

Eastern Gallery Forest Conservation Project

Biodiversity survey



A Final Research report to the Rufford Small Grant Foundation, UK

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CHAP. I. Background information

1.1. Introduction

Rwanda is covered by diversified natural ecosystems comprising mountainous humid forests, savannahs, wetlands, planted forests, agro-ecosystems and gallery-forests. The gallery forests are located in Eastern Province and comprise three forest blocks: Ibanda-Makera (the most important in the area), Rugomero and Rwakivunji. These forests cover an area of 205.6 ha. In the past, there were six forest blocks, but three of them i.e. Mushikiri-Kigina, Cyunuzi and Sarambuye have disappeared.

These forests are important water catchments in the area. They control soil erosion, contribute to the favorable micro-climatic conditions and sustain the flow of streams and rivers. They are biologically important because they host endemic species including some species of butterflies. The east of Rwanda is also the richest area in birdlife. More than 500 bird species are known to exist in the country.

Despite their importance, gallery forests are facing serious problems of destruction and illegal activities such as poaching, tree cutting for firewood and clearance of land for agriculture and do not enjoy any legal status.

Because the biodiversity of these forests is not well known, a team from the Association pour la Conservation de la Nature au Rwanda (ACNR) in partnership with the Rwanda Development Board (RDB)/ Tourism and Conservation, through “**Eastern Gallery Forests Conservation Project (EGFCP)**” with the financial support received from the Rufford, undertook a biodiversity survey in Ibanda-Makera, Rugomero and Rwakivunji gallery forests from the 10th to 17th February, 2009.

1.2. Land use activities in the area

Land use activities around eastern gallery forests are dominated by cultivation, livestock and settlements. These activities have intensified in recent years and are of particular concern as they have led to the disappearance of some galley forests i.e. Cyunuzi, Mushikiri-Kigina and Sarambuye; others such as Rwakivunji are also disappearing.

Figure 1: The remnants of Rwakivunji Gallery Forest



Photo: Ndimukaga Marc

In Rwanda, these activities have increased at an alarming rate and have had negative impacts on the overall biodiversity of the forests and their associated wood land and wetlands. Agriculture is the main source of livelihood for the local communities surrounding eastern gallery forests. In general, cultivation has had a direct and negative impact upon the forests through land clearance farmland. Food crops grown in the region are dominated by maize and bananas. Other activities associated with land use include wood cutting and burning for land clearance.

Figure 2: Wildfire at Ibanda-Makera



Photo: Ndimukaga Marc

Gallery forests have been recognized as being important water catchments in the area, in addition to supporting a range of bird species, mammals, endemic butterflies and different plant species. Human induced stresses on natural resources around Eastern gallery forests have recently increased. This has occurred through a combination of local population growth and a corresponding growth in agricultural activities. This subsistence agriculture has proved to be very efficient land-use.

CHAP II. Biodiversity survey

This survey was carried out in three gallery forests i.e. Ibanda-Makera, Rugomero and Rwakivunji. For Sarambuye, the remnant forest was woodland and only GPS points were taken for further studies and for conservation matters. The same survey also served as a training exercise for students from the National University of Rwanda, Biology Department and for the staff of ACNR to help them undertake research and monitoring in the future (see the pictures below).

Figure 3: 2 NUR students and 1 ACNR staff trained



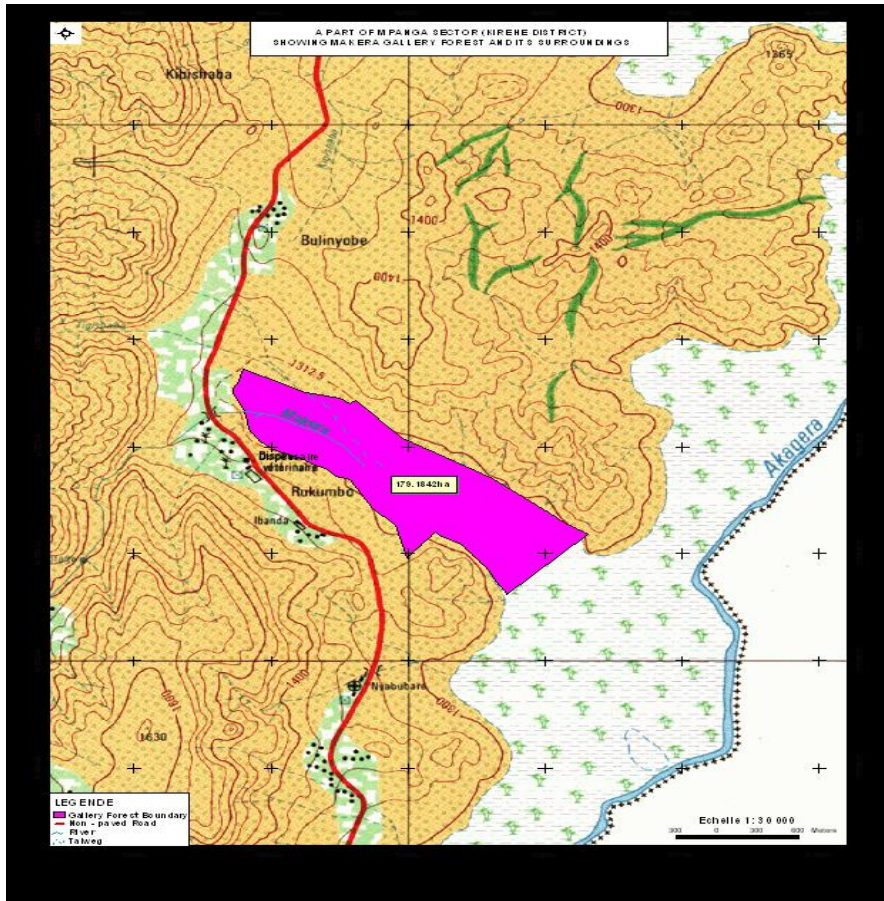
Photo: Nsengimana Serge

2.1. Ibanda-Makera gallery forest

2.1.1. General description

Ibanda-Makera gallery forest is located in Eastern Province, not far from the Tanzanian border at the grid reference 260179E 9767347S and 262104 E 9765251S. The total surface of the surveyed area is estimated at 179.1842 ha. Administratively, Ibanda-Makera falls under Kirehe district.

Figure4: Ibanda-makerama map



The gallery forest is associated with woodland and savannah in the east and papyrus swamp in the south. Ibanda-Makera gallery forest is crossed by a stream which makes this forest the water catchments for local people. The forest has been under high human pressure and consequently is degraded with large areas of bush, thicket and woodland. Only a small remnant mature forest patch still exists, thanks to the work of ISAR (Rwanda Institute of Agricultural Sciences). Ibanda-Makera south is contiguous with the papyrus swamp which extends to the Akagera River. In this report, only the remnant thick forest and the swamp forest is considered.

Figure 5: The view of Ibanda-Makera gallery forest



Photo: Ndimukaga Marc

2.1.2. Birds' survey

Materials and Methods

A bird survey was conducted at Ibanda-Makera, Rugomero and Rwakivunji gallery forests from 10th to 17th between 6 am-10 am and 15 pm-18 pm. The bird species were identified and counted using binoculars, telescope and camera. Point count method every 200m along transects set in the forests were used. Opportunistic observations within and around the forests were also used. Birds of East Africa and Birds of Africa field books were used for identification of some of the birds.

Results and discussion

A total of 78 bird species were recorded during the point counts and opportunistic observations within and around forest. Where the bird species were unknown, the survey team attempted to use common bird books for identification. However, in those cases where team members were in doubt or in those instances where identifications were judged to be suspect, photos were taken and analyzed later. However, some of these unknown birds were not forest species but were flying over the forest.

