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Structure and floristic composition of Kibira rainforest, Burundi

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Abstract: This paper gives the results of the first census of trees in the 32.15 ha plot in order to provide tree species richness in Kibira rainforest (Burundi). All trees ≥ 10 cm dbh were permanently tagged and their girth measured. The forest structure pattern analyzed were diameter at breast height (dbh), basal area, relative dominance, and relative density, Importance Value Index (IVI) and Family Importance Value (FIV). In total, 6504 trees representing 70 species, 67 genera and 37 families were recorded. Tree density was 202 stems/ha, with a basal area of 21.05 m² ha^{-1}. Seventeen families were represented by a single species each, eleven families were represented by two species each, five families were represented by three species each, and four families were represented by four species each. The most important families in relation to FIV were Euphorbiaceae, Myrtaceae and Araliaceae. *Macaranga kilimandscharica*, *Syzygium guineense* and *Polyscias fulva* were the most important species in relation to IVI. Two tree species were found to be endemic to the Albertine Rift and one species probably endemic to the Albertine Rift. The Shannon-Weiner index (H') and evenness index (J') were respectively 3.18 and 0.75. This study provides a baseline for the management of Kibira National Park. As local communities still depend on forest resources, conservation awareness-raising and education actions have to focus in nearby villages, and growing some fast-growing native trees in the vicinity of the settlement, would be helpful for local communities, this would reduce their dependence on forest resources.

Key words: Kibira, local communities, species accumulation curve, species richness, tree density, tree diversity.

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Introduction

Predicting ecological parameters that determine animal abundance is important in animal ecology because of the implications for conservation (Wasserman & Chapman 2003). To understand how animal populations respond to the scarcity of certain trees species, it is useful to know the density and distribution of the tree species that those animals depend on and to measure the spatial variations in the populations of animals and trees simultaneously. Given that 90 % of nonhuman primates live in tropical forests, the most effective way to conserve them should emphasize the conservation of tropical forest habitats (Isabirye-Basuta & Lwanga 2008) which requires data on diversity and distribution of their tree species (Eilu *et al*. 2004). Similarly, for conservation purposes, Paciulli (2010) suggested to identify the general forest and tree indices, as well as the specific tree species that affect primate densities. Numerous studies have shown inter-

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actions between primates and fruit trees in terms of animal density and ranging pattern (Albert *et al.* 2013a; Di Bitetti 2001; Oliveira *et al.* 2011; Peng-Fei & Xue-Long 2008; Tutin *et al.* 1991). Various tree species, based on their characteristics constitute food source, resting and sleeping places or nesting places for primates (Basabose & Yamagiwa 2002; Brownlow *et al.* 2001; Chapman & Onderdonk 1998; Hladik, 2002; Palma *et al.* 2011; Phoonjampa *et al.* 2010; Raboy *et al.* 2008), but some of these trees also rely on frugivores for dispersal of their seeds (Albert *et al.* 2013b; Chapman & Chapman 1996; Chapman *et al.* 1992; Howe 1984; Wrangham *et al.* 1994). If these animals were exterminated in the forest, due to poaching activities for example, seed dispersal becomes insufficient (De Melo *et al.* 2006; Nuñez-Iturri & Howe 2007; Wunderle Jr. 1997). Lack of seed dispersal disrupts forest regeneration, for example because seeds piled up below parent trees likely attract many specific enemies, which can also easily attack the seedlings (Mangan *et al.* 2010).

The Kibira Rainforest, one of Albertine Rift montane forests, harbors different species of nonhuman primates, principally *Pan troglodytes schweinfurthii*, *Cercopihtecus mitis doggetti, Cercopithecus mona, Cercopihtecus lhoesti and Colobus angolensis*. While flora of most parks and reserves in the Albertine Rift region are reasonably well known (Plumptre *et al.* 2003), information on tree species richness in the National Park is still lacking. This study consequently aims to provide composition and abundance of tree species in the Kibira rainforest. The results presented here allow us to undertake further studies on the relationship between primate species ecology and tree species available in the Kibira forest.

