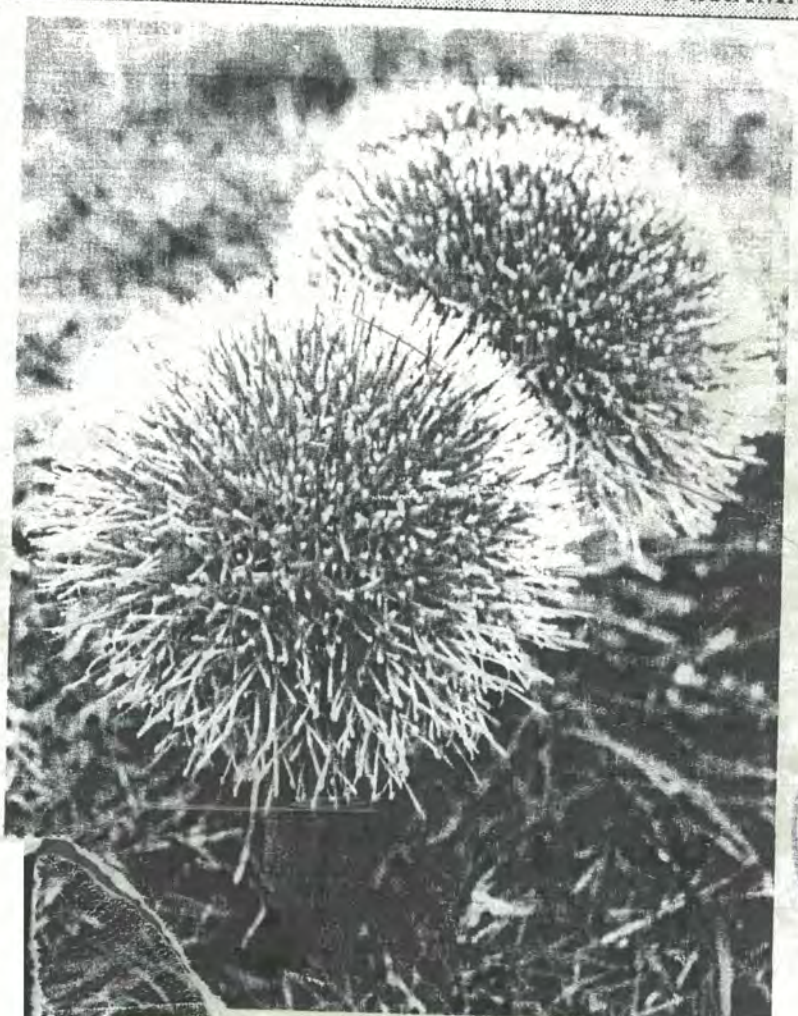
THE COSTS BENEFITS AND UNMET NEEDS OF BIOLOGICAL DIVERSITY CONSERVATION IN KENYA

THE COSTS BENEFITS AND UNMET NEEDS OF BIOLOGICAL DIVERSITY CONSERVATION IN KENYA

A STUDY PREPARED FOR
THE GOVERNMENT OF KENYA
AND
THE UNITED NATIONS ENVIRONMENT PROGRAMME



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LIST OF ACRONYMS

ACTS	-	African Centre for Technology Studies
AFDB	-	African Development Bank
AIDAB	-	Australian International Development Assistance Bureau
AMREF	-	African Medical Research Foundation
ARCT	-	African Regional Centre for Technology
ASAL	-	Arid and Semi Arid Lands
ASAO	-	Agricultural Sector Adjustment Operation
AWF	-	African Wildlife Foundation
AWP	-	Annual Work Programme
CBK	-	Coffee Board of Kenya
CGIAR	-	Consultative Group on International, Agricultural Research
CIAT	-	International Centre for Tropical Agriculture
CIDA	-	Canadian International Development Agency
CIMMYT	-	International Maize and Wheat Improvement Centre
CIP	-	International Potato Centre
CITES	-	Convention on International Trade in Endangered Species
COBRA	-	Conservation of Biodiverse Resource Areas
CRF	-	Coffee Research Foundation
CWP	-	Community Wildlife Programme
DANIDA	-	Danish International Development Agency
Dbh	-	Diameter at Breast Height
DC	-	District Commissioner
DDC	-	District Development Committee
DDF	-	Deputy Director of Forestry
DRD	-	Department of Research and Development
DRSRS	-	Department of Resource Surveys and Remote Sensing
EEC	-	European Economic Community
ESAF	-	Enhanced Structural Adjustment Facility
FAO	-	Food and Agriculture Organisation
FD	-	Forestry Department
FESD	-	Forestry Extension Services Division
FINNIDA	-	Finnish International Development Agency
FMP	-	Forestry Master Plan
GEF	-	Global Environment Facility
GoK	-	Government of Kenya

LIST OF ACRONYMS

GTZ	-	Deutsche Gesellschaft fiir Technische Zzusammenarbeit Gmbh (Federal Republic of Germany)
IAEA	-	International Atomic Energy Agency
IARCs	-	International Agricultural Research Centres
ICIPE	-	International Centre of Insect Physiology and Ecology
ICRAF	-	International Council for Research and Agroforestry
ICRISAT	-	International Crops Research Institute for the Semi-Arid-Tropics
IDA	-	International Development Agency
IDRC	-	International Development Research Centre
IFCC	-	Institut Françias du Cafe, du Cocas et autres Plantes stimulantes
IFD	-	Industrial Forestry Division
IFPRI	-	International Food Policy Research Institute
IGADD	-	Intergovernmental Authority on Drought and Development
IIBC	-	International Institute of Biological Control
IITA	-	International Institute of Tropical Agriculture
ILCA	-	International Livestock Centre for Africa
ILRAD	-	International Laboratory for Research on Animal Diseases
IPGRI	-	International Plant Genetic Resources Institute
IPR	-	Institute of Primate Research
IRCU	-	Industrial Research and Consultancy Unit
IRRI	-	International Rice Research Institute
ISNAR	-	International Service for National Agricultural Research
IVFC	-	Indigenous Fruit and Vegetable Crops Project
JICA	-	Japan International Cooperation Agency
JKUCAT	-	Jomo Kenyatta University College for Agriculture and Technology
KANU	-	Kenya African National Union
KARI	-	Kenya Agricultural Research Institute
KEFRI	-	Kenya Forestry Research Institute
KEMRI	-	Kenya Medical Research Institute

LIST OF ACRONYMS

KEMFRI	-	Kenya Marine and Fisheries Research Institute
KENSIDOC	-	Kenya Scientific Information Documentation and Communication Centre
KETRI	-	Kenya Trypanosomiasis Research Institute
KEVEVAPI	-	Kenya Veterinary Vaccine Production Institute
KIFCON	-	Kenya Indigenous Forestry Conservation Project
KFC	-	Kenya Forestry College
KFW	-	Kreditanstalt Fur Wiederaufbau
KIA	-	Kenya Institute of Administration
KIE	-	Kenya Institute of Education
KIPO	-	Kenya Industrial Property of Office
KIRDI	-	Kenya Industrial Research and Development Institute
KWS	-	Kenya Wildlife Service
MED	-	Ministry of Education
MENR	-	Ministry of Environment and Natural Resources
MIRCEN	-	Microbiological Research Centre
MIS	-	Management Information System
MOA	-	Ministry of Agriculture
MOE	-	Ministry of Energy
MOF	-	Ministry of Finance
MOLD	-	Ministry of Livestock Development
MOTW	-	Ministry of Tourism and Wildlife
MPND	-	Ministry of Planning and National Development
MPW	-	Ministry of Public Works
MRD	-	Ministry of Regional Development
MRDASAW	-	Ministry of Reclamation and Development of Arid Semi Arid Wastelands
MRST	-	Ministry of Research Science and Development
MU	-	Moi University
MWT	-	Ministry of Wildlife and Tourism
NAHRS	-	Naivasha Animal Husbandry Research Station
NACBAA	-	National Advisory Committee on Biotechnology Advances and their Applications
NCRR	-	National Centre for Research in Reproduction
NCST	-	National Council for Science and Technology
NEAP	-	National Environmental Action Plan
NFMD	-	Natural Forest Management Division

LIST OF ACRONYMS

NGO	-	Non Governmental Organisation
NMK	-	National Museums of Kenya
NORAD	-	Norwegian Agency for International Development
NRRC	-	National Range Research Centre
NZDA	-	New Zealand Development Agency
ODA	-	Overseas Development Agency
OP	-	Office of the President
ORSTOM	-	Institut Françias de Recherche Scientifique pour le Developpment en Cooperation
PPM	-	Panafrican Paper Mills
R & D	-	Research and Development
RAES	-	Rural Afforestation Extension Service
RTDS	-	Rural Tree Development Support Project
SDC	-	Swiss Development Corporation
SIDA	-	Swedish International Development Agency
SOE	-	Statement of Expenditure
SPPF	-	Special Project Preparation Facility
TBK	-	Tea Board of Kenya
TRF	-	Tea Research Foundation
TSC	-	Technical Services Contracts
UK	-	United Kingdom
UNDP	-	United Nation Development Programme
UNEP	-	United Nations Environmental Programme
UNIDO	-	United Nation Industrial Development Organisation
UoN	-	University of Nairobi
USA	-	United States of America
USAID	-	United State Agency for International Development
UOPS	-	Vegetable Oil and Protein
WARD	-	West Africa Rice Development Association
WCMD	-	World Life Conservation and Management Department
WHO	-	World Health Organisation
WIPO	-	World Intellectual Property Organisation
WMO	-	World Meteorological Organisation

CURRENCY EQUIVALENTS

Currency Unit	=	Kenya Shilling (KSh)
KSh 20	=	Kenya pound (K£)
US$1.00	=	KSh 27.0 (1991 mean value)
SDR 1.0	=	US$1.32 (1991 mean value)

WEIGHTS AND MEASURES

Metric System

ha	=	hectare
km	=	kilometre
kms	=	kilometres
l	=	litres
m	=	meter
mn	=	million

The flower on the front cover is the fireball lily, growing in the Maasi Mara

The next two pages show photographs (Figs 1.1 to 1.4) of environmental damage to natural resources in Kenya: silting of rivers, deforestation, and livestock damage at waterholes.

Figure 1.1: Rivers With Heavy Silt Loads

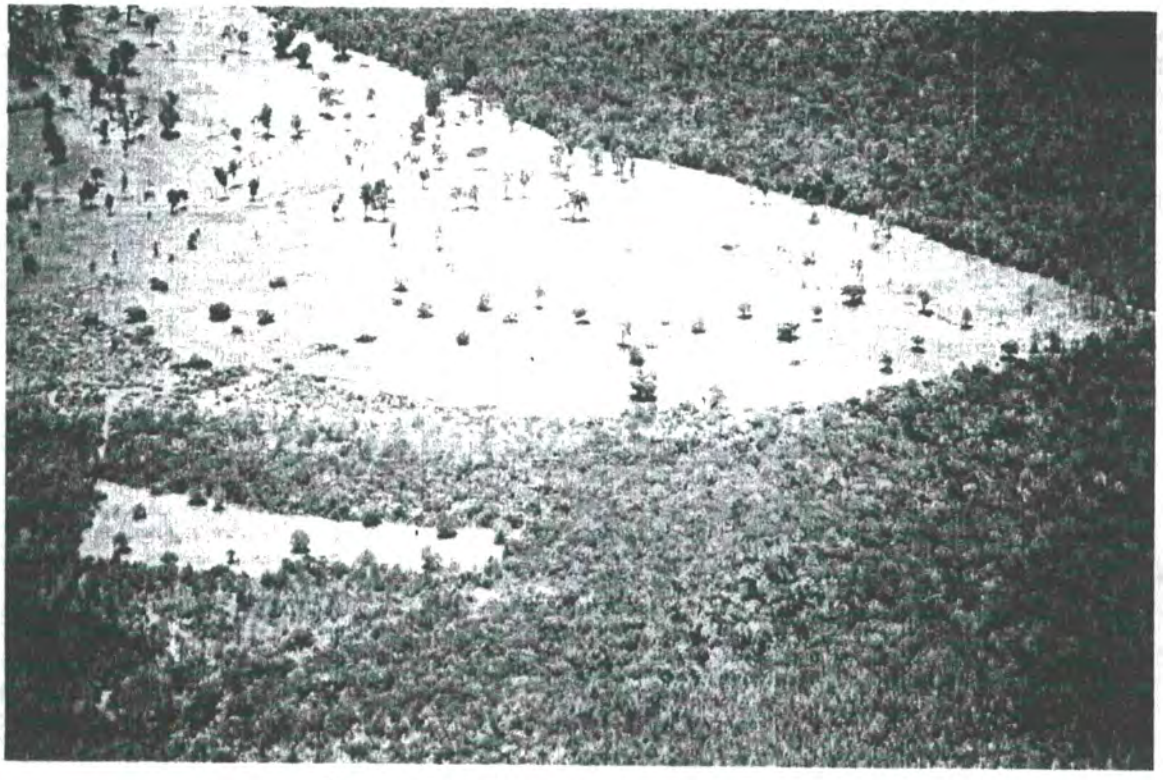


Figure 1.2: Encroachment on Forests

Figure 1.3: Deforestation for Woodfuel

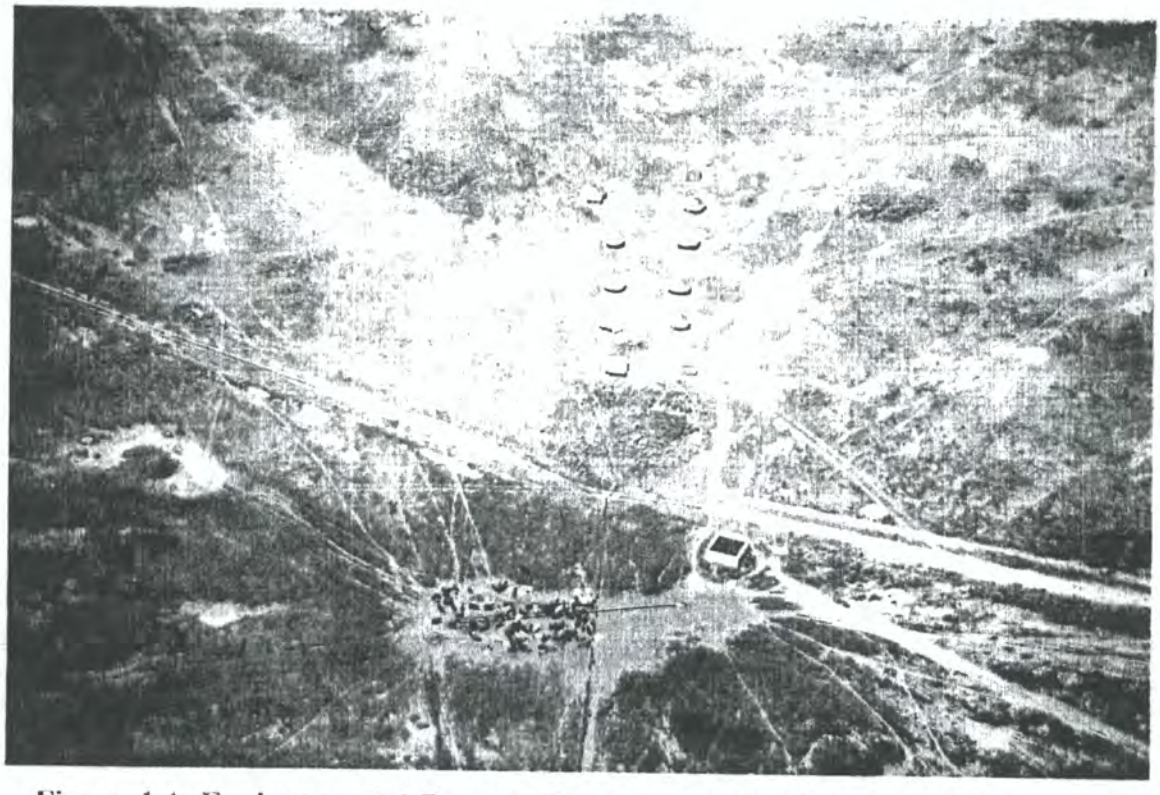


Figure 1.4: Environmental Damage Created Around Waterholes by Livestock

CHAPTER 1

CONCLUSIONS AND SUMMARY

1.1 INTRODUCTION

This Report is concerned with assessing the nature and extent of Kenya's biodiversity, examining why and in what ways it is being changed over time, what the reasons are for that change, what measures need to be taken to conserve the biological diversity of the country, and what the costs of those measures are likely to be. It has been prepared to a terms of reference provided by the Government of Kenya and the Overseas Development Administration of the United Kingdom, who financed the study. However one the main objectives has been to meet the UNEP guidelines for the 'Preparation of Country Studies on Costs, Benefits and Unmet Needs of Biological Diversity Within the Framework of the Planned Convention on Biological Diversity'[1]. Hence many of the questions raised and answered are in the framework of those Guidelines.

The Report has the following structure. Chapter 2, which follows this summary, provides a brief introduction to Kenya, its natural resources and its economy. Chapter 3 reviews the scientific state of knowledge about the country biodiversity. It brings together, in some cases for the first time, data on species and habitats within the country, and identifies the gaps in the knowledge. It also addresses the question, why are many of the important resources being lost over time? The structure follows the UNEP guidelines, and an annex to the chapter gives the data in the format set by those guidelines. Chapter 4 looks at the linkages between the economic and social development of the country and its biodiversity. It is concerned with identifying the policies that lead to degradation and those that can encourage conservation and sustainable use. Chapter 5 identifies specific programmes that Kenya needs to follow in the immediate future if it is to arrest some of the serious loss that it is facing. Chapter 6 gives the costs of the existing biodiversity programmes that are being undertaken or proposed in Kenya, as well as the costs of additional measures that should be taken if biodiversity conservation needs are to be met. Finally Chapter 7 addresses the question, what are the benefits from biodiversity conservation? To some extent this question has been raised in many places in the Report, but this last Chapter deals with it in some greater depth.

[1] UNEP/Bio.Div./Guidelines, May 1991.

1.2 INTRODUCTION TO KENYA

Kenya is a country with a complex mix of climatic regions of different size, coupled with a simple, but asymmetric, pattern of rainfall drainage through just five drainage basins (Victoria and Tana basins account for 80% of total runoff) combine to determine the biological productivity of the different regions of Kenya. There are 19 recognized ecological communities (grasslands may be divided further into 4 sub-categories). The percentage of land occupied by each of these communities varies considerably); for example, only 2.6% of the land remains as forest, whilst 75% comprises savannah, semi-arid or arid regions.

Just as country's natural biological wealth is distributed unevenly across the country, so is the value of Kenyan land for human use (agriculture, forestry, industry). Only 8% is high agricultural potential; three-quarters of Kenya's land has low or zero agricultural potential. Biological resource wealth and alternative human use of land are strongly correlated in Kenya, creating the potential for conflicts of interest.

Kenya has one of the highest population densities in Sub-Saharan Africa, with around 230 persons/km^2 of agricultural land. Four-fifths of the population, and 80% of forests, reside in one-fifth of the total land area. Agriculture contributes 80% of total employment, and will need to absorb much of the increase in labour. With a population of 24.0 million and still growing at around 3.7% p.a., and estimated to rise to 37mn by 2000, Kenya faces an expanding crisis meeting demand for land, energy and food.

From 1965 to 1980 the Kenyan economy grew at an average annual rate of 6.4 percent per annum, which being considerably in excess of the population growth rate of 3.6 percent per annum, left a growth in per-capita incomes of 2.8%. The picture was, however a deteriorating one, as population growth rates were increasing and GDP growth was declining. From 1965 to 1973 per capita income grew at 4.7 per cent and from 1973 to 1980 it grew at only 1.3 per cent. By the 1980s the population growth, at 4.1 per cent per annum (one of the highest in the world) had become faster than GDP growth, so that per capita incomes fell at -0.9 percent over the period 1980-1987. From 1987 onwards, however, the picture has improved somewhat. Real annual GDP growth has hovered at around 5 percent and per-capita GDP, has been increasing at about 1.3 per cent[2]. By international standards Kenya is a poor country. With GNP per capita of around $330 in 1897 (around $950 when corrected for purchasing power) it is in the low income group as defined by the World Bank. Compared to the countries in the sub-Saharan group, however, its performance has not been bad, especially in the 1980s, when the whole region was suffering from economic and

[2] Data are from the World Bank Development Report and Kenya Bureau of Statistics.

natural difficulties and per capita incomes of the low income sub-Saharan countries declined at 3.6 per cent per annum.

In summary, it can be said that Kenya made steady progress in an economic sense in the period from independence to 1980, although much of the benefit was absorbed in the growing population. The 1980s were a difficult period with declining real incomes for the first seven years, but the situation has improved since 1987. Per-capita growth has become positive again and population growth is beginning to decline. The country is heavily dependent on its natural resource base for its economic output; both domestically (where agriculture remains dominant) and in the external sector (where agriculture, and natural-resource based items such as hides and non-fur skins etc., and tourism) are the main sources of income.

1.3 KENYA'S BIOLOGICAL DIVERSITY

Chapter 3 reports the present state of biodiversity knowledge and its conservation in Kenya. Data for the report were provided by Kenyan specialists working in five teams covering animal biodiversity, plant biodiversity, microbial biodiversity, *in-situ* conservation and *ex-situ* conservation. Some additional material was provided by the World Conservation Monitoring Centre, Cambridge, UK and other independent scientists with experience of Kenyan biodiversity. It must be stressed that this work has been completed in three months and represents the first output from a continuing National Biodiversity Unit based at the National Museums of Kenya.

Animal Biodiversity:

A total of 25,375 described animal species were reported (see Annex 1a to Chapter 3). For some taxa, notably birds and mammals, the totals reported probably reflect true biodiversity, excluding some taxonomic confusion about sibling species and sub-species. In other taxa, either the number of species have not been formally described, or so little is known about a taxa that any realistic estimate of % total known is impossible. The total for animals is dominated by 61% of 34,863 insect species, in spite of the relatively poor level of collection for insects (Lepidoptera, Isoptera and Odonata excepted). Species numbers reported here are slightly higher than numbers recorded in world lists, and confirm Kenya's ranking as the most species dense country on the African continent (slightly fewer species than Zaire in a much smaller area). Adequate data on geographic distribution for most species are not available, preventing accurate assessment of species ecological health and reducing the objectivity of site selection for the most effective conservation of rare and endemic species. Kenya has initiated a number of appropriate studies in this are; for example, an analysis of genetic variability within and between antelope species. A considerable increase in both human resources and capital investment will be required, however, if Kenya is to improve its animal biodiversity knowledge to the level where it can

provide both conservation security and adequate economic returns to local human populations. These two issues are, of course, intimately linked.

Plant Biodiversity:
The total number of species report is 6,817 (excluding algae), of which the majority (86%) are flowering plants (Angiospermophyta). Total species lists are relatively complete, with the major exception of the undercollected NE region, but the full distribution of most species is not known. Plant endemism in Kenya is high, especially if regional endemics are included in the totals. Endemism is not restricted to one or a few sites; rather it is widely scattered at many sites and in increasingly fragmented forest patches (see Annex 1g of Chapter 3). This poses a difficult conservation dilemma, because many of these sites are threatened and, whilst only one or two rare/endemic plant species may be lost with each site lost, the cumulative effect will be a significant decline in species richness. Floristic surveys, similar to the recently completed Coastal Forest Survey, but with a stronger population distribution component are essential first steps in Kenya's plant conservation programme.

