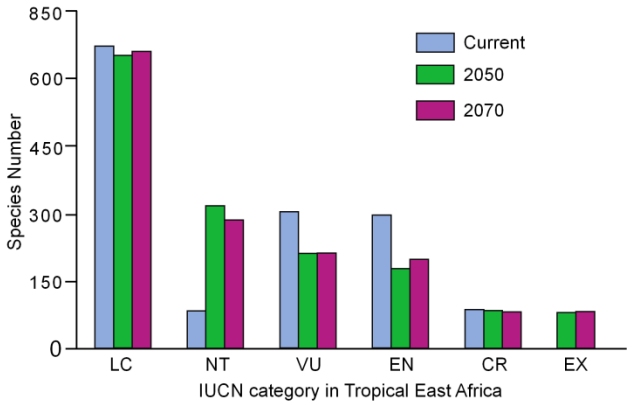
5. Risk of Plant Diversity in TEA



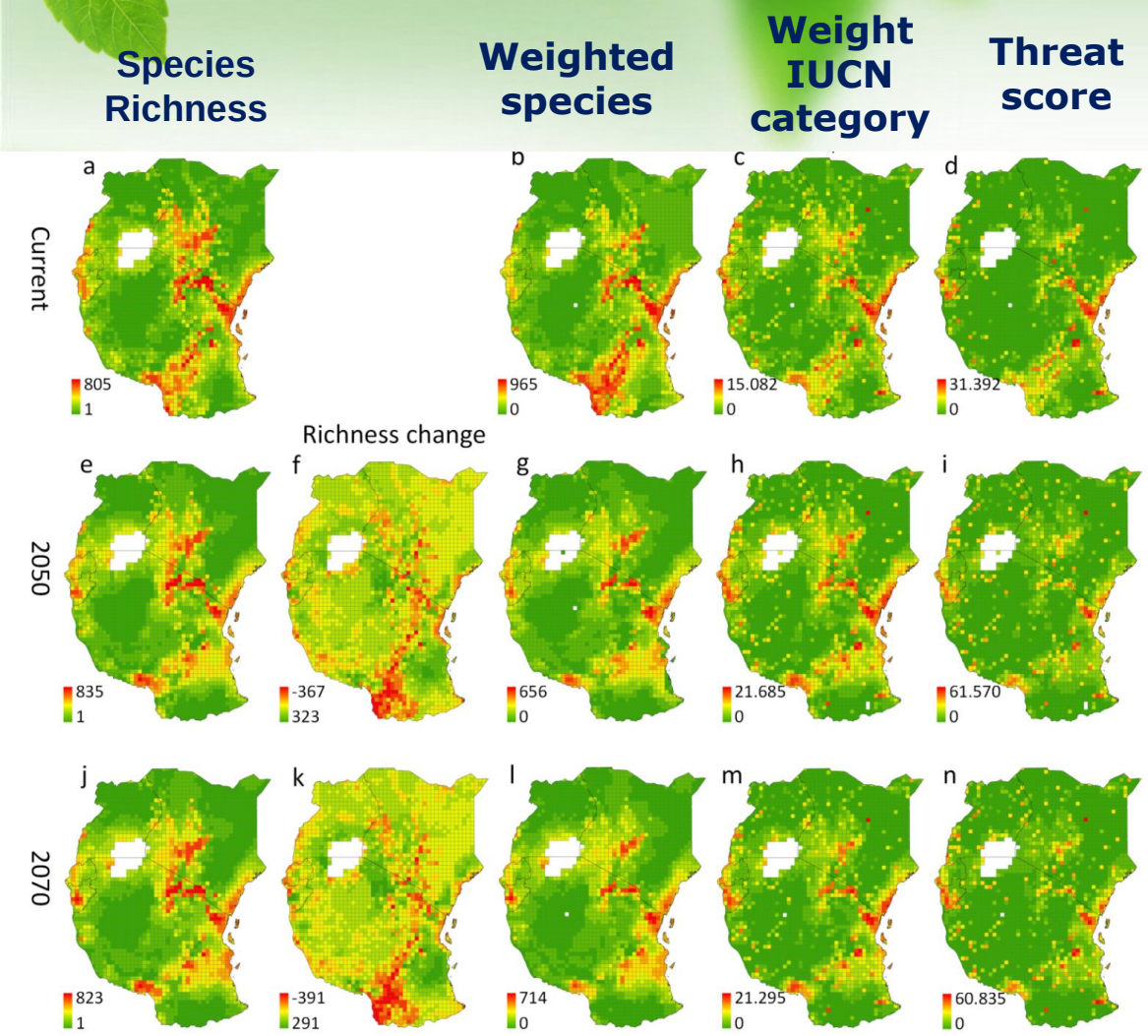
IUCN Red list Species under Climate Change

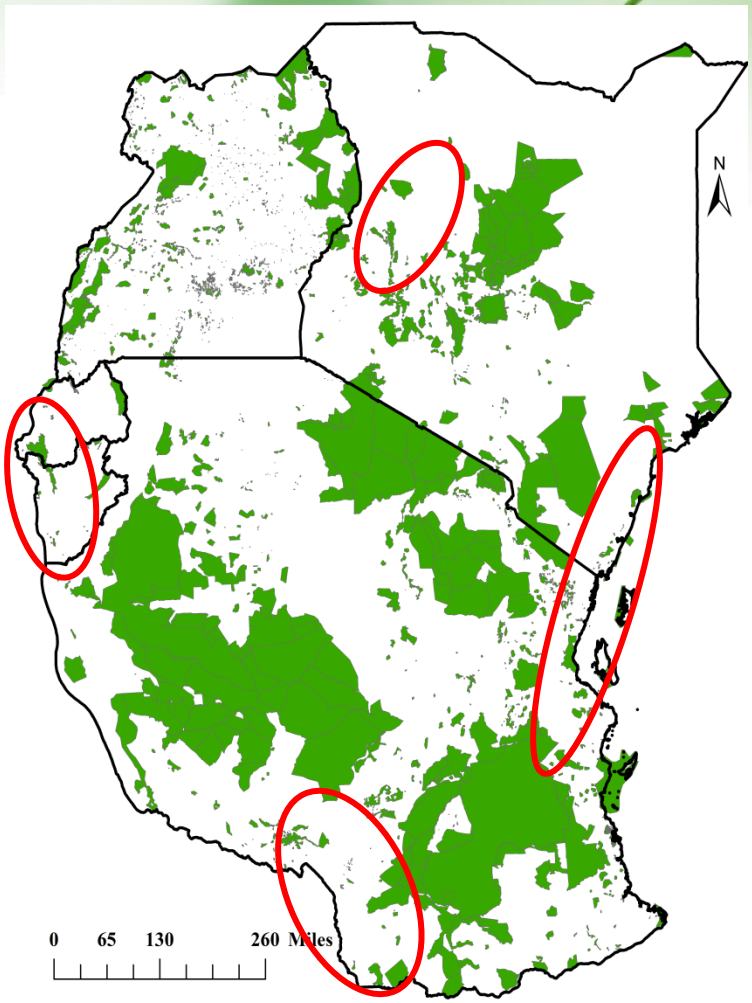
1821 IUCN Red List species in TEA in 653 genera and 162 families. 538 threatened species.





Changes in the IUCN Red List categories for the TEA plants over time

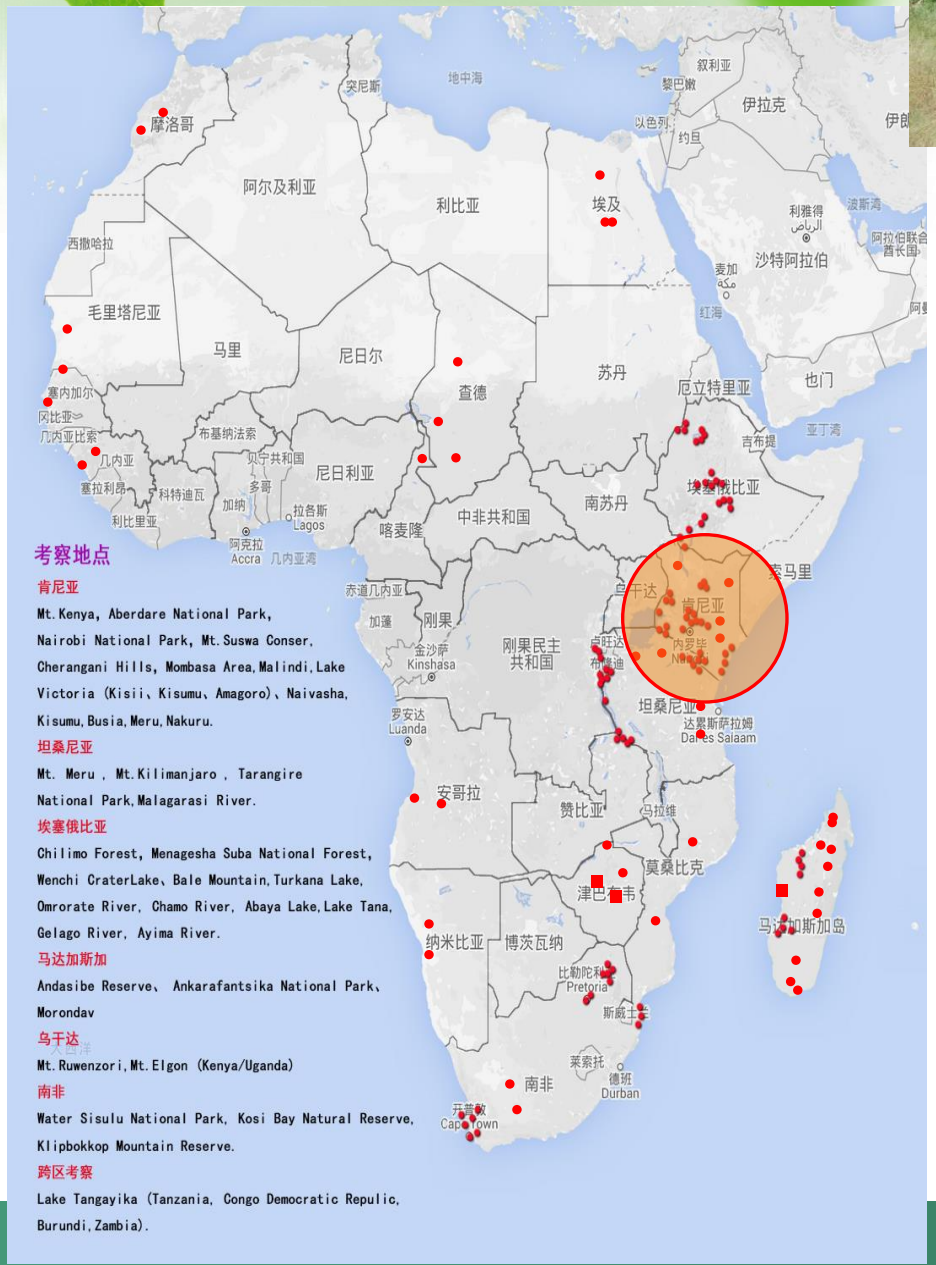




Current Protected Regions

Priority Protection Area

6. Plant diversity surveys in Africa



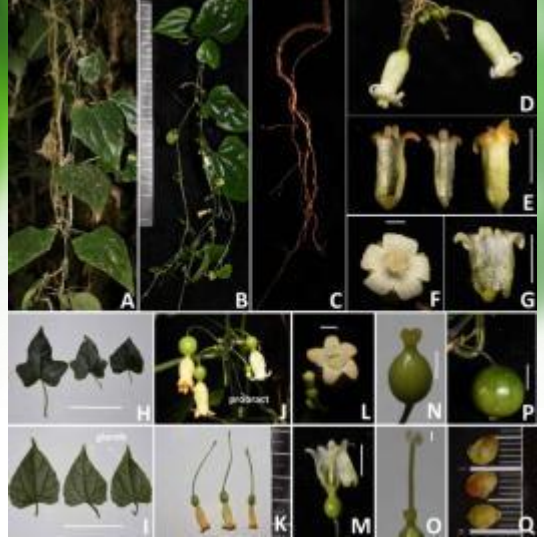
Plant diversity surveys in tropical East Africa


MOUNT KILIMANJARO
CONGRATULATIONS

Achievement of Plant Diversity Surveys in Africa

1. **More than 40 surveys have been performed (20 in tropical East Africa);**
2. **More than 11,000 specimens including ca. 5000 species have been collected;**
3. **14 new taxa of plant have been named and published;**
4. **Two books including '*Common plants of Kenya*' and '*Field Guide to Wild Plants of Africa: Mt. Kenya*' have been published;**
5. **Two volumes of '*Flora of Kenya*' including Rubiaceae and Orchidaceae have been compiled and will be published soon.**

