Conservation status of the vascular plants in East African rain forests

Dissertation

Zur
Erlangung des akademischen Grades
eines
Doktors der Naturwissenschaft
des
Fachbereich 3: Mathematik/Naturwissenschaften
der
Universität Koblenz-Landau

vorgelegt
am 29. April 2011
von Katja Rembold
geb. am 07.02.1980 in Neuss

Referent: **Prof. Dr. Eberhard Fischer**
Korreferent: **Prof. Dr. Wilhelm Barthlott**

Conservation status of the vascular plants in East African rain forests

Dissertation

Zur
Erlangung des akademischen Grades
eines
Doktors der Naturwissenschaft
des
Fachbereich 3: Mathematik/Naturwissenschaften
der
Universität Koblenz-Landau

vorgelegt
am 29. April 2011
von Katja Rembold
geb. am 07.02.1980 in Neuss

Referent: **Prof. Dr. Eberhard Fischer**
Korreferent: **Prof. Dr. Wilhelm Barthlott**

Early morning hours in Kakamega Forest, Kenya.

TABLE OF CONTENTS

1 - GENERAL INTRODUCTION

Tropical rain forests are not only among the most species rich and diverse habitats on earth (e.g. Barthlott *et al.* 1996; Barthlott *et al.* 2005; Barthlott *et al.* 2007), they also present an important source of natural products such as timber wood, food, and medicinal plants which are indispensable for the economy as well as the everyday life of the human population worldwide. This high potential of use possibilities causes the conflict that many people on the one hand depend on the persistence of the forest and its products, but on the other hand destroy it by over-exploitation. Commercial logging for instance causes yearly an immense loss of natural rain forest cover, often even within conservation areas (e.g. Asner *et al.* 2005), and while logging is a rather quick process it will take at least many decades until the forest recovers (Aide *et al.* 1995; Zou *et al.* 1995). At the same time other rain forest treasures like the medicinal possibilities are today still far from being exhausted (Herndon and Butler 2010) what often results in an underestimation of the forest value.

Another factor threatening the persistence of the incredible biodiversity of tropical rain forests is the global climate change (Sommer *et al.* 2010). Up to about 40% of the species of continental Africa might disappear till 2100 due to climatic changes and the diversity-rich regions might become restricted to retreat areas in tropical lowland wetlands and afrotropical mountains (Sommer 2008). These areas are of particular priority for the setup of sustainable conservation strategies.

But threat No. 1 for the continued existence of tropical rain forests is not climate change but habitat loss (incl. agriculture, logging, commercial development), often intensified by over-exploitation and invasive alien species (Hilton-Taylor *et al.* 2009). This habitat loss is often free from any intentions of utilizing the forest products but is associated with the high and rapidly increasing human population especially in the often fertile tropical areas: 20% of the human world population lives within the boundaries of biodiversity hot spot which cover only 12% of the earth's terrestrial surface (Cincotta *et al.* 2000).

This conflict of interest requires the development of conservation strategies, but while the species numbers are highest in the tropics, our knowledge about biodiversity richness is much higher in the temperate areas (Collen *et al.* 2008) what often makes sustainable conservation projects in tropical regions difficult. Schaanker and Ganeshaiah (2010) summarize this problem by stating that "there is not enough science to realize all the actually intended nature conservation actions". This thesis means to contribute to the amount of science available for the realization of conservation strategies.

1.1 BIODIVERSITY AND HUMAN IMPACT ON EAST AFRICAN RAIN FORESTS

East African rain forests are among the most species rich areas of the entire African continent (Küper *et al.* 2004a; Mutke and Barthlott 2005). The reason for the high diversity is concealed in the unique geologic and climatologic histories inducing continual increases and decreases of forest areas (Lovett and Wasser 1993). During a pre-12,000 B.P. arid phase the forests in East Africa were shrinking into small refugial areas and are since then in a state of constant isolation and expansion (Hamilton 1981; Couvreur *et al.* 2008).

Today tropical rain forests in Eastern Africa are of small size and show rather insular characteristics, but it is generally agreed that the forests in the Rift Valley are remains of a once connected central African rain forest belt (Trapnell and Langdale-Brown 1962; Hamilton 1974). These isolated forest fragments contain many endemic or rare plant and animal species (Chapman and Chapman 1996a). In comparison to the large guineo-congolian rain forests in West Africa, the small fragmented forests in East Africa have less species but more endemics what makes them being of higher conservation priority than the West African forests (Lovett and Wasser 1993).

There has been natural forest decline and fragmentation due to climatic factors in the past, but today the decrease of forest area in Africa is attributed to human impact (Trapnell and Langdale-Brown 1962). Due to the high population pressure about 10-20% of East African forests have already been transferred into cultivated land (Lovett and Wasser 1993). Further reasons for forest decrease are commercial and illegal logging, the creation of space for exotic tree plantations, fuel wood extraction, establishing of grazing land for domestic animals, fire clearings, charcoal production, and others (Kokwaro 1988; Oyugi 1996; Plumptre 1996; Lung and Schaab 2004; Bleher *et al.* 2006; Guthiga and Mburu 2006, Schaab *et al.* 2010). These manifold use possibilities create the impression that the best profit can be made by forest destruction, but at the same time the forest presents an irreplaceable source for vital recourses such as fuel wood, building materials, medicinal plants, and bush meat (Chapman and Chapman 1996a; Muriithi and Kenyon, 2002). While the human population has to deal with the conflict between making money out of forest destruction and depending on forest products, numerous plant and animal species clearly depend on the continued existence of the forests. Even if a forest does not completely disappear, the various ways of forests disturbance and fragmentation demonstrably affect the species numbers and composition of forest plant and animal communities (Owiunji and Plumptre 1998; Brooks *et al.* 1999; Wagner 2000; Wagner 2001; Chapman and Chapman 2004) what highlights the importance of primary forest conservation.

The alarming speed of recent forest decline in East Africa, even within protected areas, requires the elaboration and fast implementation of sustainable conservation strategies. These are often impeded by the insufficient knowledge of the species concerned and the exact consequences of forest disturbance.

1.2 AFRICAN EPIPHYTES AND DISTURBANCE

Vascular epiphytes are a typical and important component of tropical rain forests and contribute considerably to tropical biodiversity (Kress 1986; Gentry and Dodson 1987; Nieder *et al.* 2001). By their various adaptations to an arboreal life like water and nutrient tanks and animal associations, epiphytes not only increase the canopy diversity by themselves, but also enable a huge variety of animals to colonize the treetops (Neill 1951; Nadkarni and Matelson 1989; Benzing 1998; Blüthgen *et al.* 2000; Kitching 2000; Lopez *et al.* 2005; Yanoviak *et al.* 2006; Rico-Gray and Oliveira 2007; Schmit-Neuerburg and Blüthgen 2007). Furthermore epiphytes enormously increase the plant biomass and are important for carbon uptake, water storage, and nutrient cycling of the forest ecosystem (Nadkarni and Matelson 1992; Ingram and Nadkarni 1993; Nadkarni 1994; Gradstein 2008; Fayle *et al.* 2009; Benzing 1998; Köhler *et al.* 2007; Díaz *et al.* 2010).

Growing on host trees (phorophytes) far away from nutrients and water stored in the soil, epiphytes enjoy the benefit of better light conditions than on the forest floor, but become very sensitive for changes in the microclimatic conditions (Benzing 1990; Nieder and Barthlott 2001). Forest disturbance can be one reason for climatic changes as under an opened canopy a higher amount of light reaches the forest floor what causes higher temperatures and evaporation rates. Their specialization to certain climatic conditions makes epiphytes susceptible to forest disturbance and it has been shown that forest disturbance often leads to decreasing epiphyte species numbers (Eggeling 1947; Barthlott *et al.* 2001; Köster 2008; Köster *et al.* 2009).

By far the highest epiphyte diversity is found in the Neotropics, followed by tropical Asia while tropical Africa is comparably poor of epiphytes (Gentry and Dodson 1987; Benzing 1990). Accordingly most studies on epiphytes are carried out in Neotropical regions (e.g. Kreft *et al.* 2004; Küper *et al.* 2004b) while only few studies focus on African epiphytes.

Neotropical epiphyte studies report more than 600 epiphyte species (Köster 2008), but species numbers of comparable studies in African rain forests rank between 100 and 167 species (Eggeling 1947; Johansson 1974; Biedinger and Fischer 1996; Schaijes and Malaisse 2001; Engwald 2004; Zapfack and Engwald 2008). Also the species composition of African epiphyte communities differs from the Neotropics: while Bromeliaceae and Cactaceae are important Neotropical epiphyte families, they are mainly absent in Africa (Heywood *et al.* 2007) where the epiphyte communities are dominated by orchids and ferns (Johansson 1974; Benzing 1990).

1.3 PLANT CONSERVATION

Since the "Earth Summit" in Rio de Janeiro in 1992, the reduction of biodiversity loss became a global aim (Baillie *et al.* 2008). Today we know about 300.000 accepted plant species (The Plant List 2010). It would hardly be possible to include all these species in conservation projects and not all of these plants are endangered. Thus, sustainable conservation projects need to focus on the endangered species and that makes it necessary to find out which species that might be. Numerous national and international institutions already developed several strategies for the estimation of the conservation status of species. A comprehensive review of these strategies is provided in Welk (2001; 2002).

The probably best known evaluation system for the assessment of the global and regional extinction risk of species is provided by the International Union for Conservation of Nature (IUCN) and their Red List of Threatened Species™ contains extinction risk assessments for almost 56,000 species (Gärdenfors *et al.* 2001; IUCN 2001; IUCN 2003; Rodrigues *et al.* 2006; IUCN 2010). Their elaborate categories and criteria as well as the extensive and easily accessible online database present very useful tools, but in its actual stage the applicability of the IUCN Red List for conservation purposes is limited. Today only 4% of the described plants species are recorded in the IUCN Red List (Chapman 2009; IUCN 2010) what inevitable means that the extinction risk is unknown for the majority of species. Even considering the recorded species, their global extinction risk alone is insufficient for setting conservation priorities (IUCN 2003; Vié *et al.* 2009a). Furthermore the IUCN categories and criteria are not appropriate at very small scales like single forest systems (Vié *et al.* 2009a) and, like other assessment strategies, require detailed and long term observations (Welk 2001; 2002) which are often not available for tropical areas. In case of conservation status assessments for little know forest systems like in the present study, the available estimation strategies are often not appropriate.

EX-SITU CONSERVATION

Probably the most effective and important form of conservation is to protect plant and animal species within their natural habitat (in-situ) where they find all the biotic and abiotic conditions needed. However, often in-situ conservation is not possible or cannot guarantee the survival of particularly endangered species and in these cases, ex-situ conservation (= outside the natural habitat) becomes necessary to support species survival in the wild (Hamilton 1994; Cochrane *et al.* 2007). Ex-situ conservation alone has limited possibilities, but it presents an important supporting measure for in-situ conservation (Barthlott *et al.* 2000; Rauer *et al.* 2000). After species survival is ensured, the ex-situ conservation collections can serve as source for stabilization of the wild populations or reintroduction of the species in their natural habitat. The Convention on Biological Diversity (CBD) dedicates an entire article (Article 9) of the convention to the importance of ex-situ conservation for the realization of the CBD 2010 target to significantly reduce biodiversity loss until 2010 (Rauer *et al.* 2000; UNEP 2002). However, the CBD 2010 target has not been met as the risk of biodiversity loss is increasing rather than decreasing (Hilton-Taylor *et al.* 2009) what makes conservation programs more important than ever before.

The most important institutions for ex-situ conservation are Botanical Gardens (or in case of animals, Zoological Gardens). The traditional functions of Botanical Gardens include teaching, research, public relations, environmental education, and nowadays, their importance for nature conservation, such as conservation cultures of endangered plants, has become more and more important (Barthlott *et al.* 2000; Havens *et al.* 2006). Today Botanical Gardens worldwide present ex-situ treasures of plant diversity concentrated in very limited spaces cultivating one third of all described flowering plants (Barthlott *et al.* 2000).

Most Botanical Gardens are located in wealthy European and North American countries, but the highest species richness is usually found in developing countries (Barthlott *et al.* 1996; Barthlott *et al.* 2000). An expansion of ex-situ cultivations in Botanical Gardens in the countries of origin of the plants would support the sustainable implementation of species survival not only in cultivation, but also in their natural habitat as reintroduction would be much easier this way.

In context of the BIOTA East Africa project a Botanical Garden was funded at the Maseno University in Western Kenya. Close to Maseno lies Kakamega Forest which is today heavily fragmented and the decrease of natural forest area, even within protected areas, clearly indicates the insufficiency of in-situ conservation here. Therefore, an ex-situ conservation culture of endangered plants from East African rain forests in general and particularly from Kakamega Forest is planned to be established at the Botanic Garden of the Maseno University.

1.4 AIMS OF THIS STUDY

This study aims to assess the conservation priority of the vascular plants in East African rain forests. The background of the present thesis is the establishment of an ex-situ culture for endangered lokal plants at the Botanical Garden of the Maseno University (Kenya). Since the knowledge about the vegetation of the concerned areas is very insufficient, Kakamega Forest (Kenya) and Budongo Forest (Uganda) were selected to serve as model forests and were extensively investigated regarding to their floristic inventory and the impact of forests disturbance. For the best possible practicability with regards to the ex-situ culture, this study used four main approaches (Figure 1.1):

1. To learn more about the floristic inventory of the two model forests especially with regards to their vulnerability to forest disturbance (chapter 3), three main questions were investigated: 1) what is the species inventory and abundance of the two forests considering all vascular plants? 2) How does forest disturbance affect species numbers and composition? 3) Which species can serve as indicators for either disturbed or undisturbed forest?
2. Vascular epiphytes are known to be very sensitive for changes in their microclimatic conditions including those caused by forest disturbance. Since this sensibility makes them highly important for conservation purposes, the second field phase focused on epiphytes (chapter 4) following three main aims: 1) investigation of the epiphyte species inventory within the study areas, 2) estimation of the influence of forest disturbance on epiphyte diversity and composition, and 3) comparison to other studies on inner and outer African epiphyte communities.
3. For the sustainable application and implementation of the achieved data for the ex-situ cultivation it was necessary to assess the conservation priority of the concerned plant species (chapter 5). Since the existent global and national rating systems are not applicable for single forests with many unknown factors and the global extinction risk is unknown for the bigger part of the plants, this chapter aims 1) to develop a rating system for the conservation priority for the vascular plants within a small scale forest system and 2) to demonstrate the suitability of this system by taking the example of the two model forests.

4. Another aim of this study was the establishment of an initial plant collection for the ex-situ culture in Maseno Botanical Garden. Therefore chapter 6 provides a report about which processing steps already have been carried out as well as an outlook on the future development of the ex-situ project as discussed and planned together with the responsible authorities from Maseno University.

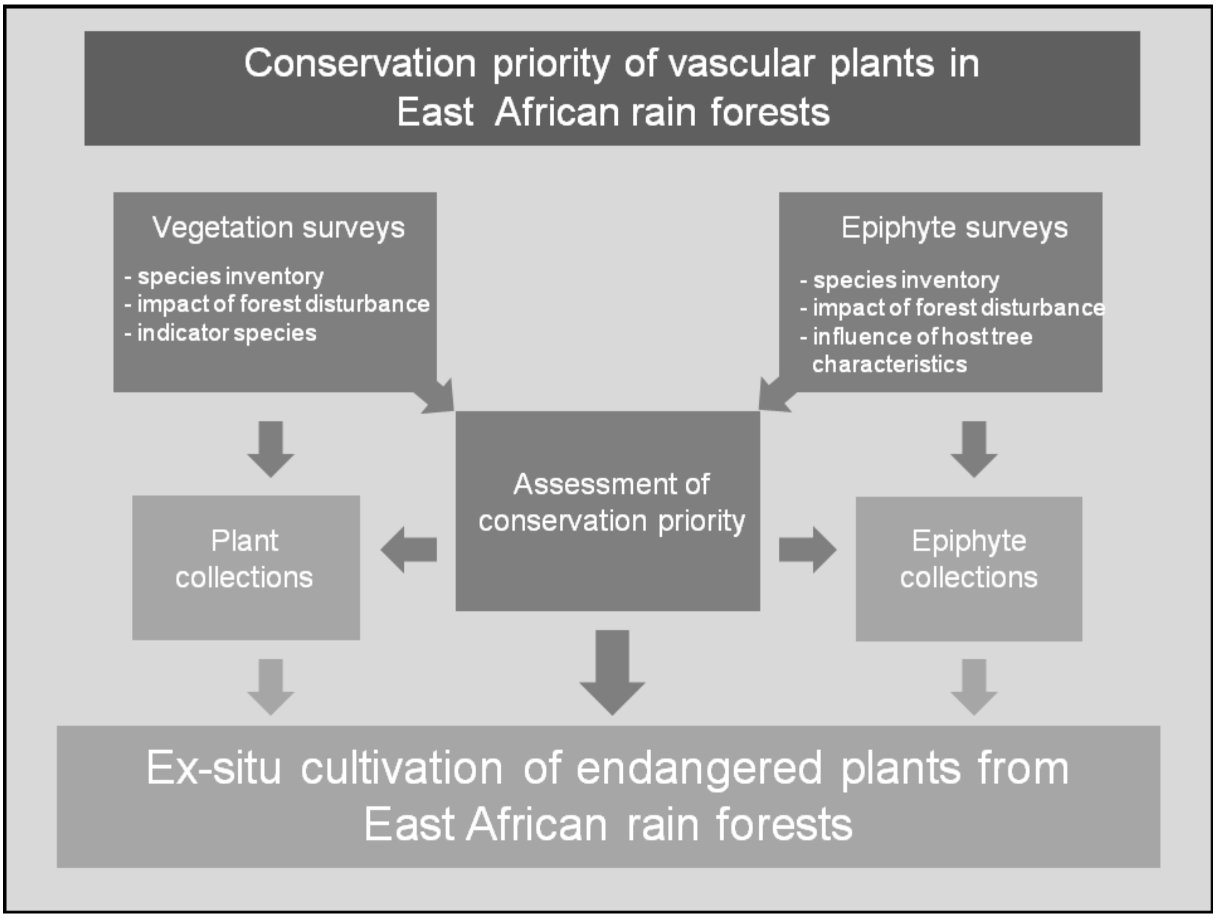

Figure 1.1 – Objective and structure of the present study. With the background of the establishment of an ex-situ culture of endangered vascular plants from East African rain forests, comprehensive vegetation surveys (including epiphytes) and the development of a rating system for the assessment of their conservation priority was required. Additionally initial plant collections create a basis for the ex-situ conservation.

The three main chapters (chapter 3 – 5) are intended for publication as contributed papers in peer-reviewed scientific journals (in revised form) and therefore the structure of the particular chapters follows the usual outline of scientific papers. To avoid repetition, a comprehensive description of the study sites is excluded from the aforementioned chapters and compiled in a separate introducing chapter (chapter 2).

2 - STUDY SITES

Today, tropical rain forests in Eastern Africa are of small size and show rather insular characteristics, but it is generally agreed that all forests in the Rift Valley, up to Kakamega Forest in the East, are only remains of a once connected central African rain forest belt (Trapnell and Langdale-Brown 1962; Hamilton 1974). Many endemic or rare plant and animal species remain in these forest fragments (Chapman and Chapman 1996a). African rain forests nowadays belong to two isolated systems: West African rain forests (guineo-congolian floral region) and East African rain forests (coastal forests and afromontane floral region) (White 1983; Couvreur *et al.* 2008).

While these days the decrease of forest area in Africa is attributed to human impact (Trapnell and Langdale-Brown 1962), there has been natural forest decline and fragmentation due to climatic factors in the past. During a pre-12,000 B.P. arid phase the forests in Africa were shrinking into small refugial areas and since then were always increasing and decreasing (Hamilton 1981; Couvreur *et al.* 2008). Based on the classification of Diamond (1981), East African forests can be divided into old refugial forests (= centers of endemism and species richness) and younger forests presenting analogies of "oceanic islands" (= poor in diversity and endemism).

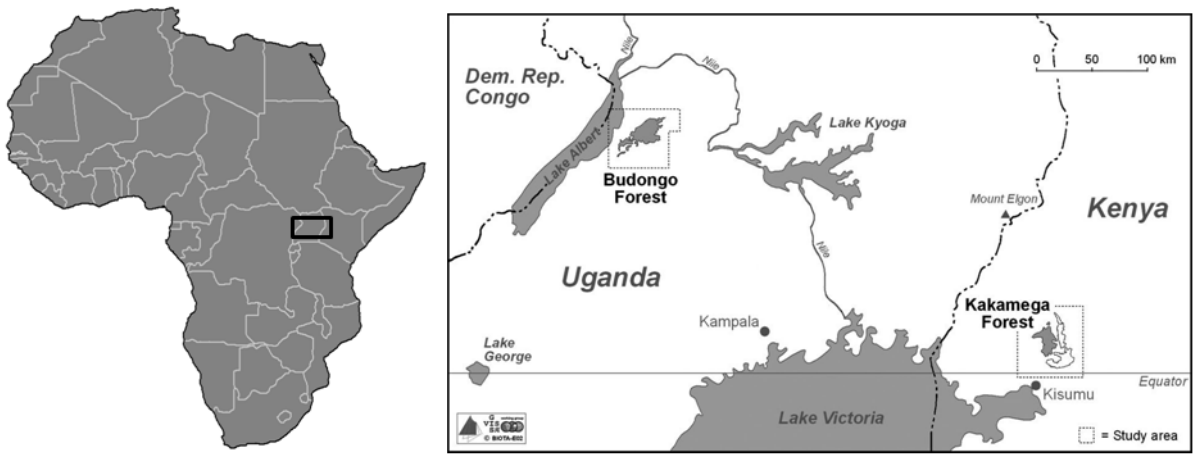

Figure 2.1: Location of the two study forests in Kenya and Uganda.

Representative for East African rain forests in general, the present study was carried out in two model forests: Kakamega Forest in Kenya and Budongo Forest in Uganda (Figure 2.1). Both forests are part of the great Rift Valley but would be rather classified as "oceanic islands" (Diamond 1981). As both forests are spaciously surrounded by farmlands and arid savanna areas, species exchange with other forests is inhibited. Although the two study forests are located in an elevation between 1100 and 1600 m above sea level (a.s.l.), they lack the typical mountainous climate as they are situated on a rather flat high plateau. This circumstance leads to an interesting combination of guineo-congolian lowland species and afromontane highland species.

2.1 KAKAMEGA FOREST, KENYA

"In Kenya, as elsewhere, the boundaries of forest reserves may theoretically only be changed by law. But in practice the boundaries of the natural forest within the reserves are being changed daily, by axes, pangas, bulldozers and matches."

(Tony Diamond 1979)

LOCATION AND ABIOTIC COMPONENTS

Kakamega Forest is located in the Western Province of Kenya, 35 km north-eastern of Kisumu near the Lake Victoria (Figure 2.2a). Situated on a high plateau in 1670 m elevation the mean annual temperature is 18.7 °C (H. Todt, unpublished data). The average precipitation amounts about 2000 mm evenly spread throughout the year (Gibbon 1994) with a rainy season from March to November (Figure 2.2b). This makes Kakamega Forest being among the areas with the highest precipitation in the whole of Kenya.

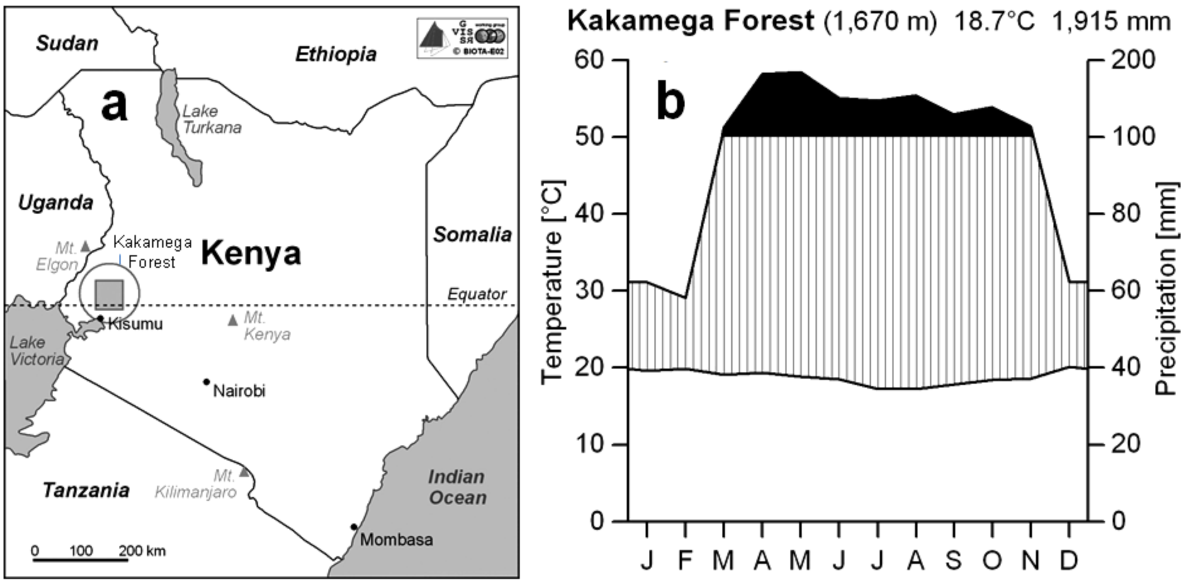

Figure 2.2: Location (a) and climate diagram (b) of Kakamega Forest in Western Kenya (source: (a) BIOTA E02 and (b) Todt unpublished data).

Officially, Kakamega Forest extents over an area of about 24,000 ha (Kokwaro 1988). However, this area does not comprise one large, integrated forest block, but combines several forest fragments (Figure 2.3). Close to the northern edge of the main forest lies the fragment called Kisere Forest which measures about 471 ha (Oyugi 1996). The main forest block is interrupted by many gaps and grasslands and reaches from the Buyango area in the north up to the Isecheno Nature Reserve in the south. Below, the main forest follows a southern fragment which is composed of the area around the Yala River Nature Reserve (~ 1000 ha, Oyugi 1996) and the area between Cherobani and Ikuywa.

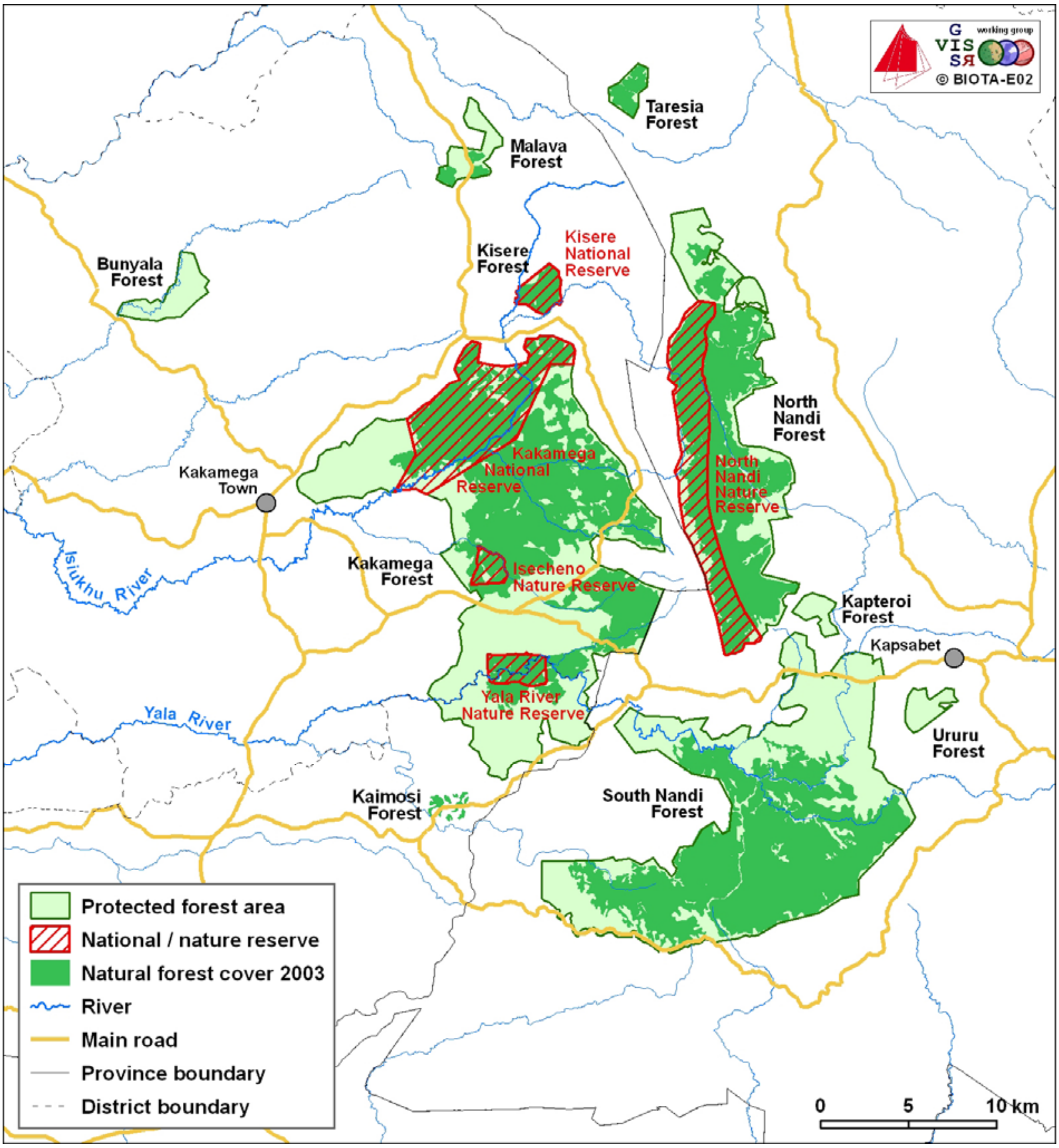

Figure 2.3: Map of Kakamega Forest and the adjacent Nandi Forest (Kenya) indicating official forest border, natural forest cover and Natural/Nature Reserves.

The forest fragments Malava Forest and Kaimosi, which are often considered as parts of Kakamega forest, were not included in this study as they are mainly composed of exotic timber plantations and the remnants of natural forest are too small for our vegetation survey.

IMPORTANCE OF KAKAMEGA FOREST FOR KENYAN BIODIVERSITY

Kakamega Forest is defined as dry peripheral semi-evergreen guineo-congolian transitional rain forest (Althof 2005). Beside the coastal forests in Eastern Kenya, Kakamega Forest is the only bigger part of lowland rainforest in the country and it is the only guineo-congolian rain forest in Kenya (Hamilton 1981; Deshmukh 1982; Kokwaro 1988). Due to its history of being the eastern most relict of an equatorial rain forest in Africa and its mid-altitude location, Kakamega Forest accommodates a unique composition of animal and plant species. Data on orchids, trees, amphibians, snakes, birds, and mammals showed that 10-20% of the plant and animal species from Kakamega Forest occur nowhere else in Kenya (Diamond 1979). Deshmukh (1982) suggests that this ratio is also valid for arthropods and other groups. The canopy height in Kakamega Forest amounts 25-30 m with emergent trees reaching heights up to 45m (Collar and Stuart 1988).

Unfortunately the humid and fertile area around Kakamega Forest is heavily overpopulated what causes an immense deforestation rate (Oyugi 1996). Tribal elder declared that before World War second the forest was 2-3 times as large as today and according to Kokwaro (1988) the increasing deforestation correlates with decreasing precipitation. This suggests serious changes on the vegetation in the remaining forests, even if the deforestation could be stopped. Large mammals like elephants (*Loxodonta africana* Blumenbach, 1797), the Cape buffalo (*Syncerus caffer* Sparrman, 1779), and the Uganda Kob (*Kobus kob* Erxleben, 1777) already disappeared from this forest (Kokwaro 1988). Four groups of the rare Brazza’s monkey (*Cercopithecus neglectus* Schlegel, 1876) are still known to live in Kakamega Forest, but already during their discovery 20 years ago it was stated that the forest is actually too small for a population of this size and that their habitat needs to be urgently protected (Muriuki and Tsingalia 1990).

The complete disappearance of Kakamega Forest would provide space for a few more shambas (small farms), but it would cause large scale problems concerning water supply and stop the income from ecotourism (Diamond 1979). Furthermore many animal and plant species would be lost for the whole of Kenya and some of them would vanish completely.

HISTORY, POPULATION PRESSURE, AND MANAGEMENT

It was already explained that Kakamega Forest is considered to be the eastern most remaining forest fragment of an ones continuous central African rain forest block. Strictly speaking this is not only true for Kakamega Forest, but also for the two Nandi forests Nandi North and Nandi South. In 1912/13 this three forests were connected to one large Kakamega-Nandi forest complex covering an area of about 80,000 ha. In the years between 1912/13 and 2003 the natural forest cover in the Kakamega-Nandi area has been reduced by more than 60 % (Schaab *et al.* 2010). Today this forest complex is divided into three main forests (Kakamega Forest, Nandi North, and Nandi South) and several small forest fragments (Figure 2.3).

The official protected forest area does not conform to the real forest cover (Figure 2.3). Diamond already observed in 1979 that of the official 238 km² forest area of Kakamega Forest only 115 km² were really covered by natural forest. For the combined Kakamega-Nandi forest complex a total of 53,794 ha is declared as protected forest area while only 64% of this area is covered by forest (Schaab *et al.* 2010). While the official forest borders remain stable over the years, the de facto forest cover is decreasing rapidly.

The greatest damage on the forest happened during the past 60 years. In the time frame between 1948 and 2003, 55% of forest cover got lost (Schaab *et al.* 2010). The main reason for this fast clearing speed was commercial logging and the creation of space for soft wood plantations for pulp mill productions (Oyugi 1996; Lung and Schaab 2004; Schaab *et al.* 2010). Even if cleared areas have been reforested, often exotic trees were planted instead of local tree species (Kigomo 1987) what changes not only the composition of the natural vegetation, but also influences water and soil conditions and the supply of many forest animals.

The reason for the ongoing forest loss in Kakamega is the high population pressure (Bleher *et al.* 2006; Guthiga and Mburu 2006). The high humidity and fertility of the area around Kakamega, compared to other Kenyan regions, results in Kakamega being the area with the highest population density in the country (Oyugi 1996; Lung and Schaab 2004). Even without large scale commercial use of the forest, the anthropogenous impact causes continuous forest lost due to transformation of forest into farmland, illegal logging, fuel wood extraction, establishing of grazing land for cattle and goats, extraction of medicinal plants, fire clearings, charcoal production and many more (Figure 2.4). Guthiga and Mburu (2006) counted 34,000 households in the area of Kakamega Forest and estimated that only the yearly extracted fire wood has a value of about 782.800 US$. With a population growth 4% per year (Oyugi 1996) it is not likely that the human pressure on the forest will bate in future. Several forest trees like *Prunus africana*, an important keystone species for forest animals, are already considered to be not able to regenerate naturally due to the limited number of fruiting trees (Kiama and Kiyiapi 2001). Nowadays the forest loss in Kakamega is not longer due to one big event, but due to many ongoing processes (Brooks *et al.* 1999).

Because of the high and ever increasing local human population and its side effects, Collar and Stuart already stated in 1988 that Kakamega Forest should become a National Park (Collar and Stuart 1988), but this advice has not been implemented so far. After all, at least some parts of the forest have the status of a nature reserve or national reserve (Figure 2.3). Already in 1967 the Isecheno Nature Reserve and the Yala Nature Reserve have been established. Later, in 1985, the Kakamega National Reserve and the Kisere National Reserve were added (Schaab *et al.* 2010). While the two national reserves are managed by the Kenyan Wildlife Service (KWS), the remaining forest (including the nature reserves) is managed by the Kenya Forest Service (KFS). The Kakamega National Reserve and the area around the Isecheno Natural Reserve are open for tourists. In both regions guides, trails and accommodation are available. In Isecheno the latter is provided by the Kakamega Environmental Education Program (KEEP). These services not only support the forest conservation organizations, but also provide regular income for the local population.

The KWS is known to be stricter than the other organizations. Though, in interviews the local population favorites the KWS as they want the forest to be effectively protected. At the same time they would like to profit from the forest and its products (Guthiga and Mburu 2006) what demonstrates the complex relation between population needs and conservation request.

During the past years the amount of illegally logged trees decreased within the national/nature reserves (Bleher *et al.* 2006). Unfortunately the reserves cover only a very small amount of the officially protected forest area and while the logging of timber trees might decrease, the amount of extracted fire wood rises with the increasing population. The demand for deadwood exceeds the availability of the like in Kakamega Forest. Consequently, in many areas the sounds of pangas are audible all day long which emanate from people not only breaking up deadwood, but also cutting down living trees for later removal.

One bright spot is that the deforestation speed seems to slow down. Diamond (1979) postulated that if the deforestation continues in the same speed than before there will be no forest left in 2008. The fact that there is still forest left in 2011 inspires hope that at least some parts of Kakamega forest will survive. Lung and Schaab (2006) even observed signs of forest regeneration in the north-east of Kakamega Forest.

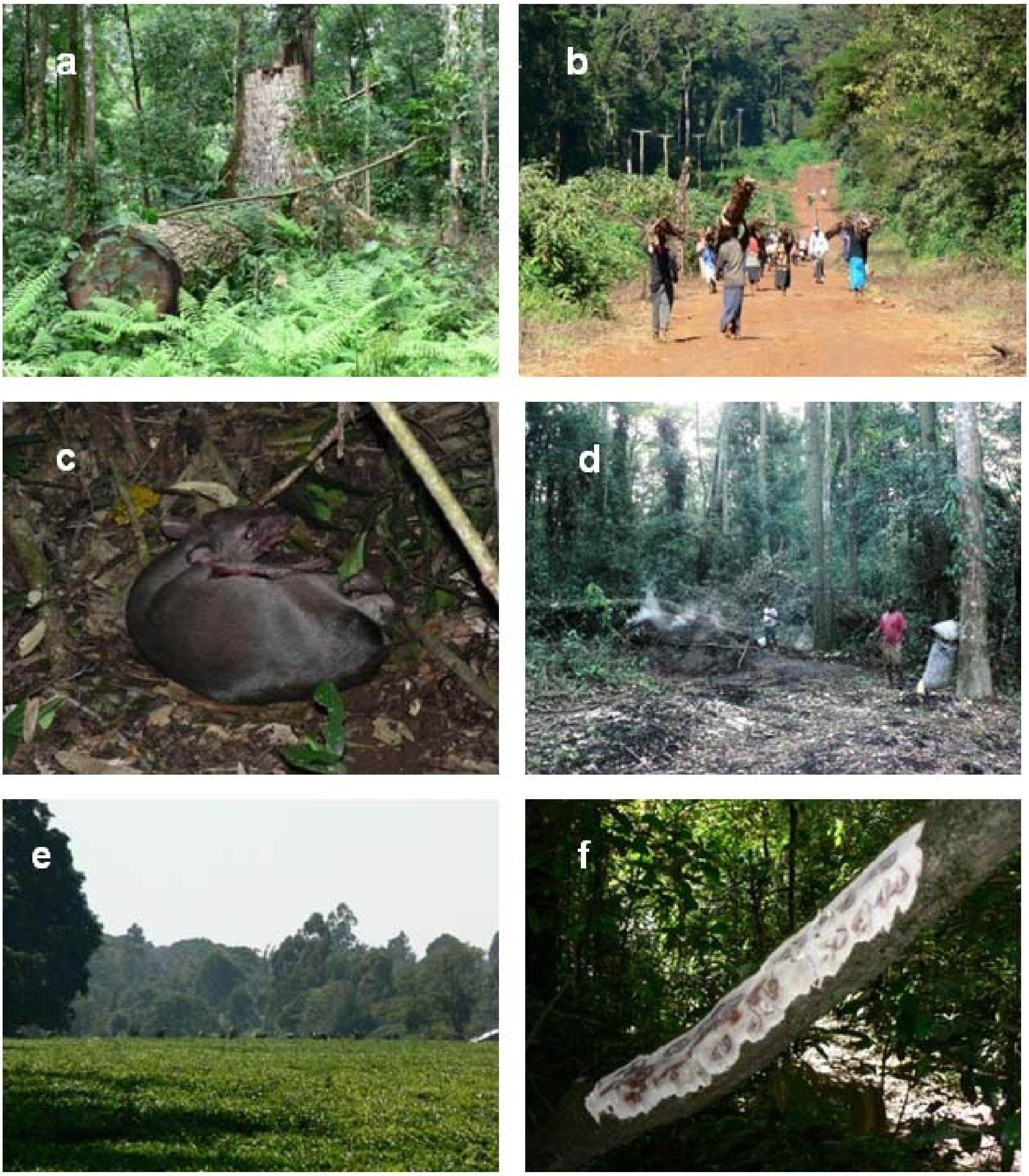

Figure 2.4: Examples for human disturbance in Kakamega Forest (Kenya) and Budongo Forest (Uganda): (a) illegal logging place (b) people transporting fire wood extracted from the forest (c) red duiker trapped in a snare from illegal hunters (d) charcoal production (e) tea plantation reaching the forest border (f) bark collected from *Craterispermum schweinfurthii* for medicinal purposes.

STUDY SITES WITHIN KAKAMEGA FOREST

In each of the two forests, six study sites were selected (12 in total), representing the full range from primary forest up to young secondary forest under different anthropogenous and ecological pressures. The location of the six study sites in Kakamega Forest are shown in Figure 2.5. The names their abbreviations, introduced in the following site characterizations, will be continuously used throughout this thesis.

Kisere (Kis): The site "Kisere" is located within the Kisere forest fragment and inside the Kisere National Reserve. The Kisere fragment is not mentioned before 1932, but clearly visible on pictures from 1948. Brooks (1999) suggests that it was fragmented in 1933 and since then did not particular change in size. This is probably due to the isolation by being surrounded by rivers and not connected to the road system what complicates access and transportation of timber wood. As Kisere has never been commercially logged it is regarded as near primary forest (Althof 2005), but being surrounded by small settlements, the signs of human disturbance are omnipresent. Especially young and/or small trees are illegally logged in large numbers and forest products like fire wood and tree bark (for medicinal purposes) are extracted as well (personal observations). The total area of the Kisere Fragment amounts 471 – 487 ha (Kokwaro 1988; Oyugi 1996).

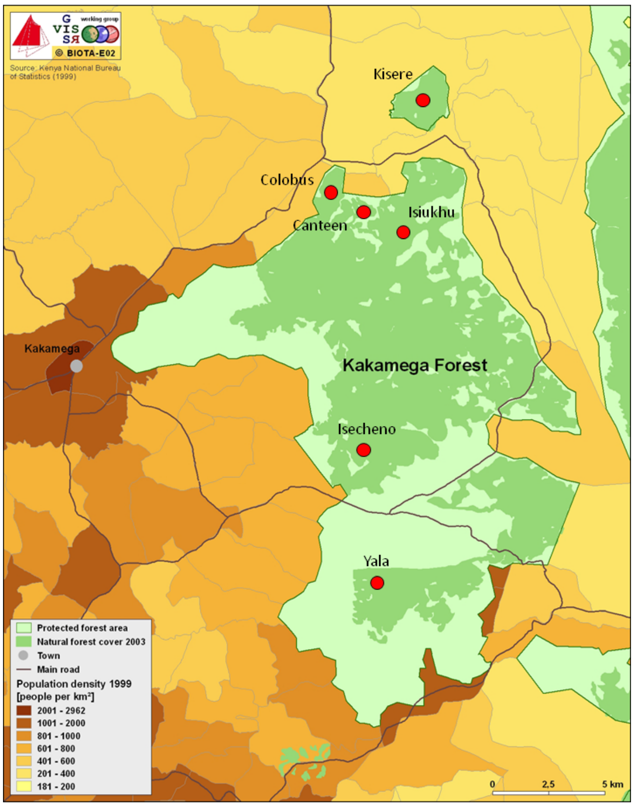

Figure 2.5: Map of Kakamega Forest (Kenya) indicating the six study sites.

Isiukhu (Isi): Very old forest along the Isiukhu River. Of the six sites in Kakamega Forest "Isiukhu" is the most intact one. It does not seem that this forest has ever been extensively logged what is probably due to its distance to the next settlement. No direct road or way leads to the "Isiukhu" site and by following the trail along the river it takes about 1.5 h to reach there from the campsite. Nevertheless even this remote area shows signs of human impact in the form of poaching for bush meat. On one day we collected 47 snares prepared for the hunting of small terrestrial animals like red duikers

(*Cephalophus natalensis* A. Smith, 1834) and the helmeted guineafowl (*Numida meleagris* (Linnaeus, 1758)). The described forest site is not to be confused with the homonymous site studied by Althof (2005), Yeshitela (2008), and others. Their studies were likewise carried out along the Isiukhu River, but in the young secondary forest near the Isiukhu Falls.

Colobus (Col): Old secondary forest around the Colobus trail in the KWS Buyangu area. Until 80 years ago this area has been commercially logged, but today the surveyed part of the area along the Colobus trail has well recovered. The Colobus trail is one of the most frequented trails in this forest as it is located close to the reserve entrance. The trails are very small and do not subdivide the forest, so that the regular usage by visitors rather supports forest recovering by avoiding illegal logging than causing damage. Despite of the high tourist frequency and its location close to the Buyangu KWS office, we observed (and removed) several traps of poachers along the Colobus trail.

Yala (Yal): Old secondary forest near the Yala River. This site was located within the Yala Nature Reserve which is today fragmented from the northern main forest block and represents our southern most study site in Kakamega Forest. The condition of the forest is comparable to Colobus and Kisere, but lots of cattle grazing retards tree regeneration on grasslands in the northern part of Yala forest (Oyugi 1996).

Isecheno (Ise): Middle-aged secondary forest, located at the southern edge of the main forest block within the Isecheno Nature Reserve (310 ha). The reserve includes not only forest areas but also large grasslands. We estimate the forest of an average age of about 50-60 years, but sometimes much older primary forest trees can be found mixed up with pioneer vegetation what makes age determination very difficult. This heterogenous forest conditions probably trace back to high human impact. Especially charcoal production, illegal logging, fuel wood collection and cattle grazing along trails play a major role concerning forest disturbance in Isecheno. These factors were already observed by Oyugi (1996) and did not change till today.

Canteen (Can): Young secondary forest near the campsite (approximately 20 years old). "Canteen" is the youngest and most disturbed area out of the 12 study sites in both forests. It is named after the signpost not only indicating the way to a (never discovered) canteen, but also the beginning of our transect.

2.2 BUDONGO FOREST, UGANDA

"The Budongo Forest lies like a sleeping giant at the top of the Albertine Rift, part of the great Rift Valley that cuts through Africa from North to South."

(Vernon Reynolds 2005)

LOCATION AND ABIOTIC COMPONENTS

Budongo Forest is situated about 200 km north-western of Kampala in the Ugandan Western Region near Lake Albert (Figure 2.6a). The nearest town is Masindi in the east of Budongo Forest, but small villages are found all along the forest border.

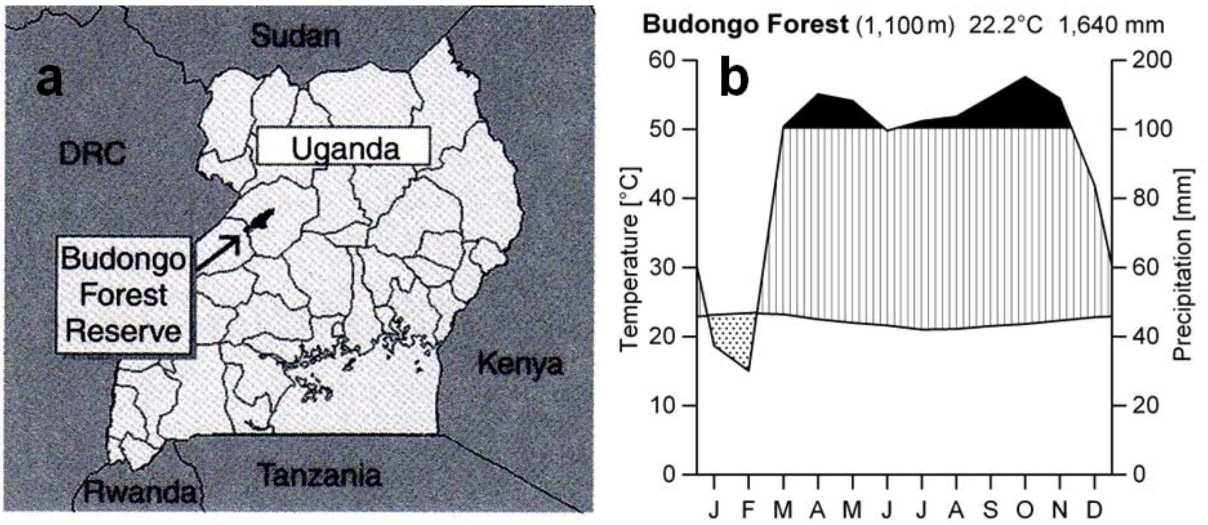

Figure 2.6: Location (a) and climate diagram (b) of Budongo Forest in Uganda (source: (a) Reynolds 2005 (b) Todt unpublished data).

Vernon Reynolds, who established the Budongo Conservation Field Station (BCFS) in the southern part of the main forest block, characterized Budongo Forest as medium altitude moist semi-deciduous tropical rain forest. Like Kakamega Forest, Budongo Forest is located on a high plateau in an elevation of 1100 m a.s.l. The precipitation amounts 1600 mm per year with a dry season from mid-December to mid-February (Reynolds 2005) and the average annual temperature is 22.2 °C (Figure 2.6b).

The natural forest cover of the Budongo Central Forest Reserve amounts only about 50% (Schaab *et al.* 2010). Unlike Kakamega Forest, Budongo Forest is not divided into many small fragments, but can be subdivided into three large forest sections. It is composed of a huge central forest block which is still connected to the smaller Siba Forest in the south west. North-eastern of the main forest block lies the today disconnected forest fragment Kaniyo Pabidi (Figure 2.7). Reynolds (2005) states that the total forest area comprises about 43,500 ha. Overall, Budongo Forest is much more intact than Kakamega Forest and was especially selected because of its intact primary forests which are absent in Kakamega.

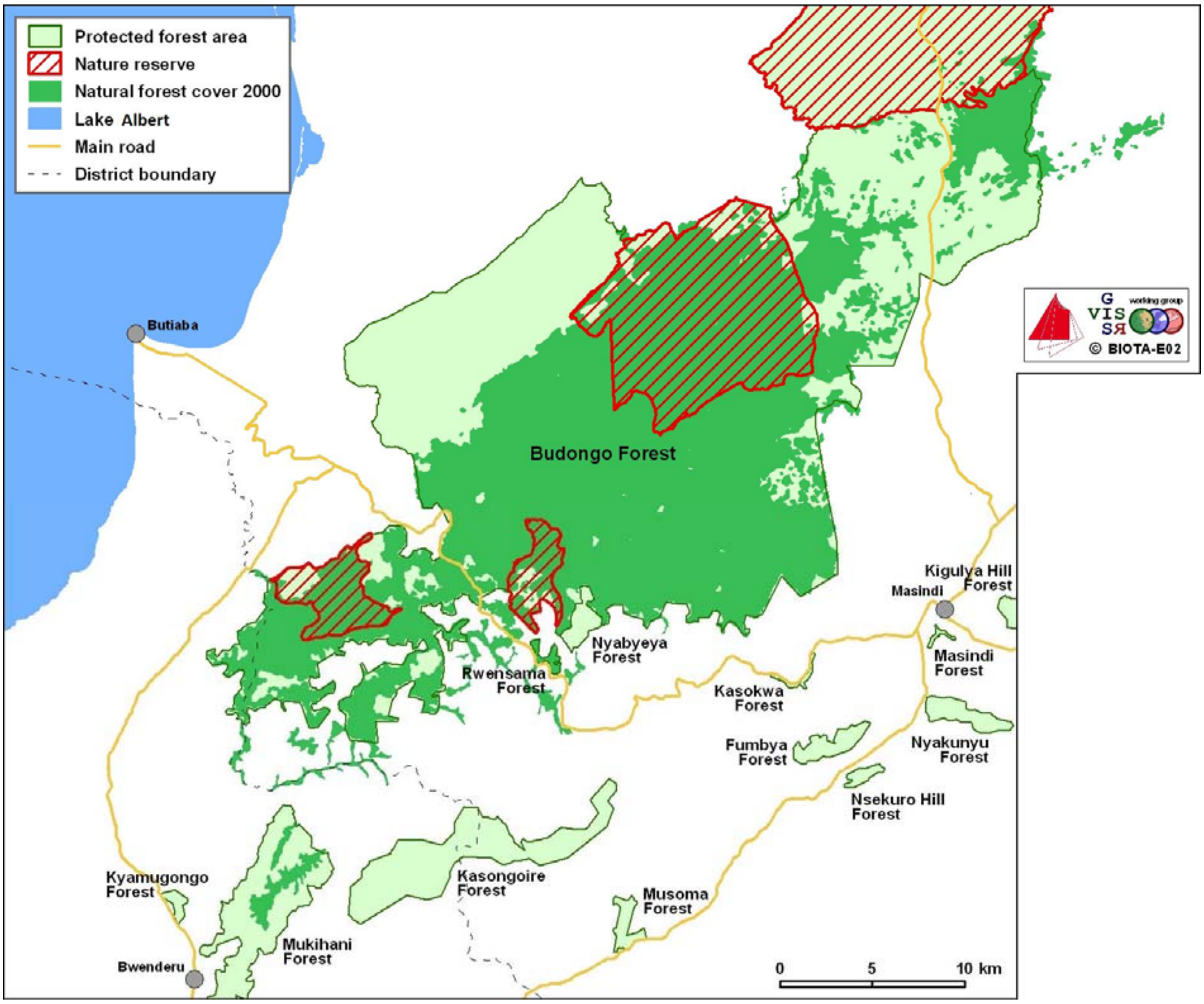

Figure 2.7: Budongo Forest (Uganda) indicating official forest border, natural forest cover and Nature Reserves.

IMPORTANCE OF BUDONGO FOREST FOR UGANDAN BIODIVERSITY

Like in Kenya, the Ugandan forests are only the remains which people left over from a continuous forest, ones covering the bigger part of the country (Hamilton 1974). Budongo Forest, classified as well developed deciduous closed canopy forest with emergent trees reaching up to 60m, is not the only rain forest in Uganda, but it is one of the largest (Sheil 1995, 2001). Being closely located to the huge Congo rain forest, the amount of guineo-congolian species in Budongo Forest is much higher than in Kakamega Forest. Numerous species like *Cynometra alexandri* C.H.Wright and *Parinari excelsa* Sabine, which are typical for the Congo forest but do not reach Kenya, have their eastern most occurrences in Budongo Forest. Unlike the Congo low land forest, Budongo is a mid-elevation forests (Chapman and Chapman 1996a) containing afromontane species as well, what leads to a very diverse species composition.

Most large mammals are today extinct in Budongo Forest. Buffaloes and the Ugandan Kob were shot in large numbers by the British colonial administration as potential hosts for the tsetse fly in 1909-1912. Elephants were spared out but then exterminated later for food by soldiers during the Ugandan civil war 1971-1986 (Reynolds 2005). The animal that made Budongo Forest of particular interest for researchers is the chimpanzee (*Pan troglodytes schweinfurthii* Blumenbach, 177). Plumptre (2003) estimated that a total of about 584 chimpanzees live in Budongo assigned to several communities. In order to conserve and study the chimpanzees of Budongo Forest, Dr Vernon Reynolds founded the Budongo Forest Project in 1990 and stared to establish a permanent research station in the southern part of the Budongo main forest block (http://culture.st-and.ac.uk/bcfs/). Today this station is called the Budongo Conservation Field Station and is frequently visited by international researchers not only studying chimpanzees but also numerous other organisms (Reynolds 2005).

Beside its nature treasures, Budongo Forest has a high commercial value due to its high amount of old, precious timber trees, especially mahogany species. Thus, Budongo Forest is an important high quality timber source which was used extensively in the past. Fortunately the responsible authorities followed a sustainable management and instead of clear felling, they practiced mainly selective logging and also reforested the removed species. As a result, the loss of forest cover in Budongo during the past 100 years is with only 2% very little compared to Kakamega Forest (Schaab *et al.* 2010).

HISTORY, POPULATION PRESSURE, AND MANAGEMENT

Around 1911 the commercial value of the Budongo timber trees was discovered (Schaab *et al.* 2010). In the period from 1930 to 1970 British foresters were in charge for Budongo Forest (Plumptre 1996; Reynolds 2005) and during this time, four saw mills were established within the forest area. 65% of the extracted timber belonged to four mahogany species: *Khaya anthotheca* (Welw.) C.DC. and *Entandrophragma* spp. (Plumptre 1996). Despite the intensive use of forest products, the forest management was sustainable as mentioned above and caused only a little forest loss. However, not all of the forestry measures were gentle. In the 1950s and 1960s none profitable tree species like the ironwood *Cynometra alexandri* were treated with arboricide to give space for mahogany species (Reynolds 2005). This procedure was based on the work of Eggeling (1947) who classified four forest types in Budongo Forest: colonizing forest, mixed forest (rich in mahogany species), ironwood forest (dominated by *Cynometra alexandri*) and swamp forest, the first three types representing a succession row. This succession row was later broadly confirmed by Sheil (1999). The foresters assumed that if they remove *Cynometra* from the ironwood forest type, they would get the mixed forest type which is rich in mahogany species (Reynolds 2005). And truly, the arboricide treatment led to heavy decline of *Cynometra* forest and an increase of a more species rich mixed forest, but the basal area of the mahogany trees in the treated areas did not differ significantly from untreated regions (Plumptre 1996, Sheil 2001). The wood of *C. alexandri* is so hard that it could not be possessed in the saw mills and was therefore of no commercial use for a long time. Later, when it was possible to harden the saw teeth, even *Cynometra* was used for timber production. The floor in the Royal Festival Hall in London for example is made out of Budongo *Cynometra* wood (Reynolds 2005).

The population numbers in and around Budongo Forest are fluctuating but they were never as high as in Kakamega Forest. After a typhus epidemic in 1904, the whole area was evacuated from 1909 – 1912 (Reynolds 2005). Afterwards the population slowly built up and especially between 1950 and 1960 many people came to live in the forest and work in the saw mills. Today the saw mills are closed and the logging of mahogany and other timber tree species is illegal. The mills were replaced by other employees like the Kinyara Sugar Works Factory. Within the last 55 years the whole area around Budongo forest was colonized and with the increasing population numbers, the pressure on the forest is increasing too. The main disturbance factors are illegal logging, the turning of forest into cropland, poaching with snares, collecting of firewood, cutting of small trees for house construction, and collecting of medicinal plants (Reynolds 2005). Unlike Kakamega Forest, here are no villages inside the forest and there is no road making the forest assessable so that disturbance in Budongo Forest mainly takes place along the forest edges.

STUDY SITES WITHIN BUDONGO FOREST

Like in Kakamega Forest, also in Budongo Forest six study sites were selected representing different disturbance stages. Most of the sites are located in the southern part of the main forest block called the Sonso area (named after the Sonso River). However, one site is located in the Kaniyo Pabidi forest fragment in the north east of the forest, about 30 km away from the Sonso area (Figure 2.8).

Nature (Nat): Very old primary forest within a nature reserve. This forest is the most intact one of all 12 study sites and has a cathedral like structure with some giant trees

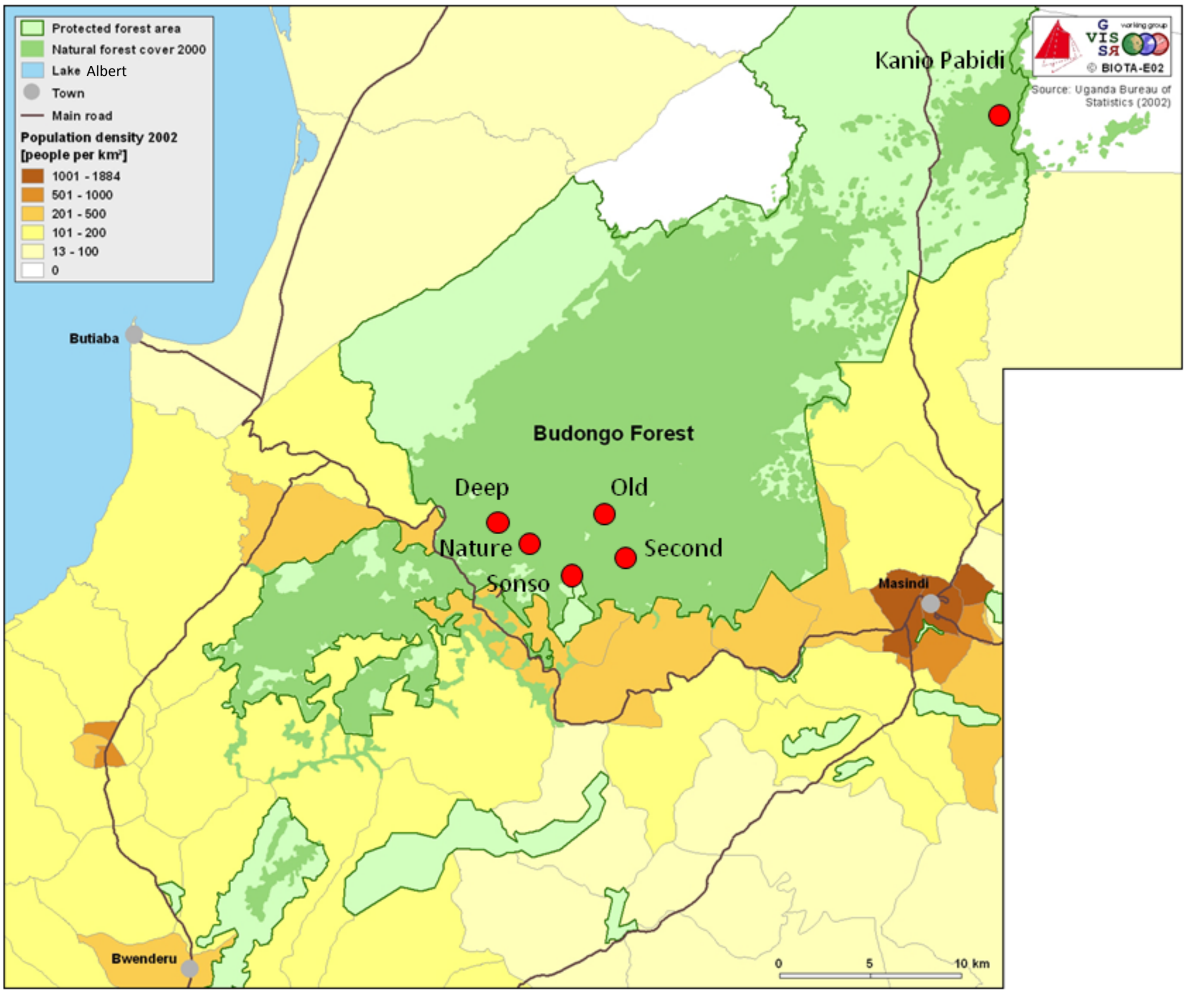

Figure 2.8: Map of Budongo Forest (Uganda) indicating the six study sites.