Microbial Biodiversity:
The total number of species recorded was 1841 (including viruses, monerans, micro-fungi and protoctistans, but excluding macro-algae. Most knowledge of microbial biodiversity if disease-related and little is known about Kenyan microbes in their natural habitats with the exception of nitrogen-fixing bacteria. *In-situ* conservation of microbes is difficulty, beyond protecting the soda lakes known to contain endemic archeabacteria. Kenya needs considerable investment in education of sufficient microbiologists to allow it to: (i) contribute to conservation of microbial biodiversity via international culture collections, and (ii) utilize global microbial resources to generate a biotechnological industry base which can contribute to economic development.

In-situ Conservation:
On paper, Kenya possesses a respectable network of protected areas covering over 7% of the total land area (see Annex 1g of Chapter 3). In reality, these protected areas are biased towards savannah/semi-arid areas with significant charismatic megafauna; and many are ecologically unstable, either through encroachment, tourist pressure or perturbations caused by fluctuations in herbivore population.

Proposed extensions to the present system, especially in forest regions, would improve total biodiversity protected. One aspect of the protected area system which requires immediate and innovative action is increased use of wildlife resources to benefit neighbouring human populations which have the potential to become either the biggest threat to, or the best conservers of, Kenya's biodiversity.

Ex-situ Conservation:
This aspect of biodiversity conservation is under-utilised in Kenya. There is a pressing need for a set of regional arboreta/botanic gardens capable of holding the hundreds of plant species likely to be, or already have been, threatened in their natural habitat within the next 20 years. Equivalent new or expanded facilities are required for agricultural livestock and forest genetic resources. In Kenya, where so much wildlife co-exists with its human population traditional zoos are considered inappropriate. But Kenya's expanding urban population will, however, require a new kind of exposure to biodiversity. Plans for a national aquarium and additional mechanisms for school level exposure to conservation needs and values must be encouraged.

1.4 BIODIVERSITY AND DEVELOPMENT

Chapter 4 begins by recognizing that Kenya is a country richly endowed in natural resources and in biodiversity. Without being one of the world's key repositories of genetic material, it contains some resources that are of international importance and many that are of considerable domestic value. However, it is also a country where the natural resource base is essential for some aspects of the country's future development, and in conflict with it for other aspects. For example Kenya earns a considerable income from tourism, much of which is almost entirely dependent on the wildlife and the coastal resources. On the other hand, the demands of agriculture, industry and urban development are damaging the habitats of animals and coral reefs which are a key feature of the coastal areas. This struggle between the needs for conservation and the imperative of economic development is being won by the latter in way that is incompatible with the longer term interests of the country. In other words, Kenya is not practising sustainable development and the damage to the resource base will result in due course (to some extent it is already happening) in lower output from the agricultural sector and in damage to the tourism industry on which the country is so dependent.

In this chapter the reasons why the country is suffering the loss of its biodiversity are examined, as well as what changes in policies and what additional resources will be needed to arrest these trends. The broad categories of causes of biodiversity loss can be summarised as (a) demographic pressures, and (b) failures in policy, by governments, markets and institutions.

The demographic forces are undoubtedly one of the most important (if not the most important) in the loss of biodiversity in Kenya. The population has close to trebled from 8.7 million since independence, and is certain to rise to around 37 million by 2000. This has created an increase in the demand for land and for resources such as woodfuel and forage, which have resulted in massive deforestation and soil erosion. The predictions are that this pressure will continue for the foreseeable future. It can

be mitigated if agricultural yields from existing lands can be increased, if more of the population can derive income from non-farm sources that do not endanger the natural resource base, if forest resources can be used to generate income in a sustainable way, so that there is less incentive to convert them to agriculture, and if some of the substitutes for forest woodfuel can be obtained from other sources.

Section 4.3 looks at polices that would be consistent with, and encourage these changes. It is clear from much of the Kenyan and other country experience that simply declaring a zone as a conservation zone and even policing it will not save it from encroachment. The relevant polices that have to bring about a change in land use are divided into microeconomic; macroeconomic; and social, legal and institutional; and those related to research and training. Microeconomic policies act at the level of the farm or individual forest, land area or water body; and macroeconomic policies act at the national or regional level. Social, institutional and legal polices are concerned with making it possible for individuals to share in the benefits of a sustainable exploitation of the natural resource base. They range from changes in the farmer and breeder rights that apply to new varieties of seeds, to institutional arrangements that permit local groups to participate forest and wildlife management.

On forestry, the economic polices at the micro level have to make private fuelwood supply more attractive, to increase energy efficiency, and to undertake replanting. At the macro level, programmes to inventory and monitor resource use are being undertaken, but more needs to be done. In some cases, the damage is so great, and the possibility of saving the forests so small that increased *ex-situ* conservation activities are required. On the socio-legal/institutional front, strengthening the management of the forests is an imperative. Changes in the legal framework, so that indigenous knowledge can be more effectively exploited by local groups are explored, as are issues relating to access to genetic resources in international collections. Finally on research and training, the focus is on a better understanding of the ecological functions of forests in water sheds and for soil conservation, and inventories and collection and classification of data and material from forests.

On agriculture, the microeconomic issues relate to making conservation uses of marginal land more attractive, by raising the returns to forestry and wildlife-compatible activities. This needs a reexamination of commodity prices, as well as a more effective sharing of the benefits of wildlife, so that it is in the interests of agro-pastoralists not to cultivate land in key dispersal areas. Controlling soil erosion through incentives such as the polluter pay principle should be considered. The macroeconomic issues are much broader. We need to look at the whole policy of wheat self-sufficiency and analyse what conflicts it creates with land conservation for wildlife. Where development is being permitted, the valuation of alternative uses of

land needs to be more complete, allowing for indirect benefits. We also need to look at the macroeconomic picture in terms of employment creation and see how future employment demand can be met with efficient use of the land/forest resource base. Finally policies that impinge on poverty are important. Kenya has an inequitable income distribution, even among developing countries. Alleviating poverty can reduce the resource pressure directly and can allow fiscal incentives to be adopted, which have an indirect effect. On the social and legal front, the framework seems to be appropriate, although some of the legislation such as that governing PBRs is not in place and should be implemented. On research, all activity that increases agricultural efficiency is important and relevant to biodiversity conservation in so far as it reduces the pressure for land expansion. In this regard the collection and development of indigenous material is of importance. Proper storage and documentation of the germplasm is required.

The marine and inland water resources of Kenya are the least studied of the natural environments. They are important for tourism, fisheries, and as sources of water. The policies needed to conserve, and sustainably exploit the biodiversity in them include control of pollution into the lakes and marine coastal areas; better regulation and monitoring of inland fisheries; and a more careful evaluation of decisions to set up mariculture in wetlands and to drain swamps. The socio-institutional aspect that needs strengthening is the capability of the Fisheries Department. Finally the research agenda in this area is very long. Information on the marine and inland water resources needs to be collected and analysed in virtually every area.

The wildlife resources of the country are of crucial importance to Kenya. Much is being done to protect them but decisions are taken without much knowledge of the true economic value of species and of the different habitats. More use of economic valuation methods is required, particularly on the demand for tourism and on the impact of overuse of parks on the willingness to pay for a visit. As mentioned earlier, sharing the benefits with local communities, and using their indigenous knowledge is important for the success of wildlife conservation. On the legal front, the framework for compensation for wildlife damage needs to be reviewed. The institutional changes made by setting up KWS are encouraging and should help conservation in this sector. The resources available for investment are also substantial and should not be an impediment to a successful conservation policy.

Biodiversity conservation is as much (if not more) about the right policies and incentives as it is about physical conservation. That is a key message from this chapter.

1.5 PROGRAMMES FOR BIODIVERSITY CONSERVATION

The preceding chapter has provided an overview of the pressures that Kenya's biological diversity is under. Clearly, there is need for further programmes to promote the conservation and sustainable utilisation of Kenya's biological resources. This fact is well recognised by GoK as will be seen by the proposed programmes that the relevant ministries intend to pursue over the next three years.

This chapter presents the proposed and additional programmes needed to meet the requirements of biodiversity in Kenya. The **proposed** programmes are based on Government of Kenya plans for the next three years, as well as those of the key NGOs involved in the private sector. The **additional** programs refer to the resource investments that have been identified by the study team as being necessary in addition to the GoK and other planned investments if the goals of biodiversity conservation are to be achieved. A period of three years has been chosen because detailed government data are available for this period, and because it is possible to make relatively firm proposals for such a short term. No dollar values are given for the programmes in this chapter, where the purpose is to identify the actions required in greater detail.

The Chapter begins by noting that the lack of institutional coordination in relation to biological resources is a major problem in Kenya. This is perhaps not surprising, given the diverse nature of biological resources and the many sectoral activities that impact on, and utilise, these resources. These institutions comprise government departments, NGOs, private sector concerns and individuals. However, there is a need for a greater degree of **overall coordination** and cooperation between these institutions. Hence many of them work independently of each other, which may lead not only to a duplication of effort but also to conflicts in programme objectives and a neglect of vital aspects of biodiversity altogether. The National Biodiversity Unit, located in the NMK, was established as the facilitating agency for the present study. There is an important role for this institution to act as the central coordinating body for biodiversity related activity in Kenya. Although its role in this respect is not mentioned in each programme in the following sections, it is assumed that it will function in this capacity, and the costs of the overall programme given in Chapter 6 include the costs of running the NBU.

In this Chapter the proposed and additional programmes are outlined in the same categories that are given in Annex 9 of the UNEP guidelines. The items are as classified as follows:

(a) Surveys, Inventories, Identification and Authentification of Biodiversity;
(b) Research, Training, Education and Public Awareness;
(c) Preparation and Implementation of Conservation Management Strategies and Plans;

(d) Monitoring of World Status of Biodiversity;
Meeting Terms of Existing Legal Requirements;
(e) National Capacity for Biotechnology and Transfer of Technology.

For each of the above categories, a set of Tables has been prepared, detailing what the proposed activities are, and in what respects they need to be enhanced and strengthened.

1.6 COSTS OF BIODIVERSITY CONSERVATION IN KENYA

In Chapter 6 the costs of existing and planned projects that are part of the existing programme of expenditure on biodiversity, by GoK as well as NGOs are looked at. The costs of the additional programmes that have been identified in the last Chapter are also given here.

Costs for additional programmes must necessarily be regarded as rough. There has not been time to provide a detailed costing of the kind that would be made even at a pre-feasibility level for most of the programmes. In some cases the information was taken from existing unfunded projects, but in most cases it is only a first attempt at the costs.

The data are reported for the current year and for the next three years. The latter cover the period 1992-1995. The primary reason for choosing this short period was that the GoK data were available for that period. However, such a short period would not permit all the desired activities to be carried out. Virtually no data could be collected from the private sector. Where they had activities in the field, such as private ranching, there was a reluctance to provide cost and revenue information.

The answers are incomplete for reasons of lack of data and time available to collect that which exists. Nevertheless there are some interesting findings. Expenditure on biodiversity related items is expected to run at around $91 mn, of which $12.6 mn would be by NGOs and the balance by GoK. The role of the private sector could not be quantified, although some effort in that direction in the future would be worthwhile. In the opinion of the team, an additional expenditure of $24.6 mn per annum is needed for the next three years. Of this about $14 mn is development, and could be funded directly under donor assistance or increased foreign NGO activity. The remainder would make a major claim on a limited GoK budget and is unlikely to be forthcoming. Hence if the requirements of a biodiversity convention are to be met, some of this recurrent cost funding will have to be sought from outside Kenya.

In terms of priorities, it has not been possible to give a proper ranking of the activities examined in this Report, primarily because the benefits of biodiveristy could not be quantified. The issue of benefits is important, not only for this reason, but also

because it allows GoK to seek funding from international sources in cases where it can be demonstrated that many of the benefits will go to the international community.

1.7 THE BENEFITS OF BIODIVERSITY

Chapter 7 looks at the benefits of biodiversity. The benefits can be divided into those that relate to the current use of the services that biodiversity provides, those that relate to future use, and those that flow from the mere existence of these resources. In technical terms the first category are called current user values, the second future user values and the third existence values. In the first two categories, it is necessary to distinguish between user values that generate a flow of income or expenditure, and those that do not.

Where there are income flows associated with benefits, the measures proposed should generate changes in these flows. Thus if, for example, one benefit of a conservation policy is to increase the numbers of wildlife, which in turn will lead to increased tourism revenue, then those benefits are measures in terms of the net income generated. Although this is possible in principle, it cannot be done accurately without more information on the determinants of the demand for tourism. However, in those cases where GoK has estimated revenues (which is principally wildlife) they have been taken into account in calculating the net costs of the programmes. In other word, the costs are net of any identifiable revenues that biodiversity conservation might generate. Areas where there should be benefits of this kind, but which have not been estimated include forestry (increased forest products), horticulture, and research in the utilisation of indigenous and exotic plants and animals within the country (including biotechnology). However, it is extremely difficult to value such benefits in monetary terms. The best that can, and has been attempted is an indication of the likely importance of different programmes in judgmental terms.

In the case of future values, one needs to distinguish between the present money value of future benefits, and the expected net incomes that will be generated by the activities in the future, discounted back to the present. Thus saving a tropical forest may generate revenue in the form of future forest products. There is some uncertainty about the size of these benefits, and it is frequently the practice that an expected or average value is taken. However, the present value of these benefits could be more than just this average value because of the uncertainty that is avoided if the resource is preserved. The difference between the expected future value and the amount that people would be willing to pay to conserve the forest now is the option value. Where it arises, it should be taken into account.

Benefits that do not generate direct cash revenues, are even more difficult to measure. In some cases there are related economic benefits, and they can be measured. This is the case for example with conservation measures that reduce erosion, or measures that

increase fish yields. In other cases the benefits are less easily identified but nevertheless real. An example would be protection of habitats, where the linkages with economic activities are much more difficult to identify.

Finally there are the existence benefits. Research in other countries has shown that the size of these benefits, which relate to the intrinsic value of objects, can be very large. They can be partially estimated by questionnaire methods, asking people what they are willing to pay to conserve something that they will never use or enjoy by visiting the site. (Pearce, Barbier and Markandya (1991)). Furthermore much of the value is in the developed countries for resources that exist in developing countries such as Kenya. The difficulty with this approach is that (a) the estimates are only partial and not available for most countries and species, (b) there are conceptual problems in isolating the value of individual species and measures for conservation in this way.

This study has not been able to do more than indicate the nature of the benefits that arise in the measures proposed. This does not mean that in future an attempt at quantification should not be made; rather it shows the need for such quantification. In the absence of such estimates, a judgmental priority has to be made for the programmes proposed. In the team's view, the priorities indicated by the relative costs and benefits of the programmes is the following:

(i) the formulation of conservation strategies that incorporate local communities, and that make the necessary policy changes that are so essential for the success of these programmes. The internationally important resources that need preservation are the coral reefs, which form a biodiversity hot spot second only to tropical rain forests; the regulation of areas high in endemism, such as the Kayas and the Tana River Primate Reserve; and the protection of the biotic communities. However, these are largely international concerns and the resources for their conservation should properly come from the international community;

(ii) from an international perspective, and a domestic point of view, many of the activities identified for data collection, surveying and monitoring are critical. Included in this group would be the floristic and wetland ecosystem inventories;

(ii) from a more domestic point it is important to increase the sustainable use of forests and to protect the catchment forests that are so important to sustainable agriculture. It is also important to increase knowledge of indigenous flora, and the enthno-botanical surveys address that. Finally the commercial exploitation of Kenya's biodiversity should not be forgotten. Often this conflicts with other development needs (eg wildlife and agriculture).

CHAPTER 2

KENYA: AN INTRODUCTION

2.1 GEOGRAPHY

Kenya occupies 582,646 km^2 of the east coast of equatorial Africa (see Map 2.1). Two percent of the total area is water-covered. Kenya shares a total of 3,368km of land border with Ethiopia and Somalia to the North, Uganda to the West, and Tanzania to the South. The coastline is estimated to be 536 km long, facing into the Indian Ocean.

2.2 CLIMATE

Despite its equatorial position, the climate of Kenya is regional, with marked inland variations caused by altitude and strong marine influences on the coast. Altitude ranges from sea level to 5,200m at Mt Kenya, with most of the central and south-west region of the country forming a plateau of between 1,400 and 2,800m above sea level. This plateau is bisected by the Eastern Rift Valley, which crosses Kenya from Lake Turkana in the north to Lake Natron in the south. The eastern edge of the Rift forms an escarpment rising to over 3,000m at some points. As Figures 2.1 to 2.4 show, the country has a varied topography, ranging from mountainous to arid, and including isolated tropical rainforest.

Monthly mean temperatures range from 6°C to 30°C whilst annual rainfall ranges from less than 100mm in the north-east to over 1500mm on the slopes of Mt Kenya. An equatorial climate is found only around Lake Victoria, in Nyanza and Western Province, whilst tropical, tropical continental desert, and true desert climates are found in Narok/South Taita, Eastern and Central Northern Kenya. The coastal and central highland regions show equatorial and tropical climates modified by maritime and altitudinal influences respectively.

2.3 ECOLOGICAL COMMUNITIES

This complex mix of climatic regions of different size, coupled with a simple, but asymmetric, pattern of rainfall drainage through just five drainage basins (Victoria and Tana basins account for 80% of total runoff) combine to determine the biological productivity of the different regions of Kenya. There are 19 recognized ecological communities (grasslands may be divided further into 4 sub-categories). The percentage of land occupied by each of these communities varies considerably (see Annex 1h for details); for example, only 2.6% of the land remains as forest, whilst 75% comprises savannah, semi-arid or arid regions.

MAP 2.1: TOPOGRAPHICAL MAP OF KENYA

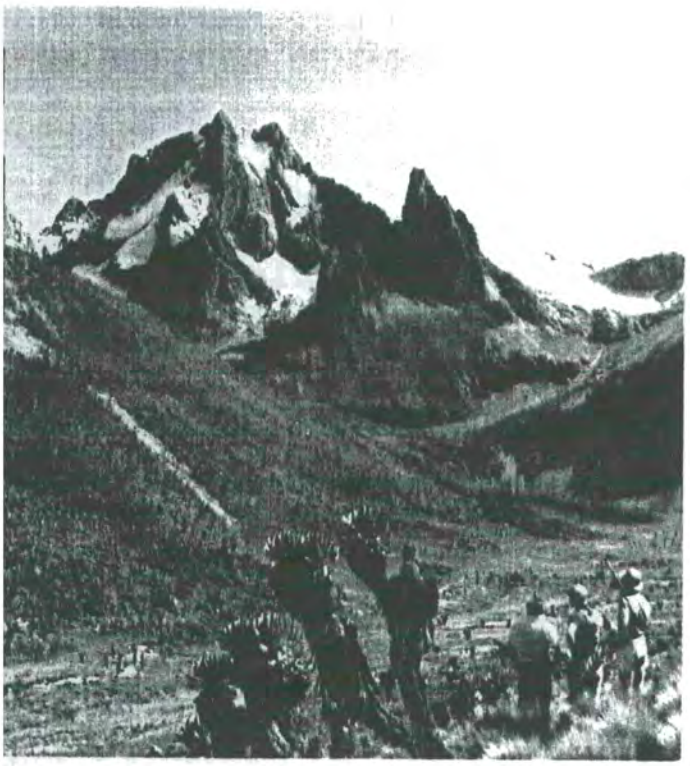


Figure 2.1: Mount Kenya

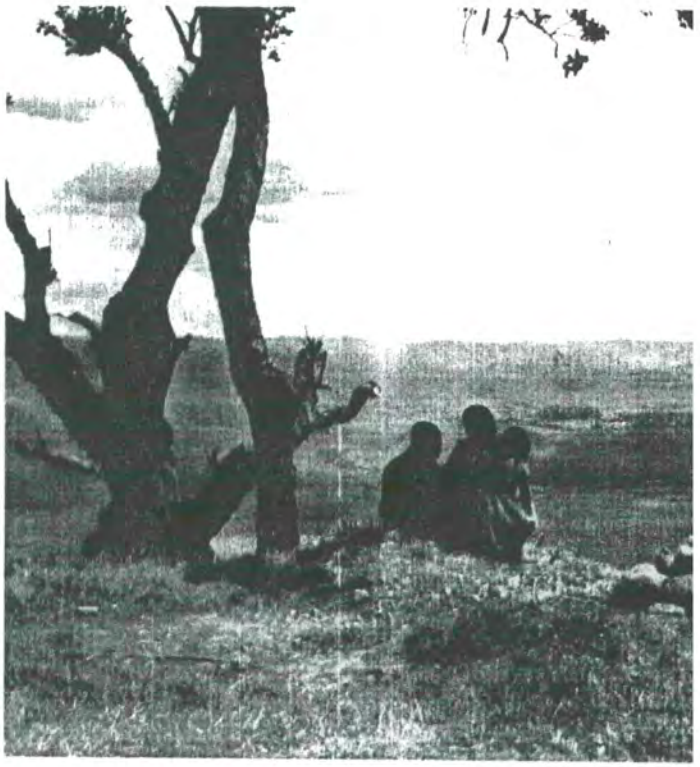


Figure 2.2: The Rift Valley

Figure 2.3: Open Savannah

Figure 2.4: Kenyan Rainforest

2.4 HUMAN LAND USE

Just as Kenya's natural biological wealth is distributed unevenly across the country, so is the value of Kenyan land for human use (agriculture, forestry, industry). Only 8% is high agricultural potential; three-quarters of Kenya's land has low or zero agricultural potential. Biological resource wealth and alternative human use of land are strongly correlated in Kenya, creating the potential for conflicts of interest.

Kenya has one of the highest population densities in Sub-Saharan Africa, with around 230 persons/km^2 of agricultural land. Four-fifths of the population, and 80% of forests, reside in one-fifth of the total land area. Agriculture contributes 80% of total employment, and will need to absorb much of the increase in labour. With a population of 24.0 million and still growing at around 3.7% p.a., and estimated to rise to 37m by 2000, Kenya faces an expanding crisis meeting demand for land, energy and food. These issues are discussed in greater detail in Chapter 4.

2.5 PROTECTED AREAS

Kenya has a total of 44,751.3km2 of protected areas, with varying levels of legal protection and land uses. This represents 7.68% of Kenya's total area. Further details and analysis of protected areas status are given in Chapter 3 and Annex 1g. The protected areas may be sub-divided as shown in Table 2.1 below.

2.6 THE ECONOMY

From 1965 to 1980 the Kenyan economy grew at an average annual rate of 6.4 percent per annum, which being considerably in excess of the population growth rate of 3.6 percent per annum, left a growth in per-capita incomes of 2.8%. The picture was, however a deteriorating one, as population growth rates were increasing and GDP growth was declining. From 1965 to 1973 per capita income grew at 4.7 per cent and from 1973 to 1980 it grew at only 1.3 per cent. By the 1980s the population growth, at 4.1 per cent per annum (one of the highest in the world) had become faster than GDP growth, so that per capita incomes fell at -0.9 percent over the period 1980-1987. From 1987 onwards, however, the picture has improved somewhat. Real annual GDP growth has hovered at around 5 percent and per-capita GDP has been increasing at about 1.3 per cent[1]. By international standards Kenya is a poor country. With GNP per capita of around $330 in 1897 (around $950 when corrected for purchasing power) it is in the low income group as defined by the World Bank. Compared to the countries in the sub-Saharan group, however, its performance has not been bad, especially in the 1980s, when the whole region was suffering from economic and natural difficulties and per capita incomes of the low income sub-Saharan countries declined at 3.6 per cent per annum.

[1] Data are from the World Bank Development Report and Kenya Bureau of Statistics.

