



SECTION 7: PLANTS



Giant Lobelia, Rwenzori Mountains.. A. Plumptre, WCS

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7.1 SUMMARY

A total of 5,793 plant species were compiled from lists and floras for the Albertine Rift. This number is about 14.5% of plant species in mainland Africa and about 23% of the Guineo-congolian, Afromontane and Zambesian phytochoria that form most of the Albertine Rift. Data for 22 sites where reasonable collections had been made contained 5,573 species (96% of the total). A total of 567 species endemic to the Albertine Rift have been tentatively identified but this is a work in progress and the number may change over time. However, we believe that we have identified most of the endemic species. Virunga National Park has the largest number of endemic species (230) of which 124 are found in the Virunga Volcanoes with Kahuzi Biega National Park (145) and Nyungwe Forest (137) in second and third place. Bwindi Impenetrable National Park and Budongo Forest Reserve have the largest number of threatened (CR/EN/VU) species (18) with Kasyoha-Kitomi Forest third (17). If data deficient and lower risk species are included, Budongo ranks highest (24) with Bwindi (22) and Kasyoha-Kitomi (21) in second and third places respectively. Reasonable collections of all plant groups were compiled for 14 sites. Trees have been more widely studied, however, and 22 sites had reasonable lists for this group. Whether trees or all plants were analysed, 90% could be protected in seven sites with over 97% of endemic species protected in these sites also. Twelve sites are required to protect all endemic and threatened plants from the 14 sites where relatively complete lists exist and 10 sites are required to protect all endemic and threatened trees.

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Au total, 5.793 espèces de plantes ont été compilées sur base des listes et la flore du Rift Albertin. Ce chiffre représente environ 14,5% d'espèces de plantes du continent Africain et environ 23% du biome Guinée-Congo, l'Fromontagne et du "phytochoria" qui forment le plus, le Rift albertin. Les données de 22 sites où les collections acceptables ont été faites contiendraient 5.573 espèces(96% du total). Un total de 567 espèces endémiques au Rift Albertin ont été provisoirement identifiées mais c'est un travail en progression et les chiffres peuvent changer à tout moment. Néanmoins, nous croyons que nous avons identifié la plupart des espèces endémiques. Le Parc National des Virunga a le nombre élevé d'espèces endémiques (230) dont 124 se retrouvent dans les volcans des Virunga et le Parc National de Kahuzi-Biega (145) et la forêt de Nyungwe (137), respectivement en deuxième et troisième place. Le Bwindi Impenetrable National Park et Budongo Forest Reserve ont le nombre élevé (18) d'espèces les menacées (CR/EN/VU) avec Kasyoha-Kitomi Forest (17), le troisième. Si les critères de l'UICN (Data deficiency et Lower risk species) sont pris en compte, Budongo Forest Reserve est de plus loin le premier (24), Bwindi Impenetrable National Park (22) et Kasyoha-Kitomi (21) en deuxième et troisième places. Les collections acceptables de tous les groupes de plantes ont été compilées pour 14 sites. Les arbres ont été largement étudiés et 22 sites avaient des listes acceptables, pour ce groupe. Même si les arbres ou toutes les plantes étaient analysés, 90% seraient protégés dans sept sites avec plus de 97% d'espèces endémiques protégées. Douze des 14 sites où les listes relativement complètes existent sont importants pour protéger toutes les plantes endémiques et menacées, et 10 sites sont importants pour protéger tous les arbres endémiques et menacés.

7.2 INTRODUCTION

Plant composition is what defines most habitats in the world and this in turn defines the presence or absence of many species of animal. Consequently we felt it was important to attempt to assess plant diversity in the Albertine Rift, although the effort in compiling species lists was considerably greater than any of the other taxa. Trees have been better surveyed than other life forms of plants in the Albertine Rift. However, many of the sites in the Albertine Rift are montane or submontane and hence do not have a great diversity of tree species. We felt it was important therefore to include all herbs, climbers and shrubs where possible so that the plant diversity was better reflected. Plant lists were compiled for as many sites as we could obtain good information, for all flowering plants, gymnosperms and ferns. Only one site had information on mosses and liverworts so these were omitted from the database.

7.3 INFORMATION SOURCES

A variety of sources were used to compile plant lists for the 22 sites where surveys had taken place. These are listed below by country. The authors of this chapter have also contributed many unpublished records.