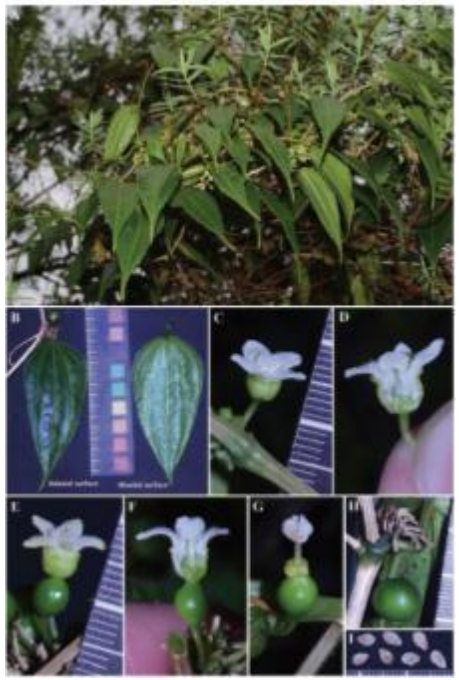
New species found in Kenya



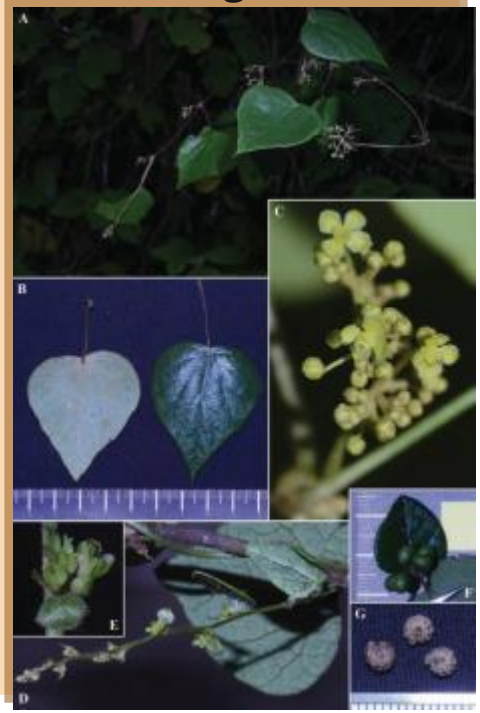
Zehneria longiflora

Zehneria tuberifera

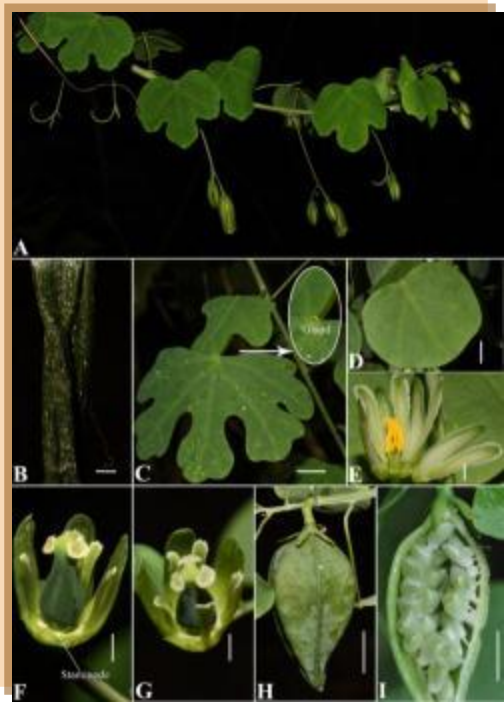
Sedum keniense



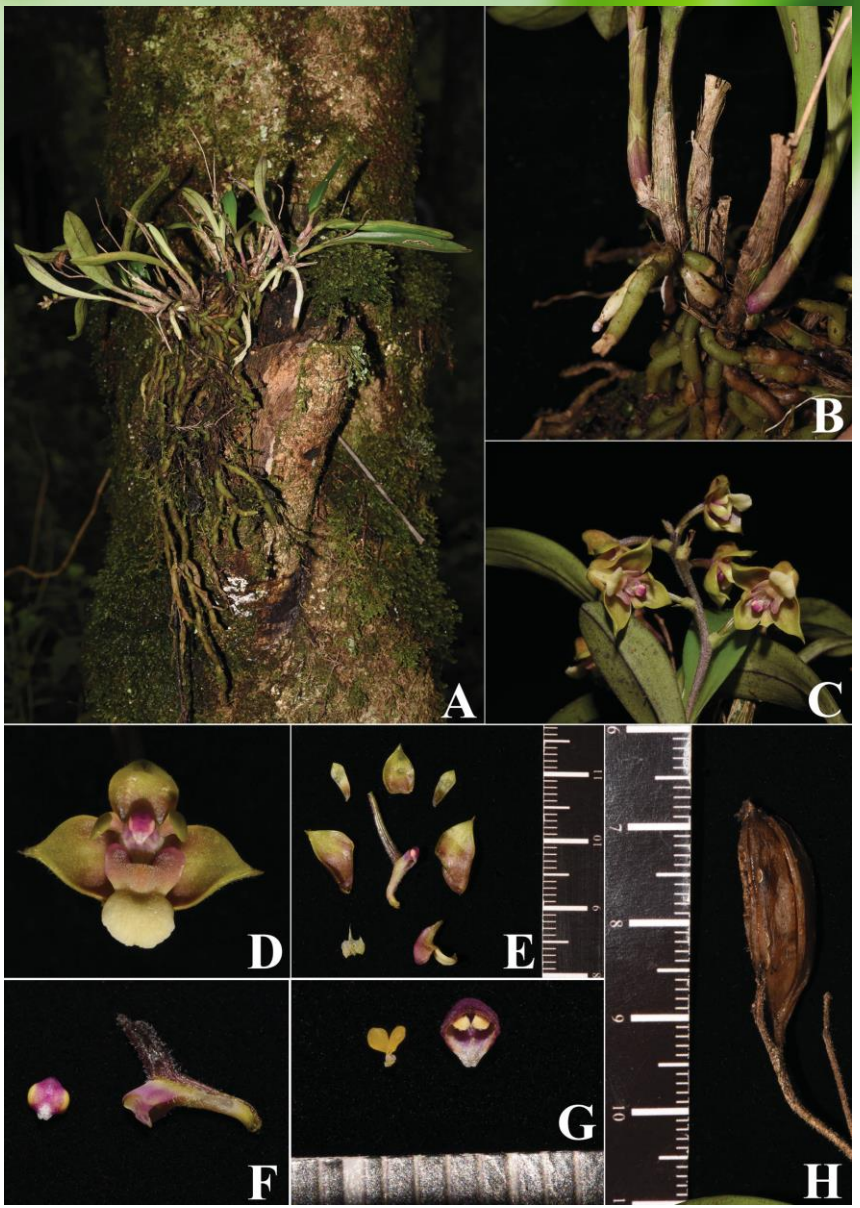
Zehneria subcoriacea

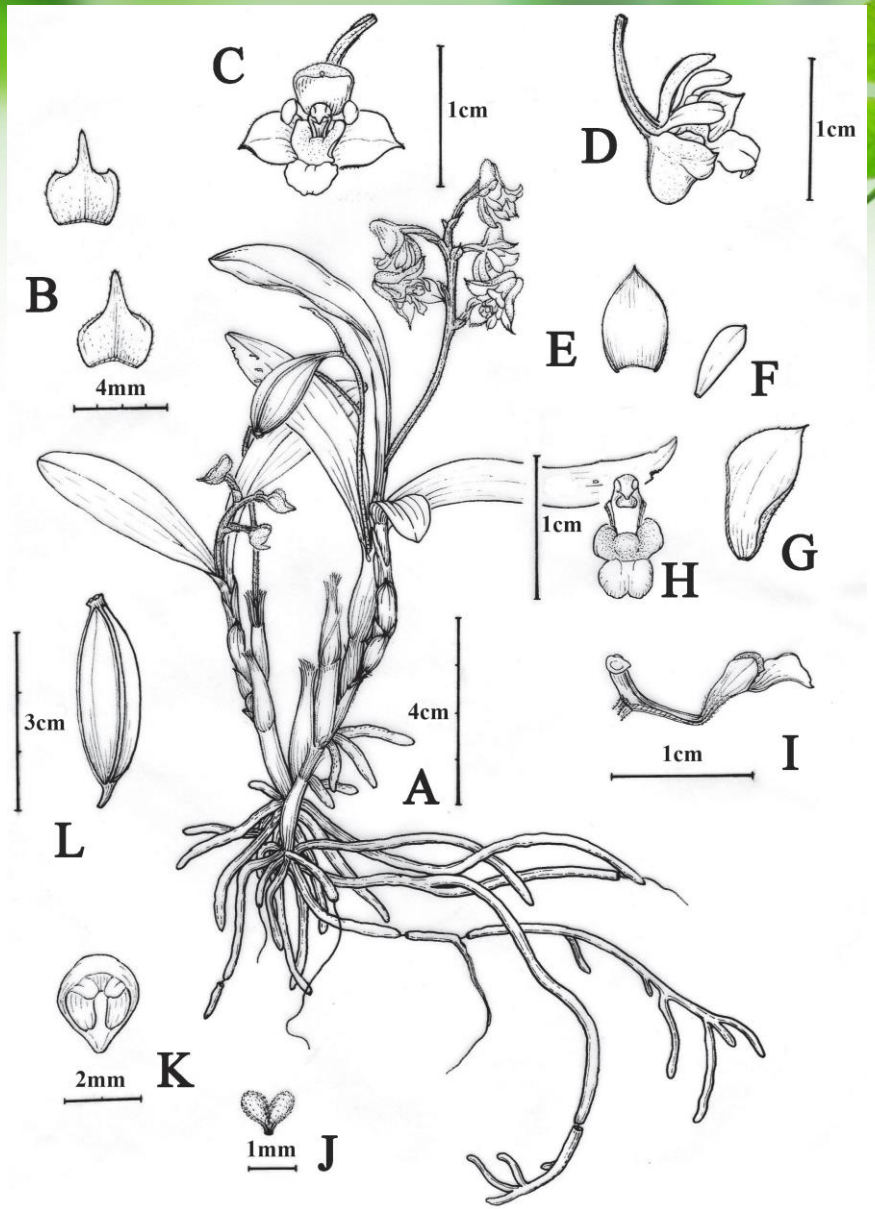


Cissampelos keniensis



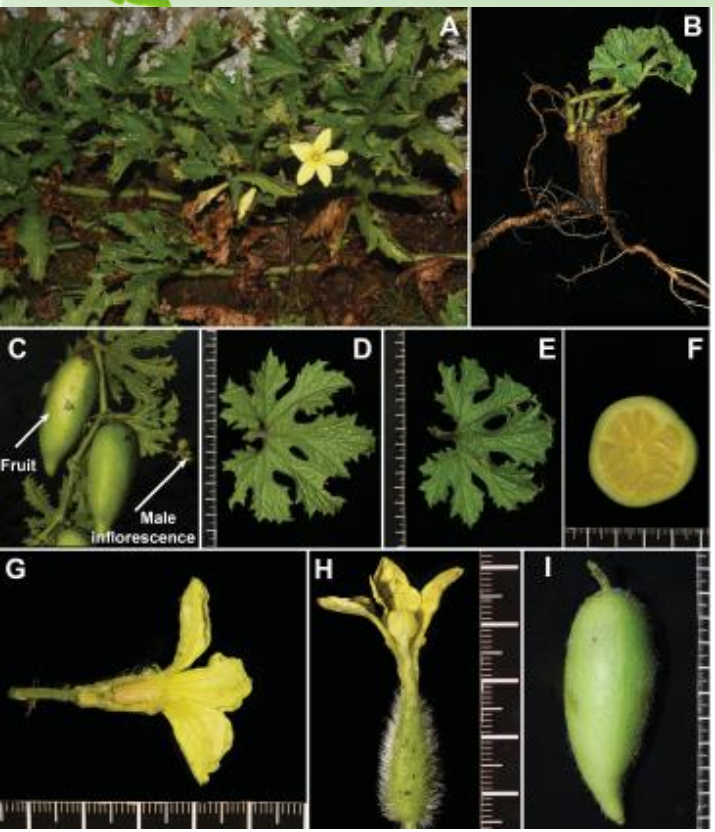
Adenia angulosa



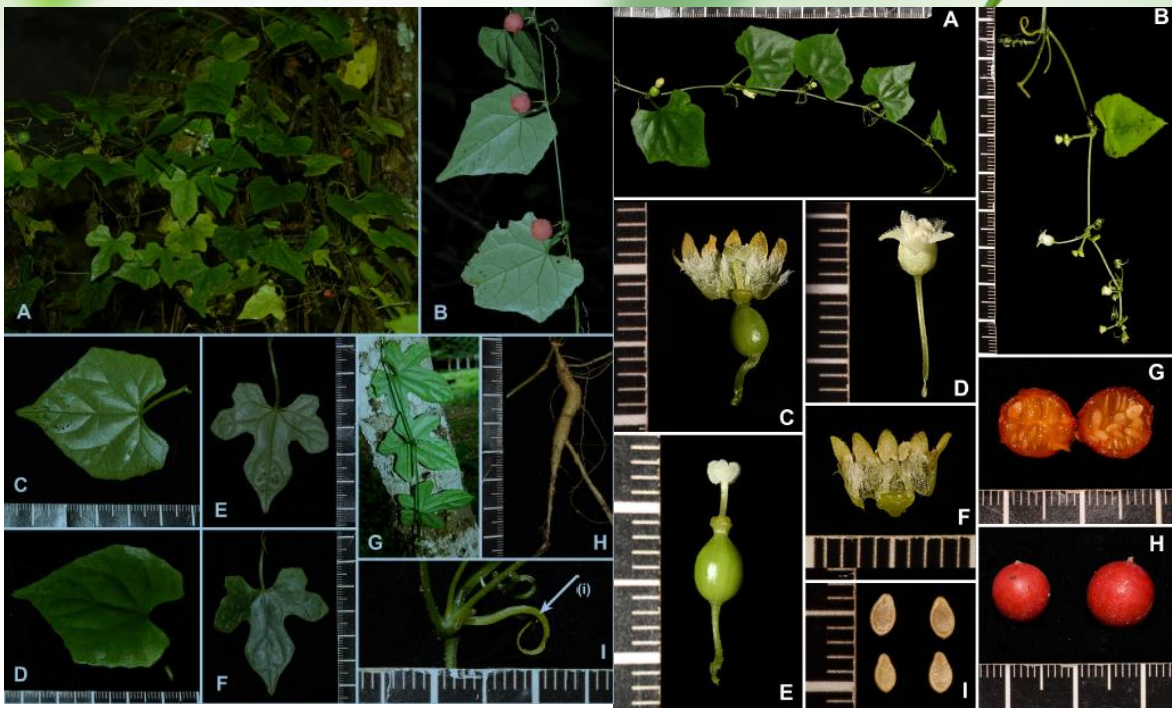


Polystachya danieliana sp. nov.