Table 1: Ibanda-Makera bird check list

No	Common names	Scientific names	Ecological type	Status
1	Woodland Kingfisher	<i>Halcyon senegalensis</i>	f ¹	
2	Red-eyed Dove	<i>Streptopelia capicola</i>	o ²	
3	Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	f	
4	Common Bulbul	<i>Pycnonotus barbatus</i>	f	
5	Splendid Starling	<i>Lamprotornis splendidus</i>	f	
6	Grey-headed Sparrow	<i>Passer griseus</i>	o	
7	Village Indigobird	<i>Vidua chalybeata</i>	o	
8	Chubb's Cisticola	<i>Cisticola chubbi</i>	f	
9	Tropical Boubou	<i>Laniarius aethiopicus</i>	f	
10	Tambourine Dove	<i>Turtur tympanistria</i>	f	
11	African Paradise Flycatcher	<i>Terpsiphone viridis</i>	f	
12	White-browed Robin-chat	<i>Cossypha heuglini</i>	o	
13	Ross's Turaco	<i>Musophaga rossae</i>	f	
14	African Harrier-Hawk	<i>Polyboroides typus</i>	f	
15	Yellow-rumped Tinkerbird	<i>Pogoniulus bilineatus</i>	f	
16	Speckled mousebird	<i>Colius striatus</i>	f	
17	Purple-crested Turaco	<i>Tauraco porphyreolophus</i>	f	
18	Lesser Striped Swallow	<i>Hirundo abyssinica</i>	o	
19	African Thrush	<i>Turdus pelios</i>	f	
20	African Pied Wagtail	<i>Motacilla aguimp</i>	o	
21	Striped Pipit	<i>Anthus lineiventris</i>	o	
22	Red-chested Cuckoo	<i>Cuculus solitarius</i>	f	Intra-African migrant
23	Brown Parrot	<i>Poicephalus meyeri</i>	f	
24	Augur Buzzard	<i>Buteo augur</i>	f	
25	Black-headed Heron	<i>Ardea melanocephala</i>	o	
26	Grosbeak Weaver	<i>Amblyospiza albifrons</i>	f	
27	Arrow-marked Babbler	<i>Turdoides jardineii</i>	f	
28	African Grey Hornbill	<i>Tockus nasutus</i>	f	
29	African Green-Pigeon	<i>Treron calva</i>	f	
30	Levaillant's Cuckoo	<i>Clamator levaillantii</i>	f	Common intra-African migrant
31	Northern Brown-throated Weaver	<i>Ploceus castanops</i>	o	
32	Green Wood-hoopoe	<i>Phoeniculus purpureus</i>	F ³	
33	European Bee-eater	<i>Merops apiaster</i>	o	Palaearctic migrant

¹ Forest dwelling but not forest dependent

² Non-forest species

³ Forest dependent species

34	White-winged Tit	<i>Parus leucomelas</i>	f	
35	Spot-flanked Barbet	<i>Tricholaema lacrymosa</i>	F	
36	Blue-naped Mousebird	<i>Urocolius macrourus</i>	f	
37	Black-headed Weaver	<i>Ploceus cucullatus</i>	o	
38	African Black-headed Oriole	<i>Oriolus larvatus</i>	f	
39	Chin-spot Batis	<i>Batis molitor</i>	F	
40	Double-toothed Barbet	<i>Lybius bidentatus</i>	f	
41	Black Cuckoo	<i>Cuculus clamosus</i>	F	Intra-African migrant
42	Eurasian Reed Warbler	<i>Acrocephalus scirpaceus</i>	f	Parearctic winter visitor(only common west of the Rift Valley)
43	Black Sunbird	<i>Chalcomitra amethystina</i>	f	
44	Red-necked Spurfowl	<i>Francolinus afer</i>	f	
45	Ruppell's Long-tailed Starling	<i>Lamprotornis purpuropterus</i>	f	
46	Pin-tailed Whydah	<i>Vidua macroura</i>	f	
47	Bronze Mannikin	<i>Lonchura cucullata</i>	o	
48	Common Waxbill	<i>Estrilda astrild</i>	o	
49	Black-and-white Mannikin	<i>Lonchura bicolor</i>	f	
50	Red-billed Firefinch	<i>Lagonosticta senegala</i>	o	
51	Yellow-fronted Canary	<i>Serinus mozambicus</i>	f	
52	Bateleur	<i>Terathopius ecaudatus</i>	f	
53	Common Fiscal	<i>Lanius collaris</i>	f	
54	Common Stonechat	<i>Saxicola torquata</i>	o	
55	Mackinnon's Fiscal	<i>Lanius mackinnoni</i>	f	
56	Red-collared Widowbird	<i>Euplectes ardens</i>	o	
57	White-winged Widowbird	<i>Euplectes albonotatus</i>	o	
58	Compact Weaver	<i>Ploceus superciliosus</i>	f	
59	Laughing Dove	<i>Streptopelia senegalensis</i>	o	
60	Eastern Grey Plantain-eater	<i>Crinifer zonurus</i>	f	Endemic to East Africa
61	Black Kite	<i>Milvus migrans</i>	o	
62	Southern Red Bishop	<i>Euplectes orix</i>	o	
63	Bare-Faced Go-away-bird	<i>Corythaixoides personata</i>	f	
64	Common Scimitarbill	<i>Rhinopomastus cyanomelas</i>	f	
65	Grey-backed Fiscal	<i>Lanius excubitoroides</i>	f	
66	Spur-winged Goose	<i>Plectropterus gambensis</i>	o	
67	Grey Crowned Crane	<i>Balearica regulorum</i>	o	Vulnerable/IUCN 2008-2009
68	Black-crowned	<i>Tchagra senegala</i>	f	

	Tchagra			
69	Grey Heron	<i>Ardea cinerea</i>	o	
70	Grassland Pipit	<i>Anthus cinnamomeus</i>	o	
71	Black-headed Gonolek	<i>Laniarius erythrogaster</i>	f	
72	Crowned Hornbill	<i>Tockus albeterminatus</i>	F	
73	Yellow-throated Longclaw	<i>Macronyx croceus</i>	o	
74	Long-crested Eagle	<i>Lophaetus occipitalis</i>	f	
75	Purple-banded Sunbird	<i>Cinnyris bifasciata</i>	f	
76	Bronze Sunbird	<i>Nectarinia kilimensis</i>	f	
77	Yellowbill	<i>Ceuthmochares aereus</i>	F	Migrant from the south to the coast

The most significance finding from this census is the recording of the Purple-banded Sunbird. This species does not occur in Rwanda according to the East Africa Field Book. Different migratory bird species were recorded i.e. Black Cuckoo-shrike *Campephaga flava* migrate from southern tropics in April-September, Levaillant's Cuckoo *Oxylophus levaillantii* and Red-chested Cuckoo *Cuculus solitarius* are intra-African migrants, Yellowbill *Ceuthmochares aereus* is migrant inhabiting forest patches and dense thickets where, like the Eurasian Reed Warbler *Acrocephalus scirpaceus* and European Bee-eater *Merops apiaster* are Palearctic winter visitors. The presence of forest depend species explains well the importance Ibanda-Makera biodiversity conservation.

2.1.3. Mammal survey

Introduction

Eastern gallery used to be home to different species of mammals, including big mammals. Nowadays, these forests are under human pressure. Illegal activities such as poaching, grazing, medicinal plant collection and wood cutting for different uses especially for firewood, cultivation and wildfire are major threats to these forests.

In February 2009, a team from the Association pour la Conservation de la Nature au Rwanda (ACNR) in collaboration with ORTPN (Rwanda Office for Tourism and National Parks) conducted a mammal survey in Ibanda-Makera gallery forest, the most important of the remaining gallery forests. The objective of that survey was to ascertain the remaining mammal species living in that forest. The survey was conducted from February 10th to 14th, 2009.

Survey area

The survey was conducted at Ibanda-Makera Gallery Forest located in Eastern province, Kirehe district, Mpanga sector, Nasho cell, in Nyawera village. Ibanda-Makera is a thick forest surrounded by woodland in the east and swamps forest in the south, the swamp extends to Akagera River.