Material and methods

Study area

Kibira rainforest (400 sq. km) is a national park located in the North-West of Burundi on the Congo-Nile Divide, between 2° 36' 52" and 3 ° 17' 08" South latitude and between 29° 13' 31" and 29° 39' 09" East longitude. It is contiguous with the Nyungwe National Park in Rwanda, both forming one block of montane forest of the Albertine Rift. The altitude varies between 1,600 and 2,666 m (Arbonier 1996). The Relief characterized by sharp slopes on both sides of the Congo Nile Divide is more marked on the Western side of the Park. An ombrothermic diagram made of data from the weather station Ruharo (period 1969 - 2011) located at an altitude of 1,628 m (Fig. 1), near the eastern border of the park shows a high thermal stability and a winter drought, which corresponds to a climate of Cwb type (temperate highland tropical climate with dry winters) accor-ding to the Köppen System (Gomes *et al.* 2003). The digitalized Köppen's 10' by 10' climate map of Kriticos *et al.* (2012) shows that the climate of the Kibira Park is mostly Cwb but the Western side of the park is partly covered by pixels of AW climate (tropical wet or dry climate) and the northern end by a Csb pixels (dry-summer subtropical climate).

Local communities living around the park are poor. Therefore, they still use the forest for firewood and timber collection, clear the forest for agriculture, and hunt for subsistence reasons, all this constituting a significant threat for the remaining forest and wildlife.

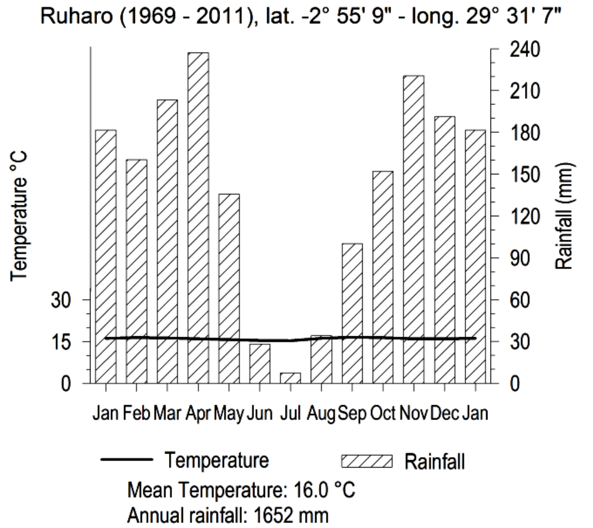

Fig. 1. Ombrothermic diagram of Ruharo weather station.

Botanical data collection

Botanical data were collected along sixteen transects of 3 km each in the Kibira rainforest (Fig. 2). Kibira forest's topography did not allow us to make equidistant transects, but transects were restricted to the interior portions of each site to minimize edge effects. Circular plots of 20 m radius were established every 200 m along each transect. A total of 256 circular plots covering a total area of 32.15 ha were established. From the center of the plots, we recorded altitude and GPS position. Diameter at breast height (dbh) of all

