



Volume 7(2)

Conservation of Biodiversity in the East African tropical Forest

Conservación de Biodiversidad en el bosque tropical del este de África

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December 2004

Download at: <http://www.lyonia.org/downloadPDF.php?pdfID=2.350.1>

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Abstract

Kakamega forest is one of the remnants of the equatorial guineo rainforest in the Eastern fringes of Africa. It was perhaps cut-off from the Congo region in the early volcanic era when the Great Rift Valley was formed. The forest is known for its diversity of biotic species, and it is home to some of the rare plants in the East African region. It has some of the rare species of, birds, snakes, insects and primates. However, despite the richness in biodiversity the forest has suffered a lot of anthropogenic destruction due to uncontrolled harvest of forest resources. To mitigate on this destruction an effort is currently being made to control the utilization of the forest products. This is only possible through education to the local communities on the better alternative uses of forest resources. The University Botanic Garden, Maseno's mission on conservation for efficient utilization program is aimed at creating cultural awareness and working close to the local communities in Western Kenya in an effort to conserve the Biodiversity of the forest. The *ex situ* approach to the biodiversity conservation in the Eastern African tropical region has began to bear fruits and feedback loop is very encouraging. It is this *ex situ* approach to conservation as compared to the fundamental and natural *in situ* methods that is being investigated in this project. Our preliminary results indicate that although the rate of growth is initially slow in the *ex situ* approach, the species growth tends to increase once they are established. We have also received favorable response from the local communities through provision of some rare wildings of some plants of herbal medicinal value for conservation in the University Botanic Garden. Therefore the contribution of this approach to biodiversity assessment and conservation cannot be over emphasized. Keywords: Conservation, equatorial forest, biodiversity, *ex situ* approach.

Resumen

El bosque de Kakamega representa uno de los remanentes del bosque húmedo Congo-Guineo en la parte este de África. Ha sido separado de la región Congo durante la formación del Rift-Valley. El bosque esta reconocido por su diversidad biológica, y contienen algunas de las plantas mas raras del Este de África. Además tiene especies raras de pájaros, serpientes, insectos y primates. No obstante, sin referencia a esta riqueza, el bosque ha sufrido destrucción grave por impactos antropicos en forma de uso de recursos forestales sin ningún control. Para mitigar la destrucción se trata de controlar ahora el uso de productos forestales. Este solo esta factible basado en educación de las comunidades locales sobre usos alternativas mejores. El Jardín Botánico de la Universidad de Maseno tiene como su misión de conservación educar la población en uso mas eficaz, creyendo una percepción cultural y trabajando muy cerca con las comunidades locales en el Oeste de Kenia en un esfuerzo de conservar la biodiversidad del bosque. Este esfuerzo *ex situ* empezó de tener frutos. Esta metodología de *ex situ* en comparación de esfuerzos *in situ* esta analizado en este articulo. Los resultados preeliminreis indican que el crecimiento esta inicialmente lento en el esfuerzo *ex situ*, pero que el crecimiento de especies nativas incrementa rápidamente cuando han sido establecido. Recibimos respuestas favorables de la comunidades locales en forma de donaciones de cultivos de plantas medicinales raras y importantes para conservación en el Jardín Botánico. No se puede sobre estimar la importancia de esta metodología entonces. Palabras clave: Conservación, bosque ecuatorial, biodiversidad, metodología *ex situ*.

Introduction

Biodiversity is a comprehensive terminology for the degree of nature's variety and it includes both the number and frequency of ecosystems, species and genes in a given assemblage (Beetle 1994). It, thus, embraces species richness and genetic diversity both of which are threatened throughout the world, hence Kakamega Forest. In this forest, there is a lot of species lose and reduction in genetic variability like in many other forests in the world.

Genetic and species loses in Kakamega Forest have been attributed to various factors. Such factors

include physical disturbance, forest excisions to give room for agricultural development or any other alternative form of land-use, and exploitation for food such as game-hunting, fruits & vegetables) amongst others. The rapidly increasing human population in areas adjacent to the forest has immensely contributed to land fragmentation and consequently habitat loss all of which have resulted or contributed to a diminished quality of life of the communities around the forest, hence the concern for this forest, the only one of its kind in Kenya. Impact of the human race on the environment is however not new (Olembo *et al.* 1995; Chweya and Eyzaguirre 1999). Thus humans have modified and changed the natural world hence Kakamega Forest.