Methodology

Mammal species were recorded while recording birds along transects and Reece. Footprints, dung and feeding signs were considered. Direct observations were done as well as information from local people.

Results and Discussion

The following species of mammals shown in Table below were recorded during this survey. In total, 9 species of mammals were recorded i.e. 3 primates' species, 4 species of herbivores and 2 carnivores' species.

Table 2: Mammal species recorded in Buhanga relict forest

Scientific name	Common name	Kinyarwanda name	Observation technique
<i>Cercopithecus mitis dogetti</i>	Blue Monkey	Inkima	S
<i>Chlorocebus aethiops</i>	Grivet	Inkende	S
<i>Papio anubis</i>	Baboon	Igitera	S
<i>Tragelaphus scriptus</i>	Bushback	Impongo	D,F
<i>Syncerus caffer caffer</i>	Buffaloes	Imbogo	D,F
<i>Potamochoerus larvatus</i>	Bushpig	Ingurube	S,F
<i>Sciurus sp</i>	Squirrel		I
<i>Felis serval</i>	Serval	Imondo	I
<i>Panthera pardus</i>	Leopard	Ingwe	I

S = seen; D = Dung piles; F = Feeding signs I = Information from local guide

As the main objective of survey which was to identify the mammal species remaining in Makera, a total of 9 mammal species were recorded during the survey. The collection of data was based on sighting or remaining signs of those species; the species like Blue Monkeys, Baboons, and Bushpig were observed; other species such as Bushback, Buffaloes, and Bushpig were identified through feeding signs. The data on Serval, Leopard and Squirrel were provided by local people (information from local guide). In spite of the disturbance that has taken place in Makera in the last decade, 9 species have been recorded including 2 species of carnivores, 4 species of herbivores and 3 species of primates, all of which still inhabit this gallery forest. Although, these species are shy, some of them were occasionally sighted on some days during the survey; the species include Blue Monkeys, Baboons, and Bushpig.

2.1.3. Plant survey

Methods

Different field methods were applied to collect data on the four galleries forests according to the level of disturbance affecting each of them.

Transects were easily used to Makera Gallery forest. 3 transects were set in North-south direction, at an espacement of 100m. The data were collected from circular plots of 10m for trees, 5m for lines and 2m radius for herbs according to the Braun-Blanket (1930) methods. The plots were set at each 200m along the line transect and the species found along transects met for the first time were also recorded.

The plant survey of this rocky savanna was along line transects inside and on basis of a list provided by local populations, the Team will evaluate the level of disturbance of species and how it has affected the composition of plant species in the forest.

The data collections at the present survey were collected during the short dry season (February 2009).

Identification

In addition to the flowering plant species, the Pteridophytes were also surveyed while the Bryophytes and Thallophytes couldn't due to the lack of information on these groups and the shortage of time.

The species identification was done with a magnifying glass and observations by microscope and Owunji (2004), Troupin Vol. I, II, III, IV as references for the flowering plant species and Agnew et al. (1994), Johns (1991), Taton (1946), Roux (2003), Schelpe (1986), for the Pteridophytes.

Voucher specimens

Voucher specimens of the majority of plants of interest in this survey were collected in duplicate to allow for further identification of those plants that could not be positively identified and to confirm the identity of those that were identified in the field.

Plant photos

Photos were taken to illustrate some aspects of the vegetation surveyed and the species on the sites. However some species weren't referenced in the existing literature and will have to be described and/or identified as new species. Their photos are presented in this report. (Include photos of the main vegetation types of different sites studied and some common/dominant species).

Results and discussions

In total, 127 plant species were recorded in Makera gallery forest mostly dominated by *Phoenix reclinata* Jacq., *Teclea nobilis* Delile, *Ficus vallis-choudae* Del. and *Dracaena afromontana* Mildbr., *Chaetacme aristata* Planch. and *Markhamia lutea* (Benth.) Schum.

With the references to the species composition: 59 are woody species dominated by *Phoenix reclinata* Jacq., *Ficus vallis-choudae* Del. and *Markhamia lutea* (Benth.) Schum., 39 bushy species mostly represented by *Teclea nobilis* Delile, *Dracaena afromontana* Mildbr., *Bridelia micrantha* (Hochst.) Ballon, *Allophylus africanus* P. Beauv., and *Grewia trichocarpa* Hochst. ex A. Rich. 12 species of shrub while 29 are lianas like *Lagenaria abyssinica* (Hook. f.) C. Jeffrey, *Basella alba* L, *Cissus quadrangularis* L.-Runya, *Paullinia pinnata* L, *Landolphia owariensis* P.Beauv., *Tacazzea apiculata* Oliver, etc. and the understorey of 47 herbaceous species *Hypoestes triflora* (Forsskal) Roemer et Schultes and *Achyranthes aspera* L . (See table in annex).

The results showed that the Moraceae family was the most represented with 5 species which belong to the *Ficus* genus, which means that Makera is a preferred habitat by *Ficus* species. *Ficus* divsp in addition to others like *Rhus divsp*, etc. are providers of fruits, making the gallery forest a suitable habitat to wildlife species, such as birds, monkeys etc...

The growth of Orchid species in Makera: *Eulophia guinensis*, *Platylepis glandulosa*, *Malaxis weberbaneriana* terrestrial orchids and *Cytorkis aquata* epiphytes indicates that the forest remains less disturbed and a site of new species for Rwanda like *Platylepis glandulosa* and *Malaxis weberbaneriana*, Orchidaceae which are only known to exist in Congo and Uganda.

Makera as a restricted habitat for these orchids in Rwanda should be protected and monitored for their long-term conservation.

The forest is facing many threats from human activities (harvesting firewood collection, Agriculture, cattle grazing, bush meat).

The fact that Makera gallery forest is surrounded by agricultural lands has led to many trails being made inside the forest. The high human presence inside the forest has resulted in increased levels of threats to the biodiversity of Makera. The closure of those trails should be a priority for better conservation.

2.2. Rugomero

2.2.1. General description

Rugomero gallery forest is also located in Eastern Province at the grid reference 222850 E 9766827 S and 223069 E 9766454 S. The total surface is estimated at 19.3984 ha. Administratively, Rugomero falls under Ngoma district. Its associated wetland has been cleared for rice cultivation.

Figure 6: Rugomero map

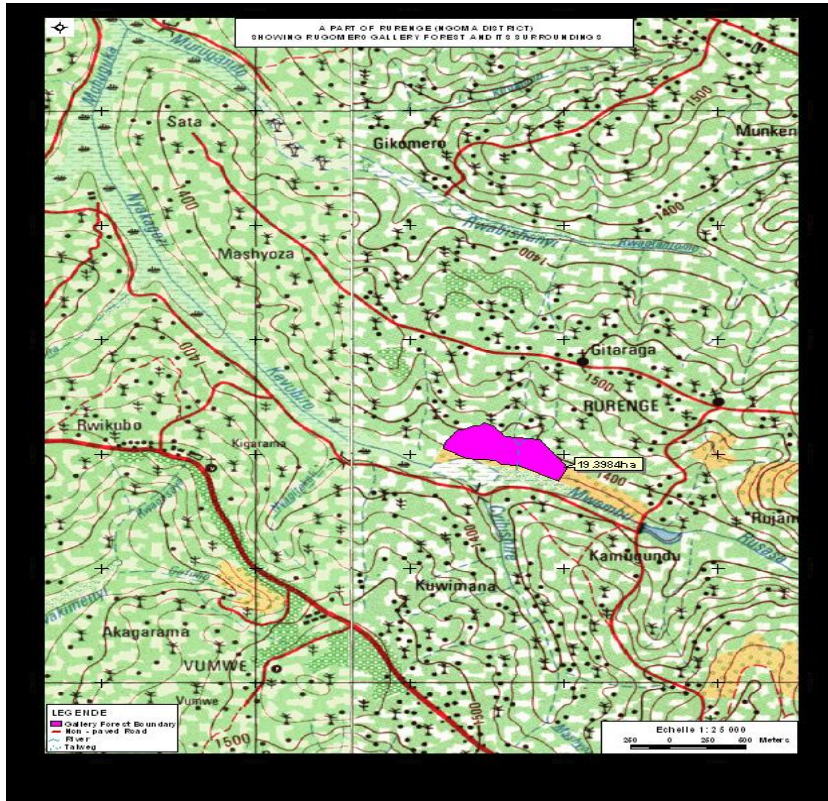


Figure 7: Rugomero gallery forest



Photo: Ndimukaga Marc

2.2.2. Birds' survey

A total of 59 bird species were recorded during the point counts and opportunistic observations within and around the forest.