(often with huge buttresses) and only small herbs or saplings in between. The edges along Sonso River, which is crossing the "Nature" forest, often have a swampy character. Located close to the Budongo Conservation Field Station (BCFS) this area is frequently visited by researchers and staff members of the station what protects the forest from illegal logging.

Deep (Dee): Closely located to the "Nature" study site, just a little bit deeper into the forest, these two areas would naturally not differ from each other. But being located outside the nature reserve and not regularly controlled by researchers and BCFS members, the "Deep" site is heavily influenced by illegal logging. Walking through this forest one regularly ends up on open gaps where a huge tree (mainly mahogany) was logged, sawed, and transported. Usually not the whole tree is used for timber production but only the section from 1.5 to about 6 m from the base of the trunk. The remaining tree is left behind (Figure 2.4a). Where the illegal loggers were disturbed they often do not come back to this logging side so that the felled tree slowly rots away. The smaller trees surrounding a logged timber tree are likewise felled either for the construction of a scaffolding which helps to saw the timber tree or to give space for sawing and removing the big tree. In these gaps, many plant species which are typical for open and/or disturbed areas enter into the forest.

Old (Old): Old Secondary Forest which is traversed by a network of small trails. The trails are regularly patrolled by chimpanzee researchers and thus, this forest is well protected from ongoing disturbance.

Sonso (Son): Mainly old secondary forest along Sonso Road (The Royal Mile), near the village Nyakafunjo. This forest is very heterogenous: while some areas have old, mature tree populations, others are covered with densely wooded copse out of shrubs, climbers, and younger trees. Regardless of the condition, the whole „Sonso" area is under heavy anthropogenous pressure from the nearby village. Especially charcoal production, fire wood collection, and the cutting of smaller trees was observed in this forest while the illegal logging of large timber trees does not seem to be a big issue in this study area.

Second (Sec): Middle-aged secondary forest. Like the former side this forest is very heterogenous. While the larger areas of old, mature trees are rare, it is mainly composed of middle-aged tree populations which are discontinued by large open gaps. These gaps are already several years old and they are mainly covered by climbers and (scrambling) shrubs. In both habitats some isolated old trees can be found. Additionally this forest contains some swamp areas with a lower canopy height compared to the remaining forest. Some of these swamps are quite intact and contain old mature trees while others are covered with nearly impervious scrubs. The "Second" site is partly within the trail network of the chimpanzee researchers. In Uganda this is the most disturbed study side.

Kaniyo Pabidi (KP): The area called "Kaniyo Pabidi" was formerly connected to the main forest block of Budongo Forest and is now isolated as a forest fragment, surrounded by dry savanna area. This forest has never been commercially logged and is therefore considered as primary forest. Beside the very old and intact forest, several old gaps and the presence of typical secondary forest species indicate (human?) disturbance in the past, but the forest is now recovering. Today, Kaniyo Pabidi is well protected from human disturbance as being located inside the Murchinson Falls National Park. However, our transect crossed an area where a heavy storm just three month ago uprooted numerous old trees. In contrast to the southern part of Budongo Forest, Kaniyo Pabidi is open for tourists who like to watch the chimpanzees. Thus, this forest is likewise traversed by a trail network which is regularly patrolled by tourists and researchers.

Being the only study site in the north eastern part of the forest, Kaniyo Pabidi has much more distance to the remaining sites than they have to each other.

3 - THE VEGETATION OF EAST AFRICAN RAIN FORESTS AND IMPACT OF FOREST DISTURBANCE

3.1 ABSTRACT

The small remains of tropical rain forest in East Africa belong to the most species rich areas of the entire African continent. The high population density in this particular regions leads to an ongoing decline of natural forest cover, often even within protected areas. Sustainable conservation projects are complicated by the insufficient knowledge on the species inventory and their vulnerability to forest disturbance. With the background of the establishment of an ex-situ culture of endangered vascular plant species from East African rain forests, comprehensive vegetation surveys were carried out in two model forests: Kakamega Forest in Kenya and Budongo Forest in Uganda. Altogether 853 species of vascular plants, belonging to 472 genera and 128 families, were recorded. Of them, 523 species were investigated in Kenya and 577 species in Uganda. The most species rich family in both forests are Orchidaceae, followed by Acanthaceae in Kenya and Rubiaceae in Uganda. Forest disturbance influences the species and growth form composition and leads to a lower basal area. Beside disturbance, spatial distances between the study sites play an important role in species composition. A list of indicator species for either disturbed or intact forest areas is provided for both study forests. *Rawsonia lucida* and *Rinorea brachypetala* emphasized their qualifications as indicator species for intact areas.

3.2 INTRODUCTION

East African rain forests and especially afroalpine regions and the Albertine Rift represent some of the most species rich areas of the African continent, but at the same time this region is affected by a high human pressure (White 1981; Küper *et al.* 2004a; Mutke and Barthlott 2005; Plumptre *et al.* 2007). Today the East African rain forests are of rather insular like character, but they are considered to be the eastern most remains of a once connected Central African rain forest belt (Trapnell and Langdale-Brown 1962; Hamilton

1974). During the past century the main reasons for forest decrease were the transformation from forest into farmland, commercial logging, and the creation of space for plantations of exotic tree species (Oyugi 1996; Plumptre 1996; Lung and Schaab 2004; Schaab *et al.* 2010). Some of these factors are nowadays of reduced impact while forests decrease continuous due to illegal logging, fuel wood extraction, establishing of grazing land for domestic animals, extraction of medicinal plants, fire clearings, charcoal production and others (Kokwaro 1988; Bleher *et al.* 2006; Guthiga and Mburu 2006).

The ongoing disturbance of these valuable small scale forest systems makes them being of high importance for conservation purposes. Our knowledge about the vegetation of many of the concerned forests is very insufficient, especially for non-tree organisms (Plumptre *et al.* 2007) what complicates sustainable conservation projects. What we know is that forests disturbance and fragmentation affects species numbers and composition of forest plant and animal communities (Owiunji and Plumptre 1998; Brooks *et al.* 1999; Wagner 2000; Wagner 2001; Chapman and Chapman 2004).

Representative for East African rain forests in general, the present study was carried out in two model forests: Kakamega Forest in Kenya and Budongo Forest in Uganda. Several previous studies on Kenyan plants include Kakamega Forest (e.g. Agnew and Agnew 1994; Stewart and Campbell 1996), but the first and so far only intent to assess the entire floristic inventory of Kakamega Forests was made by Althof (2005) and reported about 400 species of vascular plants. Contrary, the vegetation of Budongo Forest has been well studied since the 1930s and the establishment of permanents study plots provided information about forest succession (Eggeling 1947; Sheil 1995; Plumptre 1996; Sheil 1999; Sheil 2001). While most of these studies focus on trees, a checklist of the vascular plants of Budongo Forest including the herbaceous inventory is available containing 866 vascular plant species (Synnott 1985).

Aim of this study was to learn more about the floristic inventory of the two model forests especially with regard to their vulnerability to forest disturbance. Later these data are supposed to serve for the assessment of the conservation priorities of the concerned plant species and the establishment of an ex-situ culture for endangered plants. For this purpose, three main questions were investigated: a) what is the species inventory and abundance of our model forests considering all vascular plants? b) How does forest disturbance affect species numbers and composition? c) Which species can serve as indicators for either disturbed or undisturbed forest?

3.3 METHODS

This study was carried out in Kakamega Forest (western Kenya) and Budongo Forest (western Uganda), here representative for East African rain forests. Within the two model forests a total of 12 study sites was selected (six per forest), representing the full range from primary forest up to young secondary forest under different anthropogenous and ecological pressures (see chapter 2).

VEGETATION SURVEY

In each of the 12 study sites one line-transact was conducted. Each transect was 1km long and composed of 20 plots (10 x 10 m; 100 m²) with a distance of 40 m from each other. All vascular plants species within the plots were identified, measured, and counted. The herbaceous plants were identified and their height was recorded, while for plants with a minimum DBH (diameter at breast height in 1.30 m) of 1.60 cm, the DBH was recorded in addition. In case of trails or rivers crossing the plot area, the plot was moved 10 to 20 m forwards depending on the necessity.

Furthermore, 11 epiphyte/tree-plots were established in each site (132 plots in total) measuring 20 x 20 m (400 m²). On the one hand these plots served for the detection of epiphyte species by using single rope climbing techniques (see chapter 4). On the other hand all trees and shrubs with a minimum DBH of 10 cm were identified, measured (DBH + height) and counted.

In order to consider the larger distance of giant forest trees in the intact study sites, which might be underrepresented in the smaller plots, one large tree plot (50 x 30 m; 1500 m²) was established in each of the 12 study sites. Within the tree plots all woody plants (trees, shrubs and lianas) with a DBH ≥ 10 cm were recorded. The concerned plants were identified and measured (DBH and height).

Altogether 384 study plots were established covering an area of about 9.5 ha.

In case of unidentified plants, herbarium specimens were prepared and if possible identified in the herbaria of the National Museums of Kenya (Nairobi) and the Makerere University in Kampala (Uganda). Furthermore, identification literature was implemented (Hamilton 1991; Agnew and Agnew 1994; Beentje 1994; Stewart and Campbell 1996; Fischer and Killmann 2008; Fischer *et al.* 2010). The systematical classification is based on The Plant List (2010).

Figure 3.1 – Vascular plant species from Kakamega Forest (Kenya) and Budongo Forest (Uganda): a) *Trichocladus ellipticus*, Hammamelidaceae (Kenya), b) *Turraea vogelioides*, Meliaceae, c) *Palisota schweinfurthii*, Commelinaceae (Uganda), d) *Argomuellera macrophylla*, Euphorbiaceae, e) *Nervilia petraea*, Orchidaceae, f) *Thonningia sanguinea*, Balanophoraceae. Except where otherwise specified the species occurred in both forests.

STATISTICAL ANALYSIS

The first-order jack-knife species richness estimation was carried out by using the program package EstimateS (Colwell 2006) for both forests separately, basing on the species numbers of each study plot. All following analyses and related figures were performed with the R computer software (R Development Core Team 2009). Next, the data sets were checked for normal distribution with Lilliefors Kolmogorov-Smirnov normality test and as data were not normally distributed, species richness of the two model forests were compared on the basis of the species numbers per plot by Wilcoxon rank sum test (Dytham 2003). In order to find out if there is a significant difference between species numbers of the different disturbed study sites, the Kruskal-Wallis rank sum test was carried out (Sokal and Rohlf 1995). When significant differences were found, multiple comparison tests after Kruskal-Wallis were carried out by the program package "pgirmess" (Giraudoux 2010). The floristic similarity of the 12 study sites was investigated by cluster analyses on the basis of Euclidian distance. Since this data set includes all vascular plants reaching from small herbs to giant forests trees which, depending on their size, often occur in larger or smaller individual numbers, this analysis is based on the number of plots where a species occurred instead of individual numbers. The cluster analyses were carried out first for all species and then separately for herbaceous and woody plants.

Basing on the measured DBH data the basal area of each study site was calculated. Before analyzing the basal areas, the results for the different plot sizes (10 x 10 m, 20 x 20 m, 50 x 30 m) were compared. In the small transect-plots (10 x 10 m) the large trees, which grow in some distance from each other, were underrepresented while the epiphyte-plots (20 x 20 m), which were always arranged around one large phorophyte, showed an unusual high basal area. Thus, the basal areas based on the transect-plots and the epiphyte-plots were excluded from this analysis and only the basal area of the large tree-plots (50 x 30 m) was considered. The resulting basal area of each plot was converted into m² per ha and as the data were normally distributed (Lilliefors Kolmogorov-Smirnov normality test) basal areas of each forest were tested for significant differences using Welch Two Sample t-test. The impact of forest disturbance and spatial distance on the differences in floristic similarity of the 12 study sites (measured in Euclidian distance) was tested by the Mantel Test using the R library "vegan" (Legendre and Legendre 1998).

The indicator species analysis for the detection of species being typical for either intact or disturbed forest areas is based on the IndVal method (Dufrene and Legendre 1997; De Cáceres and Legendre 2009; De Cáceres *et al.* 2010) and was carried out by the R library package "labdsv". For this analysis the data from the transect plots were used which provide information about the number of individuals of each species in the particular plots. To exclude the influence of spatial distances and transition stages between intact and disturbed forest, only the plots within the respectively most intact and most disturbed study site in each forest were included.

3.4 RESULTS

A total of 853 species of vascular plants, belonging to 472 genera and 126 families, were recorded in both study forests (for the total species list see Appendix 1). Of these, 523 species were recorded in Kenya of which 91 species are new records for this area. These data are already included in a checklist of the vascular plants of Kakamega Forest (Fischer *et al.* 2010). In Uganda 577 species were detected containing 156 records which are not listed in the checklist for Budongo Forest (Synnott 1985). Figures 3.1 and 3.11 provide some impressions about the variability of the vegetation within the study areas. Out of the total species number, 645 species were recorded and measured within the study plots (367 in Kenya and 469 in Uganda) while the remaining 208 species were observed in other regions within the two model forests. In both forests the number of species recorded within the study plots amounts more than 81% of the estimated species number (first-order jack-knife species richness estimation). Epiphytic species, which amount 20% of the recorded plants, are discussed in detail in chapter 4.

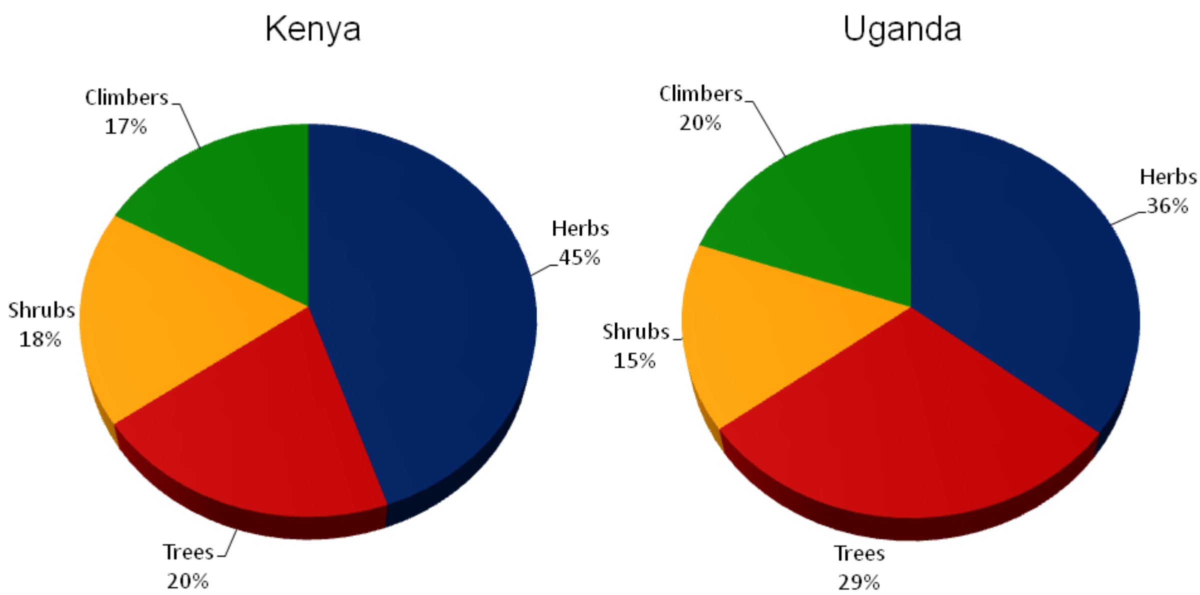

Figure 3.2 – Percentage growth form composition of 523 vascular plant species from Kakamega Forest (Kenya) and 577 species from Budongo Forest (Uganda).

FLORISTICS

The average number of species per plot is with 39 (SD 14.4) species in Kenya and 37 (SD 14.8) species in Uganda almost equal and the Wilcoxon test confirmed that there is no significant difference between species numbers in the two model forests (Wilcoxon rank sum test, $p = 0.13$). Regarding the growth form composition of the plants in the two forests it can be recorded that Kakamega Forest is characterized by a higher amount of herbaceous species and a smaller percentage of tree species compared to Budongo Forest (Figure 3.2).

The most species rich family in both forests are Orchidaceae and further Rubiaceae and Moraceae are among families with the highest species richness in both forests (Table 3.1). In Kenya these families are followed by Acanthaceae, and Asteraceae while in Uganda Fabaceae, and Euphorbiaceae are among the families with the highest species numbers. 34 families were only recorded in one of the two study forests.

Table 3.1 - Species numbers of the vascular plant families in Kakamega Forest (Kenya) and Budongo Forest (Uganda). % = percentage amount of the family on the total number of species in both forests.

Family	both forests combined	Kenya	Uganda	shared species	%
Orchidaceae	117	65	66	14	13.7
Rubiaceae	49	27	39	17	5.7
Fabaceae	36	18	26	8	4.2
Acanthaceae	33	28	11	6	3.9
Moraceae	31	20	27	16	3.6
Euphorbiaceae	30	18	25	13	3.5
Asteraceae	25	21	8	4	2.9
Aspleniaceae	24	17	16	9	2.8
Malvaceae	24	12	15	3	2.8
Apocynaceae	20	12	16	8	2.3
Cucurbitaceae	16	9	12	5	1.9
Meliaceae	16	9	15	8	1.9
Sapindaceae	15	7	13	5	1.8
Commelinaceae	14	8	9	3	1.6
Lamiaceae	14	11	7	4	1.6
Vitaceae	13	6	11	4	1.5
Annonaceae	11	3	11	3	1.3
Poaceae	11	7	7	3	1.3
Phyllanthaceae	10	7	7	4	1.2
Rutaceae	10	6	8	4	1.2
Urticaceae	10	6	8	4	1.2
Piperaceae	9	8	7	6	1.1
Zingiberaceae	9	7	6	4	1.1

Family	both forests combined	Kenya	Uganda	shared species	%
Convolvulaceae	8	6	3	1	0.9
Menispermaceae	8	5	5	2	0.9
Oleaceae	8	5	6	3	0.9
Polypodiaceae	8	6	6	4	0.9
Pteridaceae	8	4	5	1	0.9
Asparagaceae	7	6	3	2	0.8
Combretaceae	7	5	3	1	0.8
Cyperaceae	7	4	3	-	0.8
Maranthaceae	7	-	7	-	0.8
Ochnaceae	7	3	6	2	0.8
Salicaceae	7	5	7	5	0.8
Sapotaceae	7	5	7	5	0.8
Amaranthaceae	6	4	5	3	0.7
Cannabaceae	6	4	6	4	0.7
Dioscoreaceae	6	4	3	1	0.7
Melastomataceae	6	3	3	-	0.7
Rhamnaceae	6	5	4	3	0.7
Adiantaceae	5	4	3	2	0.6
Anacardiaceae	5	3	3	1	0.6
Balsaminaceae	5	4	2	1	0.6
Passifloraceae	5	-	5	-	0.6
Solanaceae	5	4	3	2	0.6
Violaceae	5	1	5	1	0.6
Araceae	4	2	4	2	0.5
Boraginaceae	4	3	2	1	0.5
Icacinaceae	4	2	2	-	0.5
Orobanchaceae	4	3	1	-	0.5
Putranjavaceae	4	2	3	1	0.5
Rosaceae	4	3	2	1	0.5
Thelypteridaceae	4	2	2	-	0.5
Verbenaceae	4	4	1	1	0.5
Amaryllidaceae	3	2	1	-	0.4
Araliaceae	3	2	1	-	0.4
Arecaceae	3	2	3	2	0.4
Bignoniaceae	3	3	3	3	0.4
Celastraceae	3	3	3	3	0.4
Clusiaceae	3	1	2	-	0.4
Connaraceae	3	2	3	2	0.4
Loganiaceae	3	1	3	1	0.4
Loranthaceae	3	2	1	-	0.4
Myrthaceae	3	3	-	-	0.4
Oleandraceae	3	1	3	1	0.4
Polygalaceae	3	2	2	1	0.4
Primulaceae	3	2	3	2	0.4
Ranunculaceae	3	3	1	1	0.4

Family	both forests combined	Kenya	Uganda	shared species	%
Smilacaceae	3	1	3	1	0.4
Thymelaeaceae	3	-	3	-	0.4
Vittariaceae	3	1	3	1	0.4
Apiaceae	2	1	1	-	0.2
Burseraceae	2	-	2	-	0.2
Capparaceae	2	1	2	1	0.2
Costaceae	2	-	2	-	0.2
Crassulaceae	2	2	-	-	0.2
Davalliaceae	2	1	2	1	0.2
Dryopteridaceae	2	2	1	1	0.2
Gentianaceae	2	2	-	-	0.2
Hymenophyllaceae	2	2	2	2	0.2
Hypericaceae	2	2	1	1	0.2
Iridaceae	2	2	1	1	0.2
Irvingiaceae	2	-	2	-	0.2
Lomariopsidaceae	2	-	2	-	0.2
Myrsinaceae	2	-	2	-	0.2
Olacaceae	2	1	2	1	0.2
Oxalidaceae	2	1	1	-	0.2
Pittosporaceae	2	2	-	-	0.2
Proteaceae	2	2	-	-	0.2
Ulmaceae	2	1	2	1	0.2
Achariaceae	1	1	1	1	0.1
Aristolochiaceae	1	-	1	-	0.1
Balanitaceae	1	-	1	-	0.1
Balanophoraceae	1	1	1	1	0.1
Basellaceae	1	1	1	1	0.1
Begoniaceae	1	1	1	1	0.1
Cactaceae	1	1	1	1	0.1
Cecropiaceae	1	-	1	-	0.1
Chrysobalanaceae	1	-	1	-	0.1
Colchicaceae	1	1	1	1	0.1
Cornaceae	1	1	1	1	0.1
Cupressaceae	1	1	-	-	0.1
Cyatheaceae	1	1	-	-	0.1
Dennstaetiaceae	1	-	1	-	0.1
Dichapetalaceae	1	-	1	-	0.1
Dilleniaceae	1	1	1	1	0.1
Ebenaceae	1	1	1	1	0.1
Eriocaulaceae	1	1	-	-	0.1
Gleicheniaceae	1	1	-	-	0.1
Hammamelidaceae	1	1	-	-	0.1
Hernandiaceae	1	1	1	1	0.1
Hypoxidaceae	1	1	-	-	0.1
Lentibulariaceae	1	1	-	-	0.1

Family	both forests combined	Kenya	Uganda	shared species	%
Linaceae	1	-	1	-	0.1
Lycopodiaceae	1	1	-	-	0.1
Melianthaceae	1	1	1	1	0.1
Myristicaceae	1	-	1	-	0.1
Nyctaginaceae	1	1	1	1	0.1
Peraceae	1	1	-	-	0.1
Phytolaccaceae	1	1	1	1	0.1
Pinaceae	1	1	-	-	0.1
Podostemonaceae	1	1	-	-	0.1
Rhizophoraceae	1	1	1	1	0.1
Selaginellaceae	1	-	1	-	0.1
Thymeliaceae	1	1	1	1	0.1
Xanthorrhoeaceae	1	1	-	-	0.1
Total	**853**	**523**	**577**	**247**	**100**

The phytogeographical origin of the plants in the two forests differs in particular with regard to the amount of guineo-congolian and afromontane species (Figure 3.3). Both forests are predominated by sub-saharan species and have almost identical percentages of east African and pantropical species. Kakamega Forest shows a slightly higher amount of paleotropical and introduced species.

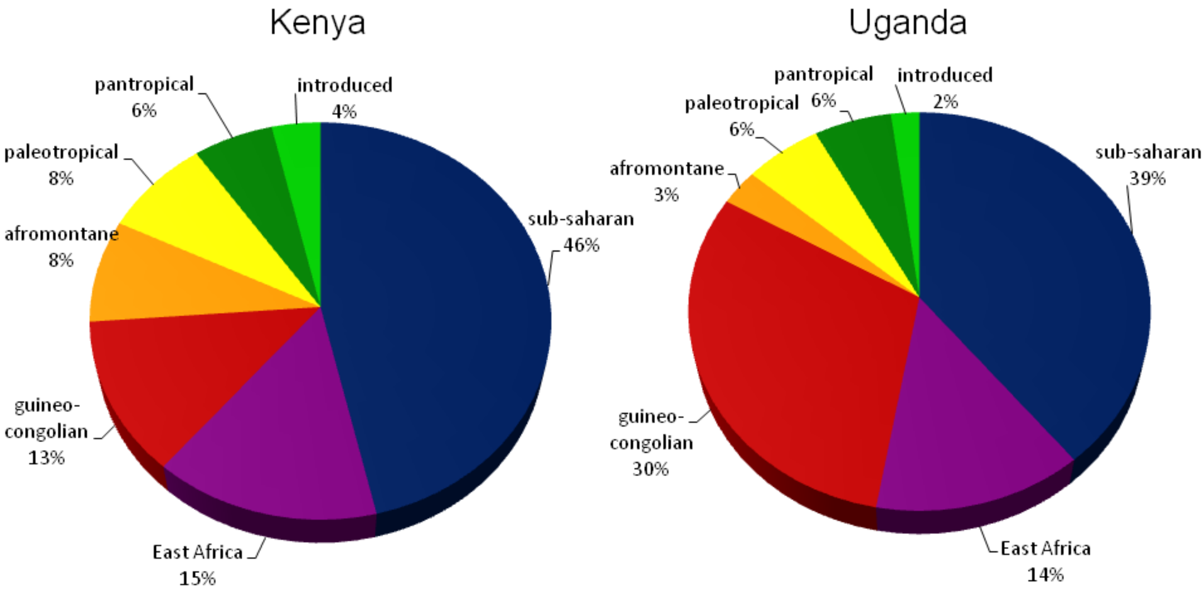

Figure 3.3 – Phytogeographical distribution of the plant species from Kakamega Forest (Kenya) and Budongo Forest (Uganda).

Cluster analysis of the floristic distances of the 12 study sites clearly separates the Kenyan sites from the Ugandan sites (Figure 3.4). In the Kenyan subtree of the dendrogram the young secondary forest (Can) secedes from all remaining sites and the two southern study sites (Yal and Ise) turn out to be a sister group to the three older sites from the northern forest part. The primary forest along Isiukhu River (Isi) is closer related to the old secondary forest (Old) than to the disturbed primary forest fragment Kisere (Kis). In Budongo Forest the primary forest fragment Kanio Pabidi (KP) which is spatially furthest away from the other sites also distinguishes strongly by its floristic composition while the remaining Ugandan sites are grouped closely together. Within the southern study sites the more disturbed sites (Son and Sec) are clustered in a sister group to the more intact sites while the floristic composition of KP is more similar to the disturbed sites. Within the cluster of the intact sites, the undisturbed natural forest (Nat) is more similar to the old secondary forest (Old) than to the primary forest with illegal logging (Dee).

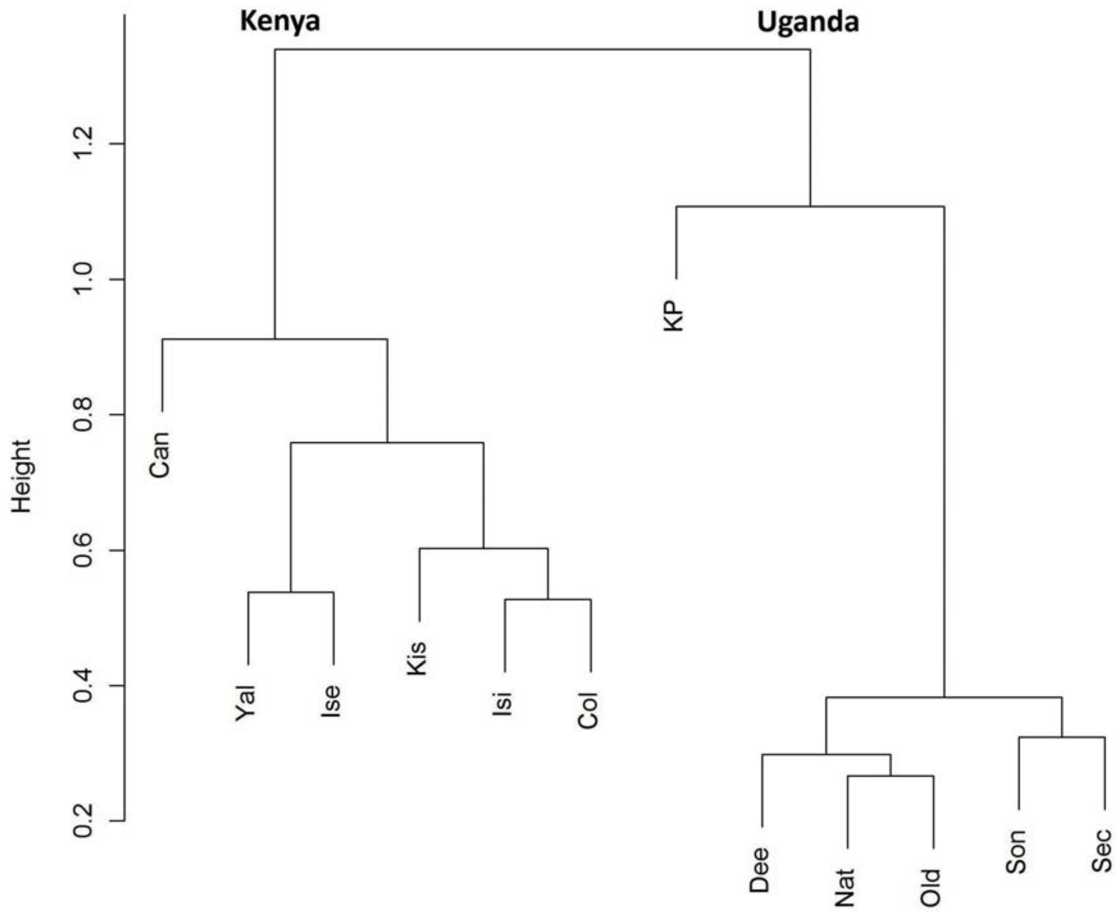

Figure 3.4 – Dendrogram of the plants from Kakamega Forest (Kenya) and Budongo Forest (Uganda) based on Euclidian distance of the floristic similarity of the study sites. Can = young secondary forest, Yal = old secondary forest (south), Ise = middle-aged secondary forest (south), Kis = primary forest fragment with high human impact, Isi = primary forest with low human impact, Col = old secondary forest, KP = primary forest fragment in the far north of the forest, Dee = primary forest with illegal logging, Nat = primary forest, Old = old secondary forest, Son = old secondary forest with high human impact, Sec = middle-aged secondary forest.

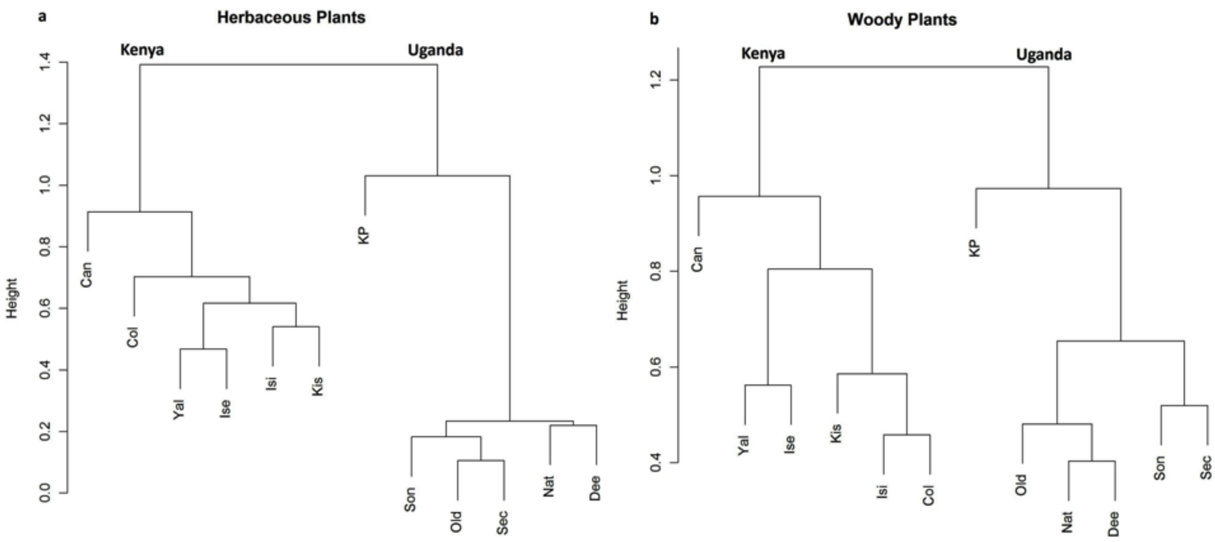

Figure 3.5 – Dendrogram of the herbaceous (a) and woody (b) plants from Kakamega Forest (Kenya) and Budongo Forest (Uganda) based on Euclidian distance of the floristic similarity of the study sites. Can = young secondary forest, Yal = old secondary forest (south), Ise = middle-aged secondary forest (south), Kis = primary forest fragment with high human impact, Isi = primary forest with low human impact, Col = old secondary forest, KP = primary forest fragment in the far north of the forest, Dee = primary forest with illegal logging, Nat = primary forest, Old = old secondary forest, Son = old secondary forest with high human impact, Sec = middle-aged secondary forest.

The cluster analyses for herbaceous and woody plants show that some patterns remain constant, regardless if considering herbaceous plants, woody plants or both (Figure 3.5). So, the Kenyan and Ugandan sites are clearly separated from each other in all three databases and the young secondary forest (Can) is always clearly distinguished from the remaining study sites in Kakamega Forest. In the same forest the two sites from the southern forest part (Yal and Ise) always cluster in one sister group. The distinction of the forest fragment Kanio Pabidi (KP) in the north of Budongo Forest is likewise constant in all three analyses. Below this basal separations the exclusion of woody plants (Figure 3.5a) causes several changes on the floristic relation of the study sites while the exclusion of herbaceous plants only leads to minor changes (Figure 3.5b). Considering only herbaceous plants, the different position of the Colobus trail area (Col) is noticeable for Kakamega Forest. While it is closely related to the primary forest at Isiukhu River (Isi) in the two analyses which include woody plants, basing on herbaceous plants it takes a position between the young secondary forest (Can) and the remaining sites. Isiukhu here shares one branch with the disturbed primary forest fragment Kisere (Kis) and together they are closest related to the two southern sites of Kakamega Forest (Yal and Ise). In Uganda the distance between KP and the remaining sites is much higher if woody plants are excluded and the most related sites are here the two primary forests Nat and Dee while it is closer related to the secondary forests if woody plants are included. The old secondary forest (Old), which was formerly grouped with the two primary forests, shares one branch with the middle-aged secondary forest if only herbaceous plants are considered.

The cluster dendrogram for the woody plants broadly resembles with Figure 3.4. The only difference is the arrangement within a group of three sites in Budongo Forest: considering only woody plants the two primary forest sites Nat and Dee share one branch while the old secondary forest (Old) represents the closest related branch. If all plants are considered, Nat shares the branch with Old and Dee is on the adjacent branch.

IMPACT OF FOREST DISTURBANCE AND SPATIAL DISTANCE

A good part of the floristic composition can be explained by forest disturbance. So the clustering of the Kenyan subtree (Figure 3.4) almost follows a disturbance gradient if the old secondary forest in Yala (Yal) is excluded. Regardless of forest disturbance the floristic composition of Yala shows more similarities to the closely located middle-aged secondary forest in Isecheno (Ise) than to the old secondary forest in the northern part of the forest.

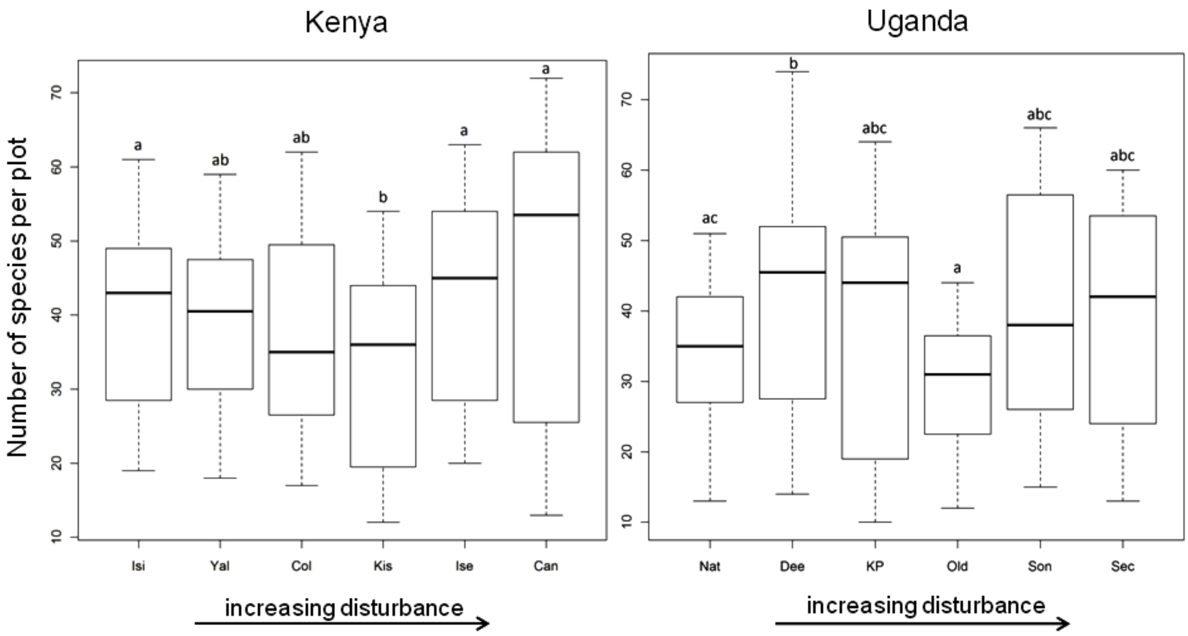

Figure 3.6 – Species richness of the different study sites in Kakamega Forest in Kenya (Kruskal-Wallis: chi-squared = 11.6703, df = 5, p-value = 0.04) and Budongo Forest in Uganda (Kruskal-Wallis: chi-squared = 12.7373, df = 5, p-value = 0.03). The results of multiple comparison test after Kruskal-Wallis are indicated by letters above the bars; equal letters refer to no significant differences (P ≥ 0.05) and unequal letters indicate significant differences (P < 0.05) between means.

In Uganda the obvious separation of the northern forest fragment Kanio Pabidi (KP) from all remaining sites in the southern forest part likewise traces back to spatial impact. Within the southern study sites there is a clear division into the little disturbed forest sites (Nat, Dee, Old) and the more disturbed sites (Son, Sec).

The Kruskal-Wallis rank sum test showed that in both forests there is a significant difference in the species numbers per plot between the different disturbed study sites (Figure 3.6). In Kenya, forest disturbance first leads to a decline of species richness towards the old secondary forests (Yal and Col) and then to increasing species numbers in the more disturbed sites which even extends the undisturbed area (Figure 3.6a). The forest fragment Kisere (Kis) has significantly lower species numbers than most of the other sites. The species richness pattern in Uganda shows insofar similarity as the species number per plot is lowest in the old secondary forest (Old) is significantly lower than in most of the other sites (Figure 3.6b). Within the three primary forests sites the undisturbed one (Nat) has significantly lower species numbers than the closely located primary forest influenced by illegal logging (Dee). The species richness of the primary forest fragment (KP) in the far north of the forest is likewise higher than in Nat, but here the difference is not significant.

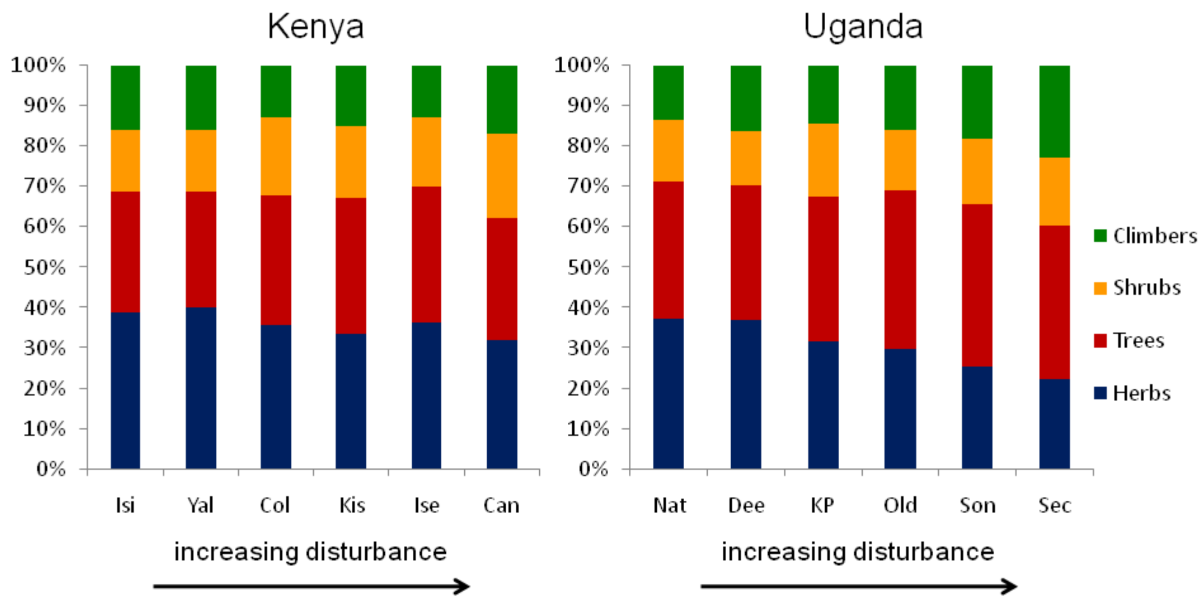

Figure 3.7 – Growth form composition along a disturbance gradient in Kakamega Forest (Kenya) and Budongo Forest (Uganda) based on species composition in the particular sites.

There is only a slight influence of forest disturbance on the growth form composition in Kenya (Figure 3.7), but towards the more disturbed sites an increased percentage of shrub species and a decreased amount of herbs can be observed. In Uganda, increasing forest disturbance clearly leads to higher percentages of climber and tree species and lower amounts of herbaceous species.

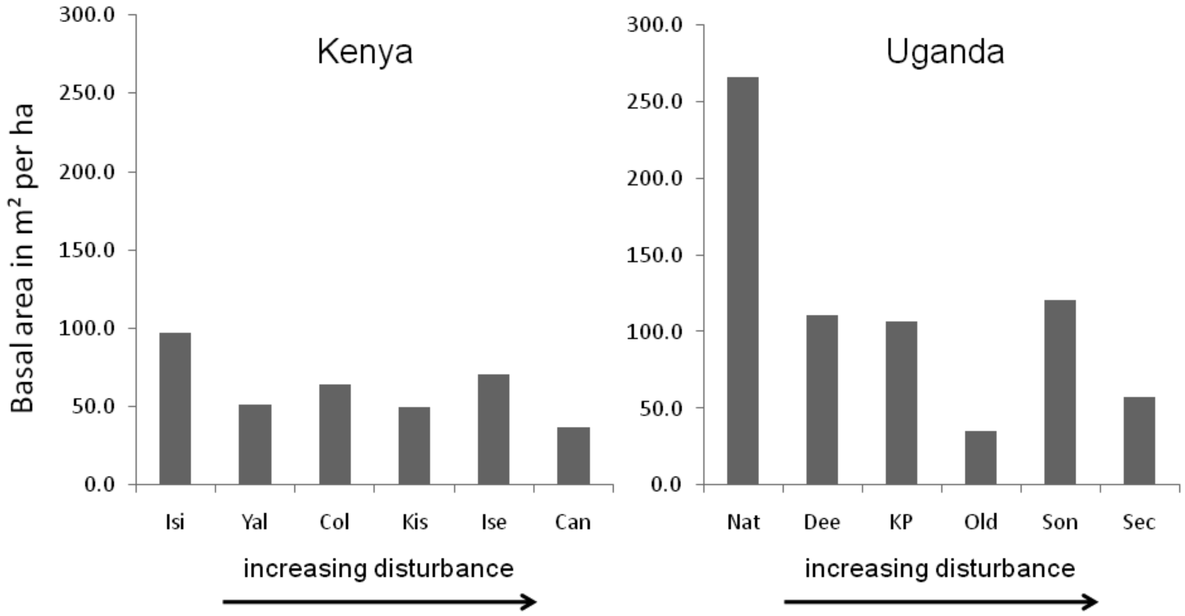

Figure 3.8 – Basal area per ha of each study site in Kakamega Forest (Kenya) and Budongo Forest (Uganda) arranged along a disturbance gradient.

The basal area in Uganda is with averagely 116.0 m² per ha considerably higher than in Kenya with averagely 61.7 m² but however, this difference is not significant (Welch Two Sample t-test: df = 5.7, p-value = 0.17). Generally forest disturbance causes a decrease of the basal area with highest basal area in the undisturbed sites and lowest in the most disturbed sites, but the old secondary forest in Uganda (Old) stands out by its extremely low basal area (Figure 3.8). Further a slight increase of basal area can be observed in the sites Col, Ise, and Son which are exceeding the more intact sites next to them but not the most intact site in the particular forest. Interesting is the comparison of the two Ugandan primary forests without (Nat) and with (Dee) illegal logging: while the growth form composition is almost identical in both sites and the percentage amount of tree species is the same (Figure 3.7), the basal tree area is considerably lower in the area with illegal logging (Figure 3.8).

Table 3.2 – Mantel Test on the impact of forest disturbance and spatial distance (Spat. Dist.) on the floristic similarities of 384 plots within the study sites in Kakamega Forest (Kenya) and Budongo Forest (Uganda) measured with Euclidian distance.

	Kenya		**Uganda**		**Uganda excl. Kanio Pabidi**	
	Disturbance	Spat. Dist.	Disturbance	Spat. Dist.	Disturbance	Spat. dist
mantelr	0.329	0.072	-0.270	0.987	0.563	-0.045

Significance codes: *p < 0.05, **p < 0.01, ***p < 0.001

The Mantel Test showed that in Kakamega Forest, forest disturbance explains 33% of differences in the floristic composition while the impact of the spatial distance of the study sites is with 7.2% rather low (Table 3.2). Contrary for Budongo Forest it is obvious that the spatial distance is the decisive factor for floristic composition by explaining 99% of floristic differences, while disturbance here is even negatively correlated. If the study site in Kanio Pabidi, which has indeed a high spatial distance from all remaining Ugandan sites, is excluded from this analysis, forest disturbance explains 56% of the floristic differences of the remaining sites and only 4.5% of the differences are explained by the spatial distance. Thus, within the southern study sites in Budongo Forests, disturbance explains the differences in the floristic composition, but the floristic differences to the northern site in Kanio Pabidi are explained by the spatial distance. Even if some of the factors provide high explanatory power, none of them is significant.

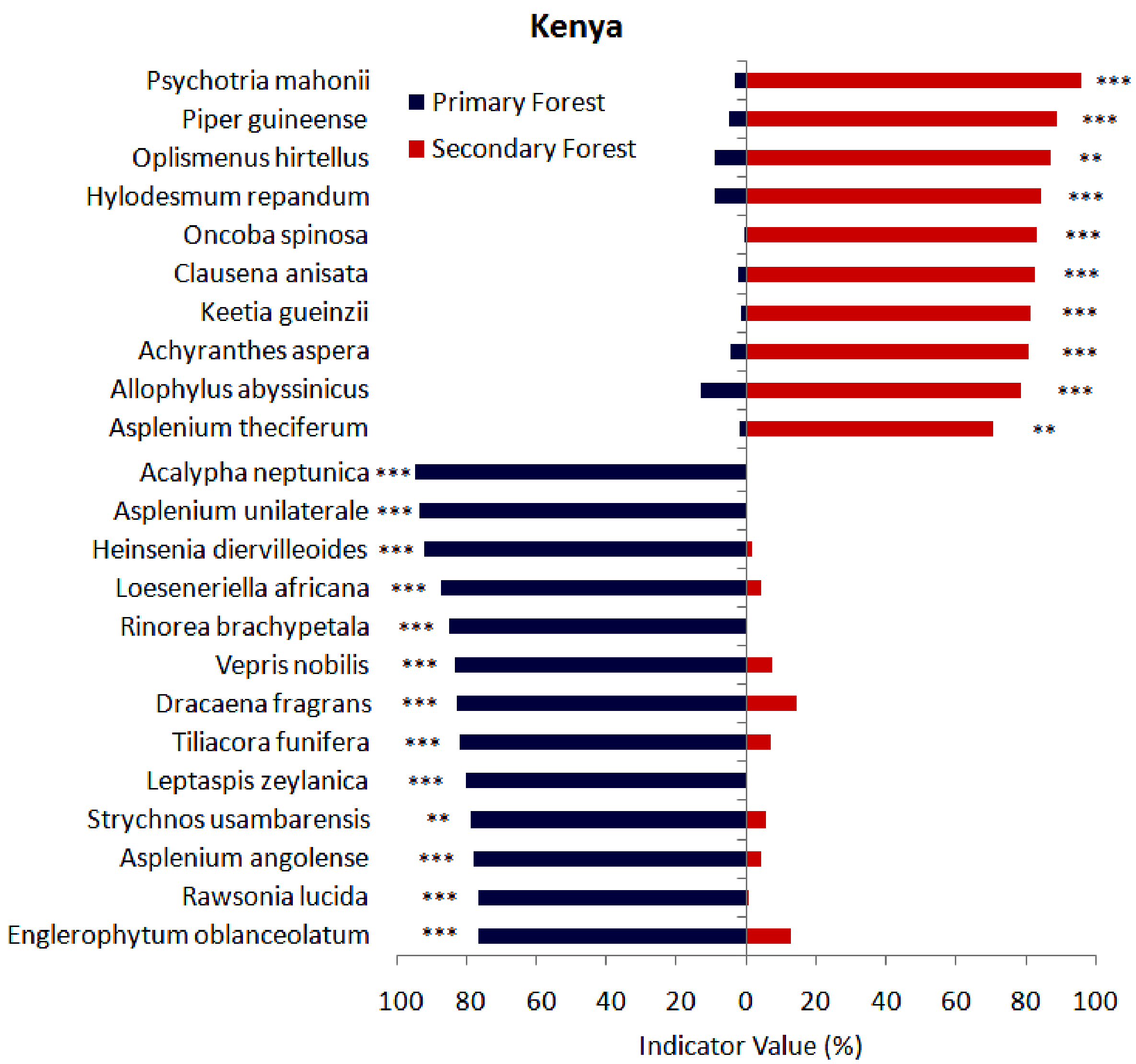

Figure 3.9 – Indicator species for intact and disturbed forest areas in Kakamega Forest (Kenya). Only indicator values ≥ 70% are considered. Stars indicating the significance level of the species as indicator for the particular forests type. Significance codes: *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001.

INDICATOR SPECIES FOR DISTURBED AND UNDISTURBED FOREST REGIONS

In both forests several plant species could be identified as significant indicator species for either undisturbed or disturbed forest areas. Altogether in Kakamega Forest 24 species were identified for indicating primary forests and 54 species for disturbed forests. In Uganda only 9 species indicate undisturbed forests and 22 species were identified as indicators for secondary forests. To reach a clear dimension of indicator species, a minimum indicator value was defined for both forests separately. Figure 3.9 and 3.10 show the most important indicator species for the two model forests including their indicator value and significance level.

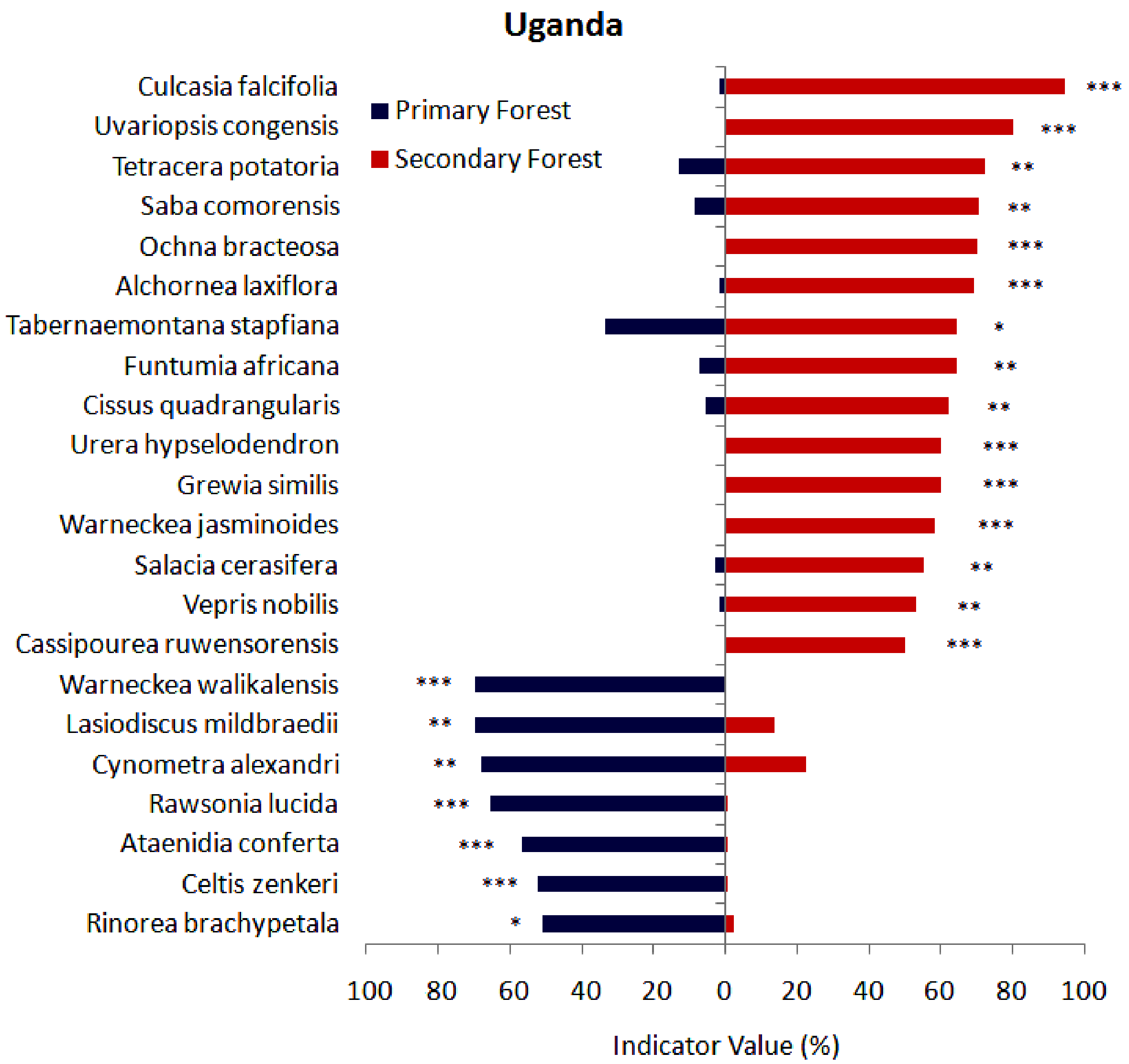

Figure 3.10 – Indicator species for intact and disturbed forest areas in Budongo Forest (Uganda). Only indicator values ≥ 50% are considered. Stars indicating the significance level of the species as indicator for the particular forests type. Significance codes: *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001.

For Kenya a minimum indicator value of 70% was defined and even if the total number of indicator species for secondary forests is much higher than for primary forests, the number of species that reached the minimum level is lower (Figure 3.9). Thus, while a smaller number of species indicates undisturbed areas, their average indicator value is higher (average indicator value: primary forest = 68%, secondary forest = 53%). In Uganda the average indicator value is almost equal in primary forest (56%) and secondary forest (55%), but here twice as much species were identified indicating disturbed areas than undisturbed areas even though the minimum indicator value was restricted to 50% (Figure 3.10).

Three species were identified to be indicator species in Kakamega and Budongo Forest. While *Rawsonia lucida* Harv. & Sond. and *Rinorea brachypetala* (Turcz.) Kuntze indicate in both forests the undisturbed areas, *Vepris nobilis* (Delile) Mziray indicates primary forest in Kenya but secondary forest in Uganda.

3.5 DISCUSSION

Although Kakamega Forest and Budongo Forest are considered to be once connected in a central African rain forest belt (Trapnell and Langdale-Brown 1962; Hamilton 1974), the plant species composition clearly separates both forests from each other. The exact periods of being connected and separated are unknown, but maps from the early 20th century show both forests already being surrounded by a densely populated agricultural area (Schaab *et al.* 2010). Thus, separation probably took place long ago. The environment of the two forests is similar as both forests are located on a high plateau with a distance of about 400 km. According to the 500 m higher elevation of Kakamega Forest the climate is slightly cooler and more humid than in Budongo Forest (chapter 2). The phytogeographical composition of the plants from Budongo Forest shows an obviously higher affinity to the guineo-congolian floral region than Kakamega Forest what can be explained by the smaller distance to the recent guineo-congolian forest. Due to the higher altitude, the higher amount of afromontane species in Kakamega is not surprising and possibly its closer location to the Indian Ocean explains the higher percentage of paleotropical species. The higher amount of introduced species in Kenya is attributable to the generally higher disturbance level of this forest.

Even though the Ugandan sites have a higher total species number, the average species number per plot is even slightly lower than in Kenya what indicates higher beta diversity for the sites in Budongo Forest. Considering the range of disturbance levels it would have been expectable that Kakamega Forest would show higher beta diversity as the Kenyan study sites cover near primary forests up to young secondary forests. In Uganda, young secondary forest was not available and so only primary forests to middle-aged secondary forests could be processed what makes it surprisingly that it still reached a higher heterogeneity. The Mantel Test showed that this heterogeneity is not due to forest disturbance but to the far distance of the primary forest fragment Kanio Pabidi to the remaining Ugandan sites (Table 3.2). This agrees with the results of Plumptre (1996) who likewise observed that in Budongo Forest the geographical location explains variation in species distribution better than the logging history.

CONSEQUENCES OF FOREST DISTURBANCE

An intact primary forest can become disturbed in various ways and each kind of disturbance causes different consequences, not only for the plant composition but also for the animal communities in the forest (Marsden *et al.* 2002). Several general trends could be observed along a disturbance gradient: in both forests, disturbance leads to a change in species and growth form composition, changing species numbers, and a reduction of the basal area. Especially the amount of herbaceous plant species decreased with higher disturbance levels in both forests while in Kenya the percentage of shrubs increased and in Uganda the amount of trees and climbers. Herbs in general and especially epiphytic herbs are more sensitive for humidity as their roots often cannot reach as deep into the soil as woody plants. Forest disturbance is usually associated with humidity loss due to a more open canopy (Gradstein 2008) what causes higher drought stress for the plants and the replacement of the sensitive herbaceous species by more drought-tolerant growth forms. Furthermore in both forests the intact sites have a generally higher basal area than the disturbed sites what is an expecting trend that has also been observed in other forests (Lwanga 2003; Chapman and Chapman 2004). However, the medium disturbed sites do not strictly follow this trend, especially in Budongo Forest, where the lowest basal area was recorded in the old secondary forest and not in the middle-aged secondary forest. These irregularities are probably caused in the logging history and high heterogeneity of some study sites. Especially the two middle-aged secondary forests (Ise and Sec) combine middle-aged succession vegetation with some large climax trees which are leftovers from older forest vegetation.

The differences in species number and composition can be explained by the changed abiotic conditions caused by forest disturbance. An intact primary forest is composed by species which are well established to the dark and humid conditions under the dense canopy (Chazdon 1988). Light-demanding plant species can usually not occur here unless they developed special adaptations like epiphytes who reach the light by growing on trees. In a younger or disturbed forest with an open canopy, the light can reach the forest floor and humidity evaporates. Here light demanding plants, usually pioneer species which depend on light for germination (Swaine and Whitmore 1988) and species from dryer and open areas, can establish. Thus, young and disturbed forests combine pioneer species, species from open areas and climax species either in form of seedlings or in case of plants which survived the disturbance. When the forest gets older, only the primary forest species stay, while pioneer and non-forest species will disappear (Swaine and Hall 1983). Therefore it is common to find higher species numbers and a different species composition in disturbed forests than in undisturbed areas (Sheil 2001). The impact of changes of the abiotic conditions is highlighted by the fact that disturbance causes only in humid areas significant changes in the vegetation composition (Ogutu 1996). In areas which are dry and flooded with light anyway, disturbance does not change the abiotic conditions and thus the floristic composition stays constant. Another possible reason for a change in species composition is that during logging the upper soil surface including the mycorrhiza is often removed whereby plant species without mycorrhiza have an advantage (Tsingalia 1990).

The comparison of the two Ugandan forest sites Nat and Dee highlights the influence of illegal logging. Both sites are located very close to each other and have not been commercially logged, but while Nat lies within the regularly controlled Nature Reserve, the signs of illegal logging are obvious in the less protected area (Dee) which lies deeper within the forest and outside the Nature Reserve. As spatial distance and forest age can be excluded here, the observed differences are traced back to illegal logging. Thus, it can be concluded that illegal logging causes increasing species numbers and a dramatically decline of the basal area, but does not change the growth form composition of the plants. The reduced basal area in the logged study site is self-explaining and the higher species numbers can be explained by the colonization of the logging places by species from open areas which would usually not occur in an intact forest under a closed canopy (Denslow 1987).

It has been demonstrated that forest disturbance changes the plant species composition in the affected areas. Consequently, the species which occur regularly in intact areas, but rarely in disturbed areas or vice versa, can serve as indicator species for the particular forest type. The resulting list of indicator species (Figure 3.9 and 3.10) especially applies for the forests where the study has been carried out and cannot necessarily be employed for a different forest. This is highlighted by the contrary indicator meaning of *Vepris nobilis* which indicates disturbance in the one forest and undisturbed areas in the other.

Figure 3.11 – Vascular plant species from Kakamega Forest (Kenya) and Budongo Forest (Uganda): a) *Dracaena fragrans*, Asparagaceae, b) *Ficus mucuso*, Moraceae (Uganda), c) *Monodora myristica*, Annonaceae, d) *Corymborkis corymbis*, Orchidaceae (Uganda), e) *Funtumia africana*, Apocynaceae, f) *Albizia gummifera*, Fabaceae. Except where otherwise specified the species occurred in both forests.