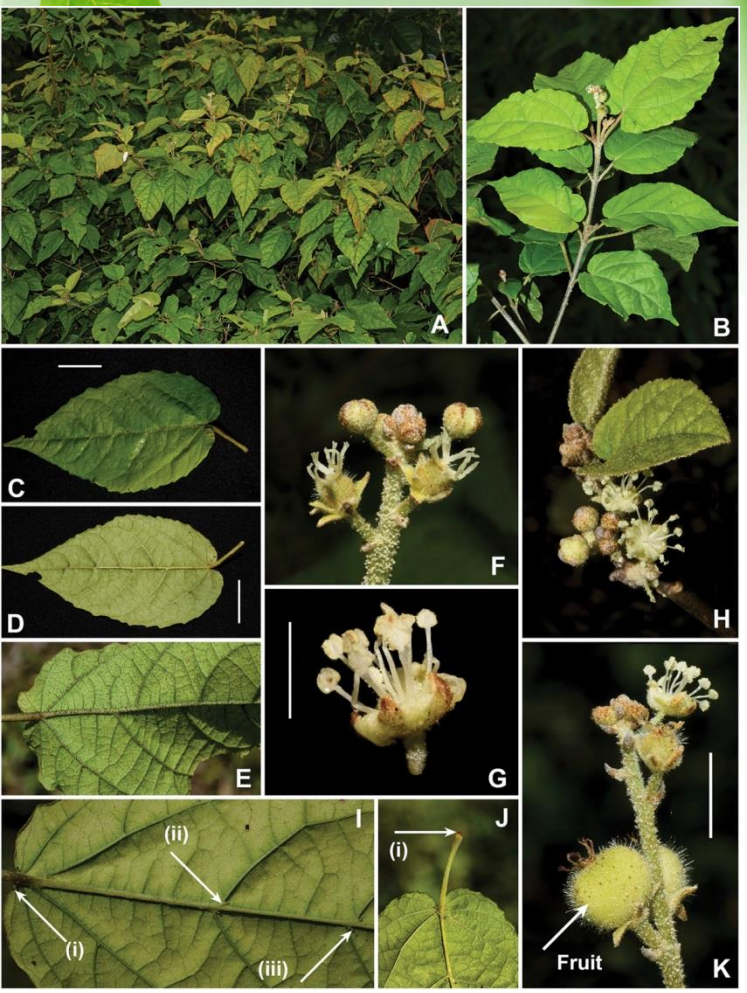
Kenya (2019)

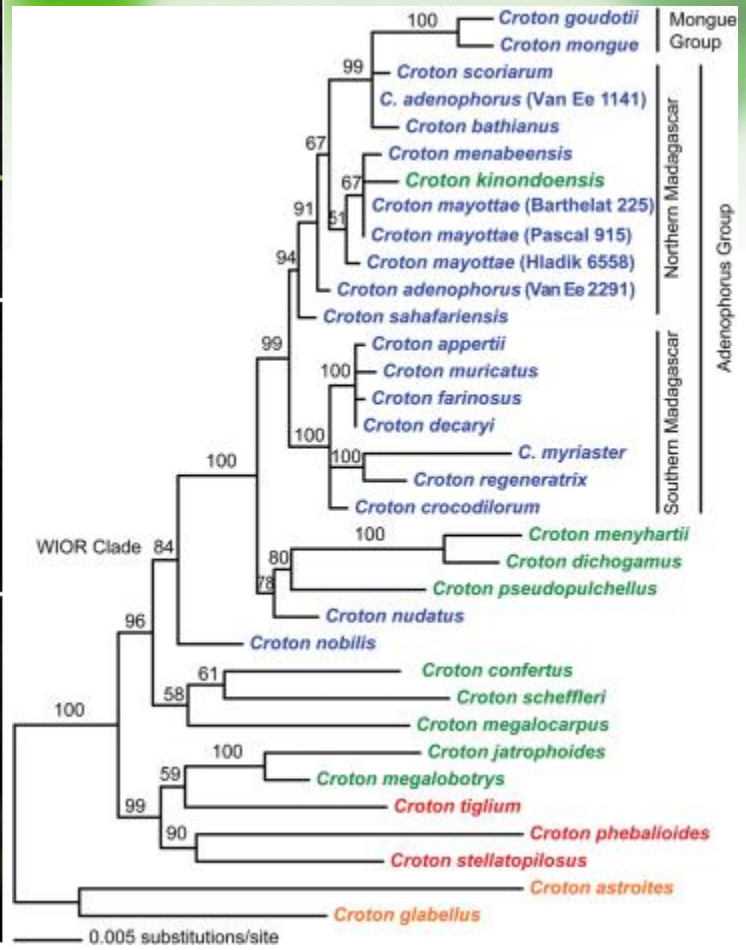


Peponium elgonensis
sp. nov.
Kenya (2020)



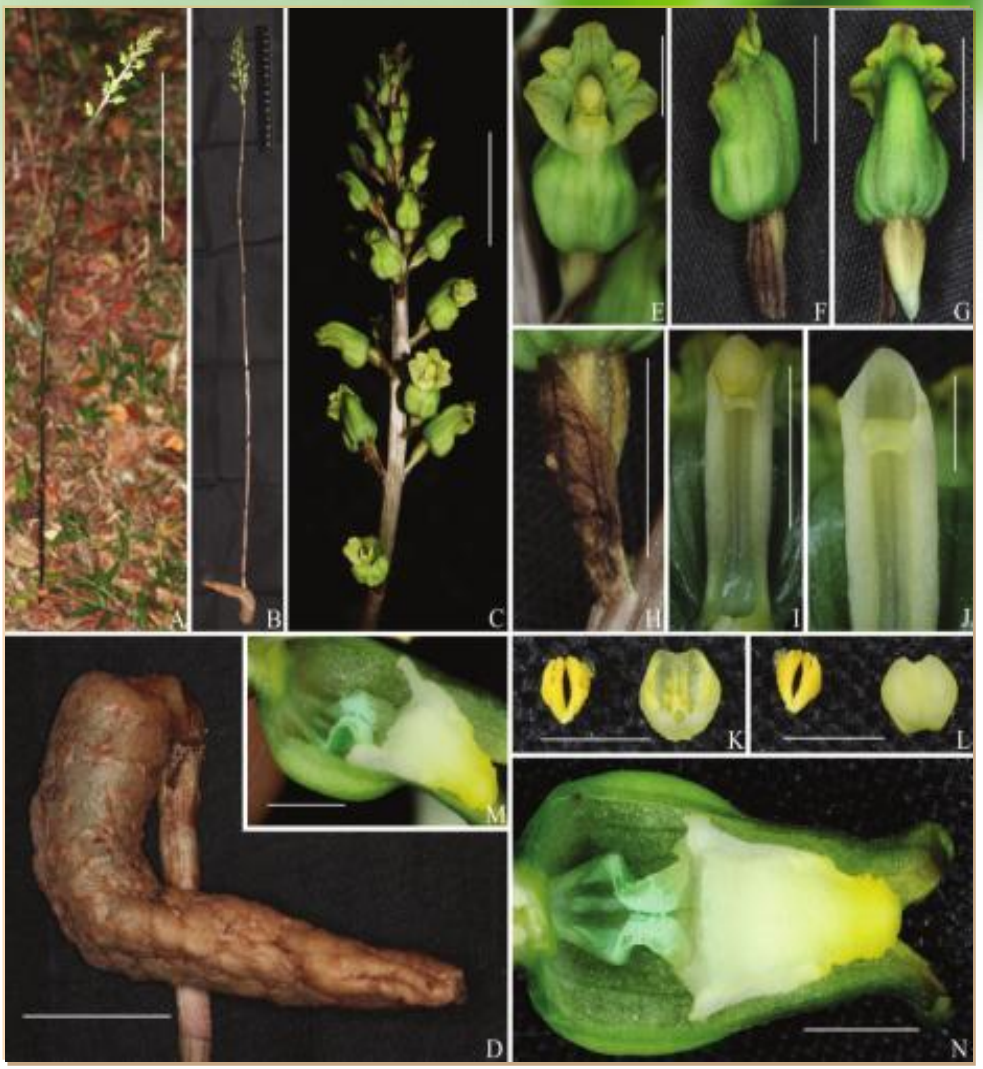
Zehneria monocarpa
sp. nov.
Kenya (2020)

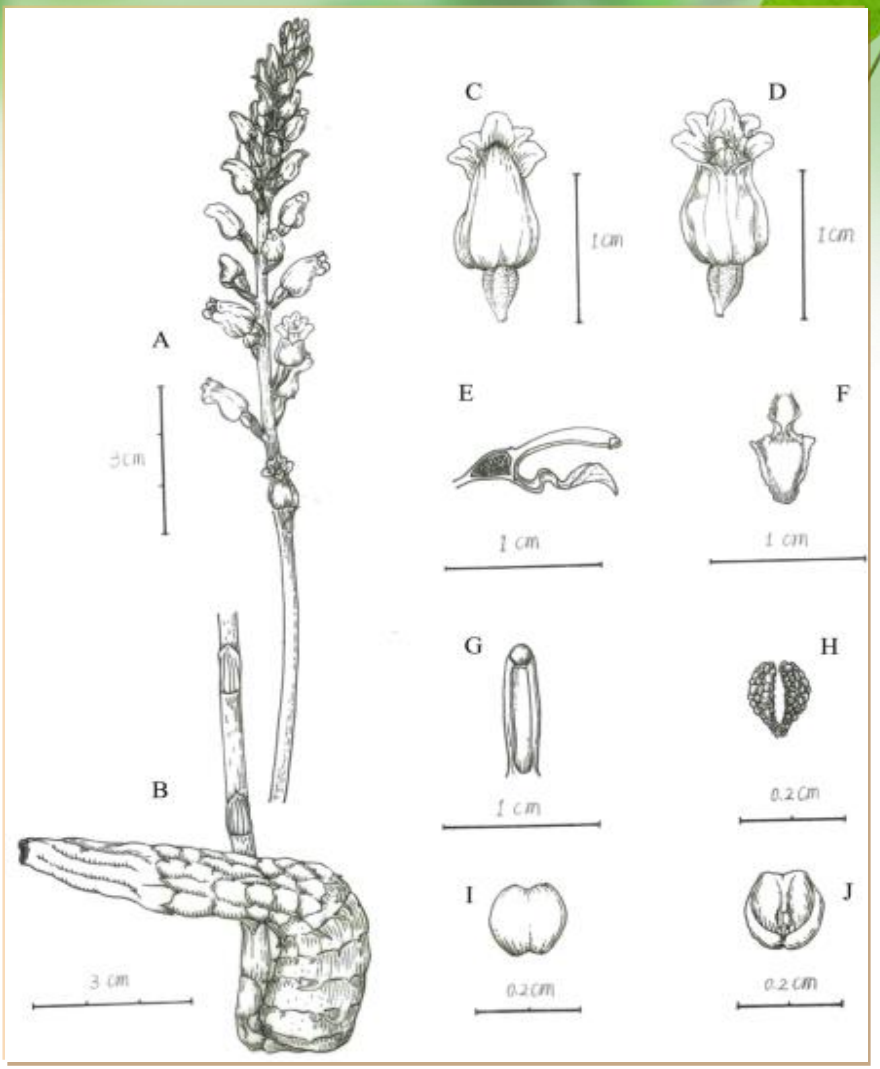




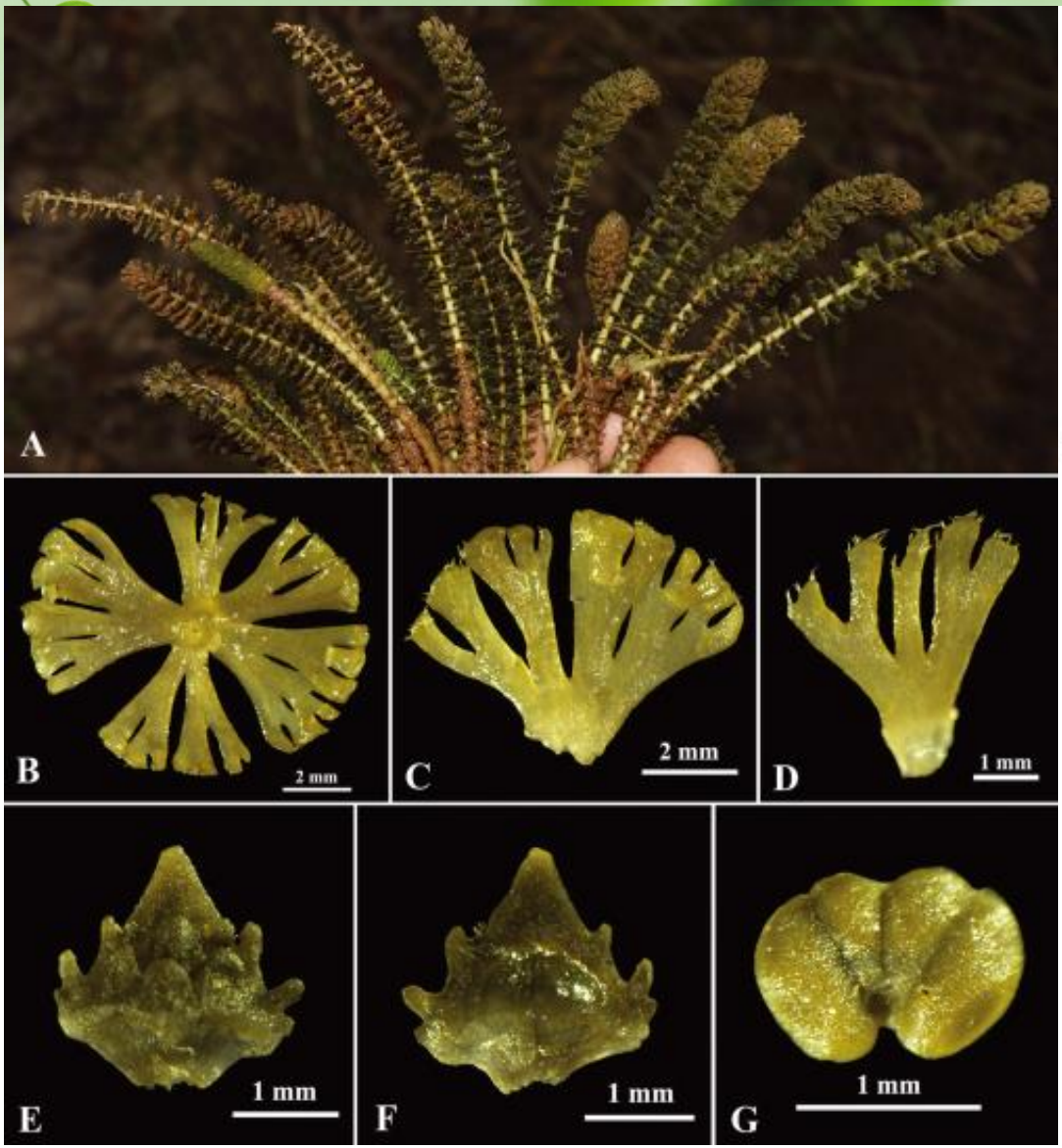
Croton kinondonesis G.W. Hu, V.M. Ngumbau & Q.F. Wang. found in coastal forest of Kenya

