



# Taxonomic Diversity of Climbers and the Preferred Support Plant Species at Brackenhurst Botanical Garden, Kiambu County, Central Kenya

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

Kenya has a flora consisting of seven plant distribution regions designated as (K1-K7). According to the early administrative division of Kenya, seven plant distribution regions (K1–K7) had been divided by "Flora of Tropical East Africa" (hereafter FTEA). Brackenhurst Botanical Garden where the current study was undertaken (Hereafter BBG) is located in Kiambu County, central Kenya, therefore falling under K4 region (the central region) and has 4 forest plots, creating great plant diversity. This study examined the current Liana and vines and their support plants diversity in BBG. This survey therefore aimed at compiling and synthesizing existing and where possible, new information on the climbers and support plants in Brackenhurst plots in Limuru, Kenya. The ultimate purpose was to provide stakeholders with information on the climbers' diversity and the resources derived from them. Information of the native range and their IUCN red list status was also investigated in the current study. The sampling design comprised of meander and patterned

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searches because of the terrain at the BBG. This method was set up specifically to facilitate ecological sampling of climbers which are notorious for clumped distribution. All the voucher specimens collected were dried and kept in herbaria at JKUAT and BBG. A total of 31 vascular plant taxa from 17 vascular plant families and 27 genera were recorded. The majority of taxa were recorded in the Passifloraceae, Rhamnaceae, and Asteraceae families. The flora of the entire site was rich in climbers and their support plants. The study recommends more research to be done on the ethnobotanical uses of the climbers since most have medicinal value as seen from this study.

**Keywords:** *Brackenhurst botanical garden (BBG); climbers (lianas and vines); support plants; diversity.*

## 1. INTRODUCTION

The broader Flora of Tropical East Africa (FTEA) includes the sub-flora of Kenya. The flora of Kenya is classified into seven flora areas (K1-K7) and is rich in vascular species diversity [1]. The current study was conducted in Kenya's K4 region at Brackenhurst Botanical Garden, Kiambu county. The Brackenhurst Botanical Garden was registered with Botanic Gardens Conservation International (BGCI) in 2004 and is situated in Tigoni, Limuru sub-county in the highlands of central Kenya. The area covers 50 acres.

Climbers are important structural components of tropical forest ecosystems and completely rely on supporting plants for their optimum growth and establishment. They are often cited as the most important physiognomic characteristics of tropical forests [2]. Climbing plants have evolved and developed successful strategies to compete with self-supporting plants for light, space and a chance for survival [3]. Climbers play a vital role in many aspects of forest functioning and dynamics, such as food resource for animals, provide habitat for arboreal animals, carbon sequestration, ornamental, medicine and construction among others. Up to date little knowledge is known of climbers and their support plants. Climbers grow on the forest floor for some part of their lives, later on anchoring and adhering to their support plants for stature and also to fight for space light and other resources.

This study aimed at assessing the diversity and also the economic importance of climbers together with their support plants. The study also explored their IUCN status, their habit and whether they are exotic or native plant species.

## 2. MATERIALS AND METHODS

The following materials were used during the survey, plant pruner (secateurs), digger, knife,