In Kenya this species occurred regularly in the primary forest, but rarely in the young secondary forest and in Uganda it occurred rarely in the primary forest, but young secondary forest was not available here. So in Uganda *V. nobilis* indicates the highest available disturbance level which was middle-aged secondary forest, but it is not unlikely that it would be rare in Ugandan young secondary forests as it is in Kenyan. If despite of this limited applicability for other forests, a species turns out to be indicator for the same disturbance level in different forests, as in the case of *Rawsonia lucida* and *Rinorea brachypetala*, its qualification as indicator species increases.

Beside forest disturbance, it could be shown that the spatial distance of the forest sites also affects the plant species composition. In Kakamega Forest the sites from the southern forest part show a higher affinity to each other than to sites from the northern part with the same disturbance level. This north-south difference has already been observed in earlier studies (Althof 2005; Dalitz and Gliniars 2010) and as temperature differences are absent and soil types do not correlate with plant communities (Althof 2005), the difference in the floristic composition can only be explained by the higher humidity in the southern forest area (Dietzsch 2004; Althof 2005). In Budongo Forest the floristic composition of the northern fragment Kanio Pabidi clearly distinguishes from all other study sites and it could be demonstrated that this differences are almost exclusively explained by the spatial distance. Unfortunately no climate data are available for Kanio Pabidi, but as this fragment is the northern most forest part before forest turns into Savanna, it is assumable that spatial distance is accompanied by climatically changes.

COMPARISON TO EARLIER STUDIES ON EAST AFRICAN RAIN FOREST FLORISTICS

The high amount of species which are not included in earlier species lists for Kakamega and Budongo Forest highlights the little knowledge of the vegetation of East African rain forests.

While there are several studies on selected plant groups or species (e.g. Tsingalia 1989), the work of Althof (2005) is so far the only study on the entire vascular vegetation of Kakamega Forest. Althof likewise recorded the highest species numbers and the lowest basal area in the most disturbed forest sites what is also true for many other forests (Swaine and Hall 1983; Sheil 2001) and only few studies report of contradictory results (Chapman and Chapman 1997; Lwanga 2003). Further Althof identified a total of 14 indicator species for either low or heavy disturbed forest types, but basing on different methods and to some extent on different study sites. However, the three species *Tiliacora funifera* (Miers) Oliv., *Loeseneriella africana* (Willd.) R.Wilczek, and *Strychnos usambarensis* Gilg were identified to indicate intact forest sites in both studies, what highlights their suitability as indicator species.

More data are available for the floristics of Budongo Forest. In the context of a study on tree diversity in forests of the Albertine Rift, Eilu *et al.* (2004) report 32 tree species (DBH ≥ 10 cm) per ha for Budongo Forest. Combining the six Ugandan tree plots (50 x 30 m) from the present study results in an area of 9000 m² what almost complies with 1 ha. Within this area 108 tree species (DBH ≥ 10 cm) were recorded. The fact that the present study obtains many times higher tree species numbers while the study area is even smaller, clarifies the influence of forest disturbance on species diversity: while Eilu *et al.* carried out their survey exclusively in an intact primary forest, the present survey is combined from six sites with different disturbance levels what increased the species numbers enormously. In comparison with data from Neotropical regions even the species numbers enhanced by forest disturbance are very low: De Oliveira and Mori (1999) reported 280 tree species (DBH ≥ 10 cm) in 1 ha of central Amazonian terra firme forest.

Also the change on the species composition becomes obvious in comparison with the data from Eilu *et al.* (2004) who reported Euphorbiaceae, Rubiaceae, and Meliaceae to be the most species rich tree families in the intact forest. Combining different disturbance levels in the present study, Moraceae are the most species rich tree family followed by Fabaceae and Meliaceae while Euphorbiaceae are listed in fourth place.

The succession stages of Budongo Forest were already intensively investigated and the authors agree that the final progression stage is a rather species poor *Cynometra* forest (Eggeling 1947; Sheil 1999). The interest of the present study was not the succession stages but differences of the vegetation with increasing disturbance levels including forest fragmentation and recent human impact on unlogged and regenerating forest types. However, our data agree insofar with the succession stages of Eggeling that *Cynometra alexandri* was identified to be an indicator for undisturbed forest regions. Also the low species numbers of this progression stage are confirmed in this study as the most intact *Cynometra* dominated study site (Nat) belongs to the most species poor sites.

Earlier studies already demonstrated that 30 or 50 years after logging the affected areas still differed from unlogged forest in terms of species composition and tree structure (Plumptre 1996; Chapman and Chapman 2004). Supplementary the results of this study show that even about 80 year old secondary forest significantly differs from primary forest. Further it can be concluded that unlogged forests with a high human impact (fire wood collecting, hunting, cutting of young trees, etc.) likewise differs from undisturbed areas in species numbers, species and growth form composition, and basal area.

4 - EPIPHYTE DIVERSITY ALONG A DISTURBANCE GRADIENT

"Der Botaniker gerät in solchen Urwäldern nicht selten in die verzweifelte Lage, das Ziel seiner Wünsche in unerreichbarer Höhe über seinem Haupte schweben zu sehen, ohne Mittel zu besitzen auch nur eines Blattes habhaft werden zu können."

(Georg Schweinfurth 1918)

Freely translated:

"In such jungles, the botanist often finds himself in the desperate situation of seeing the aim of his desires wafting in unreachable height above his head, without having the means to get hold of just one leaf."

4.1 ABSTRACT

Epiphytes represent an essential component of plant diversity and biomass of tropical rain forests where they immensely contribute towards a complex biocoenosis of arboreal animals and plants in the tree canopy. Being located far away from the Neotropical epiphyte diversity center, African epiphyte communities are so far comparatively little investigated. In this study the diversity and composition of vascular epiphytes was examined in two East African mid-elevation rain forests (Kakamega Forest in Kenya and Budongo Forest in Uganda) with a focus on the influence of forest disturbance on the epiphyte diversity. Therefore 132 study plots were established along a disturbance gradient harboring altogether 170 species of epiphytes what amounts 20% of the total vascular plant species (including non-epiphyte species) investigated in this thesis. The most diverse epiphyte groups were orchids and ferns which amount 80% of the total species number. In Budongo Forest increasing habitat disturbance leads to decreased epiphyte species richness while the diversity patterns in Kakamega Forest rather indicate a species increase from north towards south what might be due to climatic reasons. The impact of further factors concerning plot and phorophyte characteristics differed depending on the forest age. The present results broadly agree with other studies on African epiphytes, but differ considerably from Neotropical epiphyte assemblages in terms of lower species numbers and different floristic composition.

4.2 INTRODUCTION

Epiphytes play a key role in tropical rain forest ecosystems (Nadkarni 1994). About 10% of all described vascular plants species are epiphytes (Kress 1986) and thus, they are not only increasing the plant diversity enormously, but also the plant biomass (Nadkarni and Matelson 1992; Ingram and Nadkarni 1993; Gradstein 2008; Fayle *et al.* 2009). In a Chilean rain forest for instance, Díaz *et al.* (2010) estimated that the epiphyte dry weight amounts 10t/ha and increases the photosynthetic biomass by 40-150%. Further epiphytes are important for carbon uptake, water storage, and nutrient cycling of the forest ecosystem, and hosting a diverse arboreal fauna reaching from small microorganism up to vertebrates (Nadkarni 1994; Benzing 1998; Köhler *et al.* 2007; Díaz *et al.* 2010). Besides being an important food source for arboreal animals in terms of providing nectar, pollen, and fruits, epiphytes also present an important source for water, shelter, nesting material, breeding and hunting grounds (Nadkarni and Matelson 1989; Benzing 1998; Yanoviak *et al.* 2006). Some epiphytes such as bromeliads, nest-forming ferns, and pitcher plants host entire miniature ecosystems (e.g. Neill 1951; Kitching 2000; Lopez *et al.* 2005; Rembold 2009). In the case of ant-gardens and ant-plants, epiphytes and animals developed mutualistic relationships which extent the usual plant-pollinator or plant-disperser mutualisms (Blüthgen *et al.* 2000; Rico-Gray and Oliveira 2007; Schmit-Neuerburg and Blüthgen 2007). Other organisms even depend on particular epiphyte species like the orchid *Cymbidiella pardalina* (Rchb.f.) Garay that only occurs on the epiphytic fern *Platycerium madagascariense* Baker (Benzing 1990; Nieder and Barthlott 2001).

The highest epiphyte diversity occurs in the tropics and there especially in perhumid mid-elevation mountain forests (Gentry and Dodson 1987; Benzing 1990; Küper *et al.* 2004b; Cardelús *et al.* 2006). Within the tropics the diversity center of epiphytes is clearly located in the Neotropical region while Africa is considered as being comparable poor on epiphytes and tropical Asia takes an intermediate position (Gentry and Dodson 1987; Benzing 1990). There are numerous theories why the distribution of epiphyte species is that uneven. One of the most accepted reasons is the paleoclimate: in the Neotropics many humid refuges remained during Pleistocene dry periods where epiphytes could survive and had to find their particular niches within the condensed habitat. In the Paleotropical regions those refuges were often not available and so the epiphyte species disappeared and especially in Africa the cool and dry Pleistocene climate had an unusual devastating influence on the humid forest flora (Benzing 1990; Kreft *et al.* 2004). Another reason is that two important Neotropical epiphyte families are mainly absent in the old world tropics: Bromeliaceae and Cactaceae. Both families are only represented by one single species in Africa: *Rhipsalis baccifera* (J.S.Muell.) Stearn (Cactaceae) and *Pitcairnia* *feliciana* (A.Chev.) Harms & Mildbr. (Barthlott 1983; Barthlott and Taylor 1995; Porembski and Barthlott 1999; Jaques-Félix 2000; Heywood *et al.* 2007). The ecological niche of Bromeliaceae is to some extant occupied by the nest-forming ferns of the genera *Drynaria*, *Platycerium* and *Asplenium* in the old world tropics, but they never reached the dimensions and variety of the bromeliad family (Benzing 1990).

Most studies on epiphytes concentrate on the diverse Neotropical regions while in Africa only a few studies have been carried out (namely Eggeling 1947; Johansson 1974; Biedinger and Fischer 1996; Schaijes and Malaisse 2001; Engwald 2004; Zapfack and Engwald 2008). Those studies report epiphyte species numbers ranging from 100 to 167 for different African forests with up to 40 species per tree. African epiphyte communities are described as orchid-fern components while other families are underrepresented (Johansson 1974; Benzing 1990). Epiphyte phytotelmata like bromeliad water tanks or *Nepenthes* pitcher plants are absent in continental Africa as well as specialized epiphytic ant-plants like *Myrmecodia*, *Hydnophytum*, *Dischidia*, *Myrmecophila* and *Lecanopteris* (Heywood *et al.* 2007; Rico-Gray and Oliveira 2007). Hence, not only the number of epiphytic species, but also the degree of specializations for epiphyte-arthropod interactions seems to be low in Africa compared to other tropical regions. Nevertheless arboreal animals are known to benefit from epiphytes by nesting in the organic matter of African epiphyte mats (Yanoviak *et al.* 2007).

Independent from their geographical distribution, most epiphytes are very specialized and survive only under certain conditions. As epiphytes are not connected to the forest soil, they are much more vulnerable to climatic changes, especially in temperature and humidity (Benzing 1990; Benzing 1998; Nieder and Barthlott 2001). Those changes can be caused by forest disturbance and earlier studies showed that the number of epiphytes decreases in young and disturbed forests compared to primary forests (Eggeling 1947; Barthlott *et al.* 2001; Köster 2008; Köster *et al.* 2009).

Nadkarni (1992) stated that "the more we learn about epiphytes the more we want to protect them". The protection and conservation of epiphytes is also an aim of the present study. In Africa as elsewhere in the tropics the natural forest cover is rapidly decreasing due to human activities (Diamond 1979; Oyugi 1996; Schaab *et al.* 2010) and together with the forests, the epiphytes are vanishing too. As the knowledge about African epiphytes is very limited, the present study had three main aims: 1) to learn more about the inventory of the epiphyte species within the study areas in East African rainforests, 2) the assessment of the influence of forest disturbance on the epiphyte diversity and composition, and 3) the comparison to other studies on inner and outer African epiphyte communities.

4.3 METHODS

Representative for East African rain forests in general, the present study was carried out in two model forests: Kakamega Forest in Kenya and Budongo Forest in Uganda. A total of 12 study sites were selected (six per forest), representing the full range from primary forest up to young secondary forest under different anthropogenous and ecological pressures (see chapter 2). The canopy height in Kakamega Forest amounts 25-30 m with emergent trees reaching heights up to 45m (Collar and Stuart 1988). In Budongo Forest the trees are generally a few meters higher and emergent trees can reach up to 60 m (Sheil 1995, 2001).

EPIPHYTE SURVEY

In each of the 12 study sites 11 epiphyte plots were established (in total 132 epiphyte plots, 66 per forest). Each plot measured 20 x 20 m (400 m²) and had to have a minimum distance of 100 m to the next epiphyte plot. The plots were established surrounding one large phorophyte of a common tree species for the particular site with a minimum DBH (diameter at breast height in 1.30 m) of 50 cm, except for the young secondary forest ("Canteen") where the trees were generally smaller. The phorophytes were divided into five zones after Johansson (1974) and for each zone all vascular plant species (including holo- and hemiepiphytes, climbers, and seedlings of terrestrial plants) were recorded (Figure 4.1). In order to reach the upper tree zones, the phorophytes were climbed by using single rope climbing techniques (Perry 1978; Perry and Williams 1981; Dial and Tobin 1994; Ingram and Lowman 1995). The employment of binoculars afforded insight into the epiphyte community on the small outer branches of the host tree. In case of the smaller trees in the young secondary forest, the epiphyte survey was solely carried out by using binoculars without climbing the tree.

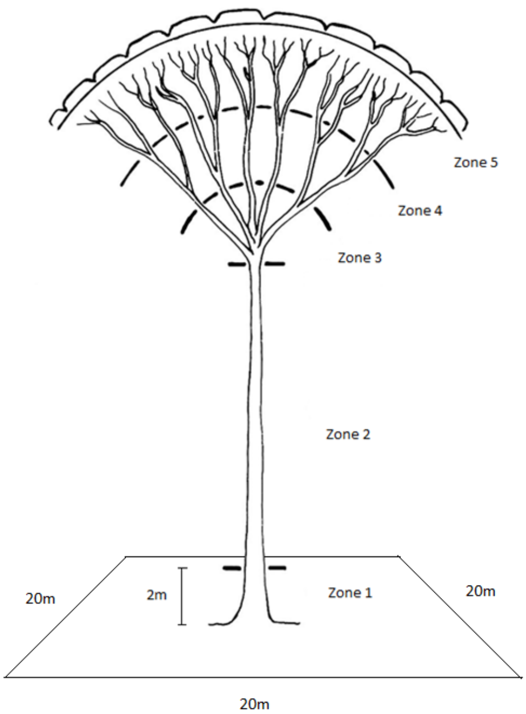

Figure 4.1 – Arrangement of the study plots and division of the main phorophyte into five Zones after Johansson 1974.

To compensate the difference in size between Zone 1 and the larger tree canopy, all vascular plant species occurring in Zone 1 of the remaining trees within the plot with DBH ≥ 10 cm were recorded as well (modified after Gradstein *et al.* (2003)). Further all trees within the plots, including the main phorophyte, were identified to species level and DBH and height were determined.

In case of species which could not be identified in the field, herbarium specimens were produced for later identification in the herbaria of the National Museums of Kenya (Nairobi) and the Makerere University in Kampala (Uganda). After identification the specimens were deposited in the particular herbarium. Species identification was supported by implementation of identification literature (Hamilton 1991; Agnew and Agnew 1994; Beentje 1994; Stewart and Campbell 1996; Fischer and Killmann 2008; Fischer *et al.* 2010). If species could not be identified to species level (what especially concerns non flowering orchids) they were assigned to morphospecies. The systematical classification is based on the TROPICOS ® data base provided by the Missouri Botanical Garden (www.tropicos.org, accessed in Dec. 2010) and The Plant List (2010).

Epiphytic orchids lying on the forest floor or growing on fallen trees were collected, identified, and delivered to the Botanical Garden of the Maseno University (Kenya) and the orchid houses of the National Museums of Kenya and the Makerere University (Uganda) for ex-situ conservation.

STATISTICAL ANALYSIS

In order to find out if the number of epiphyte species recorded in this study is representative for the study area, the first-order jack-knife species richness estimation was carried out by using the program package EstimateS (Colwell 2006). All following analyses and related figures were made with the R computer software (R Development Core Team 2009). The epiphyte species numbers per plot were tested for normal distribution with Lilliefors Kolmogorov-Smirnov normality test and as the data were normally distributed, the two sample t-test was applied to investigate differences in the species numbers between Kakamega Forest and Budongo Forest (Dytham 2003). The epiphyte diversity of the Ugandan study sites were compared by carrying out an analysis of variance (ANOVA, Sokal and Rohlf 1995). The results of the ANOVA were verified by Levene's test for homogeneity of variances (Schumacher 2007) and Tukey's honest significant differences test was performed to detected pairwise differences of epiphyte diversity between study sites (Crawley 2007). As the variances of the Kenyan dataset were not homogeneous, instead of ANOVA the Kruskal-Wallis rank sum test and multiple comparison tests after Kruskal-Wallis were carried out by the package "pgirmess" (Giraudoux 2010). Further the influence of habitat and host-tree characteristics on epiphyte diversity was tested by simple and multiple regression analysis. The floristic similarity between the 66 study plots in each of the two forests was calculated by using Sørenson's similarity coefficient. By subtracting the Sørenson's index (1 - Sørenson's index) values for the floristic dissimilarity between plots were received. Based on the Euclidian distances, non-metric multidimensional scaling (NMDS) was performed using the package library "ecodist" (Oksanen 2011) to find differences in the taxonomic composition of the epiphytes within the study plots.

4.4 RESULTS

The investigation of arboreal vascular plants within the 12 study sites recorded a total of 315 species from 158 genera and 63 families. 176 of the species could be recorded in Kakamega forest, 207 in Budongo Forest and 69 species occurred in both forests. The percentage amount of epiphytic species is with 54% in Kakamega and 53% in Budongo Forest almost equal while the remaining species are either climbers or terrestrial herbs and seedlings which only occasionally grow on trees (Figure 4.2). The main difference between the two forests is the higher amount of climber species in Budongo Forest and the consequently smaller amount of terrestrial herbs and seedlings.

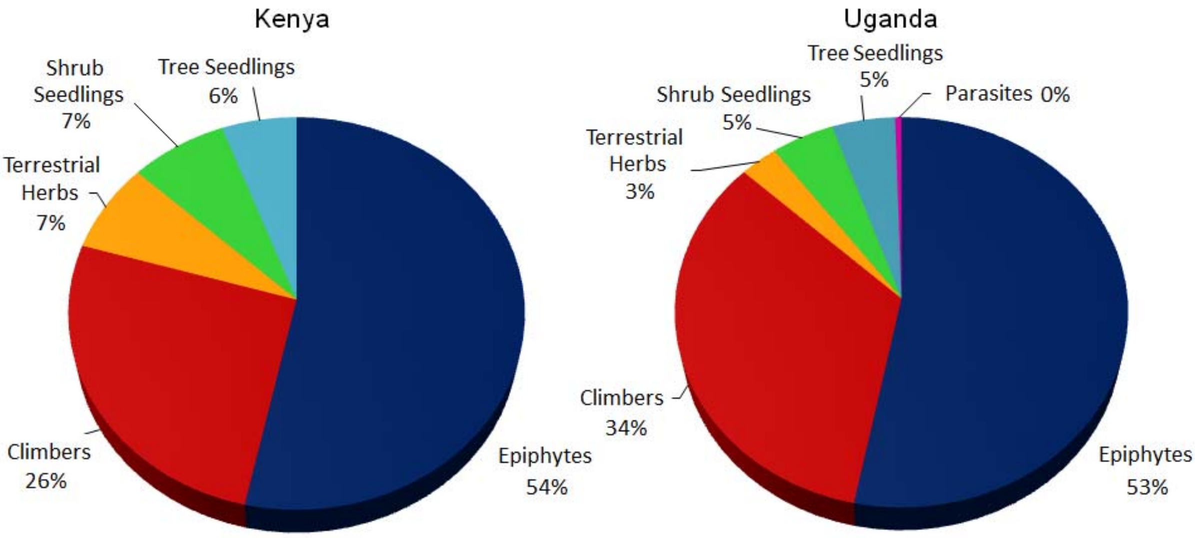

Figure 4.2 – Percentage composition of 176 arboreal vascular plant species from Kakamega Forest (Kenya) and 207 species from Budongo Forest (Uganda).

Most of the study sites in Kenya have similar compositions of arboreal life forms regardless of the degree of forest disturbance with the exception of the young secondary forest (Can) which has a higher amount of climbers and less epiphytic species (Figure 4.3). The old secondary forest in Yala (Yal) differs by the smaller amount of terrestrial seedlings and higher percentage of climbers. In Uganda the highest amount of epiphytes and consequently the lowest percentage of climbers are reached in the forest fragment Kanio Pabidi (Kan). Towards the two primary forest sites in the main forest block (Nat, Dee) the amount of epiphytic species decreases slightly while the amount of terrestrial seedlings increases. In the old and middle-aged secondary forests the percentage of epiphytes decreases with increasing disturbance while the number of climbers is rising.

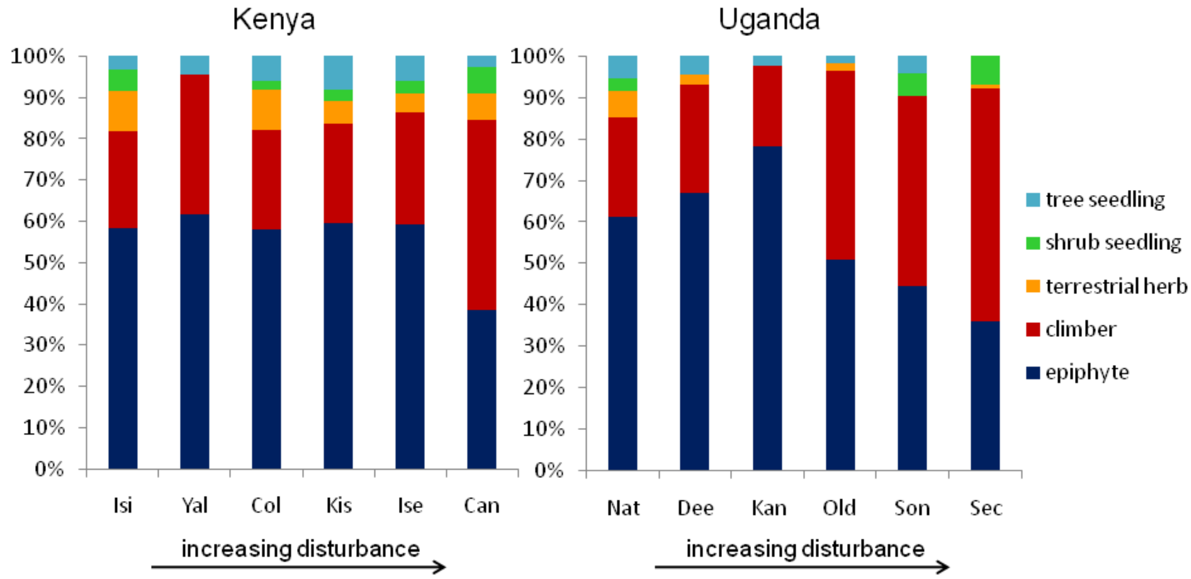

Figure 4.3 – Variation of percentage composition of arboreal vascular plant species from Kakamega Forest (Kenya) and Budongo Forest (Uganda) along a disturbance gradient.

In the following chapters climbers and seedlings are excluded and only epiphytes are considered, including holoepiphytes, hemiepiphytes and facultative epiphytes (species which can grow terrestrial but were also found growing epiphytic on several occasions). The variability of the species *Urera cameroonensis* Wedd. and *Urera hypselodendron* Wedd. made their classification difficult as they were found growing as holoepiphytes, primary hemiepiphytes, secondary hemiepiphytes, and climbers. In this study they are simply classified as hemiepiphytes.

FLORISTIC OVERVIEW OF EPIPHYTES

The entire study area including Kakamega and Budongo Forests harbored a total of 170 species of vascular epiphytes (including hemiepiphytes and facultative epiphytes) from 46 genera and 21 families (Appendix 2). Of them, 100 species could be identified to species level, 47 to unconfirmed species level or genus level, and 23 to family level. The species which were only identified to genus or family level involve almost exclusively epiphytic orchids which were not in flower and could thus only be classified into morphospecies. The total plant list of this study contains 853 species of vascular plants within the study area (chapter 3) and thus, 20% of the investigated vascular plants in these forests are epiphytes.

Figure 4.4 shows that in both forests the majority of epiphytes are composed of holoepiphytes. While the amount of hemiepiphytes is equal, Kakamega Forest has a higher percentage of facultative epiphytes and consequently the number of holoepiphytes is slightly lower than in Budongo Forest.

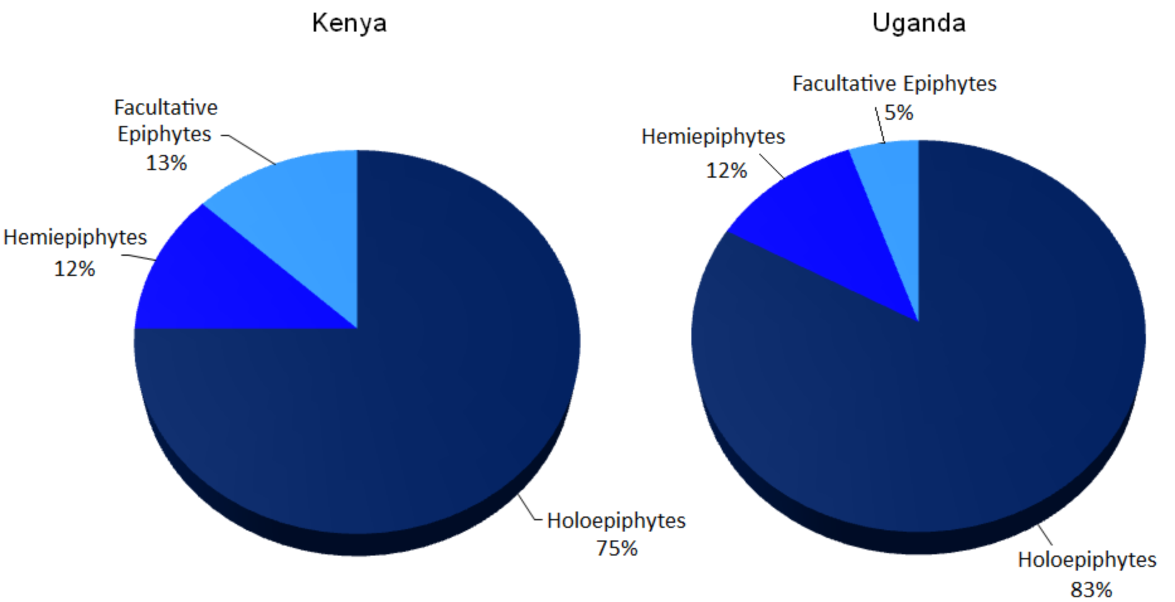

Figure 4.4 – Percentage composition of 100 vascular epiphyte species from Kakamega Forest (Kenya) and 112 species from Budongo Forest (Uganda).

In both forests the majority of epiphytes belongs to the families Orchidaceae, Aspleniaceae, and Moraceae (Table 4.1). Orchids provide the most species rich epiphyte group (98 species) followed by ferns (38 species) and other epiphytes (34 species). Figures 4.5 and 4.7 show some typical representatives of epiphyte species in the study area and illustrate the taxonomic variety.

The study area in Budongo Forests contained with 112 observed species and 100 species recorded within the plots a slightly higher number of epiphytes than Kakamega Forest with 100 observed species and 71 species within the plots. Basing on the species richness of the 66 study plots per forest, the estimated total epiphyte species number was 127.6 in Budongo and 92.7 in Kakamega (first-order jack-knife species richness estimation). Thus, in both forests more than 76% of the estimated species numbers were found.

Table 4.1 – Epiphyte species numbers of the vascular plant families in Kakamega Forest (Kenya) and Budongo Forest (Uganda). % = percentage amount of the family on the total number of epiphytic species in both forests.

Family	Both forests combined	Kenya	Uganda	Shared species	%
Orchidaceae	98	52	57	11	57.6
Aspleniaceae	19	11	15	7	11.2
Moraceae	15	10	11	6	8.8
Polypodiaceae	8	6	6	4	4.7
Piperaceae	6	5	5	4	3.5
Balsaminaceae	3	2	1	-	1.8
Oleandraceae	3	1	3	1	1.8
Urticaceae	3	2	3	2	1.8
Vittariaceae	3	1	3	1	1.8
Hymenophyllaceae	2	2	2	2	1.2
Adiantaceae	1	1	-	-	0.6
Araceae	1	1	1	1	0.6
Araliaceae	1	-	1	-	0.6
Asparagaceae	1	1	-	-	0.6
Begoniaceae	1	1	1	1	0.6
Cactaceae	1	1	1	1	0.6
Crassulaceae	1	1	-	-	0.6
Davalliaceae	1	-	1	-	0.6
Dryopteridaceae	1	1	1	1	0.6
Verbenaceae	1	1	-	-	0.6
Total	**170**	**100**	**112**	**35**	**100**

Each of the 132 plots contained averagely 11.4 (SD 5.6) epiphyte species with a maximum number of 30 epiphytes per plot. In Kakamega Forest the average number of species per plot is with 13.3 (SD 3.8) higher than in Budongo Forest with 9.5 (SD 6.5). The t-test showed that the difference in epiphyte species numbers per plot between Kakamega and Budongo Forest is highly significant (df = 105.9, p-value < 0.001). Thus, while the total number of epiphyte species is higher in Budongo, the species numbers per plot are significantly lower what indicates a higher specialization of epiphytes to the different forest types. In contrast, the epiphytic species in Kakamega must be distributed across several forest types to reach a significantly higher species number per plot with a lower total species number.

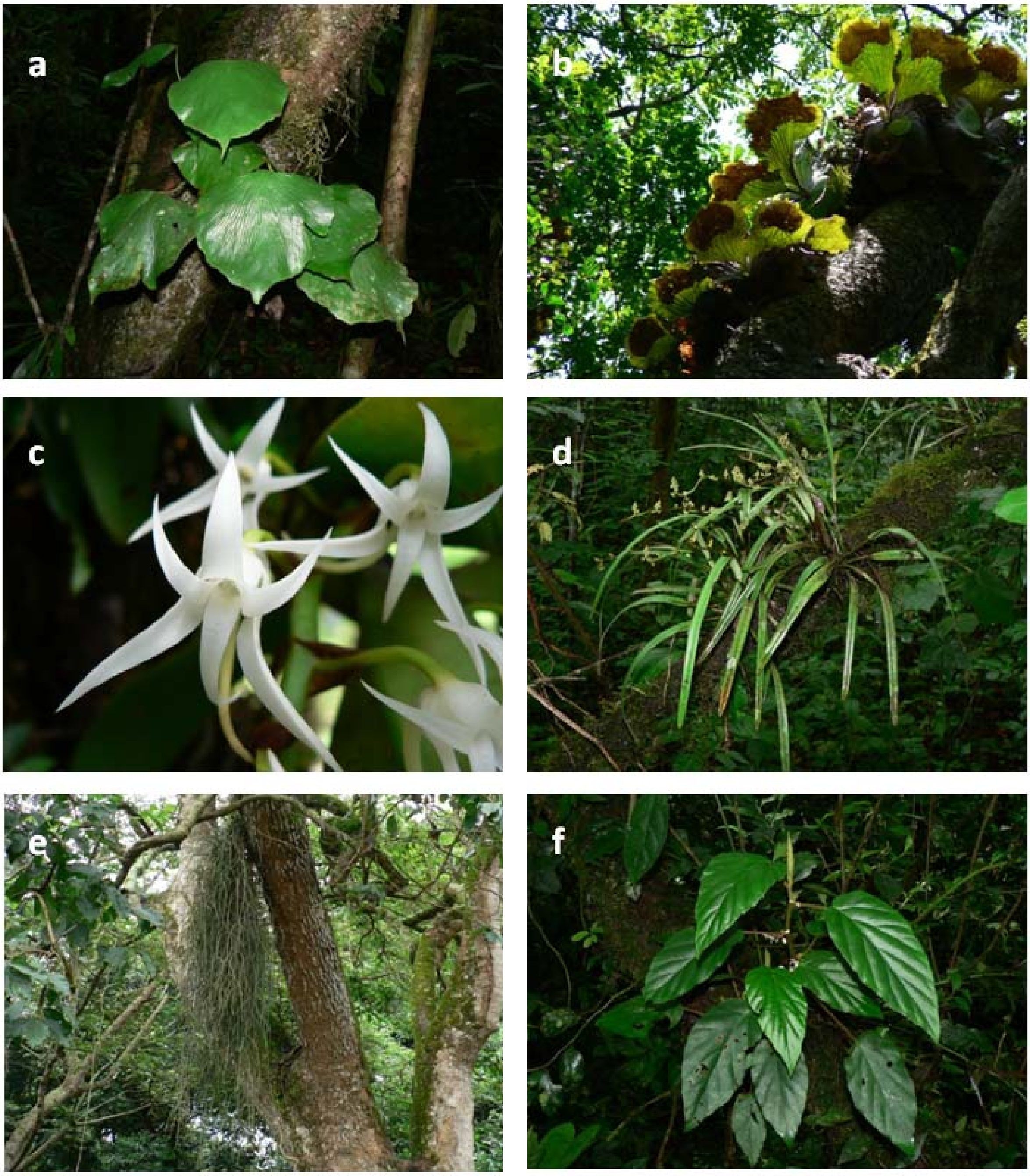

Figure 4.5 – Epiphyte species from Kakamega Forest (Kenya) and Budongo Forest (Uganda): a) *Scoliosorus mannianus*, Vittariaceae, b) *Platycerium angolense*, Polypodiaceae, c) *Cyrtorchis arcuata*, Orchidaceae, d) *Polystachya tenuissima*, Orchidaceae, e) *Rhipsalis baccifera*, Cactaceae, f) *Begonia eminii*, Begoniaceae.

This assumption is supported by the floristic similarity based on Sørenson's similarity index. With a similarity of averagely 0.60 (ranging from 0.50 to 0.69; SD 0.13) the floristic composition of the 66 study plots in Kenya is three times higher than for the 66 plots in Uganda with 0.21 (ranging from 0.10 to 0.37; SD 0.15). The lower similarity of the Ugandan sites indicates higher beta diversity in this area (Biedinger and Fischer 1996). In Kenya the average similarity is highest between plots of old secondary forests (mean [SD]

= 0.63 [0.14]), followed by primary forest (0.58 [0.20]) and young secondary forest (0.55 [0,16]). In Uganda the highest average similarity is reached between primary forest plots (0.32 [0.14]) followed by young secondary forests (0.30 [0.21]) and then old secondary forests (0.22 [0.17]).

INFULENCES ON EPIPHYTE DIVERSITY

The number of epiphyte species differed significantly between the different disturbed study sites in both forests (Figure 4.6, Kenya: Kruskal-Wallis: df = 5, p <0.001; Uganda: ANOVA, $F_{4,60}$ = 8.36, p <0.001). In Budongo Forest an increasing forests disturbance obviously leads to a lower epiphyte species number. The two primary forest sites with (Dee) and without (Nat) illegal logging have the highest numbers of epiphyte species (average species number per plot = 15.9 and 16.0) followed by the primary forest fragment (Kan, 9.8). The three secondary forests have significantly lower epiphyte species numbers with the highest number in the old secondary forest (Old, 6.5) while the lowest species numbers were observed in the old secondary forest with high human impact (Son, 6.1) and the middle-aged secondary forest (Sec, 6.3).

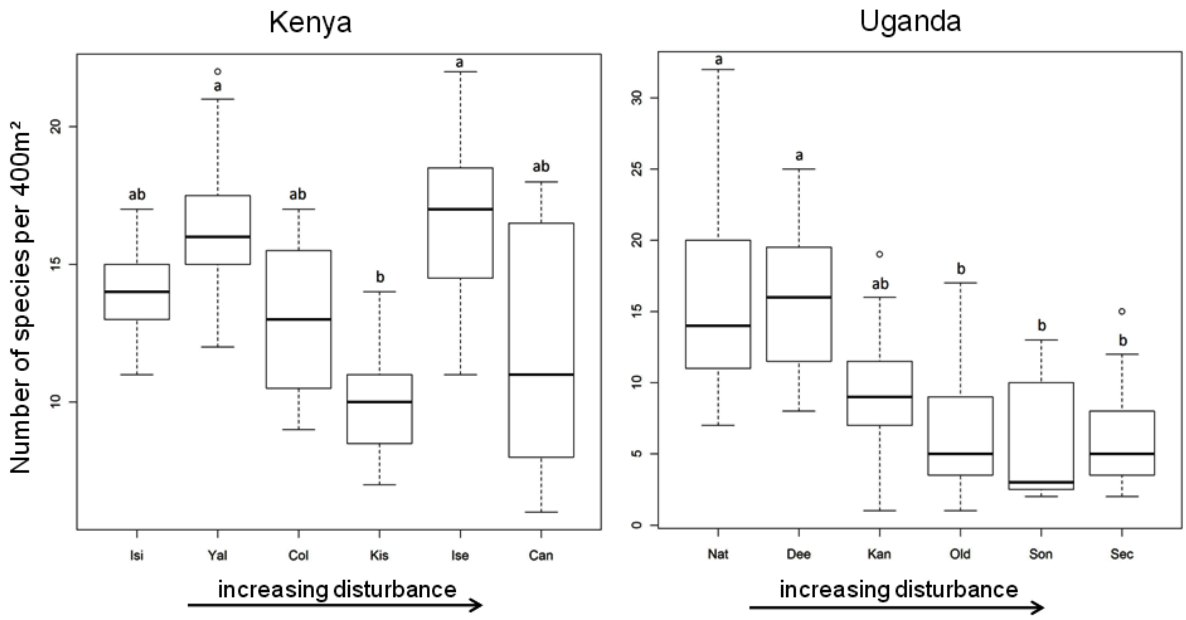

Figure 4.6 – Epiphyte species richness in 132 plots within the different study sites in Kakamega Forest (Kenya, Kruskal-Wallis: chi-squared = 25.4, df = 5, p <0.001) and Budongo Forest (Uganda, ANOVA: $F_{4,60}$ = 8.36, p <0.001). For both forests the study sites are arranged along a disturbance gradient increasing from left to right. The results of multiple comparison test after Kruskal-Wallis (Kenya) and Tuckey's honest significant differences tests (Uganda) are indicated by letters above the bars; equal letters refer to no significant differences (P ≥ 0.05) and unequal letters indicate significant differences (P < 0.05) between means.

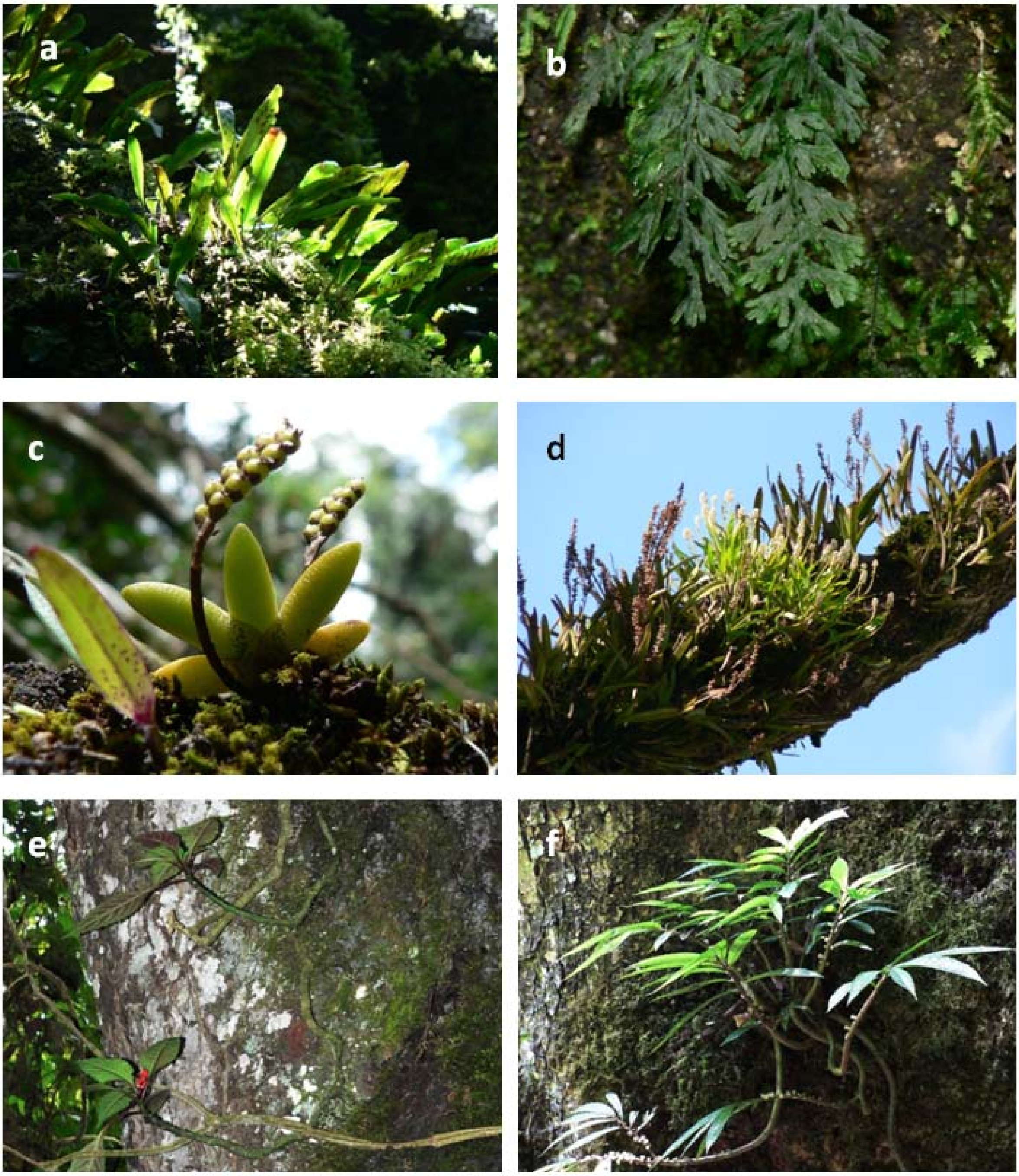

Figure 4.7 - Epiphyte species from Kakamega Forest (Kenya) and Budongo Forest (Uganda): a) *Loxogramme abyssinica*, Polypodiaceae, b) *Crepidomanes ramitrichum*, Hymenophyllaceae, c) *Bolusiella maudiae*, Orchidaceae, d) *Polystachya adansoniae*, Orchidaceae, e) *Impatiens* sp. nov., Balsaminaceae (Uganda), f) *Procris crenata*, Urticaceae (Uganda).

In Kakamega Forest no such influence of forest disturbance on epiphyte species numbers could be observed. The sites with the highest species numbers are a middle-aged secondary forest (Ise, average species number per plot = 16.6) and an old secondary forest (Yal, 16.5) from the southern part of Kakamega and the lowest numbers were recorded in a primary forest fragment with high human impact in the very north (Kis, 9.7).

If the Kenyan study sites are arranged according to their vertical distribution in the forest beginning with the Kisere forest fragment in the north towards Yala in the south, an old secondary forest (Col, 12.9) would first reach first, followed by a young secondary forest (Can, 11.9) and a primary forest (Isi, 13.8) before one would arrive in Isecheno and Yala (chapter 2, Figure 2.5). Thus, the number of epiphyte species is roughly increasing from the north in direction to the southern part of Kakamega Forest.

These results are confirmed by the simple regression analysis: while in Uganda forests disturbance significantly affects the epiphyte species numbers and explains 30% of species number composition, in Kenya the species richness is not affected by forest disturbance (Table 4.2). Contrary, epiphyte diversity is in Kenya significantly linked to a north/south divide, while such a divide does not influence species richness in Uganda.

Table 4.2 - Simple linear regressions on the influence of forest disturbance, spatial distribution as well as plot and phorophyte characteristics on species richness of vascular epiphytes in 132 study plots (66 plots per Forest) in Kakamega Forest (Kenya) and Budongo Forest (Uganda). All = all three forest types combined, prim = primary forest, old = old secondary forest, sec = young to middle-aged secondary forest, DBH = diameter at breast height (1.30 m).

	Kenya ($r^2_{adj.}$)							Uganda ($r^2_{adj.}$)					
	all		prim	old		sec		all		prim	old	sec	
Disturbance	-0.010		-	-		-		0.301	***	-	-	-	
N/S divide	0.373	***	-	-		-		-0.015		-	-	-	
Tree density	0.042		-0.053	0.324	***	-0.021		-0.014		-0.048	-0.028	0.155	
Bark	-0.005		0.173	-0.002		0.086		0.025		0.003	-0.024	0.342	*
DBH	-0.015		-0.102	-0.017		0.253	**	0.153	***	-0.007	-0.032	-0.033	
Height	0.036		-0.082	-0.019		0.296	**	-0.007		-0.029	-0.026	0.122	

Significance codes: *p < 0.05, **p < 0.01, ***p < 0.001

Altogether the factors forest disturbance, north/south divide, tree density within the plot, bark structure, DBH and height of the phorophyte explain between 0.5% and 37% of epiphyte species richness. In the Kenyan primary forest none of these factors affects the species numbers significantly, but the influence of tree density on species richness is highly significant in the old secondary forests while in young secondary forests the epiphyte diversity depends on the size of the phorophyte. The bark structure of the phorophyte does not have any significant affect in any of the Kenyan forest types, but in Ugandan young secondary forests it explains 34% of epiphyte species richness. Tree density within the plot and the height of the phorophyte do not influence epiphyte diversity in any of the Ugandan forest types and the DBH of the host tree only shows an effect when all three forest types are combined.

In a multiple regression model for Kakamega Forest including the factors north/south divide, tree density, bark structure and height, 44.2% of the species numbers are explained by these factors (r^2adj. = 0.442, $p < 0.001$). For Budongo 35.6% of the epiphyte diversity can be explained by forest disturbance and phorophyte characteristics (bark structure, BDH, height; r^2adj. = 0.356, $p < 0.001$).

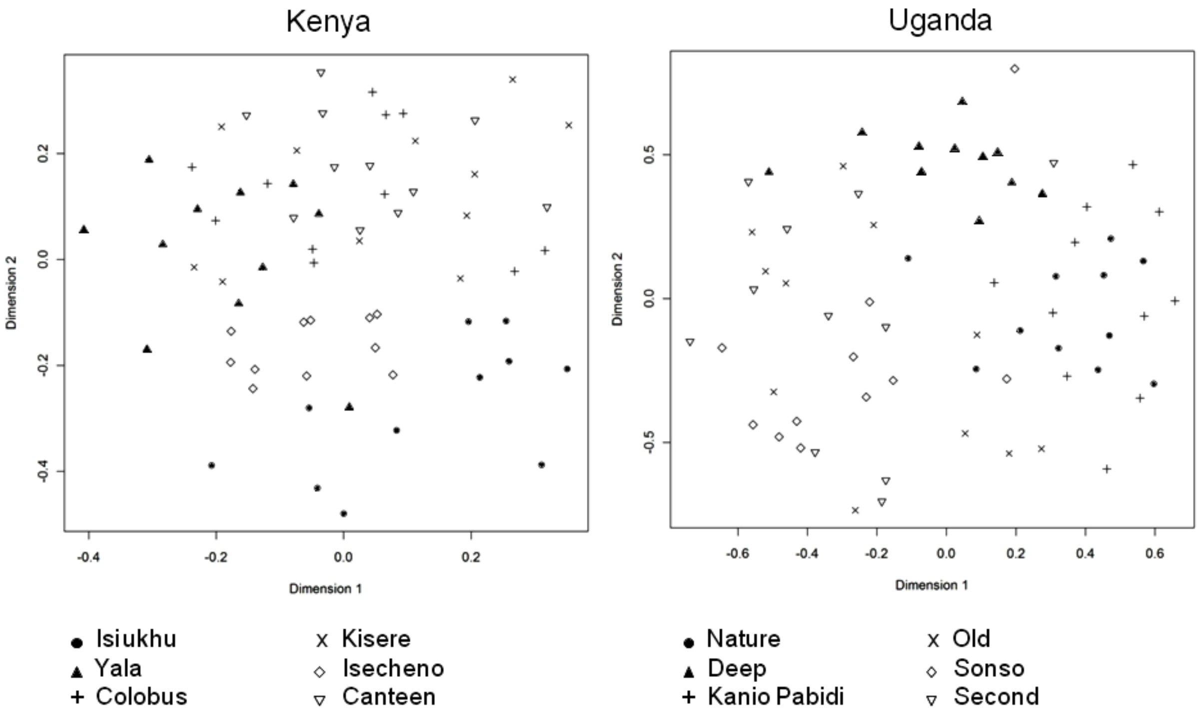

Figure 4.8 - Floristic similarity of epiphytes from different disturbed sites within Kakamega Forest (Kenya) and Budongo Forest (Uganda) from each 66 study plots per forest. Two-dimensional scatterplot of nonmetric multidimensional scaling based on Euclidean distances (Kenya: stress = 0.35; r2 = 0.50; Uganda: stress = 0.33 r2 = 0.58). Isihuku = primary forest with low human impact, Yala = old secondary forest (south), Colobus = old secondary forest (north), Kisere = primary forest fragment with high human impact, Isecheno = middle-aged secondary forest (south), Canteen = young secondary forest, Nature = primary forest, Deep = primary forest with illegal logging, Kanio Pabidi = primary forest fragment in the far north of the forest, Old = old secondary forest, Sonso = old secondary forest with high human impact, Second = middle-aged secondary forest.

The NMDS plots based on the floristic distances hardly show an obvious pattern for any of the two forests (Figure 4.8). In Kenya the sites Isiukhu and Isecheno form one group with a second group above composed by the remaining sites, but both groups are not clearly differentiated from each other. The Ugandan sites are arranged in three groups with the more disturbed sites on the left and the more intact sites on the right. So the two primary forests Nature (south) and Kanio Pabidi (north) are arranged in one group together regardless of their spatial distance. The same is true for the two most disturbed sites Sonso and Second which are grouped together on the left. The primary forest site Deep which is characterized by illegal logging forms an intermediate group on its own and the plots of the old secondary forest (Old) are spread over both groups. In both forests the stress-value is very high by exceeding 0.3.

4.5 DISCUSSION

Similar to the epiphyte-climber diversity pattern in the present study which showed that increasing forest disturbance leads to higher climber and lower epiphytes species numbers (Figure 4.3), Gentry and Dodson (1987) observed such a development due to reduced humidity. As disturbance generally causes a dryer micro climate due to a more open canopy, increased light intensity, and higher evaporation, the present observations are probably likewise attributed to the dryer micro climate in younger secondary forests.

The number of epiphytic species is higher in Budongo Forest compared to Kakamega Forest while the average number of species per plot is lower. Both forests are situated in similar habitat conditions on a rather flat high plateau. However, the altitude of Kakamega Forest is about 500 m higher and consequently the mean annual temperature is 3.5°C lower while the precipitation is 275 mm higher than in Budongo Forest (chapter 2). As epiphytes are generally highly sensitive for climatic conditions and especially humidity is a limiting factor (Gentry and Dodson 1987; Benzing 1990; Benzing 1998; Cardelús *et al.* 2006; Gradstein 2008) the observed differences in species richness and distribution are probably attributed to the differences in temperature and humidity. Due to the higher precipitation in Kakamega, the epiphytes were able to spread over a higher number of plots and study sites regardless of the degree of forest disturbance and bark structure of the phorophyte. In the generally dryer Budongo Forests where a closed and undisturbed canopy keeps more humidity during dry periods, forest disturbance is an important factor as the degree of compensation of evaporated humidity by rain is lower. So here many species find their required conditions in the primary forests and are thus, specialized on these sites, while they are unable to deal with the conditions in the old and middle-aged forests.

The precipitation within Kakamega Forest is known to increase towards south (Dietzsch 2004; Althof 2005). Hence, the north/south divide of epiphyte species richness seems to be linked to the increasing rainfall as also known from other forests (e.g. Poltz and Zotz 2011).

Numerous studies report that changes in canopy architecture influence the epiphyte community what usually results in reduced epiphyte species numbers in disturbed forests compared to primary forest (Barthlott *et al.* 2001; Köster 2008; Cascante-Marìn *et al.* 2009; Fayle *et al.* 2009; Köster *et al.* 2009). In the present study this fact agrees with the data from Budongo Forest, but not from Kakamega Forest. As stated above, one effect of forest disturbance can be a higher evaporation due to the open canopy what causes a dryer microhabitat which might be not suitable for many epiphyte species and thus leads to lower species numbers (Gradstein 2008). While such an effect was observed in Budongo Forest, the constantly higher humidity in Kakamega forest buffers the increased evaporation in disturbed forests and the increasing disturbance did not induce lower species richness.

The explanatory power of plot and phorophyte characteristics varies between the different disturbed forest types (Table 4.2). In both forests neither the tree density within the plot, nor the bark or size of the host tree shows any significant effect what is probably due to the more constant climatic conditions in those intact forest types which reduce the effect of bark structure. Furthermore, even small trees can already be very old in primary forests and old secondary forests so that epiphytes had plenty of time for colonization (Köster *et al.* 2009). In younger forests, plot and phorophyte characteristics become more important. The effect of tree density within the plot is highly significant in the old secondary forest in Kenya. A higher tree density leads to more shady and humid conditions. In primary forests these conditions are induced by a closed canopy and as the canopy might be less dense in the old secondary forests, the tree density takes up this function. The old secondary forest in Uganda is not affected by tree density what might be due to an already closer canopy that provides conditions comparable to the primary forest. In the young secondary forest the size of the phorophyte significantly affects the epiphyte species numbers. Contrary to the primary forests, phorophyte characteristics become significant factors of epiphyte diversity in young and middle-aged secondary forests in Kenya and Uganda. In young forests where light is not a limiting factor, larger trees are usually older than small trees and therefore epiphytes had more time for colonization and find more favorable microhabitats (Hietz and Hietz-Seifert 1995; Nieder and Barthlott 2001). Where time is limited, a rough bark supports a superior grip for colonization and additionally keeps humidity longer than a smooth bark where rain water drains faster.

The NMDS plots basing on the floristic similarities between the study sites showed rather weak groups and high stress values. Apparently the floristic composition of species being absent or present is too similar between the sites to produce more meaningful results. An investigation of abundance based data might be able to clarify the extent of similarities and dissimilarities of the epiphyte vegetation from different disturbed sites.

COMPARISON TO EARLIER STUDIES ON AFRICAN EPIPHYTES

Earlier studies on African epiphytes report species numbers reaching from 100 to 167 species of vascular epiphytes (Eggeling 1947; Johansson 1974; Biedinger and Fischer 1996; Schaijes and Malaisse 2001; Zapfack and Engwald 2008). With a total number of 170 epiphyte species the present study slightly tops the earlier species numbers. Also the floristic compositions with the most diverse groups being orchids and ferns while only a small amount of epiphytes is composed by other families agrees which these studies (Figure 4.9). The maximum number of epiphyte species per tree in the present study (30) likewise agrees with other African epiphyte studies reaching from 22 (Johansson 1974) to about 40 (Biedinger and Fischer 1996).

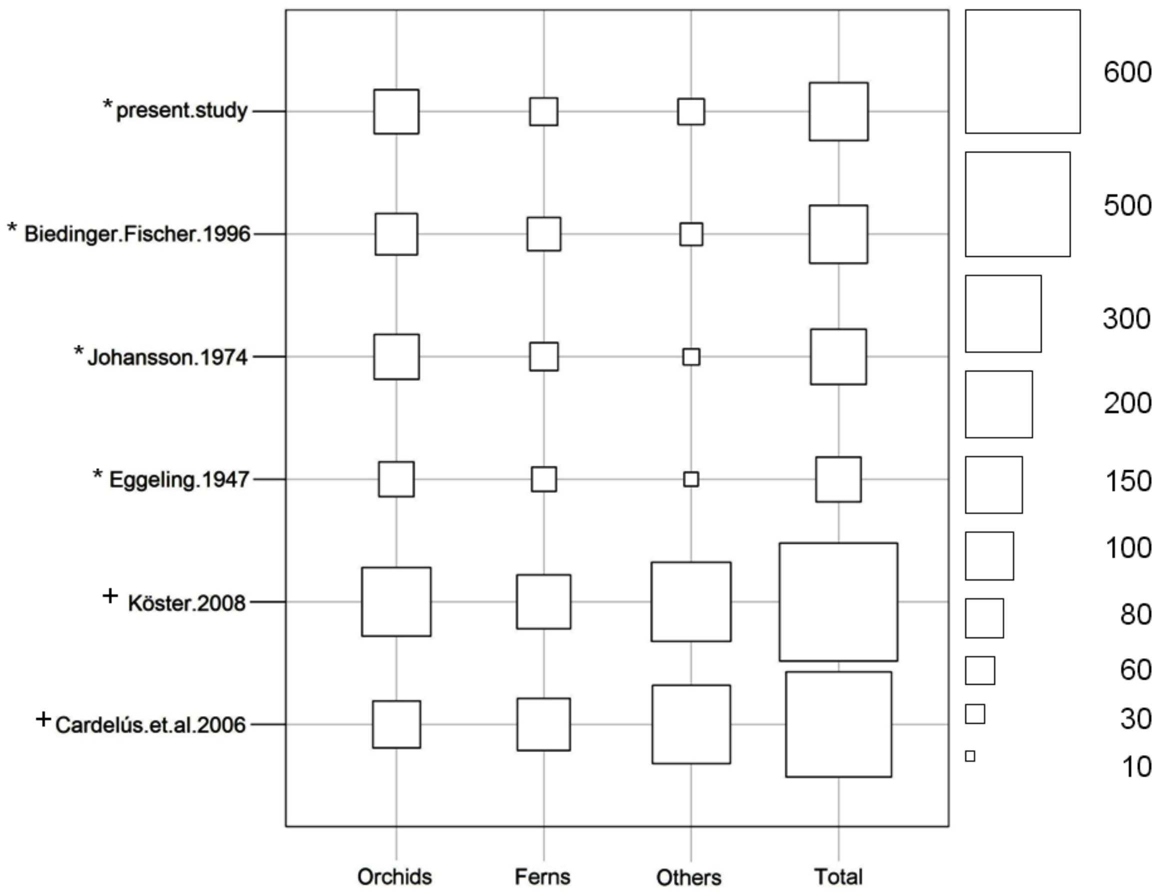

Figure 4.9 – Comparison of species numbers and floristic components from selected studies of African (*) and Neotropical (+) epiphyte communities.

The only study on African epiphytes that differs substantially from the characteristics mentioned above is the study of Engwald (2004). The very low species numbers (43 species of vascular epiphytes) and the high percentage of ferns (51%) outranging the Orchidaceae (23%) he observed in a rain forest in Gabon might be attributed to the very short data collecting period (Engwald 2004).

Eggeling (1947) was the first who paid attention to the epiphytes of Budongo Forest in context of a general vegetation study of this forest. He confirms the reduced epiphyte species richness in younger or disturbed forest parts and explains it with the young age of the trees and the lower humidity. Further Eggeling reports higher epiphyte species richness on trees with a rough bark what was likewise observed in the present study, but only in the young to middle-ages secondary forest while bark structure did not affect epiphyte species numbers in older forests. In contrast to Eggeling (1947) and Biedinger and Fischer (1996), who hardly ever observed vascular epiphytes on the smooth barked ironwood *Cynometra alexandri* C.H.Wright up to 25 species of vascular epiphytes were recorded growing on this host-tree species.

Like in Johansson's (1974) work on West African epiphytes, most of the species in the forests studied in this thesis, colonize one or two zones of their host trees (Appendix 2). But while Johansson reports that only few species occur in more than two zones, here about 40% of the species were found growing in three or more zones what indicates a higher ecological flexibility of the concerned species and a lower micro habitat preference (Hietz and Hietz-Seifert 1995, Köster personal communication).

COMPARISON TO NEOTROPICAL EPIPHYTE COMMUNITIES

The number of epiphyte species in Neotropical rain forests is generally higher than in Africa (Figure 4.9) and with 35% to 50% of neotropical vascular flora being composed by epiphytes (Gentry and Dodson 1987; Benzing 1990) their proportion on the total vegetation is likewise higher than in the present study sites with 20%. The average number of 9.5 (Uganda) to 13 (Kenya) epiphyte species per tree is likewise low compared to averagely 32 species per tree in Costa Rica (Cardelús *et al.* 2006) and 42 in Ecuador (Köster *et al.* 2009). While many studies on Neotropical epiphytes were carried out at different altitudes along mountain ranges (e.g. Cardelús *et al.* 2006; Cardelús and Mack 2010), both of our study forests are located on a flat high plateau in an elevation between 1000 and 1700 m a.s.l. Despite the relatively high altitude, the climate in Kakamega and Budongo Forest is with 1600 to 1915 mm annual precipitation rather dry compared for instance to a cloud forest in Ecuador with 2587 mm (Benzing 1990;

Nowicki; Reynolds 2005). The importance of precipitation rates on epiphyte species richness has been proven several times (Gentry and Dodson 1987; Benzing 1990; Benzing 1998; Cardelús *et al.* 2006; Gradstein 2008) and thus, one reason for the lower species numbers in this study might be the lower humidity. Additionally to the relative dryness of the present study sites, they are also much more monotonous than mountainous areas and uniform landscapes are known to lead to low epiphyte diversity (Gentry and Dodson 1987; Benzing 1990; Biedinger and Fischer 1996; Küper *et al.* 2004b). A study on epiphytes at humid African mountain ranges like the Ruwenzori in Uganda would probably produce higher species numbers (personal observations).

Also the floristic composition of African epiphyte communities is distinguished by the smaller amount of orchids and ferns and higher amount of other plant components in the Neotropics (Gentry and Dodson 1987; Benzing 1990; Cardelús *et al.* 2006; Köster *et al.* 2009). In most Neotropical epiphyte studies, orchids are still a very diverse or even the most diverse epiphyte family (Gentry and Dodson 1987; Küper *et al.* 2004b), but their percentage on the total epiphyte species is lower than in African rain forests (Figure 4.9). The floristic differences can be explained by the absence of (most) Bromeliaceae and Cactaceae in Africa which make a major contribution to Neotropical epiphyte diversity (Gradstein 2008).