Uganda

The main starting point for Uganda was the tree surveys undertaken by the Uganda Forest Department (Howard and Davenport, 1996). Additional data was added by G. Eilu (climbers) A. Poulsen (1997 - terrestrial herbs) and D. Hafashimana for epiphytes for several forests. The Wildlife Conservation Society has also been surveying many of the rift forests over the past year and the species identified were incorporated in the database (D. Nkuutu). Lock (1977) provided a list of species for Queen Elizabeth National Park. Nabanyumya (1991) listed trees for Kalinzu and Maramagambo forests. Synnott (1985) provided a checklist of plants for Budongo Forest Reserve.

Rwanda

Plant species lists for the Virunga Volcanoes were obtained from Burt (1934), Robyns (1948-1955), the Herbarium at the Karisoke Research Station and Troupin (1978-1988). Plant species for Nyungwe were compiled from Troupin (1978-1988), Troupin (1992), Plumptre *et al.* (2002) and the herbarium at the Projet Conservation de la Forêt de Nyungwe.

DR Congo

Robyns (1948-1955) provided a relatively complete list for Virunga National Park and Fischer (1996) provided a list for Kahuzi Biega national Park.

Burundi

No plant lists were obtained for sites in Burundi.

Tanzania

A list of plants of Gombe was provided by Roy Gereau from his surveys there. Toshisada Nishida kindly provided a list of plants eaten by chimpanzees for Mahale Mountains National Park. Additional species for Mahale were obtained from Vollesen and Bidgood (1996) and Vollesen and Bidgood (1999). A species list for Mbizi forest was compiled from Mwasumbi (2000) and a list of collections by Ruffo and Kisena (1987).

Zambia

No plant lists have been compiled for sites in Zambia as yet.

Many of the plant species listed in the above publications are synonyms of existing names. Lebrun and Stork (1991-1997) was used to correct synonyms to a standardised list of names.

A list of endemic plants to the Albertine Rift was compiled by Paul Ssegawa, Andrew Plumptre and Ewango Ndomba using the List of East African Plants (LEAP), the Flora of Tropical East Africa, the Flora du Congo, du Rwanda et du Burundi, Flore du Cameroun, and Flora Zambesiaca. Species names were also standardised using Lebrun and Stork (1991-1997). Henk Beentje, David Goyder and Tim Pearce helped comment on species in families that have not been published in these floras. This list is very much a provisional list as new species are still being discovered regularly and because not all families have been checked thoroughly.

7.4 RESULTS

7.4.1 Species richness

A total of 5,793 species of plant were identified as occurring in the 22 sites for which data were compiled. This is 14.5% of the total number of the estimated 40,000 plant species found on the mainland of Africa (Davis, Heywood and Hamilton, 1994). Of these 5,793 plants, 821 were trees, 499 grasses, 186 climbers, 360 ferns and the rest were other herbs and shrubs. Much of the Albertine rift is part of the Guineo-Congolian phytochorion with parts of the Afromontane and Zambezian phytochoria. These phytochoria are estimated to have 12,000, 4,000 and 8,500 species respectively (Davis, Heywood and Hamilton, 1994). The Albertine Rift therefore contains at least 23.6% of the flora of these three phytochoria. Virunga National Park had the largest species list with 2,077 species (Table 7.1) followed by Bwindi Impenetrable National Park (1,405 species) and Mahale Mountains National Park (1174 species). However only 14 sites had reasonable species lists of non-tree

species and so analyses of the sites with good data for trees were made separately from the sites with total species lists. The richest site for tree species was Budongo Forest Reserve (449 species) followed by Kalinzu-Maramagambo forests (442 species) and Kasyoha-Kitomi Forest Reserve (419 species).

7.4.2 Endemism

A total of 567 endemic plant species have been identified to date for the Albertine Rift region as defined in figure 1.1. Eleven near endemic species, which occur further south in Zambia towards Lake Malawi, could be considered but for the analyses here they have been omitted. Virunga National Park contains the most number of endemic species (230) with Kahuzi Biega National park (145 species) and Nyungwe Forest (137 species) ranking second and third respectively. The Virunga Volcanoes, part of which occurs within the Virunga National Park, has 124 endemic species and contributes greatly to the richness of endemics in this park (Table 7.1). Only 495 of these 567 endemic species (87.3%) occurred in the sites for which we compiled data.