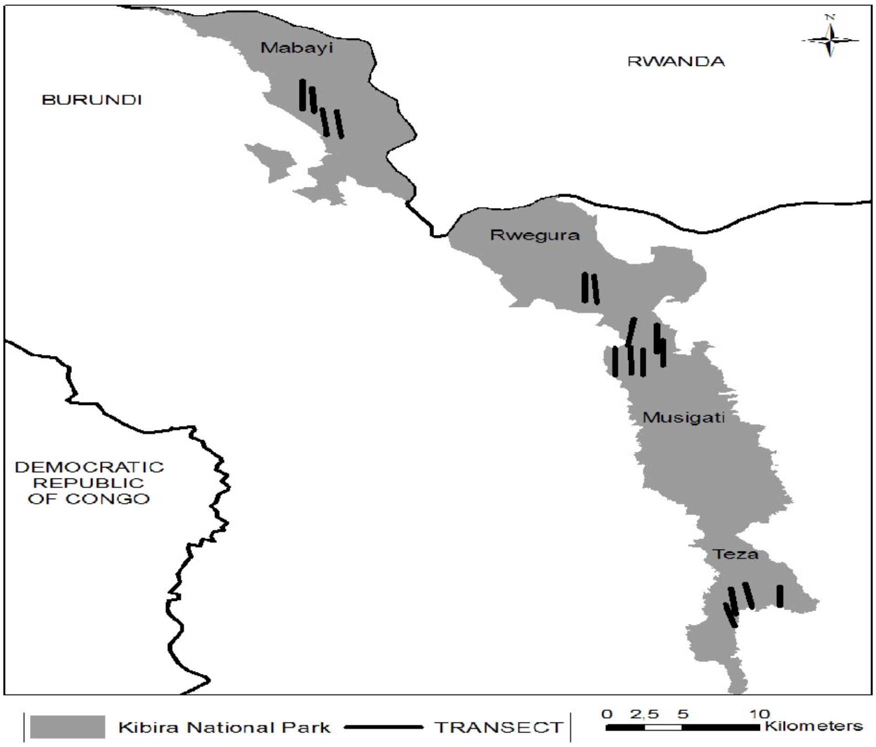

Fig. 2. Localization of the study in the 4 districts of the Kibira national park.

woody plants ≥ 10 cm dbh within the plot were measured and tree identified to the species level using available floras and botanical field guides (Fischer & Killmann 2008; Reekmans & Niyongere 1983; Troupin 1982).

Data Analysis

Shannon index of general diversity and eveness index were calculated using the equation of Magurran (2004), Lü *et al.* (2010), Adekunle *et al.* (2013) and Barthelemy *et al.* (2015):

$$H' = -\sum_{i=1}^{S} p_i \ln(p_i)$$

where S is the number of species, *pi* is the proportion of the *i*th species.

The evenness index of the community (J') was calculated as following:

$$J' = \frac{\sum_{i=1}^{S} p_i \ln(p_i)}{\ln(S)}$$

We also computed basal areas of each species (*Ba*), species densities (*D*), relative species densities (*RD*) and relative dominance (*RDo*) using the following formula:

$$D = \frac{n_i}{A}$$

Where n_i is the number of individuals of species *i* and A the surveyed area:

$$RD = \left(\frac{ni}{N}\right) \times 100$$

Where n_i is the number of individuals of species or family *i* and N the total number of individuals of all species or families.

$$RD_o = \frac{Ba_i \times 100}{\sum_{i=1}^{S} Ba_i}$$

Where Ba_i is the basal area of all individual trees belonging to a particular species *i*.

The floristic structure was examined by Importance Value Index (IVI), which is the sum of relative density, relative dominance and relative frequency of a species (Padalia *et al.* 2004), where relative frequency is number of plots where a species is found/total number of plots. For all families, we determined Family Importance Value

Table 1. Families importance index values for the study area. Ba = basal area (m² ha^{-1}); RD = relative density; RDo = relative dominance; RDi = relative diversity; FIV = family importance value.