Like in Africa, forest disturbance in Neotropical regions usually results in decreasing epiphyte richness, especially concerning desiccation intolerant species (Barthlott *et al.* 2001; Köster *et al.* 2009). All these studies agree that one important factor why disturbance causes species loss is the changed micro climatic condition. However, Gradstein (2008) states that the reaction of epiphyte species numbers on disturbance can actually be very heterogenous and if the climate is stable enough so that the disturbance does not change the micro climate, the species numbers might be stable. This observation fits very well with the situation in Kakamega Forest.

It can be concluded that the present data generally support the epiphyte diversity patterns known from earlier studies in African and Neotropical rain forests. Nevertheless, most epiphyte studies in Neotropical regions are carried out within global centers of vascular plant diversity along the Andes-Amazonia and Costa Rica-Chocó (Küper *et al.* 2004b; Barthlott *et al.* 2005). Comparable biodiversity centers are absent in East Africa, but it is assumed that higher and more diverse species richness of African epiphytes would be found in a habitat more similar to the Neotropical study sites like the high mountain ranges in the Albertine Rift.

5 - CONSERVATION STATUS OF THE VASCULAR PLANTS OF EAST AFRICAN RAIN FORESTS

"In order to mitigate biodiversity loss effectively, greater investment of conservation attention is required in tropical regions where there is the most to lose in terms of species richness and where species groups have to date been largely ignored."

(Ben Collen et al. 2008)

5.1 ABSTRACT

The small remaining area of East African rain forests and their ongoing decrease even within protected areas, cannot longer guarantee the in-situ conservation of the concerned plant populations. On that score, an ex-situ conservation culture of endangered vascular plants from East African rainforests is planned to be established in the Botanic Garden of the Maseno University in Kenya. To archive the necessary knowledge about the plant's conservation priority, two model forests were selected in Kenya (Kakamega Forest) and Uganda (Budongo Forest), where comprehensive vegetation surveys along a disturbance gradient gave evidence about the species inventory, abundance, and habitat preference.

Many national and international organisations like the IUCN provide excellent categories and criteria for the estimation of extinction risk of species in a global and regional scale. Applied to a small scale forest system and with a limited time available, most of their criteria are unfortunately not feasible. Furthermore the determination of the conservation priority requires information that goes beyond the extinction risk like the ecological and cultural value of the particular species.

Taking the example of the two model forests, a rating system is presented which assigns every occurring plant species its conservation priority within this particular forest.

5.2 INTRODUCTION

It is generally assumed that equatorial Africa was once covered with a connected central African rain forest belt reaching from West Africa up to Kenya in the East. The nowadays small isolated rain forest in Uganda and western Kenya are supposed to be relicts of this huge equatorial rain forest with Kakamega Forest (Kenya) being the most eastern forest fragment (Trapnell and Langdale-Brown 1962; Hamilton 1974). Due to this history and by being located on a high plateau (1000 - 1600 m a.s.l.) these forests combine a unique composition of guineo-congolian and afromontane species. Even if most of these forest fragments lie within protected areas, the high population pressure causes an ongoing forest decline (Oyugi 1996; Bleher *et al.* 2006; Guthiga and Mburu 2006). Increasing population rates and the future impact of climate change give reason to expect further deforestation and species loss, particularly in tropical lowland and afrotropical mountainous areas (Sommer 2008; Sommer 2010; United Nations 2009).

During the past 60 years Kakamega Forest (western Kenya) lost 55% of its de facto forest cover while the official forest border remained stable (Schaab *et al.* 2010). This rapid forest decline makes it unlikely that the actual efforts for in-situ conservation alone are sufficient for the survival of the affected populations and require additional ex-situ conservation. For this purpose an ex-situ conservation culture of endangered vascular plants from East African rain forests, with a focus on Kakamega Forest, was initiated in the Maseno Botanic Garden in Kenya (chapter 6). The ongoing disappearance of Kakamega Forest concerns all species populations within the forest what would make them all worth of protection (Faden 1970). The vascular plants alone aggregate 986 species (Fischer *et al.* 2010) and as it is hardly realizable to cultivate them all, it was necessary to assess their conservation priorities.

Many national and international institutions already developed several strategies for the estimation of the conservation status of species. A comprehensive review of these strategies is provided in Welk (2001; 2002). One of them is the International Union for Conservation of Nature (IUCN) which provides internationally accepted and successfully established categories and criteria for the assessment of the global and regional extinction risk of species (Gärdenfors *et al.* 2001; IUCN 2001; IUCN 2003; Rodrigues *et al.* 2006; IUCN 2010a). The 2010 IUCN Red List of Threatened Species™ (from here on referred to as IUCN Red List) contains extinction risk assessments for almost 56,000 species what amounts 3.1% of all described species worldwide (Chapman 2009; IUCN 2010b). Actually the recorded species are highly biased in favor of well known species: for example 66% of the recorded plants are trees (Rodrigues *et al.* 2006; Hilton-Taylor *et al.* 2009). Using the IUCN assessments concerning the likelihood of extinction as a measure for conservation priority, one would consequently be faced with the problem that only 4% of all described plants species are so far recorded in the IUCN Red List and especially few herbaceous plants.

Even regarding the recorded species, the assigned category in terms of their global population cannot be equated with their extinction risk in one particular population. The IUCN Red List categories and criteria are developed for global scale and can also be applied at regional scale (Gärdenfors *et al.* 2001; IUCN 2003), but they are not appropriate at very small scales like a single forest (Vié *et al.* 2009a). A species which is close to extinction within one forest but common elsewhere, is still of conservation priority in local terms, as it might present an important link for the ecological network of the concerned forest system and improves the forests genetic and biological diversity. Furthermore, the IUCN Red List is not intended to be used alone as a system for setting conservation priorities. This requires the extinction risk on the one hand and on the other hand criteria like the ecological, phylogenetic, historical, and cultural priorities of taxa (IUCN 2003; Vié *et al.* 2009a).

The aim of this study was 1) to develop a rating system for the conservation priority for the vascular plants within a small scale forest system and 2) to demonstrate the suitability of this system by taking the example of East African rain forests. These data are intended to support the recently established ex-situ conservation culture of endangered vascular plants of East African rain forests in the Maseno Botanic Garden.

5.3 METHODS

Two forests were chosen as model forests, both being relicts of the once connected equatorial African rain forest: Kakamega Forest in Kenya and Budongo Forest in Uganda. Within these forests a total of 12 study sites was selected (six per forest), representing the full range from primary forest up to young secondary forest under different anthropogenous and ecological pressures (chapter 2). In both forests, comprehensive vegetation surveys were carried out to learn more about the plant composition, species abundance, and their habitat requirements (chapter 3), giving particular consideration to vascular epiphytes (chapter 4).

ASSESSMENT OF CONSERVATION PRIORITY

For the assessment of the conservation priority of the plants occurring in the study area, a rating scheme, basing on a scoring system, was developed. The higher the total scoring of a species, the higher is its conservation priority. This scoring system is based on seven threat criteria:

- Worldwide Distribution (DIS): a decreasing worldwide distribution of a species results in an increasing national responsibility and thus, in a higher conservation value.
- Global extinction risk after IUCN (IUCN): an increasing global extinction risk results in an increasing national responsibility and thus, in a higher conservation value.
- Constancy (CON): percentage amount of plots where the species occurred. A decreasing percentage results in an increasing conservation value.
- Forest Type (FOR): species that were found only in primary forests gained a higher conservation value than secondary forest species or synanthropes.
- Growth Rate (GRO): trees take longer to reach a fertile phase and to reproduce than herbs what increases their conservation value.
- Useful Plants (USE): the various ways to use a plant were assigned to four use possibilities: timber wood, medicinal plants, food plants and other uses. The more use possibilities apply for a species the higher its conservation value.
- Ecological Importance (ECO): this criterion is composed of three sub-criteria:
    - Habit (hab): trees contribute in various ways to the forest ecosystem (provide habitat, regulate climate and soil conditions, etc.) what increases their ecological importance.
    - Facultative mutualism (fac): plant-pollinator-mutualism, plant-disperser-mutualism or both increase the ecological importance.
    - Obligate mutualism (obl): an obligate mutualistic relationship to another species increases the ecological importance.

Table 5.1: Assignment of the conservation priority values for the seven threat criteria. The criterion ECO is composed of three sub-criteria.

Cons. value	DIS	IUCN	CON	FOR	GRO	USE	ECO hab	ECO fac	ECO obl
-1	introduced			synanthropes					
0	worldwide	DD/LC	> 10%	young sec.	herbs	no use	herbs	no	no
1	paleotropic	NT	6 - 10%	old sec.	woody plant	1 crit.	shrub/tree	pollin./disp.	yes
2	Africa	VU	2 - 5%	prim. Forest	giant trees	2 crit.	giant trees	both	
3	trop. Africa	EN	≤ 1%			3 crit.			
4	East Africa	CR				4 crit.			
10	endemic								

A detailed introduction and discussion of the threat criteria are provided in chapter 5.5. For each criterion the plant species can gain a conservation value (Table 5.1) and the seven values can then be added up to the particular priority value of each species.

Thus, each plant species is able to gain a priority value from -2 to 30 dependent on its conservation value for each of the seven criteria. Basing on this conservation value, the species can be assigned to five priority categories. The evaluation of the given values is based on the vegetation surveys, the online data bases Prelude Medicinal Plants Database (http://www.metafro.be/, accessed Dec. 2010) and JSTOR Plant Sciences (http://plants.jstor.org/, accessed Jan. 2011), literature data (Price 1997; Maundu *et al.* 1999; Fashing 2001; Lwanga 2003; Reynolds 2005), and interviews with the local people.

STATISTICAL ANALYSIS

In this chapter the 12 study sites were assigned to three forest types: primary forest, old secondary forest, and young to middle-aged secondary forest. First of all, Lilliefors Kolmogorov-Smirnov normality test was performed to test the data for normal distribution. As none of our data were normally distributed we continued by using the Kruskal-Wallis Rank Sum Test to test if there are significant differences in the distribution of prioritized species within the three forest types (Sokal and Rohlf 1995; Dytham 2003). In case of significant differences, multiple comparison tests after Kruskal-Wallis were carried out by the program package "pgirmess" (Giraudoux 2010). Possible relationships between disturbance and the number of prioritized species per plot were estimated using linear regression. To make sure that a possible difference in number of prioritized species is not only due to a generally higher or lower species number in one forest type, both, Kruskal-Wallis Rank Sum Test and linear regression were carried out for the number of prioritized species and additionally for the percentage of prioritized species per plot. All analyses and associated figures were made with the R computer software (Version 2.10.1, R Development Core Team 2009).

5.4 RESULTS

In both forests a total of 853 vascular plant species from 127 families was recorded. Out of these, 523 species were found in Kakamega Forest and 577 species in Budongo Forest whereas 247 species did occur in both forests. Only 26 (3%) of these species are recorded in the IUCN Red List and 10 of them are considered as being threatened (http://www.iucnredlist.org/, accessed in Jan. 2011). The assessment of the conservation

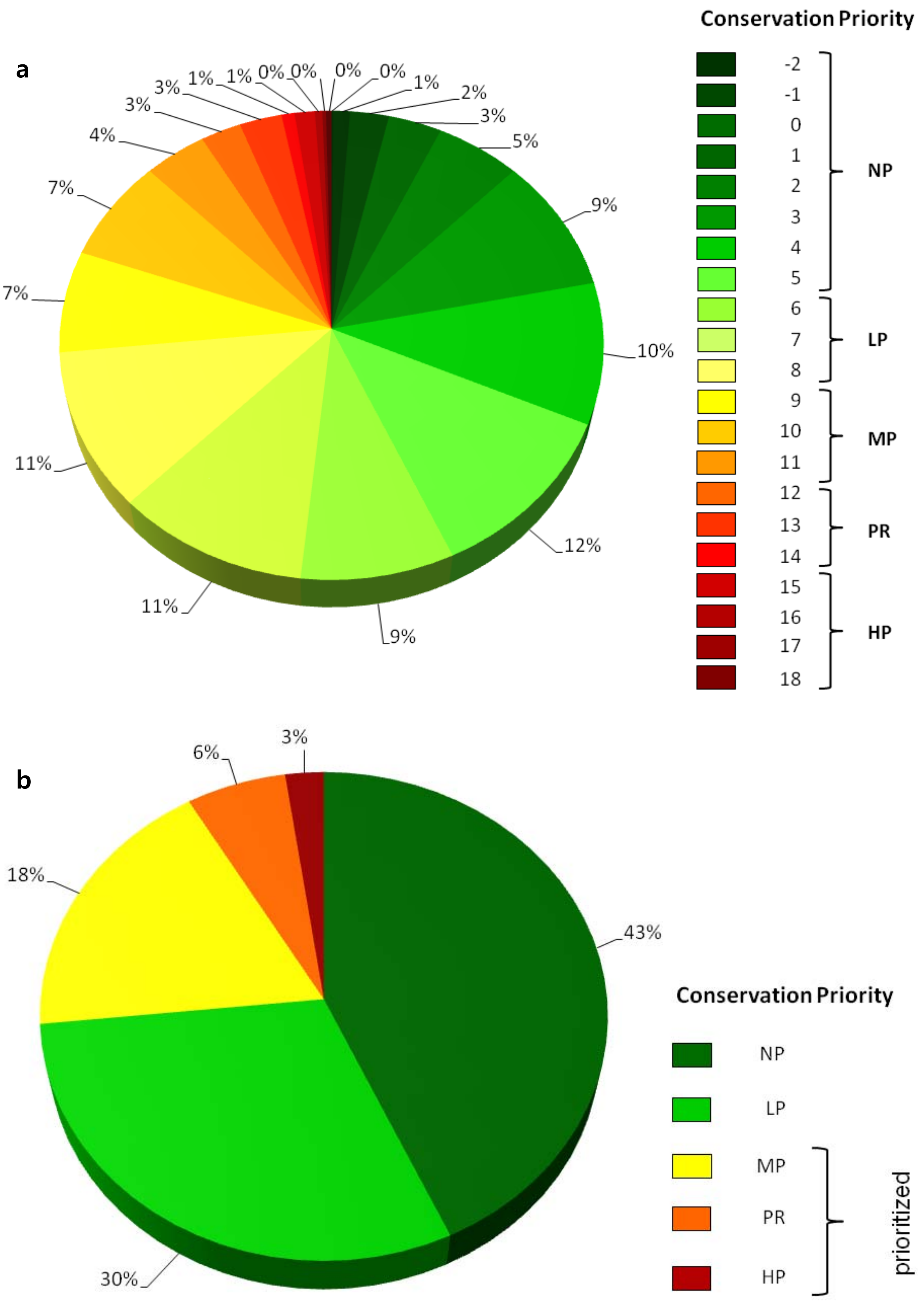

Figure 5.1: Percentage frequency of the different conservation priority values (a) and of the five priority categories (b) for the vascular plants in the two model forests.

priority of the plant species was carried out by using a rating scheme basing on a scoring system as presented and discussed in chapter 5.3 and 5.5. A detailed overview of the composition of conservation values and priority categories of each plant species is provided in Appendix 3.

For a better overview and analysis options, the values for the priority were assigned to the five priority categories "no priority", "low priority", "medium priority", "priority", and "high priority". The conservation priority values assigned to the plant species in the two model forests reach gapless from -2 to 18 (Figure 5.1a). The only species with a priority value of -2 is *Alternanthera sessilis* (L.) R.Br. ex DC., a synanthropic herb that was introduced from Australia (Townsend 1988) and has neither an ecological importance nor any other usages and is thus, of no conservation priority. The species with the highest priority value (18) are *Antrocaryon micraster* A.Chev. & Guillaumin, *Vitex keniensis* Turrill, and *Entandrophragma angolense* (Welw.) C.DC. All three of them are giant rainforest trees which are global vulnerably threatened and occur only in tropical Africa. Further they were found with little constancy in the study plots and were revalued for their use possibilities and ecological importance. *Commelina albiflora* Faden, which is the only endemic species in this study, gained a priority value of 16, whereby it is categorized as being of high conservation priority. Species with the categories "medium priority", "priority" and "high priority" are considered as being prioritized. Accordingly 27% of the plant species handled in this study are prioritized for ex-situ conservation (Figure 5.1b).

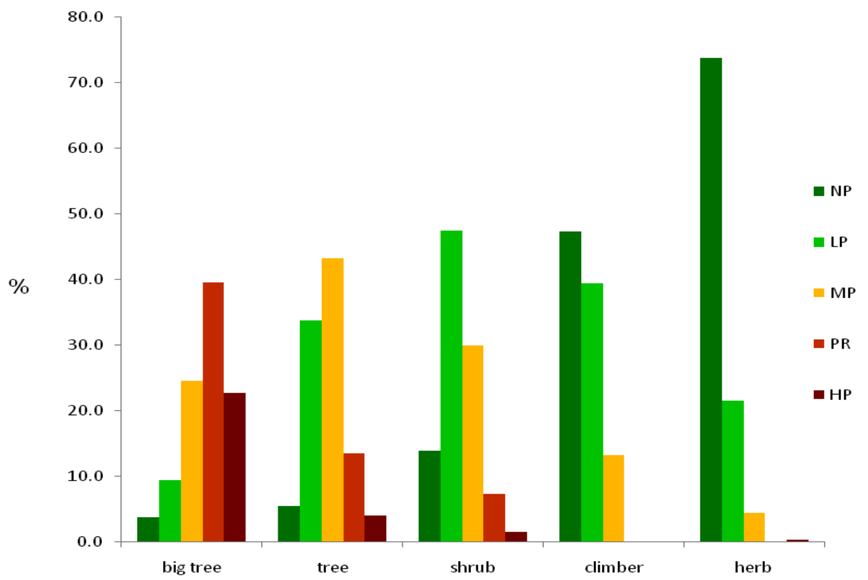

Figure 5.2: Percentage composition of conservation priorities within the life forms of the 853 vascular plant species in the two model forests. NP = no priority, LP = low priority, MP = medium priority, PR = priority, HP = high priority.

Considering the different life forms of forest plants the percentage of species with the categories "priority" and "high priority" is highest in the giant forest trees and decreasing in direction of smaller plants (Figure 5.2). Both categories do not occur in climbers and herbs with the only exception of the herb *Commelina albiflora* which is of high conservation priority because it is endemic for Kakamega Forest. With decreasing conservation priority also the size of the dominant life form decreases: plants with "medium priority" reach their highest percentage in trees, with "low priority" in climbers and with "no priority" in herbs.

HABITAT DEPENDANCE OF PRIORITIZED PLANT SPECIES

The average number of prioritized species in 192 plots per forest amounts 9.8 (SD 4.4) in Kenya and 11.9 (SD 5.2) in Uganda. While in Kenya the number of prioritized species is significantly higher in young to middle-aged forests, there is no significant difference in the percentages of prioritized species in the three forest types (Figure 5.3). In Uganda it is the other way around and there is no significant difference in the number of prioritized species, but old secondary forests have a significantly higher percentage of prioritized species than primary forests.

Forest disturbance has a significant influence on the number of prioritized plant species in Kakamega Forest and on the percentage of prioritized species in Budongo Forests (Table 5.2). Between 0.5% and 4.5% of the observed variation in number and percentage of prioritized species per plot can be explained by forest disturbance.

Table 5.2: Simple linear regression on the influence of forest disturbance on number and percentage of prioritized species of vascular plants per plot in Kakamega Forest (Kenya, n = 192) and Budongo Forest (Uganda, n = 192). % = percentage of prioritized species per plot.

	Kenya		**Uganda**	
	prioritized	%	prioritized	%
$r^2_{adj.}$	0.045**	-0.0053	0.0062	0.044**

Significance codes: *p < 0.05, **p < 0.01, ***p < 0.001

5.5 DISCUSSION

Research is usually planned and carried out by researchers and the results are shared with researchers, but if a study has a conservational intention, it needs to be accessible and understandable to politics and public as well (Burley 2001). To achieve a realistic application and implementation, a rating scheme needs to fulfil three qualifications:

- Being comprehensible and self explanatory
- Being feasible within a limited time (here three years)
- Being feasible by a small number of contributors (one to two people)

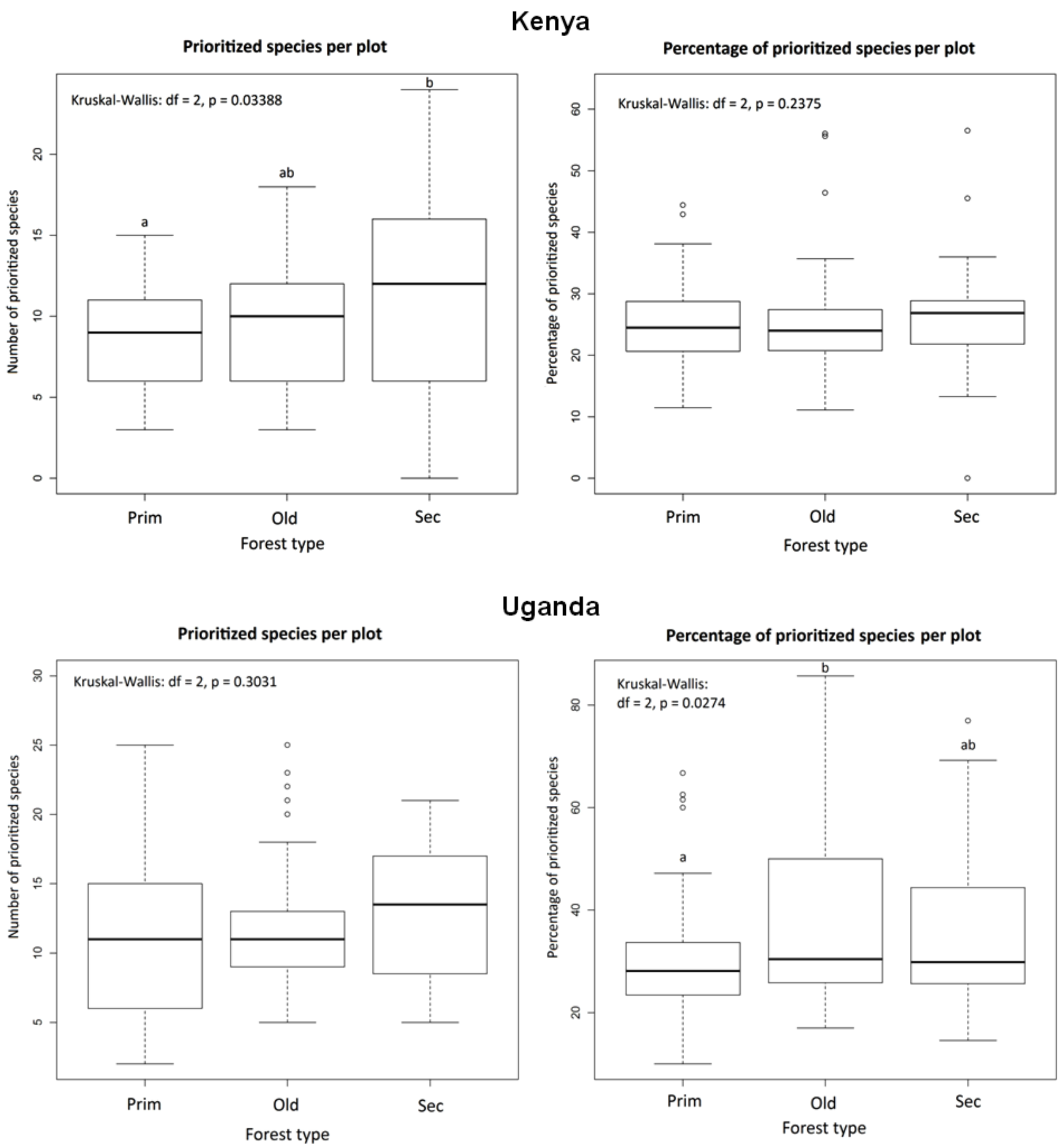

Figure 5.3: Number and percentage of prioritized species of vascular plants per plot in Kakamega Forest (Kenya, n = 192) and Budongo Forest (Uganda, n = 192). Prim = primary forest, Old = old secondary forest, Sec = young to middle-aged secondary forest. The results of multiple comparison test after Kruskal-Wallis are indicated by letters above the bars; equal letters refer to no significant differences ($P \geq 0.05$) and unequal letters indicate significant differences ($P < 0.05$) between means.

Under these conditions a scoring system for the evaluation of the conservation priority of the vascular plants within the study sites was developed. Similar scoring systems have already been successfully used by other authors (e.g. Collar and Stuart 1988; Welk 2001; 2002; IUCN 2003). Welk (2001; 2002) for instance developed eight criteria for the assessment of the international conservation relevance and the national responsibility for the vascular plants of Germany. As in Europe the knowledge of the plant inventory, abundance, naturalization status and others is much better than in the tropics, most of his criteria were not realizable for the present study as the particular information is not available.

Similarly most of the IUCN Red List criteria were not applicable in this study as they require long term observations of changes in population size over 10 years and more (IUCN 2001; IUCN 2003; Vié *et al.* 2009b). These observations would indeed be an important criterion for the assessment of the conservation priority, but due to the relatively short time available and since such information is not provided in the literature, this criterion had to be excluded from the new rating system. Maybe the present data can serve for the estimation of plant population development in future.

Collar and Stuart (1988) also used a scoring system for the assessment of key forests for threatened birds. Their system is based on the extinction risk of bird species provided by the Red Data Book. These data are mostly not available for the plant species in our study sites and the global extinction risk alone would be insufficient for the assessment of their conservation priority (IUCN 2003; Vié *et al.* 2009a).

Beside the data deficit for the plants of the concerned forests, it must also be considered, that all these studies underlie different objectives: the IUCN follows a population biological approach, Welk concentrates on the biogeographic aspects, and the present study considers the conservation priority of plants in a decreasing small scale forest system.

It can be concluded that many of the criteria provided in other works are not applicable for the present study and thus, it was necessary to develop modified or new criteria for the assessment of the conservation priority, based on data that can be obtained in the given time or which are available in the literature. In the following the seven threat criteria for the assessment of the conservation priority are explained and discussed in detail. An overview about the attainable score for each criterion is provided in chapter 5.3.

WORLDWIDE DISTRIBUTION

In the context of regional risk assessment it is important to consider not only the conditions within the region but also the status of the taxon from a global perspective (IUCN 2003). A species might be common in one forest, but if this population presents a high percentage of the total population of this species, the national responsibility increases (Welk 2001; 2002a; 2002b). While information about the different population sizes of the plant species might be present for e.g. Europe, they are not available for most tropical countries. Alternatively a simplified criterion was used: the worldwide distribution of a species. The smaller the worldwide distribution range, the higher the conservation value for the plants in the African model forests. For endemic species the national responsibility is to be considered as being particularly high and so is their conservation priority. To make sure that endemic species gain a high conservation priority even if they get only low values in other criteria, they got the highest possible conservation value in this criterion (10).

Introduced plant species got a negative value for their distribution range (-1). They do not naturally occur in the study area and thus, their disappearance from these forests would be no lost in their natural distribution. Furthermore, introduced and often invasive plants can cause problems for the native flora and fauna by replacing native plant species which again might be important food sources for forest animals (Nishida *et al.* 2001; Dorning and Cipollini 2006).

IUCN

As mentioned above, only very few plant species considered in this study are actually recorded in the IUCN database, but in case of the few recorded species the global extinction risk gives information about the national responsibility for this species. Regardless the situation in one particular forest, a species that is worldwide endangered is of higher conservation value than a species that is not endangered. Thus, an increasing global extinction risk also increases the national responsibility for this species and hence, increases its conservation value.

CONSTANCY

Based on the present field surveys all plants get a higher or lower conservation value depending on how rare or common they are. For this purpose it is possible to allocate the conservation values either according to the plants frequency or to the constancy of their occurrence. Here the constancy was chosen because even if occurring in a large total number, a plant can still be rare if all individuals occur within a few square meters and nowhere else in the forest (e.g. *Malaxis welwitschii* (Rchb.f.) ined.). Constancy here means the percentage amount of sampling areas where a species occurs measured by the total amount of sampling areas. Plant species which were found to be extremely rare, were divided into forest species, which are really rare and thus of high conservation priority, and non-forest species, which are rarely found because they do not belong into the forest. The latter were not upgraded for their rareness.

Forest type

The composition of species in an intact primary rain forest developed over long periods of time and the species occurring here are adapted to and depend on the abiotic conditions in such a habitat (e.g. light, humidity, temperature). In disturbed forests where the canopy was opened, light reaches the lower sections of the forest what causes an increasing temperature and a decreasing humidity (Ghazoul and Sheil 2010). Many primary forest species cannot exist here. They are replaced by species which are adapted to the dryer, hotter, and brighter conditions, but these species are either pioneers or species from open areas with similar conditions. Both types do not really belong into a primary forest and will disappear when the forest recovers. The conservation priority lies on the species depending on the rapidly decreasing intact primary forests and thus, species which were found only in primary forests get a higher value than species occurring in old or young secondary forests. Synanthrope species even gained a negative conservation value since the increasing human pressure on the forests leads to an extension of their habitats instead of habitat loss.

Growth rate

While herbaceous plants are often able to complete their whole life cycle within a couple of weeks/months, woody plants generally need much more time to become fertile and produce the next generation (Walter 1971). Thus, it takes them much longer for natural propagation and to recover from disturbance. On that score, woody plants receive a higher conservation value than herbs, whereas giant forest trees get a higher value than small trees and shrubs.

Useful plants

"As long as humans have existed we have used the species around us for our own survival" (Hilton-Taylor *et al.* 2009). There are multiple ways for the exploitation of a plant and often one species provides more than one use possibilities. For any use, the plant - partly or in total - is removed from the forests what inevitably affects its population stability. Even if only parts of the plants like leaves or bark are used, the damage on the remaining plant, due to over-collection or caused in order to reach the needed plant part, often leads to plant death (Kokwaro 1988; Fashing 2004). Beside the increasing threat for the plant populations, their exploitation makes them an indispensable source for the life quality of the human population. The loss of medicinal and food plants for example has a significant influence on human health in this part of the world (Hilton-Taylor *et al.* 2009). Therefore, four use criteria were composed and the more criteria apply, the higher is the conservation value:

- Timber wood: Both model forests contain high-quality timber tree species like *Milicia excelsa* (Welw.) C.C. Berg or the mahogany species *Entandrophragma* spp. and *Khaya anthotheca* (Welw.) C.DC. In the past these species were legally logged by commercial companies and manufactured in sawmills. The logging licenses were assigned by the Forest Department, but where the trees were logged legally during the day, logging continued during nighttime and holidays (Kokwaro 1988). These plants are usually not cultivated, but collected from the forest what reduces their natural stock and affects the stability of their wild populations. Today both forests are under protection and prevented from legal logging, but illegally the systematically logging of valuable timber trees still continues.
- Medicinal plants: In some African countries up to 80% of the population depends on traditional medicine for primary health care and herbal medicines are the most lucrative form of traditional medicine, generating billions of dollars in revenue (WHO 2008). In East Africa the collection of wild plants for medicinal purposes plays a great role, especially as many people are not able to afford buying medication in the pharmacy. Further the misapplication of available drugs like Chlorochin causes resistances what induces people to return to traditional medicines (Njoroge and Bussmann 2006). Especially common diseases like malaria and fever are treated with medicinal plants, which are usually not cultivated but collected in the wild (Bussmann 2006; Njoroge and Bussmann 2006). While most of the medicinal plants are only collected in small amounts for private use, some species are collected on a large scale for commercial use. So the roots of *Mondia whiteii* are intensively collected in Kakamega Forest to be sold in large parts of Kenya (personal observation). Today the plant is very rare in Kakamega Forest, but the forest floor is full of holes where the plants have been removed.
- Comestible goods: Many wild plants present an important source of food for the local population and/or domestic animals (Maundu *et al.* 1999). Even if only parts of the particular plants are collected (e.g. fruits), the extraction can influence their natural regeneration process and cause damage or dying of the remaining plant.

- Other usage: This criterion combines further ways for the usage of plants (like fuel, magic, building material, art, music, fences, fibers, source for resin, gum, and many more) which are more difficult to record due to lacking data or very specialized applications. Oyugi (1996) estimates the illegal fuel wood extraction in Kakamega Forest of about 100,000 m^3 per year with a value of about 100 Mio Kenya Shilling. Others usages might be less common, but not necessarily less influencing: Omeja *et al.* (2004) showed that even rather ignored factors like drum production, which demands certain tree species of a minimum size, can change the tree species composition of a forest.

ECOLOGICAL IMPORTANCE

A forest is a very complex ecosystem and is based on numerous networks between different species and organisms (Whitmore 1990; Ghazoul and Sheil 2010). The disappearance of a single chain in this network might negatively affect many other species which were often not even directly concerned by the initial disturbance (Gutiérrez-Granados and Dirzo 2010). Ecological interactions between plants and their environment can influence the population growth rate of the plants as well as of its interaction partner (Schemske *et al.* 1994). In order to take account of the ecological importance of a species, this criterion is divided into three sub-criteria:

Habit:

A forest is composed of many different life forms and all of them make their contribution to a functioning forest ecosystem (Whitmore 1990). However, some life forms contribute more than others. Especially the contribution of trees is immense: they create a varying habitat for numerous animal and plant species (40% of African mammals live on trees (Kokwaro 1988)), they prevent flooding and erosion, ensure the stability of long term climatic patterns and much more (Chapman and Chapman 1996b). For the human population trees have especially three big benefits: economic products (wood, energy, food, etc.), environmental benefits (soil conservation, climate, etc.), and social benefits (employment, income, diet diversity, health, etc.) (Burley 2001). All these benefits increase the conservation value of trees (especially forest giants) compared to herbal plants.

Facultative mutualism:

Numerous forest inhabitants live in a mutualistic relationship to other species and especially plant-pollinator- and plant-disperser-mutualisms are very common (Janzen 1979; Fashing 2001; Nishida *et al.* 2001; Shanahan *et al.* 2001; Eshiamwata *et al.* 2006; Plumptre and Machanda 2007). Most of the plants can be pollinated and dispersed by

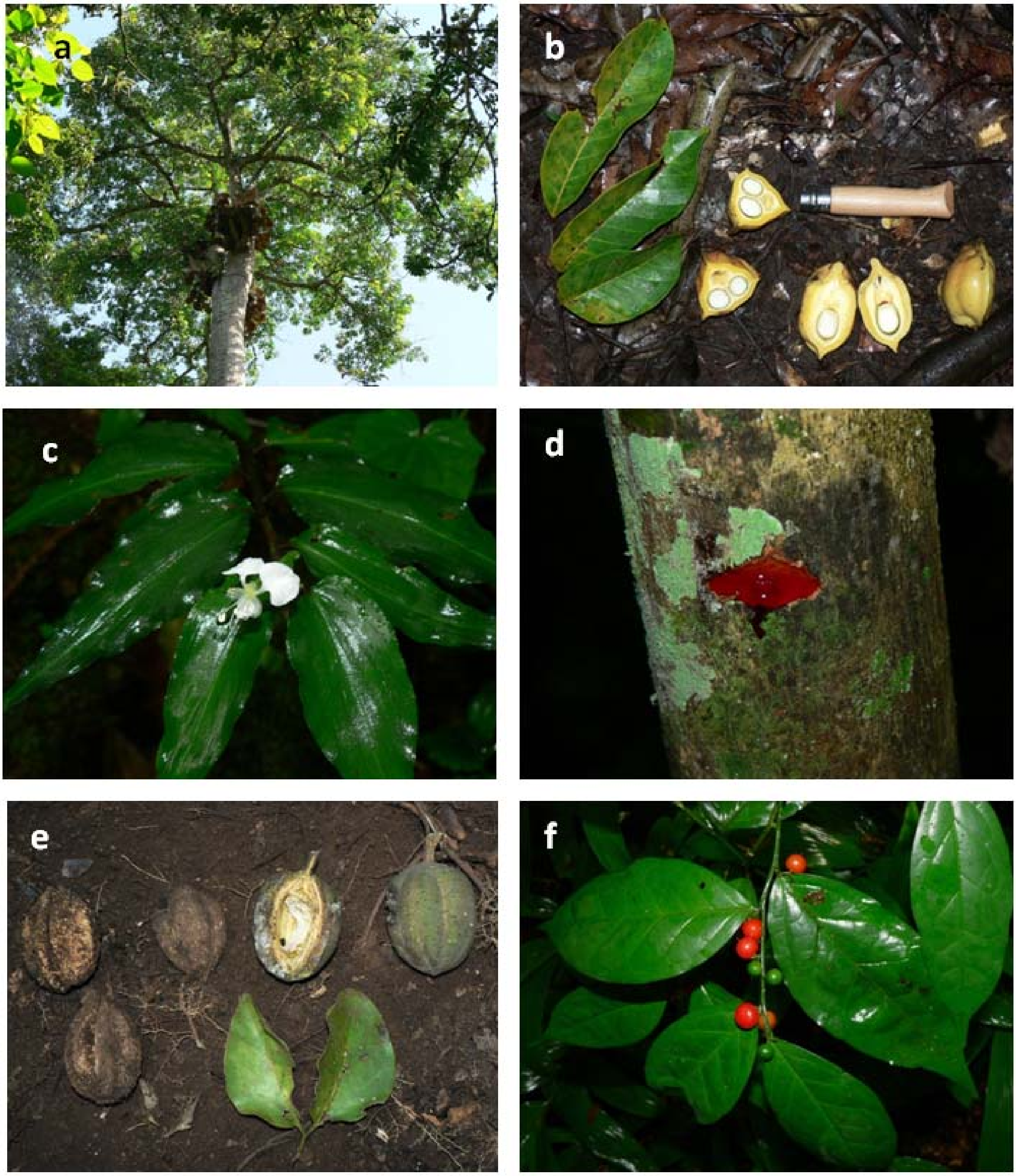

Figure 5.4 – Representatives for the category „High Priority" (HP) from Kakamega Forest (Kenya) and Budongo Forest (Uganda): a) *Alstonia boonei*, Apocynaceae (Uganda), b) *Blighia welwitschii*, Sapindaceae (Uganda), c) *Commelina albiflora*, Commelinaceae (Kenya), d) *Staudtia kamerunensis* var. *gabonensis*, Myrsinaceae, secreting typical blood-red latex if damaged (Uganda), e) *Balanites wilsoniana*, Zygophyllaceae (Uganda), f) *Olax subscorpioidea*, Olacaceae (Uganda).

several animal species and most of the animals can feed on several nectar and fruit sources. However, the disappearance of one partner of this mutualism can heavily affect the composition of the plant and animal communities within the forest (Aleixo

1999; Furuichi *et al.* 2001; Bleher *et al.* 2002; Fashing 2004; Farwig *et al.* 2006; Kirika *et al.* 2008). As pollination and seed dispersal are two independent processes, their conservation values add up if both processes apply.

Obligate mutualism:

Some plant species depend on one particular animal species for either pollination or seed dispersal and vice versa. If one partner of this obligate mutualistic relationship disappears, the other one might follow soon. One such case are *Ficus* species which are usually pollinated by one single species of fig wasps (Janzen 1979). The fig wasps again can have extremely host specific parasites (Weiblen 2002). In this case the disappearance of the fig would not only be followed the disappearance of the fig wasp, but also of its parasite. Another example is *Momordica foetida* Schumach. being pollinated by the oil-collecting bee genus *Ctenoplectra* (Vogel 1990).

For a better overview, the scores of the species can be aggregated to five conservation priority categories. These categories can be further aggregated into prioritized and not prioritized species. While these aggregations provide a better overview of conservation priorities and allow a variety of analyses, the original score shows how close a species is to change into the next higher or lower category. On this account Appendix 3 not only specifies the conservation category for each plant species but also the achieved scores.

The achieved conservation priority values only reach up to 18 although values up to 30 would have been possible. Thus, none of our plant species reached the highest possible scoring in all threat criteria what is a good sign as there are no species of extreme priority. The priority categories are adapted to the de facto distribution of priority values and not to the theoretically possible values as it would have been superfluously to create categories for values which have not been reached.

The aim was to provide a conservation priority for all species occurring within the study sites, including neophytes. Even introduced plants like *Psidium guayava* Raddi can nowadays be of high ecological value for the forest ecosystem. Those species do not belong into this forest and thus, their disappearance would be no lost in their natural distribution, but as the forest changed since their introduction, it is unclear if the present animal populations would still survive in the remaining forest without this copious food source. Thus, even introduced species can be important for forest animals and the local population, but the negative conservation value they gain for their worldwide distribution makes sure, that they are not equated with the local plant species. None of the introduced plants belongs to the prioritized species and most of them are of “no priority” while only three neophytic species are of “low priority”.

Several particularly valuable species like endemics (e.g. *Commelina albiflora*), extremely rare species such as *Entandrophragma angolense*, or important keystone species (e.g. *Prunus africana* (Hook. f.) Kalkman) were verified regarding the category allocated to them (see also Figure 5.4). All concerned species were found being among the prioritized species what demonstrates that the results of the new scoring system agree with the de facto situation in the forest.

INFLUENCE OF DISTURBANCE ON PRIORITIZED PLANT SPECIES

The significantly higher number of prioritized species in young secondary forests in Kakamega can be explained by a generally higher species number in this forest type. This is demonstrated by the percentage amount of prioritized species on the total species number per plot which does not show any significant difference. Thus, in Kenya the prioritized plant species are evenly distributed over all three forest types. In Budongo Forest the situation is contrary with the number of prioritized species not showing any significant differences, but the percentage of prioritized species being significantly higher in secondary forests compared to primary forests.

The results from the linear regression show a similar pattern: the disturbance level is positively correlated with the number of prioritized species in Kenya and with the percentage of prioritized species in Uganda. However, even if some of the differences in number and percentage of prioritized species among the three forest types were significant, only a very small percentage (up to 4.5%) of variation of threatened and important species could be explained by forest disturbance.

The fact that prioritized species occur in comparable number and percentage in all three forest types in Kenya and even in higher percentages in secondary forests in Uganda, indicates a good regeneration process in the secondary forests. Indeed many of the prioritized plants, including species with a high conservation priority, have been recorded in all three forest types, but, especially in case of trees, their seedlings could often be recorded already in young secondary forests, while the mature plants were usually only found in primary and old secondary forests.

Species which are restricted to primary and old secondary forest were higher evaluated than young secondary forest species and thus, prioritized species might have been expected to concentrate in older forests. As this is not the case, the new scoring system obviously not overvalues a single criterion. Conversely, even species which were not upgraded for their forest type preference like *Klainedoxa gabonensis* Pierre or *Mammea* *africana* Sabine could still be evaluated as prioritized if other criteria make them worth protection.

The introduced scoring system for the assessment of the conservation priority and the resulting classifications are to be considered as preliminary results. The system was developed for a concrete application: the establishment of an ex-situ conservation culture of endangered plants from selected isolated rain forests. The data about which plant species occur in the forest were very limited and an appropriate rating system for the classification of their conservation priority in small scale areas was not available. Hence, field surveys were carried out and a rating system was developed for the assessment of the conservation priority of a large number of plant species within a limited time. The results demonstrate that this procedure is feasible and obtains the desired information for the actual situation. As especially Kakamega Forest is a rapidly changing forest system, the composition of prioritized plant species might change in future.

For the application in other habitats some of the applied criteria might have to be modified and probably the scoring system can be optimized, but the new system might serve as a useful basis for similar studies. Long term observations about the decreasing or increasing size of particular populations within the forests could not be considered due to the limited time. In forests where these data or more time are available, population development would be an important criterion for the scoring system.

6 - EX-SITU CONSERVATION IN THE MASENO BOTANIC GARDEN

The tropical rain forests of East Africa are today of small scale and insular like character (Trapnell and Langdale-Brown 1962) and the ongoing decrease of natural forest area (even within protected areas) combined with the increasing population clarifies the need of pursuing conservation strategies. Kakamega Forest (Kenya) and Budongo Forest (Uganda) are only two out of a high number of these small rain forest islands in East Africa and are here chosen as model forests. Both forests have an official protected forest line and some sections even have the status of a national or nature reserve so that the in-situ conservation of their endangered species should theoretically be provided. While the natural forest cover of Budongo Forest was quite stable during the past 100 years, Kakamega Forest lost the majority of its natural forest areas during this time period (Schaab *et al.* 2010). This forest loss is mainly due to commercial timber production, the establishment of soft wood plantations, and the immense population pressure (Oyugi 1996; Lung and Schaab 2004; Bleher *et al.* 2006; Guthiga and Mburu 2006). With a population growth of 4% in Kenya (Lovett and Wasser 1993), it is not likely that the situation will release in future.

Where species survival of plants and animals in their natural habitat can not longer be guaranteed, ex-situ conservation presents an adequate strategy not only by increasing the chances of species survival, but also by providing the possibility of re-transferring the species into their natural habitats (Hamilton 1993; Chapman and Chapman 2004). Among the most extensive plant conservation resources in the world are Botanical Gardens which, besides their traditional functions such as teaching, research, public relations, and environmental education, become nowadays more and more important for nature conservation (Barthlott *et al.* 2000; Guerrant *et al.* 2004; Havens *et al.* 2006). The distribution of Botanical Gardens is actually biased on the wealthy European and North American countries while there is a great lack in tropical areas where the bigger part of the species occur (Barthlott *et al.* 1996; Barthlott *et al.* 2000). The Convention of Biological Diversity (CBD) not only highlights the importance of ex-situ conservation such as in Botanical Gardens (Article 9), but also states that it would be preferable if this conservation would take place in the country of origin of the particular species (Rauer *et al.* 2000).

Thus, the establishment of an ex-situ conservation culture of endangered vascular plants species from East African rain forests with a focus on Kakamega Forest in a Botanical Garden in Kenya would present a suitable conservation strategy for the protection of those disappearing forest islands. For a successful implementation it is important that the particular garden fulfils the space requirements and provides the appropriate climatic conditions that allow cultivation without greenhouses. These demands are met by the Botanic Garden of Maseno University (Kenya).

The Maseno University Botanic Garden is located about 40 km south-western from Kakamega (Figure 6.1) and was founded in 2001 in the context of the BIOTA East Africa project. Being a young Botanic Garden it still holds open areas for future plantings (Figure 6.2). Closely located to Kakamega Forest, Maseno has comparable climatic conditions and the short distance is very convenient for the extraction of plants for ex-situ conservation and reintroduction into the forest. Maseno Botanic Garden which is a member of Botanic Gardens Conservation International (BGCI) (http://www.bgci.org/garden.php?id=3483), already cultivates an initial collection of forest trees from Kakamega Forest.

Figure 6.1 – Location of Maseno Botanic Garden and Kakamega Forest in Western Kenya.

Sustainable conservation projects require the knowledge of species inventory of the area that needs protection, their abundance, and the stability of their population (Lovett and Wasser 1993). Therefore, in the run-up of the ex-situ culture, a comprehensive vegetation survey of the vascular plants was possessed in the two model forests (chapter 3 and 4) and a rating scheme for the assessment of their conservation priority was developed (chapter 5). Additionally initial plant collections have already been carried out and are already cultivated in Maseno Botanic Garden. The next step needs to be the specific extension of this ex-situ culture and the implementation of the aspirated plans.

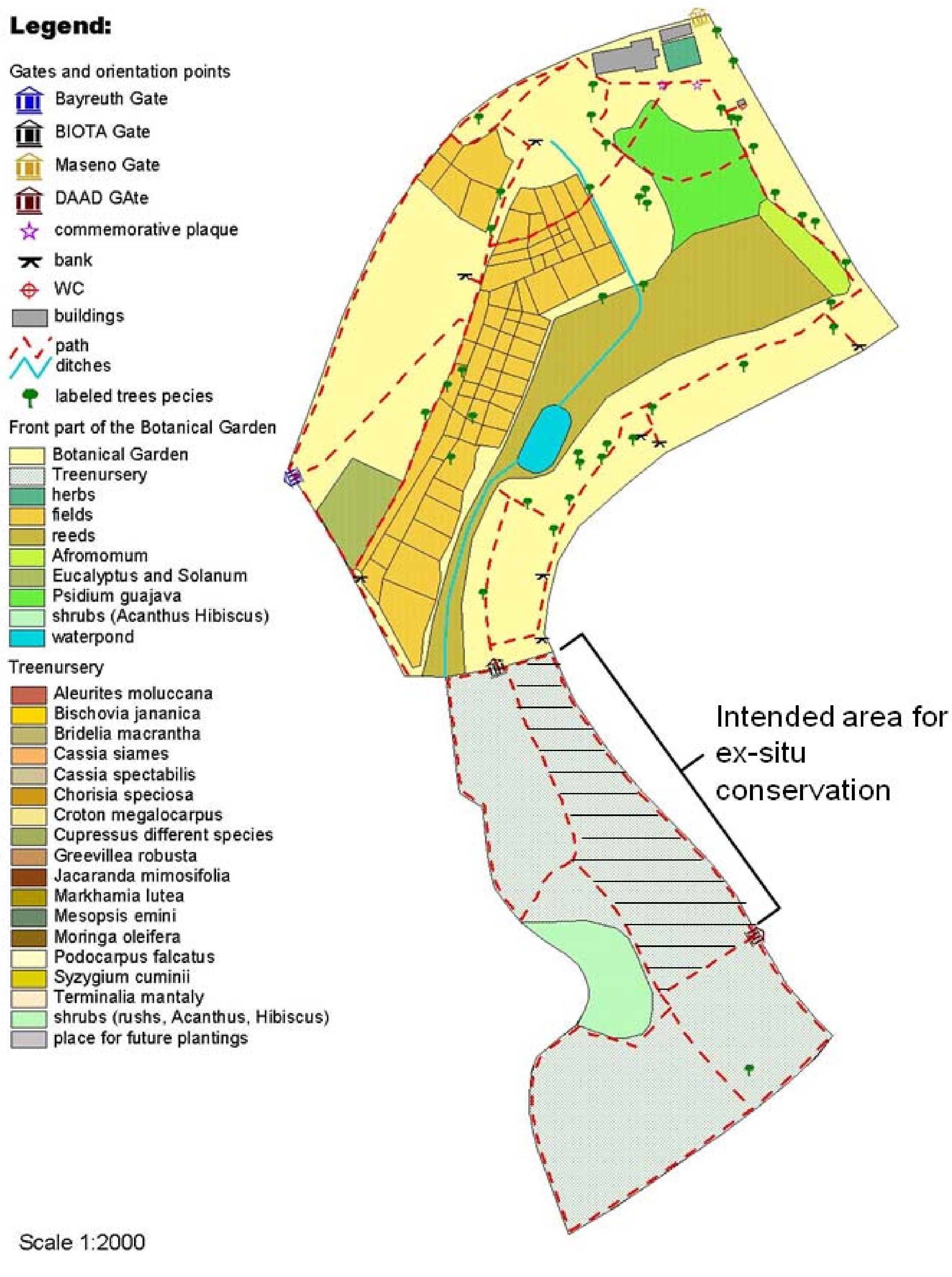

Figure 6.2: Map of Maseno University Botanic Garden showing the intended area for the cultivation of endangered vascular plants from Kakamega Forest.

6.1 INITIAL COLLECTIONS

As detailed information about the conservation priority of the plants from Kakamega Forest are not available until the end of this study, a preliminary list of endangered plants based on literature data was already composed at the beginning of this study. Basing on this list, a total of 2,578 plants, seedlings, and seeds from 101 species were collected during the field work in Kakamega Forest to form the basis of the ex-situ culture in Maseno Botanic Garden (Table 6.1, for detailed list of provided plant material see Appendix 4). Plants and seeds were only collected if found in large numbers and not more than half of the available individuals was extracted. As many small collections are better to advance the genetic diversity than a few extensive ones (Hamilton 1994), usually not more than ten individuals were collected from one site, but whenever possible the same species was collected from different sites.

Table 6.1: Overview of the collected plant material from Kakamega Forest for ex-situ conservation culture in Maseno Botanic Garden (for detailed list of species see Appendix 4).

	No. of species	No. of individuals
Seedlings	41	312
Seeds	16	1,200
Adult plants	48	265
Fruits	22	801
Total	**101**	**2,578**

In addition to the plant collection for Maseno, several epiphytic orchids were collected for cultivation in the Botanic Garden of the National Museums of Kenya (Nairobi, Kenya) and the orchid house of the Makerere University (Kampala, Uganda). All these epiphytic orchids were collected from the forest floor after falling off their host tree where they would have died sooner or later. That way in Kakamega Forest 44 orchids from 17 species were collected for the cultivation in the orchid collection of the National Museums of Kenya. The University of Makerere is actually planning to construct an orchid house and is therefore interested in local orchid species (Dr. Paul Ssegawa, pers. com.). During the field work in Budongo Forest, 61 orchids from 29 species were collected for Makerere University which are transitionally cultivated in the living plant collection next to the herbarium until the orchid house is finished. A detailed list of the collected orchid species is given in Appendix 4.

6.2 PROSPECTS

After finalizing the previous chapters the prioritized species requiring protection in form of ex-situ conservation are known and the collection for the cultivation in Maseno

Botanic Garden can now be carried out more determined. Careful collection will be continuously important to avoid further destabilizing of the already endangered plant populations.

A so far unused area in the southern part of Maseno Botanic Garden was made available for the cultivation of the plants from Kakamega Forest by Prof. Dr. J. C. Onyango and Prof. Dr. J. O. Nyabundi (Figure 6.2). Most of the already collected plants are actually cultivated in a nursery near the main building until the intended area for the ex-situ culture is prepared and the seedlings are grown older. In April 2009, the first tree seedlings were planted within the area concerned. The remaining plants are supposed to follow as soon as they are strong enough for transplanting.

In consultation with Prof. Onyango, the Kakamega plant culture is supposed to be designed in a forest like structure what does not only improve the growth conditions of the plants, but also makes it more attractive for visitors of the garden. Another benefit of this design is that a large number of species can be grown on a small area as shrubs and undergrowth species can be grown below the tree canopy while epiphytes and climbers can grow on the trees.

To provide a comfortable access to the plants and to avoid damage on terrestrial plant species the visitors can discover this little forest on a loop trail. The plants along this trail are planned to be labeled with their Latin name, the local name, and in case of useful plants with a color indication. The latter follows a color code defined in advance which provides information about the purpose this plants can be used for (medicinal plant, edible plant, timber wood, charcoal production, etc.). The respective information is provided in Appendix 3. Next to plants with a special importance or an unusual ecology (like strangler figs) an information board can take on the explanatory function. At the midway point of the trail, an open banda (traditional hut) can be used as a resting place and offers shelter from either rain or sun. Inside the banda, larger information boards would deliver the background information about the color code of the useful plants and inform about the unique characteristic of Kakamega Forest, the conservation need of its plants, and the function of the present ex-situ culture. In this way the Kakamega plant collection gets a double function: the conservation of endangered plant species on the one hand and information source as well as excursion destination for students and the local population on the other.

The complete implementation of the ex-situ conservation project, including the completion of the plant collection and the growing up of the plants, exceeds the available time frame of this PhD project. Thus, it falls to our colleagues from the Maseno

Botanic Garden to expand this unique collection of local, endangered plants from Kakamega Forest. We are grateful for their cooperation and trust that they are aware of the importance of their work for the conservation of Kenyan biodiversity. Protecting the plants of the shrinking Kakamega Forest is a contribution to protect the natural habitat for numerous animals and plants, many of them not occurring anywhere else in the country.

7 - CONCLUSIONS

Kakamega Forest (Kenya) and Budongo Forest (Uganda) are both isolated small scale forest systems, surrounded by a highly populated agricultural area. Still, they harbor a high diversity of vascular plants species, many of them not occurring anywhere else in the country (Diamond 1979). While Budongo Forest has some well preserved areas, both forests consist of a mosaic of areas affected by different degrees of human impact and in various stages of regeneration.

Generally the older and less disturbed forest areas show a higher floristic similarity among each other than to the younger or more disturbed sites. Beside forest disturbance also the spatial distances between the sites influence the floristic similarity: in Kenya the southern study sites cluster together, regardless of their disturbance level and in Uganda the northern forest fragment Kanio Pabidi obviously distinguishes from the southern sites. Forest disturbance not only changes species composition, but also species numbers, basal area and growth form composition. The variety of disturbance levels and investigated effects on vegetation structure and composition allows estimating the influence of the particular disturbance type and regeneration level. About 80 years after logging the species and growth form composition of old secondary forests generally resemble those of the unlogged forests, but regarding the herbaceous plants, the species composition of the old secondary forests shows more similarities to the younger forests than to the unlogged sites. The species numbers of old secondary forests are lower than both, unlogged and young secondary forests and the basal area of old secondary forests is considerably lower than in primary forests. Thus, 80 years after logging the area shows clear signs of regeneration, but still differs obviously in many ways. This time frame is long enough to re-establish the composition of woody plants, but the considerably lower basal area shows, that they are still much smaller than in primary forests what leads to a different forest structure what again affects the composition of herbaceous species.

In Budongo Forest, epiphyte species diversity is clearly negatively affected by forest disturbance. Not so in Kakamega Forest where the epiphyte species numbers are not declining along a disturbance gradient but from south towards north. In both forests the observed patterns can be traced back to changes in humidity, either caused by forest disturbance leading to a more open canopy an dryer microclimatic conditions, or depending on the generally dryer climate in northern Kakamega Forest (Dietzsch 2004).

While the epiphyte species numbers and composition of Kakamega and Budongo Forest agree with other studies on African epiphyte communities, their diversity is very low in comparison to Neotropical epiphyte studies. This pattern is not only true for epiphytes, but can also be observed concerning other life forms. Most of the Neotropical epiphyte studies were carried out along mountain ranges within global diversity centers for vascular plants (Küper *et al.* 2004; Barthlott *et al.* 2005). Both of the present study forests are located on a flat high plateau where the typical humid mountain climate is absent and no elevational gradient can be implied. The mountain ranges of the Albertine Rift are among the most species rich areas of tropical Africa and with geographical and climatic conditions more similar to Neotropical epiphyte study sites, they would present an adequate region for an investigation of African epiphyte communities. However, since the plant species numbers of the Albertine Rift are still considerably lower than in the Neotropical diversity centers, it is unlikely that the diversity of Albertine Rift epiphyte communities reaches the Neotropical levels.

The intensive vegetation surveys produced extensive information about species inventory, abundance, and distribution and the high number of species which were not known from this area highlights the inadequate knowledge on the floristics of the concerned forests. For the successfully implementation of the new data for the ex-situ culture of endangered plants, the conservation priority of the concerned species needed to be assessed. Since the available systems for the assessment of the plant's conservation status are not feasible for small scale forest systems and the global conservation status is unknown for most of the concerned plants, a new system was developed: basing on seven threat criteria a scoring system produces the conservation value for each implied plant species and by their particular conservation value, the plants can be assigned to five conservation categories. The threat criteria are chosen so that all necessary information is available from either the vegetation surveys and/or from literature data. Since this system was successfully applied for the plants of Kakamega and Budongo Forest, producing feasible and accurate results, it might serve as a base for the assessment of plant conservation priority in similar tropical forests where the knowledge on the vegetation is too insufficient for the application of non-tropical standards. In forests where different data are available (like long term observations on population stability) the criteria can be adapted easily.

The preliminary list of potentially endangered plant species basing on literature data and the already collected plant material served very well for an initialization of an ex-situ culture of endangered plants from East African rain forests in the Maseno Botanic Garden (Kenya). With the new data on the species inventory and their conservation priority, all necessary data are available for a specific expansion of the ex-situ collection, focusing on the prioritized species. If this project will be carried on according to plan, the Maseno Botanic Garden will soon have a unique collection of endangered local plant species. This ex-situ cultivation not only serves to ensure the survival of the concerned species if the disturbance of the natural habitat continues, but can also serve for re-establishment and re-forestation to counteract the decrease of their natural habitats.

8 - SUMMARY

Katja Rembold (2011) – **Conservation status of the vascular plants in East African rain forests.** Doctoral thesis. Institute for Integrated Natural Sciences, Biology Department, University of Koblenz-Landau.

SHORT SUMMARY

Aim of this study was the assessment of the conservation status of vascular plants in East African rain forests with the background of establishing an ex-situ culture of local endangered plants at the Botanic Garden of the Maseno University (Kenya). For a sustainable implementation it was first necessary to learn more about the general species inventory, especially concerning species composition and abundance under human impact, and to assess the conservation priority of each plant species. Representative for East African rain forests, Kakamega Forest (Kenya) and Budongo Forest (Uganda) were selected to serve as model forests. Beside the general floristic investigations including all vascular plants, a special focus was laid on vascular epiphytes and their vulnerability to forest disturbance. To assess the conservation priority of the plants, a rating system was developed based on seven threat criteria. By carrying out first plant collections, the ex-situ culture in Maseno Botanic Garden was already initiated.

SUMMARY

This thesis is part of the BIOTA East Africa (E04) project, wherefore all field work was carried out in two of the project model forests: Kakamega Forest in western Kenya and Budongo Forest in western Uganda. Both forests are located on high plateaus in an altitude of 1000 to 1700 m a.s.l. within the Great Rift Valley and are considered to be remnants of a once connected central African rain forest belt. The natural forest cover of Kakamega Forest was rapidly decreasing during the past century due to human impact and today the forest is highly fragmented. Budongo Forest still includes a compact main forest block and the forest edges stayed more or less stable during the last 100 years. In total 12 study sites were selected (six sites per forest), representing the full range from

primary forest up to young secondary forest under different anthropogenous and ecological pressures.

To record the floristic inventory, comprehensive vegetation surveys were performed over an area of about 9.5 ha in a total of 384 study plots. The total number of plots is composed of 240 plots considering all vascular plants, 132 epiphyte-plots, and 12 large tree-plots. Altogether 853 species of vascular plants, belonging to 472 genera and 126 families, were recorded. 523 species were investigated in Kenya of which 91 species are new records for this area. These data are already included in a checklist of the vascular plants of Kakamega Forest (Fischer *et al.* 2010). In Uganda 577 species were detected containing 156 new records for this forest. The most species rich family in both forests are Orchidaceae, followed by Acanthaceae in Kenya and Rubiaceae in Uganda. Forest disturbance influences the species and growth form composition and leads to a lower tree basal area. Beside disturbance, spatial distances between the study sites play an important role in species composition. For both study forests a list of indicator species for either disturbed or intact forest areas is provided.