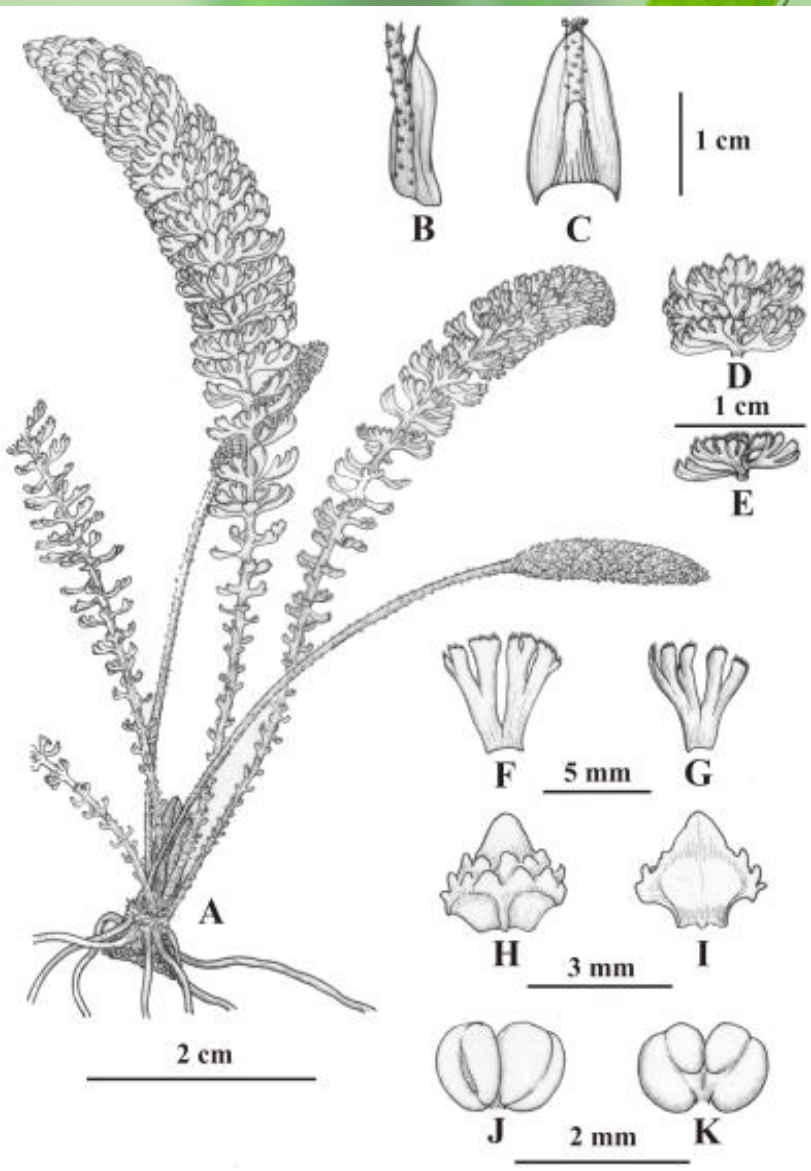
•Taxa in orange are from the New World, in red from Asia and Australia, in green from continental Africa, and in blue from Madagascar and the Comoro Islands.





***Gastrodia elatoides sp. nov.* found in Madagascar (2020)**

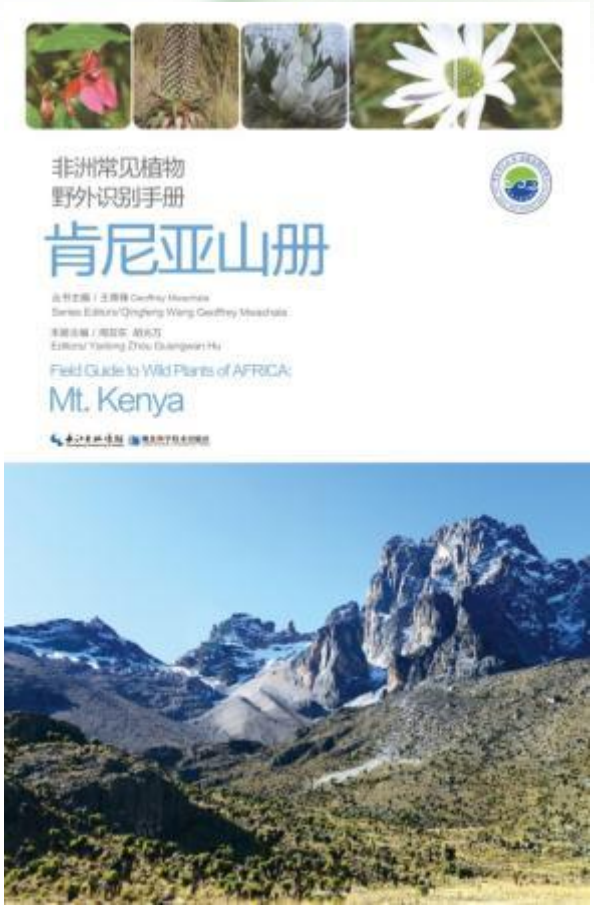




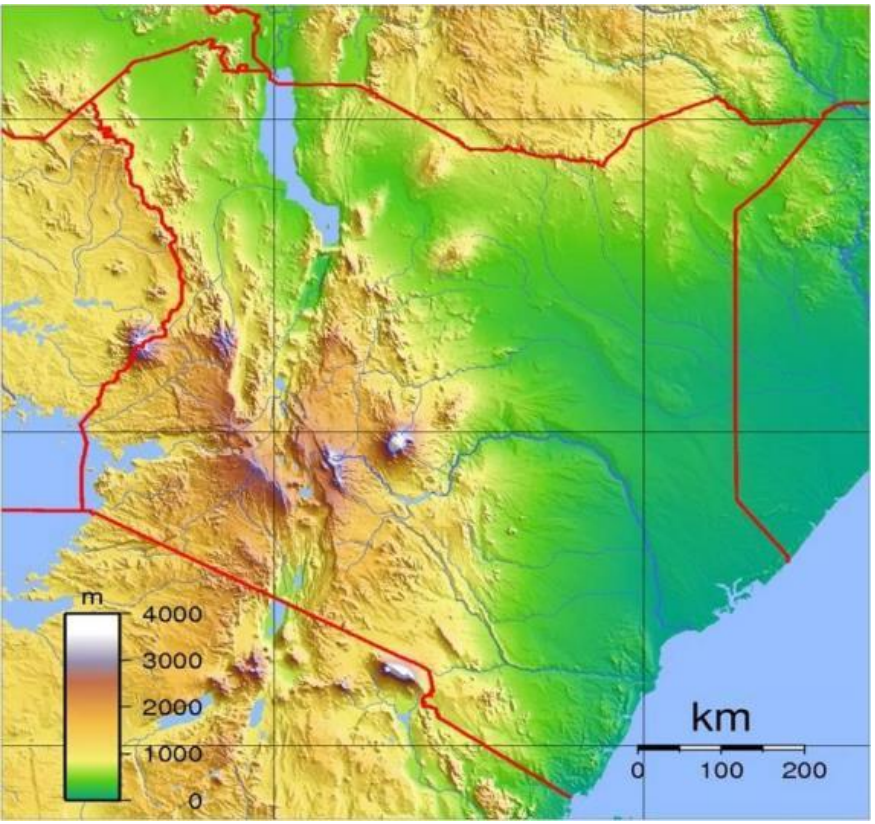
Hydrostachys flabellifera sp. nov.

found in Madagascar (2020)

Book publication



7. Project of *Flora of Kenya*



- ***Flora of Kenya*** **is planned to record all the vascular plants of about 7000 to 8000 species in Kenya. It will be published online one family by one family at first. Then hard copies will be published in 31 volumes. The whole project is planned to last for 10 to 15 years. In this book, all the families, genera and species will be revised; the arrangement will be based on the latest APG system; photographs will be used to show the important morphological characters of the plants and the interspecific differences.**

Volume arrangement

目录

[隐藏]

Volume 23: Rubiaceae

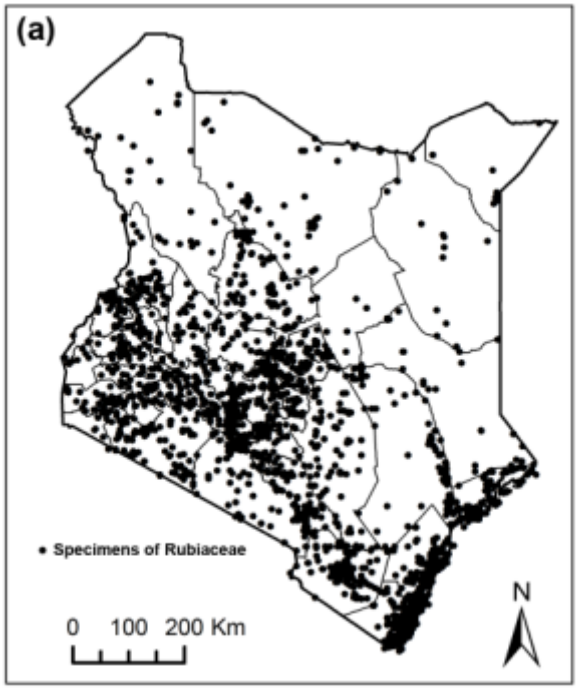
Rubiaceae in Kenya : 3 subfamilies , 21 tribes , 83 genera , 263 species (inculding subspecies and varieties)

- Color plates for 158 species
- Line drawings for 50 species

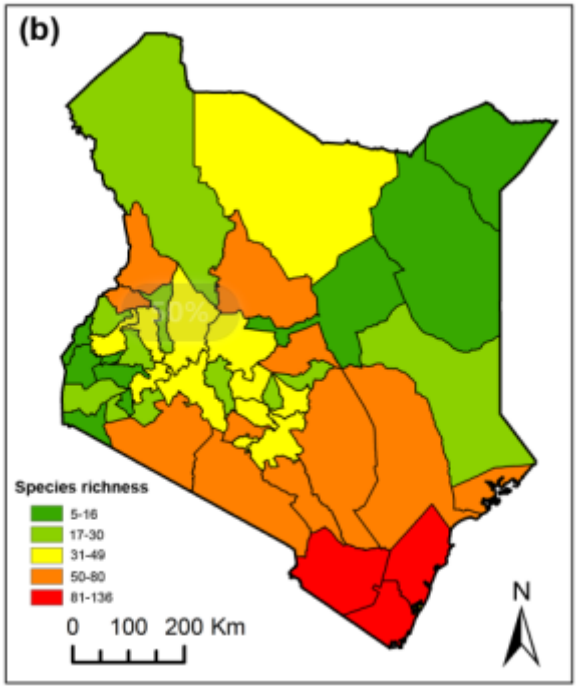
Genus	Number of species
Pavetta	24
Psychotria	24
Oldenlandia	23
Galium	14
Vangueria	12
Spermacoce	10

The genera with more 10 species in Kenya

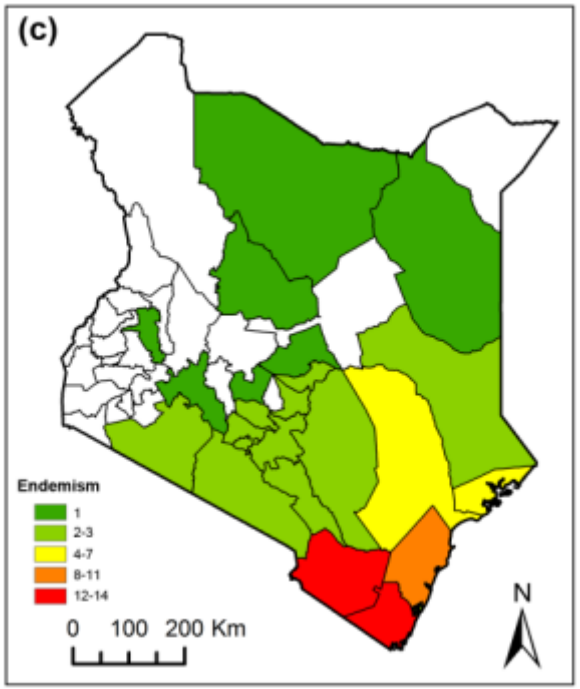
Volume 23: Rubiaceae



Spatial distribution of Specimen collection



Species richness in counties



Endemism richness in counties

Volume 23: Rubiaceae

Subfamily 1. Rubioideae

Subfamily 2. Ixoroideae

Subfamily 3. Cincbonoideae

Subfamily 4.