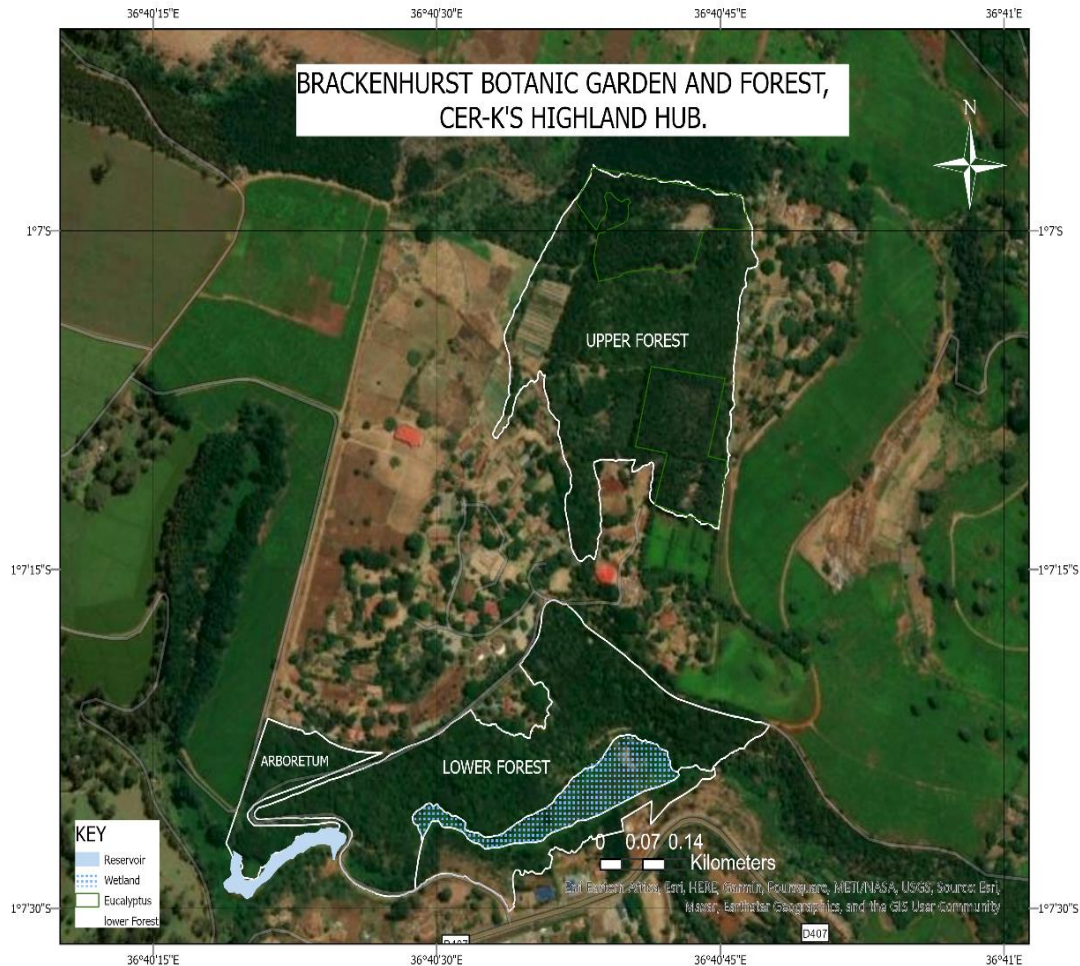
leather gloves, field note book, pencil, permanent ink pens, Ziploc plastic (poly) bags, magnifying glass, silica gel, digital camera, forceps, old newspapers, portable herbarium press, herbarium bags, envelopes, portable dryer, binocular and personal field gears. During the survey, the map of the study site was used.

### 2.1 Study Area

Brackenhurst forest is situated near Tigoni in Limuru sub-county, 25 km north of Nairobi at an altitude of between 1800 and 2000m (Fig. 1). The natural vegetation type is tropical montane forest. Most of it has been replaced by agriculture (coffee, tea, flowers and smallholder farming), exotic tree plantations (eucalyptus, wattle, and cypress), and residential land.

### 2.2 Survey Methods

To maximize recording the flora in all traversed habitats, meander and patterned searches was used. The meander walks were employed on difficult terrains such as on rocky hills, swamps, seasonal pools and deep river valleys. On the other hand, the systematic transect was employed on flat grounds, such as open grassland, flat community farms, tree plantations and shrub lands. The forest is stratified into homogeneous units, which formed the primary sampling units. The exercise was achieved by conducting ground pre-surveys guided by existing maps and information from the botanical garden workers. In each plot all climbers and their support plant species were recorded. Specimens of each plant were identified from family, genus to species level *in situ* by referencing with the Flora of Tropical East Africa. Walks were taken along permanent trails and unique areas like riverbeds and hills. Unidentified specimens were collected in triplicates, dried, detoxified, mounted, identified and assigned a voucher specimen number and deposited in the



**Fig. 1. Map of the study area**

JKUAT and Brackenhurst Botanical garden herbaria. Ex situ identification was performed by referring to the existing herbaria collections and data from previous studies. The accepted names of all species were checked using the world checklist of vascular plants [4], world checklist of selected plant families [5], and the author names were also checked using the International Plant Names Index [6]. Species native range was checked using the plants of the world online [7]. The conservation status of the BBG flora was checked from IUCN database [8]. Both climbers and support plants were identified to species level. Photographs of each plant species were taken and the following information recorded: Family species and genus names and growth habit. The information was presented in a tabulated form as per the recommendations of [9]. The data was presented in appropriate tables, pie charts and graphs.

### 3. RESULTS

#### 3.1 Flora of Brackenhurst Botanical Garden

Here we present the first expert-verified checklist of climbing plants and support flora of Brackenhurst Botanical Garden, Limuru, Kenya. The flora of the entire site was rich in climbers and their support plants (Table 2). A total of 31 vascular plant taxa from 17 vascular plant families and 27 genera were recorded within the survey area (Table 1). The majority of taxa were recorded in the Passiflora (4), Rhamnaceae (3), and Asteraceae (3) families. Therefore, the flora at the study site was rich in phyto-diversity (Table 1, Table 2, Table 3). Examples of climber species identified are represented by plate 1 and 2.