TABLE 2.1 NATIONALLY PROTECTED AREAS AND OTHER SITES OF SIGNIFICANCE

	Number	Area (ha)
National Parks	22	2,905,002
Marine National Parks	5	5,400
Nature Reserves	11	52,679[a]
National Reserves	22	1,452,755
Marine National Reserves	5	70,609
Game Sanctuaries	1	500
Forest Reserves	203	1,669,022
Private Reserves	6	13,363[a]
Biosphere Reserves	5	1,334,559[b]
Ramsar Wetlands (Lake Nakuru NP)	1	18,800[b]
Proposed Protected Area	143	938,501[ab]
TOTAL (exc. proposed areas)	272	6.103,288[a]

(a) Indicates minimum estimates of area.
(b) Some of these areas do not contribute to the total because they represent sites already included in other categories, or yet to be protected.

Source: Kenya Wildlife Service and Forest Department, 1991.

The structure of the economy has not changed much in some respects since 1965. Then agriculture accounted for 35 percent of GDP and in 1987 it accounted for 31 percent. Even today it provides the main livelihood for 85 per cent of the population and employs 70 percent of the workforce. The shift in the share of GDP was mainly to services which increased their share from 47 to 50 percent over the same period. The variations in economic performance are closely tied to variations in the performance of the agriculture sector. Thus, when due to drought agriculture suffered heavily in 1984, overall GDP growth was brought down to almost zero. Of the services sectors the one that has flourished greatly has been tourism. Foreign visitor

nights have grown at 4.1 percent per annum since 1980 and earnings have now reached $444 million. This is by far the largest foreign exchange earner as a single item. Other export earnings are mainly from natural resource based products with little processing. In 1990, total exports of natural resource items accounted for 80% of all visible exports, and of these only 24% were processed items. The major export earners in primary products are tea and coffee, which between them were worth the same as the earnings from tourism ($445 million). A fast growing item of exports (and now third in the visible exports in terms of value) is horticulture, which in 1990 accounted for exports worth $133 million. Thus the economy is heavily dependent on its natural resource base for its export earnings and any damage to that base could have serious consequences for the country.

In Chapter 4 we consider some of the constraints to economic development in Kenya. Among these is undoubtedly, the pressure on the environmental support base that the fast rising population has been creating.

In summary, we can say that Kenya made steady progress in an economic sense in the period from independence to 1980, although much of the benefit was absorbed in the growing population. The 1980s were a difficult period with declining real incomes for the first seven years, but the situation has improved since 1987. Per-capita growth has become positive again and population growth is beginning to decline. The country is heavily dependent on its natural resource base for its economic output; both domestically (where agriculture remains dominant) and in the external sector (where agriculture, and natural-resource based items such as hides and non-fur skins etc., and tourism) are the main sources of income.

2.7 ADMINISTRATION

The main Government organisations concerned with conservation of biodiversity in Kenya are as follows:

Kenya Wildlife Services (formerly Dept. of Wildlife Conservation and Management)
National Museums of Kenya (KWS)
National Environment Secretariat (NES)
Forest Department (FD) (Ministry of Environment and Natural Resources (MENR))
Department of Resources Survey and Remote Sensing (DRSRS) (Ministry of Planning and National Development (MPNMD))
Ministry of Tourism and Wildlife (MOTW)
Ministry of Agriculture (MOA)
Ministry of Livestock Development (MOLD)
Ministry of Lands and Housing
Ministry of Regional Development (MRD) (Fisheries Dept.)
Ministry of Water Development.

The following other government and parastatal organisations are involved in biodiversity activity in Kenya:

CBK	-	Coffee Board of Kenya
CRF	-	Coffee Research Foundation
IPR	-	Institute of Primate Research (NMK)
IRCU	-	Industrial Research and Consultancy Unit
JKUCAT	-	Jomo Kenyatta University College for Agriculture and Technology
KARI	-	Kenya Agricultural Research Institute
KEFRI	-	Kenya Forestry Research Institute
KEMRI	-	Kenya Medical Research Institute
KEMFRI	-	Kenya Marine and Fisheries Research Institute
KENSIDOC	-	Kenya Scientific Information Documentation and Communication Centre
KETRI	-	Kenya Trypanosomiasis Research Institute
KFC	-	Kenya Forestry College
KIPO	-	Kenya Industrial Property of Office
KIRDI	-	Kenya Industrial Research and Development Institute
MIRCEN	-	Microbiological Research Centre
MPND	-	Ministry of Planning and National Development
MRDASAW	-	Ministry of Reclamation and Development of Arid Semi Arid Wastelands
MRST	-	Ministry of Research Science and Development
MU	-	Moi University
NACBAA	-	National Advisory Committee on Biotechnology Advances and their Applications
NCRR	-	National Centre for Research in Reproduction
NCST	-	National Council for Science and Technology
NRRC	-	National Range Research Centre
OP	-	Office of the President
TBK	-	Tea Board of Kenya
TRF	-	Tea Research Foundation
UoN	-	University of Nairobi

Relevant NGOs that are involved with biodiversity in Kenya are:

ACTS	-	Africa Centre for Technology Studies
AWF	-	Africa Wildlife Foundation
KENGO	-	Kenya Energy NGOs
	-	World Freedom from Hunger

ICRAF	-	International Council for Research into Agroforestry
	-	Green Belt Movement
KFFH	-	Kenya Freedom from Hunger
KGG	-	Kenya Girl Guides Association
WCI	-	Worldlife Conservation International
WCK	-	Wildlife Clubs of Kenya
WWF	-	World Wildlife Fund

2.8 THE NATIONAL BIODIVERSITY UNIT (NBU) OF KENYA

Kenya has established a biodiversity unit (NBU). As presently constituted it has a Coordinator/Chairman and two Associates (Directors of National Museums of Kenya and National Environment Secretariat), a Secretariat, and a team of experts in various areas related to biodiversity conservation and use. The Unit is based at the National Museums of Kenya. After completion of the study the NBU will be structured such that it can address itself all issues relating to biodiversity in the country.

CHAPTER 3

BIODIVERSITY STATUS: ANIMALS, PLANTS AND MICROBES

3.1 INTRODUCTION

Kenya's biodiversity is the sum of all the species, and all the genetic variants within those species, which exist within Kenya's borders, as well as the many preserved type specimens and living representatives of Kenyan biodiversity are located outside Kenya.

Knowledge of biodiversity within Kenya exists in two forms. First there is a large corpus of cultural knowledge about biodiversity held by the different indigenous people of Kenya, many of whom have been continuously resident in a particular region of Kenya for over 2,000 years. Most of this cultural knowledge is local and strictly utilitarian. Different biological species may be given the same name if they serve the same purpose. This knowledge is often extremely comprehensive. For example, the Maasai recognize several hundred rangeland plant species and ecotypes; the Suiei Dorobo of Northern Kenya use over 500 plant species; the Bukusu in Bungoma utilise over 100 plants for food. Most of this knowledge is orally transmitted, and is being lost rapidly as cultures change. Second, there is the scientific knowledge of Kenyan biodiversity, based on Latin binomials and evolutionary relationships, which is growing rapidly, but is not yet complete enough to replace the cultural and utilitarian biodiversity knowledge which is being eroded.

A primary goal of this study was to document the status of biodiversity knowledge within Kenya. Without this raw information, rational use of biological wealth is impossible. Inevitably, this report reflects the state of scientific and indigenous knowledge of biodiversity as is currently available.

For convenience, knowledge of biodiversity can be stratified in the following levels of information:

(i) Biological/taxonomic: species names, descriptions and positions in taxonomic hierarchy. This requires knowledge of morphological, anatomical and biochemical phenotype and possibly also elements of physiological function and behaviour.

(ii) Geographical: the present distribution of biodiversity in relation to biotic communities and human land use.

(iii) Ecological: environmental requirements for species survival and the natural ecosystem services provided by species.

(iv) Economic: the economic value of species in both natural and applied environments.

Known biodiversity is, therefore, much more than just a species list. It includes knowledge of which species are found where, and the size and health of those species' populations in the socio-economic context.

Inevitably, there are many large gaps in our biodiversity knowledge. In this chapter we start to document both the existing data on biodiversity in Kenya and the major gaps in this knowledge. The following sections deal with animals, plants and microbes respectively.

3.2 ANIMAL BIODIVERSITY

Worldwide there are about 1.5 mn described animal species. Estimates of total animal species range between 5 and 80 mn. This upper limit of this range is critically dependent upon extrapolations of insect (especially beetle) species diversity from limited samples in tropical rain forests.

Kenya possesses little true tropical rainforest, and it therefore has fewer animal species than heavily forested tropical countries. However, the value of a country's biodiversity cannot be measured by species counts alone.

Kenya possesses a unique assembly of charismatic megafauna, with few parallels elsewhere in the world. East Africa is probably now the only region where vertebrate wildlife populations still resemble those present throughout Africa 5,000 years ago. This wildlife spectacle is present today, not because of the absence of human influence; rather it is due to the continuous presence within Kenya of human cultures which have evolved in equilibrium with those wildlife populations. Only in the past 100 years has this equilibrium been severely perturbed.

At present, on the evidence of this report, Kenya has an estimated 25,375 animal species. This number may underestimate actual animal biodiversity by several orders of magnitude. A simple taxonomic breakdown of wild and domesticated species and their conservation status is given in Annexes 1a, 1b and 1b.2.

The quality of information in different taxa ranges from very good to fragile (see footnotes to Annexes). The species lists for birds and mammals biodiversity are

relatively complete. For many of these species, population distribution and size are known well enough for reliable statements to be made about future viability under present, although perhaps not rapidly changing, conditions. Adequate species lists also exist for fish, butterflies, dragonflies and termites, but complete data on distribution are not available for more than a few species in these taxa. In the other animal taxa, large gaps exist in our knowledge. For only a few of these taxa does detailed information exist, usually about member species with a negative economic impact through disease to man, or his domesticated animals and plants.

These data can confirm only 6 local extinctions and a total of 263 species under threat (see Annex 1b and 1b.2). The list includes 2 endemic primates, now restricted to a single site, the remaining 3% of Kenya's original black rhino population, and the endemic Taita Hills Swallowtail butterfly. Almost certainly, more fish species from the endemic cichlid flock of Lake Victoria should be added to this list. The list would no doubt be further extended if more accurate population and distribution data were available. Efficient conservation management will be dependent upon demographic information which currently is missing in Kenya. Although data of equivalent quality is not needed for all species, regular population/census data is especially important for those keystone/indicator species whose survival reflects the stability of whole habitats/ecosystems.

3.3 PLANT BIODIVERSITY

On the basis of this report, Kenya possesses a total of 6,817 plant species. This total does not include 299 species of macroalgae, which should now be classified within the Kingdom Protoctista, nor 24 species of blue-greens, which are included in the totals for the Kingdom Monera. The distribution of plant species by taxa is given in Annex 1a.

7,000 plant species might be considered a low number for a country of Kenya's size. But it is remarkably high given that three-quarters of Kenya's land area comprises semi-arid/arid ecosystems which support low, but interesting (and currently poorly studied) plant biodiversity.

Kenya's high plant species richness (after allowance for arid regions) arises because the country lies at the intersection of four major zones of plant species diversity, briefly outlined below:

Guineo-Congolian: Kenya possesses the easternmost fragments of the Guineo-Congolian region, now restricted to the degraded forests of Kakamega and the adjacent Bonjogo forest (both under intense outside pressure and proposed for

increased conservation status). Kenya's Guineo-Congolian forests grow in a drier environment than the larger, western tracts of forest in Uganda, etc. and have somewhat different species composition. Although not rich in national endemics, this region is the only remaining patch of one of Kenya's more species rich biotic communities. 4469ha of the forest was protected as National Reserve in 1985 but the entire area remains under intense pressure from encroachment and unsustainable extractive use.

Zanzibar-Inhambane Mosaic: Along the coast, Kenya once possessed a narrow strip of vegetation (50-200km wide) belonging to the Zanzibar-Inhambane Regional Mosaic. Due to population pressure and changes in land use, the forest component of this vegetation is now highly fragmented. Each surviving region shows a high level of endemism and all remaining patches are under threat. Only two (Shimba Hills NP and Arabuko-Sokoke NR) currently receive any protection.

Somali-Maasai Region: These upland dry evergreen forests now occur only as relic stands along the eastern edges of the Rift Valley of Kenya and N. Tanzania. The most important protected areas are Ol Doinyo Sabuk NP and the Nairobi Forest Reserve. Small parts of the latter lie within Nairobi NP (80ha), or the City Park and Arboretum (100ha).

Afro-Montane Region: This is the best studied forest type in Kenya, growing on the higher regions of the Rift Escarpment and Central Highlands. These forests all serve important watershed functions, in addition to providing sites for high plant and animal biodiversity. Although some high altitude montane forests are well protected by isolated position and protected area status, others are being eroded at increasingly rapid rates. There are several prime areas for increased protection including, for example, Mau Forest (30% degraded in the last 10 years) and Mt. Kenya (lower slopes threatened by encroachment by small-farm agriculture and illegal logging).

Overall, knowledge of higher plant biodiversity in Kenya is perhaps above average for tropical countries. A preliminary listing of endemic and/or threatened species is given in Appendix 2 of this Chapter. This list records 392 national endemics, a further 336 regional endemics, 6 known extinctions and at least 258 species are threatened.

In this report we wish to highlight the critical lack of information about lower plant groups which form a significant portion of the Kenyan total. Brief notes reflecting the knowledge base are reproduced below. (K1 to K7 are the floristic regions of Kenya recognized by the Flora of East Africa).

BRYOPHYTA:

Total no. of species recorded:	608 (>46 Families/159 Genera). Only 189 species are listed from the Herbarium
Taxonomic distribution:	Musci 475; Hepaticae 133 (includes Anthoceratae?).
Geographical distribution:	The intensity of sampling is low and uneven; the number listed above is a minimum. More importantly, there is little population data available, thus no assessment of threat can be made for individual species. There are no known Kenyan endemic bryophytes; nor known introduced or domesticated bryophyte species in Kenya.
K1:	5 site records; 22 species; Maralal Mountains: 18 species. Herbarium lists no taxa for K1.
K2:	no known records. Herbarium lists 1 taxa.
K2/3 boundary:	Cherangani Hills: 21 species.
K3:	13 site records; 42 species. Herbarium lists 29 taxa.
K3/4 boundary:	Aberdares: 98 species
K3/5 boundary:	Mount Elgon: 106 species
K4:	30 site records; 312 species; Mt Kenya: 237 species. Herbarium lists 143 taxa.
K5:	? site records; 32 species (excluding Mt Elgon); Mt Tinderet: 31 species; Kakamega: 6 species. Herbarium lists 3 taxa.
K6:	5 site records; 23 species; Ngong Hills: 13 species. Herbarium lists 3 taxa.
K7:	6 site records; 33 species; Taita Hills/Mt Vuria: 24 species. Herbarium lists 7 taxa.
	44% of known species are found only in three sites (Mt Kenya: 237/Mt Elgon: 106/Aberdares: 98).

With few exceptions, bryophyte biodiversity will strongly correlate with the conservation status of moist forest land. If these areas are protected and managed, then most bryophyte species will survive. Rarer, locally threatened species could easily be held in ex-situ facilities if these existed. 16 taxa from the East African Herbarium list at NMK are recorded in two regions; all other taxa appear in just one region.

Environmental services: Water absorption by bryophyte cover has been shown to contribute to local climate and regulation of watershed runoff.

Market value: The only current positive economic value for bryophytes is collection of material for the horticultural industry, especially from forests near Nairobi. No quantitative data are available; unregulated collection is depleting populations of rarer species.

Potential value: Recent screening by Japanese biochemists has demonstrated the presence of terpenoid and other aromatic compounds in some species. No data on screening of Kenyan species are available.

PTERIDOPHYTA:
Psilophyta, Lycopodophyta, Equisetophyta, Filicinophyta:

Total number of species recorded: 266

This study has produced a list of 266 species of pteridophyta recorded at least once in Kenya. This listing has been made from a variety of sources, some quite old, and may include records of species no longer extant in Kenya.

Taxonomic distribution:	Psilophyta 1 Lycopodophyta 23 Equisetophyta 1 Filicinophyta 241
Geographical distribution:	Detailed geographical information is not well recorded for Kenyan lower plants; most records in the Herbarium refer only to regions. The number of species recorded for each region is as follows:
K1:	58
K2:	34
K3:	128
K4:	176
K5:	109
K6:	58
K7:	133

These numbers reflect the suitability of each region for lower plant species (this correlates with increasing rainfall) and the intensity of collecting effort in each region. Pteridophyte species richness will correlate with forest distribution, but small fern species may be found in patches of woodland/rock crevices, etc. throughout Kenya.

Little population data is available for any species but some assessment of threat can be made from the number and scatter of records. On this basis, the Herbarium estimates 62 species to be threatened, with 3 species considered rare. 9 of these 62 species are endemics (3 true Kenyan coastal Z-I endemics, 2 regional Z-I endemics and 4 species recorded from Z-I and one other phytogeographical region).

GYMNOSPERMAE/CONIFEROPHYTA:
Total number of species recorded: 17

Taxonomic distribution: 6 Genera are recorded.

Cycas:	1 species (on rare plants list)
Encephalartos:	5 species (on rare plants list)
Podocarpus:	4 species
Juniperus:	1 species
Cupressus:	3 introduced species
Pinus:	3 introduced species

Geographical distribution: Few data are available for these species. All the cycad species are considered to be threatened, whilst two *Podocarpus* species are known from just one or two records, including a recent new record for Kenya. Two of the six cycad species are full Kenyan endemics (one is considered endangered, the other vulnerable), a third species is a Z-I endemic and another is recorded for Z-I and one other region (these two species are considered rare). Introduced cypress (*Cupressus* spp.) form around 45% (73,900ha) of the national plantation forest , and are currently under extreme threat from the introduced European cypress aphid (*Cinaria cupressi*), first recorded in Kenya in March 1990. If these plantations are lost, Kenya will not be self-sufficient in industrial timber production, and an international appeal for assistance in developing chemical or biological control has been made (Nyaga, 1991). The aphid also feeds on indigenous cedar species which form an important part of Kenya's water catchment forest.

ANGIOSPERMOPHYTA:
Details of this large taxon could not be prepared in time for this report. An overview and some details are presented in the separate Plant Biodiversity Report available from the National Museums of Kenya.

The quality of the plant biodiversity data is due primarily to the presence of the East African Herbarium in Nairobi, and to the dedication of the staff in this institution. Sufficient knowledge already exists to allow identification of major regions of plant endemism within Kenya (see Annex 1e), but significant investment in both facilities and staff will be required if the Herbarium is to become an active conservation centre. (See Chapter 5).

The Herbarium is also the base for research programmes on economic uses of plant biodiversity. For example, the database compiled as part of the Indigenous Plant Food Programme will provide an essential store of local cultural knowledge of plant resources, at a time when traditional verbal transmission is being disrupted by rapidly changing cultural environments.

Several isolated areas of the country, notably mangrove forests and the arid regions of NW Kenya have, until recently, been little exploited. Unregulated use of both these areas is increasing. Arid rangeland vegetation is now increasingly under threat, for example by overcollection of *Aloe spp.* for commercial use. Little systematic study of the plants (and animals) of these regions has been completed, and this should be a priority for future study (See Chapter 5).

3.3A MICROBIAL BIODIVERSITY

Kenya's known microbial biodiversity is summarised in Annex 1a. There are approximately 1841 recorded microbes (viruses, monerans, microfungi and protozoa).

There are many gaps in the data. The total species number undoubtedly underestimates true microbial biodiversity. Despite this level of ignorance for microbial species lists, Kenya recognizes the vital role played by these species in both disease and ecosystem function; probably no natural ecosystem could function without its microbes.

Categories of threat are a new concept to microbiologists, but at least 1 microbe, the smallpox virus, may belong on the extinction list. Specific conservation measures for microbes will only be possible through conservation of intact habitats or *ex situ* culture collections. Kenya has begun investment in the latter (see Annex 1k), but at present does not have a large capacity to store and work on microbial diversity. Kenya lacks adequate connections to global culture collections and microbial databases.

Most of the microbes which have been isolated and described have negative economic impact (eg. *Plasmodium spp.*, *Trypanosomas spp.*, rinderpest, plant, animal and human viruses). This negative economic effect has a direct effect on biodiversity in Kenya. For example, lowered livestock productivity caused by disease increases the intensity

and area used by pastoralists, increasing pressure on other species. Elimination of these negative impacts is considered to be a priority within Kenya.

Little work has been completed on microbes with positive economic impact. Kenya derives some positive economic value from microbes through the commercial sale of nitrogen-fixing *Rhizobium* bacteria to farmers, reducing requirements for increasingly expensive fertilizers. A number of companies are producing single cell protein from *Spirulina* spp.; and fermented food and drink are still produced in many parts of Kenya.

Kenya has initiated an active research and application programme in biotechnology. Research on microbes producing secondary metabolites of potential commercial interest is being conducted by the National Agricultural Laboratory (NAL). The University of Nairobi has recently begun to utilise modern biotechnological methods (eg. DNA probes and RFLPs) to characterize microbial pathogens as a preliminary step to the development of vaccine control programmes.

With respect to microbial conservation "in the field", Kenya's soda lakes are of particular interest. Microbes play a vital role in the ecology of these lakes, where no higher plants can survive. The cyanophyte blue-green, *Spirulina platensis*, is the main food of the flamingo flocks that make Lake Nakuru a significant tourist attraction. These lakes are also home to groups of endemic prokaryote archeobacteria. This group of bacteria represent the most primitive and distinctive life forms found on Earth, similar to those thought to represent the earliest living organisms. Kenya's Rift Valley soda lakes, notably Lakes Nakuru, Bogoria, Elementaita and Magadi, present extremely hostile environmental conditions to most living organisms, with salinity of up to 25% and pH rising to 9-10. Halalkiliphic bacteria adapted to these conditions possess thermostable enzymes, able to withstand extremes of pH, which catalyze reactions of commercial interest. Biological synthesis of chemicals, unlike most organic chemical synthesis, produces pure stereo-isomeric forms, not chiral mixtures. Controlled biological synthesis of pharmaceuticals could become more important following recent tightening of legislation on safety of chiral mixtures of drugs.

3.4 *IN-SITU* CONSERVATION

3.4.1 Introduction

In this section and the following section this Chapter an attempt is made to describe evaluate current efforts at biological diversity conservation in Kenya. This section looks at *in-situ* conservation (i.e. conservation of species in their natural habitat). Section 3.5 examines *ex-situ* conservation (i.e. conservation of species outside of their original habitat).

In-situ conservation offers three main advantages over alternative, ie. *ex-situ*, conservation methods:

(i) if no land purchase is required, establishment and maintenance costs are low for the total number of species conserved;

(ii) many species, including unknown ones, are conserved, without the need for specialised conditions and treatment;

(iii) known and unknown environmental services are conserved, whilst still allowing some mixed use and future option value.

The basis of *in-situ* conservation in most countries is the system of protected areas. But generally, conservation and utilisation of biodiversity require land beyond protected areas. This section reviews the current status of Kenya's protected areas, describes the status of biodiversity beyond these areas, and discusses the connection between the two.

3.4.2 In-situ Conservation in Protected Areas

Kenya currently possesses 4,434,266ha of protected area in the form of 51 terrestrial and marine National Parks, Reserves and Sanctuaries. This represents 7.61% of the total land area. At least 176,400ha of additional protected areas have been proposed, and Kenya Wildlife Service has identified a number of other desirable extensions and additions to the current system (see below). Changes in protected area status are, however, not unidirectional. One National Reserve is being degazetted (Ngai Ndethya NR; area 212,209ha), and two other Reserves are being reduced (Mwea NR by 2,000ha to 4800ha, and North Kitui NR by 11,000ha to 63,500ha). A further 1,669,022ha of gazetted Forest Reserve is listed as IUCN category VIII, allowing sustainable use and conservation. In recent years, much of this forest area has received little real protection. Within the gazetted forest system, there are 11 Forest Nature Reserves, specifically set aside for conservation. These reserves occupy a total of 52,679ha, but one reserve, SW Mau, comprises 43,032ha of this total.