Subfamily System of Rubiaceae in Kenya

Phylogenetic tree provided by Prof. WANG Ruijiang

Volume 23: Rubiaceae

Subfamily	Tribe	Number of Genera
Rubioideae	Urophylleae	1
Rubioideae	Lasiantheae	1
Rubioideae	Craterispermeae	1
Rubioideae	Psychotrieae	4
Rubioideae	Knoxieae	10
Rubioideae	Spermacoceae	15
Rubioideae	Anthospermeae	1
Rubioideae	Paederieae	1
Rubioideae	Rubieae	2
Cinchonoideae	Hymenodictyeae	1
Cinchonoideae	Naucleeae	4
Cinchonoideae	Guettardeae	1
Ixoroideae	Mussaendeae	3
Ixoroideae	Crossopterygeae	1
Ixoroideae	Ixoreae	1
Ixoroideae	Vanguerieae	11
Ixoroideae	Coffeeae	4
Ixoroideae	Octotropideae	7
Ixoroideae	Sherbournieae	2
Ixoroideae	Pavetteae	7
Ixoroideae	Gardenieae	5

21 Tribes of Rubiaceae in Kenya

Volume 23: Rubiaceae

Family	Genus	Species	Revised genus	Revised species
Rubiaceae	*Pentas*	*decora*	*Dolichopentas*	*Dolichopentas decora (S.Moore) Kårehed & B.Bremer*
Rubiaceae	*Pentas*	*longiflora*	*Dolichopentas*	*Dolichopentas longiflora (Oliv.) Kårehed & B.Bremer*
Rubiaceae	*Pentas*	*longiflora*	*Phyllopentas*	*Phyllopentas elata (K.Schum.) Kårehed & B.Bremer*
Rubiaceae	*Pentas*	*schimperana*	*Phyllopentas*	*Phyllopentas schimperi (Hochst.) Y.D. Zhou, comb. nov.*
Rubiaceae	*Pentas*	*arbensis*	*Pentas*	*Pentas arvensis Hiern*
Rubiaceae	*Pentas*	*lanceolata*	*Pentas*	*Pentas lanceolata (Forssk.) Deflers*
Rubiaceae	*Pentas*	*wyliei*	*Pentas*	*Pentas micrantha subsp. wyliei (N.E.Br.) Verdc*
Rubiaceae	*Pentas*	*pubiflora*	*Pentas*	*Pentas pubiflora S.Moore*
Rubiaceae	*Pentas*	*suswaensis*	*Pentas*	*Pentas suswaensis Verdc.*
Rubiaceae	*Pentas*	*zanzibarica*	*Pentas*	*Pentas zanzibarica (Klotzsch) Vatke*
Rubiaceae	*Pentas*	*bussei*	*Rhodopentas*	*Rhodopentas bussei (K.Krause) Kårehed & B.Bremer*
Rubiaceae	*Pentas*	*parvifolia*	*Rhodopentas*	*Rhodopentas parvifolia (Hiern) Kårehed & B.Bremer*

Revisions on the genus of *Pentas* in Rubiaceae

- POWO ; Tropicos ; IPNI ; Taxon, Kårehed & Bremer, 2007.

Volume 23: Rubiaceae

Family	Genus	Species	Revised genus	Revised species
Rubiaceae	*Kohautia*	*aspera*	*Kohautia*	*Kohautia aspera (B.Heyne ex Roth) Bremek*
Rubiaceae	*Kohautia*	*caespitosa*	*Kohautia*	*Kohautia caespitosa Schnizl*
Rubiaceae	*Kohautia*	*coccinea*	*Kohautia*	*Kohautia coccinea Royle*
Rubiaceae	*Kohautia*	*longifolia*	*Cordylostigma*	*Cordylostigma longifolium (Klotzsch) Groeninckx & Dessein*
Rubiaceae	*Kohautia*	*obtusiloba*	*Cordylostigma*	*Cordylostigma obtusilobum (Hiern) Groeninckx & Dessein*
Rubiaceae	*Kohautia*	*prolixipes*	*Cordylostigma*	*Cordylostigma prolixipes (S.Moore) Groeninckx & Dessein*
Rubiaceae	*Kohautia*	*virgata*	*Cordylostigma*	*Cordylostigma virgatum (Willd.) Groeninckx & Dessein*

Revisions on the genus of *Kohautia* in Rubiaceae

- POWO ; Tropicos ; IPNI ; Taxon, Kårehed & Bremer, 2007.

Volume 23: Rubiaceae

Family	Genus	Species	Genus	Revised species
Rubiaceae	*Oldenlandia*	*goreensis*	*Edrastima*	*Edrastima goreensis (DC.) Neupane & N.Wikstr.*
Rubiaceae	*Oldenlandia*	*lancifolia*	*Scleromitrion*	*Scleromitrion lancifolium (Schumach.) Y.D. Zhou comb. nov.*
Rubiaceae	*Oldenlandia*	*affinis*	*Oldenlandia*	*Oldenlandia affinis (Roem. & Schult.) DC.*
Rubiaceae	*Oldenlandia*	*capensis*	*Oldenlandia*	*Oldenlandia capensis L.f.*
Rubiaceae	*Oldenlandia*	*corymbosa*	*Oldenlandia*	*Oldenlandia corymbosa L.*
Rubiaceae	*Oldenlandia*	*borrerioides*	*Oldenlandia*	*Oldenlandia cryptocarpa Chiov.*
Rubiaceae	*Oldenlandia*	*fastigiata*	*Oldenlandia*	*Oldenlandia fastigiata Bremek*
Rubiaceae	*Oldenlandia*	*friesiorum*	*Oldenlandia*	*Oldenlandia friesiorum Bremek*
Rubiaceae	*Oldenlandia*	*herbacea*	*Oldenlandia*	*Oldenlandia herbacea (L.) Roxb*
Rubiaceae	*Oldenlandia*	*ichthyoderma*	*Oldenlandia*	*Oldenlandia ichthyoderma Cufod.*
Rubiaceae	*Oldenlandia*	*johnstonii*	*Oldenlandia*	*Oldenlandia johnstonii (Oliv.) K.Schum. ex Engl.*
Rubiaceae	*Oldenlandia*	*monanthos*	*Oldenlandia*	*Oldenlandia monanthos (Hochst. ex A.Rich.) Hiern*
Rubiaceae	*Oldenlandia*	*richardsonioides*	*Oldenlandia*	*Oldenlandia richardsonioides (K.Schum.) Verdc.*
Rubiaceae	*Oldenlandia*	*rosulata*	*Oldenlandia*	*Oldenlandia rosulata K.Schum*
Rubiaceae	*Oldenlandia*	*rupicola*	*Oldenlandia*	*Oldenlandia rupicola (Sond.) Kuntze*
Rubiaceae	*Oldenlandia*	*scopulorum*	*Oldenlandia*	*Oldenlandia scopulorum Bullock*
Rubiaceae	*Oldenlandia*	*wiedemannii*	*Oldenlandia*	*Oldenlandia wiedemannii K.Schum*

Revisions on the genus of *Oldenlandia* in Rubiaceae

- POWO ; Tropicos ; IPNI ; Taxon, Neupane et al., 2015

Volume 23: Rubiaceae

Family	Genus	Species	Revised genus	Revised species
Rubiaceae	*Canthium*	*keniense*	*Afrocanthium*	*Afrocanthium keniense (Bullock) Lantz*
Rubiaceae	*Canthium*	*kilifiense*	*Afrocanthium*	*Afrocanthium kilifiense (Bridson) Lantz*
Rubiaceae	*Canthium*	*lactescens*	*Afrocanthium*	*Afrocanthium lactescens (Hiern) Lantz*
Rubiaceae	*Canthium*	*peteri*	*Afrocanthium*	*Afrocanthium peteri (Bridson) Lantz*
Rubiaceae	*Canthium*	*pseudoverticillatum*	*Afrocanthium*	*Afrocanthium pseudoverticillatum (S.Moore) Lantz*
Rubiaceae	*Canthium*	*dyscriton*	*Bullockia*	*Bullockia dyscritos (Bullock) Razafim. et al*
Rubiaceae	*Canthium*	*fadenii*	*Bullockia*	*Bullockia fadenii (Bridson) Razafim. et al*
Rubiaceae	*Canthium*	*mombazense*	*Bullockia*	*Bullockia mombazensis (Baill.) Razafim. et al*
Rubiaceae	*Canthium*	*pseudosetiflorum*	*Bullockia*	*Bullockia pseudosetiflora (Bridson) Razafim. et al*
Rubiaceae	*Canthium*	*setiflorum*	*Bullockia*	*Bullockia setiflora (Hiern) Razafim. et al*
Rubiaceae	*Canthium*	*glaucum*	*Canthium*	*Canthium glaucum Hiern*
Rubiaceae	*Canthium*	*oligocarpum*	*Canthium*	*Canthium oligocarpum Hiern*
Rubiaceae	*Meyna*	*tetraphylla*	*Canthium*	*Canthium tetraphyllum (Schweinf. ex Hiern) Baill*

Revisions on the genus of *Canthium* in Rubiaceae

- POWO ; Tropicos ; IPNI ; Ann. Missouri Bot. Gard. , Razafimandimbison et al., 2009

Volume 23: Rubiaceae

Family	Genus	Species	Revised genus	Revised species
Rubiaceae	*Lagynias*	*pallidiflora*	*Vangueria*	*Vangueria pallidiflora (Bullock) Lantz*
Rubiaceae	*Pachystigma*	*loranthifolium*	*Vangueria*	*Vangueria loranthifolia K.Schum*
Rubiaceae	*Pachystigma*	*gillettii*	*Vangueria*	*Vangueria gillettii (Tennant) Lantz*
Rubiaceae	*Rytigynia*	*induta*	*Vangueria*	*Vangueria induta (Bullock) Lantz*
Rubiaceae	*Tapiphyllum*	*schumannianum*	*Vangueria*	*Vangueria schumanniana (Robyns) Lantz*
Rubiaceae	*Vangueria*	*apiculata*	*Vangueria*	*Vangueria apiculata K.Schum*
Rubiaceae	*Vangueria*	*volkensii*	*Vangueria*	*Vangueria apiculata var. volkensii Y.D. Zhou comb. nov*
Rubiaceae	*Vangueria*	*infausta*	*Vangueria*	*Vangueria infausta subsp. rotundata*
Rubiaceae	*Vangueria*	*madagascariensis*	*Vangueria*	*Vangueria madagascariensis*
Rubiaceae	*Vangueria*	*randii*	*Vangueria*	*Vangueria randii subsp. acuminata*

Revisions on the genus of *Vangueria* in Rubiaceae

- 参考资料：POWO；Tropicos；IPNI；Pl. Syst. Evol., Lantz & Bremer, 2005

Volume 23: Rubiaceae

Family	Genus	Species	Revised genus	Revised species
Rubiaceae	*Tarenna*	*drummondii*	*Tarenna*	*Tarenna drummondii Bridson*
Rubiaceae	*Tarenna*	*pavettoides*	*Tarenna*	*Tarenna pavettoides subsp. friesiorum (K.Krause) Bridson*
Rubiaceae	*Tarenna*	*trichantha*	*Tarenna*	*Tarenna trichantha (Baker) Bremek*
Rubiaceae	*Tarenna*	*graveolens*	*Coptosperma*	*Coptosperma graveolens (S.Moore) Degreef*
Rubiaceae	*Tarenna*	*kibuwae*	*Coptosperma*	*Coptosperma kibuwae (Bridson) Degreef*
Rubiaceae	*Tarenna*	*littotalis*	*Coptosperma*	*Coptosperma littorale (Hiern) Degreef*
Rubiaceae	*Tarenna*	*nigrescens*	*Coptosperma*	*Coptosperma nigrescens Hook.f.*
Rubiaceae	*Tarenna*	*supra-axillaris*	*Coptosperma*	*Coptosperma supra-axillare (Hemsl.) Degreef*
Rubiaceae	*Tarenna*	*wajirensis*	*Coptosperma*	*Coptosperma wajirense (Bridson) Degreef*

Revisions on the genus of *Tarenna* in Rubiaceae

- POWO ; Tropicos ; IPNI ; Syst. Geogr. Pl., De Block et al., 2001

Volume 23: Rubiaceae

Family	Genus	Species
Rubiaceae	*Phyllopentas*	*Phyllopentas schimperi (Hochst.) Y.D. Zhou, comb. nov.*
Rubiaceae	*Edrastima*	*Edrastima goreensis (DC.) Neupane & N. Wikstr. var. trichocarpa (Bremek.) Y.D. Zhou, comb. nov..*
Rubiaceae	*Scleromitrion*	*Scleromitrion lancifolium (Schumach.) Y.D. Zhou, comb. nov..*
Rubiaceae	*Scleromitrion*	*Scleromitrion lancifolium (Schumach.) Y.D. Zhou var. scabridulum (Bremek.) Y.D. Zhou, comb. nov..*
Rubiaceae	*Vangueria*	*Vangueria apiculata var. volkensii Y.D. Zhou, comb. nov..*

Other Revisions in Rubiaceae

- Phytotaxa, Zhou et al., 2020

Volume 23: Rubiaceae

Rubiaceae Juss

Gen. Pl. 196. 1789

Small to large trees, shrubs or less often annual or perennial herbs, rarely lianas or climbers, unarmed or sometimes spiny. Raphides present or absent. Leaves opposite, less often whorled or decussate, entire or rarely lobed to denticulate or toothed, sometimes with bacterial nodules and domatia; stipules interpetiolar and infrequently fused to adjacent petioles, sometimes sheath-like, entire or divided into lobes or fimbriae. Inflorescences terminal, axillary or pseudo-axillary, cymose, paniculate, fasciculate, or rarely spiciform or capitate, few- to many-flowered or occasionally reduced to a solitary flower; bracteate or bracts sometimes reduced or absent, rarely enlarged. Flowers bisexual or rarely unisexual, homostylous or quite often heterostylous. Calyx gamosepalous; tube mostly fused to inferior ovary; limb usually developed, truncate, toothed or lobed. Corolla small to large, gamopetalous, white or coloured; tube funnelform, salverform, campanulate, sometimes with a very long and slender lower part; lobes imbricate or valvate, sometimes contorted, spreading to somewhat reflexed. Stamens usually inserted variously in corolla throat; anthers basi- or dorsifixed, introrse. Ovary 1–many-locular, placentation axile or parietal; ovules 1-many in each locule; style simple, usually long and narrow; stigmas 1–2(–10)-lobed, lobes capitate, linear, spatulate, clavate. Fruit small to quite large, simple, capsular, berrylike or drupaceous, indehiscent or infrequently dehiscent, sometimes united into a syncarp. Seeds 1–many, very small to large, variously ellipsoid, lenticular, flattened, oblanceoloid, angled, or plano-convex, smooth or rarely winged.

A total number of 13,000 species that are within 627 genera, with 3 or 4 subfamilies and over 40 tribes, which found around the world especially in the warm sub-tropic climates. There are 265 species of Rubiaceae in Kenya, which belong to 83 genera, 36 tribes and 3 subfamilies.