As this study comprises all vascular plants including epiphytes which are known to be highly sensitive for microclimatic changes, the focus was in the second field phase on epiphyte investigation and changes in diversity patterns caused by forest disturbance. A total of 170 vascular epiphyte species were recorded what amounts 20% of the entire species considered in this study (including non-epiphytes). With 112 epiphyte species Budongo Forest slightly surpasses Kakamega Forest with its 100 species. In both forests orchids are the most species rich plant group (98 species) followed by ferns (38) and others (34). While in Uganda, forest disturbance leads to significantly lower epiphyte species numbers, the diversity patterns in Kenya increase along a north/south divide which can be explained by the higher humidity in the southern part of the forest. Both, number and floristic composition broadly agree with earlier studies on African epiphytes, but Neotropical epiphyte studies differ by higher species numbers and higher amounts of other families like Bromeliaceae. The total of 170 epiphyte species recorded in this study ranges among the highest species numbers for African epiphyte communities and in Kakamega forest, epiphytes were studied for the first time.

After species inventory and abundance in the different disturbed forest habitats were investigated, it became necessary to find a way for the assessment of their conservation priority. Since the existing evaluation methods were not feasible for the small scale model forests, a new rating method was developed based on a scoring system: in seven threat criteria each plant species gained different conservation values which were added up to their conservation priority values. Based on this priority value, the species were assigned to five priority categories reaching from "no priority" to "high priority". The categories "medium priority" to "high priority" were combined to be the prioritized species which are considered for the ex-situ cultivation what applies for 27% of the 853 plant species. Several particularly valuable species like endemics or extremely rare species were verified regarding the category allocated to them and confirmed that the results of the new scoring system agree with the de facto situation in the forest.

Since it was anticipated that the final conservation priorities of the particular plants will not be available until the end of this study, first of all a preliminary list of potentially endangered plants based on literature data was developed and allocated to the Maseno Botanic Garden. Basing on this list, a total of 2578 plants, seedlings, seeds, and fruits from 101 species were collected during the field periods in Kenya and taken to Maseno to create a basis for the ex-situ cultivation. In addition, epiphytic orchids which were fallen to the forest floor were transferred to the Botanical Garden of the National Museums of Kenya and the orchid house of the Makerere University in Uganda. After completion of this study all necessary information are now available for the specific extension of the new ex-situ culture in Maseno for the sustainable conservation of the endangered plant species from East African rain forests.

9 - ZUSAMMENFASSUNG

Katja Rembold (2011) – **Gefährdungsstatus der vaskulären Pflanzen ostafrikanischer Regenwälder.** Dissertation. Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Universität Koblenz-Landau.

KURZZUSAMMENFASSUNG

Das Ziel dieser Studie war die Erfassung des Gefährdungsstatus der Pflanzen ostafrikanischer Regenwäldern mit dem Hintergrund eine ex-situ Kultur für gefährdete lokale Pflanzen im Botanischen Garten der Universität Maseno (Kenia) zu gründen. Für eine nachhaltige Umsetzung war es zunächst notwendig mehr über den Pflanzenbestand im Untersuchungsgebiet herauszufinden, besonders hinsichtlich der Zusammensetzung und Häufigkeit der Arten unter anthropogenem Druck, sowie die Schutzpriorität jeder Pflanzenart zu erfassen. Repräsentativ für ostafrikanische Regenwälder wurden der Kakamega Forest (Kenia) und der Budongo Forest (Uganda) als Modelwälder ausgewählt. Neben den gesamtfloristischen Untersuchungen die alle vaskulären Pflanzen umfassen, wurde ein Schwerpunkt auf vaskuläre Epiphyten und ihre Anfälligkeit für Waldstörung gelegt. Um die Schutzpriorität der Pflanzen zu erfassen, wurde ein Bewertungssystem entwickelt das auf sieben Gefärdungskriterien basiert. Durch erste Pflanzen Aufsammlungen wurde die ex-situ Kultur im Botanischen Garten Maseno bereits initiiert.

ZUSAMMENFASSUNG

Diese Arbeit ist Teil des BIOTA Ost Afrika (E04) Projektes, weshalb alle Feldarbeiten in zwei der Modelwälder des Projektes durchgeführt wurden: Kakamega Forest in west Kenia und Budongo Forest in west Uganda. Beide Wälder befinden sich auf einem Hochplateau in einer Höhe von 1000 bis 1700 m über dem Meeresspiegel innerhalb des Great Rift Valleys und werden als Überreste eines ehemals zusammenhängenden zentralafrikanischen Regenwaldgürtels betrachtet. Die natürliche Waldfläche des Kakamega Forest ist im vergangenen Jahrhundert durch menschliche Einflüsse zusehends zurückgegangen und heute ist der Wald sehr stark fragmentiert. Der Budongo Forest enthält dagegen noch immer ein zusammenhängendes Haupt-Waldgebiet und seine

Grenzen waren in den letzten 100 Jahren vergleichsweise stabil. Insgesamt wurden 12 Untersuchungsgebiete ausgewählt (sechs pro Wald), welche die ganze Bandbreite von Primärwald bis hin zu jungem Sekundärwald unter verschiedenen anthropogenem und ökologischem Druck repräsentieren.

Um den floristischen Bestand zu erfassen, wurden umfangreiche Vegetationsaufnahmen auf einer Gesamtfläche von 9,5 ha, verteilt auf insgesamt 384 Untersuchungsflächen (Plots), durchgeführt. Die Gesamtzahl der Plots stellt sich zusammen aus 240 Plots in denen alle vaskulären Pflanzen aufgenommen wurden, 132 Epiphyten-Plots und 12 großen Baum-Plots. Insgesamt wurden 853 Pflanzenarten aus 472 Gattungen und 126 Familien aufgenommen. 523 Arten wurden in Kenia erfasst von denen 91 Arten Neunachweise für diesen Wald sind. Diese Daten sind bereits in eine Checklist der vaskulären Pflanzen des Kakamega Forest eingeflossen (Fischer *et al.* 2010). In Uganda wurden 577 Pflanzenarten erfasst, darunter 156 Neunachweise für dieses Gebiet. Die artenreichste Familie sind in beiden Wäldern die Orchidaceae, gefolgt von Acanthaceae in Kenia und Rubiaceae in Uganda. Waldstörung beeinflusst die Artenzusammensetzung und Wuchsform und führt zu einer geringeren Baum-Grundfläche. Für beide Wälder wird eine Liste mit Indikatorarten für entweder gestörte oder intakte Waldgebiete zur Verfügung gestellt.

Da diese Studie alle vaskulären Pflanzen umfasst, einschließlich Epiphyten, welche für ihre hohe Sensibilität bezüglich mikroklimatischen Veränderungen bekannt sind, lag der Schwerpunkt in der zweiten Feldphase auf einer Bestandsaufnahme der Epiphyten und Änderungen der Diversitätsmuster verursacht durch Waldstörung. Insgesamt wurden 170 Arten vaskulärer Epiphyten aufgenommen, was 20% der der gesamten Pflanzenarten die in dieser Studie bearbeitet wurden umfasst (inklusive nicht epiphytischer Arten). Mit 112 Epiphytenarten übertrifft der Budongo Forest den Kakamega Forest mit seinen 100 Arten geringfügig. In beiden Wäldern sind Orchideen die artenreichste Pflanzengruppe (98 Arten), gefolgt von Farnen (38) und anderen (34). Während Waldstörung in Uganda zu signifikant geringeren Artenzahlen führt, steigen die Diversitätsmuster in Kenia entlang eines Nord-Süd Gradienten an, was durch die höheren Niederschlagsmengen im südlichen Teil des Waldes erklärt werden kann. Sowohl die Artenzahlen als auch die floristische Zusammensetzung stimmen weitestgehend mit früheren Arbeiten an afrikanischen Epiphyten überein. Studien an neotropischen Epiphyten unterscheiden sich jedoch durch ihre höheren Artenzahlen und den höheren Anteil anderer Familien wie z.B. Bromeliaceae. Die Gesamtzahl von 170 Arten die in dieser Studie erfasst wurden bewegt sich unter den höchsten Artenzahlen die für afrikanische Epiphyten-Gemeinschaften bekannt sind und im Kakamega Forest wurden Epiphyten erstmalig untersucht.

Nachdem Artenbestand und Häufigkeit der Pflanzen in den verschieden stark gestörten Gebieten bekannt waren, war es notwendig einen Weg zu finden um ihren Gefährdungsstatus zu erfassen. Da die bestehenden Evaluierungsmethoden für die kleinräumigen Modelwälder nicht anwendbar sind, wurde eine neue Bewertungsmethode entwickelt, basierend auf einem Punktesystem: jede Pflanzenart kann für sieben Gefährdungs-Kriterien unterschiedliche Naturschutz-Werte erlangen, welche dann zu einem Prioritäts-Wert aufsummiert werden. Basierend auf diesem Prioritäts-Wert werden die Pflanzen fünf Prioritäts-Kategorien zugeordnet welche von „keine Priorität" bis „hohe Priorität" reichen. Die Kategorien „mittlere Priorität" bis „hohe Priorität" werden zu den priorisierten Arten zusammengefasst, welche für die ex-situ Kultur vorgesehen sind. Dies trifft für 27% der 853 Pflanzenarten zu. Einige besonders schützenswerte Arten wie Endemiten oder extrem seltene Arten wurden hinsichtlich der ihnen zugeteilten Kategorie überprüft und bestätigten, dass die Ergebnisse des neuen Wertesystems mit der tatsächlichen Situation im Wald übereinstimmen.

Da abzusehen war, dass die endgültigen Schutz-Prioritäten erst am Ende der Studie zur Verfügung stehen würden, wurde zunächst eine vorläufige List mit potential gefährdeten Arten basierend auf Literaturdaten erstellt und dem Botanischen Garten in Maseno zur Verfügung gestellt. Basierend auf dieser Liste wurden insgesamt 2578 Pflanzen, Sämlinge, Samen und Früchte von 101 Arten während der Feldaufenthalte in Kenia gesammelt und nach Maseno gebracht um eine Basis für die ex-situ Kultur zu schaffen. Epiphytische Orchideen welche auf den Waldboden gefallen waren, wurden dem Botanischen Garten des Nationalmuseums von Kenia und dem Orchideen-Haus der Makerere Universität in Uganda übergeben. Nach Abschluss dieser Studie liegen nun alle notwendigen Informationen vor, um die neue ex-situ Kultur in Maseno gezielt zu erweitern, zum nachhaltigen Schutz der gefährdeten Pflanzenarten ostafrikanischer Regenwälder.

10 - REFERENCES

Aide, T. M., Zimmerman, J. K., Herrera, L., Maydee Rosario, M., Serrano, M. (1995): Forest recovery in abandoned tropical pastures in Puerto Rico. Forest Ecology and Management 77 (1-3): 77-86.

Agnew, A. D. Q., Agnew, S. (1994): Upland Kenya Wild Flowers: A Flora of the Ferns and Herbaceous Flowering Plants of Upland Kenya. East Africa Natural History Society (EANHS), Nairobi, Kenya.

Aleixo, A. (1999): Effects of selective logging on a bird community in the Brazilian Atlantic Forest. The Condor 101 (3): 537-548.

Althof, A. (2005): Human Impact on flora and vegetation of Kakamega Forest, Kenya - structure, distribution and disturbance of plant communities in an East African rainforest. PhD Thesis. Institute for Integrated Natural Sciences. Biology Department. University of Koblenz-Landau, Germany.

Asner, G. P., Knapp, D. E., Broadbent, E. N., Oliveira, P. J. C., Keller, M., Silva, J. N. (2005): Selective logging in the Brazilian Amazon. Science 310: 480-482.

Baillie, J. E. M., Collen, B., Amin, R., Akcakaya, H. R., Butchart, S. H. M., Brummitt, N., Meagher, T. R., Ram, M., Hilton-Taylor, C., Mace, G. M. (2008): Toward monitoring global biodiversity. Conservation Letters 1: 18–26.

Barthlott, W. (1983): Biogeography and evolution in neo- and palaeotropical Rhipsalinae (Cactaceae) In: Kubitzki, K.: Dispersal and Distribution. Hamburg, Sonderband naturwissenschaftlicher Verlag. 7: 241-248.

Barthlott, W., Hostert, A., Kier, G., Küper, W., Kreft, H., Mutke, J., Rafiqpoor, M. D., Sommer, J. H. (2007): Geographic patterns of vascular plant diversity at continental to global scales. Erdkunde 61: 305-315.

Barthlott, W., Lauer, W., Placke, A. (1996): Global distribution of species diversity in vascular plants: towards a world map of phytodiversity. Erdkunde 50: 317-328.

Barthlott, W., Mutke, J., Rafiqpoor, M. D., Kier, G., Kreft, H. (2005): Global centres of vascular plant diversity. Nova Acta Leopoldina 92: 61-83.

Barthlott, W., Rauer, G., Ibisch, P. L., Driesch, M. v. d., Lobin, W. (2000): Biodiversity and botanic gardens In: Bundesamt für Naturschutz, Bonn (ed.): Botanic Gardens and Biodiversity. Landwirtschaftsverlag, Münster, pp. 1-24.

Barthlott, W., Schmit-Neuerburg, V., Nieder, J., Engwald, S. (2001): Diversity and abundance of vascular epiphytes: a comparison of secondary vegetation and primary montane rain forest in the Venezuelan Andes. Plant Ecology 152: 145-156.

Barthlott, W., Taylor, N. P. (1995): Notes towards a monograph of Rhipsalideae (Cactaceae). Bradleya 13: 43-79.

Beentje, H. (1994): Kenya trees, shrubs and lianas. National Museums of Kenya, Nairobi.

Benzing, D. H. (1990): Vascular Epiphytes. Cambridge Tropical Biology Series Cambridge University Press, Cambridge, UK.

Benzing, D. H. (1998): Vulnerabilities of tropical forests to climate change: The significance of resident epiphytes. Climatic Change 39: 519-540.

Biedinger, N., Fischer, E. (1996): Epiphytic vegetation and ecology in central African forests (Rwanda, Zaire). Ecotropica 2 (2): 121-142.

Bleher, B., Oberranth, R., Böhning-Gaese, K. (2002): Seed dispersal, breeding system, tree density and the spatial pattern of trees - a simulation approach. Basic and Applied Ecology 3: 115-123.

Bleher, B., Uster, D., Bergsdorf, T. (2006): Assessment of threat status and management effectiveness in Kakamega Forest, Kenya. Biodiversity and Conservation 15 (4): 1159-1177.

Blüthgen, N., Verhaagh, M., Goitía, W., Blüthgen, N. (2000): Ant nests in tank bromeliads - an example of non-specific interaction. Insectes Sociaux 47: 313-316.

Brooks, T. M., Pimm, S. L., Oyugi, J. O. (1999): Time lag between deforestation and bird extinction in tropical forest fragments. Conservation Biology 13 (5): 1140-1150.

Burley, J. (2001): The balance between biodiversity conservation and sustainable use of tropical rain forests - Policy-relevant forest research. In: Hillegers, P. J. M., de Iongh, H. H.: The Balance between Biodiversity Conservation and Sustainable Use of Tropical Rain Forests. The Tropenbos Foundation, Wageningen, Netherlands, pp. 13-18.

Bussmann, R. (2006): Ethnobotany of the Samburu of Mt. Nyiru, South Turkana, Kenya. Journal of Ethnobiology and Ethnomedicine 2 (1): 35.

Cardelús, C. L., Colwell, R. K., Watkins, J. E. J. (2006): Vascular epiphyte distribution patterns: explaining the mid-elevation richness peak. Journal of Ecology 94: 144-156.

Cardelús, C. L., Mack, M. C. (2010): The nutrient status of epiphytes and their host trees along an elevational gradient in Costa Rica. Plant Ecolology 207: 25–37.

Cascante-Marìn, A., von Meijenfeldt, N., de Leeuw, H. M. H., Wolf, J. H. D., Oostermeijer, J. G. B., den Nijs, J. C. M. (2009): Dispersal limitation in epiphytic bromeliad communities in a Costa Rican fragmented montane landscape. Journal of Tropical Ecology 25: 63–73.

Chapman, A. D. (2009): Numbers of living species in Australia and the world. Report for the Australian Biological Resources Study. Second Edition. Canberra, Australia.

Chapman, C. A., Chapman, L. J. (1996a): Mid-elevation forests: a history of disturbance and regeneration. In: McClanahan, T. R., Young, T. P.: Ecosystems and Their Conservation in East Africa. Part V. Forest Ecosystems, Oxford University Press, New York, pp. 385-400.

Chapman, C. A., Chapman, L. J. (1996b): Exotic tree plantations and the regeneration of natural forests in Kibale National Park, Uganda. Biological Conservation 76: 253-257.

Chapman, C. A., Chapman, L. J. (1997): Forest Regeneration in Logged and Unlogged Forests of Kibale National Park, Uganda. Biotropica 29 (4): 396-412.

Chapman, C. A., Chapman, L. J. (2004): Unfavorable successional pathways and the conservation value of logged tropical forest. Biodiversity and Conservation 13: 2089-2105.

Chazdon, R. L. (1988): Sunflecks and their importance to forest understorey plants. Advances in Ecological Research 18: 1-63.

Cincotta, R. P., Wisnewski, J., Engelman, R. (2000): Human population in the biodiversity hotspots. Nature 404: 990-992.

Collar, N. J., Stuart, S. N. (1988): Key Forests for Threatened Birds in Africa. International Council for Bird Preservation, ICBP Monograph No. 3, Cambridge, UK.

Cochrane, J. A., Crawford, A. D., Monks, L. T. (2007): The significance of ex situ seed conservation to reintroduction of threatened plants. Australian Journal of Botany 55 (3): 356–361.

Collen, B., Ram, M., Zamin, T., McRae, L. (2008): The tropical biodiversity data gap: addressing disparity in global monitoring. Tropical Conservation Science 1 (2): 75-88.

Colwell, R. K. (2006): EstimateS: statistical estimation of species richness and shared species from samples. Version 8. Persistent URL www.purl.oclc.org/estimates.

Crawley, M. J. (2007): The R Book. John Wiley & Sons Ltd, Chichester, West Sussex, UK.

Couvreur, T. L. P., Chatrou, L. W., Sosef, M. S. M., Richardson, J. E. (2008): Molecular phylogenetics reveal multiple tertiary vicariance origins of the African rain forest trees. BMC Biology 6 (54): doi:10.1186/1741-7007-6-54.

Dalitz, H., Gliniars, R. (2010): Trees in the context of different environments. BIOTA East Africa - Concluding Conference 2010, Kakamega, Kenya.

De Cáceres, M., Legendre, P. (2009): Associations between species and groups of sites: indices and statistical inference. Ecology 90 (12): 3566-3574.

De Cáceres, M., Legendre, P., Moretti, M. (2010): Improving indicator species analysis by combining groups of sites. Oikos 119: 1674-1684.

De Oliveira, A. A., Mori, S. A. (1999): A central Amazonian terra firme forest. I. High tree species richness on poor soils. Biodiversity and Conservation 8: 1219–1244.

Denslow, J. S. (1987): Tropical rainforest gaps and tree species diversity. Annual Review of Ecology and Systematics 18: 431-451.

Deshmukh, I. K. (1982): Diversity of understory arthropods in an indigenous forest and an exotic *Eucalyptus* plantation in western Kenya. Kenya Journal of Science and Technology 3: 3-7.

Dial, R., Tobin, S. C. (1994): Description of arborist methods for forest canopy access and movement. Selbyana 15 (2): 24-37.

Diamond, A. W. (1981): Reserves as oceanic islands: lessons for conserving some East African montane forests. African Journal of Ecology 19: 21-25.

Diamond, T. (1979): Kakamega: Is there a way to stop the rot? Swara 2 (1): 25-26.

Díaz, I. A., Sieving, K. E., Pena-Foxon, M. E., Larraín, J., Armesto, J. J. (2010): Epiphyte diversity and biomass loads of canopy emergent trees in Chilean temperate rain forests: a neglected functional component. Forest Ecology and Management 259: 1490-1501.

Dietzsch, A. C. (2004): Effects of interspecific pollen transfer on seed set in two East African *Acanthus* species (Acanthaceae). Diploma thesis. Zoologisches Forschungsinstitut und Museum Alexander Koenig, Rheinische Friedrich-Wilhelms Universität Bonn, Germany.

Dorning, M., Cipollini, D. (2006): Leaf and root extracts of the invasive shrub, *Lonicera maackii*, inhibit seed germination of three herbs with no autotoxic effects. Plant Ecology 184: 287-296.

Dufrene, M., Legendre, P. (1997): Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs 67 (3): 345-366.

Dytham, C. (2003): Choosing and Using Statistics - a Biologist's Guide. Second Edition. Blackwell Publishing, Oxford, UK.

Eggeling, W. J. (1947): Observations on the ecology of the Budongo rain forest, Uganda. Journal of Ecology 34 (1): 20-87.

Eilu, G., Hafashimana, D. L. N., Kasenene, J. M. (2004): Density and species diversity of trees in four tropical forests of the Albertine rift, western Uganda. Diversity and Distributions 10 (4): 303-312.

Engwald, S. (2004): With an airship at the roof of the rain forest – biodiversity of epiphytes, forest structure and light regime of an equatorial rain forest in Gabon, Central Africa. In: Breckle, S. W., Schweizer, B. and Fangmeier, A.: Results of Worldwide Ecological Studies. Proceedings of the 2st Symposium by the A.F.W Schimper-Foundation. Verlag Günter Heimbach. Stuttgart-Hohenheim, Germany, pp. 229-242.

Eshiamwata, G. W., Berens, D., Bleher, B., Dean, W. R. J., Böhning-Gaese, K. (2006): Bird assemblages in isolated *Ficus* trees in Kenyan farmland. Journal of Tropical Ecology 22: 723-726.

Faden, R. B. (1970): A Preliminary Report on the Kakamega Forest in Kenya. Herbarium, East Africa, Nairobi, Kenya.

Farwig, N., Böhning-Gaese, K., Bleher, B. (2006): Enhanced seed dispersal of *Prunus africana* in fragmented and disturbed forests? Oecologia 147: 238–252.

Fashing, P. J. (2001): Feeding ecology of guerezas in the Kakamega Forest, Kenya: The importance of Moraceae fruit in their diet. International Journal of Primatology 22 (4): 579-609.

Fashing, P. J. (2004): Mortality trends in the African cherry (*Prunus africana*) and the implications for colobus monkeys (*Colobus guereza*) in Kakamega Forest, Kenya. Biological Conservation 120: 449–459.

Fayle, T. M., Chung, A. Y. C., Dumbrell, A. J., Eggleton, P., Foster, W. A. (2009): The effect of rain forest canopy architecture on the ditribution of epiphytic ferns (*Asplenium* spp.) in Sabah, Malaysia. Biotropica 41 (6): 676-681.

Fischer, E., Killmann, D. (2008): Illustrated Field Guide to the Plants of Nyungwe National Park Rwanda. Koblenz Geographical Colloquia. Series Biogeographical Monographs 1.

Fischer, E., Killmann, D., Delepierre, G., Lebel, J.-P. (2010): The Orchids of Rwanda. Koblenz Geographical Colloquia. Series Biogeographical Monographs 2.

Fischer, E., Rembold, K., Althof, A., Obholzer, J., Malombe, I., Mwachala, G., Onyango, J., Dumbo. B. & Theisen, I. (2010): Annotated checklist of the vascular plants of the Kakamega Forest, Western Province, Kenya. Journal of East Africa Natural History. 99 (2): 129-226.

Furuichi, T., Hashimoto, C., Tashiro, Y. (2001): Fruit availability and habitat use by chimpanzees in the Kalinzu Forest, Uganda: Examination of fallback foods. International Journal of Primatology 22 (6): 929-945.

Gärdenfors, U., Hilton-Taylor, C., Mace, G. M., Rodríguez, J. P. (2001): The application of IUCN Red List criteria at regional levels. Conservation Biology 15 (5): 1206–1212.

Gentry, A. H., Dodson, C. H. (1987): Diversity and biogeography of neotropical vascular epiphytes. Annuals of the Missouri Botanical Garden 74 (2): 205-233.

Ghazoul, J., Sheil, D. (2010): Tropical Rain Forest Ecology, Diversity, and Conservation. Oxford University Press, New York.

Gibbon, H. (1994): Conservation and market development. Ileia Newsletter: 30-31.

Giraudoux, P. (2010): pgirmess: Data analysis in ecology. R package version 1.4.9. http://CRAN.R-project.org/package=pgirmess, accessed in Apr. 2011.

Gradstein, S. R. (2008): Epiphytes of tropical montane forests - impact of deforestation and climate change. In: Gradstein, S. R., Homeier, J., Gansert, D.: The Tropical Mountain Forest - Patterns and Processes in a Biodiversity Hotspot. Universitätsverlag Göttingen, Göttingen.

Gradstein, S. R., Homeier, J., Gansert, D. (2008): The Tropical Mountain Forest - Patterns and Processes in a Biodiversity Hotspot. Universitätsverlag Göttingen, Göttingen.

Gradstein, S. R., Nadkarni, N. M., Krömer, T., Holz, I., Nöske, N. (2003): A protocol for rapid and representative sampling of vascular and non-vascular epiphyte diversity of tropical rain forests. Selbyana 24 (1): 105-111.

Guerrant, E. O., Havens, K., Maunder, M. (2004): Ex Situ Plant Conservation: Supporting Species Survival in the Wild. Island Press, Washington.

Guthiga, P., Mburu, J. (2006): Local communities' incentives for forest conservation: case of Kakamega Forest in Kenya. 11th Biannual Conference of International Association for the Study of Common Property (IASCP). Bali, Indonesia.

Gutiérrez-Granados, G., Dirzo, R. (2010): Indirect effects of timber extraction on plant recruitment and diversity via reductions in abundance of frugivorous spider monkeys. Journal of Tropical Ecology 26: 45-52.

Hamilton, A. C. (1974): Distribution patterns of forest trees in Uganda and their historical significance. Vegetatio 29: 21-35.

Hamilton, A. C. (1981): The quaternary history of African forests: its relevance to conservation. African Journal of Ecology 19: 1-6.

Hamilton, A. C. (1991): A Field Guide to Ugandan Forest Trees. Institute of Environment and Natural Resources, Makere University, Kampala.

Hamilton, M. B. (1994): Ex situ conservation of wild plant species: time to reassess the genetic assumptions and implications of seed banks. Conservation Biology 8(1): 39-49.

Havens, K., Vitt, P., Maunder, M., Guerrant, E. O., Dixon, K. (2006): Ex situ plant conservation and beyond. BioScience 56(6): 525-531.

Herndon, C. N., Butler, R. A. (2010): Significance of biodiversity to health. Biotropica 42 (5): 558–560.

Heywood, V. H., Brummitt, R. K., Cilham, A., Seberg, O. (2007): Flowering Plant Families of the World. Royal Botanical Gardens, Kew.

Hietz, P., Hietz-Seifert, U. (1995): Structure and ecology of epiphyte communities of a cloud forest in central Veracruz, Mexico. Journal of Vegetation Science 6 (5): 719-728.

Hill, J. K. (1999): Butterfly spatial distribution and habitat requirements in a tropical forest: impacts of selective logging. Journal of Applied Ecology 36: 564-572.

Hilton-Taylor, C., Pollock, C. M., Chanson, J. S., Butchart, S. H. M., Oldfield, T. E. E., Katariya, V. (2009): State of the world's species. In: Vié, J. C., Hilton-Taylor, C., Stuart, S. N. (eds.): Wildlife in a Changing World – an Analysis of the 2008 IUCN Red List of Threatened Species™. IUCN, Gland, Switzerland, pp. 15-41.

Ingram, S. W., Lowman, M. D. (1995): The collection and preservation of plant material from the tropical forest canopy. In: Lowman, M. D., Nadkarni, N. M.: Forest Canopies. Academic Press, San Diego, pp. 587-603.

Ingram, S. W., Nadkarni, N. M. (1993): Composition and distribution of epiphytic organic matter in a Neotropical cloud forest, Costa Rical. Biotropica 25 (4): 370-383.

IUCN (2001): IUCN Red List categories and criteria: Version 3.1. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN (2003): Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 26 pp.

IUCN (2010a): Guidelines for using the IUCN Red List categories and criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee in March 2010.

IUCN (2010b): http://www.iucnredlist.org/technical-documents/spatial-data, accessed in Feb. 2011.

Janzen, D. H. (1979): How to be a fig. Annual Review of Ecology and Systematics 10: 13-51.

Jaques-Félix, H. (2000): The discovery of a bromeliad in Africa: *Pitcairnia feliciana*. Selbyana 21 (1,2): 118-124.

Johansson, D. (1974): Ecology of vascular epiphytes in West African rain forest. Acta Phytogeographica Suecica 59: 1-129.

Kiama, D., Kiyiapi, J. (2001): Shade tolerance and regeneration of some tree species of a tropical rain forest in Western Kenya. Plant Ecology 156 (2): 183-191.

Kigomo, B. N. (1987): Some observations on regeneration trials in the Kakamega and south Nandi natural forests, Kenya. East African Agricultural and Forestry Journal 52 (3): 184-195.

Kirika, J. M., Farwig, N., Boehning-Gaese, K. (2008): Effects of local disturbance of tropical forests on frugivores and seed removal of a small-seeded Afrotropical tree. Conservation Biology 22 (2): 318–328.

Kitching, R. L. (2000): Food Webs and Container Habitats: the Natural History and Ecology of Phytotelmata. Cambridge University Press, New York.

Köhler, L., Tobon, C., Frumau, K. F. A., Bruijnzee, L. A. (2007): Biomass and water storage dynamics of epiphytes in old-growth and secondary montane cloud forest stands in Costa Rica. Plant Ecology 193 (2): 171-184.

Köster, N. (2008): Tropical epiphyte diversity under human impact – comparing primary forests, secondary forests, and forest fragments in Ecuador. PhD Thesis. Nees Institut for Biodiversity of Plants. University of Bonn, Germany.

Köster, N., Friedrich, K., Nieder, J., Barthlott, W. (2009): Conservation of epiphyte diversity in an Andean landscape transformed by human land use. Conservation Biology 23 (4): 911–919.

Kokwaro, J. O. (1988): Conservation status of the Kakamega Forest in Kenya: The easternmost relict of the equatorial rain forests of Africa. Monographs in Systematic Botany from the Missouri Botanical Garden 25: 471-489.

Kreft, H., Köster, N., Küper, W., Nieder, J., Barthlott, W. (2004): Diversity and biogeography of vascular epiphytes in Western Amazonia, Yasuni, Ecuador. Journal of Biogeography 31 (9): 1463-1476.

Kress, W. J. (1986): The systematic distribution of vascular epiphytes: an update. Selbyana 9: 2-22.

Küper, W., Sommer, J. H., Lovett, J. C., Mutke, J., Linder, H. P., Beentje, H. J., van Rompaey, R. S. A. R., Chatelain, C., Sosef, M., Barthlott, W. (2004a): Africa's hotspots of biodiversity redefined. Annals of the Missouri Botanical Garden 91 (4): 525-535.

Küper, W., Kreft, H., Nieder, J., Köster, N., Barthlott, W. (2004b): Large-scale diversity patterns of vascular epiphytes in Neotropical montane rain forests. Journal of Biogeography 31 (9): 1477-1487.

Legendre, P., Legendre, L. (1998): Numerical Ecology. Second English Edition. Elsevier Science BV, Amsterdam.

Lopez, L. C. S., Filizola, B., Deiss, I., Rios, R. I. (2005): Phoretic behaviour of bromeliad annelids (*Dero*) and ostracods (*Elpidium*) using frogs and lizards as dispersal vectors. Hydrobiologia 549 (1): 15-22.

Lovett, J. C., Wasser, S. K. (1993): Biogeography and Ecology of the Rain Forests of Eastern Africa. Cambridge University Press, Cambridge.

Lung, T., Schaab, G. (2004): Change-detection in Western Kenya – The documentation of fragmentation and disturbance for Kakamega Forest and associated forest areas by means of remotely-sensed imagery. ISPRS Archives, Vol. XXXV, Proceedings of the ISPRS 20th Congress.

Lung, T., Schaab, G. (2006): Assessing fragmentation and disturbance of west Kenyan rainforests by means of remotely sensed time series data and landscape metrics. African Journal of Ecology 44 (4): 491-506.

Lwanga, J. S. (2003): Forest succession in Kibale National Park, Uganda: implications for forest restoration and management. African Journal of Ecology 41: 9-22.

Marsden, S. J., Fielding, A. H., Mead, C., Zakaria Hussin, M. (2002): A technique for measuring the density and complexity of understorey vegetation in tropical forests. Forest Ecology and Management 165: 117-123.

Maundu, P. M., Ngugi, G. W., Kabuye, C. H. S. (1999): Traditional Food Plants of Kenya. Kenya Resource Center for Indigenous Knowledge (KENRIK), Nairobi.

Muriithi, S., W., K. (2002): Conservation of biodiversity in the Arabuko Sokoke Forest, Kenya. Biodiversity and Conservation 11: 1437-1450.

Muriuki, J. W., Tsingalia, M. H. (1990): A new population of de Brazza's monkey in Kenya. Oryx 24(3): 157-162.

Mutke, J., Barthlott, W. (2005): Patterns of vascular plant diversity at continental to global scales. In: I. Friis, and H. Balslev (eds.): Plant Diversity and Complexity Patterns – Local, Regional and Global Dimensions. The Royal Danish Academy of Sciences and Letters, Copenhagen. Biologiske Skrifter 55: 521-531.

Nadkarni, N. M. (1992): The conservation of epiphytes and their habitats: summary of a discussion at the international symposium on the biology and conservation of epiphytes. Selbyana 13: 140-142.

Nadkarni, N. M. (1994): Diversity of species and interactions in the upper tree canopy of forest ecosystems. American Zoologist 34: 70-78.

Nadkarni, N. M., Matelson, T. J. (1989): Bird use of epiphyte resources in Neotropical trees. The Condor 91: 891-907.

Nadkarni, N. M., Matelson, T. J. (1992): Biomass and nutrient dynamics of epiphytic litterfall in a Neotropical montane forest, Costa Rica. Biotropica 24: 24-30.

Neill, W. T. (1951): A bromeliad herpetofauna in Florida. Ecology 32 (1): 140-143.

Nieder, J., Barthlott, W. (2001): Epiphytes and their role in the tropical forest canopy. In: Nieder, J., Barthlott, W.: Epiphytes and Canopy Fauna of the Otonga Rain Forest (Ecuador). Results of the Bonn-Quito Epiphyte Project, funded by the Volkswagen Foundation (Vol. 2 of 2). Bonn, pp. 23-86.

Nieder, J., Prosperi, J., Michaloud, G. (2001): Epiphytes and their contribution to canopy diversity. Plant Ecology 153: 51–63.

Nishida, T., Wrangham, R. W., Jones, J. H., Marshall, A., Wakibara, J. (2001): Do chimpanzees survive the 21st century? In: The Apes: Challenges for the 21st Century. Conference proceedings, 2000 May 10-13; Brookfield, IL. Chicago: Chicago Zoological Society Brookfield, pp. 43-51.

Njoroge, G., Bussmann, R. (2006): Diversity and utilization of antimalarial ethnophytotherapeutic remedies among the Kikuyus (Central Kenya). Journal of Ethnobiology and Ethnomedicine 2 (1): 2-8.

Nowicki, C. (2001): Epífitas vasculares de la Reserva Otonga. In: Nieder, J. and Barthlott, W.: Epiphytes and Canopy Fauna of the Otonga Rain Forest (Ecuador). Results of the Bonn-Quito Epiphyte Project, funded by the Volkswagen Foundation (Vol. 2 of 2). Bonn: 115-160.

Ogutu, Z. A. (1996): Multivariate analysis of plant communities in the Narok district, Kenya: the influence of environmental factors and human disturbance. Plant Ecology 126: 181-186.

Oksanen, J. (2011): Multivariate analysis of ecological communities in R: vegan tutorial. http://cc.oulu.fi/~jarioksa/opetus/metodi/vegantutor.pdf, accessed in Mar. 2011.

Omeja, P., Obua, J., Cunningham, A. B. (2004): Regeneration, density and size class distribution of tree species used for drum making in central Uganda. African Journal of Ecology 42: 129-136.

Owiunji, I., Plumptre, A. J. (1998): Bird communities in logged and unlogged compartments in Budongo Forest, Uganda. Forest Ecology and Management 108 (1-2): 115-126.

Oyugi, J. O. (1996): Kakamega Forest is dying. EANHS Bulletin 26: 3-4.

Perry, D. (1978): A method of access into the crowns of emergent and canopy trees. Biotropica 10: 155-157.

Perry, D. R., Williams, J. (1981): The tropical rain forest canopy: a method providing total access. Biotropica 13: 283-285.

Plumptre, A. J. (1996): Changes following 60 years of selective timber harvesting in the Budongo Forest Reserve, Uganda. Forest Ecology and Management 89 (1-3): 101-113.

Plumptre, A. J., Cox, D., Mugume, S. (2003): The status of the chimpanzees in Uganda. Albertine Rift Technical Report Series No. 2, Wildlife Conservation Society.

Plumptre, A. J., Davenport, T. R. B., Behangana, M., Kityo, R., Eilu, G., Ssegawa, P., Ewango, C., Meirte, D., Kahindo, C., Herremans, M., Kerbis Peterhans, J., Pilgrim, J. D., Wilson, M., Languy, M., Moyer, D. (2007): The biodiversity of the Albertine Rift. Biological Conservation 134: 178-194.

Plumptre, A. J., Machanda, Z. (2007): Identified flora of the Budongo Forest Reserve. Report, Budongo Conservation Field Station (BCFS), pp. 1-3.

Poltz, K., Zotz, G. (2011): Vascular epiphytes on isolated pasture trees along a rainfall gradient in the lowlands of panama. Biotropica 43 (2): 165-172.

Porembski, S., Barthlott, W. (1999): *Pitcairnia feliciana*: the only indigenous African bromeliad. Harvard Papers in Botany 4 (1): 175-184.

Price, S. (1997): Trees - Myths and Medicines. Jacaranda Designs Limited, Nairobi.

R Development Core Team (2009): R: A language and environment for statistical computing, reference index version 2.10.1. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

Rauer, G., Ibisch, P. L., Driesch, M. v. d., Lobin, W., Barthlott, W. (2000): The convention on biodiversity and botanic gardens. In: Bundesamt für Naturschutz, Bonn (ed.): Botanic Gardens and Biodiversity Landwirtschaftsverlag, Münster, pp. 25-64.

Rembold, K. (2009): Life in *Nepenthes* Pitchers. In: McPherson, S.: Pitcher Plants of the Old World. Poole, Redfern Natural History Publications, pp. 121-141.

Reynolds, V. (2005): The Chimpanzees of the Budongo Forest. Ecology, Behavior, and Conservation. Oxford University Press, New York.

Rico-Gray, V., Oliveira, P. S. (2007): The Ecology and Evolution of Ant-Plant Interactions. The University of Chicago Press, Chicago and London.

Rodrigues, A. S. L., Pilgrim, J. D., Lamoreux, J. F., Hoffmann, M., Brooks, T. M. (2006): The value of the IUCN Red List for conservation. Trends in Ecology and Evolution 21 (2): 71-76.

Schaab, G., Khayota, B., Eilu, G., Wägele, W. (2010): The BIOTA East Africa Atlas - Rainforest Change over Time. Karlsruhe University of Applied Sciences, Karlsruhe.

Schaijes, M., Malaisse, F. (2001): Diversity of upper Katanga epiphytes (mainly orchids) and distribution in different vegetation units. Systematics and Geography of Plants 71 (2): 575-584.

Schemske, D. W., Husband, B. C., Ruckelshaus, M. H., Goodwillie, C., Parker, I. M., Bishop, J. G. (1994): Evaluating approaches to the conservation of rare and endangered plants. Ecology 75 (3): 584-606.

Schmit-Neuerburg, V., Blüthgen, N. (2007): Ant-garden epiphytes are protected against drought in a Venezuelan lowland rain forest. Ecotropica 13: 93–100.

Schumacher, J. (2007): Analysis of Variance (ANOVA) in R, 1-17. http://users.minet.uni-jena.de/~jschum/biostat/ANOVA.pdf, accessed in Mar. 2011.

Schweinfurth, G. (1918): Im Herzen von Afrika - Reisen und Entdeckungen im zentralen Äquatorial-Afrika während der Jahre 1868-1871. Ein Beitrag zur Entdeckungsgeschichte von Afrika. Edition Leipzig (1986).

Shaanker, R. U., Ganeshaiah, K. N. (2010): Is there enough science for conservation action? Biotropica 42 (5): 563–565.

Shanahan, M., So, S., Compton, S. G., Corlett, R. (2001): Fig-eating by vertebrate frugivores: a global review. Biological Reviews 76: 529-572.

Sheil, D. (1995): A critique of permanent plot methods and analysis with examples from Budongo-Forest, Uganda. Forest Ecology and Management 77 (1-3): 11-34.

Sheil, D. (1999): Developing tests of successional hypotheses with size-structured populations, and an assessment using long-term data from a Ugandan rain forest. Plant Ecology 140 (1): 117-127.

Sheil, D. (2001): Long-term observations of rain forest succession, tree diversity and responses to disturbance. Plant Ecology 155 (2): 183-199.

Sokal, R. R., Rohlf, F. J. (1995): Biometry: the Principles and Practice of Statistics in Biological Research. Third Edition. W. H. Freeman and Co., New York.

Sommer, J. H. (2008): Plant diversity and future climate change - Macroecological analyses of African and global species distributions. PhD Thesis. Nees Institute for Biodiversity of Plants. University of Bonn, Germany.

Sommer, J. H., Kreft, H., Kier, G., Jetz, W., Mutke, J., Barthlott, W. (2010): Projected impacts of climate change on regional capacities for global plant species richness. Proceedings of the Royal Society B 277: 2271-2280.

Stewart, J., Campbell, B. (1996): Orchids of Kenya. St Paul's Bibliographies, Winchester.

Swaine, M. D., Hall, J. B. (1983): Early succession on cleared forest land in Ghana. Journal of Ecology 71: 601-627.

Swaine, M. D., Whitmore, T. C. (1988): On the definition of ecological species groups in tropical rain forests. Vegetatio 75: 81-86.

Synnott, T. J. (1972): Requiem for a chimp. Africana 4(10): 10-11.

Synnott, T. J. (1985): A Checklist of the Flora of Budongo Forest Reserve, Uganda, with Notes on Ecology and Phenology. C.F.I. Occasional Papers No. 27, University of Oxford.

The Plant List (2010). Version 1. Published on the Internet; http://www.theplantlist.org/, accessed in Jan. 2011.

Townsend, C.C. (1988): Amaranthaceae. In: Launert, E. (ed.): Flora Zambesiaca. Volume 9, part 1. Flora Zambesiaca Managing Committee, London, United, p. 28.

Trapnell, C. G., Langdale-Brown, I. (1962): The natural vegetation of east Africa. In: Russell, E.: The Natural Resources of East Africa. The English Press, Nairobi, pp. 92-102.

Tropicos (2011) Missouri Botanical Garden. Published on the Internet; http://www.tropicos.org, accessed in Dec. 2010.

Tsingalia, M. H. (1989): Variation in seedling predation and herbivory in *Prunus africana* in the Kakamega Forest, Kenya. African Journal of Ecology 27 (3): 207-217.

Tsingalia, M. H. (1990): Habitat disturbance, severity and patterns of abundance in Kakamega Forest, Western Kenya. African Journal of Ecology 28 (3): 213-226.

UNEP (2002): Report on the sixth meeting of the Conference of the Parties to the Convention of Biological Diversity (UNEP/CBD/COP/20/Part 2) Strategic Plan Decision VI/26.

United Nations (2009): World population prospects: the 2008 revision. Population database. http://esa.un.org/unpp/, accessed in Feb. 2011.

Vié, J. C., Hilton-Taylor, C., Pollock, C. M., Ragle, J., Smart, J., Stuart, S. N., Tong, R. (2009a): The IUCN Red List: a key conservation tool. In: Vié, J. C., Hilton-Taylor, C. and Stuart, S. N.: Wildlife in a Changing World - an Analysis of the 2008 IUCN Red List of Threatened Species^{TM}., IUCN, Gland, Switzerland, pp. 1-13.

Vié, J. C., Hilton-Taylor, C., Stuart, S. N. (2009b): Wildlife in a Changing World – an Analysis of the 2008 IUCN Red List of Threatened Species™. IUCN, Gland, Switzerland.

Vogel, S. (1990): Ölblumen und ölsammelnde Bienen. Dritte Folge: *Momordica*, *Thladiantha* und die Ctenoplectridae. Akademie der Wissenschaften und der Literatur zu Mainz. Franz Steiner Verlag, Stuttgart.

Wagner, T. (2000): Influence of forest type and tree species on canopy-dwelling beetles in Budongo Forest, Uganda. Biotropica 32 (3): 502-514.

Wagner, T. (2001): Seasonal changes in the canopy arthropod fauna in *Rinorea beniensis* in Budongo Forest, Uganda. Plant Ecology 153 (1-2): 169-178.

Walter, H. (1971): Ecology of Tropical and Subtropical Vegetation. Oliver and Boyd, Edinburgh.

Weiblen, G. D. (2002): How to be a fig wasp. Annual Review of Entomology 47: 299–330.

Welk, E. (2001): Arealkundliche Analyse und Bewertung der Schutzrelevanz seltener und gefährdeter Gefäßpflanzen Deutschlands. PhD Thesis. Mathematisch-Naturwissenschaftlich-Technischen Fakultät. Halle/Saale, Martin-Luther-Universität Halle-Wittenberg, Germany.

Welk, E. (2002): Arealkundliche Analyse und Bewertung der Schutzrelevanz seltener und gefährdeter Gefäßpflanzen Deutschlands. Schriftenreihe für Vegetationskunde 37, Bundesamt für Naturschutz, Bonn - Bad Godesberg.

Welk, E. (2002): Arealkundliche Grundlagen der Prioritätenfindung im Artenschutz - Ermittlung nationaler und globaler Verantwortlichkeit von Bundesländern. In: Scherer-Lorenzen, M. Analyse der Artenschutzprogramme für Pflanzen in Deutschland. Bonn - Bad Godesberg, Bundesamt für Naturschutz: 161-167.

White, F. (1981): The history of the Afromontane archipelago and the scientific need for its conservation. African Journal of Ecology 19: 33-54.

White, F. (1983): The Vegetation of Africa: a descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa. Unesco, Switzerland.

Whitmore, T. C. (1990): An Introduction to Tropical Rain Forests. Oxford University Press, Oxford.

WHO (2008): Traditional medicine. Fact sheet No. 134. http://www.who.int/mediacentre/factsheets/fs134/en, accessed in Feb. 2011.

Yanoviak, S. P., Fisher, B. L., Alonso, A. (2007): Arboreal ant diversity (Hymenoptera: Formicidae) in a central African forest. African Journal of Ecology 46: 60-66.

Yanoviak, S. P., Nadkarni, N. M., Solano, R. J. (2006): Arthropod assemblages in epiphyte mats of Costa Rican cloud forests. Biotropica 36 (2): 202-210.

Yeshitela, K. (2008): Effects of anthropogenic disturbance on the diversity of foliicolous lichens in tropical rainforests of East Africa: Godere (Ethiopia), Budongo (Uganda) and Kakamega (Kenya). PhD Thesis. Institut for Integrated Natural Sciences. Biology Department. University of Koblenz-Landau, Germany.

Zapfack, L., Engwald, S. (2008): Biodiversity and spatial distribution of vascular epiphytes in two biotopes of the Cameroonian semi-deciduous rain forest. Plant Ecology 195 (1): 117-130.

Zou, X., Zucca, C. P., Waide, R. B., McDowell, W. H. (1995): Long-term influence of deforestation on tree species composition and litter dynamics of a tropical rain forest in Puerto Rico. Forest Ecology and Management 78 (1-3): 147-157.

11 - ACKNOWLEDGEMENTS

First of all I would like to thank my supervisor Prof. Dr. Eberhard Fischer (Institut of Integrated Natural Sciences, University of Koblenz) for accepting me as a PhD student and providing this interesting and sustainable project. His extensive experiences in East Africa and his tremendous knowledge of the East African flora were of great benefit for this study and I am much obliged for his kind advice and for getting the chance to work in such fascinating countries.

I am very grateful to Prof. Dr. Wilhelm Barthlott (Nees Institut for Biodiversity of Plants, University of Bonn) who kindly agreed to officiate as second referee. Moreover I would like to thank him for increasing my fascination of tropical ecosystems during my studies in Bonn with his inspiring lectures and for the instructive and pleasant long term collaboration at the Nees Institute for Biodiversity of Plants.

This study would not have been possible without the indispensable plant identification skills of my colleague and friend Bonny Dumbo. His untiring commitment and amazing knowledge of the local vegetation enabled us to work out a database in the actual extent in an absolutely pleasant and enjoyable working atmosphere.

Sincere thanks to our partner institutions in Kenya and Uganda, namely the National Museums of Kenya (Nairobi, Kenya), the Makerere University (Kampala, Uganda), the Maseno Botanic Garden, the Budongo Conservation Field Station, the Kenyan Wildlife Service, and the Ugandan Wildlife Authority for their cooperation, accommodation and for granting the research permission. I especially thank my colleagues Peris Kamau, Dr. Gerald Eilu, Dr. Itambo Malombe, Dr. Fred Babweteera, and Millicent Kathambi for their help with permit application and plant identification, but primarily I would like to thank them and their families for their friendship.

I am indebted to Nils Hasenbein, Uli Zumkier, Arne Erpenbach, Dr. Markus A. Wetzel, and Prof. Dr. Ulrich Sinsch for their patient help with the statistical analysis and for not getting upset about all my questions.

Special thanks goes to Dr. Wolfram Lobin who never tired to support me with fruitful advice, discussions, and literature concerning conservation status assessment and ex-situ conservation.

I would also like to thank Dr. Nils Köster and Dr. Jürgen Nieder for their advice and literature support concerning the epiphyte section and the very enjoyable practical training in tree climbing techniques.

Furthermore I would very much like to thank my colleagues from the Institut of Integrated Natural Sciences at the University of Koblenz for the wonderful working atmosphere and the very pleasant collaboration. My special thanks to Dr. Dorothee Killmann and Dr. Inge Theisen for reviewing of previous versions of this thesis and Inge additionally for project coordination. I am also indebted to Adane Girma Gebreselasse, Izfa Riza Hazmi, Brigitte Nilow-Lange, Dagmar Savelsberg, Carolin Thiel, and Dr. Thomas Wagner (listed in alphabetical order of family names) who accompanied this thesis from the beginning on and joined me through many ups and downs.

I also thank my colleagues from the BIOTA East Africa project, in Kakamega Forest, and at the Budongo Conservation Field Station for the good cooperation, the numerous fruitful discussions, and the great and unforgettable time we spent together.

Thanks to the Akademie der Wissenschaften und der Literatur zu Mainz for their support.

This project was realized and funded by the Federal Ministry of Education and Research (Bundesministeriums für Bildung und Forschung, BMBF) and I acknowledge the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt, DLR) for project management.

Thank you very much!

Asante sana!

Vielen Dank!

12 - CURRICULUM VITAE

PERSONAL DETAILS

Name:	Katja Rembold		
Home:	Endenicher Strasse 36 53115 Bonn, Germany	University:	Institute for Integrated Nat. Sciences University of Koblenz, Germany
Phone:	0049-(0)228-9658871		0049-(0)261-287-2243
E-mail:	katja.rembold@googlemail.de		rembold@uni-koblenz.de
Date of Birth:	07.02.1980		
Place of Birth:	Neuss, Germany		
Nationality:	German		
Family status:	single		

RESEARCH

My principal research interest lies in the field of biodiversity, ecology and conservation of tropical rain forest ecosystems with a special consideration of carnivorous plants and epiphytes.

EDUCATIONAL BACKGROUND

Dissertation

Since Dec. 2007	PhD study entitled „Conservation status of the vascular plants in East African rain forests“ at the University of Koblenz-Landau, Germany. Supervisor: Prof. Dr. E. Fischer

Academic studies

09. Jun. 2006	Submission of the diploma thesis entitled „The ecology of the carnivorous *Nepenthes madagascariensis*“, Diploma (MSc) at the Nees Institut for Biodiversity of Plants, University of Bonn, Germany. Supervisor: Prof. Dr. W. Barthlott
2000 - 2006	University studies in biology as main subject with geography as subsidiary subjects at the University of Bonn, Germany

School education

30. May 2000	general qualification for university entrance (Gymnasium Am Oelberg, Oberpleis, Germany)

EMPLOYMENT HISTORY

Jun. 2010 - Jun. 2011	Research assistant at the Nees Institut for Biodiversity of Plants, University of Bonn Teaching: course about “Biodiversity of Plants” and seminar about “Biodiversity, Ecology, and Conservation of Carnivorous Plants” Coordination of the Carnivorous Plants working group

Dec. 2007 - May 2010	Research assistant at the Institute for Integrated Natural Sciences, University of Koblenz-Landau Participant of the research project “Biodiversity Monitoring Transect Analysis in Africa” (BIOTA) East Africa (E04)
Oct. 2006 - Nov. 2007	Research assistant at the Nees Institut for Biodiversity of Plants, University of Bonn Project coordination “Biomimetic superhydrophobic surfaces: maintaining functionality via regeneration” Coordination of the Carnivorous Plants working group
Nov. 2003 - May 2006	Student research assistant at the Nees Institut for Biodiversity of Plants, University of Bonn
Oct. 2001 - Oct. 2005	Receptionist at the Sebastian-Dani-Alten- und Pflegeheim

PRACTICAL TRAININGS AND FIELD STUDIES

Oct. - Dec. 2009	Field study in Budongo Forest, Uganda
Apr. - Jun. 2009	Field study in Kakamega Forest, Kenya
Oct. - Dec. 2008	Field study in Kakamega Forest, Kenya
Jun. - Jul. 2008	Field study in Gunung Mulu National Park, Sarawak, Malaysia
Apr. - Jun. 2008	Field study in Budongo Forest, Uganda
Dec. 2007	Field study in Kakamega Forest, Kenya
Aug. - Sep. 2007	Field assistant in Sungai Liang, Brunei Darussalam
Oct. 2005 - Feb. 2006	Field study in Fort Dauphin and Ankanin´ny Nofy, Madagascar
Sep. - Nov. 2004	Practical training at the Fundacion Ecologica “Curiquingue”, Tena, Ecuador
Feb. 1997	Practical training at the Zoological Research Museum Alexander Koenig, Department of Lepidopterology

TECHNISCAL SKILLS

Applications:	Microsoft Office: Word, Excel, Power Point
Databases:	Endnote
Operating systems:	Windows 95 - Windows Vista
Statistical Analysis:	R

LANGUAGES

- German (mother tongue)
- English (fluent)
- French (medium)

MEMBERSHIP

Member of the Association of Tropical Biology and Conservation (ATBC)
Member of the Society for Tropical Ecology (Gesellschaft für Tropenökologie, GTÖ)

PUBLICATIONS

Fischer, E., Rembold, K., Althof, A., Obholzer, J., Malombe, I., Mwachala, G., Onyango, J., Dumbo. B. & Theisen, I. (2010): Annotated checklist of the vascular plants of the Kakamega Forest, Western Province, Kenya. Journal of East Africa Natural History. 99 (2): 129-226.

Rembold, K., Fischer, E., Wetzel, M., Barthlott, W. (2010): Prey composition of the pitcher plant *Nepenthes madagascariensis*. Journal of Tropical Ecology 26 (4): 365-372.

Rembold, K., Irmer, A., Rischer, H., Poppinga, S., Bringmann, G. (2010): Propagation of *Triphyophyllum peltatum* (Dioncophyllaceae) and observations on its carnivory. Carnivorous Plants Newsletter 39 (3): 71-77.

Rembold, K., Fischer, E., Barthlott, W. (2009): Prey composition and inhabitants of N*epenthes madagascariensis*. In: Lee, C.C. (ed.): Proceedings of the 2007 Sarawak *Nepenthes* Summit, Kuching, Sarawak Forestry Corporation, pp. 19-25.

Rembold, K. (2009): Life in *Nepenthes* Pitchers. In: McPherson, S.: Pitcher Plants of the Old World. Redfern Natural History Publications, pp. 121-141.

Striffler, B.F. & Rembold, K. (2009): *Henriksenia labuanica* nom. Nov., a replacement name for *Misumenops nepenthicola* Bristowe (1930) and the clarification of the current taxonomic status of *Misumenops nepenthicola* Fage (1928) (Arachnida, Araneae, Thomisidae). In: McPherson, S.: Pitcher Plants of the Old World. Redfern Natural History Publications, pp. 1334-1338.

Clarke, C.M., Bauer, U., Lee, C.C., Tuen, A.A., Rembold, K. & Moran, J.A. (2009): Tree shrew lavatories: a novel nitrogen sequestration strategy in a tropical pitcher plant. Biology Letters. 5 (5): 632-635.

ORAL PRESENTATIONS

Rembold, K., Fischer, E. (2011): How to estimate the conservation status of vascular plants in a small scale area? A case study in East African rain forests. Annual Meeting of the Society for Tropical Ecology. Frankfurt, Germany.

Rembold, K. (2010): Monitoring and assessment of biodiversity in space and time. BIOTA East Africa - Concluding Conference 2010. Kakamega, Kenya.

Rembold, K., Fischer, E., Barthlott, W. (2007): Biodiversity and ecology of carnivorous plants. Panaga Natural History Society. Panaga, Brunei Darussalam.

Rembold, K., Fischer, E., Barthlott, W. (2007): Prey composition and inhabitants of *Nepenthes madagascariensis*. Sarawak *Nepenthes* Summit, Malaysia.

POSTER PRESENTATIONS

Rembold, K., Fischer, E. (2010): The influence of habitat disturbance on epiphyte and liana communities in East African rain forests. Annual Meeting of the Association of Tropical Biology and Conversation. Bali, Indonesia.

Rembold, K., Theisen, I., Fischer, E. (2009): Advantage and conservation status of vascular plants in East African rain forests. Annual Meeting of the Association of Tropical Biology and Conservation and of the Society for Tropical Ecology. Mahrburg, Germany.

Rembold, K., Theisen, I., Onyango, J.C., Fischer, E. (2008): Conservation status and ex-situ conservation of endangered plants from Kakamega and Budongo Forest. Biodiversity of Africa – Observation and Sustainable Management for our Future! Spier/Stellenbosch, South Africa.

Rembold, K., Fischer, E., Barthlott, W. (2007): Prey composition and inhabitants of *Nepenthes madagascariensis*. Annual Meeting of the Society for Tropical Ecology. Bonn, Germany.

Koblenz, 29. April 2011

APPENDIX 1 - TOTAL SPECIES LIST

List of the vascular plant species of Kakamega Forest (Kenya) and Budongo Forest (Uganda) implied in the present study (CAT = category for conservation priority). The list includes 853 species of vascular plants and 80 synonyms. The taxonomic classification is based on the online database The Plant List (http://www.theplantlist.org/, accessed in January 2011).

Conservation priority: NP = no priority, LP = low priority, MP = medium priority, PR = priority, HP = high priority.