Raw statistics on protected areas hide some important details:

(i) two parks, Tsavo East and West, account for over 70% of the Park total area and 47% of the total protected area system. These two Parks have experienced some of the worst declines in elephant and rhino numbers, and are as seriously ecologically disturbed as many unprotected areas;

(ii) over 75% of the total protected areas lie in savanna grassland/semi-arid/arid areas of the country; areas which do not contain the highest raw biodiversity

(see commentary to Annex 1h);

(iii) three of Kenya's 19 biotic communities are not represented in these protected areas; a further 8 communities are represented in only one or two protected areas (see Annex 1h and below);

(iv) most protected areas suffer damage through encroachment, poaching, pollution, or overuse by tourists;

(v) most protected areas do not encompass complete natural ecosystems; they are therefore critically dependent upon areas beyond their boundaries (see below).

Proposed extensions to the protected area system:

The Kenya Wildlife Service has identified, in its 1990 management and development plan, a number of desirable extensions and additions to the present protected area system. These plans are described briefly below in alphabetical, not priority, order (costs and benefits of these additions are discussed more fully in Chapter 6). Recently, it is understood that no new protected areas will be declared on forest reserve land has been agreed between KWS and the Forest Department. Instead, KWS has agreed to assist the Forest Department in joint management ventures. It is not known how this will affect the proposals listed below.

Aberdare National Park: An expansion of the Park to the east (running north and south of the salient) would allow more montane forest to be protected. At present, the boundary alignment tends to exclude most of the forested area. This extension would also provide additional area for rhinoceros releases from sanctuaries with a breeding surplus. A north-western extension would allow some of the presently unrepresented Highland grassland biotic community to be incorporated into the system (see Annex 1h). The recommended extensions would add about 10,000ha on the eastern side and 2,000ha to the north-west, and would increase the total size of the park from 76,600 to about 88,600ha.

Cherangani Mountain: This substantial forested mountain range in Pokot and Elgeyo Marakwet Districts rises to over 3400 m. Some parts of the mountain extend above the tree line into the alpine zone. At present, the Lelan and Kipkunuro forest areas are under great pressure from encroachment and damage from sheep kept at higher elevations. These forests are an important catchment area, and the site has tourism potential, providing North American-style wilderness experience. Cherangani was specifically recommended for enhanced protection by IUCN in 1987. An area of about 12,5000ha would need to be protected. Most of this area is forest reserve, including some exotic plantation at lower elevations.

Coastal Forests: IUCN has urged that all remaining coastal forests in Kenya should be totally protected. Although there is a Presidential ban nationally on logging of indigenous forest, the Coastal Province is exempt because of its lack of sufficient plantation forest. The two main coastal forest areas (Shimba Hills and Arabuko-Sokoke) are partly protected, but most remaining coastal forest fragments (eg. Witu, Jombo, Mrima) are rich in plant species and worthy of increased protection/regulated use (see Appendix 3 and the forthcoming WWF Coastal Forest Survey Report, Luke and Robertson, in prep.).

Crater Lake: This lake lies within an old volcanic crater, west of Lake Naivasha. The green colour of the water is caused by abundant algal growth. The lake is surrounded by *Acacia xanthophloea* forest, and the area contains water fowl, bushbuck, Grant's gazelle, dik dik, eland, impala, kongoni, zebra and giraffe. This area has high scenic value and tourism potential. It is about 10 kms. from Hell's Gate National Park, and easily accessible by road. The land is presently owned by the Agricultural Development Corporation. The site could be protected within an area of about 600ha.

Gurar: About 30,000ha on the border with Ethiopia in Wajir District (39° 33' to 39° 45' E). This region of the country has received little study and protection, but human influence is increasing. There are unsubstantiated reports of rhinoceros and elephant from this region; guinea fowl are reported to be extremely abundant and botanists consider the area a site of plant endemism. Some catchment protection could result from bringing the area into the system.

Hell's Gate and Longonot NPs extension: The recently completed KWS management plan for these two parks considers them to belong to one ecosystem, with animal migrations occurring between them, and concludes that they should be amalgamated into one management unit by means of a corridor. Proposals were also put forward for a southerly extension of Hell's Gate and a westerly extension of Longonot. The total area involved would be 11,600ha. Much of this land is privately owned. Extension would almost double the total area of the two parks, which currently stands at 12,000ha An alternative to inclusion within the protected area system is to encourage private landowners, perhaps over a wider area extending to Suswa, to keep their land open for wildlife and participate actively in its management in liaison with the two Parks.

Kasigau Mountain: A permanently damp catchment forest, located about 40 kms. SE of Voi. Precipitous slopes has kept the forest relatively inaccessible to wood cutters. The central, highest ground is around 200ha of forest reserve, but the ecological unit is larger, and about 2,000ha would benefit from protection.

Lake Baringo: A relatively large freshwater lake in Baringo District. There are several islands in the lake, the largest of which (Ol Kokwe) has a hot spring. There is much human activity present , including a tourist lodge and a local fishing and fish processing industry. This presence would make elevation to national park status difficult. A protected area of about 15,000ha, mostly water, would include a large proportion of the lake and parts of its shoreline.

Lake Elementaita: An ephemeral soda lake that provides breeding habitat for pelicans and flamingoes when water is available. The area is very scenic, and high in tourism potential. About 4,000ha, mostly lake, would be needed to protect the lake ecosystem. Some of the surrounding land is privately owned and intensification of agriculture could easily silt up the shallow lake.

Lake Turkana: KWS already has plans to include more of Lake Turkana in the protected areas system. Proposals for extending the boundary of Central Island National Park to 3 kms. offshore have already been put forward to the Government, but the proposed extension has not been approved for gazettement. Consideration should also be given making Similar extensions of South Island National Park into the lake would conserve more aquatic habitat containing endemic fish species. If both these extensions were completed, the total addition to the system would be of the order of 16,000ha of lake, bringing further examples of the freshwater lakes biotic community into the system. At present the community is represented only by Sibiloi and Ndere Island NPs.

Lake Victoria: Lake Victoria is one of the richest lakes in the world in terms of fish diversity and endemism, yet has no protection beyond the shore of Ndere Island NP. KWS has been considering extending the boundaries of Ndere Island National Park 3 kms. out into the lake. This proposed extension would add about 10,000ha of freshwater lake biotic community into the system.

Loita Hills/Nguruman Range: This band of wooded hill country, covering around 55,000ha of southern Narok District has good tourism potential, especially for wilderness trekking, and is close enough to Maasai Mara National Reserve to be linked on the same tourism circuit. The Loita Hills section is believed to harbour a significant population of rhinoceros, with good potential for breeding, which ought to be protected *in situ*, whilst the Nguruman Range contains around 200 elephants, in addition to being a site of plant endemism.

Mathews Range: This forested mountain range in Samburu District reaches 2390m. and offers good potential for a large park or reserve. There are believed to be about 250 elephants using the area, and rhinoceros occur in the Njeng Valley, on the western side of the range. The range has high scenic value and considerable wilderness

tourism potential. It also has an important water catchment function. About 135,000ha could be added to the protected area system. Most of it (93,766ha) is presently forest reserve.

Mount Elgon National Park extension: The present 16,900ha Mount Elgon NP protects two major biotic communities: Afroalpine mountain glacier and moorland, and highland moist forest, which in total cover some 100,000ha. A proposed extension south-west of the Park was mapped in 1987 but has progressed no further. The extension measured 39,600ha of montane forest. It is recommended that this proposal be taken up again and pursued. This additional land will greatly increase the amount of catchment forest under full protection.

Mount Kenya National Park extension: Two remnant populations of rhinoceros occur in forested land to the south and west of the park. They have good breeding potential and should be protected *in situ*. A northern extension would allow some of the highland grassland biotic community to be incorporated into the system (see Annex 1h). A good deal more of the forested slopes needs protection,or much more careful utilisation. Full protection would increase the size of the Park from its present 71,500 to about 200,000ha.

Ngong Hills: Protection of this small range, about 3,000ha south-west of Nairobi, would protect a valuable catchment area and place of scenic interest. NMK staff rate the hills as area of botanical interest and importance.

Nyambeni Forest: 5,000ha of scenic forest in Meru District, under heavy pressure from the local population. It is considered to be of site of plant endemism (see Appendix 3). Unless this site receives some protection, it is unlikely to survive long.

Ol Doinyo Orok: A 2,500m high, forested hill near Namanga on the border with Tanzania. Protection of around 10,000ha would ensure forest cover remains on catchment areas and conserve an area including endemic/rare plants and animals.

South-Western Mau: A large expanse of forest on the borders of Narok, Nakuru and Kericho Districts. It is of special botanical interest and importance, and covers a section of the highland moist forest biotic community. It includes the South-Western Mau Forest, the Trans-Mara Forest and the South-Western Mau Nature Reserve. The total area covers about 110,000ha; 31,00ha of the SW Mau Summit has been proposed as a National Park.

Taiti Hills: This is an area rich in both plant and animal endemism, but with a number of species already under threat. Recently, some of the forest has been incorporated into a private reserve with tourist lodge.

Tana Delta: Around 85,500 ha of this large expanse of mangrove forest and marine beach and dune biotic community has been proposed for NP status. Mangrove is still being cleared, despite a national ban, and some areas of the delta are threatened by proposed expansion of aquaculture.

3.4.2 In-situ Conservation in Wildlife Dispersal and Buffer Zones

In Kenya, wildlife and people still coexist over large areas of the country. Three-quarters of Kenya's wildlife is located outside protected areas, despite continuous human presence in these areas for several thousand years. The wildlife of certain protected areas, notably Amboseli NP, Maasai Mara NR and Nairobi NP, disperse well beyond the boundaries of the protected areas during the wet season. The wildlife assemblages which underpin much of Kenya's tourist industry are influenced by land use changes in these dispersal and buffer zones. Exact ecological analysis of the size of these dispersal and buffer zones, and the effect their loss would have on National Parks and Reserves, should be a high priority. Current estimates of dispersal zones covering 459,407 km² (79% of total land area) are too coarse-grained to provide useful information for economic valuation. KWS has begun to refine these broad areas into priority zones, some of which are summarised below. The text here is derived from Annex 6 of the KWS 1990 Management and Development Plan.

Amboseli-Emali dispersal area: Much of the wildlife of Amboseli National Park move eastward towards Emali area during the wet seasons. The dispersal area is approximately ten times the size of the Park itself, much of which is a seasonally flooded lake bed. The immediate area around Amboseli is Olgulului group ranch which, like all group ranches in Kajiado District, is earmarked for subdivision in the near future. Three other group ranches contribute in lesser degree to the Amboseli dispersal area and a few others also support small amounts of Amboseli wildlife. If subdivision were to lead to physical subdivision of the land and fencing of individual holdings, as it will do sooner or later unless prevented, then these vital animal migrations will be impeded. Wildebeest, zebra and other large grazers of Amboseli will exceed their seasonal carrying capacity if confined to the Park. This will accelerate land degradation and soil erosion, wildlife populations will crash and one of the major pillars of Kenya's tourism industry will be severely devalued.

Amboseli-Kilimanjaro elephant corridor: In addition to the general requirements of the large mammals of Amboseli, the elephant populations have a special migration route, between Amboseli and the forests of Mount Kilimanjaro. The KWS elephant programme has proposed that this "corridor" be kept open in order to ensure that the two small elephant populations of Amboseli and Kilimanjaro remain viable in genetic, demographic and ecological terms by securing a corridor between the two populations. This would have the additional benefit of maintaining the integrity of the ecosystem for other species and also open an avenue for the future potential of cross-border

tourism between Kenya and Tanzania that would benefit both countries. The corridor is important to the Amboseli and Kilimanjaro elephants because the two populations are only separated by open savannah, agricultural land and Forest Reserve and are connected by two well-worn elephant trails. The agricultural land near the forest reserve on the Tanzania side is becoming increasingly settled and it is clear that if action is not taken to secure a corridor in the near future, the two populations will eventually become cut off. Based on information gathered during a recent survey, the only area regularly used by elephants is a strip about 15 kms. wide of *Acacia* bush in the Kitende area between the Lerangwa River ("Sawmill Korongo") on the west side and the Ibola Korongo on the east. The strip also goes through some agriculturally high potential areas. Two elephant trails between Amboseli and Kilimanjaro have been located, running along either side of the strip. The eastern boundary is marked by areas of intensive maize cultivation. Interest in establishing an elephant corridor has been expressed by wildlife officials in both countries and high level discussions have already taken place. It is not known how these plans are affected by the recent announcement of Amboseli as a 483,200 ha Biosphere Reserve.

Maasai Mara NR dispersal area: Maasai Mara is the northern tip of a vast ecosystem stretching far south into the Serengeti plains of Tanzania and containing vast populations of wildebeest, zebra and other herbivores. Associated with them are large numbers of predators which, in the Mara, are readily seen by tourists. This predator viewing and the spectacular herbivore aggregations are the outstanding attractions of Kenya's wildlife tourism. Without the Mara wilderness, Kenya's wildlife tourism could decline significantly. The degradation of the Mara in recent years, inside and outside the Reserve, is a source of grave concern in the tourism industry, motivating some to look for alternatives in Tanzania or southern Africa. The large wildlife populations depend on the group ranches around the Reserve for seasonal grazing. Surveys indicate that there is generally as much or more wildlife on the group ranches as in the Reserve. Koyiaki Group Ranch supports an exceptional proportion of the wildlife but several other ranches support significant amounts. The threats to the dispersal areas are:

(i) Subdivision: Narok District has also been targeted as a priority for subdivision of group ranches.

(ii) The expansion of wheat: Large scale wheat farming on leased group ranch land has been expanding into the Mara dispersal area, squeezing both the wildlife populations and the pastoralists with their herds into the ranches closest to the Reserve. The Government attempted to "draw the line" and, with World Bank funding, erected a fence to mark the limit of the wheat. It now stands in the middle of wheat fields.

(iii) Unplanned development of tourist accommodation: Large potential profits from tourist facilities in the Mara generate tremendous pressure from individual entrepreneurs to erect lodges. The Kenya Association of Tour Operators recognises that this haphazard development is destroying the touristic value of the Mara wilderness. A further problem is that, with the exception of a recent camping consortium deal, economic returns to the majority of group ranch people are minimal and provide no incentive to retain open habitat for wildlife and tourists. A moratorium on lodge development has been agreed but, in the absence of sound, enforceable land use planning, will not hold for long.

Olchoro Losoit Forest/Lemek Hills dispersal area: This *Walbergia* forest area lies about 35 kms. north-east of the Maasai Mara NR and has around 200 elephant. These residents are joined by some 400 or more in June - August. The forest is part of a larger migration corridor between Maasai Mara and south-west Mau forest. Most of the forest is on individually-owned land and the forest is under intense pressure from cultivation, charcoal burning and firewood collection, mostly by non-Maasai people and the tourist lodges and hotels, which remove truck loads of wood every day. The area is being used directly by tourists, as may be seen from the number of tour operator vehicles, off-road tracks, new lodges and campsites. Present use is unsustainable and the entire area could be degraded within 10 years.

Nairobi Park dispersal area (Athi-Kapiti ecosystem): The Athi-Kapiti plains are bounded on the east by the Nairobi-Konza railway, to the south by the Konza-Kajiado railway, and on the west by the rim of the rift valley escarpment. To the north they are continuous with Nairobi National Park. The Park is a dry season concentration area. In the wet season, wildlife moves southwards into the rest of the ecosystem. The whole ecosystem covers some 200,000 ha but a critical bottleneck in the dispersal area lies between Kitengala and Athi River. The proximity of the plains to Nairobi gives the wildlife high touristic and educational value. But, as human populations grow and cultural traditions change, pressure on the area is increasing. Land use on the plains is shifting rapidly from nomadic pastoralism to sedentary agriculture. Increased settlement has seen group ranches subdivided and sold as small units (in some areas such as Ongata Rongai, the land unit size is below an acre). Most of the Athi-Kapiti ecosystem is now private land (or group ranch in the process of subdivision), with the exception of the National Park, Athi River Town, Ongata Rongai, and Kitengela Market (including GoK Prisons and Kenya Army Land). Where livestock has been retained, it has changed from the nomadic traditional breeds to smaller scale, usually fenced, pedigree livestock. In the Ngong, Kitengela and Athi-River urban centre, human settlement and agriculture (both rainfed and irrigated) have increased. These land uses are increasingly incompatible with wildlife conservation. Around Nairobi the development value of land, density of settlement and industrial expansion are all increasing. The dispersal route southwards from the Park is confined now to a narrow

corridor, just a few kilometres across. Complete closure of the corridor would dramatically change the ecology of Nairobi NP. The Kenyan Government is investigating the possibilities for purchasing and keeping open a corridor down to the open plains, as part of the Export Processing Zone development proposed for Athi River area, and supported by the World Bank.

Shimba Hills/Maluganji Forest: Shimba Hills NR protects a botanically important coastal forest, and has high potential for tourism from visitors to coastal hotels. The elephant population has not been counted, but may be between 350 and 500 individuals. The elephants migrate between Shimba Hills and Maluganji forest, 5 kms. to the north. Maintenance of this dispersal area is necessary because the present elephant population is not sustainable in Shimba alone, without significant alteration to the vegetation of the Reserve. The land between the two areas is Trust Land, owned by Kwale County Council. The area is gradually being settled and the opened for cultivation. Elephants cause crop damage but, ultimately, the elephant migration corridor will be completely blocked. KWS is seeking to protect a wildlife corridor 3 kms. wide and 5 kms. long. The corridor and much of the Reserve will need to be fenced to protect the communities around them from property damage by the animals.

Laikipia Plateau: Livestock production on these plains is a major land use, especially on the large group ranches. The plateau is famous as one of the major wildlife areas of Kenya, supporting one of the largest elephant populations (2,200) and, on some private ranches, black rhinos. Wildlife has generally been tolerated as one of the land uses though, to a large extent, it has been a liability to land owners through competition for forage. Except for some recent ventures into tourism, there have been few economic returns for landowners. The southern edge of Laikipia borders agricultural land and there are serious conflicts with wildlife, especially crop damage by elephants. The plains themselves are marginal to rainfed agriculture and maize growing fails in most years, although this is frequently blamed on wildlife crop damage. Land use is changing; some of the southernmost large ranches are being bought by land companies for subdivision amongst shareholders. The resulting small plots are not viable in the arid climate of Laikipia, but the purchasers fence and cultivate the plots in the hope of getting reasonable yields in wet years. Riverside plots are favoured and the blocking of access has obvious negative implications for wildlife. The latest ranch to be earmarked for subdivision is Segera ranch, north of Ol Pejeta. It is an important elephant corridor and its loss to small scale cultivation will confine the elephants to Ol Pejeta. Wildlife populations on these ranches are increasing and loss of migration corridors will certainly lead to vegetation degradation and soil erosion unless populations are intensively managed by culling.

The combination of livestock and wildlife, used for tourism or meat, could offer

the most productive land use on these plains and could, at the same time, conserve one of Kenya's major wildlife populations. If subdivision of land ownership continues, it should be done in such a way that it does not physically divide up and fence off parcels of land, where this will destroy development options. Any subdivision should consider the impacts on neighbouring ranches using a combination of wildlife and livestock for economic purpose. Laikipia would seem to be potential area to introduce zoning according to development potential and conservation value, ensuring that wildlife habitat is kept open in certain areas.

Ngare Ndare Forest and elephant corridor: This is a Forest reserve in Meru District, with significant wildlife, including bushbuck, buffalo and elephant. Elephants migrate from Isiolo and the Leiwa Downs ranch to the forest. Acquisition of key areas of land along the corridor could ensure that it can be kept open. The area has potential for tourism.

Chyulu Hills adjacent to Tsavo West: Wildlife in the Tsavo West National Park disperses into this area, which comprises a number of group ranches, including Mbirikani, Kuku and Kimana. These are due to be subdivided into individual holdings.

Tsavo/Tana dispersal areas: This vast area, including virtually all of the Tana River District east of Tsavo East National Park contains wide ranging herbivore populations, but little is known of the relationship between productivity and seasonal movements.One enormous ranch in the area, Galana, has experimented with wildlife ranching. Wildlife provides a major income for the District, with potential for increased tourist use if reductions in poaching and improved security can be maintained.

Meru/Samburu/Buffalo Springs/Shaba dispersal areas, Mathews Range and other areas in the arid northern region: In the arid northern and eastern parts of Kenya, wildlife, livestock and man must all move seasonally in search of water and food. The wildlife of Meru NP disperses northwards and the wildlife of the Samburu/Buffalo Springs/Shaba area also move far away from the Reserves. Historically, there was migration to Mount Kenya in the dry season, but this has been blocked by agriculture. Elephant tracking from Laikipia confirms that they move rapidly over large distances and the Laikipia, Mathews Range and Samburu populations are likely to be demographically related. It is important to study these seasonal movements and make allowance for them in a regional land use planning.

Similar situations prevail for the wildlife of all the northern Reserves. Unlike the situation in Narok and Kajiado, there is little imminent danger of large scale land use change to static agriculture. However, small amounts of settlement/fencing in critical areas could easily block wildlife access to essential water sources or dry

season forage. It is important to identify these critical areas and develop a land zoning system before human land use intensity increases.

3.4.4 *In-situ* Conservation in Savanna/Semi-Arid/Arid Regions

Arid and semi-arid areas cover 41,348,500 ha of Kenya. These areas may be divided into 12 major ecosystems. In addition to containing three-quarters of Kenya's protected areas and well over half of Kenya's large animal wildlife, these regions support many pastoralist and crop/livestock farming communities, plus 60% of the country's beef cattle, 70% of the sheep and goats, and almost all of the camels. These large expanses also serve as water catchment areas (eg. Mzima spring in Tsavo supplies Mombasa) and as global carbon sinks. It is clear that 8 of the 12 semi-arid/arid ecosystems are declining in ecological quality and productive value. This is primarily due to overgrazing, subsequent soil erosion and desertification. Information for the other four ecosystems is lacking but it is likely that the situation is similar.

Savanna grasslands occupy over 8,164,000ha Most are experiencing greater external pressure and more rapid change than semi-arid and arid regions. Over 10% of original grassland savanna has been transformed. For example, the Mara-Loita-Ngorengore grasslands covered 351,000ha in 1975, with 5,000ha of wheatland. In 1987, 33,000 ha had been converted to wheatland, and a further 4,000ha converted but subsequently abandoned due to persistent crop failure. As the more productive grassland areas are converted to agriculture, livestock farmers and traditional pastoralists are pushed into smaller areas of more marginal land, increasing land degradation in these areas.

3.4.5 In-situ Conservation of Forests

Officially designated forest land in Kenya covers 2,204,676ha (3.7% of land area). Forest Department figures reveal that 45% of this area is grassland or bushland. The true forest area may be divided as follows:

Forest Type	Estimated Area (ha)
Closed natural forest	870,123
Plantations	166,188
Bushland (within gazetted forest areas)	326,670
Bamboo forest	138,479
Mangrove forest	61,574
Total	1,563,034

Gazetted forest in Kenya was surveyed recently by the Department of Resource Survey and Remote Sensing. This unpublished study reveals "some element of continuous human interference in most forest regions". Despite a Presidential ban on

felling of indigenous timber, official exemptions and illegal use are still resulting in complete clearance, selective logging, conversion to agriculture or plantation, as well as over collection of renewable forest resources. Beentje (1990) estimates that indigenous forest covers less than 586,000 ha. The average annual rate of indigenous forest conversion is 167 ha; the highest known rates are in Kakamega, and North and South Nandi, with annual deforestation rates of 245, 295 and 490 ha respectively. Over the period 1963-1989, there was a net loss of 22,900 ha., but this figure hides a significant amount of alteration to natural forest and woodland.