**Table 1. A table of the families found in the entire site and the number of genera and species found in that family**

No	Family	Species	Genera
1	Acanthaceae	3	2
2	Apiacea	1	1
3	Apocynaceae	1	1
4	Asteraceae	3	3
5	Basellaceae	1	1
6	Capparaceae	1	1
7	Cucurbitaceae	2	2
8	Laminiaceae	1	1
9	Passifloraceae	4	2
10	Phytolaccaceae	1	1
11	Ranunculaceae	1	1
12	Rhamnaceae	3	3
13	Rosaceae	3	3
14	Rubiaceae	2	2
15	Solanaceae	2	1
16	Tropaeolaceae	1	1
17	Vitaceae	1	1
	<b>TOTAL</b>	<b>31</b>	<b>27</b>

**Table 2. Climber species, their habit, their IUCN red list status, their economic importance, their voucher specimen number and whether they are exotic or native**

No	Taxa	Habit	Native/ Exotic	IUCN Red List Status	Voucher Specimen Number JKUAT- BBG/SK.2021	Economic Importance
	<b>Family: Acanthaceae</b>					
1.	<i>Thunbergia gregorii</i> S.Moore	Herb	Native	0	JKUAT- BBG/SK.2021-01	• Ornamental • Medicinal • Aromatic
2.	<i>Thunbergia alata</i> Bojer ex Sims	Herb	Native	0	SR	• Ornamental • Food source • Medicinal
3.	<i>Ruellia prostrata</i> Poir.	Herb	Native	0	JKUAT- BBG/SK.2021-02	• Medicinal
	<b>Family: Apiaceae</b>					
4.	<i>Oenanthe palustris</i> (Chiov.) C.Norman	Herb	Native	0	JKUAT- BBG/SK.2021-03	• medicinal
	<b>Family: Apocynaceae</b>					
5.	<i>Periploca linearifolia</i> Quart. -Dill. & A.Rich.	Liana	Native	0	JKUAT- BBG/SK.2021-04	• Medicinal • Food source
	<b>Family: Asteraceae</b>					
6.	<i>Senecio syringifolius</i> O.Hoffm.	Liana	Native	0	JKUAT- BBG/SK.2021-05	•
7.	<i>Distephanus biafrae</i> (Oliv. & Hiern) H.Rob.	Shrub	Native	0	SR	• Medicinal
8.	<i>Microglossa pyrifolia</i> (Lam.) Kuntze	Shrub	Native	0	SR	• Medicinal
	<b>Family: Basellaceae</b>					
9.	<i>Basella alba</i> L.	Herb	Exotic	0	JKUAT- BBG/SK.2021-06	• Food source • Medicinal • Ornamental • Food coloring
	<b>Family: Capparaceae</b>					
10.	<i>Capparis erythrocarpos</i> Isert	Shrub	Native	0	JKUAT- BBG/SK.2021-07	• Food source • Medicinal