	Species	Family	Habitus	Kenya	Uganda	CAT
1	*Abrus precatorius*	Fabaceae	climber		x	NP
2	*Abutilon longicuspe*	Malvaceae	shrub	x		NP
3	*Acacia abyssinica*	Fabaceae	shrub	x		LP
4	*Acacia montigena*	Fabaceae	climber	x	x	LP
5	*Acacia* sp.	Fabaceae	shrub		x	NP
6	*Acalypha neptunica*	Euphorbiaceae	shrub	x	x	NP
7	*Acalypha ornata*	Euphorbiaceae	shrub	x	x	LP
8	*Acalypha paniculata*	Euphorbiaceae	herb	x	x	NP
	Acalypha racemosa = synonym of *Acalypha paniculata*					
9	*Acalypha volkensii*	Euphorbiaceae	shrub	x		LP
10	*Acanthopale pubescens*	Acanthaceae	herb	x	x	NP
11	*Acanthus eminens*	Acanthaceae	shrub	x		MP
12	*Acanthus polystachius*	Acanthaceae	shrub	x		LP
	Acanthus pubescens = synonym of *Acanthus polystachius*					
13	*Achyranthes aspera*	Amaranthaceae	herb	x	x	LP
14	*Achyrospermum parviflorum*	Lamiaceae	herb	x		NP
15	*Achyrospermum schimperi*	Lamiaceae	herb	x		NP
16	*Adenia bequaertii*	Passifloraceae	climber		x	LP
17	*Adenia cissampeloides*	Passifloraceae	climber		x	LP
18	*Adenia lobata*	Passifloraceae	climber		x	LP
19	*Adenia schweinfurthii*	Passifloraceae	climber		x	NP
20	*Adenia venenata*	Passifloraceae	climber		x	MP
21	*Adenostemma caffrum*	Asteraceae	herb	x		NP
22	*Adiantum comorense*	Adiantaceae	herb		x	NP
23	*Aerangis ugandensis*	Orchidaceae	herb	x	x	NP
24	*Aframomum angustifolium*	Zingiberaceae	herb	x		LP
25	*Aframomum* cf. *alboviolaceum*	Zingiberaceae	herb		x	MP
	Aframomum latifolium = synonym of *Aframomum alboviolaceum*					
26	*Aframomum mala*	Zingiberaceae	herb	x	x	MP
27	*Aframomum* sp. nov.	Zingiberaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
28	*Aframomum subsericeum*	Zingiberaceae	herb	x	x	LP
29	*Aframomum zambesiacum*	Zingiberaceae	herb	x		LP
	Afrosersalisia cerasifera = synonym of *Synsepalum cerasiferum*					
30	*Agelaea pentagyna*	Connaraceae	shrub	x	x	LP
31	*Agelanthus pennatulus*	Loranthaceae	shrub		x	LP
32	*Ageratum conyzoides*	Asteraceae	herb		x	NP
33	*Ageratum* sp.	Asteraceae	herb	x		NP
34	*Alangium chinense*	Cornaceae	shrub	x	x	MP
35	*Albizia ferruginea*	Fabaceae	tree		x	MP
36	*Albizia glaberrima*	Fabaceae	tree		x	LP
37	*Albizia grandibracteata*	Fabaceae	tree		x	NP
38	*Albizia gummifera*	Fabaceae	tree	x	x	LP
39	*Albizia* sp.	Fabaceae	tree		x	NP
40	*Albuca donaldsonii*	Asparagaceae	herb	x		NP
41	*Alchornea cordifolia*	Euphorbiaceae	climber		x	LP
42	*Alchornea floribunda*	Euphorbiaceae	shrub		x	MP
43	*Alchornea hirtella*	Euphorbiaceae	shrub		x	MP
44	*Alchornea laxiflora*	Euphorbiaceae	shrub	x	x	LP
45	*Allophylus abyssinicus*	Sapindaceae	tree	x	x	LP
46	*Allophylus dummeri*	Sapindaceae	tree		x	MP
47	*Allophylus ferrugineus*	Sapindaceae	tree	x	x	MP
	Allophylus macrobotrys = synonym of *Allophylus ferrugineus*					
48	*Alstonia boonei*	Apocynaceae	big tree		x	HP
	Alternanthera nodiflora = synonym of *Alternanthera sessilis*					
49	*Alternanthera sessilis*	Amaranthaceae	herb		x	NP
50	*Amorphophallus calabaricus*	Araceae	herb	x	x	NP
51	*Anchomanes difformis*	Araceae	herb		x	MP
52	*Aneilema aequinoctiale*	Commelinaceae	herb	x	x	NP
53	*Aneilema beniniense*	Commelinaceae	herb		x	LP
54	*Aneilema* sp.	Commelinaceae	herb	x		NP
55	*Angraecum humile*	Orchidaceae	herb	x		MP
56	*Angraecum infundibulare*	Orchidaceae	herb		x	LP
57	*Angraecum* sp. 1	Orchidaceae	herb		x	LP
58	*Angraecum* sp. 2	Orchidaceae	herb	x		NP
59	*Angraecum* sp. 3	Orchidaceae	herb		x	LP
	Aningeria altissima = synonym of *Pouteria altissima*					
	Annona arenaria = synonym of *Annona senegalensis*					
60	*Annona senegalensis*	Annonaceae	tree		x	MP
61	*Anonidium mannii*	Annonaceae	small tree		x	HP
62	*Ansellia africana*	Orchidaceae	herb	x		NP
63	*Anthocleista grandiflora*	Gentianaceae	shrub	x		LP
64	*Anthocleista vogelii*	Gentianaceae	tree	x		LP
65	*Antiaris toxicaria*	Moraceae	tree	x	x	LP
66	*Antidesma laciniatum*	Euphorbiaceae	tree		x	MP
67	*Antrocaryon micraster*	Anacardiaceae	big tree		x	HP

	Species	Family	Habitus	Kenya	Uganda	CAT
	Antrophyum mannianum = synonym of *Scoliosorus mannianus*					
68	Apocynaceae Gen. sp.	Apocynaceae	climber	x		LP
69	*Apodytes dimidiata*	Icacinaceae	tree	x		LP
70	*Ardisia kivuensis*	Myrsinaceae	shrub		x	LP
71	*Argomuellera macrophylla*	Euphorbiaceae	shrub	x	x	LP
	Aristolochia elegans = synonym of *Aristolochia littoralis*					
72	*Aristolochia littoralis*	Aristolochiaceae	climber		x	NP
73	*Artabotrys likimensis*	Annonaceae	climber	x	x	LP
74	*Artabotrys stenopetalus*	Annonaceae	climber		x	LP
75	*Arthropteris monocarpa*	Oleandraceae	herb		x	NP
76	*Arthropteris orientalis*	Oleandraceae	herb	x	x	NP
77	*Arthropteris palisotii*	Oleandraceae	herb		x	LP
	Asplenium aethiopicum = synonym of *Asplenium praemorsum*					
78	*Asplenium africanum*	Aspleniaceae	herb	x	x	NP
79	*Asplenium angolense*	Aspleniaceae	herb	x		NP
	Asplenium anisophyllum = synonym of *Asplenium feei*					
80	*Asplenium barteri*	Aspleniaceae	herb	x		NP
81	*Asplenium blastophorum*	Aspleniaceae	herb	x	x	NP
82	*Asplenium bugoiense*	Aspleniaceae	herb	x		NP
83	*Asplenium ceii*	Aspleniaceae	herb	x		NP
84	*Asplenium dregeanum*	Aspleniaceae	herb	x	x	NP
85	*Asplenium emarginatum*	Aspleniaceae	herb		x	NP
	Asplenium erectum = synonym of *Asplenium barteri*					
86	*Asplenium feei*	Aspleniaceae	herb		x	NP
87	*Asplenium holstii*	Aspleniaceae	herb		x	LP
88	*Asplenium inaequilaterale*	Aspleniaceae	herb	x	x	NP
89	*Asplenium laurentii*	Aspleniaceae	herb		x	LP
90	*Asplenium lividum*	Aspleniaceae	herb	x		NP
91	*Asplenium macrophlebium*	Aspleniaceae	herb	x	x	NP
92	*Asplenium macrophyllum*	Aspleniaceae	herb		x	NP
93	*Asplenium mannii*	Aspleniaceae	herb	x		NP
94	*Asplenium megalura*	Aspleniaceae	herb	x		NP
95	*Asplenium praemorsum*	Aspleniaceae	herb	x	x	NP
96	*Asplenium protensum*	Aspleniaceae	herb	x		NP
	Asplenium sandersonii = synonym of *Asplenium vagans*					
97	*Asplenium* sp.	Aspleniaceae	herb		x	NP
98	*Asplenium theciferum*	Aspleniaceae	herb	x	x	NP
99	*Asplenium unilaterale*	Aspleniaceae	herb	x	x	NP
100	*Asplenium vagans*	Aspleniaceae	herb	x	x	NP
101	*Asplenium warneckei*	Aspleniaceae	herb		x	LP
102	*Asystasia gangetica*	Acanthaceae	herb	x		NP
103	*Asystasia* sp.	Acanthaceae	herb	x		NP
104	*Ataenidia conferta*	Maranthaceae	herb		x	LP
105	*Baikiaea insignis*	Fabaceae	tree		x	PR
106	*Baissea multiflora*	Apocynaceae	climber		x	MP

	Species	Family	Habitus	Kenya	Uganda	CAT
107	*Balanites wilsoniana*	Zygophyllaceae	big tree		x	HP
108	*Balsamocitrus dawei*	Rutaceae	tree		x	LP
109	*Barleria ventricosa*	Acanthaceae	herb	x		NP
110	*Basella alba*	Basellaceae	climber	x	x	LP
111	*Bauhinia thonningii*	Fabaceae	shrub	x		LP
112	*Begonia eminii*	Begoniaceae	herb	x	x	LP
113	*Belonophora coffeoides* subsp. *hypoglauca*	Rubiaceae	small tree	x	x	LP
	Belonophora hypoglauca = synonym of *Belonophora coffeoides* subsp. *hypoglauca*					
	Bequaertiodendron oblanceolatum= synonym of *Englerophytum oblanceolatum*					
114	*Bersama abyssinica*	Melianthaceae	tree	x	x	MP
115	*Biophytum abyssinicum*	Oxalidaceae	herb	x		NP
116	*Bischofia javanica*	Phyllanthaceae	big tree	x		NP
117	*Blighia unijugata*	Sapindaceae	big tree	x	x	LP
118	*Blighia welwitschii*	Sapindaceae	big tree		x	HP
119	*Blumea brevipes*	Asteraceae	herb	x		NP
120	*Boehmeria macrophylla*	Urticaceae	shrub	x	x	NP
121	*Bolbitis acrostichoides*	Lomariopsidaceae	herb		x	LP
122	*Bolbitis auriculata*	Lomariopsidaceae	herb		x	NP
123	*Bolusiella iridifolia*	Orchidaceae	herb	x	x	LP
124	*Bolusiella maudiae*	Orchidaceae	herb	x	x	NP
125	*Brachiaria cf. decumbens*	Poaceae	herb	x		NP
126	*Bridelia micrantha*	Phyllanthaceae	small tree	x	x	MP
127	*Bridelia scleroneura*	Phyllanthaceae	tree		x	LP
128	*Brillantaisia cicatricosa*	Acanthaceae	herb	x		NP
129	*Brillantaisia owariensis*	Acanthaceae	herb	x	x	NP
130	*Brillantaisia vogeliana*	Acanthaceae	herb	x	x	NP
131	*Broussonetia papyrifera*	Moraceae	tree		x	NP
132	*Bryophyllum proliferum*	Crassulaceae	herb	x		NP
133	*Buchnera capitata*	Orobanchaceae	herb	x		NP
	Buforrestia imperforata = synonym of *Stanfieldiella imperforata*					
	Bulbophyllum bequaertii = synonym of *Bulbophyllum cochleatum* var. *bequaertii*					
134	*Bulbophyllum cochleatum*	Orchidaceae	herb	x		LP
135	*Bulbophyllum cochleatum* var. *bequaertii*	Orchidaceae	herb	x	x	NP
136	*Bulbophyllum encephalodes*	Orchidaceae	herb	x		LP
137	*Bulbophyllum scaberulum*	Orchidaceae	herb		x	LP
138	*Bulbophyllum* sp.	Orchidaceae	herb		x	NP
139	*Burgmansia* sp.	Solanaceae	shrub		x	NP
140	*Caesalpinia angolensis*	Fabaceae	climber	x		NP
141	*Caesalpinia* cf. *volkensii*	Fabaceae	climber	x		LP
142	*Calamus deerratus*	Arecaceae	climber		x	LP
143	*Calanthe sylvatica*	Orchidaceae	herb	x		NP
144	*Caloncoba schweinfurthii*	Salicaceae	big tree		x	MP
145	*Calyptrochilum christyanum*	Orchidaceae	herb		x	NP
146	*Canarium schweinfurtii*	Burseraceae	big tree		x	HP

	Species	Family	Habitus	Kenya	Uganda	CAT
147	*Cardiospermum halicacabum*	Vitaceae	climber	x	x	NP
	Carissa edulis = synonym of *Carissa spinarum*					
148	*Carissa spinarum*	Apocynaceae	climber	x	x	NP
149	*Carpolobia alba*	Polygalaceae	shrub		x	PR
150	*Carpolobia goetzei*	Polygalaceae	tree	x		MP
151	*Casearia battiscombei*	Salicaceae	small tree	x	x	LP
152	*Cassipourea ruwensorensis*	Rhizophoraceae	tree	x	x	LP
153	*Celosia anthelminthica*	Amaranthaceae	herb	x	x	LP
154	*Celtis africana*	Cannabaceae	tree	x	x	MP
155	*Celtis gomphophylla*	Cannabaceae	big tree	x	x	MP
156	*Celtis mildbraedii*	Cannabaceae	tree	x	x	MP
157	*Celtis philippensis*	Cannabaceae	tree		x	LP
	Celtis wightii = synonym of *Celtis philippensis*					
158	*Celtis zenkeri*	Cannabaceae	tree		x	MP
	Chaetacme aristata = synonym of *Chaetacme madagascariensis*					
159	*Chaetacme madagascariensis*	Ulmaceae	small tree	x	x	LP
160	*Chamaeangis cf. odoratissima*	Orchidaceae	herb	x		LP
161	*Chamaeangis sarcophylla*	Orchidaceae	herb		x	LP
162	*Chamaeangis* sp.	Orchidaceae	herb	x		NP
163	*Chamaeangis vesicata*	Orchidaceae	herb		x	LP
164	*Chassalia cristata*	Rubiaceae	shrub		x	LP
165	*Chionanthus mildbraedii*	Oleaceae	shrub	x	x	LP
166	*Chlorophytum cameronii*	Asparagaceae	herb		x	LP
167	*Chlorophytum comosum*	Asparagaceae	herb	x		LP
	Chlorophytum sparsiflorum = synonym of *Chlorophytum comosum*					
168	*Chlorophytum subpetiolatum*	Asparagaceae	herb	x		LP
169	*Christella dentata*	Thelypteridaceae	herb	x		NP
170	*Christella guienziana*	Thelypteridaceae	herb	x		NP
171	*Christella* sp.	Thelypteridaceae	herb		x	NP
172	*Chrysophyllum albidum*	Sapotaceae	tree	x	x	PR
173	*Chrysophyllum muerense*	Sapotaceae	tree		x	MP
174	*Chrysophyllum perpulchrum*	Sapotaceae	tree		x	PR
175	*Chrysophyllum viridifolium*	Sapotaceae	tree	x	x	MP
176	*Cissampelos mucronata*	Menispermaceae	climber	x		LP
177	*Cissampelos pareira*	Menispermaceae	climber	x		NP
178	*Cissus* cf. *aphyllantha*	Vitaceae	climber		x	LP
179	*Cissus oliveri*	Vitaceae	climber	x	x	NP
180	*Cissus petiolata*	Vitaceae	climber		x	NP
181	*Cissus quadrangularis*	Vitaceae	climber		x	NP
182	*Cissus rotundifolia*	Vitaceae	climber	x	x	LP
183	*Cissus* sp.	Vitaceae	climber		x	NP
184	*Citropsis articulata*	Rutaceae	shrub		x	LP
185	*Citropsis* sp.	Rutaceae	shrub	x		PR
	Claoxylon hexandrum = synonym of *Discoclaoxylon hexandrum*					
186	*Clausena anisata*	Rutaceae	tree	x	x	LP

	Species	Family	Habitus	Kenya	Uganda	CAT
187	*Cleistanthus polystachyus*	Phyllanthaceae	big tree		x	MP
188	*Cleistopholis patens*	Annonaceae	tree		x	PR
189	*Clematis brachiata*	Ranunculaceae	climber	x		LP
190	*Clematis simensis*	Ranunculaceae	climber	x	x	LP
	Clerodendrum buchholzii = synonym of *Clerodendrum silvanum* var. *silvanum*					
191	*Clerodendrum capitatum*	Lamiaceae	climber	x	x	LP
192	*Clerodendrum formicarum*	Lamiaceae	shrub		x	LP
193	*Clerodendrum johnstonii*	Lamiaceae	climber	x	x	MP
194	*Clerodendrum melanocrater*	Lamiaceae	shrub	x	x	LP
195	*Clerodendrum silvanum* var. *silvanum*	Lamiaceae	climber		x	MP
196	*Clutia abyssinica*	Peraceae	shrub	x		LP
197	*Cnestis mildbraedii*	Connaraceae	tree		x	MP
	Cnestis ugandensis = synonym of *Cnestis mildbraedii*					
198	*Coccinia adoensis*	Cucurbitaceae	climber	x	x	MP
199	*Coccinia mildbraedii*	Cucurbitaceae	climber		x	LP
200	*Coffea canephora*	Rubiaceae	small tree		x	LP
201	*Coffea eugenioides*	Rubiaceae	shrub	x	x	LP
	Coffea robusta = synonym of *Coffea canephora*					
202	*Cola gigantea*	Malvaceae	big tree		x	PR
203	*Combretum adenogonium*	Combretaceae	shrub	x		LP
204	*Combretum collinum*	Combretaceae	tree	x		LP
205	*Combretum molle*	Combretaceae	shrub	x	x	LP
206	*Combretum paniculatum*	Combretaceae	climber	x		MP
207	*Combretum pentagonum*	Combretaceae	climber		x	LP
208	*Combretum* sp. 1	Combretaceae	climber	x		NP
209	*Combretum* sp. 2	Combretaceae	shrub		x	LP
210	*Commelina albiflora*	Commelinaceae	herb	x		HP
211	*Commelina capitata*	Commelinaceae	herb	x	x	NP
212	*Commelina* sp.	Commelinaceae	herb		x	NP
213	*Connarus longistipitatus*	Connaraceae	climber	x	x	LP
214	*Coptosperma graveolens*	Rubiaceae	shrub		x	MP
	Cordia abyssinica = synonym of *Cordia africana*					
215	*Cordia africana*	Boraginaceae	tree	x		PR
216	*Cordia millenii*	Boraginaceae	tree		x	PR
217	*Corymborkis corymbis*	Orchidaceae	herb		x	NP
218	*Costus* cf. *lucanusianus*	Costaceae	herb		x	NP
	Costus englerianus = synonym of *Paracostus englerianus*					
219	*Courtoisina cyperoides*	Cyperaceae	herb		x	NP
220	*Craibia brownii*	Fabaceae	small tree	x	x	LP
	Crassocephalum bumbense = synonym of *Crassocephalum montuosum*					
221	*Crassocephalum montuosum*	Asteraceae	herb	x	x	LP
222	*Crassocephalum picridifolium*	Asteraceae	herb	x		NP
223	*Craterispermum schweinfurthii*	Rubiaceae	small tree	x		MP
224	*Craterosiphon scandens*	Thymelaeaceae	climber		x	MP
225	*Crepidomanes mannii*	Hymenophyllaceae	herb	x	x	NP

	Species	Family	Habitus	Kenya	Uganda	CAT
226	*Crepidomanes ramitrichum*	Hymenophyllaceae	herb	x	x	NP
227	*Crinum* cf. *kirkii*	Amaryllidaceae	herb	x		NP
	Crinum ornatum = synonym of *Crinum zeylanicum*					
228	*Crinum zeylanicum*	Amaryllidaceae	herb	x		NP
229	*Crotalaria agatiflora*	Fabaceae	shrub	x		LP
230	*Croton macrostachyus*	Euphorbiaceae	tree	x	x	MP
231	*Croton megalocarpus*	Euphorbiaceae	big tree	x	x	PR
232	*Croton sylvaticus*	Euphorbiaceae	tree	x	x	LP
233	*Cucumis aculeatus*	Cucurbitaceae	climber	x	x	LP
234	*Cucumis ficifolius*	Cucurbitaceae	climber	x		NP
	Cucumis figarei = synonym of *Cucumis ficifolius*					
235	*Cucumis* sp. 1	Cucurbitaceae	climber	x		NP
236	*Cucumis* sp. 2	Cucurbitaceae	climber		x	NP
237	Cucurbitaceae Gen. sp.	Cucurbitaceae	climber		x	NP
238	*Culcasia falcifolia*	Araceae	climber	x	x	NP
239	*Cupressus lusitanica*	Cupressaceae	tree	x		NP
240	*Cuscuta kilimanjari*	Convolvulaceae	climber		x	NP
	Cyanotis barbata = synonym of *Cyanotis vaga*					
241	*Cyanotis* cf. *vaga*	Commelinaceae	herb	x		NP
242	*Cyanotis* sp.	Commelinaceae	herb	x		NP
243	*Cyathea manniana*	Cyatheaceae	herb	x		LP
244	*Cyathula uncinulata*	Amaranthaceae	herb	x		NP
245	*Cynoglossum lanceolatum*	Boraginaceae	herb	x		NP
246	*Cynometra alexandri*	Fabaceae	big tree		x	MP
247	*Cyphostemma maranguense*	Vitaceae	climber	x		LP
248	*Cyphostemma* sp. 1	Vitaceae	climber	x		NP
249	*Cyphostemma* sp. 2	Vitaceae	climber		x	NP
250	*Cyphostemma* sp. 3	Vitaceae	climber		x	NP
251	*Cyrtorchis arcuata*	Orchidaceae	herb	x	x	NP
252	*Cyrtorchis* sp. 1	Orchidaceae	herb		x	NP
253	*Cyrtorchis* sp. 2	Orchidaceae	herb		x	NP
254	*Dacryodes edulis*	Burseraceae	tree		x	PR
255	*Dalbergia lactea*	Fabaceae	climber	x	x	NP
	Davallia chaerophylloides = synonym of *Davallia denticulata*					
256	*Davallia denticulata*	Davalliaceae	herb		x	NP
257	*Deinbollia kilimandscharica*	Sapindaceae	small tree	x		LP
258	*Desmodium adscendens*	Fabaceae	herb	x	x	NP
	Desmodium repandum = synonym of *Hylodesmum repandum*					
259	*Desplatsia dewevrei*	Malvaceae	tree		x	MP
260	*Dialium excelsum*	Fabaceae	big tree		x	PR
261	*Diaphananthe bidens*	Orchidaceae	herb		x	LP
262	*Diaphananthe* cf. *fragrantissima*	Orchidaceae	herb	x	x	LP
263	*Diaphananthe* cf. *pellucida*	Orchidaceae	herb		x	LP
264	*Diaphananthe* sp.	Orchidaceae	herb		x	NP
265	*Diaphananthe* sp. 2	Orchidaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
	Diaphananthe subsimplex = synonym of *Rhipidoglossum subsimplex*					
266	*Dicliptera elliotii*	Acanthaceae	herb		x	MP
267	*Dicranolepis buchholzii*	Thymelaeaceae	shrub		x	MP
268	*Dicranopteris linearis*	Gleicheniaceae	herb	x		NP
269	*Didymodoxa caffra*	Urticaceae	herb		x	NP
270	*Didymoplexis africana*	Orchidaceae	herb		x	MP
271	*Dietes iridioides*	Iridaceae	herb	x		NP
272	*Dioscorea alata*	Dioscoreaceae	climber		x	NP
273	*Dioscorea bulbifera*	Dioscoreaceae	climber	x	x	NP
274	*Dioscorea dumetorum*	Dioscoreaceae	climber		x	NP
	Dioscorea odoratissima = synonym of *Dioscorea praehensilis*					
275	*Dioscorea praehensilis*	Dioscoreaceae	climber	x		NP
276	*Dioscorea schimperiana*	Dioscoreaceae	climber	x		NP
277	*Dioscorea* sp.	Dioscoreaceae	climber	x		NP
278	*Diospyros abyssinica*	Ebenaceae	big tree	x	x	MP
279	*Discoclaoxylon hexandrum*	Euphorbiaceae	shrub		x	LP
280	*Disperis reichenbachiana*	Orchidaceae	herb	x		NP
	Dissotis canescens = synonym of *Heterotis canescens*					
	Dissotis rotundifolia = synonym of *Heterotis rotundifolia*					
281	*Dissotis speciosa*	Melastomataceae	shrub	x		LP
282	*Dombeya kirkii*	Malvaceae	shrub		x	MP
	Dombeya mukole = synonym of *Dombeya kirkii*					
283	*Dombeya rotundifolia*	Malvaceae	shrub	x		LP
284	*Dorstenia brownii*	Moraceae	herb	x	x	NP
285	*Dorstenia hildebrandtii*	Moraceae	herb	x	x	NP
286	*Dorstenia kameruniana*	Moraceae	herb		x	PR
287	*Dorstenia psilurus*	Moraceae	herb		x	NP
288	*Doryopteris kirkii*	Adiantaceae	herb	x	x	NP
289	*Doryopteris* sp.	Adiantaceae	herb	x		NP
290	*Dovyalis macrocalyx*	Salicaceae	shrub	x	x	LP
291	*Dracaena fragrans*	Asparagaceae	shrub	x	x	LP
292	*Dracaena laxissima*	Asparagaceae	shrub	x	x	LP
293	*Dracaena steudneri*	Asparagaceae	shrub	x		LP
294	*Droguetia iners*	Urticaceae	herb		x	NP
295	*Drynaria volkensii*	Polypodiaceae	herb	x	x	NP
296	*Drypetes gerrardii*	Putranjavaceae	shrub	x	x	MP
297	*Drypetes* sp. 1	Putranjavaceae	shrub	x		MP
298	*Drypetes* sp. 2	Putranjavaceae	shrub		x	MP
299	*Drypetes ugandensis*	Putranjavaceae	shrub		x	MP
300	*Duranta erecta*	Verbenaceae	climber	x		NP
301	*Ehretia cymosa*	Boraginaceae	small tree	x	x	MP
302	*Ekebergia capensis*	Meliaceae	tree	x	x	MP
	Ekebergia senegalensis = synonym of *Ekebergia capensis*					
303	*Elatostema* cf. *monticolum*	Urticaceae	herb		x	NP
304	*Elytraria marginata*	Acanthaceae	herb		x	NP

	Species	Family	Habitus	Kenya	Uganda	CAT
305	*Embelia libeniana*	Primulaceae	shrub		x	HP
306	*Embelia schimperi*	Primulaceae	shrub	x	x	MP
307	*Englerophytum oblanceolatum*	Sapotaceae	small tree	x	x	MP
308	*Entandrophragma angolense*	Meliaceae	big tree	x	x	HP
309	*Entandrophragma excelsum*	Meliaceae	big tree		x	MP
310	*Entandrophragma utile*	Meliaceae	big tree		x	HP
311	*Eriocaulon transvaalicum*	Eriocaulaceae	herb	x		NP
312	*Erythrina abyssinica*	Fabaceae	small tree	x		LP
313	*Erythrina excelsa*	Fabaceae	big tree		x	HP
314	*Erythrococca atrovirens*	Euphorbiaceae	shrub	x		MP
315	*Erythrococca atrovirens* var. *flaccida*	Euphorbiaceae	shrub		x	PR
	Erythrococca oleracea = synonym of *Erythrococca atrovirens* var. *flaccida*					
316	*Erythrophleum suaveolens*	Fabaceae	big tree		x	PR
317	*Eucalyptus saligna*	Myrthaceae	big tree	x		NP
318	*Eulophia rosea*	Orchidaceae	herb	x		NP
319	*Eulophia streptopetala*	Orchidaceae	herb	x		NP
320	*Euphorbia hirta*	Euphorbiaceae	herb	x		NP
321	*Euphorbia teke*	Euphorbiaceae	tree		x	LP
	Fagara leprieurii = synonym of *Zanthoxylum leprieurii*					
322	*Fagaropsis angolensis*	Rutaceae	tree	x	x	MP
323	*Ficus asperifolia*	Moraceae	shrub	x	x	MP
324	*Ficus bubu*	Moraceae	tree	x	x	MP
325	*Ficus capreifolia*	Moraceae	tree	x		LP
326	*Ficus conraui*	Moraceae	tree		x	MP
327	*Ficus cyathistipula*	Moraceae	tree	x	x	LP
	Ficus eriobotryoides = synonym of *Ficus saussureana*					
328	*Ficus exasperata*	Moraceae	tree	x	x	MP
329	*Ficus ingens*	Moraceae	tree		x	MP
330	*Ficus lingua*	Moraceae	tree		x	MP
331	*Ficus lutea*	Moraceae	big tree	x	x	MP
332	*Ficus mucuso*	Moraceae	big tree		x	PR
333	*Ficus natalensis*	Moraceae	tree	x	x	PR
334	*Ficus ovata*	Moraceae	tree		x	PR
	Ficus persicifolia = synonym of *Ficus thonningii*					
335	*Ficus sansibarica*	Moraceae	tree	x		LP
336	*Ficus saussureana*	Moraceae	tree		x	MP
337	*Ficus* sp. 1	Moraceae	tree	x		MP
338	*Ficus* sp. 2	Moraceae	big tree		x	LP
	Ficus stipulifera = synonym of *Ficus conraui*					
339	*Ficus sur*	Moraceae	big tree	x	x	MP
340	*Ficus thonningii*	Moraceae	big tree	x	x	MP
341	*Ficus tremula*	Moraceae	big tree	x	x	MP
	Ficus urceolaris = synonym of *Ficus asperifolia*					
342	*Ficus vallis-choudae*	Moraceae	big tree	x		MP
343	*Ficus verruculosa*	Moraceae	small tree	x	x	MP

	Species	Family	Habitus	Kenya	Uganda	CAT
344	*Flacourtia indica*	Salicaceae	big tree	x	x	LP
345	*Fleroya stipulosa*	Rubiaceae	tree		x	LP
346	*Friesodielsia enghiana*	Annonaceae	climber		x	LP
347	*Funtumia africana*	Apocynaceae	tree	x	x	LP
348	*Garcinia buchananii*	Clusiaceae	shrub	x		LP
349	*Garcinia volkensii*	Clusiaceae	shrub		x	MP
350	*Gardenia vogelii*	Rubiaceae	shrub		x	PR
	Geniosporum rotundifolium = synonym of *Platostoma rotundifolium*					
351	*Geophila repens*	Rubiaceae	herb	x	x	NP
352	*Geophila* sp. 1	Rubiaceae	herb		x	LP
353	*Geophila* sp. 2	Rubiaceae	herb		x	LP
354	*Geophila* sp. 3	Rubiaceae	herb		x	LP
355	*Gladiolus dalenii*	Iridaceae	herb	x	x	NP
356	*Glenniea africana*	Sapindaceae	tree		x	LP
357	*Globimetula braunii*	Loranthaceae	herb	x		LP
358	*Gloriosa superba*	Colchicaceae	climber	x	x	NP
359	*Glyphaea brevis*	Malvaceae	small tree		x	MP
360	*Gomphia densiflora*	Ochnaceae	shrub	x	x	LP
361	*Gomphia hiernii*	Ochnaceae	small tree	x	x	MP
362	*Gomphocarpus semilunatus*	Apocynaceae	herb	x		NP
363	*Gongronema angolense*	Apocynaceae	climber	x	x	NP
364	*Gouania longispicata*	Rhamnaceae	climber	x	x	LP
365	*Graphorkis lurida*	Orchidaceae	herb		x	NP
366	*Greenwayodendron suaveolens*	Annonaceae	tree		x	MP
367	*Grevillea robusta*	Proteaceae	shrub	x		NP
368	*Grewia capitellata*	Malvaceae	climber		x	LP
	Grewia ectasicarpa = synonym of *Grewia capitellata*					
369	*Grewia mildbraedii*	Malvaceae	tree		x	MP
370	*Grewia pubescens*	Malvaceae	shrub		x	MP
371	*Grewia similis*	Malvaceae	shrub	x	x	MP
372	*Guarea cedrata*	Meliaceae	big tree		x	PR
373	*Gymnosporia heterophylla*	Celastraceae	shrub	x	x	LP
374	*Gynura scandens*	Asteraceae	climber		x	MP
375	*Habenaria malacophylla*	Orchidaceae	herb	x		NP
376	*Halopegia azurea*	Maranthaceae	herb		x	LP
377	*Haplopteris volkensii*	Vittariaceae	herb		x	LP
378	*Harungana madagascariensis*	Hypericaceae	tree	x	x	LP
379	*Harveya thonneri*	Orobanchaceae	herb		x	NP
380	*Haumania* sp.	Maranthaceae	climber		x	NP
381	*Heckeldora staudtii*	Meliaceae	shrub		x	PR
382	*Heinsenia diervilleoides*	Rubiaceae	shrub	x	x	LP
383	*Helichrysum* cf. *forskahlii*	Asteraceae	herb	x		LP
384	*Hemerocallis fulva*	Xanthorrhoeaceae	herb	x		NP
385	*Heterotis canescens*	Melastomataceae	herb	x		NP
386	*Heterotis rotundifolia*	Melastomataceae	herb		x	NP

	Species	Family	Habitus	Kenya	Uganda	CAT
387	*Hibiscus articulatus*	Malvaceae	herb	x		NP
388	*Hibiscus calyphyllus*	Malvaceae	shrub	x		NP
389	*Hibiscus cannabinus*	Malvaceae	shrub		x	NP
390	*Hibiscus fuscus*	Malvaceae	shrub	x		NP
391	*Hibiscus vitifolius*	Malvaceae	shrub		x	NP
392	*Hilleria latifolia*	Phytolaccaceae	herb	x	x	LP
	Hippocratea africana = synonym of *Loeseneriella africana*					
393	*Holoptelea grandis*	Ulmaceae	big tree		x	PR
394	*Hugonia platysepala*	Linaceae	climber		x	LP
395	*Hydrocotyle ranunculoides*	Araliaceae	herb	x		NP
396	*Hylodesmum repandum*	Fabaceae	herb	x	x	NP
397	*Hymenocoleus hirsutus*	Rubiaceae	herb		x	LP
398	*Hymenocoleus libericus*	Rubiaceae	herb		x	MP
399	*Hymenocoleus neurodictyon*	Rubiaceae	herb		x	LP
400	*Hymenodictyon floribundum*	Rubiaceae	shrub	x		LP
401	*Hypericum lalandii*	Hypericaceae	herb	x		NP
402	*Hypoestes forsskaolii*	Acanthaceae	herb	x		NP
403	*Hypoxis angustifolia*	Hypoxidaceae	herb	x		NP
404	*Illigera pentaphylla*	Hernandiaceae	climber	x	x	LP
405	*Impatiens burtonii*	Balsaminaceae	herb	x		MP
406	*Impatiens hochstetteri*	Balsaminaceae	herb	x	x	NP
407	*Impatiens niamniamensis*	Balsaminaceae	herb	x		MP
408	*Impatiens* sp. nov.	Balsaminaceae	herb		x	LP
409	*Impatiens stuhlmannii*	Balsaminaceae	herb	x		MP
410	*Iodes seretii*	Icacinaceae	climber		x	LP
411	*Ipomoea cairica*	Convolvulaceae	climber	x	x	NP
412	*Ipomoea* cf. *pileata*	Convolvulaceae	climber	x		NP
413	*Ipomoea coscinosperma*	Convolvulaceae	climber		x	NP
	Ipomoea involucrata = synonym of *Ipomoea pileata*					
414	*Ipomoea* sp. 1	Convolvulaceae	climber	x		NP
415	*Ipomoea* sp. 2	Convolvulaceae	climber	x		NP
416	*Ipomoea tenuirostris*	Convolvulaceae	climber	x		NP
417	*Ipomoea wightii*	Convolvulaceae	climber	x		NP
418	*Irvingia gabonensis*	Irvingiaceae	big tree		x	HP
419	*Isoglossa laxa*	Acanthaceae	herb	x		NP
420	*Isoglossa substrobilina*	Acanthaceae	herb	x		NP
421	*Jasminum abyssinicum*	Oleaceae	climber		x	LP
422	*Jasminum* cf. *schimperi*	Oleaceae	climber	x		LP
423	*Jasminum fluminense*	Oleaceae	climber	x		MP
424	*Jasminum pauciflorum*	Oleaceae	climber		x	LP
425	*Justicia betonica*	Acanthaceae	herb	x		NP
426	*Justicia* cf. *striata*	Acanthaceae	herb		x	NP
427	*Justicia extensa*	Acanthaceae	shrub	x		LP
428	*Justicia flava*	Acanthaceae	herb	x		NP
429	*Justicia* sp.	Acanthaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
430	*Justicia striata*	Acanthaceae	herb	x		NP
431	*Kalanchoe crenata*	Crassulaceae	herb	x		NP
	Kalanchoe prolifera = synonym of *Bryophyllum proliferum*					
432	*Keetia gueinzii*	Rubiaceae	climber	x	x	NP
433	*Khaya anthotheca*	Meliaceae	big tree	x	x	PR
434	*Kigelia africana*	Bignoniaceae	tree	x	x	MP
435	*Klainedoxa gabonensis*	Irvingiaceae	big tree		x	PR
436	*Kotschya africana*	Fabaceae	shrub	x		NP
437	*Kyllinga chrysantha*	Cyperaceae	herb	x		NP
438	*Kyllinga* sp.	Cyperaceae	herb	x		NP
	Laggera brevipes = synonym of *Blumea brevipes*					
439	*Landolphia buchananii*	Apocynaceae	climber	x	x	LP
440	*Landolphia eminiana*	Apocynaceae	climber		x	MP
441	*Landolphia owariensis*	Apocynaceae	climber		x	MP
442	*Lannea edulis*	Anacardiaceae	herb	x		LP
443	*Lannea welwitschii*	Anacardiaceae	tree		x	HP
444	*Lantana camara*	Verbenaceae	shrub	x	x	LP
445	*Lantana trifolia*	Verbenaceae	shrub	x		LP
446	*Laportea alatipes*	Urticaceae	herb	x		MP
447	*Laportea* sp.	Urticaceae	herb	x	x	NP
448	*Lasiodiscus mildbraedii*	Rhamnaceae	small tree		x	LP
449	*Leea guineense*	Vitaceae	shrub	x	x	LP
450	*Leonotis ocymifolia*	Lamiaceae	herb	x		NP
451	*Lepidotrichilia volkensii*	Meliaceae	small tree	x		MP
452	*Lepisanthes senegalensis*	Sapindaceae	shrub	x	x	LP
453	*Lepisorus excavatus*	Polypodiaceae	herb	x		NP
454	*Leptactina platyphylla*	Rubiaceae	climber	x	x	LP
	Leptaspis cochleata = synonym of *Leptaspis zeylanica*					
455	*Leptaspis zeylanica*	Poaceae	herb	x	x	NP
	Lindackeria schweinfurthii = synonym of *Oncoba schweinfurthii*					
456	*Liparis caillei*	Orchidaceae	herb		x	LP
457	*Liparis nervosa*	Orchidaceae	herb	x		NP
458	*Lippia kituiensis*	Verbenaceae	shrub	x		PR
459	*Loeseneriella africana*	Celastraceae	climber	x	x	LP
460	*Lovoa trichilioides*	Meliaceae	big tree		x	HP
461	*Loxogramme abyssinica*	Polypodiaceae	herb	x	x	NP
462	*Lychnodiscus cerospermus*	Sapindaceae	tree		x	LP
463	*Lycopodiella cernua*	Lycopodiaceae	herb	x		NP
464	*Macaranga monandra*	Euphorbiaceae	tree		x	PR
465	*Macaranga schweinfurthii*	Euphorbiaceae	shrub	x	x	MP
466	*Macaranga spinosa*	Euphorbiaceae	shrub		x	MP
467	*Maerua duchesnei*	Capparaceae	small tree		x	MP
468	*Maesa lanceolata*	Primulaceae	shrub	x	x	LP
469	*Maesopsis eminii*	Rhamnaceae	big tree	x	x	PR
470	*Majidea forsteri*	Sapindaceae	big tree		x	PR

	Species	Family	Habitus	Kenya	Uganda	CAT
471	*Malaxis maclaudii*	Orchidaceae	herb		x	LP
	Malaxis weberbaueriana = synonym of *Malaxis welwitschii*					
472	*Malaxis welwitschii*	Orchidaceae	herb	x	x	LP
473	*Mallotus oppositifolius*	Euphorbiaceae	shrub	x	x	LP
474	*Malva parviflora*	Malvaceae	herb	x		NP
475	*Mammea africana*	Clusiaceae	big tree		x	HP
476	*Manilkara butugi*	Sapotaceae	big tree	x	x	MP
477	*Marantochloa purpurea*	Maranthaceae	herb		x	LP
478	*Margaritaria discoidea*	Phyllanthaceae	big tree	x	x	PR
	Mariscus cyperoides = synonym of *Courtoisina cyperoides*					
479	*Markhamia lutea*	Bignoniaceae	shrub	x	x	LP
	Maytenus heterophylla = synonym of *Gymnosporia heterophylla*					
480	*Megaphrynium macrostachyum*	Maranthaceae	herb		x	MP
	Melanodiscus cf. africana = synonym of *Glenniea africana*					
481	*Melanthera scandens*	Asteraceae	climber		x	LP
	Memecylon jasminoides = synonym of *Warneckea jasminoides*					
	Memecylon walikalense = synonym of *Warneckea walikalensis*					
482	*Metarungia pubinervia*	Acanthaceae	shrub	x	x	NP
483	*Meyna tetraphylla*	Rubiaceae	shrub	x	x	MP
	Mezoneuron angolense = synonym of *Caesalpinia angolensis*					
484	*Microcoelia globulosa*	Orchidaceae	herb	x		LP
485	*Microcoelia microglossa*	Orchidaceae	herb		x	LP
486	*Microcoelia* sp.	Orchidaceae	herb	x	x	NP
487	*Microglossa densiflora*	Asteraceae	climber		x	NP
488	*Microglossa pyrifolia*	Asteraceae	climber	x	x	NP
489	*Microlepia speluncae*	Dennstaetiaceae	herb		x	NP
490	*Microsorum punctatum*	Polypodiaceae	herb		x	NP
491	*Mikania chenopodifolia*	Asteraceae	climber	x		NP
492	*Mikania cordata*	Asteraceae	climber	x	x	NP
493	*Mikaniopsis clematoides*	Asteraceae	climber	x		NP
494	*Mikaniopsis usambarensis*	Asteraceae	climber	x		NP
495	*Mildbraediodendron excelsum*	Fabaceae	big tree		x	PR
496	*Milicia excelsa*	Moraceae	big tree	x	x	PR
497	*Mimosa pudica*	Fabaceae	herb		x	NP
498	*Mimulopsis arborescens*	Acanthaceae	shrub	x		LP
499	*Mimulopsis solmsii*	Acanthaceae	herb	x		NP
	Mitragyna stipulosa = synonym of *Fleroya stipulosa*					
500	*Momordica boivinii*	Cucurbitaceae	climber		x	LP
501	*Momordica foetida*	Cucurbitaceae	climber	x	x	MP
502	*Momordica friesiorum*	Cucurbitaceae	climber	x	x	NP
503	*Momordica* sp.	Cucurbitaceae	climber		x	NP
504	*Mondia whitei*	Apocynaceae	climber	x	x	MP
505	*Monodora angolensis*	Annonaceae	shrub		x	LP
506	*Monodora myristica*	Annonaceae	small tree	x	x	MP
507	*Monothecium aristatum*	Acanthaceae	herb		x	LP

	Species	Family	Habitus	Kenya	Uganda	CAT
508	*Morinda morindoides*	Rubiaceae	tree		x	MP
509	*Morus mesozygia*	Moraceae	tree	x	x	MP
510	*Mukia maderaspatana*	Cucurbitaceae	climber	x		NP
511	*Murdannia* cf. *simplex*	Commelinaceae	herb	x		NP
512	*Mussaenda arcuata*	Rubiaceae	shrub	x	x	LP
513	*Mussaenda erythrophylla*	Rubiaceae	climber		x	NP
514	*Mussaenda microdonta*	Rubiaceae	shrub		x	LP
515	*Myrianthus arboreus*	Cecropiaceae	tree		x	MP
516	*Neoboutonia macrocalyx*	Euphorbiaceae	shrub	x	x	LP
517	*Nephrolepis undulata*	Davalliaceae	herb	x	x	NP
518	*Nervilia bicarinata*	Orchidaceae	herb	x	x	NP
519	*Nervilia* cf. *fuerstenbergiana*	Orchidaceae	herb		x	NP
520	*Nervilia kotschyi*	Orchidaceae	herb	x		NP
521	*Nervilia petraea*	Orchidaceae	herb	x		LP
522	*Nervilia* sp. 1	Orchidaceae	herb	x		NP
523	*Nervilia* sp. 2	Orchidaceae	herb	x		NP
524	*Nervilia subintegra*	Orchidaceae	herb		x	NP
525	*Ochna bracteosa*	Ochnaceae	small tree		x	LP
526	*Ochna insculpta*	Ochnaceae	small tree	x		MP
527	*Ochna membranacea*	Ochnaceae	small tree		x	LP
528	*Ochna* sp.	Ochnaceae	shrub		x	LP
529	*Oeceoclades maculata*	Orchidaceae	herb	x		NP
530	*Oeceoclades saundersiana*	Orchidaceae	herb		x	LP
531	*Oeceoclades* sp.	Orchidaceae	herb	x		NP
532	*Oeceoclades ugandae*	Orchidaceae	herb	x		NP
533	*Olax subscorpioidea*	Olacaceae	shrub		x	HP
534	*Oldenlandia* cf. *goreensis*	Rubiaceae	herb	x		NP
535	*Oldenlandia* sp.	Rubiaceae	herb	x		NP
536	*Olea capensis*	Oleaceae	big tree	x	x	PR
537	*Olea welwitschii*	Oleaceae	big tree		x	PR
538	*Olyra latifolia*	Poaceae	herb	x	x	NP
539	*Oncinotis tenuiloba*	Apocynaceae	climber		x	LP
540	*Oncoba schweinfurthii*	Salicaceae	shrub		x	MP
541	*Oncoba spinosa*	Salicaceae	small tree	x	x	MP
542	*Oplismenus hirtellus*	Poaceae	herb	x	x	NP
543	Orchidaceae Gen. sp. 01	Orchidaceae	herb		x	NP
544	Orchidaceae Gen. sp. 02	Orchidaceae	herb	x		NP
545	Orchidaceae Gen. sp. 03	Orchidaceae	herb	x		NP
546	Orchidaceae Gen. sp. 04	Orchidaceae	herb		x	NP
547	Orchidaceae Gen. sp. 05	Orchidaceae	herb	x		NP
548	Orchidaceae Gen. sp. 06	Orchidaceae	herb		x	NP
549	Orchidaceae Gen. sp. 07	Orchidaceae	herb	x		NP
550	Orchidaceae Gen. sp. 08	Orchidaceae	herb	x		NP
551	Orchidaceae Gen. sp. 09	Orchidaceae	herb		x	NP
552	Orchidaceae Gen. sp. 10	Orchidaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
553	Orchidaceae Gen. sp. 11	Orchidaceae	herb	x		NP
554	Orchidaceae Gen. sp. 12	Orchidaceae	herb		x	NP
555	Orchidaceae Gen. sp. 13	Orchidaceae	herb		x	NP
556	Orchidaceae Gen. sp. 14	Orchidaceae	herb		x	NP
557	Orchidaceae Gen. sp. 15	Orchidaceae	herb		x	NP
558	Orchidaceae Gen. sp. 16	Orchidaceae	herb		x	NP
559	Orchidaceae Gen. sp. 17	Orchidaceae	herb	x		NP
560	Orchidaceae Gen. sp. 18	Orchidaceae	herb	x		NP
561	Orchidaceae Gen. sp. 19	Orchidaceae	herb	x		NP
562	Orchidaceae Gen. sp. 20	Orchidaceae	herb	x		NP
563	Orchidaceae Gen. sp. 21	Orchidaceae	herb	x		NP
564	Orchidaceae Gen. sp. 22	Orchidaceae	herb	x		NP
565	Orchidaceae Gen. sp. 23	Orchidaceae	herb	x		NP
566	*Oreosyce africana*	Cucurbitaceae	climber	x	x	NP
	Ornithogalum donaldsonii = synonym of *Albuca donaldsonii*					
	Ouratea densiflora = synonym of *Gomphia densiflora*					
	Ouratea hiernii = synonym of *Gomphia hiernii*					
567	*Ouratea* sp.	Ochnaceae	shrub		x	LP
568	*Oxalis* cf. *latifolia*	Oxalidaceae	herb		x	NP
569	*Oxyanthus lepidus*	Rubiaceae	small tree	x		MP
570	*Oxyanthus speciosus*	Rubiaceae	tree	x	x	PR
	Oxymitra grandiflora = synonym of *Friesodielsia enghiana*					
571	*Palisota ambigua*	Commelinaceae	herb		x	LP
572	*Palisota schweinfurthii*	Commelinaceae	herb		x	NP
573	*Pancovia harmsiana*	Sapindaceae	tree		x	LP
574	*Panicum maximum*	Poaceae	herb		x	NP
575	*Paracostus englerianus*	Costaceae	herb		x	LP
576	*Parinari excelsa*	Chrysobalanaceae	big tree		x	PR
577	*Parkia filicoidea*	Fabaceae	tree		x	PR
578	*Paspalum scrobiculatum*	Poaceae	herb		x	NP
579	*Paullinia pinnata*	Sapindaceae	climber	x	x	LP
580	*Paullinia* sp.	Sapindaceae	climber		x	NP
	Pavetta insignis = synonym of *Pavetta molundensis*					
581	*Pavetta molundensis*	Rubiaceae	tree		x	LP
582	*Pavetta oliveriana*	Rubiaceae	shrub	x	x	MP
583	*Pavetta* sp.	Rubiaceae	shrub	x		NP
584	*Pavonia* cf. *propinqua*	Malvaceae	herb	x		NP
585	*Peddiea fischeri*	Thymeliaceae	shrub	x	x	MP
586	*Peddiea* sp.	Thymelaeaceae	shrub		x	LP
587	*Pellaea doniana*	Adiantaceae	herb	x	x	NP
588	*Pellaea viridis*	Adiantaceae	herb	x		NP
589	*Penianthus longifolius*	Menispermaceae	small tree		x	PR
590	*Peperomia abyssinica*	Piperaceae	herb	x	x	NP
591	*Peperomia fernandopoiana*	Piperaceae	herb	x	x	NP
592	*Peperomia retusa*	Piperaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
593	*Peperomia rotundifolia*	Piperaceae	herb	x	x	NP
594	*Peperomia stuhlmannii*	Piperaceae	herb		x	NP
595	*Peperomia tetraphylla*	Piperaceae	herb	x	x	NP
596	*Periploca linearifolia*	Apocynaceae	climber		x	MP
597	*Phaulopsis imbricata*	Acanthaceae	shrub	x		LP
598	*Phoenix reclinata*	Arecaceae	tree	x	x	PR
599	*Phragmanthera usuiensis*	Loranthaceae	shrub	x		NP
600	*Phyllanthus fischeri*	Phyllanthaceae	shrub	x	x	LP
601	*Phyllanthus muellerianus*	Phyllanthaceae	shrub	x	x	MP
602	*Phyllanthus ovalifolius*	Phyllanthaceae	shrub	x		LP
603	*Phyllanthus* sp.	Phyllanthaceae	shrub	x		NP
604	*Phymatosorus scolopendria*	Polypodiaceae	herb		x	NP
605	*Picralima nitida*	Apocynaceae	small tree		x	PR
606	*Pilea johnstonii*	Urticaceae	herb	x		LP
	Piliostigma thonningii = synonym of *Bauhinia thonningii*					
607	*Pinus patula*	Pinaceae	tree	x		NP
608	*Piper capense*	Piperaceae	herb	x		NP
609	*Piper guineense*	Piperaceae	climber	x	x	LP
610	*Piper umbellatum*	Piperaceae	herb	x	x	NP
611	*Piptadeniastrum africanum*	Fabaceae	small tree		x	MP
612	*Pisonia aculeata*	Nyctaginaceae	climber	x	x	NP
613	*Pittosporum mannii*	Pittosporaceae	small tree	x		MP
614	*Pittosporum viridiflorum*	Pittosporaceae	small tree	x		LP
615	*Platostoma rotundifolium*	Lamiaceae	herb	x		NP
616	*Platycerium angolense*	Polypodiaceae	herb	x	x	NP
	Platycerium elephantotis = synonym of *Platycerium angolense*					
617	*Pleopeltis macrocarpa*	Polypodiaceae	herb	x		NP
618	*Pneumatopteris unita*	Thelypteridaceae	herb		x	LP
619	*Poaceae* Gen. sp. 1	Poaceae	herb	x		NP
620	*Poaceae* Gen. sp. 2	Poaceae	herb	x		NP
621	*Poaceae* Gen. sp. 3	Poaceae	herb		x	NP
622	*Podangis dactyloceras*	Orchidaceae	herb		x	LP
623	*Pollia condensata*	Commelinaceae	herb	x	x	LP
624	*Polyscias fulva*	Araliaceae	tree	x		LP
625	*Polyspatha hirsuta*	Commelinaceae	herb		x	LP
626	*Polystachya adansoniae*	Orchidaceae	herb	x	x	NP
627	*Polystachya bennettiana*	Orchidaceae	herb	x		NP
628	*Polystachya* cf. *bicarinata*	Orchidaceae	herb	x		LP
629	*Polystachya* cf. *caloglossa*	Orchidaceae	herb		x	NP
630	*Polystachya* cf. *cultriformis*	Orchidaceae	herb	x		LP
631	*Polystachya* cf. *fallax*	Orchidaceae	herb		x	LP
632	*Polystachya* cf. *lindblomii*	Orchidaceae	herb	x		NP
633	*Polystachya* cf. *odorata*	Orchidaceae	herb		x	LP
634	*Polystachya galeata*	Orchidaceae	herb		x	NP
635	*Polystachya mauritiana* s.l.	Orchidaceae	herb		x	NP

	Species	Family	Habitus	Kenya	Uganda	CAT
636	*Polystachya modesta* s.l.	Orchidaceae	herb		x	NP
637	*Polystachya* sp. 1	Orchidaceae	herb	x		NP
638	*Polystachya* sp. 2	Orchidaceae	herb	x		NP
639	*Polystachya* sp. 3	Orchidaceae	herb		x	NP
640	*Polystachya* sp. 4	Orchidaceae	herb		x	NP
641	*Polystachya* sp. 5	Orchidaceae	herb		x	NP
642	*Polystachya* sp. 6	Orchidaceae	herb		x	NP
643	*Polystachya* sp. 7	Orchidaceae	herb		x	NP
644	*Polystachya* sp. 8	Orchidaceae	herb		x	NP
645	*Polystachya tenuissima*	Orchidaceae	herb	x	x	LP
646	*Pouteria altissima*	Sapotaceae	tree	x	x	MP
647	*Premna angolensis*	Lamiaceae	tree	x	x	PR
648	*Procris crenata*	Urticaceae	herb		x	LP
649	*Protea madiensis*	Proteaceae	shrub	x		LP
650	*Prunus africana*	Rosaceae	big tree	x	x	PR
651	*Pseuderanthemum ludovicianum*	Acanthaceae	herb	x	x	LP
652	*Pseudospondias microcarpa*	Anacardiaceae	tree	x	x	LP
653	*Psidium guajava*	Myrthaceae	small tree	x		LP
654	*Psophocarpus lancifolius*	Fabaceae	climber		x	NP
655	*Psychotria mahonii*	Rubiaceae	herb	x	x	LP
656	*Psychotria peduncularis*	Rubiaceae	herb	x		LP
657	*Psychotria sp.*	Rubiaceae	herb		x	LP
658	*Pteris atrovirens*	Pteridaceae	herb		x	NP
659	*Pteris buchananii*	Pteridaceae	herb	x		NP
660	*Pteris burtonii*	Pteridaceae	herb		x	NP
661	*Pteris catoptera*	Pteridaceae	herb	x	x	NP
662	*Pteris hamulosa*	Pteridaceae	herb		x	LP
663	*Pteris preussii*	Pteridaceae	herb	x		NP
664	*Pteris pteridioides*	Pteridaceae	herb	x		NP
665	*Pteris tripartita*	Pteridaceae	herb		x	NP
666	*Pterygota mildbraedii*	Malvaceae	big tree		x	PR
667	*Pupalia lappacea*	Amaranthaceae	herb		x	NP
668	*Pycnanthus angolensis*	Myristicaceae	tree		x	HP
669	*Pycnostachys* cf. *coerulea*	Lamiaceae	herb	x		NP
670	*Pycreus* cf. *niger*	Cyperaceae	herb		x	NP
671	*Pycreus flavescens*	Cyperaceae	herb	x		NP
	Pycreus melanostachyus = synonym of *Pycreus niger*					
672	*Pyrenacantha* cf. *vogeliana*	Icacinaceae	climber	x		MP
673	*Pyrenacantha sylvestris*	Icanicaceae	climber		x	NP
674	*Pyrrosia mechowii*	Polypodiaceae	herb	x	x	NP
	Pyrrosia schimperiana = synonym of *Pyrrosia mechowii*					
675	*Raphia farinifera*	Arecaceae	tree	x	x	MP
676	*Rauvolfia caffra*	Apocynaceae	small tree	x		MP
677	*Rawsonia lucida*	Achariaceae	shrub	x	x	LP
678	*Renealmia engleri*	Zingiberaceae	herb	x	x	LP

	Species	Family	Habitus	Kenya	Uganda	CAT
679	*Renealmia* sp. nov.	Zingiberaceae	herb	x	x	LP
680	*Rhamnus cf. staddo*	Rhamnaceae	small tree	x		NP
681	*Rhamnus prinoides*	Rhamnaceae	shrub	x		MP
682	*Rhaphidophora africana*	Araceae	climber		x	MP
683	*Rhipidoglossum rutilum*	Orchidaceae	herb	x		NP
684	*Rhipidoglossum* sp. 01	Orchidaceae	herb	x		NP
685	*Rhipidoglossum* sp. 02	Orchidaceae	herb	x		NP
686	*Rhipidoglossum* sp. 03	Orchidaceae	herb	x		NP
687	*Rhipidoglossum* sp. 04	Orchidaceae	herb	x		NP
688	*Rhipidoglossum* sp. 05	Orchidaceae	herb		x	NP
689	*Rhipidoglossum* sp. 06	Orchidaceae	herb		x	NP
690	*Rhipidoglossum* sp. 07	Orchidaceae	herb		x	NP
691	*Rhipidoglossum* sp. 08	Orchidaceae	herb		x	LP
692	*Rhipidoglossum* sp. 09	Orchidaceae	herb		x	NP
693	*Rhipidoglossum* sp. 10	Orchidaceae	herb		x	NP
694	*Rhipidoglossum* sp. 11	Orchidaceae	herb	x		NP
695	*Rhipidoglossum subsimplex*	Orchidaceae	herb	x	x	LP
696	*Rhipsalis baccifera*	Cactaceae	herb	x	x	NP
697	*Rhoicissus tridentata*	Vitaceae	shrub		x	MP
698	*Rhus natalensis*	Anacardiaceae	shrub	x		MP
699	*Rhynchosia hirta*	Fabaceae	climber	x		LP
700	*Rhynchosia orthobotrya*	Fabaceae	climber		x	NP
701	*Rhynchospora corymbosa*	Cyperaceae	herb		x	NP
702	*Ricinodendron heudelotii*	Euphorbiaceae	big tree		x	PR
703	*Ricinus communis*	Euphorbiaceae	herb	x		NP
704	*Rinorea angustifolia* subsp. *ardisiiflora*	Violaceae	small tree		x	LP
	Rinorea ardisiiflora = synonym of *Rinorea angustifolia* subsp. *ardisiiflora*					
705	*Rinorea brachypetala*	Violaceae	small tree	x	x	LP
706	*Rinorea dentata*	Violaceae	small tree		x	LP
707	*Rinorea ilicifolia*	Violaceae	small tree		x	MP
708	*Rinorea oblongifolia*	Violaceae	small tree		x	MP
709	*Ritchiea albersii*	Capparaceae	small tree	x	x	MP
710	*Rothmannia longiflora*	Rubiaceae	shrub	x		PR
711	*Rothmannia urcelliformis*	Rubiaceae	shrub	x	x	MP
712	*Rothmannia whitfieldii*	Rubiaceae	shrub		x	PR
713	Rubiaceae Gen. sp.	Rubiaceae	herb		x	LP
714	*Rubus apetalus*	Rosaceae	shrub		x	LP
715	*Rubus scheffleri*	Rosaceae	shrub	x		MP
716	*Rubus steudneri*	Rosaceae	shrub	x		MP
717	*Rutidea fuscescens*	Rubiaceae	climber		x	LP
718	*Rutidea orientalis*	Rubiaceae	climber	x	x	LP
719	*Rutidea smithii*	Rubiaceae	climber		x	LP
720	*Rytigynia acuminatissima*	Rubiaceae	shrub	x		MP
721	*Rytigynia neglecta*	Rubiaceae	shrub		x	MP
722	*Rytigynia verruculosa*	Rubiaceae	shrub		x	MP

	Species	Family	Habitus	Kenya	Uganda	CAT
723	*Saba comorensis*	Apocynaceae	climber	x	x	LP
724	*Salacia cerasifera*	Celastraceae	climber	x	x	LP
725	*Sanicula elata*	Apiaceae	herb	x		NP
	Sapium ellipticum = synonym of *Shirakiopsis elliptica*					
726	*Scadoxus cinnabarinus*	Amaryllidaceae	herb		x	MP
727	*Schefflera goetzenii*	Araliaceae	shrub		x	MP
728	*Schrebera arborea*	Oleaceae	tree	x	x	HP
729	*Scleria distans*	Cyperaceae	herb	x		NP
730	*Scoliosorus mannianus*	Vittariaceae	herb	x	x	NP
731	*Scutia myrtina*	Rhamnaceae	climber	x	x	LP
732	*Secamone stuhlmannii*	Apocynaceae	climber	x	x	NP
733	*Securidaca welwitschii*	Polygalaceae	climber	x	x	NP
734	*Selaginella versicolor*	Selaginellaceae	herb		x	NP
735	*Senecio syringifolius*	Asteraceae	climber	x	x	LP
736	*Senna didymobotrya*	Fabaceae	shrub	x		NP
737	*Senna spectabilis*	Fabaceae	tree	x	x	NP
738	*Sericostachys scandens*	Amaranthaceae	climber	x	x	NP
739	*Setaria longiseta*	Poaceae	herb	x		NP
740	*Setaria megaphylla*	Poaceae	herb		x	NP
741	*Shirakiopsis elliptica*	Euphorbiaceae	tree	x	x	LP
742	*Sida* sp.	Malvaceae	herb		x	NP
743	*Sida tenuicarpa*	Malvaceae	shrub	x		LP
744	*Siphonochilus aethiopicus*	Zingiberaceae	herb		x	MP
745	*Smilax anceps*	Smilacaceae	climber	x	x	LP
746	*Smilax aspera*	Smilacaceae	climber		x	LP
747	*Smilax kraussiana*	Smilacaceae	climber		x	NP
748	*Solanecio mannii*	Asteraceae	shrub	x		MP
749	*Solanum* cf. *aculeastrum*	Solanaceae	shrub	x		LP
750	*Solanum incanum*	Solanaceae	shrub	x	x	LP
751	*Solanum mauritianum*	Solanaceae	shrub	x		NP
752	*Solanum terminale*	Solanaceae	climber	x	x	NP
753	*Spathodea campanulata*	Bignoniaceae	tree	x	x	NP
754	*Spermacoce* sp.	Rubiaceae	herb	x		NP
755	*Sphaeranthus suaveolens*	Asteraceae	herb	x		NP
756	*Spilanthes mauritiana*	Asteraceae	herb	x		NP
757	*Stanfieldiella imperforata*	Commelinaceae	herb		x	MP
758	*Staudtia kamerunensis* var. *gabonensis*	Myrsinaceae	big tree		x	HP
	Staudtia stipitata = synonym of *Staudtia kamerunensis* var. *gabonensis*					
759	*Steganotaenia araliacea*	Apiaceae	shrub		x	NP
760	*Stephania abyssinica*	Menispermaceae	climber	x	x	NP
761	*Stephania cyanantha*	Menispermaceae	climber	x		NP
762	*Sterculia dawei*	Malvaceae	big tree		x	LP
763	*Stolzia repens*	Orchidaceae	herb	x		NP
764	*Striga asiatica*	Orobanchaceae	herb	x		NP
765	*Striga elegans*	Orobanchaceae	herb	x		NP

	Species	Family	Habitus	Kenya	Uganda	CAT
766	*Strombosia scheffleri*	Olacaceae	tree	x	x	PR
767	*Strophanthus preussii*	Apocynaceae	climber		x	LP
768	*Strychnos scheffleri*	Loganiaceae	climber		x	MP
769	*Strychnos spinosa*	Loganiaceae	climber		x	PR
770	*Strychnos usambarensis*	Loganiaceae	small tree	x	x	MP
771	*Suregada procera*	Euphorbiaceae	tree	x	x	MP
772	*Synsepalum cerasiferum*	Sapindaceae	tree	x		PR
773	*Syzygium guineense*	Myrthaceae	tree	x		PR
	Tabernaemontana johnstonii = synonym of *Tabernaemontana stapfiana*					
774	*Tabernaemontana stapfiana*	Apocynaceae	tree	x	x	MP
775	*Tabernaemontana ventricosa*	Apocynaceae	small tree	x		LP
776	*Tagetes minuta*	Asteraceae	herb	x		NP
777	*Tapura fischeri*	Dichapetalaceae	tree		x	MP
	Tarenna graveolens = synonym of *Coptosperma graveolens*					
778	*Tarenna pavettoides*	Rubiaceae	small tree	x	x	MP
	Teclea grandifolia = synonym of *Vepris grandifolia*					
	Teclea nobilis = synonym of *Vepris nobilis*					
779	*Tectaria angelicifolia*	Dryopteridaceae	herb	x	x	LP
780	*Tectaria gemmifera*	Dryopteridaceae	herb	x		NP
781	*Telfairia occidentalis*	Cucurbitaceae	climber		x	MP
782	*Tetracera potatoria*	Dilleniaceae	climber	x	x	LP
783	*Tetrapleura tetraptera*	Fabaceae	tree	x	x	MP
784	*Tetrorchidium didymostemon*	Euphorbiaceae	tree		x	LP
785	*Thalia geniculata*	Maranthaceae	herb		x	MP
	Thalia welwitschii = synonym of *Thalia geniculata*					
786	*Thalictrum rhynchocarpum*	Ranunculaceae	herb	x		LP
787	*Thecacoris lucida*	Phyllanthaceae	shrub		x	MP
788	*Thonningia sanguinea*	Balanophoraceae	herb	x	x	LP
789	*Thunbergia alata*	Acanthaceae	climber	x		LP
790	*Thunbergia fasciculata*	Acanthaceae	climber	x	x	NP
791	*Thunbergia gregorii*	Acanthaceae	climber	x		LP
792	*Thunbergia paulitschkeana*	Acanthaceae	climber	x		LP
793	*Thunbergia* sp.	Acanthaceae	climber	x		NP
794	*Thunbergia usambarica*	Acanthaceae	climber	x		NP
795	*Tiliacora funifera*	Menispermaceae	climber	x	x	LP
796	*Tinnea aethiopica*	Lamiaceae	shrub	x		LP
797	*Tinospora oblongifolia*	Menispermaceae	climber		x	MP
798	*Tithonia diversifolia*	Asteraceae	herb	x		NP
799	*Toddalia asiatica*	Rutaceae	climber	x		NP
800	*Trachyphrynium braunianum*	Maranthaceae	climber		x	MP
801	*Tragia brevipes*	Euphorbiaceae	climber	x		NP
802	*Tragia* cf. *insuavis*	Euphorbiaceae	climber		x	NP
803	*Treculia africana*	Moraceae	big tree		x	PR
804	*Trema orientalis*	Cannabaceae	tree	x	x	LP
805	*Trichilia emetica*	Meliaceae	tree	x	x	LP

	Species	Family	Habitus	Kenya	Uganda	CAT
806	*Trichilia prieuriana*	Meliaceae	tree		x	LP
807	*Trichilia rubescens*	Meliaceae	tree		x	LP
808	*Trichocladus ellipticus*	Hammamelidaceae	small tree	x		PR
	Trichomanes mannii = synonym of *Crepidomanes mannii*					
809	*Triclisia sacleuxii*	Menispermaceae	climber		x	LP
810	*Tridactyle anthomaniaca*	Orchidaceae	herb	x	x	LP
811	*Tridactyle bicaudata*	Orchidaceae	herb	x		NP
812	*Tridactyle filifolia*	Orchidaceae	herb	x	x	NP
813	*Tridactyle* sp. 1	Orchidaceae	herb		x	NP
814	*Tridactyle* sp. 2	Orchidaceae	herb		x	NP
815	*Tridactyle* sp. 3	Orchidaceae	herb	x		NP
816	*Trilepisium madagascariensis*	Moraceae	shrub	x	x	LP
817	*Trimeria grandifolia*	Salicaceae	shrub	x	x	LP
818	*Tristemma mauritianum*	Melastomataceae	herb	x		NP
819	*Tristicha trifaria*	Podostemonaceae	herb	x		NP
820	*Triumfetta brachyceras*	Malvaceae	herb	x	x	NP
821	*Triumfetta rhomboidea*	Malvaceae	shrub	x	x	LP
822	*Turraea floribunda*	Meliaceae	shrub	x	x	PR
823	*Turraea holstii*	Meliaceae	shrub	x	x	MP
824	*Turraea robusta*	Meliaceae	small tree	x	x	MP
825	*Turraea vogelioides*	Meliaceae	shrub	x	x	MP
826	*Uncaria africana*	Rubiaceae	climber	x	x	LP
827	*Urena lobata*	Malvaceae	shrub	x		NP
828	*Urera cameroonensis*	Urticaceae	climber	x	x	LP
829	*Urera hypselodendron*	Urticaceae	climber	x	x	LP
830	*Utricularia arenaria*	Lentibulariaceae	herb	x		NP
831	*Uvariopsis congensis*	Annonaceae	tree	x	x	LP
832	*Vangueria apiculata*	Rubiaceae	small tree	x	x	MP
833	*Vangueria madagascariensis*	Rubiaceae	shrub	x	x	MP
834	*Vepris grandifolia*	Rutaceae	big tree		x	LP
835	*Vepris nobilis*	Rutaceae	shrub	x	x	MP
836	*Vernonia amygdalina*	Asteraceae	shrub	x		MP
837	*Vernonia auriculifera*	Asteraceae	small tree	x		MP
838	*Vernonia conferta*	Asteraceae	tree	x		MP
839	*Vernonia* sp.	Asteraceae	herb	x		NP
840	*Vigna heterophylla*	Fabaceae	climber		x	LP
841	*Vigna parkeri*	Fabaceae	herb	x		NP
842	*Vitex ferruginea*	Lamiaceae	tree		x	LP
843	*Vitex keniensis*	Lamiaceae	tree	x		HP
844	*Vittaria guineensis*	Vittariaceae	herb		x	LP
845	*Warneckea jasminoides*	Melastomataceae	shrub		x	LP
846	*Warneckea walikalensis*	Melastomataceae	tree		x	MP
847	*Whitfieldia elongata*	Acanthaceae	herb		x	LP
848	*Xylopia aethiopica*	Annonaceae	tree		x	MP
849	*Zanha golungensis*	Sapindaceae	big tree		x	MP

	Species	Family	Habitus	Kenya	Uganda	CAT
850	*Zanthoxylum gilletii*	Rutaceae	tree	x	x	HP
851	*Zanthoxylum leprieurii*	Rutaceae	tree		x	MP
852	*Zehneria scabra*	Cucurbitaceae	climber	x		NP
853	*Zehneria* sp.	Cucurbitaceae	climber		x	NP

APPENDIX 2 - EPIPHYTE SPECIES LIST

List of the vascular epiphyte species of Kakamega Forest (Kenya) and Budongo Forest (Uganda) implied in the present study (CAT = category for conservation priority). The list includes 170 species of vascular plants and 11 synonyms. The taxonomic classification is based on the online database The Plant List (http://www.theplantlist.org/, accessed in Jan. 2011). The roman numerals I to V conform to the five phorophyte zones after Johansson (1974).