Family	Genera	Species	Ba	RD	RDo	RDi	FIV
Alangiaceae	1	1	0.30	1.77	1.45	1.43	4.64
Annacardiaceae	1	1	0.65	0.66	3.07	1.43	5.16
Apiaceae	1	1	0.01	0.02	0.04	1.43	1.49
Apocynaceae	3	3	1.21	7.16	5.73	4.29	17.18
Aquifoliaceae	1	1	0.04	0.15	0.19	1.43	1.77
Araliaceae	2	2	2.70	5.21	12.83	2.86	20.90
Asteraceae	1	1	0.00	0.02	0.01	1.43	1.46
Bignoniaceae	2	2	0.16	0.29	0.76	2.86	3.91
Celastraceae	1	1	0.25	2.57	1.19	1.43	5.18
Chrysobalanaceae	2	2	1.54	1.55	7.34	2.86	11.75
Clusiaceae	4	4	1.08	2.84	5.12	5.71	13.68
Cornaceae	1	1	0.03	0.15	0.12	1.43	1.70
Cyatheaceae	1	1	0.02	0.14	0.11	1.43	1.68
Dracaenaceae	1	2	0.11	1.77	0.54	2.86	5.16
Ericaceae	1	1	0.02	0.77	0.09	1.43	2.29
Euphorbiaceae	4	4	2.20	25.14	10.46	5.71	41.31
Flacourtiaceae	2	2	0.08	0.43	0.37	2.86	3.66
Icacinaceae	1	1	0.01	0.03	0.02	1.43	1.48
Lauraceae	2	2	0.46	0.65	2.21	2.86	5.71
Meliaceae	3	3	1.51	5.98	7.16	4.29	17.43
Melianthaceae	2	2	0.21	1.17	1.02	2.86	5.04
Mimosaceae	2	2	0.38	0.80	1.83	2.86	5.49
Monimiaceae	1	1	0.30	4.61	1.42	1.43	7.46
Moraceae	2	4	1.36	6.37	6.47	5.71	18.55
Myrsinaceae	3	3	0.16	1.34	0.76	4.29	6.39
Myrtaceae	2	2	3.19	7.96	15.15	2.86	25.97
Olacaceae	1	1	0.87	4.70	4.12	1.43	10.25
Oleaceae	1	1	0.05	0.17	0.26	1.43	1.86
Proteaceae	1	1	0.56	4.37	2.67	1.43	8.46
Rhizophoraceae	1	1	0.05	0.29	0.22	1.43	1.94
Rosaceae	2	2	0.24	1.20	1.14	2.86	5.20
Rubiaceae	4	4	0.33	2.32	1.58	5.71	9.61
Rutaceae	3	3	0.12	0.58	0.58	4.29	5.45
Sapotaceae	3	3	0.40	1.38	1.90	4.29	7.57
Sterculiaceae	1	1	0.01	0.17	0.07	1.43	1.67
Stilbaceae	1	1	0.15	3.20	0.70	1.43	5.32
Theaceae	2	2	0.28	2.06	1.31	2.86	6.23

Table 2. Shannon and evenness index by transect.

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16
H'	2.48	2.18	2.59	2.73	1.80	2.59	2.49	2.89	2.80	2.74	2.85	2.66	2.93	2.42	2.88	2.68
J'	0.78	0.81	0.79	0.78	0.56	0.77	0.75	0.86	0.83	0.82	0.83	0.77	0.88	0.85	0.86	0.87

(FIV), which is the sum of relative density, relative dominance and relative diversity, where relative diversity is number of species of family i/total number of species (Mori *et al*. 1983).

A species cumulative curve was produced using EstimateS (Colwell 2009) in order to estimate species richness of the study area and the exhaustivity degree of the sampling.

Results

Tree species richness and diversity

The total number of trees recorded was 6,504 belonging to 70 species, 37 families and 67 genera (Tables 1 & 2). Figure 3 shows the species accumulative curve. Tree density was 202 stems ha^{-1}, with a basal area of 21.05 m^2 ha^{-1} and a mean dbh of 28.9 cm. Seventeen families were represented by a single species each, eleven families were represented by two species each, five families were represented by three species each, and four families were represented by four species each (Table 1). The Shannon-Weiner index (H') and evenness index (J') were important with respectively 3.18 and 0.75 as values. Index values for each transect from south to north are given in Table 2. More than 88 % of the species areas were discovered in the sampled. Since the sampling was not homogeneously conducted across the whole park, additional species are supposed to grow inside.

Forest structure

The highest relative density encountered was 20.79 for *Macaranga kilimandscharica* which yields an absolute density of 42.05 stems ha^{-1} (Appendix Table 1). This species could be considered as the most abundant in Kibira forest. The second abundant species was *Syzygium guineense* with a relative density of 7.90 and 15.99 stems ha^{-1}. The third abundant species was *Tabernaemontana stapfiana* with 6.46 for relative density and 13.9 stems ha^{-1}. In terms of dominance, the highest relative dominance was 14.95 for *Syzygium guineense*, which yields an absolute basal area of 3.15 m^2 ha^{-1}. This was followed by *Polyscias fulva* with a relative dominance of 12.80 and a basal area of 2.69 m^2 ha^{-1}. The third dominant species was *Macaranga kilimandscharica* with a relative dominance of 8.33 and a basal area of 1.75 m^2 ha^{-1}. Stem abundance was inversely proportional to the diameter sizes. As the diameter increased, there was a decrease in the number of stems (Fig. 4).