No	Taxa	Habit	Native/ Exotic	IUCN Red List Status	Voucher Specimen Number JKUAT- BBG/SK.2021	Economic Importance
<b>Family: Cucurbitaceae</b>						
11.	<i>Zehneria scabra</i> (L.f.) Sond.	Herb	Native	O	JKUAT- BBG/SK.2021-08	• Medicinal • Insecticides
12.	<i>Momordica foetida</i> Schumach.	Herb	Native	O	JKUAT- BBG/SK.2021-09	• Medicinal • Animal feed • Food source • Makes insecticides
<b>Family: Lamiaceae</b>						
13.	<i>Clerodendrum johnstonii</i> Oliv.	Shrub	Native	LC	JKUAT- BBG/SK.2021-10	• Ornamental
<b>Family: Passifloraceae</b>						
14.	<i>Passiflora edulis</i> Sims	Herb	Exotic	O	SR	• Food source
15.	<i>Passiflora ligularis</i> Juss.	Herb	Exotic	O	JKUAT- BBG/SK.2021-11	• Food source • Aromatic • Ornamental
16.	<i>Passiflora mollissima</i> (Kunth) L.H.Bailey	Herb	Exotic	O	JKUAT- BBG/SK.2021-12	• Food source • Ornamental • Aromatic
17.	<i>Basananthe hanningtoniana</i> (Mast.) J.J.de Wilde	Herb	Native	O	JKUAT- BBG/SK.2021-13	
<b>Family: Phytolaccaceae</b>						
18.	<i>Phytolacca dodecandra</i> L'Hér.	Shrub	Native	O	SR	• Medicinal • Soap making • Food source
<b>Family: Ranunculaceae</b>						
19.	<i>Clematis hirsuta</i> Guill. & Perr.	Shrub	Native	O	SR	• Medicinal
<b>Family: Rhamnaceae</b>						
20.	<i>Helinus integrifolius</i> (Lam.) Kuntze	Shrub	Native	O	JKUAT- BBG/SK.2021-14	• Soap making
21.	<i>Gouania longispicata</i> Engl.	Shrub	Native	O	JKUAT- BBG/SK.2021-15	• Food source • Medicinal • Phytochemical use
22.	<i>Rhamnus prinoides</i> L'Hér.	Shrub	Native	LC	SR	• Medicinal • Ornamental
<b>Family: Rosaceae</b>						
23.	<i>Rubus steudneri</i> Schweinf.	Shrub	Native	O	SR	• Food source
24.	<i>Rubus apatetus</i> R.Keller		Exotic	O	JKUAT- BBG/SK.2021-16	• Food source • Medicinal • Used as boundary marker
25.	<i>Rubus pinnatus</i> Willd.	Shrub	Native		JKUAT- BBG/SK.2021-17	• Food source • Medicinal • Agroforestry use • Produces dye
<b>Family: Rubiaceae</b>						
26.	<i>Rubia cordifolia</i> L.	Herb	Native	O	JKUAT- BBG/SK.2021-18	• Dye making • Medicinal
27.	<i>Keetia gueinzii</i> (Sond.) Bridson	Shrub	Native	LC	SR	
<b>Family: Solanaceae</b>						
28.	<i>Solanum terminale</i> Forssk.	Shrub	Native	O	JKUAT- BBG/SK.2021-19	• Medicinal • Construction of

No	Taxa	Habit	Native/ Exotic	IUCN Red List Status	Voucher Specimen Number JKUAT- BBG/SK.2021	Economic Importance
29.	<i>Solanum benderianum</i> G.W.Schimp. ex Engl.	Shrub	Native	O	JKUAT- BBG/SK.2021-20	traditional buildings
<b>Family: Tropaeolaceae</b>						
30.	<i>Tropaeolum majus</i> L.	Shrub	Exotic	O	SR	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Ornamental</li> <li>• Food source (flavor)</li> <li>• Dye producing</li> <li>• Insecticides</li> </ul>
<b>Family: Vitaceae</b>						
31.	<i>Cyphostemma kilimandscharicum</i> (Gilg) Desc. ex Wild & R.B.Drumm.	Herb	Native	O	JKUAT- BBG/SK.2021-21	

### 3.2 Support Plants

**Table 2. Support plant species, their habit, their IUCN red list status, their economic importance, and whether they are exotic or native**

No	Taxa	Habit	Native/ Exotic	IUCN Red List Status	Economic Importance	
<b>Family: Asteraceae</b>						
1.	<i>Gymnanthemum auriculiferum</i> (Hiern) Isawumi	Shrub	Native	LC	<ul style="list-style-type: none"> <li>• Medicinal</li> </ul>	
<b>Family: Boraginaceae</b>						
2.	<i>Cordia africana</i> Lam.	Shrub	Native	O	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Food source</li> <li>• Ornamental</li> <li>• Agroforestry use</li> <li>• Twigs used as fire stick</li> </ul>	
<b>Family: Campanulaceae</b>						
3.	<i>Lobelia giberroa</i> Hemsl.		Native	O	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Ornamental</li> </ul>	
<b>Family: Euphorbiaceae</b>						
4.	<i>Erythrococca bongensis</i> Pax	Shrub	Native	LC	<ul style="list-style-type: none"> <li>• Food source</li> <li>• Branches used to make walking sticks and arrow shafts</li> <li>• Medicinal</li> </ul>	
<b>Family: Lamiaceae</b>						
5.	<i>Vitex fischeri</i> Gürke	Tree	Native	LC	<ul style="list-style-type: none"> <li>• Food source</li> <li>• Agroforestry use</li> <li>• Ornamental</li> <li>• Firewood and charcoal production</li> </ul>	
<b>Family: Malvaceae</b>						
6.	<i>Dombeya torrida</i> (J.F.Gmel.) Bamps	Tree	Native	O	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Rope, string and cloth making</li> <li>• Construction</li> <li>• Fuel source and charcoal</li> <li>• Ornamental</li> </ul>	