Table 3: Rugomero bird check list

No	Common name	Scientific name	Ecological type	Endemism status
1	Long-crested Eagle	<i>Lophaetus occipitalis</i>	f	
2	Speckled Mousebird	<i>Colius striatus</i>	f	
3	Red-billed Firefinch	<i>Lagonosticta senegala</i>	o	
4	Yellow-fronted Canary	<i>Serinus mozambicus</i>		
5	Tropical Boubou	<i>Laniarius aethiopicus</i>	f	
6	White-browed Robin-chat	<i>Cossypha heuglini</i>	o	
7	Red-eyed Dove	<i>Streptopelia capicola</i>	o	
8	Common Bulbul	<i>Pycnonotus barbatus</i>	f	
9	African Thrush	<i>Turdus pelios</i>	f	
10	Ross's Turaco	<i>Musophaga rossae</i>	f	
11	Hadada Ibis	<i>Bostrychia hagedash</i>	o	
12	African Cuckoo-Hawk	<i>Aviceda cuculoides</i>	f	uncommon
13	Grey-headed Sparrow	<i>Passer griseus</i>	o	
14	Southern Red Bishop	<i>Euplectes orix</i>	o	
15	Black-headed Gonolek	<i>Laniarius erythrogaster</i>	f	
16	Yellow-billed Stork	<i>Mycteria ibis</i>	o	
17	Open-billed Stork	<i>Anastomus lamelligerus</i>	o	
18	Scarlet-chested Sunbird	<i>Chalcomitra senegalensis</i>	f	
19	Bronze Sunbird	<i>Nectarinia kilimensis</i>	f	
20	Hamerkop	<i>Scopus umbretta</i>	o	
21	Fan-tailed Widowbird	<i>Euplectes axillaris</i>	o	
22	Grassland Pipit(Jackson's)	<i>Anthus cinnamomeus</i>	o	
23	Bronze Mannikin	<i>Lonchura cucullata</i>	o	
24	Grey Heron	<i>Ardea cinerea</i>	o	
25	Black-headed Heron	<i>Ardea melanocephala</i>	o	
26	African Harrier-Hawk	<i>Polyboroides typus</i>	f	
27	Black Kite	<i>Milvus migrans</i>	o	
28	Tambourine Dove	<i>Turtur tympanistria</i>	f	
29	Yellow-whiskered Greenbull	<i>Andropadus latirostris</i>	F	
30	African Paradise Flycatcher	<i>Terpsiphone viridis</i>	f	
31	Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	f	
32	Black Cuckoo-shrike	<i>Campephaga flava</i>	f	
33	Arrow-marked Babbler	<i>Turdoides jardineii</i>	f	
34	Sacred Ibis	<i>Threskiornis aethiopicus</i>	o	
35	Woodland Kingfisher	<i>Halcyon senegalensis</i>	f	
36	Cape Wagtail	<i>Motacilla capensis</i>	o	
37	Ruppell's Long-tailed Starling	<i>Lamprotornis</i>	f	

		<i>purpuropterus</i>		
38	Black-headed Weaver	<i>Ploceus cucullatus</i>	o	
39	Black-and-white Mannikin	<i>Lonchura bicolor</i>	o	
40	Eastern Grey Plantain-eater	<i>Crinifer zonurus</i>	f	
41	African Jacana	<i>Actophilornis africanus</i>	o	
42	Pied Kingfisher	<i>Ceryle rudis</i>	o	
43	Long-tailed Cormorant	<i>Pharacrocorax africanus</i>	o	
44	Common Stonechat	<i>Saxicola torquata</i>	o	
45	White-browed Coucal	<i>Centropus superciliosus</i>	f	
46	Grosbeak Weaver	<i>Amblyospiza albifrons</i>	o	
47	Brown Parrot	<i>Poicephalus meyeri</i>	f	
48	Dusky Crested-flycatcher	<i>Trochocercus nigromitratus</i>	F	
49	Lesser Grey Shrike	<i>Lanius minor</i>	f	Common passage migrant
50	Red-backed Shrike	<i>Lanius collurio</i>	f	Conspicuous Palearctic migrant and winter visitor
51	Augur Buzard	<i>Buteo augur</i>	f	
52	European Bee-eater	<i>Merops apiaster</i>	o	Palearctic migrant
53	African Pied Wagtail	<i>Motacilla aguimp</i>	o	
54	Yellow-billed Duck	<i>Anas undulata</i>	o	
55	Red-chested Cuckoo	<i>Cuculus solitarius</i>	f	Intra-African migrant
56	Pin tailed Whydah	<i>Vidua macroura</i>	f	
57	Violet-backed Starling	<i>Cinnyricinclus leucogaster</i>	f	Intra-African migrant from south
58	Spot-flanked Barbet	<i>Tricholaema lacrymosa</i>	f	
59	Green Wood-hoopoe	<i>Phoeniculus purpureus</i>	F	

As at Ibanda-Makera, migratory species were recorded i.e. Violet-backed Starling *Cinnyricinclus leucogaster* which is the intra-African migrant from the south, Red-chested Cuckoo *Cuculus solitarius* the intra-African migrant, the Palearctic migrant European Bee-eater *Merops apiaster*, the Conspicuous Palearctic migrant and winter visitor Red-backed Shrike *Lanius collurio* and the Common passage migrant Lesser Grey Shrike *Lanius minor*. The uncommon species African Cuckoo-Hawk *Aviceda cuculoides* was recorded (Terry Stevenson & John Fanshawe, 2002).

Plant survey

Methods

The vegetation growth and the species diversity at Rugomero are related to the climate in the area and the previous disturbance that had affected it. Established on the low elevation on slope overhanging the wetland used for fish and rice production, it seems to be a misnomer to call Rugomero a gallery forest.

The vegetation survey on it was done in the direction of slope along existing trails used by local populations for different activities (agriculture, fetching water, etc.) making it feasible in this bushy and closed savanna. Data collection was done in plots laid out at 100m intervals along the trails and life forms recorded as described above.

Results and discussion

Rugomero gallery forest is a heavily disturbed site. It's a secondary gallery forest dominated by xerophytes species. The total number of plant species identified in Rugomero is 131 species. Among them 70 are woody species; 39 herbs and 22 lianas.

The tree dominance is represented by *Acacia polyacantha* var. *campylacantha* (Hochst. ex A. Rich.) Brenan; *Prunus Africana* (Hook.) Kalkman; *Vangueria volkensii* Schuman; *Acacia sieberana* Dc. *Blighia unijugata* Baker; *Celtis africana* Burm.f. and *Rhus divsp.*

A part from a few individual trees dominating the canopy, the vegetation is mostly dominated by woody shrubs and characterized by a power understory and undergrowth.

Human activities in recent years have also led to the growth of invasive species such as *Lantana camara* L., *Lantana trifolia* L. and *Acanthus pubescens* (Thomson ex Oliver) Engl. The invasive species have had serious adverse impacts on the growth of other plant species on the site.