Table 7.1 The total number of species compiled, number of tree species, number of Albertine Rift (AR) endemic species, number of threatened species and total number of IUCN-listed species. Virunga National Park is divided into five sectors due to its size and habitat types and numbers are given separately for each sector as well as the total. *= reasonably surveyed for all plants groups (incl. ferns, herbs, climbers and shrubs).

| Site | Species no. | No. Tree species | AR endemic species | Threatened CR,EN, VU | IUCN listed species |
|------------------------------|-------------|------------------|--------------------|----------------------|---------------------|
| Murchison Falls NP | 149 | 145 | 1 | 5 | 8 |
| Budongo FR * | 1064 | 449 | 29 | 18 | 24 |
| Bugoma FR | 256 | 245 | 7 | 12 | 14 |
| Kagombe FR | 211 | 201 | 3 | 5 | 9 |
| Kitechura FR | 113 | 108 | 2 | 0 | 2 |
| Matiri FR | 113 | 105 | 2 | 2 | 3 |
| Itwara FR | 258 | 248 | 7 | 10 | 15 |
| Semliki NP | 333 | 318 | 7 | 14 | 18 |
| Rwenzori Mountains NP * | 696 | 199 | 55 | 5 | 7 |
| Kibale NP * | 532 | 330 | 16 | 12 | 17 |
| Kasyoha-Kitomi FR * | 901 | 419 | 41 | 17 | 21 |
| Kalinzu-Maramagambo FR * | 787 | 442 | 34 | 12 | 17 |
| Queen Elizabeth * | 950 | 288 | 22 | 5 | 7 |
| Bwindi Impenetrable NP * | 1405 | 393 | 74 | 18 | 22 |
| Mafuga FR | 115 | 100 | 7 | 2 | 2 |
| Echuya FR * | 423 | 131 | 32 | 1 | 2 |
| Virunga Volcanoes * | 878 | 81 | 124 | 4 | 5 |
| Virunga south * | 510 | 58 | 45 | 0 | 1 |
| Virunga central * | 863 | 120 | 44 | 2 | 2 |
| Virunga Rwenzori * | 537 | 80 | 99 | 2 | 2 |
| Virunga north * | 326 | 77 | 36 | 2 | 3 |
| Virunga Total * | 2077 | 264 | 230 | 10 | 10 |
| Nyungwe Forest * | 1105 | 230 | 137 | 7 | 9 |
| Kahuzi Biega National Park * | 1171 | 218 | 145 | 9 | 12 |
| Gombe NP * | 510 | 112 | 12 | 0 | 2 |
| Mahale Mountains NP * | 1174 | 220 | 39 | 9 | 12 |
| Mbizi/Ufipa * | 765 | 76 | 30 | 1 | 1 |

7.4.3 Threatened species

Two categories of threatened species were analysed: 1. threatened (including critically threatened, endangered and vulnerable) and 2. all IUCN-listed species (CR, EN, VU and lower risk and data deficient species). Species conservation status was taken from the IUCN red list of threatened species (Hilton-Taylor, 2000). This is currently a conservative list and mainly includes plant species being used commercially. It is currently being updated to produce a more comprehensive list of species. A total of 40 species are threatened and 51 are IUCN-listed in the Albertine Rift. Budongo Forest and Bwindi Impenetrable National Park have the largest number of threatened species (18) with Kasyoha-Kitomi Forest Reserve running a close second (17). Similarly these three forests rank as the highest three for IUCN-listed species with 24, 22 and 21 threatened species respectively (Table 7.1).

7.4.4 Complementarity analysis

A complementarity analysis was made of both the total plant data set (14 sites) and the total tree data set (22 sites). The analysis selected those sites with the highest number of endemic (Albertine Rift and near-endemic) and IUCN-listed species (all categories) initially until all of these species had been selected and then selected those sites that contributed the most number of additional species.