No	Taxa	Habit	Native/Exotic	IUCN Red List Status	Economic Importance
<b>Family: Myrtaceae</b>					
7.	<i>Syzygium guineense</i> (Willd.) DC.	Shrub	Native	LC	<ul style="list-style-type: none"> <li>• Ornamental</li> <li>• Food source</li> <li>• Medicinal</li> <li>• Agroforestry</li> <li>• Fuel and charcoal</li> <li>• Construction</li> <li>• Dye making</li> <li>• Source of tannins</li> </ul>
<b>Family: Oleaceae</b>					
8.	<i>Olea welwitschii</i> (Knobl.) Gilg & G.Schellenb.	Tree	Native	O	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Timber source</li> <li>• Firewood source</li> </ul>
<b>Family: Phyllanthaceae</b>					
9.	<i>Bridelia micrantha</i> (Hochst.) Baill.	Shrub	Native	LC	<ul style="list-style-type: none"> <li>• Ornamental</li> <li>• Food source</li> <li>• Medicinal</li> <li>• Agroforestry use</li> <li>• Source of tannins</li> <li>• Dye production</li> <li>• Source of resin</li> <li>• Firewood and charcoal source</li> </ul>
<b>Family: Rosaceae</b>					
10.	<i>Prunus africana</i> (Hook.f.) Kalkman	Tree	Native	VU	<ul style="list-style-type: none"> <li>• Medicinal</li> <li>• Construction</li> <li>• Fuel source</li> </ul>
11.	<i>Rubus pinnatus</i> Willd.	Shrub	Native	O	<ul style="list-style-type: none"> <li>• Food source</li> <li>• Medicinal</li> <li>• Agroforestry use</li> <li>• Produces dye</li> </ul>
<b>Family: Salicaceae</b>					
12.	<i>Heptaca africana</i> Lour.		Exotic	O	
<b>Family: Solanaceae</b>					
13.	<i>Solanum americanum</i> Mill.	Herb	Exotic	O	Food source Medicinal

Key: O= red list conservation status non categorized, LC= least concern, VU= Vulnerable  
Majority of the climbers and support plants fell under not categorized and of least concern only one of the support plants species [*Prunus africana* (Hook.f.) Kalkman] was vulnerable and needs to be conserved because it may become extinct

The table also shows their habit in which several species of climbers fall



Plate 1. *Basella alba*. A dominant climber found at Brackenhurst Botanic Garden





**Plate 2. *Rubus pinnatus* willd. A support plant that also doubles up as a climber**

## **4. DISCUSSION**

### **4.1 Climbers Diversity**

Climber species featured prominently in the plant community of the Brackenhurst botanic garden. Majority of the species of climbers found there belong to family Passifloraceae followed by Rhamnaceae and Rosaleae.

Similar and different data on the diversity, abundance and richness of climber species have been documented from other forests in the world. Examples include: 69 climber plants in the low lands forest of Ecuador [3] with a variety of 35 to 50 hemiepiphytes and lianas per 0.1 ha for five plots and 12 to 65 liana climbers per 0.1 ha in terra-firme in Yasunni, Ecuador [10] in neotropical forest of America. Conservation of climbers is critically important because this group of plants not only provide valuable services for the humankind but also play a key role in the forest regeneration by supplementing many pollinators throughout the year due to their different phenological behaviors as compared to other flowering species. Climbers are also widely used by local people, mostly for medicine, food, house construction and artisan work.

### **4.2 Climbers Relationship with the Support Plants**

Climbing plants need to attach themselves to an external support—typically neighbouring plants—in order to grow vertically to a significant extent and enhance light acquisition. Climber plants

play significant ecological role in nutrients cycling, forests dynamics and hence establish an essential tropic level within an ecosystem. Climbing or veining has an impact on nature's wonderful economy. It enables the plant to realize its maximum potential.

Most climbers and support plants in this study are native to Kenya and the larger East Africa. There are several exotic climbers and support plants as seen in the tables (Table 2 and Table 3). In regards to their conservation status most of the climbers and support plants are listed under not categorized (O) and least concern (LC). It has been reported by other researchers that floristic composition and pattern distribution of climbers is related to the elevation and other macroclimatic variables [11]. This aspect shall be investigated in phase two of the current research project.

## **5. CONCLUSION**

The flora of Brackenhurst Botanical garden comprised of fragmented habitats with native and economically important species of climbers and support plants. Most climbers together with their support plants were native to Kenya. Host species, habitat and the interaction between them as well as human activities were the important factors that determined climber diversity. Climbers and their support plants contribute substantially to the diversity of the forest and and they play a critical role in carbon sequestration among many other roles carried out by plants in an ecosystem, hence the critical importance of this study.



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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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