Conservation priority: NP = no priority, LP = low priority, MP = medium priority, PR = priority, HP = high priority.

	Species	Family	Kenya	Uganda	I	II	III	IV	V	CAT
1	*Aerangis ugandensis*	Orchidaceae	x	x		x				**NP**
2	*Angraecum humile*	Orchidaceae	x					x		**MP**
3	*Angraecum infundibulare*	Orchidaceae		x			x	x		**LP**
4	*Angraecum* sp. 1	Orchidaceae		x						**LP**
5	*Angraecum* sp. 2	Orchidaceae	x							**NP**
6	*Angraecum* sp. 3	Orchidaceae		x				x		**LP**
7	*Ansellia africana*	Orchidaceae	x				x			**NP**
	Antrophyum mannianum = synonym of *Scoliosorus mannianus*									
8	*Arthropteris monocarpa*	Oleandraceae		x				x		**NP**
9	*Arthropteris orientalis*	Oleandraceae	x	x				x	x	**NP**
10	*Arthropteris palisotii*	Oleandraceae		x	x					**LP**
	Asplenium aethiopicum = synonym of *Asplenium praemorsum*									
11	*Asplenium africanum*	Aspleniaceae		x	x	x	x	x	x	**NP**
12	*Asplenium angolense*	Aspleniaceae	x		x					**NP**
	Asplenium anisophyllum = synonym of *Asplenium feei*									
13	*Asplenium blastophorum*	Aspleniaceae	x	x		x				**NP**
14	*Asplenium ceii*	Aspleniaceae	x		x	x	x			**NP**
15	*Asplenium dregeanum*	Aspleniaceae	x	x	x			x		**NP**
16	*Asplenium emarginatum*	Aspleniaceae		x	x					**NP**
17	*Asplenium feei*	Aspleniaceae		x		x	x	x	x	**NP**
18	*Asplenium holstii*	Aspleniaceae		x	x	x	x	x	x	**LP**
19	*Asplenium laurentii*	Aspleniaceae		x				x		**LP**
20	*Asplenium macrophlebium*	Aspleniaceae	x	x	x	x				**NP**
21	*Asplenium macrophyllum*	Aspleniaceae		x	x		x			**NP**
22	*Asplenium mannii*	Aspleniaceae	x		x	x	x	x	x	**NP**
23	*Asplenium megalura*	Aspleniaceae	x					x		**NP**
24	*Asplenium praemorsum*	Aspleniaceae	x	x	x	x	x	x	x	**NP**
	Asplenium sandersonii = synonym of *Asplenium vagans*									
25	*Asplenium* sp.	Aspleniaceae		x	x			x		**NP**

	Species	Family	Kenya	Uganda	I	II	III	IV	V	CAT
26	*Asplenium theciferum*	Aspleniaceae	x	x	x	x	x	x	x	**NP**
27	*Asplenium unilaterale*	Aspleniaceae	x	x				x		**NP**
28	*Asplenium vagans*	Aspleniaceae	x		x	x				**NP**
29	*Asplenium warneckei*	Aspleniaceae		x		x	x	x		**LP**
30	*Begonia eminii*	Begoniaceae	x	x	x		x	x	x	**LP**
31	*Bolusiella iridifolia*	Orchidaceae	x	x				x	x	**LP**
32	*Bolusiella maudiae*	Orchidaceae	x	x		x	x	x	x	**NP**
	Bulbophyllum bequaertii = synonym of *Bulbophyllum cochleatum* var. *bequaertii*									
33	*Bulbophyllum cochleatum*	Orchidaceae	x					x		**LP**
34	*Bulbophyllum cochleatum* var. *bequaertii*	Orchidaceae	x	x			x	x	x	**NP**
35	*Bulbophyllum encephalodes*	Orchidaceae	x					x		**LP**
36	*Bulbophyllum scaberulum*	Orchidaceae		x				x		**LP**
37	*Bulbophyllum* sp.	Orchidaceae		x		x	x	x	x	**NP**
38	*Calyptrochilum christyanum*	Orchidaceae		x		x	x	x	x	**NP**
39	*Chamaeangis cf. odoratissima*	Orchidaceae	x					x		**LP**
40	*Chamaeangis sarcophylla*	Orchidaceae		x			x	x	x	**LP**
41	*Chamaeangis* sp.	Orchidaceae	x					x		**NP**
42	*Chamaeangis vesicata*	Orchidaceae		x				x		**LP**
43	*Crepidomanes mannii*	Hymenophyllaceae	x	x	x	x	x	x		**NP**
44	*Crepidomanes ramitrichum*	Hymenophyllaceae	x	x	x	x	x	x	x	**NP**
45	*Culcasia falcifolia*	Araceae	x	x	x	x	x	x		**NP**
46	*Cyrtorchis arcuata*	Orchidaceae	x	x					x	**NP**
47	*Cyrtorchis* sp. 1	Orchidaceae		x			x	x	x	**NP**
48	*Cyrtorchis* sp. 2	Orchidaceae		x				x		**NP**
	Davallia chaerophylloides = synonym of *Davallia denticulata*									
49	*Davallia denticulata*	Davalliaceae		x		x	x	x	x	**NP**
50	*Diaphananthe bidens*	Orchidaceae		x		x		x	x	**LP**
51	*Diaphananthe* cf. *fragrantissima*	Orchidaceae	x	x		x		x	x	**LP**
52	*Diaphananthe* cf. *pellucida*	Orchidaceae		x				x		**LP**
53	*Diaphananthe* sp.	Orchidaceae		x					x	**NP**
54	*Diaphananthe* sp. 2	Orchidaceae	x						x	**NP**
	Diaphananthe subsimplex = synonym of *Rhipidoglossum subsimplex*									
55	*Disperis reichenbachiana*	Orchidaceae	x		x					**NP**
56	*Doryopteris kirkii*	Adiantaceae	x		x	x				**NP**
57	*Dracaena fragrans*	Asparagaceae	x		x		x	x		**LP**
58	*Drynaria volkensii*	Polypodiaceae	x	x		x	x	x	x	**NP**
59	*Ficus bubu*	Moraceae	x	x	x	x	x	x	x	**MP**
60	*Ficus capreifolia*	Moraceae	x		x			x		**LP**
61	*Ficus cyathistipula*	Moraceae	x	x	x	x	x	x		**LP**
62	*Ficus ingens*	Moraceae		x	x	x	x			**MP**
63	*Ficus lingua*	Moraceae		x	x	x	x	x		**MP**
64	*Ficus lutea*	Moraceae	x	x	x	x	x	x	x	**MP**
65	*Ficus mucuso*	Moraceae		x	x					**PR**

	Species	Family	Kenya	Uganda	I	II	III	IV	V	CAT
66	*Ficus natalensis*	Moraceae	x	x	x	x	x	x	x	**PR**
67	*Ficus ovata*	Moraceae		x	x					**PR**
	Ficus persicifolia = synonym of *Ficus thonningii*									
68	*Ficus* sp. 1	Moraceae	x		x					**MP**
69	*Ficus* sp. 2	Moraceae		x	x			x		**LP**
70	*Ficus sur*	Moraceae	x					x		**MP**
71	*Ficus thonningii*	Moraceae	x	x	x	x	x	x	x	**MP**
72	*Ficus tremula*	Moraceae	x	x	x					**MP**
73	*Ficus verruculosa*	Moraceae	x		x	x		x		**MP**
74	*Graphorkis lurida*	Orchidaceae		x		x				**NP**
75	*Haplopteris volkensii*	Vittariaceae		x				x		**LP**
76	*Impatiens hochstetteri*	Balsaminaceae	x		x					**NP**
77	*Impatiens niamniamensis*	Balsaminaceae	x				x			**MP**
78	*Impatiens* sp. nov.	Balsaminaceae		x	x			x		**LP**
79	*Kalanchoe crenata*	Crassulaceae	x				x	x		**NP**
80	*Lepisorus excavatus*	Polypodiaceae	x		x			x	x	**NP**
81	*Liparis caillei*	Orchidaceae		x	x	x	x		x	**LP**
82	*Liparis nervosa*	Orchidaceae	x		x					**NP**
83	*Lippia kituiensis*	Verbenaceae	x		x					**PR**
84	*Loxogramme abyssinica*	Polypodiaceae	x	x	x	x	x	x	x	**NP**
85	*Microcoelia globulosa*	Orchidaceae	x						x	**LP**
86	*Microcoelia microglossa*	Orchidaceae		x					x	**LP**
87	*Microcoelia* sp.	Orchidaceae	x	x	x			x	x	**NP**
88	*Microsorum punctatum*	Polypodiaceae		x	x	x	x	x	x	**NP**
89	*Nephrolepis undulata*	Dryopteridaceae	x	x	x	x		x	x	**NP**
90	Orchidaceae Gen. sp. 01	Orchidaceae		x				x		**NP**
91	Orchidaceae Gen. sp. 02	Orchidaceae	x				x	x	x	**NP**
92	Orchidaceae Gen. sp. 03	Orchidaceae	x			x			x	**NP**
93	Orchidaceae Gen. sp. 04	Orchidaceae		x				x	x	**NP**
94	Orchidaceae Gen. sp. 05	Orchidaceae	x					x		**NP**
95	Orchidaceae Gen. sp. 06	Orchidaceae		x					x	**NP**
96	Orchidaceae Gen. sp. 07	Orchidaceae	x						x	**NP**
97	Orchidaceae Gen. sp. 08	Orchidaceae	x							**NP**
98	Orchidaceae Gen. sp. 09	Orchidaceae		x						**NP**
99	Orchidaceae Gen. sp. 10	Orchidaceae	x							**NP**
100	Orchidaceae Gen. sp. 11	Orchidaceae	x							**NP**
101	Orchidaceae Gen. sp. 12	Orchidaceae		x					x	**NP**
102	Orchidaceae Gen. sp. 13	Orchidaceae		x		x			x	**NP**
103	Orchidaceae Gen. sp. 14	Orchidaceae		x				x	x	**NP**
104	Orchidaceae Gen. sp. 15	Orchidaceae		x		x		x	x	**NP**
105	Orchidaceae Gen. sp. 16	Orchidaceae		x				x	x	**NP**
106	Orchidaceae Gen. sp. 17	Orchidaceae	x						x	**NP**
107	Orchidaceae Gen. sp. 18	Orchidaceae	x						x	**NP**
108	Orchidaceae Gen. sp. 19	Orchidaceae	x						x	**NP**
109	Orchidaceae Gen. sp. 20	Orchidaceae	x						x	**NP**

	Species	Family	Kenya	Uganda	I	II	III	IV	V	CAT
110	Orchidaceae Gen. sp. 21	Orchidaceae	x						x	**NP**
111	Orchidaceae Gen. sp. 22	Orchidaceae	x							**NP**
112	Orchidaceae Gen. sp. 23	Orchidaceae	x					x	x	**NP**
113	*Peperomia abyssinica*	Piperaceae	x	x	x	x				**NP**
114	*Peperomia retusa*	Piperaceae	x		x	x				**NP**
115	*Peperomia rotundifolia*	Piperaceae	x	x	x	x	x	x	x	**NP**
116	*Peperomia stuhlmannii*	Piperaceae		x	x	x	x	x	x	**NP**
117	*Peperomia tetraphylla*	Piperaceae	x	x	x	x		x	x	**NP**
118	*Phymatosorus scolopendria*	Polypodiaceae		x		x	x	x	x	**NP**
119	*Piper umbellatum*	Piperaceae	x	x	x	x		x		**NP**
120	*Platycerium angolense*	Polypodiaceae	x	x		x	x	x	x	**NP**
	Platycerium elephantotis = synonym of *Platycerium angolense*									
121	*Pleopeltis macrocarpa*	Polypodiaceae	x		x					**NP**
122	*Podangis dactyloceras*	Orchidaceae		x	x			x	x	**LP**
123	*Polystachya adansoniae*	Orchidaceae	x	x	x		x	x	x	**NP**
124	*Polystachya bennettiana*	Orchidaceae	x				x	x	x	**NP**
125	*Polystachya* cf. *bicarinata*	Orchidaceae	x				x			**LP**
126	*Polystachya* cf. *caloglossa*	Orchidaceae		x		x			x	**NP**
127	*Polystachya* cf. *cultriformis*	Orchidaceae	x							**LP**
128	*Polystachya* cf. *fallax*	Orchidaceae		x				x		**LP**
129	*Polystachya* cf. *lindblomii*	Orchidaceae	x				x	x	x	**NP**
130	*Polystachya* cf. *odorata*	Orchidaceae		x				x		**LP**
131	*Polystachya galeata*	Orchidaceae		x		x				**NP**
132	*Polystachya mauritiana* s.l.	Orchidaceae		x				x		**NP**
133	*Polystachya modesta* s.l.	Orchidaceae		x				x	x	**NP**
134	*Polystachya* sp. 1	Orchidaceae	x		x					**NP**
135	*Polystachya* sp. 2	Orchidaceae	x						x	**NP**
136	*Polystachya* sp. 3	Orchidaceae		x				x		**NP**
137	*Polystachya* sp. 4	Orchidaceae		x				x	x	**NP**
138	*Polystachya* sp. 5	Orchidaceae		x		x		x	x	**NP**
139	*Polystachya* sp. 6	Orchidaceae		x					x	**NP**
140	*Polystachya* sp. 7	Orchidaceae		x			x			**NP**
141	*Polystachya* sp. 8	Orchidaceae		x				x	x	**NP**
142	*Polystachya tenuissima*	Orchidaceae	x	x		x	x	x	x	**LP**
143	*Procris crenata*	Urticaceae		x	x					**LP**
144	*Pyrrosia mechowii*	Polypodiaceae	x	x	x	x	x	x	x	**NP**
	Pyrrosia schimperiana = synonym of *Pyrrosia mechowii*									
145	*Rhipidoglossum rutilum*	Orchidaceae	x					x		**NP**
146	*Rhipidoglossum* sp. 01	Orchidaceae	x							**NP**
147	*Rhipidoglossum* sp. 02	Orchidaceae	x				x	x	x	**NP**
148	*Rhipidoglossum* sp. 03	Orchidaceae	x		x	x	x	x	x	**NP**
149	*Rhipidoglossum* sp. 04	Orchidaceae	x							**NP**
150	*Rhipidoglossum* sp. 05	Orchidaceae		x		x	x	x	x	**NP**
151	*Rhipidoglossum* sp. 06	Orchidaceae		x				x	x	**NP**
152	*Rhipidoglossum* sp. 07	Orchidaceae		x		x	x	x	x	**NP**

	Species	Family	Kenya	Uganda	I	II	III	IV	V	CAT
153	*Rhipidoglossum* sp. 08	Orchidaceae		x				x	x	**LP**
154	*Rhipidoglossum* sp. 09	Orchidaceae		x	x					**NP**
155	*Rhipidoglossum* sp. 10	Orchidaceae		x				x		**NP**
156	*Rhipidoglossum* sp. 11	Orchidaceae	x				x	x		**NP**
157	*Rhipidoglossum subsimplex*	Orchidaceae	x	x			x	x	x	**LP**
158	*Rhipsalis baccifera*	Cactaceae	x	x		x	x	x	x	**NP**
159	*Schefflera goetzenii*	Araliaceae		x	x					**MP**
160	*Scoliosorus mannianus*	Vittariaceae	x	x	x					**NP**
161	*Stolzia repens*	Orchidaceae	x				x	x	x	**NP**
	Trichomanes mannii = synonym of *Crepidomanes mannii*									
162	*Tridactyle anthomaniaca*	Orchidaceae	x	x				x	x	**LP**
163	*Tridactyle bicaudata*	Orchidaceae	x				x	x		**NP**
164	*Tridactyle filifolia*	Orchidaceae	x	x			x	x	x	**NP**
165	*Tridactyle* sp. 1	Orchidaceae		x		x		x	x	**NP**
166	*Tridactyle* sp. 2	Orchidaceae		x				x	x	**NP**
167	*Tridactyle* sp. 3	Orchidaceae	x				x	x		**NP**
168	*Urera cameroonensis*	Urticaceae	x	x	x	x	x	x	x	**LP**
169	*Urera hypselodendron*	Urticaceae	x	x	x	x	x	x	x	**LP**
170	*Vittaria guineensis*	Vittariaceae		x			x			**LP**

APPENDIX 3 – CONSERVATION PRIORITY

List of the vascular plants of Kakamega Forest (Kenya) and Budongo Forest (Uganda) implied in the present study with detailed information about the composition of their conservation priority (VAL = priority value, CAT = priority category). The seven threat criteria are explained and discussed in chapter 5 (DIS = worldwide distribution, IUCN = global conservation status, CON = constancy, FOR = forest type, GRO = growth rate, USE = useful plants, ECO = ecological importance). The conservation values are composed as follows:

Cons. value	DIS	IUCN	CON	FOR	GRO	USE	ECO		
							hab	fac	obl
-1	introduced			synanthropes					
0	worldwide	DD/LC	> 10%	young sec.	herbs	no use	herbs	no	no
1	paleotropic	NT	6 - 10%	old sec.	woody plant	1 crit.	shrub/tree	pollin./disp.	yes
2	Africa	VU	2 - 5%	prim. Forest	giant trees	2 crit.	giant trees	both	
3	trop. Africa	EN	≤ 1%			3 crit.			
4	East Africa	CR				4 crit.			
10	endemic								

Conservation priority:

-2 to 5 = no priority (NP)

6 to 8 = low priority (LP)

9 to 11 = medium priority (MP)

12 to 14 = priority (PR)

15 to 18 = high priority (HP)

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Abrus precatorius	-1	0	2	0	0	0	1	0	0	0	1	0	**3**	**NP**
Abutilon longicuspe	2	0	0	-1	1	0	0	0	0	1	1	0	**4**	**NP**
Acacia abyssinica	4	0	0	0	1	0	1	0	0	1	1	0	**8**	**LP**
Acacia montigena	4	0	0	0	1	0	0	0	0	0	1	0	**6**	**LP**
Acacia sp.	NA	0	0	0	1	0	0	0	0	1	1	0	**3**	**NP**
Acalypha neptunica	2	0	0	0	1	0	0	0	0	1	1	0	**5**	**NP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Acalypha ornata	2	0	0	0	1	0	1	1	1	1	0	0	**7**	**LP**
Acalypha paniculata	1	0	0	0	0	0	1	0	0	0	0	0	**2**	**NP**
Acalypha volkensii	4	0	0	0	1	0	1	0	0	1	0	0	**7**	**LP**
Acanthopale pubescens	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Acanthus eminens	4	0	1	2	0	0	0	0	0	1	1	0	**9**	**MP**
Acanthus polystachius	4	0	0	0	1	0	1	0	0	1	1	0	**8**	**LP**
Achyranthes aspera	2	0	0	0	0	0	1	1	1	0	1	0	**6**	**LP**
Achyrospermum parviflorum	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Achyrospermum schimperi	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Adenia bequaertii	4	0	0	0	1	0	0	0	0	0	2	0	**7**	**LP**
Adenia cissampeloides	3	0	0	0	1	0	1	0	1	0	2	0	**8**	**LP**
Adenia lobata	3	0	0	0	1	0	1	0	1	0	2	0	**8**	**LP**
Adenia schweinfurthii	2	0	0	0	1	0	0	0	0	0	2	0	**5**	**NP**
Adenia venenata	2	0	2	2	1	0	1	0	1	0	2	0	**11**	**MP**
Adenostemma caffrum	2	0	0	1	0	0	1	0	0	0	1	0	**5**	**NP**
Adiantum comorense	2	0	0	-1	0	0	0	0	0	0	0	0	**1**	**NP**
Aerangis ugandensis	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Aframomum angustifolium	2	0	0	0	0	0	1	1	0	0	2	0	**6**	**LP**
Aframomum cf. *alboviolaceum*	3	0	2	1	0	0	1	1	0	0	2	0	**10**	**MP**
Aframomum mala	4	0	0	1	0	0	1	1	0	0	2	0	**9**	**MP**
Aframomum sp. nov.	NA	0	0	0	0	0	1	1	0	0	2	0	**4**	**NP**
Aframomum subsericeum	3	0	1	0	0	0	1	1	0	0	2	0	**8**	**LP**
Aframomum zambesiacum	2	0	0	0	0	0	1	1	0	0	2	0	**6**	**LP**
Agelaea pentagyna	2	0	0	1	1	0	0	0	0	1	2	0	**7**	**LP**
Agelanthus pennatulus	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**
Ageratum conyzoides	-1	0	0	-1	0	0	1	1	1	0	1	0	**2**	**NP**
Ageratum sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Alangium chinense	2	0	2	0	1	0	0	0	1	1	2	0	**9**	**MP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Albizia ferruginea	2	2	0	0	1	0	1	0	1	1	2	0	**10**	**MP**
Albizia glaberrima	2	0	0	0	1	0	1	0	0	1	1	0	**6**	**LP**
Albizia grandibracteata	2	0	0	0	1	0	0	0	0	1	1	0	**5**	**NP**
Albizia gummifera	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Albizia sp.	NA	0	0	0	1	0	0	0	0	1	1	0	**3**	**NP**
Albuca donaldsonii	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Alchornea cordifolia	2	0	0	0	1	0	1	1	1	0	1	0	**7**	**LP**
Alchornea floribunda	3	0	1	1	1	0	1	1	1	1	0	0	**10**	**MP**
Alchornea hirtella	2	0	3	1	1	0	1	0	1	1	0	0	**10**	**MP**
Alchornea laxiflora	2	0	0	0	1	0	0	0	1	1	1	0	**6**	**LP**
Allophylus abyssinicus	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**
Allophylus dummeri	2	0	3	0	1	0	0	0	0	1	2	0	**9**	**MP**
Allophylus ferrugineus	3	0	2	0	1	0	0	0	0	1	2	0	**9**	**MP**
Alstonia boonei	4	0	1	1	2	1	1	0	1	2	2	0	**15**	**HP**
Alternanthera sessilis	-1	0	0	-1	0	0	0	0	0	0	0	0	**-2**	**NP**
Amorphophallus calabaricus	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Anchomanes difformis	3	0	2	2	0	0	1	1	0	0	1	0	**10**	**MP**
Aneilema aequinoctiale	2	0	0	-1	0	0	1	1	0	0	2	0	**5**	**NP**
Aneilema beniniense	3	0	2	0	0	0	0	0	0	0	1	0	**6**	**LP**
Aneilema sp.	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Angraecum humile	4	0	3	1	0	0	0	0	0	0	1	0	**9**	**MP**
Angraecum infundibulare	3	0	2	2	0	0	0	0	0	0	1	0	**8**	**LP**
Angraecum sp. 1	NA	0	3	2	0	0	0	0	0	0	1	0	**6**	**LP**
Angraecum sp. 2	NA	0	3	1	0	0	0	0	0	0	1	0	**5**	**NP**
Angraecum sp. 3	NA	0	3	2	0	0	0	0	0	0	1	0	**6**	**LP**
Annona senegalensis	3	0	0	0	1	0	1	1	1	1	2	0	**10**	**MP**
Anonidium mannii	3	0	3	2	1	0	1	1	1	1	2	0	**15**	**HP**
Ansellia africana	2	0	0	0	0	0	1	0	0	0	0	0	**3**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Anthocleista grandiflora	4	0	0	0	1	0	0	0	0	1	1	0	**7**	**LP**
Anthocleista vogelii	3	0	0	0	1	0	0	0	0	1	1	0	**6**	**LP**
Antiaris toxicaria	1	0	0	0	2	0	1	0	0	2	2	0	**8**	**LP**
Antidesma laciniatum	2	0	2	1	2	0	0	0	0	2	2	0	**11**	**MP**
Antrocaryon micraster	3	2	2	1	2	1	1	1	1	2	2	0	**18**	**HP**
Apocynaceae Gen. sp.	NA	0	3	1	1	0	0	0	0	0	1	0	**6**	**LP**
Apodytes dimidiata	1	0	2	0	1	0	1	0	0	1	2	0	**8**	**LP**
Ardisia kivuensis	3	0	0	1	1	0	1	0	0	1	1	0	**8**	**LP**
Argomuellera macrophylla	2	0	0	0	1	0	1	0	0	1	2	0	**7**	**LP**
Aristolochia littoralis	0	0	0	-1	1	0	1	0	0	0	0	0	**1**	**NP**
Artabotrys likimensis	3	0	1	0	1	0	0	0	0	0	2	0	**7**	**LP**
Artabotrys stenopetalus	3	0	0	0	1	0	1	0	0	0	2	0	**7**	**LP**
Arthropteris monocarpa	2	0	0	2	0	0	0	0	0	0	0	0	**4**	**NP**
Arthropteris orientalis	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Arthropteris palisotii	1	0	3	2	0	0	0	0	0	0	0	0	**6**	**LP**
Asplenium africanum	2	0	0	0	0	0	0	0	1	0	0	0	**3**	**NP**
Asplenium angolense	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Asplenium barteri	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Asplenium blastophorum	2	0	2	0	0	0	0	0	0	0	0	0	**4**	**NP**
Asplenium bugoiense	4	0	0	1	0	0	0	0	0	0	0	0	**5**	**NP**
Asplenium ceii	4	0	0	0	0	0	0	0	0	0	0	0	**4**	**NP**
Asplenium dregeanum	2	0	2	1	0	0	0	0	0	0	0	0	**5**	**NP**
Asplenium emarginatum	3	0	1	0	0	0	0	0	0	0	0	0	**4**	**NP**
Asplenium feei	2	0	1	2	0	0	0	0	0	0	0	0	**5**	**NP**
Asplenium holstii	2	0	2	2	0	0	0	0	0	0	0	0	**6**	**LP**
Asplenium inaequilaterale	0	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Asplenium laurentii	3	0	3	2	0	0	0	0	0	0	0	0	**8**	**LP**
Asplenium lividum	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Asplenium macrophlebium	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Asplenium macrophyllum	1	0	2	2	0	0	0	0	0	0	0	0	**5**	**NP**
Asplenium mannii	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Asplenium megalura	2	0	3	0	0	0	0	0	0	0	0	0	**5**	**NP**
Asplenium praemorsum	0	0	0	0	0	0	1	0	0	0	0	0	**1**	**NP**
Asplenium protensum	2	0	1	1	0	0	0	0	0	0	0	0	**4**	**NP**
Asplenium sp.	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Asplenium theciferum	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Asplenium unilaterale	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**NP**
Asplenium vagans	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Asplenium warneckei	2	0	2	2	0	0	0	0	0	0	0	0	**6**	**LP**
Asystasia gangetica	1	0	0	-1	0	0	1	1	1	0	1	0	**4**	**NP**
Asystasia sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Ataenidia conferta	3	0	1	0	0	0	1	0	1	0	1	0	**7**	**LP**
Baikiaea insignis	3	0	3	1	2	0	1	1	0	2	1	0	**14**	**PR**
Baissea multiflora	3	0	2	1	1	0	1	1	1	0	1	0	**11**	**MP**
Balanites wilsoniana	3	0	3	1	2	0	0	1	1	2	2	0	**15**	**HP**
Balsamocitrus dawei	4	0	0	0	1	0	0	0	0	1	1	0	**7**	**LP**
Barleria ventricosa	4	0	0	-1	0	0	0	0	0	0	1	0	**4**	**NP**
Basella alba	0	0	2	0	0	0	1	1	1	0	1	0	**6**	**LP**
Bauhinia thonningii	2	0	0	0	1	0	1	1	1	1	1	0	**8**	**LP**
Begonia eminii	3	0	1	2	0	0	0	0	0	0	2	0	**8**	**LP**
Belonophora coffeoides subsp. *hypoglauca*	3	0	0	0	1	0	1	0	0	1	2	0	**8**	**LP**
Bersama abyssinica	4	0	1	0	1	0	0	0	0	1	2	0	**9**	**MP**
Biophytum abyssinicum	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Bischofia javanica	-1	0	0	0	1	1	0	0	0	1	1	0	**3**	**NP**
Blighia unijugata	2	0	0	0	1	0	0	0	1	1	2	0	**7**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Blighia welwitschii	3	0	3	1	2	0	1	1	1	2	2	0	**16**	**HP**
Blumea brevipes	2	0	0	-1	0	0	0	0	1	0	1	0	**3**	**NP**
Boehmeria macrophylla	1	0	0	0	1	0	1	0	0	1	1	0	**5**	**NP**
Bolbitis acrostichoides	3	0	3	1	0	0	0	0	0	0	0	0	**7**	**LP**
Bolbitis auriculata	2	0	1	1	0	0	0	0	0	0	0	0	**4**	**NP**
Bolusiella iridifolia	2	0	2	1	0	0	0	0	0	0	1	0	**6**	**LP**
Bolusiella maudiae	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Brachiaria cf. *decumbens*	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**NP**
Bridelia micrantha	2	0	1	0	1	0	1	1	1	1	2	0	**10**	**MP**
Bridelia scleroneura	2	0	0	0	1	0	1	0	0	1	2	0	**7**	**LP**
Brillantaisia cicatricosa	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Brillantaisia owariensis	2	0	0	1	0	0	0	0	0	0	1	0	**4**	**NP**
Brillantaisia vogeliana	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Broussonetia papyrifera	-1	0	0	-1	1	0	0	0	0	1	1	0	**1**	**NP**
Bryophyllum proliferum	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Buchnera capitata	2	0	0	0	0	0	0	0	1	0	1	0	**4**	**NP**
Bulbophyllum cochleatum	2	0	3	2	0	0	0	0	0	0	0	0	**7**	**LP**
Bulbophyllum cochleatum var. *bequaertii*	3	0	1	0	0	0	0	0	0	0	0	0	**4**	**NP**
Bulbophyllum encephalodes	2	0	3	2	0	0	0	0	0	0	0	0	**7**	**LP**
Bulbophyllum scaberulum	2	0	2	2	0	0	0	0	0	0	0	0	**6**	**LP**
Bulbophyllum sp.	NA	0	2	2	0	0	0	0	0	0	0	0	**4**	**NP**
Burgmansia sp.	-1	0	0	-1	1	0	0	0	0	1	1	0	**1**	**NP**
Caesalpinia angolensis	2	0	0	1	0	0	0	0	0	0	1	0	**4**	**NP**
Caesalpinia cf. *volkensii*	4	0	0	1	1	0	1	0	0	0	1	0	**8**	**LP**
Calamus deerratus	3	0	2	0	1	0	0	0	1	0	1	0	**8**	**LP**
Calanthe sylvatica	1	0	2	0	0	0	0	0	0	0	0	0	**3**	**NP**
Caloncoba schweinfurthii	3	0	2	0	1	0	0	0	0	1	2	0	**9**	**MP**
Calyptrochilum christyanum	3	0	0	1	0	0	1	0	0	0	0	0	**5**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Canarium schweinfurtii	3	0	3	2	2	0	1	1	1	2	1	0	**16**	**HP**
Cardiospermum halicacabum	1	0	0	0	0	0	1	1	0	0	1	0	**4**	**NP**
Carissa spinarum	1	0	0	0	1	0	1	0	0	0	1	0	**4**	**NP**
Carpolobia alba	3	0	2	1	1	0	1	1	1	1	2	0	**13**	**PR**
Carpolobia goetzei	2	0	3	1	1	0	0	0	0	1	2	0	**10**	**MP**
Casearia battiscombei	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**
Cassipourea ruwensorensis	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Celosia anthelminthica	4	0	2	1	0	0	0	0	0	0	1	0	**8**	**LP**
Celtis africana	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Celtis gomphophylla	2	0	0	0	2	0	1	0	1	2	2	0	**10**	**MP**
Celtis mildbraedii	2	0	0	0	2	0	1	1	1	2	2	0	**11**	**MP**
Celtis philippensis	0	0	0	0	1	0	1	0	1	1	2	0	**6**	**LP**
Celtis zenkeri	2	0	0	0	2	0	1	1	1	2	2	0	**11**	**MP**
Chaetacme madagascariensis	2	0	1	0	1	0	0	0	0	1	2	0	**7**	**LP**
Chamaeangis cf. *odoratissima*	2	0	3	2	0	0	0	0	0	0	1	0	**8**	**LP**
Chamaeangis sarcophylla	4	0	2	1	0	0	0	0	0	0	1	0	**8**	**LP**
Chamaeangis sp.	NA	0	2	1	0	0	0	0	0	0	1	0	**4**	**NP**
Chamaeangis vesicata	2	0	3	2	0	0	0	0	0	0	1	0	**8**	**LP**
Chassalia cristata	2	0	2	0	1	0	0	0	0	1	1	0	**7**	**LP**
Chionanthus mildbraedii	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**
Chlorophytum cameronii	3	0	3	1	0	0	0	0	0	0	1	0	**8**	**LP**
Chlorophytum comosum	2	0	2	2	0	0	0	0	0	0	1	0	**7**	**LP**
Chlorophytum subpetiolatum	2	0	2	1	0	0	0	0	0	0	1	0	**6**	**LP**
Christella dentata	0	0	1	0	0	0	0	0	0	0	0	0	**1**	**NP**
Christella guienziana	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Christella sp.	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Chrysophyllum albidum	3	0	0	0	2	1	1	1	1	2	2	0	**13**	**PR**
Chrysophyllum muerense	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Chrysophyllum perpulchrum	3	0	0	0	2	1	1	1	1	2	2	0	**13**	**PR**
Chrysophyllum viridifolium	2	0	0	0	2	1	0	1	0	2	2	0	**10**	**MP**
Cissampelos mucronata	2	0	2	0	0	0	1	0	1	0	1	0	**7**	**LP**
Cissampelos pareira	1	0	0	0	0	0	1	0	0	0	1	0	**3**	**NP**
Cissus cf. *aphyllantha*	4	0	0	2	0	0	0	0	0	0	1	0	**7**	**LP**
Cissus oliveri	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Cissus petiolata	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Cissus quadrangularis	0	0	0	0	1	0	1	1	1	0	1	0	**5**	**NP**
Cissus rotundifolia	4	0	1	0	0	0	0	1	0	0	1	0	**7**	**LP**
Cissus sp.	NA	0	1	0	0	0	0	0	0	0	1	0	**2**	**NP**
Citropsis articulata	3	0	0	0	1	0	1	0	0	1	2	0	**8**	**LP**
Citropsis sp.	3	0	3	1	1	0	1	0	0	1	2	0	**12**	**PR**
Clausena anisata	1	0	0	0	1	0	1	0	1	1	2	0	**7**	**LP**
Cleistanthus polystachyus	2	0	3	1	1	1	0	0	0	1	2	0	**11**	**MP**
Cleistopholis patens	2	0	2	0	2	0	1	0	1	2	2	0	**12**	**PR**
Clematis brachiata	2	0	2	0	1	0	0	0	0	0	1	0	**6**	**LP**
Clematis simensis	2	0	0	0	1	0	1	0	1	0	1	0	**6**	**LP**
Clerodendrum capitatum	3	0	0	0	1	0	1	0	1	0	2	0	**8**	**LP**
Clerodendrum formicarum	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Clerodendrum johnstonii	4	0	2	0	1	0	1	0	0	0	2	0	**10**	**MP**
Clerodendrum melanocrater	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Clerodendrum silvanum var. *silvanum*	3	0	2	0	1	0	1	0	0	0	2	0	**9**	**MP**
Clutia abyssinica	4	0	0	0	1	0	1	0	0	1	1	0	**8**	**LP**
Cnestis mildbraedii	4	0	2	1	1	0	0	0	0	1	2	0	**11**	**MP**
Coccinia adoensis	4	0	0	2	0	0	1	1	0	0	2	0	**10**	**MP**
Coccinia mildbraedii	4	0	0	1	0	0	0	0	0	0	2	0	**7**	**LP**
Coffea canephora	3	0	0	0	1	0	0	1	0	1	2	0	**8**	**LP**
Coffea eugenioides	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Cola gigantea	3	0	2	0	2	0	1	1	0	2	2	0	**13**	**PR**
Combretum adenogonium	2	0	0	0	1	0	1	0	0	1	1	0	**6**	**LP**
Combretum collinum	2	0	0	0	1	0	1	0	1	1	1	0	**7**	**LP**
Combretum molle	2	0	0	0	1	0	1	0	1	1	1	0	**7**	**LP**
Combretum paniculatum	2	0	2	0	1	0	1	1	1	0	1	0	**9**	**MP**
Combretum pentagonum	4	0	2	0	1	0	0	0	0	0	1	0	**8**	**LP**
Combretum sp. 1	NA	0	0	0	1	0	0	0	0	0	1	0	**2**	**NP**
Combretum sp. 2	NA	0	2	1	1	0	0	0	0	1	1	0	**6**	**LP**
Commelina albiflora	10	0	3	2	0	0	0	0	0	0	1	0	**16**	**HP**
Commelina capitata	2	0	1	0	0	0	1	0	0	0	1	0	**5**	**NP**
Commelina sp.	NA	0	3	1	0	0	0	0	0	0	1	0	**5**	**NP**
Connarus longistipitatus	3	0	0	0	1	0	0	0	0	0	2	0	**6**	**LP**
Coptosperma graveolens	4	0	2	1	1	0	0	0	0	1	2	0	**11**	**MP**
Cordia africana	3	0	2	0	1	1	1	1	1	1	2	0	**13**	**PR**
Cordia millenii	3	0	2	1	1	1	1	0	1	1	2	0	**13**	**PR**
Corymborkis corymbis	2	0	0	0	0	0	1	0	0	0	0	0	**3**	**NP**
Costus lucanusianus	0	0	0	0	0	0	1	1	1	0	2	0	**5**	**NP**
Courtoisina cyperoides	2	0	0	-1	0	0	0	0	0	0	0	0	**1**	**NP**
Craibia brownii	4	0	0	0	1	0	0	0	0	1	1	0	**7**	**LP**
Crassocephalum montuosum	2	0	2	0	0	0	1	1	0	0	1	0	**7**	**LP**
Crassocephalum picridifolium	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Craterispermum schweinfurthii	2	0	1	1	1	0	1	0	1	1	2	0	**10**	**MP**
Craterosiphon scandens	3	0	3	1	1	0	0	0	1	0	1	0	**10**	**MP**
Crepidomanes mannii	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Crepidomanes ramitrichum	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Crinum cf. *kirkii*	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Crinum zeylanicum	3	0	0	-1	0	0	1	0	0	0	1	0	**4**	**NP**
Crotalaria agatiflora	4	0	0	-1	1	0	0	0	1	1	1	0	**7**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Croton macrostachyus	2	0	2	1	1	0	1	0	1	1	2	0	**11**	**MP**
Croton megalocarpus	4	0	0	0	2	0	1	0	1	2	2	0	**12**	**PR**
Croton sylvaticus	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Cucumis aculeatus	4	0	0	0	0	0	0	0	0	0	2	0	**6**	**LP**
Cucumis ficifolius	2	0	0	0	0	0	1	0	0	0	2	0	**5**	**NP**
Cucumis sp. 1	NA	0	0	0	0	0	0	0	0	0	2	0	**2**	**NP**
Cucumis sp. 2	NA	0	0	2	0	0	0	0	0	0	2	0	**4**	**NP**
Cucurbitaceae Gen. sp.	NA	0	2	1	0	0	0	0	0	0	2	0	**5**	**NP**
Culcasia falcifolia	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Cupressus lusitanica	-1	0	0	-1	1	1	0	0	0	1	0	0	**1**	**NP**
Cuscuta kilimanjari	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Cyanotis cf. *vaga*	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Cyanotis sp.	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Cyathea manniana	2	0	3	2	0	0	1	0	0	0	0	0	**8**	**LP**
Cyathula uncinulata	4	0	0	0	0	0	1	0	0	0	0	0	**5**	**NP**
Cynoglossum lanceolatum	1	0	0	-1	0	0	1	0	0	0	1	0	**2**	**NP**
Cynometra alexandri	4	0	0	0	2	0	0	0	0	2	2	0	**10**	**MP**
Cyphostemma maranguense	3	0	0	0	0	0	1	0	0	0	2	0	**6**	**LP**
Cyphostemma sp. 1	NA	0	0	0	0	0	0	0	0	0	2	0	**2**	**NP**
Cyphostemma sp. 2	NA	0	0	0	0	0	0	0	0	0	2	0	**2**	**NP**
Cyphostemma sp. 3	NA	0	0	0	0	0	0	0	0	0	2	0	**2**	**NP**
Cyrtorchis arcuata	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Cyrtorchis sp. 1	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Cyrtorchis sp. 2	NA	0	2	2	0	0	0	0	0	0	1	0	**5**	**NP**
Dacryodes edulis	3	0	3	1	1	0	0	1	0	1	2	0	**12**	**PR**
Dalbergia lactea	2	0	0	0	1	0	1	0	0	0	1	0	**5**	**NP**
Davallia denticulata	2	0	0	1	0	0	0	0	0	0	0	0	**3**	**NP**
Deinbollia kilimandscharica	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Desmodium adscendens	0	0	1	0	0	0	1	0	0	0	1	0	**3**	**NP**
Desplatsia dewevrei	3	0	0	0	1	0	1	1	1	1	2	0	**10**	**MP**
Dialium excelsum	4	3	0	0	2	0	0	0	0	2	2	0	**13**	**PR**
Diaphananthe bidens	3	0	2	1	0	0	1	0	0	0	0	0	**7**	**LP**
Diaphananthe cf. *fragrantissima*	2	0	2	2	0	0	0	0	0	0	0	0	**6**	**LP**
Diaphananthe cf. *pellucida*	3	0	3	2	0	0	0	0	0	0	0	0	**8**	**LP**
Diaphananthe sp. 1	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Diaphananthe sp. 2	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Dicliptera elliotii	3	0	3	1	0	0	1	0	0	0	1	0	**9**	**MP**
Dicranolepis buchholzii	3	0	2	2	1	0	0	0	1	1	1	0	**11**	**MP**
Dicranopteris linearis	1	0	0	0	0	0	1	0	1	0	0	0	**3**	**NP**
Didymodoxa caffra	2	0	0	-1	0	0	0	0	0	0	0	0	**1**	**NP**
Didymoplexis africana	4	0	3	2	0	0	0	0	0	0	0	0	**9**	**MP**
Dietes iridioides	2	0	0	0	0	0	1	0	0	0	0	0	**3**	**NP**
Dioscorea alata	-1	0	2	1	0	0	1	1	0	0	0	0	**4**	**NP**
Dioscorea bulbifera	1	0	1	0	0	0	1	1	0	0	0	0	**4**	**NP**
Dioscorea dumetorum	2	0	0	-1	0	0	1	1	0	0	0	0	**3**	**NP**
Dioscorea praehensilis	2	0	2	0	0	0	0	1	0	0	0	0	**5**	**NP**
Dioscorea schimperiana	2	0	2	0	0	0	1	0	0	0	0	0	**5**	**NP**
Dioscorea sp.	NA	0	0	0	0	0	0	1	0	0	0	0	**1**	**NP**
Diospyros abyssinica	2	0	0	0	2	0	1	0	1	2	2	0	**10**	**MP**
Discoclaoxylon hexandrum	3	0	0	0	1	0	0	0	0	1	1	0	**6**	**LP**
Disperis reichenbachiana	2	0	2	0	0	0	0	0	0	0	1	0	**5**	**NP**
Dissotis speciosa	2	0	0	0	1	0	0	1	0	1	1	0	**6**	**LP**
Dombeya kirkii	4	0	2	1	1	0	0	0	1	1	1	0	**11**	**MP**
Dombeya rotundifolia	2	0	0	0	1	0	1	0	0	1	1	0	**6**	**LP**
Dorstenia brownii	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Dorstenia hildebrandtii	4	0	0	1	0	0	0	0	0	0	0	0	**5**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Dorstenia kameruniana	2	0	3	2	1	0	1	1	1	1	1	0	**13**	**PR**
Dorstenia psilurus	3	0	0	1	0	0	0	0	0	0	0	0	**4**	**NP**
Doryopteris kirkii	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Doryopteris sp.	NA	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Dovyalis macrocalyx	2	0	0	0	1	0	0	1	0	1	2	0	**7**	**LP**
Dracaena fragrans	2	0	0	0	1	0	0	0	1	1	2	0	**7**	**LP**
Dracaena laxissima	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Dracaena steudneri	4	0	0	-1	1	0	0	0	0	1	2	0	**7**	**LP**
Droguetia iners	1	0	0	0	0	0	0	1	0	0	0	0	**2**	**NP**
Drynaria volkensii	2	0	1	1	0	0	0	0	0	0	0	0	**4**	**NP**
Drypetes gerrardii	4	0	0	0	1	0	0	0	1	1	2	0	**9**	**MP**
Drypetes sp. 1	NA	0	3	2	1	0	0	0	1	1	2	0	**10**	**MP**
Drypetes sp. 2	NA	0	2	2	1	0	0	0	1	1	2	0	**9**	**MP**
Drypetes ugandensis	4	0	1	0	1	0	0	0	1	1	2	0	**10**	**MP**
Duranta erecta	-1	0	0	-1	1	0	0	0	0	1	2	0	**2**	**NP**
Ehretia cymosa	2	0	1	0	1	0	1	1	1	1	2	0	**10**	**MP**
Ekebergia capensis	2	0	1	0	1	1	1	0	0	1	2	0	**9**	**MP**
Elatostema cf. *monticolum*	2	0	0	-1	0	0	0	0	0	0	0	0	**1**	**NP**
Elytraria marginata	3	0	0	-1	0	0	0	0	0	0	1	0	**3**	**NP**
Embelia libeniana	4	0	3	2	1	0	1	1	0	1	2	0	**15**	**HP**
Embelia schimperi	2	0	2	0	1	0	1	1	0	1	2	0	**10**	**MP**
Englerophytum oblanceolatum	3	0	0	0	1	0	0	1	1	1	2	0	**9**	**MP**
Entandrophragma angolense	3	2	3	2	2	1	1	0	1	2	1	0	**18**	**HP**
Entandrophragma excelsum	3	0	1	0	2	1	0	0	0	2	1	0	**10**	**MP**
Entandrophragma utile	2	2	2	2	2	1	1	0	1	2	1	0	**16**	**HP**
Eriocaulon transvaalicum	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Erythrina abyssinica	2	0	0	-1	1	0	1	0	1	1	2	0	**7**	**LP**
Erythrina excelsa	4	0	3	2	2	0	0	0	1	2	1	0	**15**	**HP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Erythrococca atrovirens	2	0	2	0	1	0	1	0	0	1	2	0	**9**	**MP**
Erythrococca atrovirens var. *flaccida*	3	0	2	2	1	0	1	0	0	1	2	0	**12**	**PR**
Erythrophleum suaveolens	3	0	2	1	2	0	1	0	1	2	2	0	**14**	**PR**
Eucalyptus saligna	-1	0	0	-1	2	0	0	0	0	2	1	0	**3**	**NP**
Eulophia rosea	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Eulophia streptopetala	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Euphorbia hirta	-1	0	0	-1	0	0	1	1	0	0	0	0	**0**	**NP**
Euphorbia teke	3	0	2	1	1	0	0	0	0	1	0	0	**8**	**LP**
Fagaropsis angolensis	4	0	1	0	1	0	1	0	0	1	2	0	**10**	**MP**
Ficus asperifolia	2	0	0	0	1	0	1	1	1	1	1	1	**9**	**MP**
Ficus bubu	3	0	1	1	1	0	0	0	1	1	1	1	**10**	**MP**
Ficus capreifolia	2	0	2	0	1	0	0	0	0	1	1	1	**8**	**LP**
Ficus conraui	3	0	0	1	1	0	0	0	1	1	1	1	**9**	**MP**
Ficus cyathistipula	2	0	2	0	1	0	0	0	0	1	1	1	**8**	**LP**
Ficus exasperata	2	0	0	0	1	0	1	1	1	1	1	1	**9**	**MP**
Ficus ingens	2	0	2	2	1	0	0	0	0	1	1	1	**10**	**MP**
Ficus lingua	2	0	1	1	1	0	0	0	1	1	1	1	**9**	**MP**
Ficus lutea	2	0	1	0	2	0	1	0	0	2	1	1	**10**	**MP**
Ficus mucuso	3	0	2	1	2	0	0	0	0	2	1	1	**12**	**PR**
Ficus natalensis	2	0	2	1	1	0	1	1	1	1	1	1	**12**	**PR**
Ficus ovata	2	0	3	0	1	0	1	1	1	1	1	1	**12**	**PR**
Ficus sansibarica	2	0	0	0	2	0	0	0	0	2	1	1	**8**	**LP**
Ficus saussureana	3	0	0	0	1	0	0	1	1	1	1	1	**9**	**MP**
Ficus sp. 1	NA	0	3	2	1	0	0	0	0	1	1	1	**9**	**MP**
Ficus sp. 2	NA	0	2	2	1	0	0	0	0	1	1	1	**8**	**LP**
Ficus sur	2	0	0	0	1	0	1	1	1	1	1	1	**9**	**MP**
Ficus thonningii	2	0	0	0	2	0	1	1	1	2	1	1	**11**	**MP**
Ficus tremula	2	0	3	1	1	0	0	0	0	1	1	1	**10**	**MP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Ficus vallis-choudae	2	0	3	0	1	0	1	1	0	1	1	1	**11**	**MP**
Ficus verruculosa	2	0	3	0	1	0	0	1	1	1	1	1	**11**	**MP**
Flacourtia indica	1	0	0	0	1	0	1	1	1	1	2	0	**8**	**LP**
Fleroya stipulosa	2	0	0	0	2	0	1	0	1	2	0	0	**8**	**LP**
Friesodielsia enghiana	1	0	2	1	1	0	0	0	0	0	2	0	**7**	**LP**
Funtumia africana	2	0	0	0	1	1	1	0	1	1	1	0	**8**	**LP**
Garcinia buchananii	2	0	2	0	1	0	1	0	0	1	1	0	**8**	**LP**
Garcinia volkensii	2	0	2	1	1	0	1	0	0	1	2	0	**10**	**MP**
Gardenia vogelii	3	0	2	1	1	0	1	0	1	1	2	0	**12**	**PR**
Geophila repens	0	0	0	0	0	0	1	1	0	0	2	0	**4**	**NP**
Geophila sp. 1	NA	0	3	1	0	0	0	0	0	0	2	0	**6**	**LP**
Geophila sp. 2	NA	0	3	1	0	0	0	0	0	0	2	0	**6**	**LP**
Geophila sp. 3	NA	0	3	1	0	0	0	0	0	0	2	0	**6**	**LP**
Gladiolus dalenii	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Glenniea africana	2	0	1	0	1	0	0	1	0	1	2	0	**8**	**LP**
Globimetula braunii	2	0	0	0	1	0	1	1	0	1	1	0	**7**	**LP**
Gloriosa superba	2	0	0	0	0	0	1	0	1	0	1	0	**5**	**NP**
Glyphaea brevis	2	0	2	0	1	0	1	1	1	1	1	0	**10**	**MP**
Gomphia densiflora	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Gomphia hiernii	3	0	2	2	1	0	0	0	0	1	2	0	**11**	**MP**
Gomphocarpus semilunatus	4	0	0	-1	0	0	0	0	1	0	1	0	**5**	**NP**
Gongronema angolense	2	0	0	0	0	0	0	1	1	0	1	0	**5**	**NP**
Gouania longispicata	2	0	0	0	1	0	1	1	0	0	1	0	**6**	**LP**
Graphorkis lurida	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Greenwayodendron suaveolens	3	0	0	0	1	1	1	0	1	1	2	0	**10**	**MP**
Grevillea robusta	-1	0	0	-1	1	0	0	0	1	1	1	0	**2**	**NP**
Grewia capitellata	4	0	0	0	1	0	0	0	0	0	2	0	**7**	**LP**
Grewia mildbraedii	2	0	2	1	1	0	0	1	1	1	2	0	**11**	**MP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Grewia pubescens	2	0	2	0	1	0	1	1	1	1	2	0	**11**	**MP**
Grewia similis	3	0	0	0	1	0	1	1	0	1	2	0	**9**	**MP**
Guarea cedrata	2	2	0	0	2	1	1	0	1	2	2	0	**13**	**PR**
Gymnosporia heterophylla	1	0	2	0	1	0	0	0	0	1	2	0	**7**	**LP**
Gynura scandens	4	0	3	2	0	0	0	0	0	0	2	0	**11**	**MP**
Habenaria malacophylla	2	0	2	0	0	0	0	0	0	0	1	0	**5**	**NP**
Halopegia azurea	3	0	1	0	0	0	0	0	1	0	1	0	**6**	**LP**
Haplopteris volkensii	3	0	3	2	0	0	0	0	0	0	0	0	**8**	**LP**
Harungana madagascariensis	2	0	1	0	1	0	1	0	0	1	2	0	**8**	**LP**
Harveya thonneri	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Haumania sp.	NA	0	2	1	1	0	0	0	0	0	1	0	**5**	**NP**
Heckeldora staudtii	3	0	3	2	1	0	1	0	1	1	1	0	**13**	**PR**
Heinsenia diervilleoides	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**
Helichrysum cf. *forskahlii*	4	0	0	0	0	0	1	0	0	0	1	0	**6**	**LP**
Hemerocallis fulva	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Heterotis canescens	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Heterotis rotundifolia	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Hibiscus articulatus	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Hibiscus calyphyllus	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Hibiscus cannabinus	0	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Hibiscus fuscus	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Hibiscus vitifolius	1	0	0	1	0	0	0	0	0	0	1	0	**3**	**NP**
Hilleria latifolia	0	0	2	1	0	0	1	1	1	0	2	0	**8**	**LP**
Holoptelea grandis	2	0	2	1	2	0	1	0	1	2	2	0	**13**	**PR**
Hugonia platysepala	3	0	1	0	1	0	1	0	1	0	1	0	**8**	**LP**
Hydrocotyle ranunculoides	0	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Hylodesmum repandum	1	0	0	0	0	0	1	1	0	0	1	0	**4**	**NP**
Hymenocoleus hirsutus	4	0	1	0	0	0	0	0	0	0	2	0	**7**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Hymenocoleus libericus	3	0	3	1	0	0	1	0	0	0	2	0	**10**	**MP**
Hymenocoleus neurodictyon	3	0	2	0	0	0	0	0	0	0	2	0	**7**	**LP**
Hymenodictyon floribundum	2	0	0	0	1	0	1	0	1	1	1	0	**7**	**LP**
Hypericum lalandii	1	0	0	1	0	0	1	0	0	0	1	0	**4**	**NP**
Hypoestes forsskaolii	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Hypoxis angustifolia	2	0	0	0	0	0	0	1	1	0	1	0	**5**	**NP**
Illigera pentaphylla	3	0	2	0	1	0	1	0	0	0	1	0	**8**	**LP**
Impatiens burtonii	4	0	3	1	0	0	1	0	0	0	1	0	**10**	**MP**
Impatiens hochstetteri	2	0	1	0	0	0	1	0	0	0	1	0	**5**	**NP**
Impatiens niamniamensis	3	0	3	2	0	0	1	0	0	0	1	0	**10**	**MP**
Impatiens sp. nov.	NA	0	2	2	0	0	1	0	0	0	1	0	**6**	**LP**
Impatiens stuhlmannii	3	0	3	1	0	0	1	0	0	0	1	0	**9**	**MP**
Iodes seretii	3	0	1	1	0	0	0	0	0	0	2	0	**7**	**LP**
Ipomoea cairica	0	0	0	-1	0	0	1	0	1	0	1	0	**2**	**NP**
Ipomoea cf. *pileata*	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Ipomoea coscinosperma	3	0	0	0	0	0	0	1	0	0	1	0	**5**	**NP**
Ipomoea sp. 1	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Ipomoea sp. 2	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Ipomoea tenuirostris	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Ipomoea wightii	1	0	0	0	0	0	0	0	0	0	1	0	**2**	**NP**
Irvingia gabonensis	2	1	3	2	2	0	0	1	0	2	2	0	**15**	**HP**
Isoglossa laxa	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Isoglossa substrobilina	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Jasminum abyssinicum	2	0	2	0	1	0	0	0	0	0	2	0	**7**	**LP**
Jasminum cf. schimperi	4	0	0	0	1	0	0	0	0	0	2	0	**7**	**LP**
Jasminum fluminense	2	0	2	0	1	0	1	1	1	0	2	0	**10**	**MP**
Jasminum pauciflorum	3	0	0	0	1	0	0	0	1	0	2	0	**7**	**LP**
Justicia betonica	1	0	0	0	0	0	0	0	0	0	1	0	**2**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Justicia cf. *striata*	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Justicia extensa	3	0	1	1	0	0	1	0	0	0	1	0	**7**	**LP**
Justicia flava	2	0	0	0	0	0	1	0	1	0	1	0	**5**	**NP**
Justicia sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Justicia striata	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Kalanchoe crenata	2	0	0	0	0	0	1	0	1	0	1	0	**5**	**NP**
Keetia gueinzii	2	0	0	0	1	0	0	0	0	0	2	0	**5**	**NP**
Khaya anthotheca	2	2	0	0	2	1	1	0	1	2	2	0	**13**	**PR**
Kigelia africana	2	0	1	0	1	0	1	1	1	1	2	0	**10**	**MP**
Klainedoxa gabonensis	3	0	2	0	2	0	1	1	1	2	2	0	**14**	**PR**
Kotschya africana	2	0	0	-1	1	0	1	0	0	1	1	0	**5**	**NP**
Kyllinga chrysantha	4	0	0	0	0	0	0	0	0	0	0	0	**4**	**NP**
Kyllinga sp.	NA	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Landolphia buchananii	2	0	0	0	1	0	1	1	1	0	2	0	**8**	**LP**
Landolphia eminiana	4	0	2	1	1	0	0	1	0	0	2	0	**11**	**MP**
Landolphia owariensis	4	0	0	1	1	0	1	1	1	0	2	0	**11**	**MP**
Lannea edulis	2	0	0	0	0	0	1	1	0	0	2	0	**6**	**LP**
Lannea welwitschii	3	0	3	2	2	0	1	1	1	2	2	0	**17**	**HP**
Lantana camara	-1	0	2	0	1	0	1	1	0	1	2	0	**7**	**LP**
Lantana trifolia	-1	0	0	0	1	0	1	1	1	1	2	0	**6**	**LP**
Laportea alatipes	4	0	3	1	0	0	0	0	1	0	0	0	**9**	**MP**
Laportea sp.	NA	0	0	-1	0	0	0	0	0	0	0	0	**-1**	**NP**
Lasiodiscus mildbraedii	2	0	0	0	1	0	0	0	0	1	2	0	**6**	**LP**
Leea guineense	1	0	0	0	1	0	1	1	1	1	2	0	**8**	**LP**
Leonotis ocymifolia	4	0	0	-1	0	0	1	0	0	0	1	0	**5**	**NP**
Lepidotrichilia volkensii	4	0	1	0	1	0	0	0	0	1	2	0	**9**	**MP**
Lepisanthes senegalensis	1	0	0	0	1	0	1	0	0	1	2	0	**6**	**LP**
Lepisorus excavatus	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Leptactina platyphylla	2	0	3	1	1	0	0	0	0	0	1	0	**8**	**LP**
Leptaspis zeylanica	3	0	0	0	0	0	1	0	0	0	1	0	**5**	**NP**
Liparis caillei	3	0	3	2	0	0	0	0	0	0	0	0	**8**	**LP**
Liparis nervosa	0	0	2	0	0	0	0	0	1	0	0	0	**3**	**NP**
Lippia kituiensis	4	0	2	0	1	0	1	1	1	1	1	0	**12**	**PR**
Loeseneriella africana	4	0	0	0	1	0	1	0	1	0	1	0	**8**	**LP**
Lovoa trichilioides	3	2	3	1	2	1	1	0	1	2	1	0	**17**	**HP**
Loxogramme abyssinica	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Lychnodiscus cerospermus	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Lycopodiella cernua	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Macaranga monandra	2	0	3	2	1	0	1	0	1	1	1	0	**12**	**PR**
Macaranga schweinfurthii	2	0	2	0	1	0	1	0	1	1	1	0	**9**	**MP**
Macaranga spinosa	3	0	0	1	1	0	1	0	1	1	1	0	**9**	**MP**
Maerua duchesnei	2	0	1	1	1	0	1	0	1	1	2	0	**10**	**MP**
Maesa lanceolata	2	0	1	0	1	0	1	0	0	1	2	0	**8**	**LP**
Maesopsis eminii	2	0	1	0	2	1	1	1	1	2	2	0	**13**	**PR**
Majidea forsteri	3	0	2	1	2	0	1	0	0	2	2	0	**13**	**PR**
Malaxis maclaudii	3	0	3	1	0	0	0	0	0	0	0	0	**7**	**LP**
Malaxis welwitschii	2	0	3	1	0	0	0	0	0	0	0	0	**6**	**LP**
Mallotus oppositifolius	2	0	1	0	1	0	1	0	1	1	1	0	**8**	**LP**
Malva parviflora	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Mammea africana	3	0	2	0	2	1	1	1	1	2	2	0	**15**	**HP**
Manilkara butugi	4	0	0	0	2	0	0	0	0	2	2	0	**10**	**MP**
Marantochloa purpurea	2	0	0	0	0	0	1	0	1	0	2	0	**6**	**LP**
Margaritaria discoidea	2	0	1	0	2	0	1	1	1	2	2	0	**12**	**PR**
Markhamia lutea	3	0	0	0	1	0	1	0	1	1	1	0	**8**	**LP**
Megaphrynium macrostachyum	3	0	0	2	0	0	1	1	1	0	2	0	**10**	**MP**
Melanthera scandens	2	0	2	0	0	0	1	1	1	0	1	0	**8**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Metarungia pubinervia	2	0	0	0	1	0	0	0	0	1	1	0	**5**	**NP**
Meyna tetraphylla	3	0	2	0	1	0	1	1	0	1	2	0	**11**	**MP**
Micrococelia globulosa	2	0	3	1	0	0	0	0	0	0	0	0	**6**	**LP**
Microcoelia microglossa	3	0	3	1	0	0	0	0	0	0	0	0	**7**	**LP**
Microcoelia sp.	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Microglossa densiflora	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Microglossa pyrifolia	1	0	0	0	0	0	1	0	1	0	1	0	**4**	**NP**
Microlepia speluncae	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Microsorum punctatum	1	0	2	0	0	0	1	0	0	0	0	0	**4**	**NP**
Mikania chenopodifolia	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Mikania cordata	0	0	1	0	0	0	1	1	1	0	1	0	**5**	**NP**
Mikaniopsis clematoides	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Mikaniopsis usambarensis	3	0	1	0	0	0	0	0	0	0	1	0	**5**	**NP**
Mildbraediodendron excelsum	3	0	2	0	2	1	0	0	1	2	1	0	**12**	**PR**
Milicia excelsa	2	1	2	1	2	1	0	0	1	2	1	0	**13**	**PR**
Mimosa pudica	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Mimulopsis arborescens	4	0	1	0	1	0	0	0	0	1	1	0	**8**	**LP**
Mimulopsis solmsii	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Momordica boivinii	2	0	0	2	0	0	0	0	0	0	2	0	**6**	**LP**
Momordica foetida	2	0	2	0	0	0	1	1	0	0	2	1	**9**	**MP**
Momordica friesiorum	2	0	1	0	0	0	0	0	0	0	2	0	**5**	**NP**
Momordica sp.	NA	0	0	-1	0	0	0	0	0	0	2	0	**1**	**NP**
Mondia whiteii	2	0	2	0	1	0	1	1	1	0	1	0	**9**	**MP**
Monodora angolensis	2	0	1	0	1	0	0	0	0	1	2	0	**7**	**LP**
Monodora myristica	2	0	1	0	1	0	1	1	1	1	2	0	**10**	**MP**
Monothecium aristatum	4	0	1	0	0	0	0	0	0	0	1	0	**6**	**LP**
Morinda morindoides	3	0	0	2	1	0	1	0	0	1	2	0	**10**	**MP**
Morus mesozygia	2	0	0	0	2	0	1	1	1	2	2	0	**11**	**MP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Mukia maderaspatana	1	0	0	0	0	0	1	1	0	0	2	0	**5**	**NP**
Murdannia cf. simplex	1	0	0	0	0	0	0	1	0	0	1	0	**3**	**NP**
Mussaenda arcuata	2	0	0	0	1	0	1	1	0	1	2	0	**8**	**LP**
Mussaenda erythrophylla	0	0	0	-1	1	0	1	0	0	0	2	0	**3**	**NP**
Mussaenda microdonta	4	0	0	-1	1	0	0	0	0	1	2	0	**7**	**LP**
Myrianthus arboreus	3	0	0	0	1	0	1	1	1	1	2	0	**10**	**MP**
Neoboutonia macrocalyx	4	0	0	0	1	0	1	0	0	1	0	0	**7**	**LP**
Nephrolepis undulata	1	0	0	0	0	0	1	0	1	0	0	0	**3**	**NP**
Nervilia bicarinata	2	0	3	0	0	0	0	0	0	0	0	0	**5**	**NP**
Nervilia cf. fuerstenbergiana	3	0	1	0	0	0	0	0	0	0	0	0	**4**	**NP**
Nervilia kotschyi	2	0	3	0	0	0	0	0	0	0	0	0	**5**	**NP**
Nervilia petraea	2	0	3	1	0	0	0	0	0	0	0	0	**6**	**LP**
Nervilia sp. 1	NA	0	3	0	0	0	0	0	0	0	0	0	**3**	**NP**
Nervilia sp. 2	NA	0	3	0	0	0	0	0	0	0	0	0	**3**	**NP**
Nervilia subintegra	3	0	2	0	0	0	0	0	0	0	0	0	**5**	**NP**
Ochna bracteosa	3	0	1	0	1	0	0	0	0	1	2	0	**8**	**LP**
Ochna insculpta	4	0	2	1	1	0	0	0	0	1	2	0	**11**	**MP**
Ochna membranacea	2	0	1	1	1	0	0	0	0	1	2	0	**8**	**LP**
Ochna sp.	NA	0	2	1	1	0	0	0	0	1	2	0	**7**	**LP**
Oeceoclades maculata	0	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Oeceoclades saundersiana	2	0	2	1	0	0	0	0	0	0	1	0	**6**	**LP**
Oeceoclades sp.	NA	0	3	1	0	0	0	0	0	0	1	0	**5**	**NP**
Oeceoclades ugandae	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Olax subscorpioidea	3	0	3	2	1	0	1	1	1	1	2	0	**15**	**HP**
Oldenlandia cf. *goreensis*	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Oldenlandia sp.	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Olea capensis	4	0	1	0	2	1	1	0	0	2	2	0	**13**	**PR**
Olea welwitschii	2	0	3	1	2	0	0	0	0	2	2	0	**12**	**PR**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Olyra latifolia	0	0	0	0	0	0	1	0	1	0	0	0	**2**	**NP**
Oncinotis tenuiloba	4	0	0	0	1	0	0	0	0	0	1	0	**6**	**LP**
Oncoba schweinfurthii	3	0	2	0	1	0	0	0	0	1	2	0	**9**	**MP**
Oncoba spinosa	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Oplismenus hirtellus	0	0	0	0	0	0	0	1	0	0	0	0	**1**	**NP**
Orchidaceae Gen. sp. 01	NA	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Orchidaceae Gen. sp. 02	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. sp. 03	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. sp. 04	NA	0	2	2	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. sp. 05	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Orchidaceae Gen. sp. 06	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Orchidaceae Gen. sp. 07	NA	0	3	0	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. sp. 08	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Orchidaceae Gen. sp. 09	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Orchidaceae Gen. sp. 10	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Orchidaceae Gen. sp. 11	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. Sp. 12	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. sp. 13	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. sp. 14	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. sp. 15	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. Sp. 16	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. Sp. 17	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Orchidaceae Gen. sp. 18	NA	0	0	1	0	0	0	0	0	0	0	0	**1**	**NP**
Orchidaceae Gen. sp. 19	NA	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Orchidaceae Gen. sp. 20	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. sp. 21	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Orchidaceae Gen. sp. 22	NA	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Orchidaceae Gen. sp. 23	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Oreosyce africana	1	0	1	0	0	0	1	0	0	0	2	0	**5**	**NP**
Ouratea sp.	NA	0	3	1	1	0	0	0	0	1	2	0	**8**	**LP**
Oxalis cf. *latifolia*	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Oxyanthus lepidus	3	0	3	1	1	0	0	0	0	1	2	0	**11**	**MP**
Oxyanthus speciosus	4	0	2	0	1	0	1	1	1	1	2	0	**13**	**PR**
Palisota ambigua	3	0	1	0	0	0	1	0	1	0	2	0	**8**	**LP**
Palisota schweinfurthii	2	0	0	0	0	0	1	0	0	0	2	0	**5**	**NP**
Pancovia harmsiana	3	0	0	0	1	0	0	0	1	1	2	0	**8**	**LP**
Panicum maximum	0	0	0	-1	0	0	1	1	1	0	0	0	**2**	**NP**
Paracostus englerianus	3	0	0	0	0	0	1	0	0	0	2	0	**6**	**LP**
Parinari excelsa	2	0	2	1	2	0	1	1	1	2	2	0	**14**	**PR**
Parkia filicoidea	2	0	3	2	2	0	1	0	0	2	1	0	**13**	**PR**
Paspalum scrobiculatum	1	0	0	1	0	0	1	1	0	0	0	0	**4**	**NP**
Paullinia pinnata	0	0	1	0	1	0	1	1	1	0	2	0	**7**	**LP**
Paullinia sp.	NA	0	0	0	1	0	0	0	0	0	2	0	**3**	**NP**
Pavetta molundensis	2	0	0	0	1	0	0	0	0	1	2	0	**6**	**LP**
Pavetta oliveriana	4	0	2	1	1	0	0	0	0	1	2	0	**11**	**MP**
Pavetta sp.	NA	0	0	0	1	0	0	0	0	1	2	0	**4**	**NP**
Pavonia cf. *propinqua*	4	0	0	-1	0	0	0	0	0	0	1	0	**4**	**NP**
Peddiea fischeri	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Peddiea sp.	NA	0	3	1	1	0	0	0	0	1	2	0	**8**	**LP**
Pellaea doniana	2	0	2	0	0	0	0	0	0	0	0	0	**4**	**NP**
Pellaea viridis	1	0	0	1	0	0	0	0	0	0	0	0	**2**	**NP**
Penianthus longifolius	3	0	2	1	1	0	1	0	1	1	2	0	**12**	**PR**
Peperomia abyssinica	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Peperomia fernandopoiana	3	0	1	0	0	0	0	0	0	0	0	0	**4**	**NP**
Peperomia retusa	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Peperomia rotundifolia	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Peperomia stuhlmannii	3	0	0	2	0	0	0	0	0	0	0	0	**5**	**NP**
Peperomia tetraphylla	0	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Periploca linearifolia	4	0	2	1	1	0	1	0	0	0	1	0	**10**	**MP**
Phaulopsis imbricata	2	0	0	0	0	0	1	1	1	0	1	0	**6**	**LP**
Phoenix reclinata	2	0	3	0	1	0	1	1	1	1	2	0	**12**	**PR**
Phragmanthera usuiensis	2	0	0	0	1	0	0	0	0	1	1	0	**5**	**NP**
Phyllanthus fischeri	2	0	2	0	1	0	0	0	0	1	2	0	**8**	**LP**
Phyllanthus muellerianus	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Phyllanthus ovalifolius	2	0	0	0	1	0	0	0	0	1	2	0	**6**	**LP**
Phyllanthus sp.	NA	0	0	-1	1	0	0	0	0	1	2	0	**3**	**NP**
Phymatosorus scolopendria	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Picralima nitida	3	0	3	1	1	0	1	1	1	1	1	0	**13**	**PR**
Pilea johnstonii	4	0	3	0	0	0	0	0	0	0	0	0	**7**	**LP**
Pinus patula	-1	0	0	-1	1	1	0	0	0	1	0	0	**1**	**NP**
Piper capense	2	0	0	0	0	0	1	1	0	0	1	0	**5**	**NP**
Piper guineense	2	0	0	0	1	0	1	1	0	0	1	0	**6**	**LP**
Piper umbellatum	0	0	1	0	0	0	1	1	0	0	1	0	**4**	**NP**
Piptadeniastrum africanum	2	0	2	1	1	1	1	0	1	1	1	0	**11**	**MP**
Pisonia aculeata	0	0	0	0	1	0	1	0	1	0	1	0	**4**	**NP**
Pittosporum mannii	2	0	2	0	1	0	1	0	1	1	2	0	**10**	**MP**
Pittosporum viridiflorum	1	0	2	0	1	0	1	0	0	1	2	0	**8**	**LP**
Platostoma rotundifolium	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**
Platycerium angolense	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Pleopeltis macrocarpa	0	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Pneumatopteris unita	2	0	3	2	0	0	0	0	0	0	0	0	**7**	**LP**
Poaceae Gen. sp. 1	NA	0	0	1	0	0	0	0	0	0	0	0	**1**	**NP**
Poaceae Gen. sp. 2	NA	0	0	1	0	0	0	0	0	0	0	0	**1**	**NP**
Poaceae Gen. sp. 3	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Podangis dactyloceras	3	0	2	2	0	0	1	0	0	0	0	0	**8**	**LP**
Pollia condensata	3	0	0	0	0	0	1	0	0	0	2	0	**6**	**LP**
Polyscias fulva	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Polyspatha hirsuta	3	0	3	1	0	0	0	0	0	0	1	0	**8**	**LP**
Polystachya adansoniae	2	0	0	1	0	0	0	0	1	0	0	0	**4**	**NP**
Polystachya bennettiana	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Polystachya cf. *bicarinata*	3	0	3	2	0	0	0	0	0	0	0	0	**8**	**LP**
Polystachya cf. *caloglossa*	3	0	2	0	0	0	0	0	0	0	0	0	**5**	**NP**
Polystachya cf. *cultriformis*	2	0	3	1	0	0	1	0	0	0	0	0	**7**	**LP**
Polystachya cf. *fallax*	3	0	2	1	0	0	0	0	0	0	0	0	**6**	**LP**
Polystachya cf. *lindblomii*	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Polystachya cf. *odorata*	3	0	3	1	0	0	0	0	0	0	0	0	**7**	**LP**
Polystachya galeata	3	0	2	0	0	0	0	0	0	0	0	0	**5**	**NP**
Polystachya mauritiana s.l.	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Polystachya modesta s.l.	3	0	1	1	0	0	0	0	0	0	0	0	**5**	**NP**
Polystachya sp. 1	NA	0	1	1	0	0	0	0	0	0	0	0	**2**	**NP**
Polystachya sp. 2	NA	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Polystachya sp. 3	NA	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Polystachya sp. 4	NA	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Polystachya sp. 5	NA	0	2	1	0	0	0	0	0	0	0	0	**3**	**NP**
Polystachya sp. 6	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Polystachya sp. 7	NA	0	3	0	0	0	0	0	0	0	0	0	**3**	**NP**
Polystachya sp. 8	NA	0	3	1	0	0	0	0	0	0	0	0	**4**	**NP**
Polystachya tenuissima	3	0	2	0	0	0	0	0	1	0	0	0	**6**	**LP**
Pouteria altissima	3	0	0	0	2	1	0	0	1	2	2	0	**11**	**MP**
Premna angolensis	3	0	2	1	1	0	1	0	1	1	2	0	**12**	**PR**
Procris crenata	1	0	3	2	0	0	0	0	0	0	1	0	**7**	**LP**
Protea madiensis	2	0	0	0	1	0	1	1	1	1	1	0	**8**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Prunus africana	2	2	1	0	2	0	1	1	1	2	2	0	**14**	**PR**
Pseuderanthemum ludovicianum	3	0	0	0	0	0	1	1	1	0	1	0	**7**	**LP**
Pseudospondias microcarpa	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Psidium guajava	-1	0	1	0	1	0	1	1	1	1	2	0	**7**	**LP**
Psophocarpus lancifolius	2	0	0	0	0	0	0	1	0	0	1	0	**4**	**NP**
Psychotria mahonii	4	0	0	0	0	0	0	0	0	0	2	0	**6**	**LP**
Psychotria peduncularis	2	0	2	0	0	0	1	0	0	0	2	0	**7**	**LP**
Psychotria sp.	4	0	0	0	0	0	1	0	0	0	2	0	**7**	**LP**
Pteris atrovirens	3	0	0	0	0	0	1	0	0	0	0	0	**4**	**NP**
Pteris buchananii	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Pteris burtonii	3	0	0	0	0	0	0	0	0	0	0	0	**3**	**NP**
Pteris catoptera	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**NP**
Pteris hamulosa	2	0	3	2	0	0	0	0	0	0	0	0	**7**	**LP**
Pteris preussii	4	0	0	0	0	0	0	0	0	0	0	0	**4**	**NP**
Pteris pteridioides	2	0	2	0	0	0	0	0	0	0	0	0	**4**	**NP**
Pteris tripartita	0	0	3	2	0	0	0	0	0	0	0	0	**5**	**NP**
Pterygota mildbraedii	4	0	2	1	2	0	0	0	0	2	2	0	**13**	**PR**
Pupalia lappacea	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**NP**
Pycnanthus angolensis	4	0	2	1	2	0	1	1	1	2	2	0	**16**	**HP**
Pycnostachys cf. *coerulea*	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Pycreus cf. *niger*	-1	0	0	0	0	0	0	0	0	0	0	0	**-1**	**NP**
Pycreus flavescens	0	0	0	-1	0	0	0	0	0	0	0	0	**-1**	**NP**
Pyrenacantha cf. *vogeliana*	3	0	3	2	0	0	0	0	1	0	2	0	**11**	**MP**
Pyrenacantha sylvestris	3	0	0	0	0	0	0	0	0	0	2	0	**5**	**NP**
Pyrrosia mechowii	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Raphia farinifera	2	0	2	1	1	0	0	0	1	1	2	0	**10**	**MP**
Rauvolfia caffra	2	0	0	1	1	0	1	0	1	1	2	0	**9**	**MP**
Rawsonia lucida	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Renealmia engleri	4	0	0	1	0	0	0	1	0	0	2	0	**8**	**LP**
Renealmia sp. nov.	4	0	0	1	0	0	0	1	0	0	2	0	**8**	**LP**
Rhamnus cf. *staddo*	2	0	0	-1	1	0	0	0	0	1	2	0	**5**	**NP**
Rhamnus prinoides	2	0	2	0	1	0	1	1	1	1	2	0	**11**	**MP**
Rhaphidophora africana	3	0	2	2	1	0	1	0	0	0	0	0	**9**	**MP**
Rhipidoglossum rutilum	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Rhipidoglossum sp. 01	NA	0	2	1	0	0	0	0	0	0	1	0	**4**	**NP**
Rhipidoglossum sp. 02	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Rhipidoglossum sp. 03	NA	0	2	0	0	0	0	0	0	0	1	0	**3**	**NP**
Rhipidoglossum sp. 04	NA	0	2	2	0	0	0	0	0	0	1	0	**5**	**NP**
Rhipidoglossum sp. 05	NA	0	1	1	0	0	0	0	0	0	1	0	**3**	**NP**
Rhipidoglossum sp. 06	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Rhipidoglossum sp. 07	NA	0	2	1	0	0	0	0	0	0	1	0	**4**	**NP**
Rhipidoglossum sp. 08	NA	0	3	2	0	0	0	0	0	0	1	0	**6**	**LP**
Rhipidoglossum sp. 09	NA	0	2	1	0	0	0	0	0	0	1	0	**4**	**NP**
Rhipidoglossum sp. 10	NA	0	3	1	0	0	0	0	0	0	1	0	**5**	**NP**
Rhipidoglossum sp. 11	NA	0	3	1	0	0	0	0	0	0	1	0	**5**	**NP**
Rhipidoglossum subsimplex	4	0	3	0	0	0	0	0	0	0	1	0	**8**	**LP**
Rhipsalis baccifera	2	0	0	0	0	0	0	0	0	0	2	0	**4**	**NP**
Rhoicissus tridentata	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Rhus natalensis	2	0	0	0	1	0	1	1	1	1	2	0	**9**	**MP**
Rhynchosia hirta	2	0	0	0	0	0	1	1	1	0	1	0	**6**	**LP**
Rhynchosia orthobotrya	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Rhynchospora corymbosa	0	0	0	-1	0	0	1	0	1	0	0	0	**1**	**NP**
Ricinodendron heudelotii	3	0	2	1	2	0	1	0	1	2	2	0	**14**	**PR**
Ricinus communis	2	0	0	-1	0	0	1	0	0	0	1	0	**3**	**NP**
Rinorea angustifolia subsp. *ardisiiflora*	3	0	0	0	1	0	0	0	1	1	1	0	**7**	**LP**
Rinorea brachypetala	3	0	0	0	1	0	0	0	1	1	1	0	**7**	**LP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Rinorea dentata	2	0	1	0	1	0	1	0	0	1	1	0	**7**	**LP**
Rinorea ilicifolia	2	0	2	1	1	0	1	0	1	1	1	0	**10**	**MP**
Rinorea oblongifolia	2	0	3	2	1	0	0	0	0	1	1	0	**10**	**MP**
Ritchiea albersii	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**
Rothmannia longiflora	3	0	3	1	1	0	1	0	1	1	2	0	**13**	**PR**
Rothmannia urcelliformis	2	0	1	0	1	0	1	0	1	1	2	0	**9**	**MP**
Rothmannia whitfieldii	3	0	3	1	1	0	1	1	1	1	2	0	**14**	**PR**
Rubiaceae Gen. sp.	NA	0	3	2	0	0	0	0	0	0	1	0	**6**	**LP**
Rubus apetalus	2	0	0	-1	1	0	0	1	0	1	2	0	**6**	**LP**
Rubus scheffleri	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**
Rubus steudneri	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**
Rutidea fuscescens	4	0	0	0	1	0	0	0	0	0	2	0	**7**	**LP**
Rutidea orientalis	4	0	0	0	1	0	0	0	0	0	2	0	**7**	**LP**
Rutidea smithii	4	0	0	0	0	0	1	0	1	0	2	0	**8**	**LP**
Rytigynia acuminatissima	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**
Rytigynia neglecta	2	0	3	0	1	0	0	0	0	1	2	0	**9**	**MP**
Rytigynia verruculosa	3	0	2	1	1	0	0	0	0	1	2	0	**10**	**MP**
Saba comorensis	2	0	0	0	1	0	1	1	1	0	2	0	**8**	**LP**
Salacia cerasifera	3	0	0	0	1	0	0	0	1	0	2	0	**7**	**LP**
Sanicula elata	1	0	2	0	0	0	1	0	0	0	1	0	**5**	**NP**
Scadoxus cinnabarinus	3	0	0	2	0	0	1	0	1	0	2	0	**9**	**MP**
Schefflera goetzenii	4	0	2	2	1	0	0	0	0	1	1	0	**11**	**MP**
Schrebera arborea	4	0	3	1	2	1	0	0	1	2	1	0	**15**	**HP**
Scleria distans	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**NP**
Scoliosorus mannianus	2	0	2	1	0	0	0	0	0	0	0	0	**5**	**NP**
Scutia myrtina	1	0	0	0	1	0	1	1	0	0	2	0	**6**	**LP**
Secamone stuhlmannii	4	0	0	0	0	0	0	0	0	0	1	0	**5**	**NP**
Securidaca welwitschii	2	0	0	0	0	0	1	0	0	0	1	0	**4**	**NP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Selaginella versicolor	3	0	0	2	0	0	0	0	0	0	0	0	**5**	**NP**
Senecio syringifolius	4	0	2	0	0	0	0	0	0	0	1	0	**7**	**LP**
Senna didymobotrya	2	0	0	-1	1	0	1	0	0	1	1	0	**5**	**NP**
Senna spectabilis	-1	0	0	-1	1	0	1	1	1	1	1	0	**4**	**NP**
Sericostachys scandens	2	0	1	0	0	0	1	1	0	0	0	0	**5**	**NP**
Setaria longiseta	2	0	0	0	0	0	1	1	0	0	0	0	**4**	**NP**
Setaria megaphylla	0	0	1	1	0	0	1	0	1	0	1	0	**5**	**NP**
Shirakiopsis elliptica	2	0	2	0	1	0	0	0	1	1	1	0	**8**	**LP**
Sida sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Sida tenuicarpa	4	0	0	-1	1	0	1	0	0	1	1	0	**7**	**LP**
Siphonochilus aethiopicus	2	0	3	1	0	0	1	1	0	0	1	0	**9**	**MP**
Smilax anceps	2	0	0	0	1	0	1	1	1	0	2	0	**8**	**LP**
Smilax aspera	0	0	3	1	1	0	0	0	0	0	2	0	**7**	**LP**
Smilax kraussiana	1	0	0	1	1	0	0	0	0	0	2	0	**5**	**NP**
Solanecio mannii	2	0	0	1	1	0	1	0	1	1	2	0	**9**	**MP**
Solanum cf. *aculeastrum*	2	0	0	-1	1	0	1	1	0	1	2	0	**7**	**LP**
Solanum incanum	1	0	0	1	1	0	1	0	0	1	2	0	**7**	**LP**
Solanum mauritianum	-1	0	0	0	1	0	1	0	1	1	2	0	**5**	**NP**
Solanum terminale	2	0	0	0	0	0	1	0	0	0	2	0	**5**	**NP**
Spathodea campanulata	0	0	0	-1	1	0	1	1	1	1	1	0	**5**	**NP**
Spermacoce sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Sphaeranthus suaveolens	2	0	0	-1	0	0	0	0	0	0	1	0	**2**	**NP**
Spilanthes mauritiana	4	0	0	-1	0	0	0	0	0	0	1	0	**4**	**NP**
Stanfieldiella imperforata	4	0	2	2	0	0	1	0	0	0	1	0	**10**	**MP**
Staudtia kamerunensis var. *gabonensis*	3	0	2	1	2	1	1	0	1	2	2	0	**15**	**HP**
Steganotaenia araliacea	2	0	0	-1	1	0	0	0	0	1	1	0	**4**	**NP**
Stephania abyssinica	2	0	0	0	0	0	1	0	0	0	2	0	**5**	**NP**
Stephania cyanantha	2	0	0	0	0	0	0	0	0	0	2	0	**4**	**NP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Sterculia dawei	2	0	0	0	1	0	0	0	0	1	2	0	**6**	**LP**
Stolzia repens	2	0	2	1	0	0	0	0	0	0	0	0	**5**	**NP**
Striga asiatica	1	0	0	0	0	0	1	1	1	0	1	0	**5**	**NP**
Striga elegans	2	0	0	0	0	0	0	0	0	0	1	0	**3**	**NP**
Strombosia scheffleri	4	0	1	0	2	1	0	0	1	2	2	0	**13**	**PR**
Strophanthus preussii	2	0	0	0	1	0	1	1	1	0	1	0	**7**	**LP**
Strychnos scheffleri	3	0	2	2	1	0	0	0	0	0	2	0	**10**	**MP**
Strychnos spinosa	2	0	3	1	1	0	1	1	1	1	2	0	**13**	**PR**
Strychnos usambarensis	4	0	0	0	1	0	1	0	0	1	2	0	**9**	**MP**
Suregada procera	4	0	2	1	1	0	0	0	0	1	0	0	**9**	**MP**
Synsepalum cerasiferum	3	0	2	1	2	0	0	0	0	2	2	0	**12**	**PR**
Syzygium guineense	2	0	2	0	1	1	1	1	1	1	2	0	**12**	**PR**
Tabernaemontana stapfiana	4	0	0	0	1	0	1	0	0	1	2	0	**9**	**MP**
Tabernaemontana ventricosa	2	0	0	1	1	0	1	0	1	1	1	0	**8**	**LP**
Tagetes minuta	-1	0	0	-1	0	0	0	0	0	0	1	0	**-1**	**NP**
Tapura fischeri	4	0	0	0	1	0	0	0	1	1	2	0	**9**	**MP**
Tarenna pavettoides	4	0	1	0	1	0	1	0	0	1	2	0	**10**	**MP**
Tectaria angelicifolia	3	0	2	1	0	0	0	0	0	0	0	0	**6**	**LP**
Tectaria gemmifera	2	0	1	0	0	0	0	0	0	0	1	0	**4**	**NP**
Telfairia occidentalis	3	0	3	1	0	0	0	0	0	0	2	0	**9**	**MP**
Tetracera potatoria	3	0	0	0	1	0	1	1	0	0	1	0	**7**	**LP**
Tetrapleura tetraptera	3	0	1	0	1	0	1	0	1	1	2	0	**10**	**MP**
Tetrorchidium didymostemon	3	0	0	1	1	0	1	0	1	1	0	0	**8**	**LP**
Thalia geniculata	3	0	0	2	0	0	1	0	1	0	2	0	**9**	**MP**
Thalictrum rhynchocarpum	2	0	3	1	0	0	1	0	0	0	1	0	**8**	**LP**
Thecacoris lucida	3	0	1	1	1	0	0	0	0	1	2	0	**9**	**MP**
Thonningia sanguinea	2	0	2	1	0	0	1	1	0	0	1	0	**8**	**LP**
Thunbergia alata	2	0	0	0	0	0	1	1	1	0	1	0	**6**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Thunbergia fasciculata	3	0	0	0	0	0	0	0	0	0	1	0	**4**	**NP**
Thunbergia gregorii	4	0	0	1	0	0	0	0	0	0	1	0	**6**	**LP**
Thunbergia paulitschkeana	4	0	0	1	0	0	0	0	0	0	1	0	**6**	**LP**
Thunbergia sp.	NA	0	0	-1	0	0	0	0	0	0	1	0	**0**	**NP**
Thunbergia usambarica	2	0	0	1	0	0	0	0	0	0	1	0	**4**	**NP**
Tiliacora funifera	2	0	0	0	1	0	1	0	1	0	2	0	**7**	**LP**
Tinnea aethiopica	2	0	0	0	1	0	1	0	1	1	1	0	**7**	**LP**
Tinospora oblongifolia	4	0	2	0	1	0	0	0	0	0	2	0	**9**	**MP**
Tithonia diversifolia	-1	0	0	-1	0	0	0	0	1	0	1	0	**0**	**NP**
Toddalia asiatica	1	0	1	0	0	0	0	0	0	0	2	0	**4**	**NP**
Trachyphrynium braunianum	3	0	2	0	0	0	1	1	1	0	2	0	**10**	**MP**
Tragia brevipes	2	0	2	1	0	0	0	0	0	0	0	0	**5**	**NP**
Tragia cf. *insuavis*	4	0	0	-1	0	0	0	0	0	0	0	0	**3**	**NP**
Treculia africana	1	0	3	2	2	0	0	1	0	2	1	0	**12**	**PR**
Trema orientalis	1	0	0	1	1	0	1	0	0	1	2	0	**7**	**LP**
Trichilia emetica	2	0	0	0	1	0	1	0	1	1	2	0	**8**	**LP**
Trichilia prieuriana	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Trichilia rubescens	3	0	0	0	1	0	1	0	0	1	2	0	**8**	**LP**
Trichocladus ellipticus	4	0	3	2	1	0	0	0	0	1	1	0	**12**	**PR**
Triclisia sacleuxii	2	0	2	0	1	0	0	0	0	0	2	0	**7**	**LP**
Tridactyle anthomaniaca	2	0	2	2	0	0	0	0	0	0	0	0	**6**	**LP**
Tridactyle bicaudata	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Tridactyle filifolia	2	0	0	0	0	0	0	0	0	0	0	0	**2**	**NP**
Tridactyle sp. 1	NA	0	2	0	0	0	0	0	0	0	0	0	**2**	**NP**
Tridactyle sp. 2	NA	0	1	2	0	0	0	0	0	0	0	0	**3**	**NP**
Tridactyle sp. 3	NA	0	2	2	0	0	0	0	0	0	0	0	**4**	**NP**
Trilepisium madagascariensis	2	0	0	0	1	0	1	0	0	1	2	0	**7**	**LP**
Trimeria grandifolia	2	0	2	0	1	0	0	0	0	1	2	0	**8**	**LP**