Cupressus spp. make up 45% of Kenya's plantation forest. This entire area is under threat from attack by the introduced aphid, *Cinaria cupressi*. Loss of this forest will exacerbate Kenya's shortage of timber and woodfuel supply. It has been estimated that the deficit in woodfuel supply will be the equivalent of 450,000ha of catchment forest or 2,700,000 ha of savannah cleared of timber between 1995-2005.

As well as supplying local and industrial timber and woodfuel, forest regions support the highest densities of biodiversity, including many of Kenya's threatened endemic plants, birds, mammals and butterflies. Forests also provide important water catchment areas, regulating soil erosion and seasonal river discharge. Although some forest lies within National Parks and Reserves, the bulk of forest land is managed by the Forest Department. This Department has only recently been allocated an increased role in forest conservation. It will require increased funding for management and training of personnel to adequately fulfil this new role. KWS plans, through joint management ventures with the Forest Department, to increase the importance of forest protected areas in its tourist development of Parks and Reserves. Potential revenue benefits from tourism need to be considered in full in relation to present regulated and unregulated land use.

3.4.6 *In-situ* Conservation of Wetlands

The total area of Kenyan wetlands is estimated to be about 1,460,300 ha. (2.5% of the total land area). This area includes 18 large, and many small, natural lakes, 6 artificial lakes, in addition to marshes, swamps and the banks of the 5 main watershed river systems. Of these areas, only 7 (Lakes Amboseli, Nakuru, Borogia and parts of Turkana, plus Saiwa Swamp NP, Tana River Primate NR and Boni NR) receive protection. Two new areas are proposed for protection: the Tana River Delta, an important mangrove forest, and Fourteen Falls, an area of swampy, riverine habitat.

It has been estimated that wetland areas are being converted to agriculture at around 9% per annum, and even protected wetland sites are being eroded by external threats. For example, agricultural and industrial effluents are polluting Lake Nakuru, and the altered flow rate of Tana River caused by impoundments is altering the pattern of riverine forest succession. Eight of Kenya's main lakes are being degraded by a

combination of siltation, reduced inflow, overfishing, introduced species and pollution. Virtually all swamps and marshes are in danger from agricultural encroachment, despite their known, but difficult to value, ecosystem services as nurseries for aquatic reproduction, water purification sites, regulators of runoff, and biomass producers (papyrus and other reeds). In addition, wetlands are major wildlife refuges for sitatunga, hippos, amphibians, crocodiles and hundreds of resident and migratory bird species.

3.4.7 *In-situ* Conservation of Marine Systems

Kenya has set a world standard in designation of protected area status to its marine systems. It has 4 Marine National Parks and 5 Marine National Reserves, totalling around 75,000 ha. (some of the Reserve areas include some of the Park areas). The protected areas, plus two more proposed sites at Ras Tenweni and Diani, are primarily designed to conserve Kenya's coral reefs, which run along the entire coast and form a biodiversity hotspot second only to tropical rainforest. The larger protected areas also enclose important breeding sites for migratory sea-birds, marine mammals, and 3 species of turtle.

The true biodiversity of Kenya's coral reefs is not known. Well-studied reefs in other parts of the world contain about 3,000 plant and animal species, including the reef-building organisms themselves and fish and invertebrates which support lucrative fishery and tourist industries.

Kenya's coral reefs and offshore resources have been exploited in a poorly regulated manner for many years by an increasing number of fishermen, collectors and tourist operators. This pressure, coupled with increased silt deposition from rivers draining agricultural land, has diminished both the productivity and species richness of the entire coast.

Recovery of degraded coral reefs is very slow, up to 50 years if damaged by dynamiting (the worst form of reef collecting). Only a firmly regulated policy of utilisation will ensure the continued high productivity of these important national resources.

3.5 *EX-SITU* CONSERVATION

3.5.1 Introduction

Possible *ex-situ* facilities for conservation include zoological and botanic gardens, seed banks, microbial and tissue culture facilities and genome (DNA) libraries. Such facilities can provide several important functions, notably:

(i) insurance against *in-situ* extinctions,
(ii) education about biodiversity,
(iii) recreation facilities,
(iv) commercial utilisation of biodiversity, and
(v) research to complement research in the field.

To date, Kenya has not taken full advantage of the potential of *ex-situ* sites to conserve biodiversity, or to extract full commercial value from biological resources. Ex-situ sites have developed haphazardly, usually with no special reference to conservation.

In the absence of coordinated national information, even the collection of information presented a difficult task. This preliminary review considers *ex-situ* conservation of biodiversity, first for animals and plants, then for the more applied topics of crop plant, forest, microbial and tissue culture resources.

3.5.2 *Ex-situ* Conservation of Animals

Kenya lacks a National Zoological Garden, but several institutions fulfil some traditional functions of a zoo. The Nairobi Animal Sanctuary contains around 80 animals in cages or enclosures. Others institutions, like the Institute of Primate Research at the NMK and the Kenya Agricultural Research Institute's (KARI) Wildlife Diseases Research Project, hold breeding stocks of particular species for research purposes.

Despite the importance of pastoral and dairy livestock, Kenya lacks extensive *ex-situ* facilities for the maintenance of genetic diversity of domesticated animals, with the exception of the artificial insemination unit at Kabete. Even this facility stores mostly exotic livestock semen rather than that of indigenous zebu and boran cattle.

A further category of *ex-situ* animal sites are the 11 black rhino sanctuaries, designed to prevent extinction of a single high profile species. All rhino sanctuaries, 5 privately and 6 publicly owned, are in habitat once occupied by wild rhino. All 400 surviving black rhino belong to the Kenya Government. Beyond these examples, there are many private ex-situ sites. Some are purely commercial ventures (eg. snake and crocodile farms, game and ostrich ranches). Others result from the zoological "philanthropy" of private individuals, and usually focus on charismatic mammalian species (eg. Sheldrick Elephant Shelter, AFEW Giraffe Centre).

To date there has been little national planning of *ex-situ* conservation. Animal conservation in Kenya is likely to need an increased amount of *ex-situ* assistance. To be effective, this will require Government planning and coordination.

3.5.3 *Ex-situ* Conservation of Plants:

As shown in Annex 1e, many sites of plant endemism may be destroyed in the next 15 years. Many endemic and commercially valuable plant species and varieties will be threatened with local, if not global, extinction. *Ex-situ* conservation on a much larger scale than Kenya can currently perform may be the only possible way of saving these species. It is likely that inappropriate development of some of these fragile ecosystems will lead to a rapid increase in degraded and abandoned land. This land offers an opportunity for restoration of lost plant communities if the constituents of the original flora can be preserved *ex-situ*.

Already, a number of small-scale projects, working in severely altered habitats, such as abandoned quarry sites (eg. the Bamburi Project, Baobab Farm, Mombasa), have shown that ecological restoration is possible given sufficient funding and commitment. But restoration will be possible only if the species diversity originally present in degraded areas is still available for recolonisation. This is particularly true for plants which form the productivity base of most ecosystems. *Ex-situ* conservation of plant resources thus has a vital role to play for future habitat restoration, in addition to providing a protected gene bank for applied plant research in forest and crop improvement (see below).

Unfortunately, the present ex-situ sites in Kenya are totally inadequate for these tasks. There are about 20 public and 10 private botanic gardens/arboreta in Kenya. Most public sites are in disrepair, with poor maintenance and species documentation. The private sites are in better condition, but are primarily horticultural, reflecting the private or commercial interest of their owners. At this stage, the number and type of species present in these sites are not documented.

The taxonomic knowledge needed for a national system of botanic gardens exists within the East African Herbarium, based at the National Museums of Kenya. Kenya contains four major phytogeographical regions, each with its own set of species adapted to different environmental conditions. No one botanic garden could serve as a national repository unless it could recreate the ecological requirements of different phytogeographical zones. A more practical proposal would be to situate a botanic garden within each of the four phytogeographical zones. Suitable sites already exist in all four regions.

Ex-situ propagation of plants for commercial profit is restricted to a few species, mostly of horticultural value. In one case, commercial use threatens several wild plant species. Kenya possesses over 50 species of the genus *Aloe*, a group of succulent, arid-region plants with a 2,000 year history of medicinal use in many different cultures, wherever the genus is found growing. Plantations of Kenyan *Aloe spp.* were first established near Mombasa in 1986 following a Presidential decree protecting the

entire genus from wild-harvesting. Unregulated initial stocking and restocking of these plantations is probably still depleting the wild populations of *Aloe* species. It appears that commercial utilisation of *Aloe spp.* might be more productive and sustainable if it were based on plantations of imported *A. vera*, until indigenous species plantations can be established without continual collection from the wild. Ideally, commercial plantations should serve the opposite role, providing material for ecological restoration.

3.5.4 *Ex-situ* Conservation of Crop Plant Genetic Resources.

Ex-situ conservation of plants must give priority to protection of plant genetic resources of immediate economic significance to Kenya.

Ex-situ conservation of genetic resources is centred on two institutions: the Kenya Forestry Research Institute (KEFRI), which concentrates on forest tree and ornamental plant species (see next section), and the National Gene Bank of Kenya, founded in 1988, which concentrates on crop plant genetic resources. The National Gene Bank at Muguga operates within the framework of the Kenya Agricultural Research Institute (KARI). It is responsible for organisation and coordination of field collections of germplasm, maintenance and propagation of collected germplasm, exchange of information and research on germplasm storage techniques. A further 5 field gene banks provide temporary stores for field collections and allow propagation of species which have recalcitrant seeds or are purely vegetative.

A total of 36,351 accessions are held, covering over 50 crop species. The majority of these are either forage grasses/legumes, beans or sorghum. A further 52,945 germplasm accessions are held at other research stations specialising on one particular crop (eg. tea, coffee, cereals, roots/tubers).

3.5.5 *Ex-situ* Conservation of Forest Germplasm

The main repository for forest tree species is the Kenya Forest Seed Centre (KFSC), founded in 1985 with assistance from the German Agency for Technical Cooperation (GTZ). This Centre operates as a sub-division of KEFRI. KFSC has three main objectives.

(i) Collection of commercially significant amounts of seed from all important indigenous and exotic tree species. Collections are made from all ecological zones of Kenya through 6 regional collection centres at Gede, Kibwezi, Nyeri, Londiani, Kakamega and Kitale.

(ii) Research to improve methods of extraction, storage and germination.

(iii) Initiation of conservation of endangered indigenous tree species.

In 1989, around 7,000 kg of seed from over 220 different species were held in store. The Centre has a total cold-room storage capacity of 10,000 kg of seed, plus a limited number of freezers for long-term storage. In 1988, the proportions of seed held were:

Indigenous species	50.0%
Cuppressus lusitanica	16.2%
Eucalyptus spp.	6.1%
Grevillea robusta	2.0%
Pinus spp.	1.1%
Unspecified	24.6%

Several indigenous trees, notably *Brachylaena hutchinsii* and *Dalbergia melanoxylon*, which are currently endangered through over-harvesting for wood carving, are represented within the seed collection, but there are probably several hundred other tree species in need of similar ex-situ conservation.

Seed collection in 1988 totalled 6,950 kg, whilst 5,500 kg of seed were dispatched to users within Kenya and overseas. This corresponds to approximately 120 mn tree seedlings. In 1990, the breakdown of users was as follows:

Forest Department and Rural Afforestation Services	63.0%
Individual farmers	25.0%
NGOs	8.3%
Overseas	2.0%
Discarded	1.7%

The Kenyan Government recognizes that current wood utilization for timber, poles and woodfuel exceeds reafforestation, and is eroding the forest and woodland resource base of the country at an increasing rate. The Government has a target of 200 mn seedling to be planted each year, by numerous NGO, church and local self-help groups. As interest in planting of indigenous tree species has increased, KFSC has been unable to supply seed in adequate amounts and quality. KFSC hopes to rectify this situation by increasing its storage facilities and creating extension networks by training members of womens' groups, individual farmers and foresters to increase seed collection.

3.5.6 *Ex-situ* Conservation of Micro-organisms

Ex-situ collections of microbes in developing countries are coordinated by 6 regional Microbiological Resources Centres (MIRCENS) established through UNEP/UNESCO funding in 1975. Kenya has one Centre, based at the University of Nairobi, Kabete Campus. This centre has concentrated its limited resources and technical expertise on

collection of nitrogen-fixing *Rhizobium spp.* and, more recently, the entomopathogen, *Bacillus thuringienesis*. In addition, the University maintains cultures of around 14 miscellaneous bacteria of medical importance, but has no systematic collection for these species.

Research into nitrogen fixation by *Rhizobium spp.* associated with tree species is also being conducted by KEFRI, in conjunction with the University of Dundee (funded by EEC). 75 *Rhizobium* strains have been isolated, as well as some *Bradyrhizobium* strains.

Cultures of microbes causing diseases of tree are held at KEFRI. Almost all of these cultures are microfungi (27 species in total). An additional 5,000 micofungi specimens are stored in the University of Nairobi, Mycology Department, but no species level information is available.

Ex-situ collections of protozoans causing important livestock diseases are held at KARI. Current work focuses on the following species:

Theileria parva (East Coast Fever);
Babesia bigemina (Babesiosis);
Anaplasma sp. (Anaplasmosis);
-- (Heart water);

all of which are maintained in culture. Genetically engineered vaccines against these tick-borne diseases are being developed.

Cultures of *Trypanosomas brucei* sub-groups are identified using DNA probes and held at the Kenya Trypanosomiasis Research Institute (KETRI) and also at the International Laboratory for Research on Animal Diseases (ILRAD). The latter also identifies and maintains cultures of *Theileria spp.*

The University of Nairobi's Department of Food Technology and Nutrition maintains a collection of over 50 species of bacteria and microfungi of importance in fermentation technology and food contamination.

3.5.7 *Ex-situ* Collections of Tissue Cultures

Tissue culture techniques are beginning to be used in some Kenyan institutes. KEFRI is using micropropagation techniques for tissue culture 5 important timber species (3 indigenous and 2 exotic) for which normal seed storage is difficult.

The University of Nairobi Department of Crop Science has applied tissue culture techniques to strawberry, apple, citrus fruits, potato, sugarcane, cassava,

chrysanthemum and ferns in order to establish pathogen-free clones. Somatic embryogenesis has also been used on coffee. Some similar work has been undertaken by the Horticultural Department of the Jomo Kenyatta University of Agriculture and Technology.

There are several universal problems which limit Kenya's *ex-situ* biodiversity resource conservation and utilization. Most prominent is a lack of investment in culture growing and storage facilities and a lack of taxonomic and technical expertise.

ANNEX 1a: SPECIES DIVERSITY DATA.

Data for Annex 1a were collected by members of the Animal, Plant and Microbial Biodiversity teams listed at the front of this report. More detailed breakdown of some of these numbers is provided in their original reports (copies are held at UNEP and the National Museums of Kenya). Much of the data have been compiled from records held at the National Museum, or from lists of microbrial cultures. The totals represent approximate lists, and require thorough revision and verification to align them with more recent taxonomic nomenclature. Work is in progress to maintain all of these lists as computer files, pending the establishment of a central biological database for Kenya.

There was some variation in the method of estimating total number of species; wherever possible the numbers reported refer to known described species. If species for which no formal description has been made were to be included, then numbers reported would be considerably higher, especially for the microbes.

The 34,863 species total reported here represents 2.5% of the global total (1,392,485) used in this report. The Kenya species list is dominated by insects and flowering plants (61 and 19% of total, respectively) despite the relatively incomplete coverage of collections for both groups in Kenya. Experts in most sections consider that the totals reported here underestimate true biodiversity within their groups, possibly by several orders of magnitude for lower invertebrates.

Kingdom	Sub-Division	English Common Name	Global Species Total	Kenya Species Total	Footnote
	Virus	Viruses	1000	101	1
Monera	Total Species		4760	278	
	Bacteria	Bacteria	3000	254	2
	Myxoplasma		60	no data	
	Cyanophycota	Blue-greens	1700	24	
Fungi	Total Species		46983	1279	3
	Zygomycota		665	20	
	Ascomycota	Cup fungi	10650	100	
	Lichenes	Lichens	18000	196	
	Basidomycota	Club fungi	16000	335	
	Deuteromycetes	Fungi Imperfecti		500	
	Oomycota	Water moulds	580	100	
	Chytridiomycota	Chytrids	575	20	
	Acrasiomycota	Slime moulds (cellular)	13	3	
	Myxomycota	Slime moulds (plasmodial)	500	5	
Algae	Total species		26900	299	4
	Chlorophyta	Green algae	7000	100	
	Phaeophyta	Brown algae	1500	54	
	Rhodophyta	Red algae	4000	145	
	Chrysophyta	Diatoms, etc.	12500	no data	
	Pyrrophyta	Dinoflagellates	1100	no data	
	Euglenophyta	Euglenoids	800	no data	
Plantae	Total Species		248428	6817	5
	Bryophyta	Mosses/Hornworts Liverworts	16600	608	
	Vascular plants				
	Psilophyta	Psilopsids	9	1	
	Lycopodophyta	Lycophytes	1275	23	
	Equisetophyta	Horsetails	15	1	
	Filicinophyta	Ferns	10000	241	
	Gymnospermophyta	Conifers	529	17	
	Angiospermophyta	Flowering plants			
	Monocotyledons	Monocots	50000	1359	
	Dicotyledons	Dicots	170000	4567	
Protozoa	Total Species		30800	714	6
	Sarcomastigophora			400	
	Ciliata	Ciliates	8000	14	
	Apicomplexa	Sporozoans	4000	300	
Animalia	Total Species		1033614	25375	
	Porifera	Sponges	5000	5	7
	Cnidaria plus	Jellyfish/anemones/corals	9000	8	
	Ctenophora	Comb-jellies		1	
	Platyhelminthes	Flatworms	12200	47	
	Nematoda	Roundworms	12000	76	
	Annelida	Segmented Worms	12000	30	
	Mollusca	Molluscs	50000	434	
	Echinodermata	Sea Urchins/Starfish	6100	11	
	Arthropoda				8
	Insecta	Insects	751000	21557	
	Non-insect arthropods		123161	398	
	Arachnida	Arachnids		191	
	Crustacea	Crustaceans		204	
	Chilopoda	Centipedes		2	
	Diplopoda	Millipedes		1	
	Minor Invert. phyla	Nemertina/Rotifera	9300	16	9
	Chordata				10
	Tunicata	Tunicates	1250		
	Cephalochordata		23		
	Vertebrata				
	Agnatha	Jawless fish	63	0	
	Chondrichthyes	Cartilaginous fish	843	41	
	Osteichthyes	Bony fish	18150	642	
	Amphibia	Amphibians	4184	101	
	Reptilia	Reptiles	6300	211	
	Aves	Birds	9040	1079	
	Mammalia	Mammals	4000	320	
TOTAL			1320468	34952	11

Footnotes:

1. VIRUSES:

Comments on global total: The current global total of 5,000 described species is estimated to represent less than 5% of true global viral biodiversity (Hawksworth, 1992). As obligate parasites of other cellular living organisms, most viruses are restricted to a small range of taxonomically-related host species. Biodiversity of viruses will be a function of the number of "cellular" species to be found in a country. Few systematic studies of the viral load of specific species have been made anywhere in the world.

Comments on Kenyan total: Systematic/taxonomic knowledge of viruses in Kenya is growing, with 141 viruses recorded. Of these, only 101 have been formally described and around 20 are held in culture facilities. Most knowledge of viruses is related to disease of man, domesticated species or mammals with high tourism value. The Virology Division of the National Veterinary Research Centre, Kenya Agricultural Research Institute, has initiated surveys of wildlife/livestock disease exchange which include screening for viruses, whilst KEMRI has an active viral research group, including work on HIV. A partial list of the 21 crop plant and 120 animal (including human) viruses is available from the National Museums of Kenya on request.

The true number of viruses present in Kenya is undoubtedly much higher than 141. Extrapolating from the global estimates, Kenya would be expected to eventually record an absolute minimum of 3,000 viruses. Virtually no data is available about genetic diversity within viral isolates in Kenya, but this diversity may be of considerable economic importance. Conservation of viral biodiversity in Kenya will be determined by the continued existence of a suitable density of host organisms, or by maintenance of selected species in *ex situ* ie. culture facilities. Specific action to conserve viruses alone is unlikely to be a high priority compared with investment to minimise the negative economic impact of viruses, an impact which contributes to biodiversity decline by reducing human health or crop and livestock productivity.

2. MONERA (Bacteria and Blue-Greens):

Comments on global total: The true global number of microbial species will never be known. Even the most sophisticated screening techniques isolate less than 10% of bacterial species from complex habitats (soil, coral reefs, guts) and even conservative estimates of bacterial species diversity range as high as 100,000.

Comments on Kenyan total: The total of 254 bacteria plus 24 blue-greens represents formally described monerans; around 800 additional incompletely described bacterial isolates are reported from Kenya. As with viruses, most Kenyan bacterial knowledge relates to disease of man, domestic species and large mammalian wildlife. Little detail is known of the role of bacteria in Kenyan ecosystems. Positive economic value arises from the use of bacteria in nitrogen fixation, slurry fermentation, sewage treatment and single cell protein, as well as from tourism, via the specialised *Spirulina* -feeding ecology of flamingoes. These positive economic values are small compared with negative economic impacts via disease. Bacterial

biodiversity has a large potential economic value through biotechnological manipulation. For example, many of the potential drugs isolated from marine invertebrates originate from associated microbes, not the invertebrates themselves.

3. FUNGI:

Comments on global total: The number of described species is around 69,000; current species totals reflect intensity of effort rather than true species richness. Extrapolated estimates now range as high as 1.5 million (Hawksworth, 1991).

Comments on Kenyan total: Kenya has been relatively well collected with respect to macrofungi (Basidomycota) and Lichenes, because of the historical placement of these groups within traditionally defined botany. Despite a list of over 500 species, little is known beyond the collection locality for most of these species, making assessment of levels of endemism, threat, local utilisation, etc. impossible to determine with any confidence. Amongst the microfungi (Zygomycota, Ascomycota, Fungi Imperfecti and smaller groups), large numbers of isolates are known, but less than 50% have been fully described. (Described species numbers are reported in this study, except for the groups Deuteromycetes, Oomycota, Cytridomycota, Acrasiomycota and Myxomycota where data on described Kenyan species were not available). As with other microbial groups, the majority of recorded species are known from their significance as causative agents in disease of man, crops and livestock. Hence the total number of species in this taxon is underestimated. Virtually nothing is known about microfungi in natural habitats, despite their importance in ecosystem function (decomposition, nutrient cycling, mychorrhizae of forest trees, etc).

4. ALGAE:

Comments on the global total: The high global total for this taxon is generated mostly by large numbers of diatoms, dinoflagellate, euglenoids, plus unicellular and colonial green algae. Many of these planktonic species have habitat ranges which are oceanic in scale.

Comments on the Kenyan total: Taxonomic knowledge in this group is split between the macroalgae studied by botanists and the microalgae studied by aquatic plankton specialists (the microalgae also include the blue-greens, grouped with bacteria in the Kingdom Monera). For the microalgae, very little is known, either for marine or freshwater species, despite the fundamental role these species play in fisheries productivity.
Marine macroalgae are relatively well collected, but little is known of the population status and ecology of most species. Freshwater algae are poorly recorded and little studied, despite their potential as bioindicators of aquatic system health in the face of increasing industrial and agricultural pollution.