Virunga National Park was selected first followed by Kahuzi Biega National Park and Mahale Mountains National Park for the total plant data set. These three sites accounted for 64.9% of all plants at the 14 sites and 84.2% of endemic and threatened species. Twelve sites were necessary to protect all endemic and threatened plants in at least one site and all 14 sites were necessary to protect all plant species. However, these sites only contained 47 threatened species out of the 51 found at all sites and 380 endemic species of the 567 found within the Albertine Rift. Bwindi Impenetrable National Park, Nyungwe Forest and Budongo Forest Reserve were the first three sites to be selected respectively for the tree data set. These three sites contributed 77.7% of the total number of trees and 84.6% of endemic and threatened trees. Ten sites were required to protect all endemic and threatened trees in at least one site and 21 of the 22 sites were required to protect all tree species (Table 7.2).

Once again the complementarity analyses select sites at both ends of the Albertine Rift (Budongo FR (north) and Mahale Mountains NP (south)). In both cases, however, two sites, which have montane floras, are selected as the first two sites indicating that it is the montane forests that have more of the endemic and threatened species.

7.4.5 Cluster analyses

A cluster analysis was performed on both the tree data set and the total plant data set. As the Virunga Park is large and extends over several habitat types it was subdivided into 5 sectors (volcanoes, south, central, Rwenzori and northern sectors) and these separate areas were included in the cluster analyses.

The clusters for the total plant data set group into five main groups (Fig. 7.1). These are: 1. low-mid altitude forests (Budongo, Kibale, Kasyoha-Kitomi, Kalinzu-Maramagambo and Bwindi); 2. mainly high altitude forests (Rwenzori (Uganda and DRC), Echuya, Virunga Volcanoes and Virunga south – Gombe, Mbizi/Ufipa and Virunga north are in this group also); 3. Mahale Mountains park forms its own group; 4. Nyungwe and Kahuzi Biega form a group of medium altitude forests in the center

of the Albertine Rift; and 5. the savanna sites (Queen Elizabeth, Virunga central and all the Virunga National Park).

Table 7.2 Results of the complementarity analysis indicating the minimum number of sites that together would maximise the number of plants and also the number of trees.

| All plant species (14 sites) | | | Tree species (22 sites) | | |
|------------------------------|---------------|----------------|-------------------------|---------------|----------------|
| Sites | Species added | ARE/IUCN added | Sites | Species added | ARE/IUCN added |
| Virunga Park | 2077 | 240 | Bwindi Impenetrable NP | 397 | 46 |
| Kahuzi Biega NP | 692 | 82 | Nyungwe Forest | 95 | 22 |
| Mahale Mountains NP | 850 | 36 | Budongo FR | 178 | 9 |
| Budongo Forest | 423 | 18 | Virunga NP | 46 | 7 |
| Mbizi/Ufipa | 467 | 16 | Mahale Mountains NP | 38 | 2 |
| Nyungwe Forest | 180 | 16 | Kasyoha-Kitomi FR | 21 | 1 |
| Bwindi Impenetrable NP | 374 | 7 | Murchison Falls NP | 18 | 1 |
| Gombe Stream NP | 110 | 4 | Kahuzi Biega NP | 16 | 1 |
| Kasyoha-Kitomi FR | 92 | 2 | Semliki NP | 11 | 1 |
| Kibale NP | 13 | 2 | Rwenzori Mountains NP | 9 | 1 |
| Queen Elizabeth NP | 172 | 1 | Mbizi/Ufipa | 10 | 0 |
| Rwenzori Mountains NP | 59 | 1 | Queen Elizabeth NP | 8 | 0 |
| Echuya FR | 46 | 0 | Gombe Stream NP | 3 | 0 |
| Kalinzu-Maramagambo FR | 18 | 0 | Kibale NP | 2 | 0 |
| | | | Echuya FR | 2 | 0 |
| | | | Kalinzu-Maramagambo FR | 2 | 0 |
| | | | Itwara FR | 2 | 0 |
| | | | Kagombe FR | 1 | 0 |
| | | | Kitechura FR | 1 | 0 |
| | | | Matiri FR | 1 | 0 |
| | | | Mafuga FR | 1 | 0 |