The highest important value index (IVI) recorded in our study site was 94.3 for *Macaranga kilimandscharica*, followed by *Syzygium guineense* and *Polyscias fulva* with an IVI of 72.5 and 71.5, respectively.

Euphorbiaceae family had the highest relative density (25.4), followed by Myrtaceae (7.96) and Apocynaceae (7.16) (Table 1). However, the family with the highest relative dominance was Myrtaceae (15.15), with a basal area of 3.19 m^2 ha^{-1}. This was followed by Araliaceae with a relative dominance of 12.83 and a basal area of 2.70 m^2 ha^{-1}. The third family was Euphorbiaceae, with a relative dominance of 10.46 and a basal area of 2.20 m^2 ha^{-1}.

The highest family importance value (FIV) observed was 41.31 for Euphorbiaceae, followed by Myrtaceae (25.97) and Araliaceae (20.90).

Discussion

The results of this study revealed that floristic diversity of Kibira forest is very close to other Albertine Rift forests. The Euphorbiaceae family was the most abundant in this study. It is consistent with the results of Eilu *et al*. (2004) in four forests of Uganda (Bwindi Impenetrable National Park, Kasyoha-Kitomi Forest Reserve, Kibale National Park and Budongo Forest Reserve), where the Euphorbiaceae family had the largest number of tree species, by taking into account trees of dbh $\geq$ 10 cm. In Nyungwe forest (Rwanda), contiguous with Kibira, existing data are based on inventory of trees with a dbh $\geq$ 30 cm (Plumptre *et al*. 2002). Euphorbiaceae was also the most abundant family in Nyungwe. Considering trees of diameter $\geq$ 30 cm, *Syzygium guineense* was the most abundant tree species in both forests. However, tree density in our study site (202 stems ha^{-1}, for trees $\geq$ 10 cm dbh) is low when compared to Uganda forests (344 - 577 stems ha^{-1}). Compared with the results of Eilu *et al.* (2004) and Swamy *et al*. (2000) in tropical forests, tree density and basal area in Kibira forest are relatively low. According to Sundarapandian (1997), the low density and basal area could be attributed to the degree of disturbance, which affects species composition, age structure, and successional stage of the forest. Following Paijmans (1970), Proctor *et al*. (1983), Butynski (1990); Swamy *et al*. (2000), structure and composition of tropical forest trees vary considerably not only between forests, but also between different sites within the same forest. Chapman *et al*. (1997),

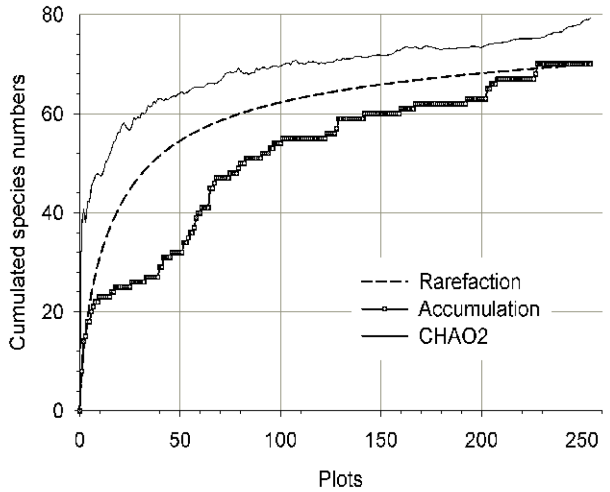

Fig. 3. Cumulative number of species. CHAO2 is a non-parametric species richness estimator of Chao (1984, 1987). It converges faster than the observed number to the maximum species number. Here, its maximum value is 79.