5. PLANTAE:

Comments on global totals: The numbers given here are below the true number for Bryophyta, Filicinophyta and Angiospermophyta, but are probably nearly complete for relict taxa (Psilophyta, Equisetophyta, Lycopodophyta and Coniferophyta).

Comments on Kenyan totals: Despite the high standard of botanical work associated with the East African Herbarium, Kenya remains undercollected in most regions (see Map 1a.1), and lacks complete distribution and demographic data for most plant species. The recent WWF sponsored K7 Coastal Forest Survey added 50 new records for Kenya, including 3 species new to science, in an area previously thought to be well-collected. Similar inventories in the other regions must be considered a priority.

Forests aside, Kenya comprises a series of botanical islands (hills and valleys) sitting in a sea of semi-arid/arid savannah/bush/woodland. Such fragmented habitat structure is likely to produce high levels of local specialisation/endemism not localised in easily protected sites, but thinly distributed over the whole country.

6. PROTOZOA:

Comments on global total: This taxon is ill-defined and it is not possible to comment on the total. The sub-group Sarcomastigophora would include species already included in Chlorophyta, etc. Global estimates for Ciliata are around 5,000; for Apicomplexa (Sporozoa) around 4,000.

Comments on Kenyan total: The Kenyan estimate also suffers from poor definition. Detailed knowledge of pathogenic species is held at ILRAD, KEFRI, KETRI and IPR, but little work has been completed in natural systems. The number of described species is <50% of the number of known species.

7. NON-ARTHROPOD INVERTEBRATES:

Comments on global total: No comment.

Comments on Kenyan total: The numbers reported here reflect only the current lack of information on these taxa. No specialist staff/academics are currently working on the taxonomy of these groups, despite their importance in coral reef ecosystems (Porifera/Cnidaria/Mollusca/Echinodermata), disease (Platyhelminthes/Nematoda/ Mollusca) and soil fertility (Annelida).

8. ARTHROPODA:

Comments on global total: Estimates range as high as 80 million, based on tropical rainforest canopy/soil insect extrapolations. The exact size of the global total will not alter Kenyan arthropod biodiversity, since Kenya has little true rainforest.

Comments on Kenyan total: The number supplied comes almost entirely from National Museum records; some records are 50 years old and little recent work on distribution and population is available. "Random" collections anywhere in the country made by specialists provide new records for most insect orders, reflecting the low percentage of total arthropod diversity currently described. A breakdown of the insect numbers is supplied in the Animal Biodiversity Report available from Dr Richard Bagine at the National Museums of Kenya.

9. MINOR INVERTEBRATE PHYLA:
Comments on global total: No comment.

Comment on Kenyan total: The 16 species recorded here are all Rotifers. Knowledge of other minor phyla is minimal. Most of these taxa are marine groups for which Kenya currently lacks the resources for study.

10. CHORDATA:
Comments on global total: No comment.

Comments on Kenyan total: Species lists are relatively complete for vertebrate groups. For the non-vertebrate chordates, see comments above. The population status of most species in the major classes is poorly known, even for birds, a well studied and documented group. Birds and mammals are the main attraction of Kenya's wildlife tourism industry. For vertebrates, see detailed comments below.

Agnatha: No species from this group have been recorded from Kenyan waters.

Chondrichthyes: The total (41) is generated from data provided by the Fisheries Department and Kenyatta University; there is little population data available.

Osteichthyes: The Rift Valley lakes of Eastern Africa represent one of evolution's most recent explosions of new species. The total of freshwater fish for Kenya given here (220) is incomplete, but contains a high proportion of national/regional endemic species. The marine total (422) is probably more complete, but little knowledge of population status exists, especially for coral reef fish. Most aquatic systems in Kenya are stressed, in ecological terms, by overfishing, exotic introductions, damming, increased silt load. Many fish species are likely to become more threatened. Freshwater fish provide >90% of Kenya's fish catch.

Amphibians: The total given (101) for this globally threatened taxon could be improved by more field surveys. Amphibian species could serve as indicator species for aquatic/moist habitats in Kenya. Most of these habitats (lakes, swamps, moist forest) will be increasingly threatened by pollutants and encroachment over the next 20 years.

Reptiles: The total (211) given here reflects a museum count and there appears to be little recent systematic fieldwork on most reptiles. The number represents a considerable increase over previous estimates and makes Kenya an important site of reptilian diversity in Africa. The Class provides some economic return to Kenya, through crocodile farms and snake parks and undoubtedly plays an important ecological role in arid/semi-arid habitats.

Birds: The total given here (1079) reflects the quality of ornithological knowledge in the National Museums, and in Kenya in general. The total is the second largest in Africa, behind Zaire. This species richness is due mostly to the wide variety of ecological habitats contained in a relatively small area. The bird species of Kenya make a large contribution to its tourist potential, second only to the large aggregations of mammal species.

Threatened/endemic bird species or sub-species occur in most sites identified for further protection in Annex 1e. Kenya's birds could be used as key indicator species for monitoring the ecological quality of both protected and non-protected areas.

Mammals: The species total (320) recorded here represents current records which are being updated. This total confirms Kenya as the African country with the most mammalian species per unit area (only Zaire, a much larger country, has more mammalian species).

The list includes 26 pairs (or triplets) of sub-species present in Kenya. In most cases, these sub-species are distinct morphological forms; they represent evolution in progress and possess a non-consumptive use value, through tourism/research, etc., independent of related sub-species. The National Museum is engaged in molecular taxonomic studies of African antelopes and the population genetics of other mammalian species which will contribute to clarification of the true status of the sub-groups.

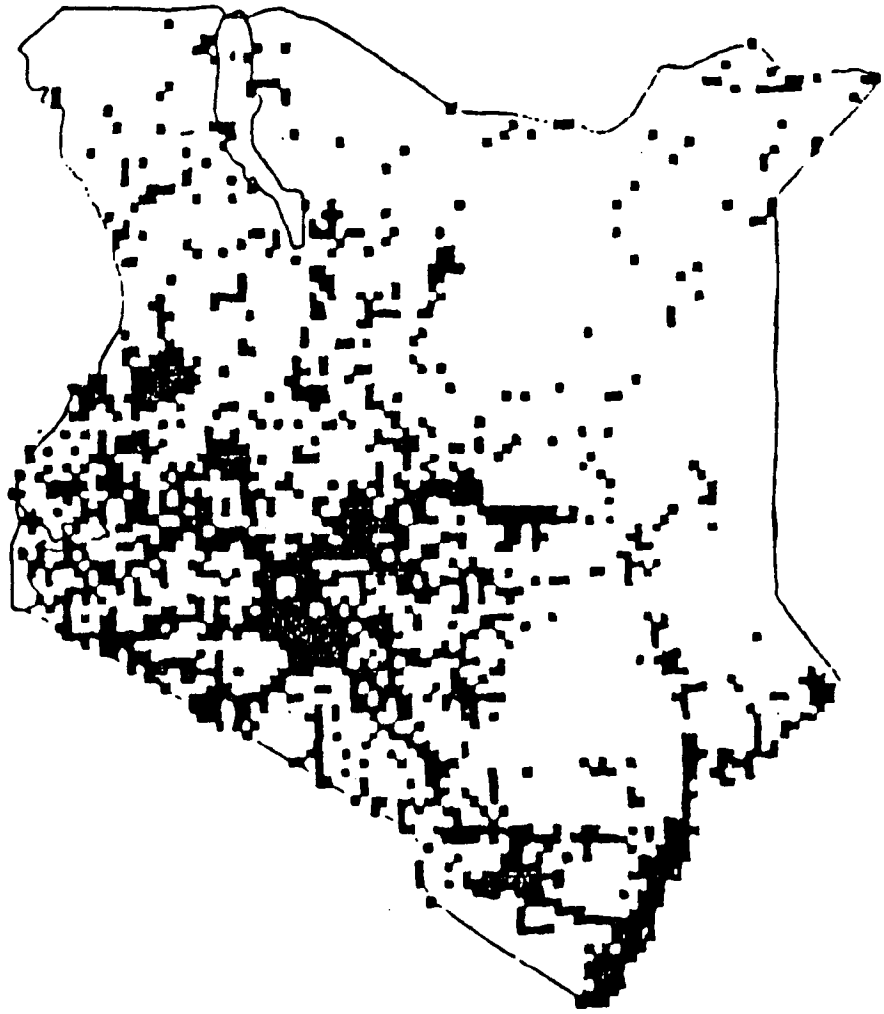
The total also includes domesticated and introduced species, but does not count varieties, with the exception of Maasai, Rothchild's and Reticulated giraffes. Extinct taxa are not included in the total. The level of knowledge in this Class is uneven, but small mammals, nocturnal mammals, and especially bats are poorly known. The latter represent some 25% of all mammals and play important ecological roles as plant pollinators, seed dispersers and insectivores. Work should continue on this listing, especially in consultation with IUCN/SSC group experts.

11. TOTAL:

Comment on the global total: It is well known and agreed that this is an underestimate. A total of around 10 million species appears to be a reasonable concensus number.

Comment on the Kenyan total: The grand total of 34,863 does not make Kenya a biodiversity "hotspot". Nor is Kenya a Vavilov centre of crop diversity. But it may be the case that the biodivesity of Kenya makes a larger total contribution to economic wealth than in any other country. The value of Kenyan wildlife tourism, plus the value of its woodfuel, plus the value of its subsistence agriculture and livestock, makes Kenya a country almost totally dependent upon biological resources and, to some extent, dependent upon the diversity of those biological resources. Tourists come to see a range of species; different trees and crops grow best in different soils; different livestock, both domestic and wild, will be most productive in different regions of the country. If a country's biodiversity is to be conserved, it must be put to work improving the quality of human life in that country. Kenya has the potential to do this.

MAP 1a.1 COLLECTED AND UNDER COLLECTED AREAS OF KENYA (PLANTS)



Black Squares Denote Areas of 32x32 km Where 2 or More Plants Species Have Been Collected. Samples Prepared from 1060 Distribution Maps of Woody Plants of Kenya

ANNEX 1b: SPECIES ECOLOGICAL STATUS BY CATEGORY.

It is not possible to categorise data on species ecological status in Kenya into historical time periods. The original Annex 1b has been omitted, and replaced by an alternative Annex where data are divided by taxonomic group.

Data in Annex 1b are presented in three broad groups: lower organisms (viruses, bacteria, protozoa, algae and fungi), plants and animals. Further details for each of these groups are presented in the attached Annexes 1b.1, 1b.2 and 1b.3, respectively. Appendix 2 of this report contains list of species in each categories of threat, where these are available. No species is known to have been missing for more than 50 years, thus all species fall into the IUCN category: Extinct?. Extinctions are assumed to be local rather than global unless the species concerned was considered a national endemic. Categories of threat reported here refer to status of a species within Kenya; for most groups, information on global status was not readily available. In some cases, information provided by WCMC has been added to the lists but the recent status of these species could not be verified by Kenyan experts in the time available. It should be noted that the categories extinct, endangered, vulnerable, rare and insufficiently known are mutually exclusive, but species included in these categories may also appear as endemic, introduced or domesticated. Blank spaces in the tables represent absence of information, not absence of threat.

Some difficulty was experienced in standardising the use of IUCN categories of threat across such a wide range of species and levels of knowledge. Ambiguity over category was resolved by placing the species concerned in the highest category of threat (ie. in the spirit of a green, rather than red, list).

In some groups, data for the category regional endemic has been included. For some of these species, Kenya may represent the main, or safest, habitat for the species concerned. Kenya is concerned to develop a coordinated regional response to conservation problems, recognising that neither species and conservation threats are not constrained by national boundaries. In all cases, the results given represent minimum numbers. Not all available data could be collected and incorporated into this report in time. True numbers of threatened taxa are undoubtedly higher. For example, all 1200 species on the rare and endemic plant list in Appendix 2 are considered by Kenyan researchers to be under some threat, yet because little or no population data is available, these species cannot be classified with any confidence until such data are available.

UNEP BIODIVERSITY GUIDELINES ANNEX 1b:
Species ecological status by category

CATEGORY		Lower Organisms	Animals	Plants	Total
Known extinctions	Local	4	8	2	14
	Global	1		4	5
Endangered		1	89	31	121
Vulnerable		99	36	54	189
Rare		6	67	70	143
Insufficiently Known		165	75	103	343
Endemic		56	114	392	562
Regional Endemic			18	336	354
Introduced/Exotic		many	56	7	63
Domesticated		24	21		45

UNEP BIODIVERSITY GUIDLINES: ANNEX 1b.1
Species ecological status by category: Lower organisms

CATEGORY	VIRUSES	MONERA	PROTOZOA	ALGAE	FUNGI			TOTAL
					Microfungi	Lichens	Macrofungi	
Total species	101	278	714	299	748	196	335	2671
Known extinctions: local	4							4
:global	1							1
Endangered		1						1
Vulnerable	2	1			2		1	6
Rare	11				33	30	25	99
Insufficiently known	most	most			83		82	165
Endemic		3			9	35	9	56
Introduced/Exotic	9	2			6		6	23
Domesticated	20	4						24

UNEP BIODIVERSITY GUIDELINES ANNEX 1b.2
Species ecological status by category: Animals

CATEGORY	INVERTEBRATA excl. INSECTA	INSECTA	FISH	AMPHIBIA	REPTILIA	AVES	MAMMALIA	TOTAL
Total species	1424	21557	683	101	211	1079	320	25375
Known extinctions: local			7				1	8
:global								
Endangered	3	1	60	2	11	3	9	89
Vulnerable	13	2	7		2	3	9	36
Rare	2	24	16	1	3	10	11	67
Insufficiently known	14		8			1	52	75
National Endemic		3	54	13	17	13	14	114
Regional Endemic						18		18
Introduced	2	33	13			4	1	53
Domesticated		2				6	13	21

UNEP BIODIVERSITY GUIDELINES ANNEX 1B.3
Species ecological status by category: Plants

CATEGORY	BRYOPHYTA	PSILOPHYTA	LYCOPODOPHYTA	EQUISETOPHYTA	FILICINOPHYTA	GYMNOSPERMOP	ANGIOSPERMOPHYTA	TOTAL
Species in taxa	608	1	23	1	241	17	5926	6817
Known extinctions: local							2	2
:global							4	4
Endangered spp.						1	30	31
Vulnerable spp.						2	52	54
Rare spp.			1		4	4	61	70
Insufficiently known			5		52	1	45	103
National Endemic					3	2	387	392
Regional Endemic					2	1	333	336
Introduced/Exotic					1	6	not known	7
Domesticated							many	0

UNEP BIODIVERSITY GUIDELINES ANNEXES 1c and 1d:

Annex 1c and Annex 1d have been combined into a single Annex to avoid repetition. The following questions appear in the UNEP guidelines to Annexes 1c/1d.

1. Has your country described, documented or produced maps of its existing range of habitat/ecosystem diversity?

   Answer: Yes

   A variety of maps related to habitat and ecosystem type are available within Kenya. Examples include:

   (i) The Biotic Communities and Natural Regions of Kenya 1983 (see Annex 1h.)
   (ii) Kenya Atlas (contains maps of Forest Cover, Agricultural Potential Zones, Ecological Potential).
   (iii) The Department of Resource Surveys and Remote Sensing (DRSRS) and Kenya.

   Wildlife Service (KWS) produce maps of Wildlife Population Density, Wildlife Dispersal Areas and Livestock Population Density.

   Both DRSRS and KWS possess GIS facilities, but no information is available about which, if any, habitat/ecosystem maps are currently held in this form. The World Conservation Monitoring Centre (WCMC), Cambridge, UK. also maintains GIS maps of Kenya's forest and protected areas.

2. Has your country assessed the value of any such biodiversity functions that have been lost? If so, please indicate.

   Answer: No. No formal study of economic value lost through habitat change has been completed. Provisional opportunity costs and non-quantified biodiversity values are included in Annex 1c/d below.

UNEP BIODIVERSITY GUIDLINES: ANNEX 1.c & ANNEX 1.d
Habitat/Ecosystem Diversity

Habitat	Total Area (ha)	% of Kenya	% Area lost in 10 yrs	Biodiversity Function/role	Economic value of lost function	Footnote
Forests	2204676	3.780	12	consumptive use value productive use value non-consumptive use value watershed function	lost non-commercial use lost timber revenue lost tourism revenue increased soil erosion/irregular water supply	1
Grasslands	8164000	14.012	10	wildlife livestock agriculture	wildlife: KSh100 per ha. livestock: KSh91-126 per ha. agriculture: wheat 2 tons per ha.	2
Arid/Semi-Arid	41348500	70.967	15	wildlife (tourism/game) livestock/agriculture	same as above less than above	3
Deserts	0	0.000	0	no true desert in Kenya		
Lakes	1231590	2.114	not known	wildlife fisheries climate modification	wildlife conservation and tourism more than 90% of total fisheries	4
Wetland swamp and floodplain	1460300	2.506	1	wildlife/fisheries water purification	same as above cost of equivalent technology	5
Mangroves	52980	0.091	15	poles, masts, other wood products, fodder, medicines tannins, marine nursery, aquatic nursery	not quantified in Kenya opportunity cost of aquaculture and salt farming (up to KSh2m/ha/yr) depleted fishery yields	6
Marine Offshore	234600	0.403	0	fishery	profit of current fishery	7
Coral Reefs	50000	0.086	not known	wildlife fishing shells, etc.	tourism revenue local fisheries value of aquarium trade	8
Total	**54512046**	**93.556**				9

Footnotes to Annex 1c:

1. Forest area estimates in Kenya change constantly, due to a combination of changing methods of measurement and rapidly changing status of forests. The figure given is the most recent estimate for the total area of 362 gazetted and ungazetted forests recognised by the Forest Department. Forest Department data at District level reveal that, on average, 45% of this area is bush or grassland; a further 165,000ha (7.5%) of forest area is plantation. Beentje (1990) estimates that only 585,000ha of indigenous forest remains in Kenya and that, despite a Presidential ban on felling of indigenous timber, forest areas are still declining rapidly, especially in montane, riverine and coastal forest regions.

2. As with forests, exact estimates of grassland area are difficult due to the presence of transitional scrub/bushland habitat. The estimate given here is probably on the high side. More confidence can be attached to the rate of loss estimate; natural grasslands throughout Kenya are being squeezed between the twin pressures of loss via conversion to agriculture and degradation through increasing livestock density.

3. The majority of non-agricultural land in Kenya falls into this category. Virtually all of this rangeland is used, more or less intensively, for livestock production. Some rangeland is being lost through inappropriate conversion to agriculture, but the main loss arises from increased erosion and desertification caused by overstocking of cattle, sheep, camels and goats.

4. Kenyan lakes undergo considerable changes in water surface area in response to long-term climatic fluctuations, making area estimation and human-induced % change difficult to guage. Total area is dominated by Lake Victoria (Kenyan section: 413,340ha) and the brackish Lake Turkana (756,000ha). The 20+ other lakes are all less than 20,000ha and most, especially the closed lakes, are susceptible to external influence through introduction of foreign species and pollution via agricultural or industrial effluent. Economic value of lakes through tourism is focussed on Lake Nakuru NP (138,624 visitors in 1988), plus Lakes Naivasha, Bogoria and Baringo. Fisheries value is dominated by the catch from Lakes Victoria, Naivasha and Turkana; all three lakes are ecologically disturbed by introductions of exotic species.

5. Wetland areas along rivers are difficult to estimate. Loss through drainage in large swamps (Yala/Kano) is easier to estimate, but wetland losses resulting from damming and irrigation are less clear. Much wetland in Kenya is potential agricultural land. Most is already surrounded by agricultural land with a high population density and will come under increased pressure for alternative use in the future. Some regional estimates of loss are as high as 9% per year.

6. Mangrove estimates have remained fairly constant over the past 20 years, despite extensive subsistence and small market use. This perhaps reflects the high regenerative capacity of mangrove ecosystems if they are not completely cleared. Around 8,000ha of mangrove/tidal flats is occupied by salt farms and around 4000ha of mangrove is

considered suitable for aquaculture, which offers a much higher net income than timber and fishery use.

7. Marine offshore areas are currently underused by Kenya due to lack of large fishing vessels. Increasingly, long-distance fishing vessels from other countries are using Kenyan waters.

8. Coral reef exists along most the Kenyan coast. The area estimate given here was calculated by multiplying an average estimate of the length of coastline by $1km^2$. This value differs from the estimate (58,500ha) derived from the biotic community map (See Annex 1.h). Virtually all reef outside of the marine parks is degraded to some extent. In the extreme south, some coral has been destroyed by dynamite fishing, whilst coral reef near river mouths is suffering from increased siltation levels, especially near the Sabaki River.

9. Total areas and % land areas reported in this annex do not add up to 100% for two reasons: the difficulty of delineating boundaries for some ecosystems and the omission of some ecosystems, eg. Afro-alpine moorland, agricultural land, river water (see Annex 1h for a complete list of biotic communities present in Kenya). A coordinated country-wide survey of ecosystem status in relation to alternative land use pressures would seem to be a priority. The recently created Department of Resource Surveys and Remote Sensing has GIS facilities which would enable this data to be used in regional planning.

UNEP BIODIVERSITY GUIDELINES ANNEX 1e: AREAS OF HIGH SPECIES ENDEMISM

Protection of national endemic species is an important contribution each country can make to global species diversity. Whilst non-endemic species, eg. the elephant, may make important contributions to national tourism, their extinction in any one country does not represent a global biodiversity loss.

Endemic species, by virtue of the specialist ecology which restricts them to local regions and habitats, are mostly ecologically rare, and thus easily pushed into threatened conservation status by habitat alteration, over-utilisation, etc. A large proportion of the endemic species listed in this report also appear in the endangered, vulnerable and rare categories of threat, notably the two endemic primates, restricted to a single, protected but ecologically unstable site, the Tana River Primate Reserve.

Annex 1e lists those sites in Kenya which contain more than just one or two endemic species, for those endemic species whose distribution is known. A detailed list of plant sites is included in Appendix 3, along with a map. The large number of sites, especially for plants, poses a particular conservation challenge. It is unlikely that many small, scattered sites will be incorporated into an extended protected area system. Many endemic species will need protection outside of these areas and may have to taken into ex-situ facilities if their long-term survival is to be guaranteed.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.e
Areas of High Species Endemism

Category	Number of Sites	Total Area (ha)	Biodiversity Value	Footnotes
Monera	3	65300	existence/option value; tourism; biotechnolgy	1
Protoctista	no data			
Fungi	no data			
Plantae	64	1209878	existence/option value; tourism; use value, including biotechnology	2
Animalia	>20	2144828	existence/option value; tourism value	3
TOTAL	85	3420006		4

UNEP BIODIVERSITY GUIDELINES ANNEX 1e

Footnotes:

1. For microbes, the concept of endemism is new and perhaps inappropriate, but the soda/saline lakes of Kenya (especially Lakes Nakuru, Magadi and Bogoria) are prominent in the uniqueness of their microbial composition. The microbial species of these lakes include *Spirulina* spp., the main food of the flamingoes, and archeaobacteria thought to resemble the earliest cellular life forms. These microbes are adapted to hot, extreme pH conditions, similar to those used in biochemical synthesis and could provide heat-stable enzymes for use in biotechnology.

   It is likely that most specialised micro-habitats, from forest soils to termite guts, would contain endemic bacterial strains of potential use through biotechnology, if thoroughly investigated.

2. Plant endemism in Kenya is not restricted to particular regions of the country. Rather, it is found at low density over much of the country, hence the large total area of the endemic sites in the Annex table. The 64 sites are listed along with a map showing location in Appendix 3. Some of these sites are already protected, some are proposed for protection and some will undoubtedly be lost in the next few years. The Herbarium of the National Museum plans to refine and focus this list as it completes a preliminary database on endemic/threatened plants in Kenya, and initiates inventories of undercollected regions, notably the North-East. Annex 1b.3 lists 392 true Kenyan endemic species and also 333 regional endemic plant species. Kenya sits at the intersection of four major phytogeographical zones (Guineo-Congolean, Zanzibar-Inhambane, Somalia-Maasai and Afro-montane). Coordinated international strategies will be required for efficient conservation of many East African plant species.