In this forest, certain parts or species have so much been affected that natural regeneration alone cannot balance the losses in nature. There is therefore need not only for *in situ* conservation but also for *ex situ* conservation in addition to species enrichment. Further, there is need to evaluate the policies that govern the management of this forest in relation to the continued existence of the forest versus sustainable utilization as is practiced under the Forest Department (FD) - an arm of the Ministry of Environment and Natural Resources (MENR) and, protection against any form of use save for research, education and tourism, as occurs under the section covered by the Kenya Wildlife Services (KWS).

Kenya's Position in Biodiversity Conservation

Kenya has physical and biological resources that are of considerable domestic, international, economic and intrinsic value. It is estimated that the country has 35,000 known species of animals, plants and microorganisms. This wealth is fundamental to Kenya's prosperity in many ways for example as a source of employment and foreign exchange earnings. Life and economy are based on natural resources such as water, rocks and soils. These and their ecosystems are increasingly under pressure from unsustainable use resulting in pollution, erosion and depletion. Biological resources, which are sources of food, medicine, shelter, income and fuel, are only assured if sustainably used (MENR 2000). The level of institutional awareness is encouraging. There is therefore need to educate and raise awareness of the general public on these matters. In order to meet the challenges and requirements of protection, conservation, and management of biodiversity, whilst containing and preventing the loss of biodiversity, the government is already addressing itself to specific management policies and measures, enforce current laws on biodiversity, formulate land use plans/ tenures and develop systems for rehabilitation and restoration (ANONYM 2000).

Kenya has a clear position regarding conservation of biodiversity and is a signatory to the Biodiversity Convention, which the government ratified in 1994. The National Museums was then chosen as the Center for Biodiversity. This same year saw the development of the National Environment Action Plan, NEAP, in response to the Rio Convention, as an attempt to domesticate the AGENDA 21. The NEAP was a strategy document that saw the creation of the Environmental Management and Coordination Act and the passing of a policy on Environment and Development in Sessional Paper Number 6 in 1999 (MENR 2000). The creation of the Kenya National Biodiversity Strategy and Action Plan in the year 2000 and the subsequent establishment of the National Environmental Management Authority, NEMA, in the same year, closely followed this. The Biodiversity document is clear on the establishment of Botanic Gardens as a means of *ex situ* conservation and that each region in the country needs to develop one hence the establishment of the Maseno University Botanical Garden (Onyango *et al.* 2002). There are several forest types in Kenya; the coastal forests are indigenous, have closed canopy and include the Khaya Forests, the Mangrove Forests and Arabuko-Sokoke, world famous for birds and butterflies, as well as forest plantations. The Dryland Forests, also are indigenous, they cover dry areas and have closed canopies restricted to islands at high altitudes. The Mount Kenya Forest Block is the largest continuous indigenous closed canopy forest though it also includes forest plantations. The Western Forests, indigenous, includes Kakamega Forest, which is enriched by contact with the montane forests of the Rift Valley Escarpment and the Mount Elgon Forests (KIFCON 1994). Kakamega forest has been home to many endemic species of both flora and fauna. It was rich in biodiversity up to 1970s when the forest protection policy was enforced according to the law by the Kenya government. However, from 1974 the harvesting of trees for timber and excision of the forest for agriculture shot up due to change in the government policy. This led to part of the forest being destroyed to mine murram for road construction. The effect of this change in protection policy resulted in the destruction of the primary forest and severe losses of biodiversity.

The forest contain, amongst others, 100 rare plant species, 35 bird species and 75 large mammals,

which are forest dependent, and are considered threatened. Forest degradation will therefore lead to disappearance of such species. In Kenya, Forest resources are among the country's most important natural resources and their sustainable management is an integral part of national management. Forests cover only about 2.5 % of the total area in Kenya; of this, indigenous forests cover just over one million hectares while forest plantations cover over 120,000 hectares (Anonym 2000). About 3 Million people in Kenya live within 5 km of forest boundaries and benefit from a whole range of goods and services from the forest. This has resulted in pressure leading to encroachment, excisions, over exploitation and loss of flora and fauna. The government is making efforts to conserve the remaining forests by strengthening management, creating awareness and encouraging the planting of trees on farmlands and public utility areas. This however has been slow. The government has also prepared a National Forestry Master Plan to govern forest management for the next 25 years. Forestry policies and new legislation is being reviewed. Meanwhile, there is joint monitoring of forests by the FD and KWS and efforts to enhance community participation. The objective of the study was to investigate the effect of *ex situ* conservation practices in species establishment. It was also aimed at re-introduction of *ex situ* wildings to the protected parts of the forest for re-afforestation and preservation of species diversity (Myers 2002).