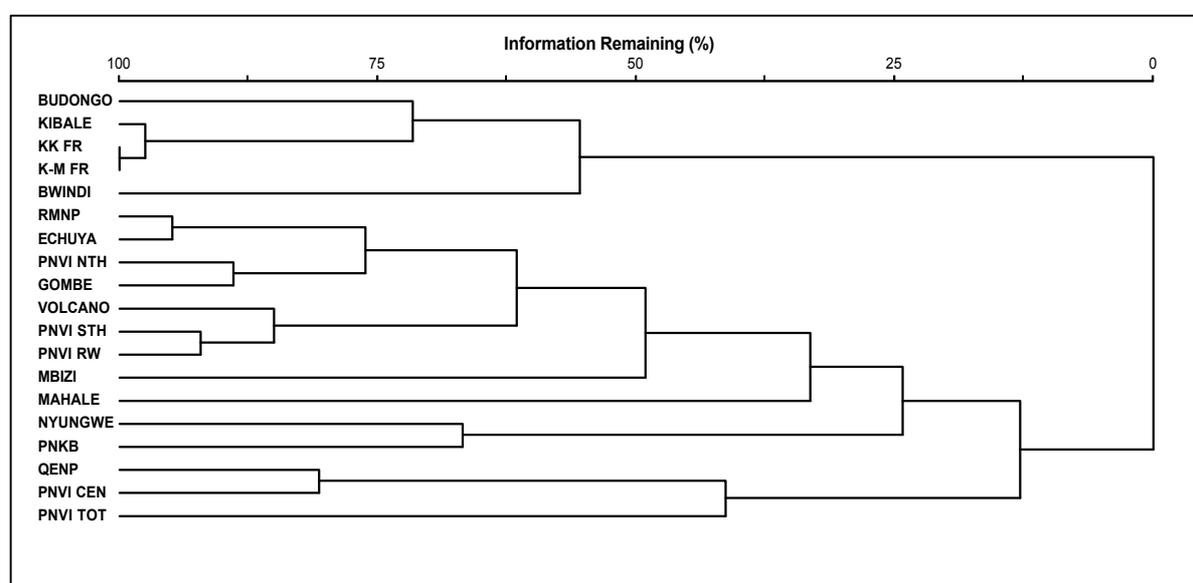


Figure 7.1 A cluster dendrogram for the total plant data set. The Virunga National Park (PNVi) is separated into five subsectors (Volcanoes, south – PNVi sth, central – PNVI cen, north – PNVI nth and Rwenzori – PNVI RW). QENP=Queen Elizabeth park, PNKB=Kahuzi Biega park, KK=Kasyoha-Kitomi Forest Reserve, K-M=Kalinzu-Maramagambo forests, RMNP=Rwenzori mountains park.