3. Animal endemism appears to be more localised than plant endemism, but this may be a reflection of the bias of knowledge towards vertebrates, and to sites only intensively studied because of the rare birds and mammals known to be present. The current list of endemic animals (see Annex 1b.3) is focussed on 12 sites, with a long additional list of sites with one or a few endemics. These endemic "hotspots" should be considered priorities for inclusion in an extended system of protected areas where they are not already included. Isolated endemics (a single endemic in a small habitat) must be considered as priorities for *ex situ* conservation, eg. coastal forest species restricted to Kaya forest fragments.

4. The total area is large for two reasons: the area needed to cover wide-ranging plant endemism, and also the overlap in endemism, so some sites have been counted more than once (for plants and animals). A more extensive analysis could eliminate this overlap, adjust site importance in terms of number of endemics and degree of threat, and allow prioritisation of sites for conservation action.

Map Ref. No.	Site	Region	District	Latitude/Longtitude	Area (ha)	Conservation Status	Comments
1	Taita Hills:	K7	Taita-Taveta	3 19'S 38 20'E	283	Ungazetted trustland	high endemism, shared
	Mbololo/Mraru, Ngangao					Mbololo 168ha/Nangao 98ha	with E.Arc Mts.
	Chawia,Bura Bluff, Ronge					scattered forest patches	Ngangao/Mbololo being gazetted
	Sagala, Vuria						
	Mwaganini, Kinyesha Mvua, Choke					all plantation: 557ha in total	
15	Kasigau	K7	Taita-Taveta	c3 50'S 38 40'E	230	Gazetted, trustland	
14	Kilibasi		Taita-Taveta				relatively undisturbed
13	Maungu Hills	K7	Taita-Taveta	3 38'S 38 44'E	150	ungazetted trustland; private land	close to Tsavo East boundary
3	Taveta Forest	K7	Taita-Taveta	3 24'S 37 40'E	160	ungazetted, trustland	degraded, no recent work
5	Arabuko-Sokoke Forest	K7	Kilifi	c3 20'S 39 52'E	38430	Gazetted, Government	KIFCON project, recent
						Nature Reserve: 4300ha	managment strengthening
12	Gedi Forest	K7	Kilifi	3 18S 40 01'E		Gedi National Monument: 44ha	
						Plantation: 690ha	
4	South Coast forests:	K7	Kwale/Kilifi	MIXED	8150	Total area of all forest patches	
	incl. Mwachi, Mailunganji						
	Gogoni(K), Buda				2890	Gazetted, Government.	
	incl. Mkongani N. and W., Jombo,						
	Mrima, Marenji, Gonja				4655	Gazetted, trustland	
	incl. Pangani(K), Chavingo,						
	Mazeras, Muhaka, Diani(K),				830	ungazetted	
	Gandini, Waa(K), Mangea Hill						
	Other Kaya forests:		Kilifi			ungazetted	
	incl. Cha Simba, Mwara, Ribe,				Kambe 75	all Kayas to be gazetted: 1992	mixed status, many degraded
	Rabai, Kambe, Kinondo, Kivara				Ribe 100		
	Chonyi Rock				Rabai 600		
					Kivara150		Jombo and Mrima same/Smithsonian?
2	Shimba Hills/Makandara Forest	K7	Kwale	c4 07'-4 20'S, 39 25'E	11185	Gazetted, National Reserve	FD/KWS joint management
	Mailunganji Forest			4 06'S 39 28'E	1355	Gazetted, trustland?	proposed extension to Shimba Hills
12	Shimoni	K7	Kwale	4 38'S 39 23'E		ungazetted trustland	proposed road and development
							coral rag, unsuitable for agriculture
6	Taru Hill	K7	Kwale	3 45'S 39 07'E			degraded forest, orchids
							in quarry below
11	Lali Hills	K7/4	Kilifi/Kitui	3 04'S 39 16'E			edge of Galana Ranch, no great threat
							except fire and overgrazing
7	Witu Forest	K7	Lamu	2 22'S 40 30'E	1420	Gazetted, Government	
	also known as Utwani/Mambosasa					gazetted forest reserve: 3937ha	
8	Boni Forest	K1/7	Lamu	1 40'S 41 10'E	133900	Nature Reserve?	proposed to link Boni NR and Dodori
							NR, forming large protected area
							but also planned for development

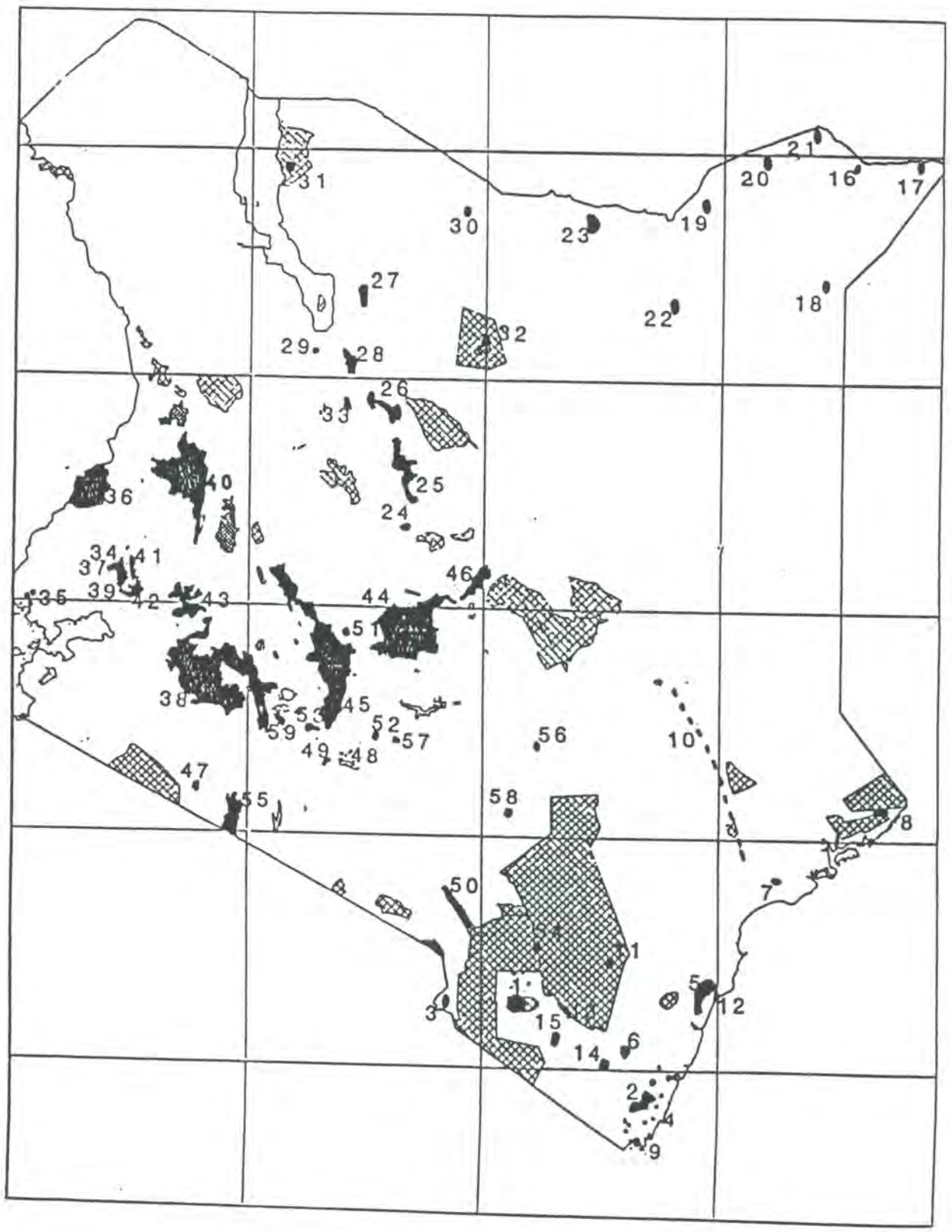
UNEP BIODIVERSITY COUNTRY STUDY: KENYA
APPENDIX 2: SITES OF PLANT ENDEMISM

Map Ref. No.	Site	Region	District	Latitude/Longtitude	Area (ha)	Conservation Status	Comments
16	Ramu	K1	Mandera	3 56'N 41 13'E		Government Land	22-29: all poorly studied. This
17	Mandera Limestone		Mandera	3 30'N 40 40'E			entire region is a high priority
18	El Wak		Mandera	2 49'N 40 56'E			for floristic survey.
20	Banissa		Mandera	3 57'N 40 21'E			
21	Malka Mari		Mandera	4 16'N 40 46'E			contained in National Reserve
19	Dandu (near Gurar)		Mandera/Wajir	3 26'N 39 52'E			
22	Buna		Wajir	2 47'N 39 31'E			
23	Moyale		Marsabit	3 30'N,39 05'E			
27	Mt. Kulal	K1	Marsabit	c2 43'N 36 55'E	2240	forest: Ungazetted trustland	now a Biosphere Reserve
							45931 ha forest
32	Mt. Marsabit	K1	Marsabit	c2 18'N 37 58'E	13675	Gazetted Government	Also National Park and Reserve
30	Huri Hills	K1	Marsabit	3 30'N 37 50'E	30000	ungazetted	
28	Ol Dolnyo Nyiru	K1	Samburu	2 15'N 36 50'E	7890	Gazetted, Government	45,931.7ha forest gaz1956
26	Ndoto Mountains	K1	Samburu	c1 45'N 37 08'E	10155	Gazetted, Government	97164ha when gazetted in 1956
25	Mathews Range	K1	Samburu	c1 16'N 37 17'E	26330	Gazetted, Government	93765ha when gazetted in 1956
	same as Ol Dolnyo Lenyiko/Warges						
24	Lolokwe Mt.	K1	Samburu	0 50'N 37 32'E	105		
31	L. Turkana area, near Koobi Fora	K1	Turkana	3 57'N 36 13'E	not known	In Sibolol NP	In Sibolol NP (World Heritage Site)
33	Baragoi, El Barta Plains	K1	Turkana	1 47'N 36 48'E	not known		
29	Ayangyangi Swamp	K1	Turkana	1 55'N 36 05'E	not known	L. Turkana Basin	
34	Kakamega Forest	K5	Kakamega	c0 15'N 34 52'E	14300	Gazetted, trustland	
						plantation: 2655	
						proposed NP:1500	
						not gazetted 1988; (heavily	
						threatened by agricultural	
						expansion; 300ha lost)	
35	Busia	K5	Kakamega	0 13'N 34 37'E		gazetted 1986	four forest patches, 579.7ha total
	Ukwala			0 12'N 34 11'E			probably all degraded
	Bukura			0 28'N 34 05'E			Guineo-Congolian remnants
37	Yala River Forest	K5	Kisumu/Kakamega	0 03'N 34 58'E			remnant patches in high density
							agricultural region, probably lost
39	Kalmosi Forest	K5	Kakamega	0 08'N 34 56'E	19		probably degraded
36	Mt. Elgon Forest	K3/5	Trans Nozia/	c1 08'N 34 33'E	68640	Gazetted, Government	gazetted 1932, poor protection
			Bungoma			Plantation: 4500	many Kenya/Uganda endemics
						National Park: 5000 forest	
						severely depleted outside NP	
38	Mau Forest	K3/6	Kericho/Narok/	c0 35'S 36 03'E	205605	Gazetted, trustland: 128380	high priority
			Nakuru			Gazetted Government: 77225	
						of which much disturbed/cleared	
						Plantation: 52528	
41	North Nandi	K5	Nandi	c0 20'N 34 59'E	9100	Gazetted, trustland/depleted	1967-80: loss 295ha/yr
42	South Nandi	K5	Nandi	c0 05'N 35 00'E	15580	Gazetted, trustland/depleted	1967-80: loss 490ha/yr
						part plantation/part Nature Reserve	S. Nandi now all settled?
	Including Kipkarren	K5	Kakamega	0 37'N 34 58'E			
40	Cherangani Hills	K3	West Pokot/Elgeyo	c1 15'N 35 27'E	89000	Gazetted, trustland	high priority
			Marakwet/Trans			Plantation: 5515	
			Nozia			most heavily disturbed	

Map Ref. No.	Site	Region	District	Latitude/Longtitude	Area (ha)	Conservation Status	Comments
	Nyanza Basin Forest	K3	Nyanza?	not known			high agriculture region now destroyed/plantation
43	Tinderet Forest /E. Elburgon	K3	Uasin Gishu/ Kericho/Baringo	c0 05S 35 30'E	92110	Gazetted, Government: 76965 Lembus/Metkei/Chemorogoch trustland much is plantation	
10	Tana River	K4/7	Tana River	c1 30'S 39 30'E	5935	Ungazetted, trustland; includes Tana River Primate NR: 1150ha	check areas for forest v mangrove high priority
44	Mt. Kenya Forest	K4	Meru/Nyeri/ Kirinyaga	c0 09'S 37 19'E	174055	Gazetted, Government Plantation: 9665 forest almost all outside NP	high priority, cedar/camphor/podo overcut important Afro-Alpine/lowerplants
46	Nyambeni Hills	K4	Meru	c0 15'N 37 55'E	6825	Gazetted, trustland	possibly altered by khat/miraa trade see Imenti Forests?
45	Aberdares Forest	K4	Nyeri/Laikipia/ Murangau/Kiambu/ Nyandarau	c0 05'-0 45'S, 36 26'-36 52'E	180810	Gazetted, Government Plantation: 23000	
53	Ndarugu River	K4	Kiambu	c0 51'S 3637'E- 1 07'S 37 10'E			
48	Nairobi Area Forests:	K4		MIXED	4015	plantation: 1060	80ha in Nairobi NP
	Karura, Ngong Road,		Nairobi			gazetted, Government	Dagoretti: 585 plantation
	Ololua		Nairobi		325	p gazetted, trustland owned by NMK	degraded
	Embakasi		Nairobi		520	gazetted, trustland	mostly plantation
	Kamiti, Karura		Nairobi			gazetted, Government	
	City Park/Arboretum		Nairobi		80	City Council/Forestry	
	Kiambu, Muguga		Kiambu				
52	14 falls	K6	Kiambu	1 04'S 37 15'E			proposed NP
51	Chania Gorge	K6	Nyeri	0 27'S 36 43'E			Faden/same as 14 falls
49	Ngong Hills	K6	Kajiado	c1 25'S 36 38'E	150	Gazetted as National Reserve much disturbed 250ha forest lost 1967-80	80% drop in water production
50	Chyulu Hills	K4/6/7	Machakos/Kajiado/ Taita-Taveta	c2 18'-2 50'S, 37 40'-38 00'E	4640	W of crest: Ungazetted, trustland E of crest: Chyulu East NP South and Ngulia: Tsavo West NP rest degraded by burning/charcoal	NP in 1990, settlement/squatters still remain; some areas degraded by burning and miraa collection stopped in 1989
54	Lugard Falls/Ngulia	K4/7	Kitui/Taita-Taveta	3 02'S 38 42'E		in Tsavo Nat. Park	some protection within Tsavo NP
58	Mutomo Plant Sanctuary	K4	Kitui	c1 50'S 38 15'E	16	still present but much degraded	semi-arid succulents
55	Nguruman Hills	K6	Narok	1 48'S 35 56'E	47750	Ungazetted, trustland; cycad site 33000ha forest in 1980	see Fayed 1980 ecological survey unpublished report, Herbarium.
47	Lolta Hills	K6	Narok	c1 40'S 35 50'E	2055	Ungazetted, trustland 50% forest	remnants of forest in valleys
59	Mt. Suswa	K3/6	Naivasha	c1 09'S 36 21'E		proposed extension to Hell's Gate	some succulents/scenic value
57	Ol Doinyo Sapuk	K4	Machakos	1 08'S 37 15'E	1800	National Park 18km2	evergreen bushland
56	Kitui Hills	K4	Kitui	1 16'S 38 34'E	890	Ungazetted, trustland:	Endau reduced from 720ha to 455ha
	Endau,Mutha,Mutitu,Makongo,Nuu, Nthoani, Kabonge					Endau, Mutha, Nthoani. Gazetted, trustland: rest	over period 1967-76
	TOTAL OF ALL SITES				1209878		

MAP 1e.1: MAP OF SITES OF PLANT ENDEMISM

Black areas indicate forests.
Cross hatching indicates protected areas.



UNEP BIODIVERSITY GUIDELINES ANNEX 1f: SIGNIFICANT CHANGES IN POPULATIONS OF SPECIALLY SELECTED SPECIES OF NATIONAL IMPORTANCE OVER THE LAST TEN YEARS

It is certain that many species of national importance have undergone significant population change over the past 10 years. But, within the timeframe of this study, few data were available which spanned an adequate period of time or the entire whole country.

Data for viruses are included to empahasis the pervasive role disease plays in national patterns of human interaction with the environment. Ecological shifts caused by the rinderpest epidemic earlier this century are still a major influence on patterns of pastoralist movement through much of East Africa. Transmission of disease between wildlife and livestock (eg. Malignant Catarrhal Disease, East Coast Fever) and the current AIDS epidemic will have as large an impact on biological diversity as any traditional conservation programme, highlighting the need for wide ranging studies of the best investment for long term biodiversity conservation.

Some data is available for fish species of commercial significance, but only through catch figures. These data cannot distinguish significant population changes from changes in fishery practise (eg. changes in mesh size). There is an urgent need for the population of both freshwater and marine fish stocks to be more thoroughly studied and monitored.

Large mammalian herbivore and predator populations are monitored at selected sites across the entire country by the Department of Resource Surveys and Remote Sensing. In recent years most of these species have shown small population increases, recovering from the lows reached in the early 1980s, but the long term security of these species in many areas is still precarious. Data for most other taxa are almost non-existent.

Data on population changes in plant species is nearly all qualitative; some representative examples of particualr concern are listed in the Annex Table. Collection of sytematic population data for a range of species in representative sites is an urgent priority. Regular relatively coarse-grained data collected over a wide area and long periods of time are likely to be of more use in long-term conservation management in Kenya than intensive, detailed studies.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.f
Significant Changes in Populations of Specially Selected Species of National Importance over the Past 10 Years.

Taxon	Species	% Increase/Decrease	Derived/Lost Economic Benefit	Causes of Loss
Virus	HIV	mean of 3.5% of population HIV +ve	loss of workforce/social disruption	lack of awareness/condoms/vaccine
	Rinderpest	100% decrease in Kenya	not known	vaccination of domestic cattle
	Acelaphine herpesvirus-1	increasing as wilderbeest numbers rise	not known	
Animalia	Procrambus clarki		important fishery	overharvesting
	Penaeus spp.		important fishery	overharvesting
	Panulirus ornatus			
	Loxodonta africana	87% decline from 1973 to 16,000 in 1989	major tourist attraction/ecological	habitat loss/poaching
	Lycaon pictus			habitat loss/persecution
	Diceros bicornis	97% decline from 1970 to around 500	major tourist attraction	habitat loss/poaching
	Acinonyx jubalatus			habitat loss/persecution/viral epidemic
	Panthera pardus			habitat loss/persecution
	Damaliscus lunatus hunteri	population around 1700		livestock competition/poaching
	Hippotigris grevi			
	Dugong dugong			
	Colobus badius rufomitratus	83% decline in past 15 years to 250	unquantified existence value/	habitat loss/fragmentation
	Cercebus galeritus galeritus	45% decline in past 15 years to 1,100	/future tourism	habitat loss/fragmentation
Plantae	Comercial timber species			
	Afzelia quanzensis	Shimba/Hills/Arabuko-Sokoke/Witu	important woodcarving species	illegal/unregulated logging
	Brachylaena hutchinii	Arabuko-Sokoke, other coastal forests	posts/flooring/woodcarving	illegal/unregulated logging
	Combretum schumanii	Arabuko-Sokoke/Shimba Hills	wood carving	illegal/unregulated logging
	Dalbergia melanoxylon		woodcarving ebony	illegal/unregulated logging
	Juniperus procera	Highland forests	timber	
	Ocotea keneinsis	West Mt. Kenya	timber?	logging/agricultural encroachment
	Ocotea usambarensis	E and W Mt. Kenya/S Aberdares/Kikuyu esc	timber?	logging/agricultural encroachment
	Olea welwitschii	Kakamega/N and S Nandi/Mt Elgon	timber?	logging/ agricultural encroachment
	Podocarpus falcatus	Mt Kenya/Mt Elgon/highland forests	timber?	illegal logging
	Podocarpus latifolius	Mt Kenya/Mt Elgon/highland forests	timber?	illegal logging
	MEDICINAL PLANTS			
	Znathoxylum chalybeum	semi-evergreen/dry forest/coastal thicket	root/stem/bark	overcollection
	Prunus africona	moist evergreen forest		overcollection for export
	Strychnos henningsi	upland dry forest/evergreen thicket	all parts used	overcollection
	Warburgia stuhlmannii	Kwale/Kilifi coastal dry bushland	stem	overcollection
	Myosine africana	upland dry forest/rocky hills	seed/root used	
	Lannea schweinfurthii var. stuhlmannii	wooded grassland/semi-evergreen bushland/dr	stem/root	
	Voacanya thouarsii	Kakemega swamps		
	Voacanya africana	extreme SE Kenya swamps		

UNEP BIODIVERSITY GUIDELINES ANNEX 1g: PROTECTED AREAS

The protected area system of Kenya (National Parks, National Reserves and Gazetted Forest Reserves only) covers around 7.9% of the country; a total of over 45,800km^2. Other categories of protected sites (Ramsar Sites, Biosphere Reserves, World Heritage Sites) may already be included in this total whilst other areas (eg. ungazetted forest) receive little or no real protection.

Whilst Kenya's achievement in establishing the present protected area system is one of the best in Africa, it must also be stressed that these protected areas are unlikely to provide adequate security for Kenya's biodiversity if current trends in land policy, population growth and unregulated utilisation continue.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.g
National Parks/Nature Reserves/Gazetted Forests (per IUCN categories) & other Protected Sites

Protected Area	Total No. of Sites	Total Area of Sites (ha)	% of total land area	Biodiversity Value/Role/Function Also see footnotes	See Ftnote
Existing Land Parks	22	2905002	4.69		1
Existing Marine Parks	4	5400	0.01		1
Existing Land Reserves	22	1452755	2.49		2
Existing Marine Reserves	5	70609	0.12		2
Proposed Land Parks	4	not known		increased wildlife protection	1
Proposed Marine Parks	3	121400	0.21		1
Proposed Land Reserves	1	55000	0.09		2
Proposed Marine Reserve	0				2
Existing Biosphere Reserves	5	1334559	2.29	areas different to parks? Amboseli, Mt. Kulal Mt. Kenya, Malindi, Kiunga	3
Proposed Biosphere Reserves	0	0			3
Existing Ramsar Sites	1	18800	0.03	Lake Nakuru National Park	3
Proposed Ramsar Sites	1	85500	0.15	Tana Delta	3
Existing World Heritage Sites	0				3
Proposed World Heritage Sites	1	157085	0.26	Sibiloi NP/more proposed after UNESCO entry 5/9/91	3
Others	1	500	<0.01	Maralal Game Sanctuary	3
Existing Gazetted Forest Reserves	203	1669022	2.86	includes non-forest area 203 GF from WCMC	4
Forest Nature Reserves	11	52679	0.09	exist within GF/WCMC figure	4
Proposed Gazetted Forest Reserves	133	525501	0.90	FAO 1988 report/check none gazetted since 1987	4
Existing Ungazetted Forest Reserves	136	535653	0.92	forest outside current GR	4

Footnotes:

1. Details of Kenya's National Parks system are given in Appendix 4. The National Park system is dominated by the size of two parks: Tsavo East and Tsavo West, which account for over 70% of the total park area. National Parks are classified in Category II of the IUCN, which allows only scientific, educational and recreational use compatible with ecological stability and diversity. In the wake of the collapse and dissolution of the old Wildlife Conservation and Management Department (WCMD), many of Kenya's National Parks are still being utilised for other purposes and are not ecologically stable (notably Amboseli NP and Lake Nakura NP). Kenya Wildlife Service has as a priority action the development and implementation of management plans for all National Parks and Reserves. To date, management plans only exist for some protected areas.