Materials and Methods

Plant materials especially seeds and wildings were collected from the forest and raised in the University Botanic Garden nursery from June 2001. Transects were also established in Kakamega forest to study the rate of debarking of trees with medicinal value. The destruction of trees for charcoal or timber was also recorded. A transect walk was conducted between the Lurambi forest department section to the KWS station on Malava road. This was to record the effect of human activities in the forest. Indigenous vegetables and other traditional food crops were planted in the Botanic garden for the socio-economic impact assessment and evaluation of the most effective use of land. The indigenous knowledge was collected from the communities living around the forest based on their value and use of the forest products for various practices.

Results and Discussion

Causes of losses in biodiversity in Kakamega forest

The main cause of biodiversity loss in Kakamega forest was found to be the rapidly increasing human population at a rate of about 3% per year. This was worsened by the population structure, which had too many forest dependants, and few job opportunities. The result of this was excessive exploitation of species and natural areas for resources (fuel, food, timber and medicine). Politics was also found to determine the forest management strategy. Forestland excision and forest clearing for agriculture and development by both national and international developers have affected the forest regeneration negatively. However, since January 2003 this destructive practice has been halted and some positive effects on forest conservation are being felt at the Kakamega forest (Kokwaro 1993).

Exploitation of forest resources for example, for game (hunting) has resulted in the near extinction of the bush pig, and reduction in numbers of the blue monkey which is eaten by the local people, as well as birds such guinea fowl. Birds whose habitats outside the forest have been encroached upon, like cranes, and plants like *Trichilia emetica*, *Olea capense*, *Zanthoxylum* sp., *Prunus africana*, and *Croton megalocarpus* amongst others which have been heavily targeted for medicine and wood have also been affected and need attention. Fuel and timber extraction, for example, for domestic use, construction, and industry such as paper mills, tea curing and bricks baking have also contributed to over exploitation of this forest. For now, there is a government ban on timber extraction even from the planted forest blocks. Habitat fragmentation / reduction, that is insularization, was also found to contribute to degradation (Bakamwesiga *et al.* 2000). It was clear that the niche of the community bordering the forest was expanding at the expense of the forest resulting in fragmentation, loss of biotic communities in areas bordering edges of the fragments thus created and sometimes species extinctions. It therefore means that the Minimum Critical Size Ecosystem needs to be studied to determine its impact on mortality of species (Martin 1996).

In Kakamega Forest, insularization has resulted not only in reduction in populations but also in

extinctions of species. For example the Kaimosi Blind Snake has no recent records, the bushbuck is on the decline, the leopard was only last spotted in 1991 and so on. It has not been shown whether insularization has resulted in loss to keystone species on which the ecology of other species depends but taxa have been isolated. There are some that are now found in Kisere and not main Buyangu Forest. The fear is that such isolation could lead to faunal collapse and genetic drift, which will not augur well for the forest biodiversity. Based on research findings from on-going work, there is need for awareness campaign to educate the communities living around the forest through open days, workshops and seminars to chat a conservation and utilization priorities.

This needs to be sustainable as a basis for conservation as is practiced in the Forest Department side of the forest. Caution is that this has tended towards unsustainability meaning that limits to use will be enforced in future. Protection as a means of conservation will finally also pay well through tourism, education, research and environmental awareness. The forest has two management strategies protection and sustainable use. The effect of both on forest sustainability and continuity is the subject of study. Protection is paying well on the KWS side but community perception should not be underscored. On the FD side, it is evident that there is too much extraction from the forest and already makes forest sustainability doubtful.