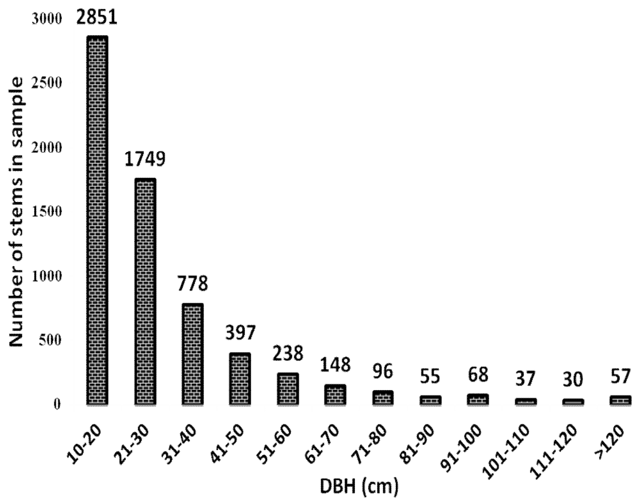

Fig. 4. Distribution of trees in diameter classes.

Rakotomalaza & Messmer (1999) and Eilu *et al.* (2004) noted that slight changes in soil composition, altitude, rainfall and temperature contribute to spatial differences in forest composition. Determination of attributes responsible for the success of abundant species compared to the rare species of the same community remains still difficult (Connell & Lowman 1989; Hart *et al.* 1989).

Furthermore, we pointed out that 54 % of tree species in Kibira forest have less than one stem ha^{-1}. Pitman *et al.* (2001) observed similar distributions in Amazonian forests.

The stem abundance and number of species decreased with increasing dbh in this study. Similar results were obtained elsewhere, e.g. by Parthasarathy and Karthikeyan (1997) and Swamy *et al.* (2000) in India.

Referring to Plumptre *et al.* (2002) results, we found *Oricia renieri* and *Pentadesma reyndersii* tree species to be endemic to the Albertine Rift and *Ixora burundiensis* probably endemic to the Albertine Rift. At Nyungwe forest, 10 tree species (*Beilschmiedia michelsonii* , *Cassipourea ndando*, *Cassipourea ndando*, *Harungana Montana*, *Lobelia petiolata*, *Oricia renieri*, *Peddiea rapaneoides*, *Pentadesma reyndersii*, *Pittosporum mildbraedii*, *Rubus runssorensis and Tarenna rwandensis*) are identified to be endemic to the Albertine Rift and 14 species (*Ixora burundensis*, *Lobelia stuhlmanii, Lovoa brownie*, *Mimulopsis excellens*, *Pavetta pierlotii*, *Peddiea orophila*, *Philippia johnstonii*, *Psychotria palustris*, *Pycnostrachys goetzenii*, *Rytigynia kigeziensis*, *Tricalysia kivuensis*, *Vernonia kirungae*, *Warneckea walikalensis* and *Zeyherelle rwandense*) to be probably endemic to Albertine Rift.

Conclusion

The study site is a protected national park; therefore preservation of this forest is crucial not only for conservation of its rich tree diversity, but also for the long-term survival of primate it harbors. As in other sites surveyed, chimpanzees in the Kibira National Park select particular tree species for nest building. Therefore, attention must be given to the conservation of the twelve preferred tree species (*Parinari excelsa*, *Carapa grandiflora*, *Strombosia scheffleri*, *Ekebergia capensis*, *Beilschmiedia rwandensis*, *Aningeria adolfi-friderici*, *Ardisia kivuensis*, *Newtonia buchananii*, *Casearia runssorica, Ocotea michelsonii*, *Prunus africana* and *Strophanthus bequaertii*) in management plan of the park, because of the likely impact for the long-term conservation of Kibira's primates, particularly chimpanzees.

As the local communities depend on that forest for some of their needs, conservation awareness-raising and education actions have to focus in nearby villages from where are probably coming illegal hunters, poachers or other forest users as suggested by Gandiwa *et al.* (2014). Growing some fast-growing native trees in the vicinity of the settlement, would be helpful for local communities, and would reduce their dependence on forest resources.

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Appendix Table 1. Density (stems ha^{-1}); mean dbh; basal area (Ba: m^2 ha^{-1}) and importance value index (IVI) of different tree species occurring in the study site.