Species	DIS	IUCN	CON	FOR	GRO	USE				ECO			VAL	CAT
						tim	med	foo	ous	hab	fac	obl		
Tristemma mauritianum	2	0	0	0	0	0	1	1	0	0	1	0	**5**	**NP**
Tristicha trifaria	0	0	3	0	0	0	0	0	0	0	0	0	**3**	**NP**
Triumfetta brachyceras	4	0	0	-1	0	0	0	0	1	0	1	0	**5**	**NP**
Triumfetta rhomboidea	0	0	0	0	1	0	1	1	1	1	1	0	**6**	**LP**
Turraea floribunda	4	0	2	1	1	0	1	0	0	1	2	0	**12**	**PR**
Turraea holstii	4	0	2	0	1	0	0	0	0	1	2	0	**10**	**MP**
Turraea robusta	2	0	2	0	1	0	0	0	1	1	2	0	**9**	**MP**
Turraea vogelioides	4	0	1	0	1	0	0	0	0	1	2	0	**9**	**MP**
Uncaria africana	3	0	0	0	1	0	1	0	0	0	1	0	**6**	**LP**
Urena lobata	0	0	0	-1	1	0	1	1	1	1	1	0	**5**	**NP**
Urera cameroonensis	2	0	0	0	1	0	1	1	1	0	1	0	**7**	**LP**
Urera hypselodendron	4	0	0	0	1	0	1	1	0	0	1	0	**8**	**LP**
Utricularia arenaria	1	0	0	0	0	0	0	0	0	0	1	0	**2**	**NP**
Uvariopsis congensis	3	0	0	0	1	0	0	0	0	1	2	0	**7**	**LP**
Vangueria apiculata	4	0	1	0	1	0	0	1	1	1	2	0	**11**	**MP**
Vangueria madagascariensis	2	0	1	0	1	0	0	1	1	1	2	0	**9**	**MP**
Vepris grandifolia	2	0	0	0	1	0	0	0	0	1	2	0	**6**	**LP**
Vepris nobilis	4	0	0	0	1	0	1	0	0	1	2	0	**9**	**MP**
Vernonia amygdalina	2	0	2	0	1	0	1	1	1	1	1	0	**10**	**MP**
Vernonia auriculifera	4	0	0	0	1	0	1	0	1	1	1	0	**9**	**MP**
Vernonia conferta	3	0	3	0	1	0	0	0	0	1	1	1	**10**	**MP**
Vernonia sp.	NA	0	0	0	0	0	0	0	0	0	1	0	**1**	**NP**
Vigna heterophylla	2	0	2	0	0	0	0	1	1	0	1	0	**7**	**LP**
Vigna parkeri	4	0	0	-1	0	0	0	1	0	0	1	0	**5**	**NP**
Vitex ferruginea	2	0	2	0	1	0	0	0	0	1	2	0	**8**	**LP**
Vitex keniensis	4	2	3	0	2	1	0	1	1	2	2	0	**18**	**HP**
Vittaria guineensis	2	0	3	2	0	0	0	0	0	0	0	0	**7**	**LP**
Warneckea jasminoides	4	0	0	0	1	0	0	0	0	1	2	0	**8**	**LP**

Species	**DIS**	**IUCN**	**CON**	**FOR**	**GRO**	**USE**				**ECO**			**VAL**	**CAT**
						tim	**med**	**foo**	**ous**	**hab**	**fac**	**obl**		
Warneckea walikalensis	3	0	1	1	1	0	1	0	0	1	2	0	**10**	**MP**
Whitfieldia elongata	3	0	0	-1	0	0	1	0	1	0	2	0	**6**	**LP**
Xylopia aethiopica	2	0	0	0	1	1	1	0	1	1	2	0	**9**	**MP**
Zanha golungensis	2	0	0	0	2	1	1	0	1	2	2	0	**11**	**MP**
Zanthoxylum gilletii	2	0	2	1	2	1	1	1	1	2	2	0	**15**	**HP**
Zanthoxylum leprieurii	3	0	2	0	1	0	1	1	1	1	1	0	**11**	**MP**
Zehneria scabra	1	0	0	0	0	0	1	0	0	0	2	0	**4**	**NP**
Zehneria sp.	NA	0	0	2	0	0	0	0	0	0	2	0	**4**	**NP**

APPENDIX 4 - PLANT MATERIAL COLLECTED FOR EX-SITU CONSERVATION

List of plant material collected in Kakamega Forest for ex-situ conservation in Maseno Botanic Garden in October – November 2008 and April – May 2009.

	Species	Family	Condition	Origin	Quantity
1	*Acacia montingena*	Fabaceae	seedling	Yala	5
2	*Acalypha neptunica*	Euphorbiaceae	seedling	Isiukhu	3
	Acalypha neptunica	Euphorbiaceae	seedling	Isiukhu	5
3	*Aerangis ugandensis*	Orchidaceae	plant	Kisere	1
4	*Aframomum* sp. nov.	Zingiberaceae	fruits	Isecheno	1
	Aframomum sp. nov.	Zingiberaceae	seedling	Colobos	10
	Aframomum sp. nov.	Zingiberaceae	seedling	Isecheno	2
	Aframomum sp. nov.	Zingiberaceae	seedling	Kisere	5
	Aframomum sp. nov.	Zingiberaceae	seedling	Yala	2
5	*Aframomum zambesiacum*	Zingiberaceae	fruits	Yala	5
	Aframomum zambesiacum	Zingiberaceae	seeds	Canteen	100
6	*Albizia gummifera*	Fabaceae	seedling	Yala	5
7	*Allophylus abyssinicus*	Sapindaceae	seedling	Canteen	5
	Allophylus abyssinicus	Sapindaceae	seedling	Isiukhu	4
8	*Amorphophallus calabaricus*	Araceae	plant	Colobus	1
	Amorphophallus calabaricus	Araceae	plant	Kisere	5
	Amorphophallus calabaricus	Araceae	plant	Kisere	1
	Amorphophallus calabaricus	Araceae	plant	Kisere	1
	Amorphophallus calabaricus	Araceae	plant	Yala	2
9	*Angraecum humile*	Orchidaceae	plant	Isiukhu	2
10	*Antiaris toxicaria*	Moraceae	seedling	Isecheno	3
	Antiaris toxicaria	Moraceae	seeds	Canteen	20
11	*Blighia unijugata*	Sapindaceae	fruits	Isecheno	4
	Blighia unijugata	Sapindaceae	seedling	Kisere	4
	Blighia unijugata	Sapindaceae	seedling	Isecheno	3
	Blighia unijugata	Sapindaceae	seedling	Yala	1
	Blighia unijugata	Sapindaceae	seedling	Colobus	1
12	*Bolusiella iridifolia*	Orchidaceae	plant	Isiukhu	2
13	*Bolusiella maudiae*	Orchidaceae	plant	Isiukhu	4
	Bolusiella maudiae	Orchidaceae	plant	Isiukhu	2
	Bolusiella maudiae	Orchidaceae	plant	Colobus	5
	Bolusiella maudiae	Orchidaceae	plant	Kisere	8
	Bolusiella maudiae	Orchidaceae	plant	Isecheno	21
	Bolusiella maudiae	Orchidaceae	plant	Isecheno	20
	Bolusiella maudiae	Orchidaceae	plant	Isiukhu	9
	Bolusiella maudiae	Orchidaceae	plant	Isiukhu	1
	Bolusiella maudiae	Orchidaceae	plant	Isiukhu	8

	Species	Family	Condition	Origin	Quantity
14	*Bulbophyllum cochleatum* var. *bequaertii*	Orchidaceae	plant	Isecheno	2
	Bulbophyllum cochleatum var. *bequaertii*	Orchidaceae	plant	Isiukhu	1
15	*Bulbophyllum encephalodes*	Orchidaceae	plant	Isiukhu	2
16	*Calanthe sylvatica*	Orchidaceae	plant	Isecheno	5
	Calanthe sylvatica	Orchidaceae	plant	Yala	1
17	*Casearia battiscombei*	Salicaceae	fruits	Isiukhu	6
18	*Cassipourea ruwensorensis*	Rhizophoraceae	seedling	Colobus	1
19	*Celtis africana*	Cannabaceae	seeds	Kisere	13
20	*Celtis gomophophylla*	Cannabeaceae	fruits	Buzambuli	28
	Celtis gomophophylla	Cannabeaceae	fruits	Kisere	7
	Celtis gomophophylla	Cannabaceae	seeds	Kisere	6
	Celtis gomophophylla	Cannabaceae	seeds	Kisere	20
21	*Chamaeangis* cf. *odoratissima*	Orchidaceae	plant	Canteen	1
	Chamaeangis cf. *odoratissima*	Orchidaceae	plant	Buyango	1
	Chamaeangis cf. *odoratissima*	Orchidaceae	plant	Isiukhu	1
	Chamaeangis cf. *odoratissima*	Orchidaceae	plant	Isiukhu	1
22	*Chrysophyllum albidum*	Sapotaceae	seedling	Colobus	3
	Chrysophyllum albidum	Sapotaceae	seeds	Yala	20
	Chrysophyllum albidum	Sapotaceae	seeds	Colobos	40
23	*Clausena anisata*	Rutaceae	seedling	Buyangu	5
	Clausena anisata	Rutaceae	seedling	Canteen	5
24	*Commelina albiflora*	Commelinaceae	plant	Isiukhu	10
25	*Commelina* sp.	Commelinaceae	plant	Yala	5
26	*Connarus longistpitatus*	Connaraceae	fruits	Buyango	11
27	*Cordia abyssinica*	Boraginaceae	seedling	Kisere	5
28	*Craibia brownii*	Fabaceae	seedling	Isiukhu	2
29	*Croton megalocarpus*	Euphorbiaceae	seedling	Isiukhu	10
	Croton megalocarpus	Euphorbiaceae	seedling	Yala	5
	Croton megalocarpus	Euphorbiaceae	seedling	Isecheno	5
	Croton megalocarpus	Euphorbiaceae	seedling	Isiukhu	5
30	*Culcasia falcifolia*	Araceae	seedling	Yala	5
	Culcasia falicifolia	Araceae	fruits	Colobus	20
	Culcasia falicifolia	Araceae	fruits	Isiukhu	20
	Culcasia falicifolia	Araceae	plant	Isiukhu	1
31	*Diospyros abyssinica*	Ebenaceae	seedling	Kisere	5
	Diospyros abyssinica	Ebenaceae	seedling	Yala	5
	Diospyros abyssinica	Ebenaceae	seedling	Colobus	5
32	*Disperis reichenbachiana*	Orchidaceae	plant	Canteen	3
	Disperis reichenbachiana	Orchidaceae	plant	Canteen	1
33	*Dorstenia brownii*	Moraceae	plant	Isecheno	1
34	*Dovyalis macrocalyx*	Salicaceae	seedling	Isecheno	2
35	*Dracaena fragrans*	Ruscaceae	fruits	Colobus	35
	Dracaena fragrans	Agavaceae	seedling	Kisere	5
36	*Dracaena laxissima*	Agavaceae	seedling	Isecheno	5

	Species	Family	Condition	Origin	Quantity
37	*Drypetes gerrardii*	Putranjavaceae	fruits	Yala	16
	Drypetes gerrardii	Putranjavaceae	fruits	Colobos	11
38	*Eckebergia capensis*	Meliaceae	fruits	Isiukhu	290
39	*Englerophytum oblanceolatum*	Sapotaceae	seedling	Kisere	1
	Englerophytum oblanceolatum	Sapotaceae	seedling	Kisere	1
	Englerophytum oblanceolatum	Sapotaceae	seedling	Isecheno	5
	Englerophytum oblanceolatum	Sapotaceae	seedling	Colobus	2
40	*Ficus asperifolia*	Moraceae	seedling	Canteen	5
41	*Gladiolus dalenii*	Iringiaceae	seeds	Isecheno	236
42	*Habenaria malacophylla*	Orchidaceae	plant	Kisere	1
43	*Heinsenia diervilleoides*	Rubiaceae	seedling	Kisere	5
44	*Keetia gueinzii*	Rubiaceae	seedling	Canteen	5
45	*Lepisanthes senegalensis*	Sapindaceae	seedling	Kisere	5
	Lepisanthes senegalensis	Sapindaceae	seedling	Isiukhu	1
46	*Liparis nervosa*	Orchidaceae	plant	Canteen	3
47	*Loeseneriella africana*	Celastraceae	fruits	Isecheno	1
	Loeseneriella africana	Celastraceae	seedling	Isiukhu	4
	Loeseneriella africana	Celastraceae	seeds	Colobus	7
48	*Loxogramme abyssinica*	Polypodiaceae	plant	Colobus	1
49	*Manilkara butugi*	Sapotaceae	seedling	Isiukhu	5
	Manilkara butugi	Sapotaceae	seedling	Isiukhu	5
50	*Markhamia lutea*	Bignoniaceae	seeds	Buyango	5
51	*Microcoelia* sp.	Orchidaceae	plant	Kisere	3
	Microcoelia sp.	Orchidaceae	plant	Kisere	1
	Microcoelia sp.	Orchidaceae	plant	Kisere	1
	Microcoelia sp.	Orchidaceae	plant	Kisere	2
	Microcoelia sp.	Orchidaceae	plant	Yala	4
	Microcoelia sp.	Orchidaceae	plant	Isiukhu	2
	Microcoelia sp.	Orchidaceae	plant	Kisere	1
52	*Mondia whitei*	Apocynaceae	seedling	KEEP-nursery	1
53	*Morus mesozygius*	Moraceae	seedling	Isecheno	1
54	*Mussaenda arcuata*	Rubiaceae	fruits	Salazar	20
55	*Oeceoclades* sp.	Orchidaceae	plant	Isiukhu	3
56	*Olea capensis*	Oleaceae	fruits	Kisere	30
	Olea capensis	Oleaceae	fruits	Isecheno	20
	Olea capensis	Oleaceae	seeds	Kisere	40
57	Orchidaceae Gen. sp.	Orchidaceae	plant	Canteen	1
	Orchidaceae Gen. sp.	Orchidaceae	plant	Kisere	1
58	Orchidaceae Gen. sp. 09	Orchidaceae	plant	Isiukhu	1
59	Orchidaceae Gen. sp. 18	Orchidaceae	plant	Yala	1
60	Orchidaceae Gen. sp. 19	Orchidaceae	plant	Kisere	1
61	Orchidaceae Gen. sp. 20	Orchidaceae	plant	Isecheno	5
	Orchidaceae Gen. sp. 20	Orchidaceae	plant	Kisere	4
	Orchidaceae Gen. sp. 20	Orchidaceae	plant	Kisere	5
62	Orchidaceae Gen. sp. 21	Orchidaceae	plant	Kisere	1

	Species	Family	Condition	Origin	Quantity
63	Orchidaceae Gen. sp. 22	Orchidaceae	plant	Canteen	5
64	Orchidaceae Gen. sp. 24	Orchidaceae	plant	Yala	4
	Orchidaceae Gen. sp. 24	Orchidaceae	plant	Isecheno	1
	Orchidaceae Gen. sp. 24	Orchidaceae	plant	Isecheno	1
	Orchidaceae Gen. sp. 24	Orchidaceae	plant	Isecheno	1
	Orchidaceae Gen. sp. 24	Orchidaceae	plant	Yala	1
65	Orchidaceae Gen. sp. 25	Orchidaceae	plant	Isiukhu	2
	Orchidaceae Gen. Sp. 25	Orchidaceae	plant	Yala	1
66	*Peperomia abyssinica*	Piperaceae	plant	Yala	2
67	*Peperomia retusa*	Piperaceae	plant	Yala	2
	Peperomia retusa	Piperaceae	plant	Colobus	1
68	*Peperomia tetraphylla*	Piperaceae	plant	Isiukhu	1
69	*Phoenix reclinata*	Arecaceae	seeds	Isiukhu	80
70	*Piper capensis*	Piperaceae	plant	Canteen	5
71	*Piper guineense*	Piperaceae	fruits	Isiukhu	80
	Piper guineense	Piperaceae	fruits	Isecheno	100
	Piper guineesne	Piperaceae	seeds	Isecheno	40
72	*Pisonia aculeata*	Nyctaginaceae	seedling	Isiukhu	5
73	*Polystachya adansoniae*	Orchidaceae	plant	Isecheno	2
	Polystachya adansoniae	Orchidaceae	plant	Isiukhu	3
	Polystachya adansoniae	Orchidaceae	plant	Kisere	1
74	*Polystachya* cf. *bicarinata*	Orchidaceae	plant	Isiukhu	1
75	*Polystachya* cf. *cultriformis*	Orchidaceae	plant	Yala	2
76	*Polystachya* cf. *lindblomii*	Orchidaceae	plant	Isiukhu	1
	Polystachya cf. *lindblomii*	Orchidaceae	plant	Isiukhu	1
	Polystachya cf. *lindblomii*	Orchidaceae	plant	Isiukhu	1
	Polystachya cf. *lindblomii*	Orchidaceae	plant	Buzambuli	1
77	*Polystachya* sp. 1	Orchidaceae	plant	Salazar	2
	Polystachya sp. 1	Orchidaceae	plant	Salazar	2
	Polystachya sp. 1	Orchidaceae	plant	Canteen	3
78	*Polystachya* sp. 2	Orchidaceae	plant	Isiukhu	1
	Polystachya sp. 2	Orchidaceae	plant	Yala	1
	Polystachya sp. 2	Orchidaceae	plant	Isecheno	1
	Polystachya sp. 2	Orchidaceae	plant	Isecheno	1
	Polystachya sp. 2	Orchidaceae	plant	Yala	1
79	*Polystachya tenuissima*	Orchidaceae	plant	Yala	2
	Polystachya tenuissima	Orchidaceae	plant	Isecheno	2
	Polystachya tenuissima	Orchidaceae	plant	Yala	1
	Polystachya tenuissima	Orchidaceae	plant	Isiukhu	4
	Polystachya tenuissima	Orchidaceae	plant	Isiukhu	1
80	*Pouteria altissima*	Sapotaceae	seedling	Kisere	5
81	*Prunus africana*	Rosaceae	fruits	Yala	20
	Prunus africana	Rosaceae	seedling	Kisere	5
	Prunus africana	Rosaceae	seeds	Isecheno	7
82	*Psychotria mahonii*	Rubiaceae	seedling	Canteen	5
83	*Pyrrosia mechowii*	Polypodiaceae	plant	Isiukhu	1

	Species	Family	Condition	Origin	Quantity
	Pyrrosia mechowii	Polypodiaceae	plant	Colobus	1
84	*Rawsonia lucida*	Acharicaceae	fruits	Kisere	30
	Rawsonia lucida	Acharicaceae	seedling	Colobus	2
	Rawsonia lucida	Acharicaceae	seedling	Isiukhu	4
85	*Renealmia engleri*	Zingiberaceae	seedling	Isecheno	5
86	*Rhipidoglossum* sp. 02	Orchidaceae	plant	Isiukhu	4
	Rhipidoglossum sp. 02	Orchidaceae	plant	Isecheno	1
	Rhipidoglossum sp. 02	Orchidaceae	plant	Isiukhu	2
87	*Rhipidoglossum* sp. 03	Orchidaceae	plant	Isecheno	4
	Rhipidoglossum sp. 03	Orchidaceae	plant	Isiukhu	2
	Rhipidoglossum sp. 03	Orchidaceae	plant	Isiukhu	3
88	*Rhipidoglossum* sp. 10	Orchidaceae	plant	Kisere	1
	Rhipidoglossum sp. 10	Orchidaceae	plant	Yala	3
89	*Rhipsalis baccifera*	Cactaceae	fruits	Salazar	10
	Rhipsalis baccifera	Cactaceae	plant	Salazar	1
	Rhipsalis baccifera	Cactaceae	plant	Isiukhu	2
	Rhipsalis baccifera	Cactaceae	plant	Isiukhu	1
90	*Rinorea brachypetala*	Violaceae	fruits	Isiukhu	6
	Rinorea brachypetala	Violaceae	fruits	Kisere	6
	Rinorea brachypetala	Violaceae	seedling	Isiukhu	5
	Rinorea brachypetala	Violaceae	seedling	Isecheno	5
	Rinorea brachypetala	Violaceae	seedling	Isiukhu	5
	Rinorea brachypetala	Violaceae	seedling	Isiukhu	5
	Rinorea brachypetala	Violaceae	seeds	Isiukhu	5
91	*Rothmannia longiflora*	Rubiaceae	fruits	Isiukhu	1
92	*Stolzia repens*	Orchidaceae	plant	Isiukhu	1
	Stolzia repens	Orchidaceae	plant	Isiukhu	1
	Stolzia repens	Orchidaceae	plant	Colobus	1
	Stolzia repens	Orchidaceae	plant	Buzambuli	1
	Stolzia repens	Orchidaceae	plant	Yala	1
	Stolzia repens	Orchidaceae	plant	Isecheno	1
	Stolzia repens	Orchidaceae	plant	Isiukhu	2
93	*Strychnos usambarensis*	Loganiaceae	fruits	Kisere	17
	Strychnos usambarensis	Loganiaceae	seedling	Kisere	5
	Strychnos usambarensis	Loganiaceae	seedling	Kisere	5
	Strychnos usambarensis	Loganiaceae	seedling	Kisere	3
	Strychnos usambarensis	Loganiaceae	seedling	Colobus	3
	Strychnos usambarensis	Loganiaceae	seedling	Colobus	3
	Strychnos usambarensis	Loganiaceae	seedling	Isiukhu	5
	Strychnos usambarensis	Loganiaceae	seeds	Kisere	20
	Strychnos usambarensis	Loganiaceae	seeds	Isecheno	6
	Strychnos usambarensis	Loganiaceae	seeds	Colobus	5
94	*Suregada procera*	Euphorbiaceae	fruits	Yala	3
95	*Trichilia emetica*	Meliaceae	fruits	Buzambuli	2
	Trichilia emetica	Meliaceae	fruits	Kisere	1
	Trichilia emetica	Meliaceae	seedling	Kisere	5

	Species	Family	Condition	Origin	Quantity
96	*Tridactyla filifolia*	Orchidaceae	plant	Isecheno	2
97	*Trilepiseum madagascariensis*	Moraceae	seedling	Isecheno	2
	Trilepiseum madagascariensis	Moraceae	seedling	Colobus	5
	Trilepiseum madagascariensis	Moraceae	seedling	Colobus	4
98	*Uvariopsis congensis*	Annonaceae	seedling	Kisere	5
	Uvariopsis congensis	Annonaceae	seedling	Kisere	5
	Uvariopsis congensis	Annonaceae	seedling	Kisere	4
	Uvariopsis congensis	Annonaceae	seedling	Kisere	3
99	*Vepris nobilis*	Rutaceae	seedling	Isecheno	5
	Vepris nobilis	Rutaceae	seedling	Yala	3
	Vepris nobilis	Rutaceae	seedling	Isiukhu	5
	Vepris nobilis	Rutaceae	seeds	Isecheno	30
100	*Vernonia conferta*	Asteraceae	seedling	Yala	5
101	*Zanthoxylum gilletii*	Rutaceae	seeds	Isecheno	500

List of orchids collected in Kakamega Forest for ex-situ conservation collection in the Botanic Garden of the National Museums of Kenya (Nairobi) in April – May 2009.

	Species	Origin	Quantity
1	*Angraecum humile*	Isiukhu	2
2	*Bolusiella maudiae*	Isiukhu	16
3	*Bulbophyllum cochleatum* var. *bequaertii*	Isiukhu	1
4	*Bulbophyllum encephalodes*	Isiukhu	4
5	*Chamaeangis cf. odoratissima*	Canteen	1
6	Orchidaceae Gen. sp. 6	Yala	2
7	*Polystachya adansoniae*	Kisere	1
8	*Polystachya* cf. *bicarinata*	Isiukhu	1
9	*Polystachya* cf. *lindblomii*	Isiukhu	2
10	*Polystachya* sp. 1	Salazar	2
11	*Polystachya* sp. 2	Isecheno	2
12	*Polystachya tenuissima*	Salazar	3
13	*Rhipidoglossum* sp. 2	Isiukhu	2
14	*Rhipidoglossum* sp. 3	Isiukhu	1
15	*Stolzia repens*	Isecheno	1
	Stolzia repens	Yala	1
16	*Tridactyla filifolia*	Isecheno	2

List of orchids collected in Budongo Forest (Uganda) for ex-situ conservation collection in the orchid house of the Makerere University (Kampala, Uganda) in October – December 2009.

	Species	Origin	Quantity
1	*Angraecum* sp.	Sonso area	1
2	*Ansellia* sp.	Sonso area	1
3	*Bolusiella iridifolia*	Sonso area	2
4	*Bolusiella maudiae*	Sonso area	3
5	*Bulbophyllum scaberulum*	Sonso area	4
6	*Bulbophyllum* sp. 1	Sonso area	3
7	*Calyptrochilum christyanum*	Sonso area	4
8	*Chamaeangis sarcophylla*	Sonso area	1
9	*Cyrtorchis* sp. 1	Sonso area	1
10	*Diaphananthe bidens*	Sonso area	1
	Diaphananthe bidens	Sonso area	2
11	*Diaphananthe* cf. *pellucida*	Sonso area	1
12	*Diaphananthe sp.*	Sonso area	3
13	*Microcoelia microglossa*	Sonso area	4
14	Orchidaceae Gen. sp. 04	Sonso area	1
15	Orchidaceae Gen. sp. 07	Sonso area	1
16	Orchidaceae Gen. sp. 20	Sonso area	1
17	Orchidaceae Gen. sp. 23	Sonso area	1
18	Orchidaceae Gen. sp. 24	Sonso area	1
19	*Podangis dactyloceras*	Sonso area	6
20	*Polystachya* sp. 5	Sonso area	3
21	*Polystachya* sp. 6	Sonso area	1
22	*Polystachya* sp. 8	Sonso area	3
23	*Polystachya tenuissima*	Sonso area	2
24	*Rhiphidoglossum* sp. 4	Sonso area	2
25	*Rhiphidoglossum* sp. 5	Sonso area	1
26	*Rhiphidoglossum* sp. 6	Sonso area	3
27	*Tridactyle filifolia*	Sonso area	2
28	*Tridactyle* sp. 1	Sonso area	1
29	*Tridactyle* sp. 2	Sonso area	1

ERKLÄRUNG

Hiermit erkläre ich,

- dass ich die eingereichte Dissertation selbstständig verfasst habe und alle von mir für die Arbeit genutzten Hilfsmittel in der Arbeit angegeben sowie die Anteile etwaig beteiligter Mitarbeiter sowie anderer Autoren klar gekennzeichnet sind;

- dass ich die Dissertation oder Teile hiervon nicht als Prüfungsarbeit für eine staatliche oder andere wissenschaftliche Prüfung eingereicht habe;

- dass ich die gleiche oder eine andere Abhandlung nicht in einem anderen Fachbereich oder einer anderen wissenschaftlichen Hochschule als Dissertation eingereicht habe.

Koblenz, 29. April 2011 Katja Rembold