Traditional Religion/Culture

The forest has continued to exist partly because of the cultural and religious zeal of the people. There are cultural and religious restrictions pegged on certain taxa such as *Erythrina abyssinica* and particular sections of the forest such as those used for circumcision rites amongst others. This has led to the conservation of certain parts of the forest with these sections remaining fairly intact as compared to other parts. This is the case of the forest portion bordered by for example the Tiriki people. The place of culture in conservation needs recognition (Olembo *et al.* 1995; Kokwaro and Johns 1998). The Kakamega Environmental Educational Program, (KEEP), has continued to actively educate adults and children alike on the value of the Kakamega Forest biodiversity to the local people. The impact of this educational program has been impressive as seen from weekly attendance and the impact of this program on families bordering the forest. The community members have started planting the trees on their farms and homes to reduce pressure on the forest due to provision of alternative sources of forest products. The University Botanic Garden, Maseno, KEEP and MENR-FD as well as the Isukha Heritage group have been providing seedlings for sale (income generation, job creation) for interested buyers. Many youths have been employed as field assistants and forest guides and have been instrumental in marketing the conservation of the valuable Kakamega Forest to the people.

In Situ Conservation and Species Enrichment of the forest has also been encouraged and needs further strengthening. This has been common in the Forest Department side of the forest especially in areas that had been previously logged, farmed, or disturbed in a way. Illegal harvesting and poaching have however watered down the impact of this form of conservation thus strengthening the need for *ex situ* conservation (Williams *et al.* 1989). The taxa deliberately planted in Species Enrichment and conservation programs have still been adversely affected further strengthening the need for *ex situ* efforts. Taxa targeted include: *Azadirachta indica*, *Prunus africana*, *Zanthoxylum* spp. *Olea* spp, *Trichilia emetica* among others.

Ex Situ Conservation

The University Botanical Garden, Maseno is currently undertaking *ex situ* plant propagation. The exercise has seen over 100 species in the form of wildings and seedlings transferred and planted in the garden to compliment *in situ* efforts which have not been able to cope up with the rate of species loss. Endemic taxa that don't breed well in captivity may eventually be chosen as flagship species for the conservation for efficient utilization process (Venkateswaran and Parthasarathy 2003). This process is labor intensive but it provides the best method of regenerating the affected plant population within a short time. Re-introduction of the raised plant to wild may be considered for equally protected area of the original forest habitat (Cirne *et al.* 2003). Harvesting of plants of high medicinal and cultural value is efficiently controlled for species already established in the Garden. Inventory of users are kept and a nominal fee is charged to enforce control over the visitation to garden for herbal collection purposes. The establishment of the exotic species such as *Eucalyptus* Sp., *Azadirachta indica* and *Persea americana* (Avocado) fruits was found to be faster than that of the indigenous trees. However, *Olea capensis* and *Prunus africana* established at a considerably faster rate than other trees of the indigenous origin.

The botanic garden in conjunction with KEFRI has been at the forefront in germplasm / seed collection for preservation. This however is still at its infancy. It is hoped that the garden will in the long run act as a midway house in making genetic resources available for the people's use. There is already success in bulking seeds of traditional vegetables for local communities' consumption and this has relieved the pressure from wild forms. It has also provided clean stock of seeds for research on traditional vegetables as opposed to seeds available in local markets. The *ex situ* conservation project has established links with herbalists, herb collectors, conservation groups, youth groups, wildlife clubs, institutions and individuals who have an interest in the conservation of Kakamega forest for information flow and feedback loop with the local communities at the grassroots. This is also useful in coordinating research activities in the forest for the creation of knowledge and improvement of human life.

Recommendation

Policy coordination and management effectiveness will have to be closely monitored and reviewed, only then will policy impact on conservation be fully realized. All these will have to take into account the input of the local communities.

The *ex situ* conservation project will have to determine priority taxa for conservation since it may be impractical to conserve all threatened plants. But the conservation effort should be taken together with sustainable utilization of the forest products for it to have any understandable meaning to the local communities.

Benefits of *ex situ* conservation are long term and the project therefore needs to be focused into the future and its scope be widened in line with the initial slow pace of development before the benefits accrued can be felt.

It will be important to monitor status of species and ecosystems as an aspect of biodiversity conservation of Kakamega forest once the effects of conservation becomes apparent due to enforced control measures by the government on the harvest of the forest products.

In Summary, KKF helps maintain essential ecological processes and life supports systems even for the lake basin, where it lies. The forest helps in the conservation of genetic diversity of species and crop relatives, and, it may in future serve as a splendid example of a splendid sustainable utilization of species and ecosystems. *Ex situ* conservation will therefore come in to compliment *in situ* conservation efforts and natural regeneration strategies both of which have been slow.

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12