1a. Erect or climbing herbs, often adhesive due to prickles and harsh hairs; leaves with leaflike stipules in whorls of 4–6(–8) or rarely many; ovary 1–2-locular, with single ovule in each locule 2
1b. Herbs, shurbs, trees or lianas, not adhesive; leaves usually paired, or rarely 3–6-whorled, with stipules developed between each pair; ovary 1–many-locular, with single to many ovules in each locule 3
2a. Leaf-blades large, ovate to lanceolate, with petiole very well developed; flowers 5-merous ..... 35. **Rubia**
2b. Leaf-blades smaller, linear to lanceolate, or rarely ovate, sessile to shortly petiolate; flowers 4-merous ..... 36. **Galium**

3a. Climbing herb, scandent shrub or lianas 4
3b. Erect, decumbent or procumbent herbs, shrubs or trees 11
4a. Stems 4-angled, with recurved spines 5
4b. Stems occasionally 4-angled; spine straight or absent 6
5a. Flowers in completely spherical heads; fruit a fusiform capsule; seeds winged ..... 40. **Uncaria**
5b. Flowers in dense corymbs or subcapitate; fruit a globose berry; seeds unwinged ..... 74. **Cladoceras**
6a. Several calyx-lobes on each inflorescence develop into a stalked white to colored, membranous, stipitate calycophylls ..... 45. **Mussaenda**
6b. No calyx-lobes developed into enlared calycophylls 7
7a. Plants evil-smelling; fruits flattened ..... 34. **Psederia**
7b. Plants not evil-smelling; fruits not flattened 8
8a. Rhaphides absent; flowers not heterostylous; corolla-lobes contorted; stigma fusiform, entire ..... 72. **Rutidea**
8b. Rhaphides present; flowers heterostylous; stigma usually bifid 9
9a. Rhaphides present; flowers heterostylous; stigma bifid ..... 5. **Chasalia cristata**
9b. Rhaphides absent; flowers not heterostylous; stigmatic knob cylindrical 10
10a. Leaves chartaceous to subcoriaceous, rarely coriaceous; calyx-limb dentate or slightly lobed ..... 48. **Keetia**
10b. Leaves usually subcoriaceous to coriaceous; calyx-limb a dentate to repand rim, usually much smaller ..... 50. **Psydrax**
11a. Herbs, woody herbs or rarely subshrubs; rhaphides present; corolla usually valvate 12
11b. Subshrubs, shrubs or rarely herbaceous shoots from a woody rootstock; rhaphides present or absent; corolla valvate, contorted or sometimes imbricate 37
12a. Ovules solitary in each locule 13
12b. Ovules 2–many in each locule 21
13a. Flowers usually unisexual ..... 33. **Anthospermum**
13b. Flowers always bisexual 14
14a. Flowers usually 5-merous 15
14b. Flowers usually 4-merous, or rarely 3–6-merous 17
15a. Creeping herbs, rooting at nodes; fruit a drupe, orange or red ..... 6. **Geophila**
15b. Erect or trailing herbs, never rooting at nodes; fruit a capsule or drupe, not orange or red 16
16a. Rhaphides present; leaves paired; flowers several in terminal or pseudo-axillary, capitate or spike-like inflorescences ..... 32. **Richardia**
17b. Ovary 2(–3)-locular; stigmas 1–2; capsules with 2 valves or 2 cocci, or circumscissile 18
18a. Fruit circumscissile ..... 29. **Mitracarpus**
18b. Fruit indehiscent or open by longitudinal slits or 2-cocceus 19
19a. Fruit capsular with 2 valves or with 2 cocci, usually dehisent ..... 31. **Spermacoce**

- **Publishing style**
- Family description
- Distribution
- Key to genera

Volume 23: Rubiaceae

1a. Raphides present ..... Subfamily Rubioideae
1b. Raphides absent 2
2a. Flowers without secondary pollen presentation ..... Subfamily Cinchonoideae
2b. Flowers often with secondary pollen presentation ..... Subfamily Ixoroideae

Subfamily 1. **Rubioideae** Verdc.

Bull. Jard. Bot. État Brux. 28: 280. 1958.

Shrubs, herbs or rarely trees, with raphides (calcium oxalate crystals). Flowers usually heterostylous. Stipules entire, bifid or often fimbriate. Corolla aestivation always valvate. Ovary 1–12-celled, usually with 1 to several ovules in each cell. Fruits dry or fleshy, dehiscent or indehiscent. Seeds with albumen. Tribes 1–9, genera 1–36.

1a. Ovule solitary in each locule 2
1b. Ovules 1-many in each locule 7
2a. Ovary 2-locular 3
2b. Ovary 2–12-locular 6
3a. Shrubs or trees, stipules entire, connate to form a tube ..... Tribe 3. **Craterispermeae**
3b. Herbs, climbers or rarely subshrubs; stipules always leaf-like and whorled with leaves 4
4a. Usually foetid smelling climbers; leaves opposite ..... Tribe 8. **Paederieae**
4b. Plants not evil-smelling; leaves and leaf-like stipules in whorls of 4–8 or more 5
5a. Flowers unisexual or hermaphrodite; ovules attached to the base of the ovary-locules ..... Tribe 7. **Anthospermeae**
5b. Flowers hermaphrodite; ovules affixed to the septum, amphitropous ..... Tribe 9. **Rubieae**
6a. Stipules entire, often triangular; inflorescences axillary or supra-axillary ..... Tribe 2. **Luculieae**
6b. Stipules often divided or rarely entire; inflorescences always terminal ..... Tribe 4. **Psychotrieae**
7a. Stipules entire or fringed; fruit fleshy ..... Tribe 1. **Urophylleae**
7b. Stipules fimbriate; fruits dry 8
8a. Calyx-lobes usually unequal; ovary 2–10-locular ..... Tribe 5. **Knoxieae**
8b. Calyx-lobes usually equal; ovary 2(or rarely 3–4)-locular ..... Tribe 6. **Spermacoceae**

Tribe 1. **Urophylleae** Bremek. ex Verdc.

Bull. Jard. Bot. État Brux. 28: 281. 1958.

Subshrubs, shrubs or small trees, with raphides. Stipules entire or fringed. Flowers homostylous or heterostylous. Ovary 2–many-locular, with numerous ovules in each locule. Fruit a berry, 2–many-locular, with many seeds. Genus 1.

1. **Pauridiantha** Hook. f.

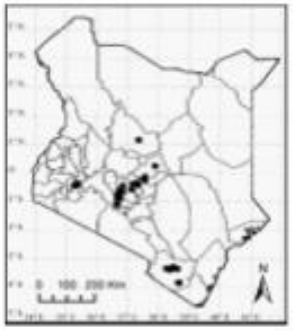
Gen. Pl. 2: 69. 1873.

Shrubs or small trees. Leaves opposite or whorled, shortly petiolate; blades long-acuminate, often with domatia; stipules triangular to ovate, entire. Inflorescences axillary or terminal, trichotomously corymbose or subumbellate, sessile or pedunculate, 1–many-flowered. Flowers heterostylous. Calyx-tube short, dentate or lobed. Corolla salver-shaped, white to cream; tube short, funnel-shaped or cylindrical, upper half hairy inside; lobes triangular, ovate or oblong-lanceolate, glabrous inside. Stamens included or slightly exserted in short-styled flowers. Ovary 2–3-locular; ovules numerous in each locules; stigmas 2, globose. Fruit a globose berry. Seeds numerous; endosperm oily.

About 50 species confined in tropical Africa and Madagascar, with only one species found in Kenya.

1. **Pauridiantha paucinervis** (Hiern) Bremek., Bot. Jahrb. Syst. 71: 212. 1940. Fig. 1-1 & 1-2.

Shrub or small tree, up to 12 m tall. Leaves opposite, shortly petiolate; blades oblong-elliptic or -lanceolate, 3.5–15.5 × 1–5.5 cm, apex acuminate, base cuneate; stipules lanceolate, up to 1.5 cm, adpressed pubescent. Inflorescences axillary, shortly pedunculate, 1–3-flowered, bracts lanceolate, 1.5–2.5 mm long. Flowers heterostylous. Calyx with tube ca. 1 mm long; lobes lanceolate, up to 2.8 mm long. Corolla salver-shaped, white or cream, tube 2–5 mm long; lobes oblong-lanceolate, 1.5–3 mm long. Stamens as long as the corolla-lobes in short-styled flowers, just included in long-styled flowers. Ovary 2–3-locular, with numerous ovules in each locule. Style 3–5 mm long in long-styled flowers, 1.5–3 mm long in short-styled flowers; stigmas 2, globose. Fruit



- **Publishing style**
- Key to subfamily
- Subfamily description
- Key to tribes

Volume 23: Rubiaceae

Tribe 4. **Psychotrieae** Cham. & Schltdl.
Linnaea 4: 4. 1829.

Shrubs, trees or rarely herbs. Stipules divided or rarely entire. Flowers heterostylous. Ovary 2–6-locular, with single erect ovule in each locule. Fruit a drupe or berry, fleshy, with one-seeded pyrenes. Seeds often with horny endosperm. Genera 4–7.

1a. Creeping herbs, rooting at nodes ..... 6. **Geophila**
1b. Subshrubs, shrubs or rarely erect herbs 2
2a. Stipules entire or lobed, not becoming corky; fruit not dehiscent ..... 7. **Psychotria**
2b. Stipules entire, often becoming corky; fruit more or less dehiscent 3
3a. Corolla-tube often slightly curved and winged; lobes often winged ..... 5. **Chassalia**
3b. Corolla-tube and lobes not as above ..... 4. **Eumachia**

4. **Eumachia** DC.

Prodr. [A. P. de Candolle] 4: 478. 1830.

Shrubs. Stems usually 2-ribbed, with pale corky bark. Leaves opposite or 3–4-whorled; stipules absent; domatia present, small. Stipules entire or 2(–many)-fid. Flowers heterostylous, 5-merous, several in terminal head-like or paniculate inflorescences; bracts and bracteoles very small or absent. Calyx tube very short, with truncate or toothed limb. Corolla yellow or white; tube cylindrical, hairy at the throat; lobes triangular to elliptic-lanceolate. Stamens included or slightly exserted. Ovary 2-loculed, with single erect ovule per locules; style with 2 stigma lobes. Fruit a drupe with 2 pyrenes. Seeds pale; endosperm not ruminate.

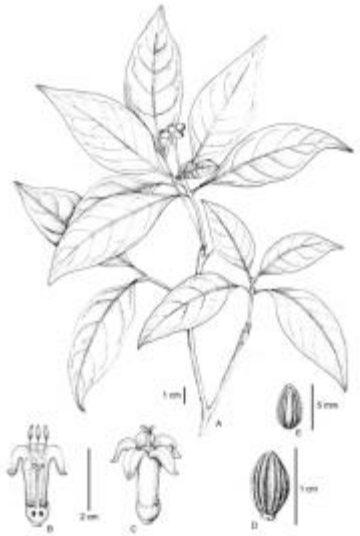
A genus of 85 species widely distributed in tropics of Africa, America, Asia, Australia, New Guinea, and Pacific Islands. Only one species with two varieties found in Kenya.

1. **Eumachia abruptа** (Hiern) J.H. Kirkbr., J. Bot. Res. Inst. Texas 9: 76. 2015.

Synonyms: *Chiococcella abruptа* (Hiern) E.M.A. Petit & Verdc., Kew Bull. 30: 268. 1975.

Small shrub, up to 4.5 m tall. Stems with whitish-grey corky bark, the internodes usually with 2 longitudinal keels. Leaves opposite or sometimes 3-whorled, shortly petiolate; blades elliptic to ovate-lanceolate, up to 20 × 10 cm; apex acute to acuminate, base cuneate; nodules absent; domatia reduced to small white tufts; stipule ovate or triangular, ca. 2 mm long, bifid or with several teeth. Flowers in terminal head-like clusters, 5-merous. Calyx-tube obtuse-conic, ca. 1 mm long; limb very shallow. Corolla bright yellow; tube ca. 2.8 mm long; lobes ca. 1.5 mm long, spreading. Stamens included or slightly exserted. Ovary 2-locular, with single erect ovule per locules; style ca. 1.8 mm long in short-styled flowers, ca. 3.5 mm long in long-styled flowers. Fruit an ellipsoid drupe, 6–10 mm long; pyrene 2, pale, 6–7 mm long. Seeds pale brown, compressed, ca. 5 mm long.

020 ‖ FLORA OF KENYA VOLUME 23



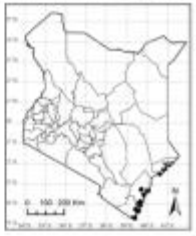
1a. Leaf-blades very thin, large, up to 20 × 10 cm ..... a. var. **abruptа**
1b. Leaf-blades rather thick, small, up to 6 × 3 cm ..... b. var. **parvifolia**

a. **Eumachia abruptа** (Hiern) J.H. Kirkbr. var. **abruptа**. Fig. 4-1 & 4-2.

Habitat: Coastal evergreen forest or thicket, up to 500 m.

Distribution: Coastal Kenya. [Ethiopia to South Tropical Africa].

KIBR: Kaya Kinondo, *Robertson & Luke 4081* (EAU, K!); Sokoke Forest, Longvidge *91* (EAU); Mangea Hill, *Luke & Robertson 1019* (EAU). Kwale: Mwache Forest Reserve, *Robertson & Luke 6175* (EAU); Muhaka Forest, *Gillett 21832* (EAU, K!); Shimba Hills, *Magogo & Glover 375* (EAU, K!). Tana River: Nanzobo Ranch, *Fazan & Luke 3391* (EAU, K!).



022 ‖ FLORA OF KENYA VOLUME 23

- **Publishing style**
- Key in tribe to genera
- Tribe description
- Genus description

- **Publishing style**
- Key in genus to species
- Species description, habitat, distribtution and specimens citation

Volume 23: Rubiaceae

3. **Craterispermum** Benth.

Niger Fl. 411. 1849.