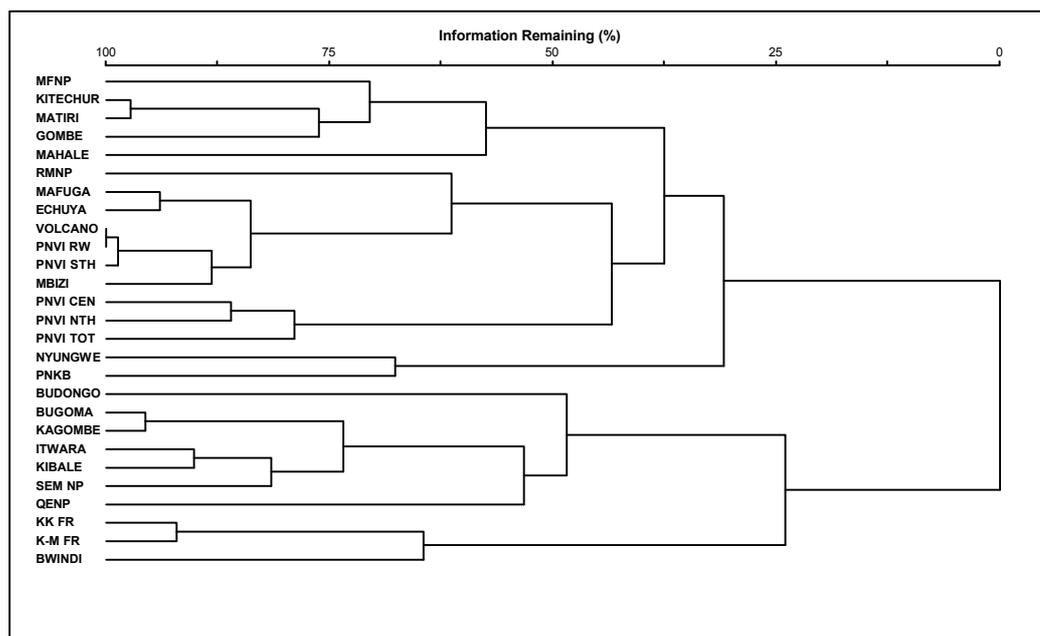


Figure 7.2 Cluster dendrogram for the sites with reasonable lists of tree species. The Virunga National Park (PNVi) is separated into five subsectors (Volcanoes, south – PNVi sth, central – PNVi cen, north – PNVi nth and Rwenzori – PNVi RW). MFNP=Murchison Falls Park, QENP=Queen Elizabeth Park, PNKB=Kahuzi Biega Park, SEM=Semliki, KK=Kasyoha-Kitomi Forest Reserve, K-M=Kalinzu-Maramagambo forests, RMNP=Rwenzori Mountains Park.

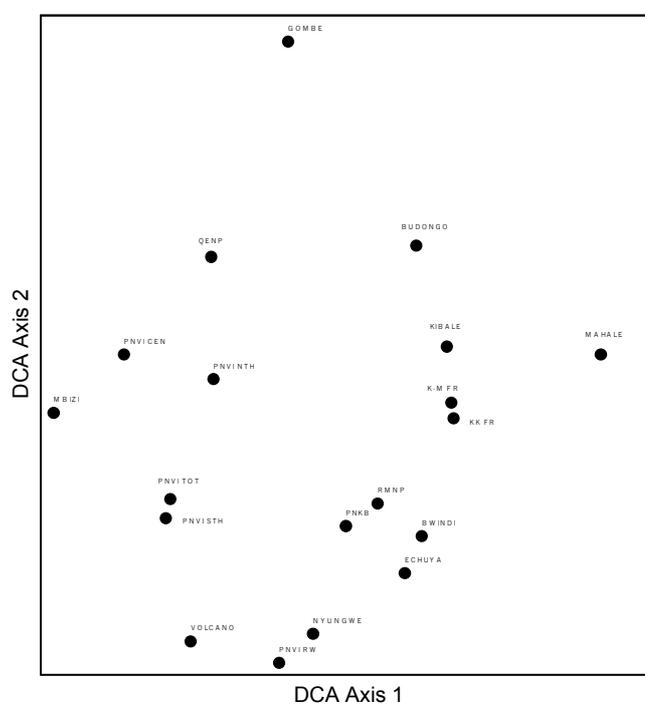


Figure 7.3 The first two axes of a detrended correspondence analysis of the total plant data set. Points that are close to each other are more closely related in species composition.

The cluster analysis for the tree data set for the 22 sites (and 5 sectors of Virunga park) forms roughly six groups (Figure 7.2): 1. Woodland sites with lower altitude scrubby forest (Murchison Falls, Kitechura, Matiri, Gombe and Mahale); 2. High altitude forests (Rwenzori (Uganda and DRC), Mafuga, Echuya, Virunga Volcanoes, Virunga south and again Mbizi/Ufipa); 3. Virunga central, north and the whole Virunga park form a cluster; 4. Nyungwe and Kahuzi Biega also form a cluster again; 5. Lower altitude forest and woodland (Budongo, Bugoma, Kagombe, Itwara, Kibale, Semliki and Queen Elizabeth); 6. Forests in sw Uganda (Kasyoha-Kitomi, Kalinzu-Maramagambo and Bwindi).

7.4.6 Ordination of sites

For the case of the plants ordinations were carried out to assess the associations of sites separately to the cluster analyses. Detrended correspondence analysis was used to ordinate the two data sets using detrending by segments. The first two axes were plotted to show the associations between sites visually

The data for the total plant species shows that the three sites in Tanzania are very different and explain much of the variation in the data set. This is probably because there are several species that have been newly identified at these sites and these help to differentiate them because they are not found at other sites.

The ordination of the tree data shows a closer relationship between the three Tanzanian sites although Mbizi/Ufipa is still pretty distinct. The first DCA axis separates the higher altitude forests on the right from the lower altitude and savanna woodland sites on the left.