Rugomero remains a site of in situ conservation for different plant species which have disappeared in Rwandan lowlands, savannas and galleries due to human pressure. Some species are still represented and should be preserved there: *Celtis africana* Burm.f. *Ekebergia capensis* Sparman, *Prunus africana* (Hook.f.) Kalkman, *Pseudospondias microcarpa* (A. Rich.) Engl., *Croton macrostachys* Hochst. Ex Delile, *Pterygota mildbraedii* Engl., *Blighia unijugata* Baker, *Zanha golungensis* Hiern, *Bridelia micrantha* (Hochst.) Ballon, *Grewia dvsp.*, *Bersama abyssinica* Fresen ; *Commiphora madagascarensis* Jaq.; *Cordia africana* Lam., *Bridelia micrantha* (Hochst.) Ballon ; *Pittosporum spathicalyx* De Wild. ; *Haplocoelum gallense* (Engl.) Radlk, *Paullinia pinnata* L. and *Cardiospermum halicacabum* L..

Fruiting trees on the site have attracted wildlife such as monkeys and birds which play a big role in seed dispersal and contribute to the regeration and survival of this forest. The presence of crops within the forest like *Capsicum frutescens* L. and *Coffea arabica* L. is also due the same process of seed dispersal.

The growth of orchids in Rugomero indicates the level of human activities affecting the site has been low. The wild distribution of *Eulophia guinensis* and *Eulophia streptopetala* terrestrial orchids, is due to the wet conditions and the vegetation cover, which provide suitable conditions for their growth. In addition there is an abundance of epiphytes (*Tridactyle anthomaniaca*) on *Acacia* sp. which have been found without flowers.

Two species known to grow naturally in high altitude above 2500 m altitude *Pittosporum spathicalyx* De Wild. and *Prunus africana* (Hook.f.) Kalkman (CITES species) at 1400 m altitude, were also observed.

Sustainable management of this small forest should be reinforced and local initiatives supported for its better conservation. Local people should be sensitized on the importance of this forest, and the trails inside it removed.

Two other gallery forests were surveyed. The trees in them were found to have been depleted at a very fast rate. Deforestation has been on-going in these forests for several decades.

The massive destruction of these forests has adversely affected its biodiversity, as well as being one of the major contributory factors to the massive loss of species that is ongoing in Rwanda.

The destruction of the forests is occurring due to various reasons, one of the main reasons being the pursuit of short term economic benefits. Some of the more common causes of deforestation in the Eastern gallery forests include land clearance for agriculture and livestock and the cutting down of trees for firewood or charcoal.

2.3. Rwakivunji

2.3.1. General description

Also located in Eastern Province, Rwakivunji gallery forest is located at the grid reference 223829 E 9750354 S and 224309 E 9750363 S. Administratively, Rugomero falls under Ngoma district. The remnant forest estimated at 5.9991 ha is now under destruction by being cleared for agriculture.

Figure 8: Rwakivunji map

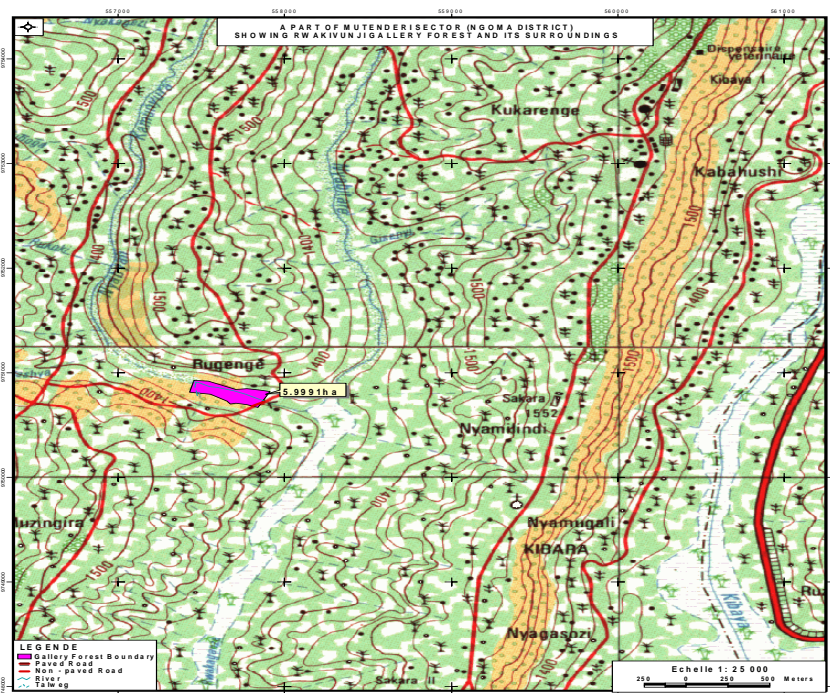


Figure 9: Rwakivunji gallery forest



Photo: Ndimukaga Marc

2.3.2. Birds' survey

A total of 27 bird species were recorded during the point counts and opportunistic observations within and around the remnant forest.

Table 4: Rwakivunji bird check list

No	Common name	Scientific name	Ecological type	Status
1	Tambourine Dove	<i>Turtur tympanistria</i>	f	
2	African Paradise-flycatcher	<i>Terpsiphone viridis</i>	f	
3	Chubb's Cisticola	<i>Cisticola chubbi</i>	f	
4	Ruppell's Long-tailed Starling	<i>Lamprotornis purpuropterus</i>	f	
5	White-browed Coucal	<i>Centropus superciliosus</i>	f	
6	Lesser Grey Shrike	<i>Lanius minor</i>	f	Common passage migrant
7	White-browed Robin-chat	<i>Cossypha heuglini</i>	o	
8	Common Bulbul	<i>Pycnonotus barbatus</i>	f	
9	Arrow-marked Babbler	<i>Turdoides jardineii</i>	f	
10	Grey-headed Sparrow	<i>Passer griseus</i>	o	
11	Speckled Mousebird	<i>Colius striatus</i>	f	
12	Ross's Turaco	<i>Musophaga rossae</i>	f	
13	Yellow-rumped Tinkerbird	<i>Pogoniulus bilineatus</i>	f	
14	Levaillant's Cuckoo	<i>Clamator levaillantii</i>	f	Intra-African migrant
15	Bronze Sunbird	<i>Nectarinia kilimensis</i>	f	
16	Purple-crested Turaco	<i>Tauraco porphyreolophus</i>	f	
17	Green-backed Woodpecker	<i>Campethera cailliautii</i>	F	
18	Southern Red Bishop	<i>Euplectes orix</i>	o	
19	Brown Parrots	<i>Poicephalus meyeri</i>	f	
20	Black-billed Weaver	<i>Ploceus nigerrimus</i>	f	
21	Black Kite	<i>Milvus migrans</i>	o	
22	Red-eyed Dove	<i>Streptopelia capicola</i>	o	
23	Long-crested Eagle	<i>Lophaetus occipitalis</i>	f	
24	Bearded Woodpecker	<i>Dendropicops namaquus</i>	f	
25	Marsh Tchagra	<i>Tchagra minuta</i>	o	
26	Tropical Boubou	<i>Laniarius aethiopicus</i>	f	
27	Yellow Bishop	<i>Euplectes capensis</i>	o	

2.3.4. Plant survey

Rwakivunji gallery forest was created by Bishop Kayinamura Télésphore for preservation of medicinal plants. The forest was estimated at 9 hectares and located between Muzingira and Gahura. The forest stands on both riparian zones of Rwakivunji river, from which the forest derives its name. The swamp conditions have led to the dominance of *Cyperus papyrus* in the middle of the forest.

The primary forest was dominated by trees around *Cyperus* grasses and mostly dominated by *Mitragyna rubostipulata*. Where deep and firm soils occur, several trees species are found, mainly *Blighia unijugata*, *Anthocleista grandiflora*, *Trimeria grandiflora*, *Xanthophyllum chalbeum*, *Clausena anisata*, *Toddalia asiatica* and *Bridelia micrantha*.

The piedmont levels were dominated by a ticket of sub shrubs of *Pittosporum spatycalyx*, *Cordia Africana*, *Albizia sp.* and *Acacia divsp.* Covered by lianas like: *Paulinia pinnata*, *Tacazzea floribunda*, *Ficus asperifolia*, *Roicissus tridentata* and *Neorautanenia mitis* and these have been cleared to create space for agriculture. It was also known that the moist conditions were preferred by a ticket of *Acanthus pubescens* and *Ensete ventricosum*.