Families	Scientific names	Density	dbh	Ba	IVI
Alangiaceae	*Alangium chinense* (Lour.) Harms	3.58	29.30	0.30	21.6
Annacardiaceae	*Ozoroa reticulata* (Baker f.) R. & A. Fern.	1.34	65.12	0.65	11.9
Apiaceae	*Steganotaenia araliacea* Hochst.	0.03	60.00	0.01	0.4
Apocynaceae	*Pleiocarpa pycnantha* (K.Schum.) Stapf	1.31	27.73	0.09	3.8
Apocynaceae	*Strophanthus bequaertii* Staner & Michotte	0.09	60.40	0.03	1.8
Apocynaceae	*Tabernaemontana stapfiana* Britten	13.09	28.68	1.08	46.8
Aquifoliaceae	*Ilex mitis* (L.) Radlk.	0.30	39.36	0.04	2.7
Araliaceae	*Polyscias fulva* (Hiern) Harms	10.45	48.57	2.69	71.5
Araliaceae	*Schefflera abyssinica* (Hochst.ex A.Rich.)Harms	0.09	26.76	0.01	1.2
Asteraceae	*Solanecio mannii* (Hook.f.) C.Jeffrey	0.03	32.17	0.00	0.4
Bignoniaceae	*Kigelia africana* (Lam.) Benth.	0.50	51.66	0.14	5.6
Bignoniaceae	*Markhamia lutea* (Benth.) K. Schum.	0.09	46.70	0.02	1.3
Celastraceae	*Maytenus acuminata* (L.f.) Loes	5.19	21.66	0.25	19.4
Chrysobalanaceae	*Hirtella montana* Spirlet	0.87	33.44	0.09	7.1
Chrysobalanaceae	*Parinari excelsa* Sabine	2.27	75.07	1.46	22.5
Clusiaceae	*Harungana madagascariensis* Poir.	0.03	27.10	0.00	0.4
Clusiaceae	*Hypericum revolutum* Vahl.	0.03	14.50	0.00	0.4
Clusiaceae	*Pentadesma reyndersii* Spirlet	0.47	65.01	0.17	2.2
Clusiaceae	*Symphonia globulifera* Lin.f.	5.23	39.10	0.90	33.4
Cornaceae	*Afrocrania volkensii (Harms) Hutch.*	0.31	29.42	0.03	1.4
Cyatheaceae	*Alsophila manniana* (Hook.) R.M.Tryon	0.28	21.09	0.02	2.6
Dracaenaceae	*Dracaena afromontana* Mildbr.	1.68	13.91	0.03	4.1
Dracaenaceae	*Dracaena steudneri* Engl.	1.90	21.79	0.08	17.0
Ericaceae	*Erica johnstonii* (Schweinf. ex Engl.) Dorr	1.56	12.32	0.02	2.4
Euphorbiaceae	*Bridelia brideliifolia (*Pax) Fedde	1.34	18.09	0.04	6.7
Euphorbiaceae	*Macaranga kilimandscharica* Pax	42.05	35.33	1.75	94.3
Euphorbiaceae	*Neoboutonia macrocalyx* Pax	6.66	22.25	0.32	31.0
Euphorbiaceae	*Sapium ellipticum* (Hochst.ex Krauss) Pax	0.81	30.09	0.09	5.1
Flacourtiaceae	*Casearia runssorica* Gilg	0.78	31.43	0.08	6.6
Flacourtiaceae	*Lindackeria kivuensis* Bamps	0.09	13.37	0.00	0.8
Icacinaceae	*Apodytes dimidiata* E.Mey.ex Arn.	0.06	30.25	0.01	0.8
Lauraceae	*Beilschmiedia rwandensis* R.Wilczek	1.09	66.98	0.44	9.3
Lauraceae	*Ocotea michelsonii* Robyns & R. Wilczek	0.22	38.26	0.03	2.2
Meliaceae	*Carapa grandiflora* Sprague	9.46	26.52	0.73	38.6
Meliaceae	*Ekebergia capensis* Sparrm.	1.43	55.90	0.46	14.2
Meliaceae	*Entandrophragma excelsum (*Dawe & Sprague) Sprague	1.21	46.36	0.31	7.5
Melianthaceae	*Bersama abyssinica* Fresen.	2.33	28.80	0.21	17.8
Melianthaceae	*Erythrina abyssinica* Lam. ex DC.	0.03	12.00	0.00	0.4
Mimosaceae	*Albizia gummifera* (J.F.Gmel.) C.A.Sm.	1.03	34.38	0.14	10.2
Mimosaceae	*Newtonia buchanani* (Baker) Glbert & Boutique	0.59	56.34	0.24	5.0