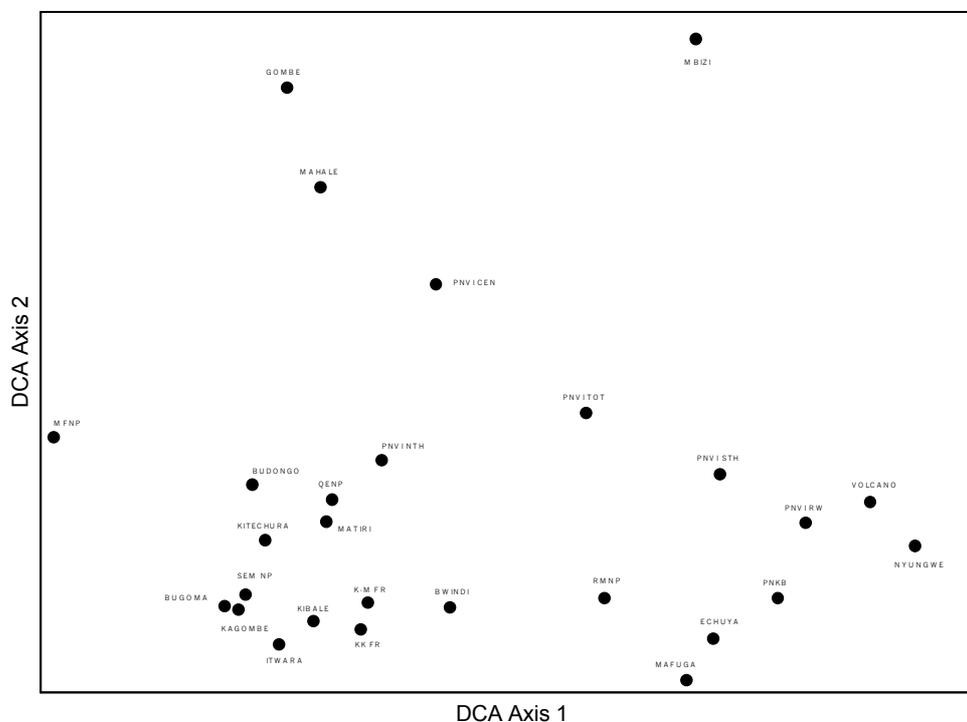


Figure 7.4 The first two axes of a detrended correspondence analysis of the tree data set. Points that are close to each other are more closely related in species composition.

7.5 DISCUSSION

Linder (1998) identified the western rift mountains as an area of high species richness and endemism for 794 species of plants. This study compiled lists for many more species and confirms that the Albertine Rift is an important site for endemic species and total species diversity. It is also very clear how little is known about the plant composition of much of the Albertine Rift. Many sites had few plants listed in the floras and consequently were not analysed here. With time and funds more species would be certainly added to these lists if the herbaria with collections could be catalogued and collection sites identified. The sites with high tree species richness were forests in Uganda that have been fairly intensively surveyed. These are unlikely to represent true richness, as it would be expected that the lowland forest in Kahuzi Biega and northern Virunga parks would be found to have more species if collections were made.

However with the lists we have Virunga National Park ranks highest in terms of species numbers and in numbers of endemic and threatened species because of its large size and diverse habitats. Kahuzi Biega National Park and Nyungwe Forest are important sites also but are similar floristically so that if one site is selected in the complementarity analysis the other does not appear until later. Bwindi Impenetrable National Park is important for endemic and threatened tree species and Mahale Mountains National Park also is important in terms of plant diversity. Studies of plant diversity in sub-Saharan Africa show that western and southern Tanzania and northern Zambia is a region of high plant diversity (Lebrun and Stork, 1991-1997) and hence it is not surprising that Mahale has a high diversity.

Several sites in the rift need surveying because they could potentially be important sites. In particular the Itombwe Massif should be surveyed because it is rich in other taxa (both diversity and endemism). Similarly the Marungu Massif and Mt Kabobo could be important sites for endemic species as these areas have been isolated from other parts of the rift and most likely have new species to science. The northern sector of Virunga Park has not been surveyed very intensively and has fewest species for any of the five sectors despite being lowland tropical forest that would be expected to be most species rich. The flora (Robyns, 1948-1955) for this park does not include ferns either. Consequently the numbers of plants for this park could increase much further. The lowland sector of Kahuzi Biega national park probably has many more species than the current list also.

Figure 7.5 summarises the results using GIS. Plant species richness is relatively evenly spread along the rift while tree species richness is much higher in the lower elevation forests in Uganda. Endemism is higher nearer the central part of the Rift but threatened species mirror the pattern on the tree species richness. This is because most threatened plants are trees, which have economic value.