Actually the forest has been very much reduced in size except some remnant species sparsely distributed. A total of 32 plant species were recorded during the survey, 20 of them woody species, 6 lianas and 5 herbs. The remnant trees are represented by few individuals, mostly by *Sapium ellipticum* (Hochst.ex Krauss) Pax., *Maesa lanceolata* Forsskal, *Mitragyna rubrostipulosa* (Schumann) Havil, *Blighia unijugata* Baker, *Albizia gummifera* (J.F. Gemel) C.A. Smith and *Anthocleista grandiflora*. The removal of canopy trees is correlated with the decrease of climbers (lianas) and herbs mostly due anthropogenic activities. Their presence was found not to be significant important in the present survey, due to the level of degradation of Rwakivunji forest.

There has also been a big loss of medicinal plants. The total number of medicinal plants in Rwakivunji Primary Forest known to be used by the local healers was estimated at 112, 31 of species (1/4) are indigenous in the site.

Some important trees species such as *Trimeria grandiflora*, *Cordia Africana*, *Xanthoxylum chalbeum*, *Toddalia asiatica*, *Bridelia micrantha* *Pittosporum spathicalyx*, no longer exist on this site.

Rwakivunji forest was very important for Rwanda traditional life. It was a site for the preservation of medicinal plants that were harvested and used by Bare traditional healing clinics. This site should be restored for Rwandan traditional knowledge on the plant use and in situ conservation; this practice is still working and preferred by some sections of the Rwandan population.

2.4. Sarambuye

Sarambuye forest is located in Eastern Province at the grid reference 233701 E 9756354 S and 233833 E 9756269 S. Administratively, Sarambuye falls under the Kirehe district. The remnant gallery forest is dominated by one *Pterygota mildbraedii* tree species. The remaining forest is mainly woodland.

Figure 1: Woodland at Sarambuye



Photo: Ndimukaga Marc

The picture shows that agriculture in this area has almost totally taken over Sarambuye gallery forest. Only rare savanna species are growing up on rocky areas, which are inappropriate to crops. The plant diversity is composed mainly of the xerophytes species (index 4.).

CHAP V: Conclusion and recommendations

Eastern gallery forests appear to be heavily encroached on all sides leaving a small remnant of forest. Yet even this small remnant is under pressure as this area shows higher timber extraction and poaching i.e. Ibanda-Makera. The number of birds recorded and plant species identified shows that Eastern gallery forests are rich in biodiversity. Ibanda-Makera gallery forest was found to host 78 bird species and 9 species of mammals were recorded i.e. 3 primates' species, 4 species of herbivores and 2 carnivores' species whereas 59 and 27 bird species were found at Rugomero and Rwakivunji respectively. Other species like the Nile Monitor Lizard *Varanus niloticus* was encountered at Ibanda-Makera and is a CITES Appendix II species. No bird species were recorded which are endemic to the Eastern gallery forests and only one species Eastern Grey Plantain-eater *Crinifer zonurus* was recorded at Ibanda-Makera gallery forest as a near-endemic, having a restricted range limited to the East Africa region. The vulnerable Grey Crowned Crane *Balearica regulorum* (IUCN Red List 2008-2009) was also recorded at Ibanda-Makera forest. The presence of forest dependent birds' species and some plant species which are not found anywhere else in the country i.e. new species for Rwanda like *Platylepis glandulosa* and *Malaxis weberbaneriana*, Orchidaceae which are only known to exist in Congo and Uganda, explains well the importance of conserving these only remaining gallery forests in Rwanda.

Consequently, positive measures towards eastern gallery forests conservation were recommended in consultation with all stakeholders involved in conservation i.e. local authorities, local communities and other NGOs acting in the region:

1. Ecological restoration programs should be implemented in degraded areas so to recover the ecosystem services these areas used to provide i.e. Rwakivunji gallery forest and a buffer zone to be created around all gallery forests.
2. Ibanda-Makera as a restricted habitat for *Platylepis glandulosa* and *Malaxis weberbaneriana* in Rwanda should be protected and monitored for their long-term conservation.
3. Awareness on the link between conservation and long term availability of resources should be promoted through both formal and informal educational programs.
4. Sustainable harvesting should be promoted, making evident for people how they can still use resources without losing the opportunity for using them in the middle and long terms.
5. Funding sources should be looked for to promote capacity building for developing ecotourism projects and other alternatives.
6. The value of ecosystem services provided by gallery forests should be recognized and gradually integrated into national policies towards a sustainable development.
7. National policies on gallery forests conservation management which can conform with agricultural development policies are vital. Attention must be paid to the fragility of the

ecological and hydrological processes of each gallery forest and how different types of unsustainability will impact its ecosystem.

8. Management programs need to be implemented and developed. A Site Action Plan should seek to gain better formal protection for the sites, promote environmental awareness through an education program and develop alternative forms of local land-use and employment, including developing its considerable potential as sites for bird-watching and eco-tourism.
9. Strategies and actions for ensuring sustainable harvesting of non timber forest products (medicinal plants) need to be established.

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Appendices

Appendix 1. Plant list of Makera

MAKERA			Canopy (%)	1	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	#	21	#	#	#	#	#	P
SPECIES	FAMILY	Bio. forms		7	2	5	67,	8	5	7	7	7	7	3	2	7	6	7	7	7	7	7	7	2	67,	5	5	5	67,	5
1	<i>Ficus vallis-choudae</i> Del.	MORACEAE	tree	4			1		1				1		2		2	2	2	1	1	+		+		2		1	III	
2	<i>Phoenix reclinata</i> Jacq.	ARECACEAE	tree	4	2			1	+	1	5	1		2	4	3	2	2	2	4	3	4	4	+	+	1	3	1		V
3	<i>Pavonia urens</i> Cav.	MALVACEAE	shrub	3			2																							I
4	<i>Teclea nobilis</i> Delile	RUTACEAE	shrub	+			+		+	4	2	2	2	2		2	1	3	1	2	1			3	4	3	3	4	2	I V
5	<i>Rhus vulgaris</i> Melke	ANACARDIACEAE	shrub	+																										I
6	<i>Bridelia micrantha</i> (Hochst.) Ballon	EUPHORBIACEAE	shrub	+	1											+	+								+			+		II
7	<i>Ipomoea involucrata</i> P. Beauv.	CONVOLVULACEAE	grass	1				1																						I
8	<i>Lagenaria abyssinica</i> (Hook. f.) C. Jeffrey	CUCURBITACEAE	liana	1		1		+		1						1														I
9	<i>Basella alba</i> L.	BASELLACEAE	liana	+	4	+											+				+			+						II
10	<i>Cissus quadrangularis</i> L.-Runya	VITACEAE	liana	+	+	1		+	2				+								+			+					1	II
11	<i>Tragia brevipes</i> Pax	RUTACEAE	liana	+	+	1		+	1											+								+		II
12	<i>Dracaena afromontana</i> Mildbr.	AGAVACEAE	shrub	3				1		2	3	3	2			2	1	4	1				+	1			3	2		III
13	<i>Hypoestes triflora</i> (Forsskal) Roemer et Schultes	ACANTHACEAE	grass	2	+			1								+	4	4	3	1	3						5	4	3	III
14	<i>Panicum hyemeniochilum</i> Nees	POACEAE	grass	3						4	4	3																		I
15	<i>Achyranthes aspera</i> L.	AMARANTHACEAE	grass	+	2	2	1		2	1				2	2	5			+					1	2	1		1		III
16	<i>Carissa edulis</i> (Forsskal) Vahl	APOCYNACEAE	shrub	+						1	1	+									1			+	2			1		II
17	<i>Oplismenus hirtellus</i> (L.) P. Beauv.	POACEAE	grass	1	2				1								4			4	4									II
18	<i>Cardiospermum halicacabum</i> L.	SAPINDACEAE	grass	1				+	+						2															I
19	<i>Maytenus undata</i> (Thunb.) Blakelock	CELASTERACEAE	shrub	1					1	1										+										I
20	<i>Rytiginia castanea</i> Robyins	RUBIACEAE	bush	1				1																						I
21	<i>Acacia polyacantha</i> Var. <i>campylacantha</i> (Hochst.ex A. Rich.) Brenan	MIMOSACEAE	tree		2	1	3						3	2	+									1						II
22	<i>Allophylus africanus</i> P. Beauv.	SAPINDACEAE	shrub		1		+		+		+	+			1		1													II
23	<i>Vernonia amygdalina</i> Delile	ASTERACEAE	shrub			1								+		+								+						I
24	<i>Vernonia pogosperma</i> Klatt	ASTERACEAE	shrub		1																				2					I