Contd...

Appendix Table 1. Continued.

Families	*Scientific names*	Density	dbh	Ba	IVI
Monimiaceae	*Xymalos monospora* (Harv.) Baill. ex Warb.	9.33	18.61	0.30	37.7
Moraceae	*Ficus exasperata* Vahl.	0.19	36.00	0.00	0.5
Moraceae	*Ficus ovata* Vahl.	0.03	20.00	0.00	0.4
Moraceae	*Ficus thonningii* Blume	0.03	37.97	0.03	2.5
Moraceae	*Myrianthus holstii* Engl.	12.63	30.25	1.33	45.0
Myrsinaceae	*Ardisia kivuensis* Taton	0.65	34.79	0.07	4.6
Myrsinaceae	*Embelia schimperi* Vatke	1.37	19.36	0.05	4.5
Myrsinaceae	*Maesa lanceolata* Forssk.	0.68	21.42	0.03	6.7
Myrtaceae	*Eucalyptus saligna* Smith	0.12	59.50	0.04	0.6
Myrtaceae	*Syzygium guineense* (Willd.) DC.	15.99	40.34	3.15	72.5
Olacaceae	*Strombosia scheffleri* Engl.	9.52	29.29	0.87	40.1
Oleaceae	*Schrebera alata* (Hochst.) Welw.	0.34	36.36	0.05	2.8
Proteaceae	*Faurea saligna* Harvey	8.83	25.26	0.56	18.0
Rhizophoraceae	*Cassipourea ruwenzoriensis* (Engl.) Alston	0.59	28.63	0.05	6.0
Rosaceae	*Hagenia abyssinica* (Bruce) J.F.Gmel.	2.21	21.34	0.10	8.2
Rosaceae	*Prunus africana* (Hook.f.) Kalkm.	0.22	82.39	0.14	3.5
Rubiaceae	*Chassalia subochreata* (De Wild.) Robyns	0.68	40.95	0.17	7.4
Rubiaceae	*Galiniera saxifraga* (Hochst.) Bridson	3.36	20.05	0.13	17.1
Rubiaceae	*Ixora burundiensis* Bridson	0.40	20.77	0.02	1.5
Rubiaceae	*Rytygynia kivuensis* (Krause) Robyns.	0.25	16.55	0.01	2.5
Rutaceae	*Oricia renieri* G.Gilbert	0.34	16.26	0.01	2.2
Rutaceae	*Teclea nobilis* Del.	0.72	27.98	0.07	6.2
Rutaceae	*Zanthoxylum gilletii* (De Wild.) Waterm.	0.12	61.50	0.04	1.4
Sapotaceae	*Aningeria adolfi-friderici* (Engl.) Robyns & G.C.C. Gilbert	1.37	29.53	0.15	9.6
Sapotaceae	*Chrysophyllum gorungosanum* Engl.	0.96	35.99	0.13	7.7
Sapotaceae	*Uknown.* Sp	0.47	50.91	0.13	4.7
Sterculiaceae	*Dombeya goetzenii* K. Schum.	0.34	21.36	0.01	3.4
Stilbaceae	*Nuxia floribunda* Benth.	6.47	16.03	0.15	14.4
Theaceae	*Ficalhoa laurifolia* Hiern	2.27	32.52	0.22	9.6
Theaceae	*Melchioria schliebenii* (Melchior) Kobuski	1.90	16.87	0.05	5.5