Shrubs or trees. Leaves yellow-green, glabrous, opposite, petiolate; blades mostly oblong or elliptic, coriaceous, net-veined; stipules entire, connate to form a tube. Inflorescences usually supra-axillary; peduncle short and stout or less often long and slender, strongly compressed; bracteoles present. Flowers hermaphrodite, heterostylous. Calyx-tube turbinate; limb cupular, truncate, sinuate or 5-toothed. Corolla funnel-shaped or shortly salver-shaped; tube short, hairy in throat; lobes 5, ovate, spreading. Stamens 5, inserted on the throat of the corolla, more or less exserted; anthers linear-oblong, dorsifixed. Ovary 2-locular, with a single pendulous ovule in each locule; style filiform; stigma bifid. Fruit a subglobose berry, one-seeded.

About 18 species in tropical Africa, Madagascar and the Seychelles, with only one species found in Kenya.

1. **Craterispermum schweinfurthii** Hiern, Fl. Trop. Afr. 3: 161. 1877. Fig. 3:1 & 3:2.

Shrub or tree, up to 15 m tall, glabrous. Leaves opposite, usually yellow-green when dry, blades elliptic, oblong or obovate, 5–18 × 2–8 cm, coriaceous, with fine net-veining, apex obtuse to shortly acuminate, base cuneate; stipules entire, 2.5–5 mm long, connate to form a tube. Inflorescences supra-axillary, several-flowered; peduncles stout, compressed, up to 1 cm long; bracts and bracteoles triangular, keeled, ca. 1.5 mm long. Calyx-tube 0.5–1.5 mm long, limb slightly toothed. Corolla white, sweet-scented; tube 3.5–6 mm long, hairy inside at the throat; lobes oblong-lanceolate to ovate, 3–6 mm long. Stamens 5, more or less exserted; anthers linear-oblong, dorsifixed. Ovary 2-locular, with a single pendulous ovule in each locule; style exserted or included, 5–7.5 mm long in long-styled flowers, 2.5–4 mm long in short-styled flowers; stigma bifid, lobes 1–2.5 mm long. Fruit a berry, subglobose or ellipsoid, dark purple when ripe, 5–6 mm long. Seed bowl-shaped.

Habitat: Lowland or upland evergreen forest and rain forest or woodland; 20–1650 m.

Distribution: Western and coastal Kenya. (Tropical Africa)

Kakamega: Kakamega Forest, *SAYE 005779* (HFP). **Kwale:** Majoreni Area, *Lisle & Lisle 3797* (EAU, K).

Craterispermum 1 017

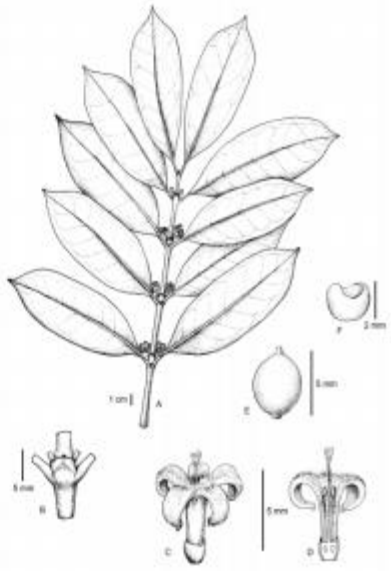


Figure 3-1. **Craterispermum schweinfurthii** Hiern. A, branch and leaves; B, stipule; C & D, long-styled flower; E, fruit. F, seed. Drawn by N. Jia.

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Figure 3-2. A–E **Craterispermum schweinfurthii** Hiern.

Craterispermum 1 019

Tribe 4. **Psychotrieae** Cham. & Schldl.

Linnaea 4: 4. 1829.

Shrubs, trees or rarely herbs. Stipules divided or rarely entire. Flowers heterostylous. Ovary 2–6-locular, with single erect ovule in each locule. Fruit a drupe or berry, fleshy, with one-seeded pyrenes. Seeds often with hairy endosperm. Genera 4–7.

1a. Creeping herbs, rooting at nodes ..... 6. **Geophila**
1b. Subshrubs, shrubs or rarely erect herbs 2
2a. Stipules entire or lobed, not becoming corky; fruit not dehiscent ..... 7. **Psychotria**
2b. Stipules entire, often becoming corky; fruit more or less dehiscent 3
3a. Corolla-tube often slightly curved and winged; lobes often winged ..... 5. **Chassalia**
3b. Corolla-tube and lobes not as above ..... 4. **Eumachia**

4. **Eumachia** DC.

Prodr. [A. P. de Candolle] 4: 478. 1830.

Shrubs. Stems usually 2-ribbed, with pale corky bark. Leaves opposite or 3–4-whorled; nodules absent; domatia present, small; Stipules entire or 2(–many)-fid. Flowers heterostylous, 5-merous, several in terminal head-like or paniculate inflorescences; bracts and bracteoles very small or absent. Calyx tube very short, with truncate or toothed limb. Corolla yellow or white; tube cylindrical, hairy at the throat; lobes triangular to elliptic-lanceolate. Stamens included or slightly exserted; Ovary 2-locular, with single erect ovule per locules; style with 2 stigma lobes. Fruit a drupe with 2 pyrenes. Seeds pale; endosperm not ruminate.

A genus of 83 species widely distributed in tropics of Africa, Americas, Asia, Australia, New Guinea, and Pacific Islands. Only one species with two varieties found in Kenya.

1. **Eumachia abrupta** (Hiern) DI. Krebs., J. Bot. Res. Inst. Texas 9: 76. 2015.

Synonym: *Chassalia abrupta* (Hiern) E.M.A. Petit & Verdc., Kew Bull. 30: 268. 1975.

Small shrub, up to 4.5 m tall. Stems with whitish-grey corky bark, the internodes usually with 2 longitudinal keels. Leaves opposite or sometimes 3-whorled, shortly petiolate. Blades elliptic to ovate-lanceolate, up to 20 × 10 cm; apex acute to acuminate, base cuneate; nodules absent; domatia reduced to small white tufts; stipule ovate or triangular, ca. 2 mm long, bifid or with several teeth. Flowers in terminal head-like clusters, 5-merous. Calyx-tube oblong-ovate, ca. 1 mm long; limb very shallow. Corolla bright yellow; tube ca. 2.8 mm long; lobes ca. 1.5 mm long, spreading. Stamens included or slightly exserted. Ovary 2-locular, with single erect ovule per locules; style ca. 1.8 mm long in short-styled flowers, ca. 3.5 mm long in long-styled flowers. Fruit an ellipsoid drupe, 6–10 mm long; pyrens 2, pale, 6–7 mm long. Seeds pale brown, compressed, ca. 5 mm long.

020 | FLORA OF KENYA VOLUME 23

- **Publishing style**
- Map of distribution
- Line drawing
- Figure with color photos

Volume 4: Orchidaceae

LINNEAN SOCIETY BOTANICAL Journal

Botanical Journal of the Linnean Society, 2015, **177**, 151–174. With 1 figure

INVITED REVIEW

An updated classification of Orchidaceae

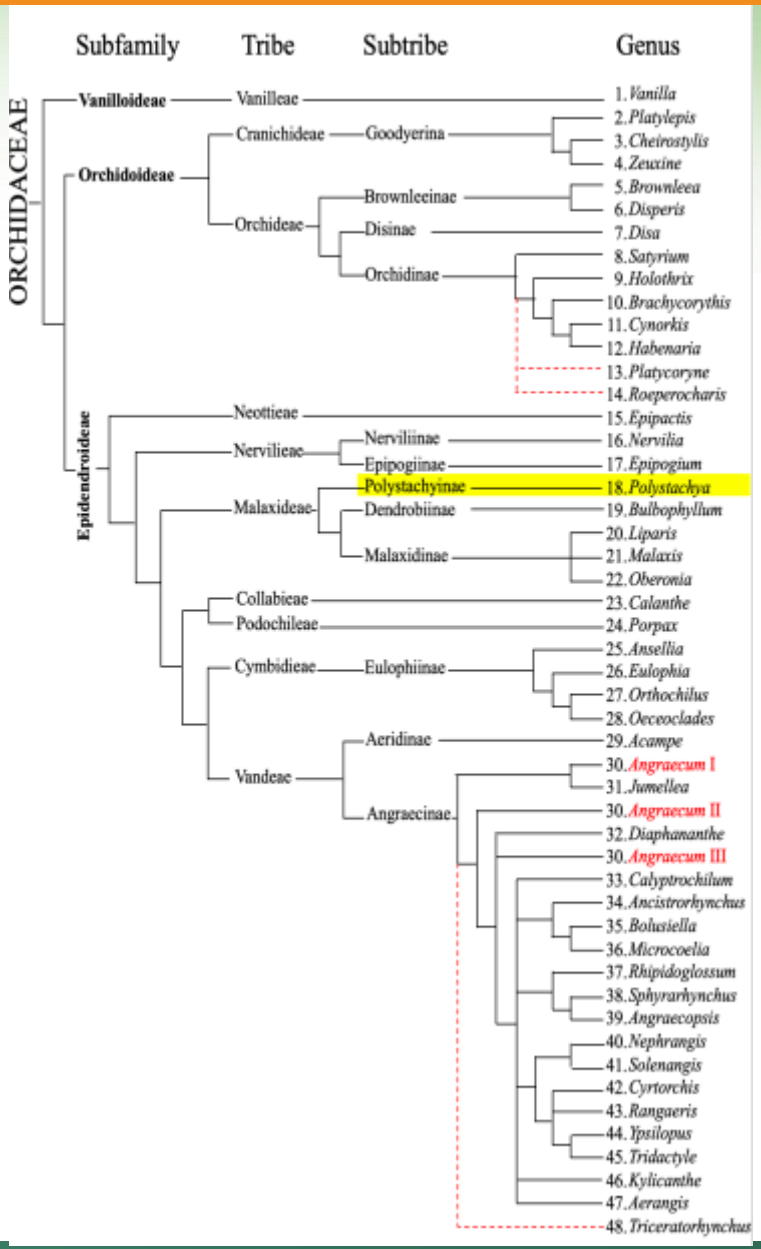
MARK W. CHASE[1,2*], KENNETH M. CAMERON[3], JOHN V. FREUDENSTEIN[4], ALEC M. PRIDGEON[1], GERARDO SALAZAR[5], CÁSSIO VAN DEN BERG[6] and ANDRÉ SCHUITEMAN[1]

New literature

New field observation

New specimens

3/5 subfamilies
10/22 tribes
12/49 subtribes
48/736 genera
303 species, **4** subspecies, **6** varieties/ca. 25 000 species



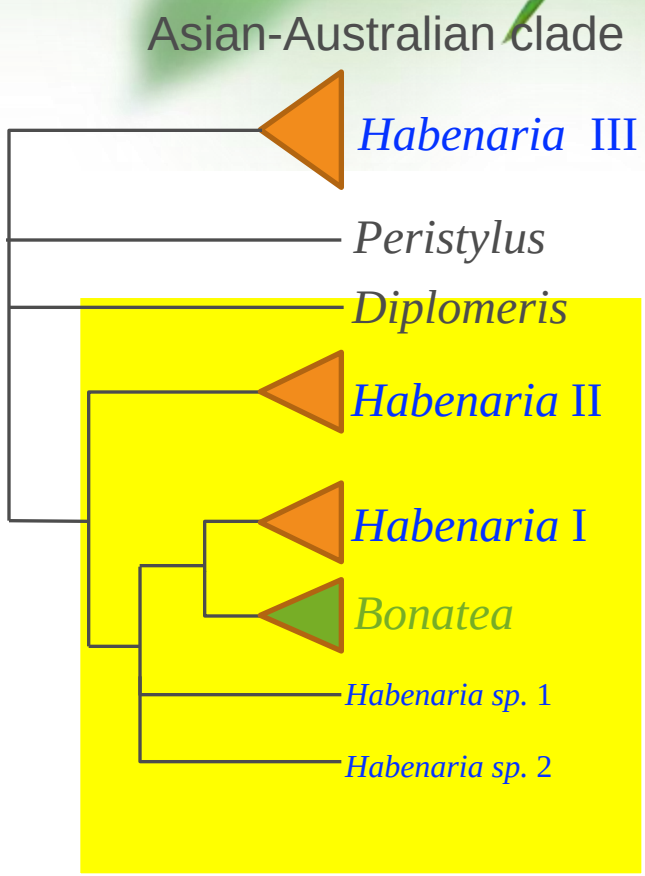
Volume 4: Orchidaceae

Merger of genera：

1) ***Chaseella*** → ***Bulbophyllum*** **(Pridgeon et al., 2014);**
2) ***Bonatea*** →***Habenaria*** **(Jin et al. 2017; Rascoti & Ale 2019);**
3) ***Chamaeangis*** →***Diaphananthe*** **(Cribb & Carlsward 2012);**
4) ***Stolzia*** → ***Porpax*** **(Ng & al. 2018);**
5) ***Cribbia, Margelliantha*** →***Rhipidoglossum*** **(Farminhão et al. 2108);**
6) ***Pteroglossaspis*** → ***Orthochilus*** **(Martos et al. 2014; Bone et al. 2015);**

Separation or restoration of genera：

1) ***Rhipidoglossum*** ← ***Diaphananthe*** **(Carlsward et al. 2006)**
2) ***Orthochilus*** ← ***Eulophia*** **(Martos et al. 2014; Bone et al. 2015);**
3) ***Kylicanthe*** ← ***Diaphananthe*** **(Dubuisson & Stévart 2018)**
4) ***Sphyrarhynchus*** ← ***Angraecopsis*** **(Martos et al. 2018);**



Jin et al. (2017) BMC Plant Biology

Statistics:

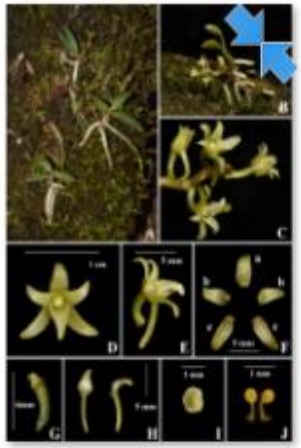
- **3 subfamilies, 10 tribes, 12 subtribes, 48 genera, 303 species, 4 subspecies, 6 varieties**
  - 14 species with a single subspecies or variety in Kenya.
  - 1 species cultivated and escaped: *Vanilla planifolia*
  - Endemic: 13 species 2 subspecies
  - 1 new subspecies
  - 1 new record
  - 15 taxa doubtful in Kenya
  - 25 taxa with only a single collection in Kenya (including 7 taxa only known from the single type collection)
  - 23 taxa (or more) needs lectotypification;
  - 6 taxa (or more) needs neotypification
  - 3 species lacking descriptions