19	<i>Dovyaris macrocalyx</i> (Oliver) Warb.	FLACOURTIACEAE	shrub	+					3							I
20	<i>Dracaena afromontana</i> Mildbr.	AGAVACEAE	shrub				1		2		1		1			II
21	<i>Ekebergia capensis</i> Sparman	MELIACEAE	tree							+						I
22	<i>Erythrina abyssinica</i> Lam. ex Dc.	FABACEAE	tree	+						+						I
23	<i>Ficus thonningii</i> Blume	MORACEAE	tree					+								I
24	<i>Gloriosa superba</i> L.	LILIACEAE	liana	+			+	+								II
25	<i>Grevillea robusta</i> A. Cunn.	PROTEACEAE	tree	1												I
26	<i>Grewia forbesii</i> Harvey ex Masters	TILIACEAE	shrub			2			+	+	+				+	III
27	<i>Grewia trichocarpa</i> Hochst. ex A. Rich.	TILIACEAE	shrub			1										I
28	<i>Hibiscus fuscus</i> Garcke	MALVACEAE	sufflutex	+												I
29	<i>Hypoeostyes forskalei</i> (Vahl) Sol. ex Roemer et Schultes	ACANTHACEAE	sufflutex				+						1			I
30	<i>Hypoeses triflora</i> (Forsskal) Roemer et Schultes	ACANTHACEAE	grass				1	3	2							II
31	<i>Impatiens burtonii</i> Hook. f.	BALSAMINACEAE	grass							+					1	I
32	<i>Ipomea wightii</i> (Wallich) Choisy	CONVOLVULACEAE	grass			2			1		1					II
33	<i>Jasminum abyssinicum</i> Hochst. ex Dc.	OLEACEAE	liana	2												I
34	<i>Jasminum fluminense</i> Vell.	OLEACEAE	liana	1												I
35	<i>Lagenaria sphaerica</i> (Sonder) Naudin	CUCURBITACEAE	liana				+				+					I
36	<i>Lantana camara</i> L.	VERENACEAE	bush	3		3	1			2	2			4		IV
37	<i>Maytenus undata</i> (Thunb.) Blakelock	CELASTERACEAE	shrub	+				+			+					II
38	<i>Melanthera scandens</i> (Schum. et Thonn.) Roberty	ASTERACEAE	grass						2							I
39	<i>Oplismenus hirtellus</i> (L.) P. Beauv.	POACEAE	grass	+			+		+							II
40	<i>Panicum hyemeniophilum</i> Nees	POACEAE	grass		+										+	I
41	<i>Panicum sp.</i>	POACEAE	grass			2	+		2	1						II
42	<i>Paullinia pinnata</i> L.	SAPINDACEAE	liana		1	+			2					1	1	III
43	<i>Pavetta oliverana</i> Hiern	RUBIACEAE	shrub	+					1					1		II
44	<i>Phytolacca dodecandra</i> L'Herit	PHYTOLACCACEAE	bush		+		+			+				1		III
45	<i>Polygonum setosulum</i> Hochst.	POLYGONACEAE	grass					+								I
46	<i>Prunus africana</i> (Hook.f.) Kalkman	AMYGDALACEAE	tree	+			+	1	2	+	1			+	+	IV
47	<i>Rhus vulgaris</i> Meikle	ANACARDIACEAE	shrub	1	1							1				II
48	<i>Ricinus communis</i> L.	EUPHORBIACEAE	tree	+												I
49	<i>Rhoicissus revollii</i> Plancton	VITACEAE	liana	+												I
50	<i>Rhoicissus tridentata</i> (L.f.) Willd. et Drummond	VITACEAE	liana	+							1					I
51	<i>Rytiginia castanea</i> Robyns	RUBIACEAE	bush											+		I
52	<i>Sesbania sesban</i> L.	FABACEAE	grass			+								+		I
53	<i>Stephania abyssinica</i> (Dill. et Rich.)	MENISPERMACEAE	liana	+												I

54	<i>Tragia brevipes</i> Pax	RUTACEAE	liana					2								1	I
55	<i>Triumfetta cordifolia</i> A.Rich.	TILIACEAE	sub-shrub					+									I
56	<i>Vernonia amygdalina</i> Delile	ASTERACEAE	shrub	+				+									II
57	<i>Vernonia pogosperma</i> Klatt	ASTERACEAE	shrub					1									I
58	<i>Vigna frutescens</i> A.Rich.	FABACEAE	grass					1	1				+				II
59	<i>Justicia flava</i> (Vahl) Vahl	ACANTHACEAE	sufflutex		1												I
60	<i>Securinega virosa</i> (Roxb. Ex Willd.) Baillon	EUPHORBIACEAE	shrub		+			1		+	1	2					III
61	<i>Capparis fascicularis</i> DC.	CAPPARACEAE	bush		1					1							I
62	<i>Vangueria volkensii</i> Schumann.	RUBIACEAE	tree	1	1			1					1				II
63	<i>Tarenna graveolens</i> (S. Moore) Bremek.	RUBIACEAE	shrub		1	1	1	+									II
64	<i>Erythrocca bongensis</i> Pax	EUPHORBIACEAE	shrub		1								2	+	+		II
65	<i>Combretum molle</i> R. Br. Ex G. Don	COMBRETACEAE	shrub			+											I
66	<i>Jasminum schimperi</i> Vatke	OLEACEAE	liana	1		+	+	3	1	2	1				1	1	IV
67	<i>Clerodendron sp.</i>	VERENACEAE	bush			1	1										I
68	<i>Gynura scandens</i> O. Hoffm.	ASTERACEAE	liana					1							1		I
69	<i>Commiphora madagascarensis</i> Jaq.	BRUSERACEAE	shrub					+		+	+						II
70	<i>Allophylus rubifolius</i> (Hochst. ex. Rich) Engl.	SAPINDACEAE	tree					+	1								I
71	<i>Bersama abyssinica</i> Fresen	MELIANTHACEAE	shrub					+									I
72	<i>Thunbergia mildbraediana</i> Lebrun et L. Touss.	ACANTHACEAE	liana					1									I
73	<i>Cassia didymobotya</i> Fresen	CAESALPINIACEAE	shrub					1									I
74	<i>Zehneria scabra</i> (L.F.) Sonder	CUCURBITACEAE	liana					1	1				+			1	II
75	<i>Mezoneuron angolense</i> Oliv.	CAESALPINIACEAE	liana											+			I
76	<i>Acacia sieberana</i> Dc.	MIMOSACEAE	tree					1		+			1				II
77	<i>Maesa lanceolata</i> Forsskal	MYRSINACEAE	shrub					+	+								I
78	<i>Acalypha racemosa</i> Wallich et Ballon	EUPHORBIACEAE	grass					3									I
79	<i>Tridactyle anthomaniaca</i>	ORCHIDACEAE	grass					+									I
80	<i>Pseudospondias microcarpa</i> (A. Rich.) Engl.	ANNONACEAE	tree						1								I
81	<i>Panicum adenophorum</i> Schumann	POACEAE	grass						4								I
82	<i>Markhamia lutea</i> (Benth.) Schum.	BIGNONIACEAE	tree						1				1				I
83	<i>Phyllanthus ovarifolius</i> Forsskal	EUPHORBIACEAE	shrub						1				+				I
84	<i>Toddalia asiatica</i> (L.) Lam.	RUTACEAE	shrub						2				1		+		II
85	<i>Vernonia purpurea</i> Schultz-Bip	ASTERACEAE	shrub						1								I
86	<i>Caesalpinia decapetala</i> (Roth) Alston	CAESALPINIACEAE	liana							2			+	2	1		II
87	<i>Cordia africana</i> Lam.	BORAGINACEAE	shrub							+							I
88	<i>Acacia monticola</i> Brenan et Exell	MIMOSACEAE	shrub							+							I