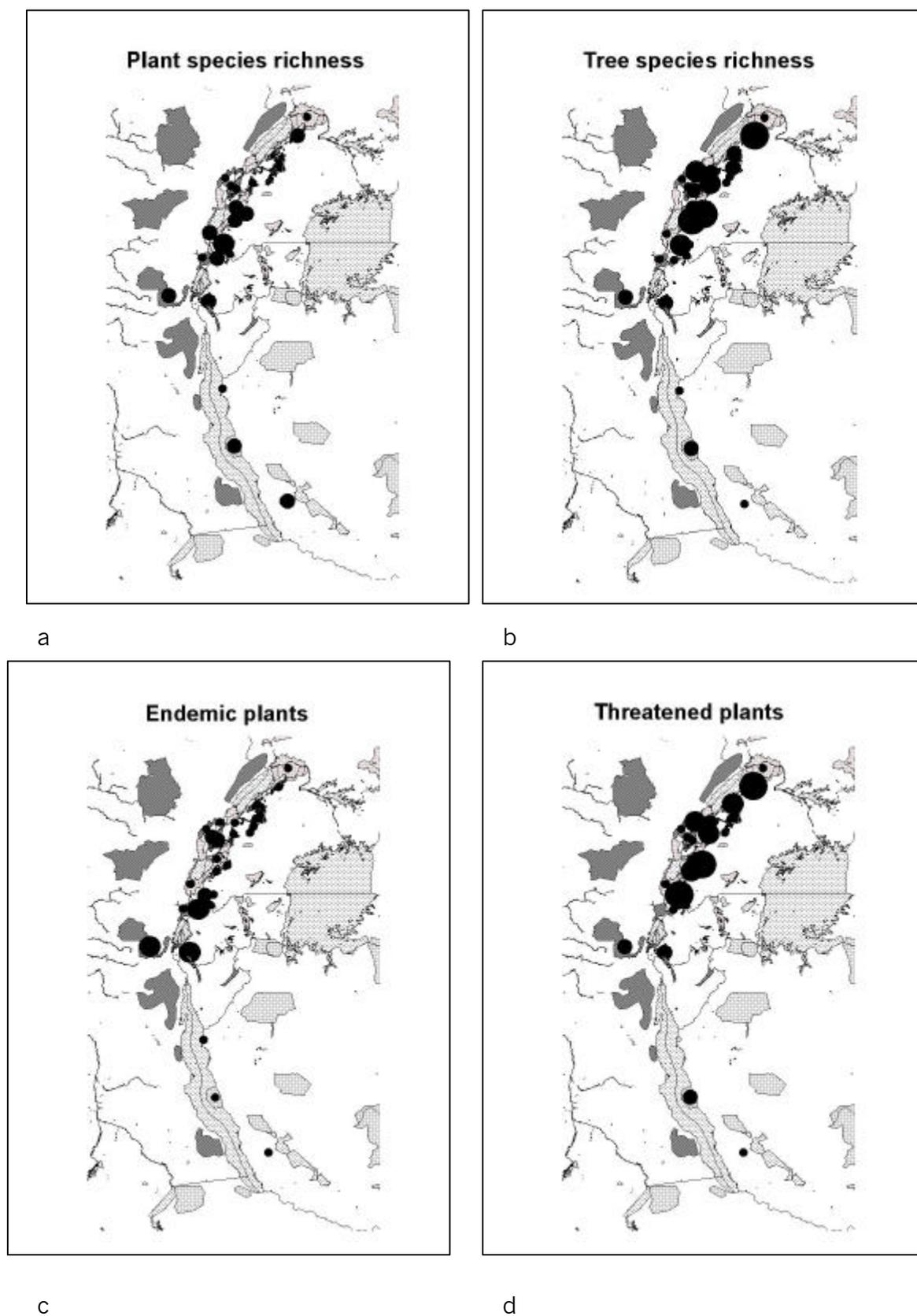


Figure 7.5 A summary of the results for the plant data represented geographically. Each site that has non-zero data is represented by a circle of varying size depending on the number of species. a) Total plant species richness; b) Tree species richness; c) endemic plants; d) threatened plants (CR, EN and VU).