Endemic taxa: 13 species 2 subspecies

- *Ancistrorhynchus paysanii*
- *Angraecum keniae*
- *Bulbophyllum bidenticulatum* subsp. *joyceae*
- *Eulophia stricta*
- *Habenaria keniensis*
- *Habenaria kraenzlinii*
- *Habenaria thomsonii*
- *Holothrix pentadactyla*
- *Microcoelia africana*
- *Microcoelia grahamii*
- *Platycoryne crocea* subsp. *keniensis*
- *Polystachya bella*
- *Polystachya danieliana*
- *Polystachya teitensis*
- *Rhipidoglossum montanum*

Volume 4: Orchidaceae

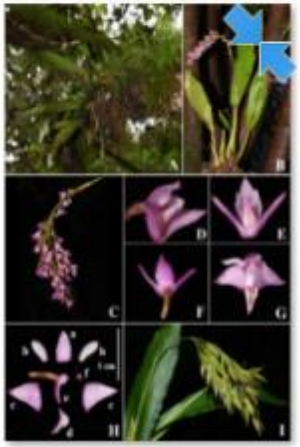
Cheirostylis lepida



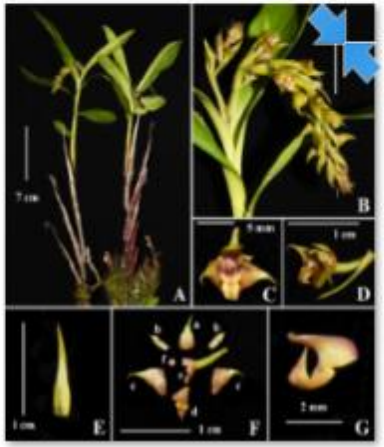
Diaphananthe montana

Epigegium rosetum

Eulophia calantha

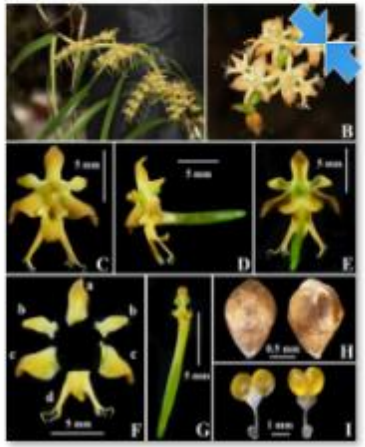


Polystachya cultriformis



Polystachya simplex

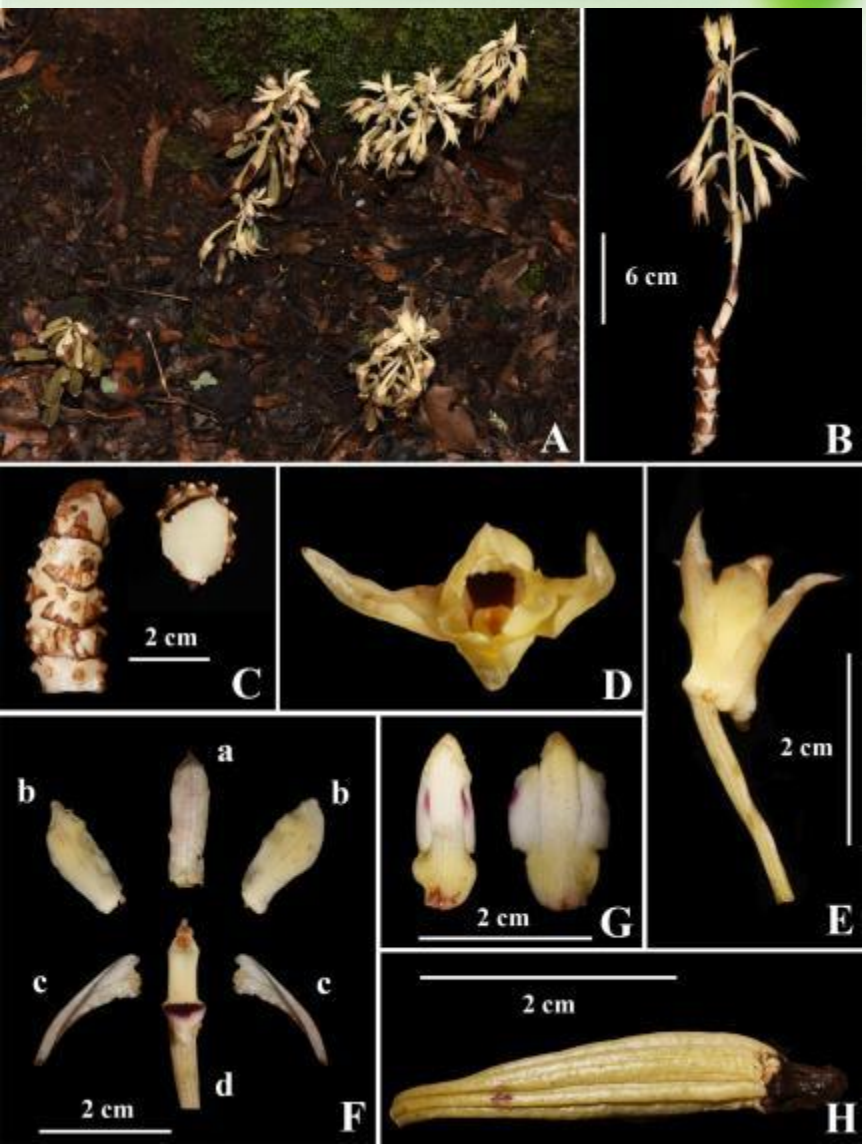
Satyrium crassicaule



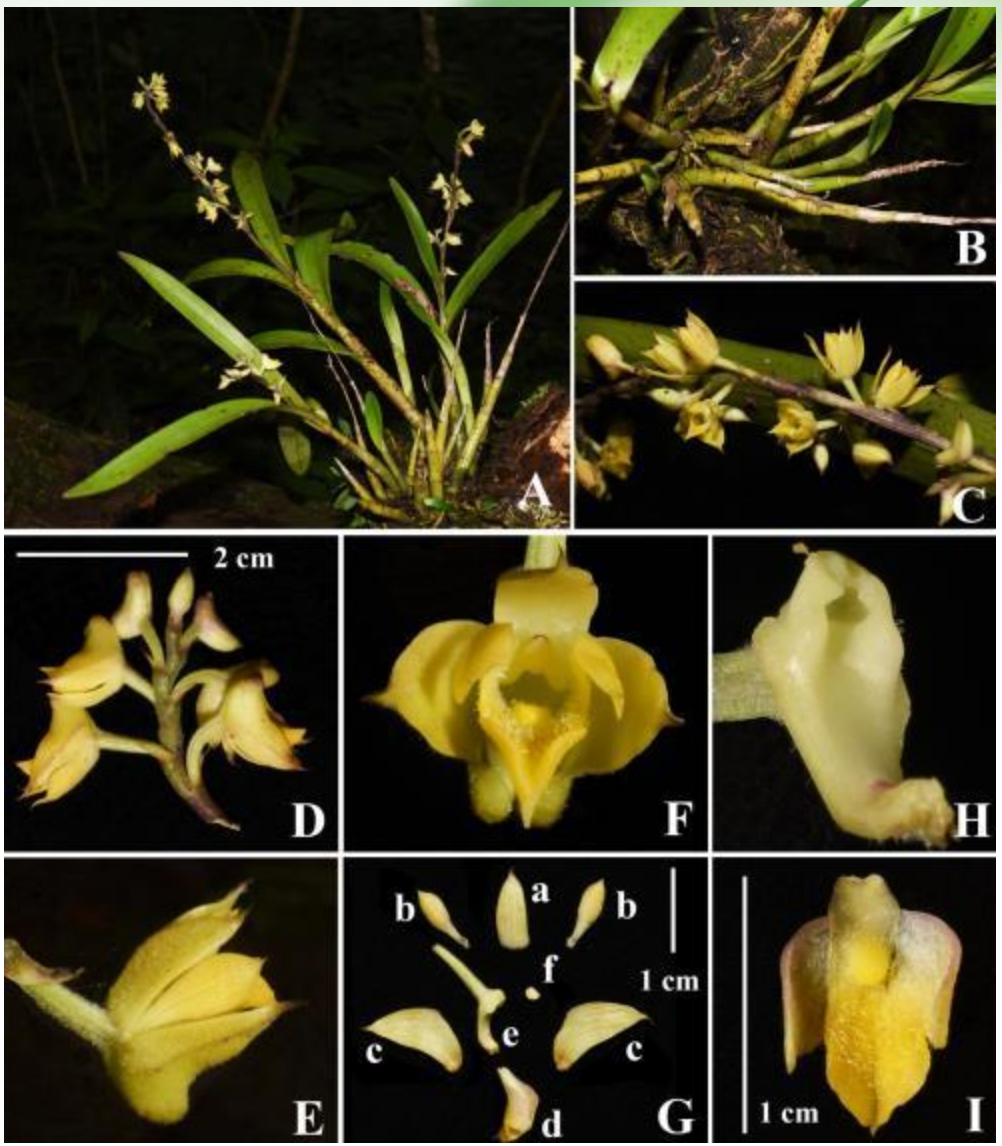
Tridactyle bicaudata

Plates with color photos covered
36 genera and 94 species

Volume 4: Orchidaceae



Eulophia galeoloides



Polystachya bennettiana

Volume 4: Orchidaceae

Hand drawings will cover all the species without color photos

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TJ038


TJ039


TJ040


TJ044


TJ047

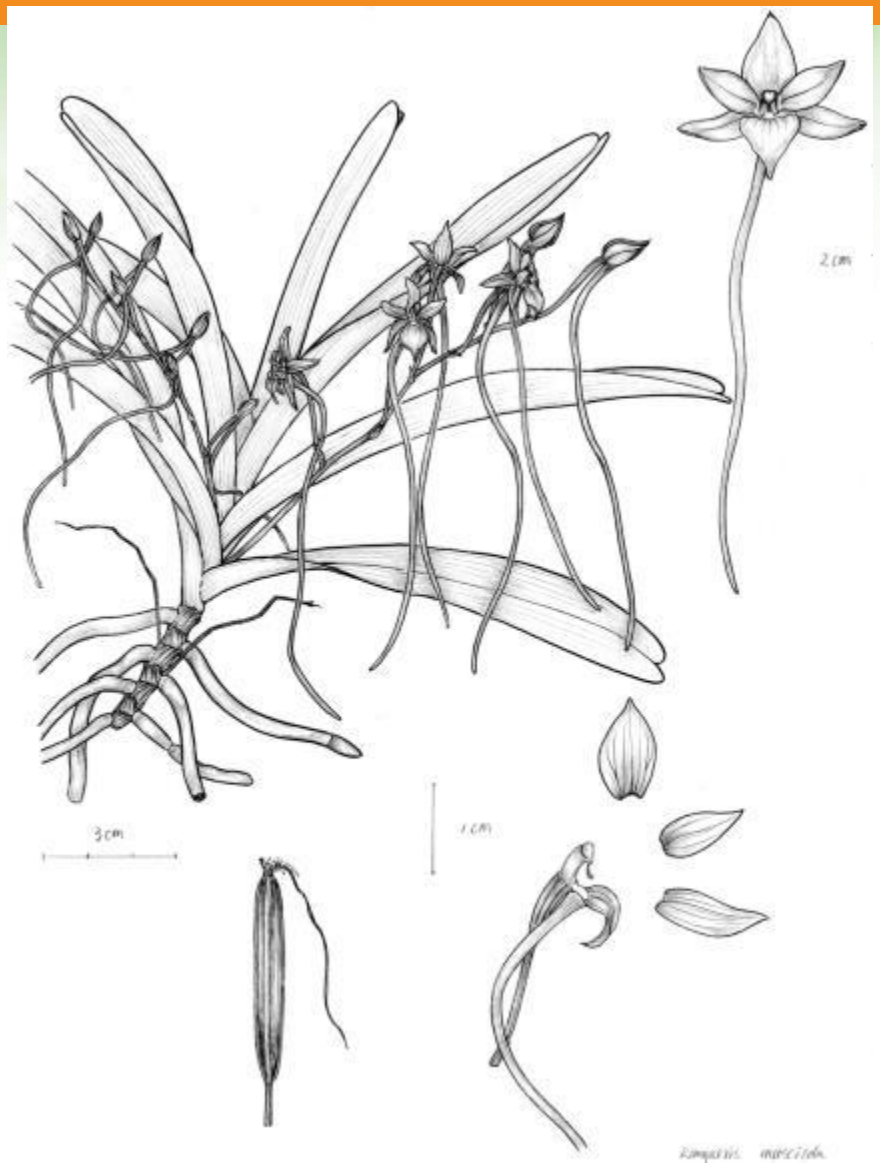

TJ048


TJ049


TJ050

Part hand drawings

Volume 4: Orchidaceae



Examples of hand drawing

Compilation process of *FoK*:

- **Compilation finished:**:
- **Rubiaceae: will be published in 2021.**
- **Orchidaceae: will be published in 2021.**
- **Vitaceae: will be published in 2022.**

- **Compilation in process:**
- **Asteraceae: 1 volume will be finished in 2021, the other one will be finished in 2022;**
- **Fabales: 1 volume will be finished in 2021, the other two will be finished in 2022 and 2023;**
- **Rosales: will be finished in 2023;**
- **Sapindales、Zingiberales: will be finished in 2023;**
- **Lamiaceae: will be finished in 2023;**
- **Caryophyllales: will be finished in 2025.**

Acknowledgement

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Kenya Forest Service (KFS)
Tanzania National Parks Administration (TNPA)
Ethiopian Biodiversity Institute（EBI)
University of Antananarivo (UAN)
Parc Botanique et Zoologique de Tsimbazaza


Thanks!