124	<i>Tridactyle anthomaniaca</i>	ORCHIDACEAE	grass					1							+				I
125	<i>Echnops amplexicaulis</i> Oliver	ASTERACEAE	sufflutex																I
126	<i>Eulophia guinensis</i>	ORCHIDACEAE	grass	+	+			1	+	1					+	+	+		IV
127	<i>Echnops amplexicaulis</i> Oliver	ASTERACEAE	grass							+									I
128	<i>Vangueria apiculata</i> Schumann.	RUBIACEAE	shrub	+						+									I
129	<i>Haplocoelum gallense</i> (Engl.) Radlk	SAPINDACEAE	shrub								+								I

Appendix3. Rwakivunji remnant plant species

No	SPECIES	FAMILY	Biol. forms
1	<i>Ficus dekdekena</i> (Miq.) A.Rich.	MORACEAE	tree
2	<i>Pavetta sp.</i>	RUBIACEAE	tree
3	<i>Albizia gummifera</i> (J.F. Gemel) C.A. Smith	MIMOSACEAE	shrub
4	<i>Zehneria scabra</i> (L.F.) Sonder	CUCURBITACEAE	liana
5	<i>Sapium ellipticum</i> (Hochst.ex Krauss) Pax	EUPHORBIACEAE	tree
6	<i>Desmodium repandum</i> (Vahl) Dc.	FABACEAE	grass
7	<i>Achyranthes aspera</i> L.	AMARANTHACEAE	grass
8	<i>Paullinia pinnata</i> L.	SAPINDACEAE	liana
9	<i>Erytrina abyssinica</i> Lam. ex Dc.	FABACEAE	tree
10	<i>Erythrocca bongensis</i> Pax	EUPHORBIACEAE	shrub
11	<i>Acanthus pubescens</i> (Thomson ex Oliver) Engl.	ACANTHACEAE	shrub
12	<i>Stephania abyssinica</i> (Dill. Et Rich.) Walp.	MENISPERMACEAE	liana
13	<i>Gynura scandens</i> O. Hoffm.	ASTERACEAE	liana
14	<i>Maesa lanceolata</i> Forsskal	MYRSINACEAE	shrub
15	<i>Bridelia micrantha</i> (Hochst.) Ballon	EUPHORBIACEAE	shrub
16	<i>Cordia africana</i> Lam.	BORAGINACEAE	shrub
17	<i>Tacazzea floribunda</i>	ASCLEPIADACEAE	liana
18	<i>Ensete ventricosum</i> (Welw.) Cheesman	MUSACEAE	grass
19	<i>Mitragyna rubrostipulosa</i> (Schumann) Havil	RUBIACEAE	tree
20	<i>Stephania cyanantha</i> Welw. Ex Hiern	MENISPERMACEAE	liana
21	<i>Grewia trichocarpa</i> Hochst. ex A. Rich.	TILIACEAE	shrub
22	<i>Clausena anisata</i> (Willd.) Hook.f. Ex Benth.	RUTACEAE	shrub
23	<i>Trema orientalis</i> (L.) Blume	ULMACEAE	shrub
24	<i>Blighia unijugata</i> Baker	SAPINDACEAE	tree
25	<i>Allophylus africanus</i> P. Beauv.	SAPINDACEAE	shrub
26	<i>Dovyaris macrocalyx</i> (Oliver) Warb.	FLACOURTIACEAE	shrub
27	<i>Blumea sp.</i>	ASTERACEAE	grass
28	<i>Canthium scimperioanum</i> A.Rich.	RUBIACEAE	shrub
29	<i>Combretum molle</i> R. Br. Ex G. Don	COMBRETACEAE	shrub
30	<i>Euphorbia schimperiana</i> Scheele	EUPHORBIACEAE	grass
31	<i>Premna angolensis</i> Guerke	VERBENACEAE	shrub

Appendix4. Sarambuye plant list.

No	SPECIES	FAMILY	Biol. forms
1	<i>Acacia kirkii</i> Oliv.	MIMOSACEAE	tree
2	<i>Acocanthera scimperi</i>		
3	<i>Albizia gummifera</i> (J.F. Gemel.) C.A. Smith.	MIMOSACEAE	tree
4	<i>Albizia versicolor</i> Welw. Ex Oliv.	MIMOSACEAE	shrub
5	<i>Annona senegalensis</i> Pers	ANNONACEAE	shrub
6	<i>Blighia unijugata</i> Baker	SAPINDACEAE	tree
7	<i>Bridelia micrantha</i> (Hochst.) Ballon	EUPHORBIACEAE	shrub
8	<i>Carissa edulis</i> (Forsskal) Vahl	APOCYNACEAE	shrub
9	<i>Clausena anisata</i> (Willd.) Hook.f. Ex Benth.	RUTACEAE	shrub
10	<i>Clutia abyssinica</i> Jaub.et Spach.	EUPHORBIACEAE	tree
11	<i>Combretum molle</i> R. Br. Ex G. Don	COMBRETACEAE	shrub
12	<i>Dalbergia</i> sp. (shrub sarmenteux)	FABACEAE	shrub
13	<i>Dissotis senegambiensis</i> (Guill. et Perr.) Triana	MELASTOMATACEAE	grass
14	<i>Dodonea viscosa</i> (L.) Jacq.	SAPINDACEAE	bush
15	<i>Dovyaris macrocalyx</i> (Oliver) Warb.	FLACOURTIACEAE	shrub
16	<i>Erythrocarpa bongensis</i> Pax	EUPHORBIACEAE	shrub
17	<i>Ficus brachypoda</i> Hutch.	MORACEAE	tree
18	<i>Indigofera</i> sp.	FABACEAE	bush
19	<i>Jasminum</i> sp.	OLEACEAE	liana
20	<i>Lantana camara</i> L.	VERENACEAE	bush
21	<i>Markhamia obtusifolia</i> (Baker) Sprague	BIGNONIACEAE	tree
22	<i>Maytenus senegalensis</i> (Lam.) Exell	CELASTRACEAE	shrub
23	Orchidaceae a feuille lineaire	ORCHIDACEAE	grass
24	<i>Ozoroa reticulata</i> (Baker f.) R. et A. Fernandes	ANACARDIACEAE	shrub
25	<i>Parinari curatellifolia</i> Planch. Ex Benth.	CHRYSOBALANACEAE	shrub
26	<i>Paullinia pinnata</i> L.	SAPINDACEAE	liana
27	<i>Pavetta</i> sp.	RUBIACEAE	tree
28	<i>Premna angolensis</i> Guerke	VERENACEAE	shrub

29	<i>Pterygota mildbraedii</i> Engl.	STERCULIACEAE	tree
30	<i>Rhoicissus tridentata</i> (L.f.) Willd. et Drummond	VITACEAE	liana
31	<i>Rhus natalensis</i> Bernh. ex Krause	ANACARDIACEAE	shrub
32	<i>Rhus vulgaris</i> Meikle	ANACARDIACEAE	shrub
33	<i>Rutidea sp.</i>	RUBIACEAE	liana
34	<i>Rytiginia sp.(umutukutuku)</i>	RUBIACEAE	bush
35	<i>Strychnos lucens</i> Baker	LOGANIACEAE	liana
36	<i>Chaetacme aristata</i> Planch.	ULMACEAE	shrub