2. Details of Kenya's National National Reserves are given in Appendix 3. National Reserves are classified in IUCN Category IV, which allows specific manipulation for conservation, but restricting main use to scientific research, environmental monitoring and educational use. In Kenya, until recently, all National Reserves were owned and managed by County Councils and have been utilized for a range of activities beyond those listed above. This poorly regulated use is especially apparent in the marine reserves. KWS has agreed to manage two National Reserves (Shimba Hills and Maasai Mara) jointly with County Councils. This should improve the quality of ecological monitoring, tourism revenue and revenue redistribution to suit local needs. This joint management policy should be extended to more reserves as KWS develops the institutional capability to cope.

3. Biosphere Reserves: four of the five Biosphere Reserves overlap with, but are larger than, already protected areas. The newly-created Amboseli BR is ten times the size of the central protected area, providing ample scope for the development of the biosphere concept. In the case of Malindi/Watamu and Kiunga BR, the additional area (18,000ha and 35,000ha respectively) appears to be all marine water whilst in Mt Kenya the BR is only 259ha larger than the area of the National Park, leaving little scope for the application of the bisphere concept beyond the presently protected area. Mt Kulal BR has been the focus of Kenya's ASAL research programme in Northern Kenya and is discussed in more detail in the separate report on Cultural Aspects of Biodiversity.

   Ramsar Sites: Kenya's one Ramsar Site is Lake Nakuru NP, an important site for flamingoes, but is undergoing marked ecological change, both in the lake, through fish introductions, alterations of water input, agricultural and industrial run-off, and on land, where loss/exclusion of browsing herbivores is allowing rapid scrub/bush expansion. The second proposed Ramsar Site, Tana River Delta, is already under increased pressure from planned aquaculture expansion, increasing mangrove harvesting and alterations in river flow from damming of the Tana River. It is likely that stronger control of use than the Ramsar Convention can provide will be needed for this area if its ecological and natural resource functions are to be reconciled.

UNEP BIODIVERSITY COUNTRY STUDY: KENYA
APPENDIX 3: LIST OF NATIONAL PARKS

PARK NAME	DISTRICT	YEAR	TOTAL AREA	% LAND AREA	% OF PARK TOTAL	BIOTIC COMMUNITY PRESENT	BIODIVERSITY VALUE/ ROLE/FUNCTION
LAND NATIONAL PARKS							
Nairobi	Nairobi	1946	11721	0.0200	0.40	4,6b	WC/T/R
Aberdare	Nyeri/Muranga	1950	76619	0.1300	2.63	1,2	WC/T/WF
Amboseli	Kajiado	1974	39206	0.0700	1.35	6c,8,14	WC/T/R Biosphere R 483km2
Tsavo East	Taita Taveta-Kitui	1948	1174700	2.0000	40.37	6d,8	WC/T/R
Tsavo West	Taita Taveta	1948	906500	1.5400	31.15	8	WC/T/R/WF?
Mt. Kenya	Nyeri/Meru/Kirinyaga/Embu	1949	71500	0.1200	2.46	1	WC/T/R/WF Biosphere R 718km2
Meru	Meru	1966	87044	0.1500	2.99	7,8	WC/T/R?/WF
Ol Donyo Sabuk	Machakos	1967	1842	0.0030	0.06	4	WC/T/R?/WF
Mt. Elgon	Trans Nozia	1968	16923	0.0290	0.58	1,2	WC/T/R/WF
Sibiloi	Marsabit	1973	157085	0.0270	5.40	9	WC/T/R
Chyulu	Machakos	1983	47090	0.0800	1.62	8	WC/T/R/WF
Longonot	Nakuru	1983	5200	0.0090	0.18	5	WC/T/WF
Ruma	South Nyanza	1983	12000	0.0020	0.41	6b	WC/T/R/RSS
Hell's Gate	Nakuru	1984	6800	0.0120	0.23	5	WC/T/RSS
Kora	Tana River	1989	178780	0.3040	6.14	8	WC/T/R
Malka Mari	Mandera	1989	87600	0.1490	3.01	9	WC/T
Arabuko Sokoke	Kilifi	1990	600	0.0010	0.02	5	WC/T/R/RSS
Saiwa Swamp	Trans Nozia	1974	192	0.0003	0.01	14	
Ndere Island	Kisumu	1986	420	0.0007	0.01	15	WC/RSS/FN
Central Island Turkana	Turkana/Marsabit	1983	500	0.0008	0.02	15	WC/RSS
South Island Turkana	Marsabit	1983	3880	0.0066	0.13	15	WC
Lake Nakuru	Nakuru	1967	18800	0.0319	0.65	16	WC/T/R
TOTAL			**2905002**	**4.6863**	**99.82**		
MARINE NATIONAL PARKS							
Malindi Marine	Kilifi	1968	600	0.001	0.02	19	WC/T/R (sits within reserve)
Watamu Marine	Kilifi	1968	1000	0.002	0.03	19	WC/T/R
Mombasa Marine	Mombasa	1986	1000	0.002	0.03	19	WC/T/R (sits within reserve)
Kisite/Mpunguti	Kwale	1978	2800	0.005	0.10	19	WC/T/R
TOTAL			**5400**	**0.010**	**0.18**		
GRAND TOTAL			**2910402**	**4.991**	**100.00**		
PROPOSED PARKS							
Fourteen Falls	Kiambu		200	0.0003			
Mau Summit	Nakuru/Narok		31000	0.0530		2 (bamboo)	forest reserve/KWS manage
Marsabit	Marsabit		36000	0.0618		4,5,7,8	sits within reserve
Bonjoge	Nandi		2100	0.0004			
Kisumu Impala	Kisumu		100	0.0002			
Lake Simbi	South Nyanza		4200	0.0072			
Nasalot	West Pokot		9200	0.0158			already a NR
South Turkana	Turkana		109100	0.1872			already a NR
Kakamega	Kakamega		44700	0.0767			already a NR
TOTAL			**236600**	**0.1148**			
PROPOSED MARINE PARKS							
Tana River Delta			85500	0.1452		18,19	WC/FN
Ras Tenewi			35600	0.0605		19	WC currently being gazetted
Diani Marine			300	0.0005		19	WC
TOTAL			**121400**	**0.2062**			

WC = WILDLIFE CONSERVATION
R = RESEARCH
T = TOURISM
NR = NATIONAL RESERVE
WF = WATERSHED FUNCTION
RSS = RARE SPECIES SURVIVAL
FN = FISHERY NURSEY

UNEP BIODIVERSITY COUNTRY STUDY: KENYA
APPENDIX 3: LIST OF NATIONAL RESERVES

RESERVE NAME	DISTRICT	YEAR	TOTAL AREA ha	% LAND AREA	% OF RESERVE TOTAL	BIOTIC COMMUNITY PRESENT
LAND RESERVES						
Arawale	Garissa	1974	53324	0.009	3.51	8
Marsabit	Marsabit	1949	155400	0.270	9.77	4,5,7,8
Shimba Hills	Kwale	1968	19251	0.070	1.27	6b,10
Shaba	Isiolo	1974	23910	0.040	1.58	8
Maasai Mara	Narok	1974	151000	0.300	9.96	5,6b,7
Mwea	Embu	1976	6803	0.010	0.45	7,8
Rahole	Garissa	1976	127000	0.020	8.37	8
Tana River Primate	Tana River	1976	16900	0.030	1.11	8,11
Boni	Garissa	1976	133900	0.020	8.83	6b,11
Losai	Marsabit	1976	180680	0.030	11.91	7,8
Nasolot	West Pokot	1979	9200	0.020	0.61	8
Kerio Valley	Elgeyo Marakwet	1983	6600	0.010	0.44	6b,8,10,11,18
Bisanadi	Isiolo	1979	60600	0.100	4.00	8
South Turkana	Turkana	1979	109100	0.200	7.19	8
Kamnarok	Baringo	1983	8774	0.015	0.58	8
Samburu	Samburu	1985	16500	0.030	1.09	8
Buffalo Springs	Isiolo	1985	13100	0.030	0.86	6b,11
Kakamega	Kakamega	1985	4469	0.007	0.29	3
Lake Bogoria	Baringo	1970	10705	0.020	0.71	8
North Kitui	Kitui	1979	74500	0.130	4.91	8
South Kitui	Kitui	1979	183300	0.130	12.09	6b,10
Dodori	Lamu	1976	87739	0.200	5.78	6b,8,11,12,18
Ngai Ndeithya	Machakos	1976	212209			being degazetted
TOTAL			**1452755**	**1.691**	**95.3**	
MARINE RESERVES						
Mpunguti	Kwale	1978	1100		0.07	19
Kiunga Marine	Lamu	1979	25000	0.040	1.65	18,19
Mombasa Marine	Mombasa	1986	20000	0.030	1.32	19
Malindi Watamu	Kilifi	1968	21309		1.40	19
Watamu	Kilifi	1968	3200		0.21	19
TOTAL			**70609**	**0.070**	**4.6**	
GAME SANCTUARY						
Maralal	Samburu		500		0.03	
GRAND TOTAL			**1523864**	**1.761**	**100.0**	
PROPOSED LAND RESERVES						
Kirimun (Laikipia)			550	0.090		7,8
PROPOSED MARINE RESERVES						
None						

UNEP BIODIVERSITY COUNTRY STUDY: KENYA
APPENDIX 3: LIST OF OTHER PROTECTED AREAS

PROTECTED AREA NAME	DISTRICT	DATE	TOTAL AREA ha	% LAND AREA
BIOSPHERE RESERVE				
Mount Kenya BR	Nyeri/Meru/Kirinyaga/Embu	1978	71759	0.123%
Mount Kulal BR	Marsabit	1978	700000	1.201%
Malindi/Watamu BR	Kilifi	1979	19600	0.034%
Amboseli BR	Narok	1991	483200	0.829%
Kiunga BR	Lamu	1980	60000	0.103%
Total			**1334559**	**2.291%**
RAMSAR SITE				
Lake Nakuru NP	Nakuru	1990	18800	0.032%
PROPOSED RAMSAR SITE				
Tana River Delta	Tana River		85500	0.147%
PROPOSED WORLD HERITAGE SITE				
Sibiloi NP	Marsabit		157085	0.270%
OTHER				
None Listed				

UNEP BIODIVERSITY GUIDELEINES ANNEX1h:

The biogeographical provinces, biotic communities and natural regions of Kenya are listed below. The distribution of the biotic communities and natural regions are shown on the two maps below. More detailed descriptions of the biotic communities and natural regions are given in Dean and Trump (1983).

The following questions appear in the UNEP guidelines to Annex 1h.

(a) How many national biogeographical provinces or biotic communities are there in your country?

Biogeographical Provinces: 5

Biotic Communities: 19 (grasslands divided into 4 sub-categories).

Natural Regions: 13 (sub-divided into 23 sub-regions).

(b) Please give in the table below the number and size of those biogeographic provinces or biotic communities which are NOT protected or represented in the present network of national parks/nature reserves/gazetted forests because of financial and other constraints, and indicate their biodiversity value/role/function.

See Annex Table 1h. More details of the natural regions of Kenya are given below.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.h
Additional National Biotic Communities/Biogeographic Provinces currently not protected in the National Parks/Reserve System or Sites Listed above.

Biotic Community/ Biogeographical Region	Size of Community (ha)	% of Total Land Area	Biodiversity Role/Value/Function See Footnote
Highland Grassland	32000	0.05	Adropogon/Pennisetum grasses
Coastal Palmstands	55500	0.09	Hyphaene/Borassus palms/birds/primates
Marine Beaches and Dunes	27000	0.05	Little biotic value/erosion control

Biogeographical Provinces of Kenya:

Kenya possesses 5 of the 29 biogeographical provinces listed as present in the Afrotropical Realm (Africa South of the Sahara). These are:

1. Somalian
2. East African Highlands
3. Lake Victoria
4. East African Woodland/Savanna
5. Lake Turkana

All five provinces are represented in the present system of protected areas, but details of exact areas were not available.

Natural Regions:

The Kenyan Natural Regions attempt to divide the country into easily recognized areas through a combination of topographical and ecological uniformity. Details of the exact method of classification are not available. The regions are:

1. Nyanza Plateau
2. Western Highlands
3. Rift Valley
4. Turkana Arid Lands
5. Marsabit Arid Lands
6. Central Highlands
7. Ukambani
8. Chyulu/Kilimanjaro Volcanics
9. Nyika
10. Sedimentary Plains
11. Moyale Foothills
12. Mandera Plateaux
13. Kenya Coast

All of the natural regions are represented in the protected areas system with the exception of the Moyale Foothills on the northern border with Ethiopia.

Biotic Communities:

The biotic communities present in Kenya were described and mapped by Dean and Trump in 1983. Their classification recognises 19 distinct natural communities, but further divides grasslands into 4 distinct sub-categories. Three further categories: agricultural, barren and not determined, also appear on the map. These communities and their approximate areas are given in the table below.

The distribution and amount of each biotic community vary greatly within Kenya (see Table, Map and Graph below). Three communities (arid thorn bushland and woodland, agricultural and semi-desert) account for over 75% of land area; each other community covers, less than 5% of the country, with 11 covering less than 0.2% each.

Adequate representation of all biotic communities is a major goal of a countries protected area system, as a relatively sure way to protect a wide range of species. Present representation of biotic communities within protected areas in Kenya is shown in the table below. Three communities (highland grasses, coastal palmstands, marine beaches and dunes) are not represented at present, although it is possible that patches of these communities, too small to be mapped at 1: 1,000,000 scale, may appear within protected areas.

Each of the unrepresented communities is rare.

Marine beaches and dunes are found in four clear patches: Lamu Island, the Malindi coast, the Tana Delta and Ras Tenewi. The last two are both proposed as future Marine National Parks (Ras Tenewi is currently being gazetted).

Coastal palmstands are found in three patches; two in the South near Ramisi and one larger patch in the North near the Kenyatta Settlement scheme. None appear to planned for protection. This community does not appear to harbour endemic or rare species and is not particularly rich in species.

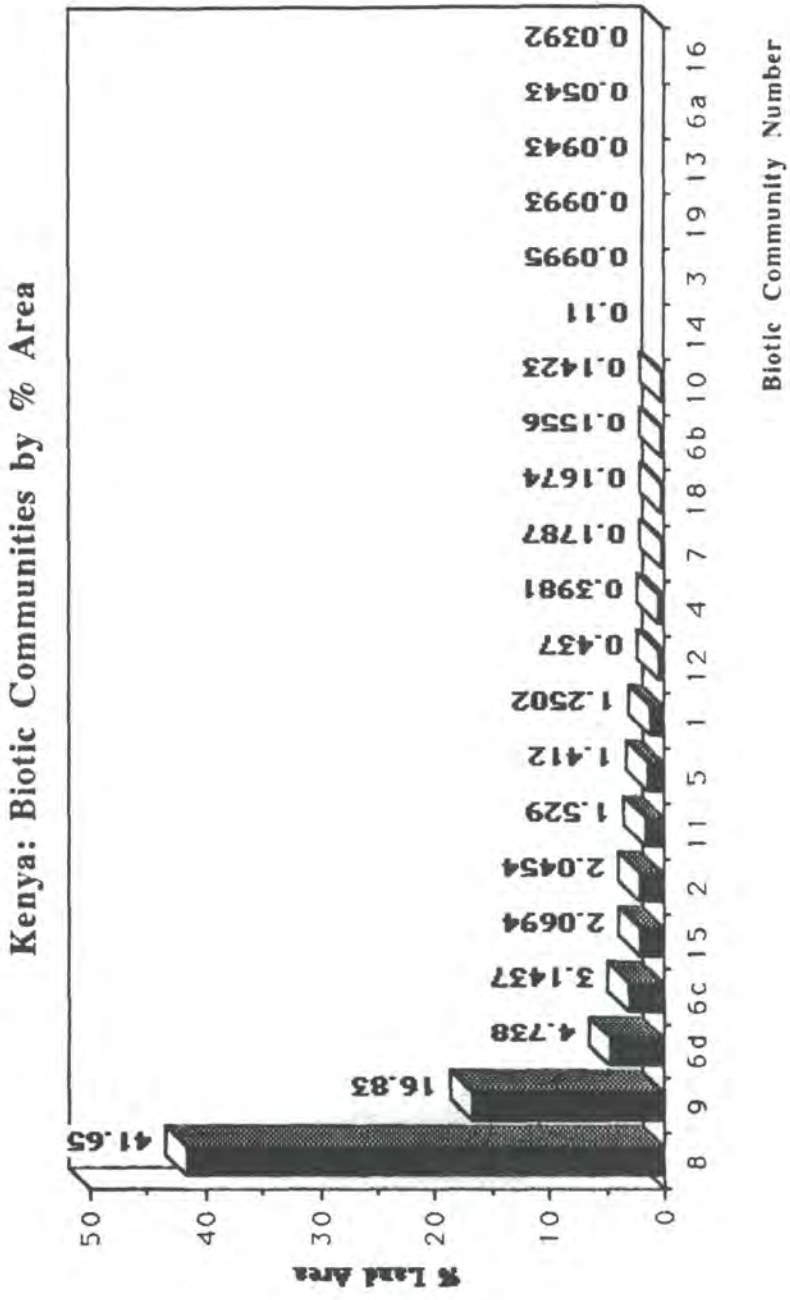
Highland grasslands are found in five patches: Cherangani Hills, Mau, Tinderet, Aberdares and Mt Kenya. Proposed NW and N extensions of Aberdare and Mt Kenya NPs would bring some grassland under protection.

A further eight communities are only represented twice, whilst the most abundant community appears 24 times. A crude assessment of the patch size, nearest neighbour and amount of each biotic community within protected areas is being completed. The GIS capability of UNEP, KWS or the DRSRS will eventually produce a more dynamic database. These studies will provide a clearer picture of the future protection of different communities.

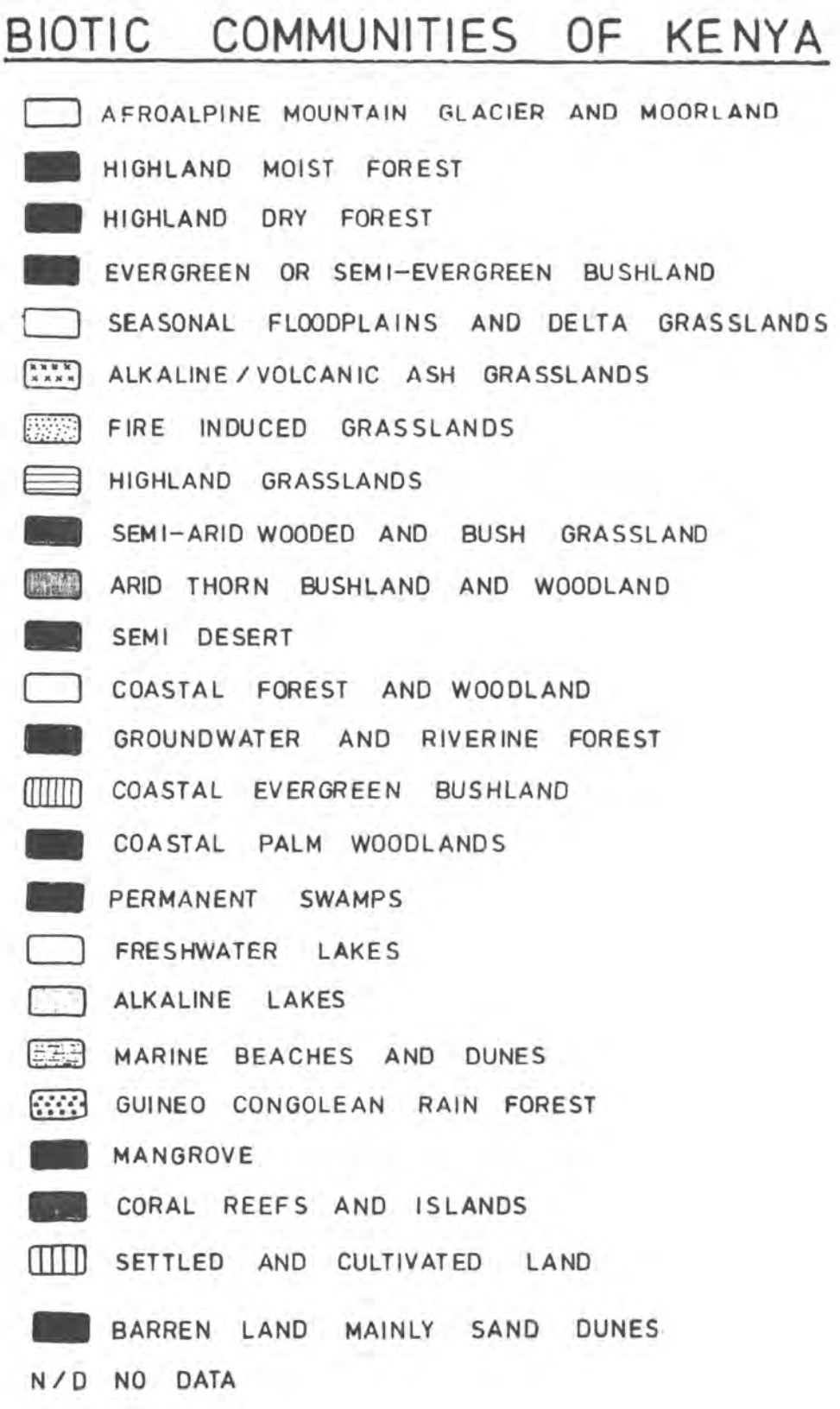
Overall, representation of biotic communities within Kenya appears good. What is not known so well is the true status of some of the smaller communities on the ground and the likelihood of their survival as viable ecological systems.

KENYA: BIOTIC COMMUNITIES BY PERCENTAGE AREA

NUMBER	BIOTIC COMMUNITY TYPE	AREA (ha)	% TOTAL LAND AREA	TIMES PRESENT IN PA SYSTEM
1	Afro-Alpine Glacier and Moorland	735900	1.2502	6
2	Highland Moist Forest	1204000	2.0454	7
3	Guineo-Congolean Rain Forest	58600	0.0995	2
4	Highland Dry Forest	234300	0.3980	3
5	Evergreen/Semi-Evergreen Bushland	831200	1.4120	4
6a	Highland Grassland	32000	0.0543	0
6b	Fire-Induced Grassland	1850500	3.1437	8
6c	Alkaline Volcanic Ash Grassland	91600	0.1556	1
6d	Seasonal Floodplain and Delta Grassland	2789000	4.738	4
7	Semi-Arid Wooded and Bush Grassland	105200	0.1787	2
8	Arid Thorn Bushland and Woodland	24522500	41.6592	30
9	Semi-Desert	9906900	16.8300	5
10	Coastal forest and Woodland	83800	0.1423	2
11	Groundwater and Riverine Forest	900000	1.5290	6
12	Coastal Evergreen Bushland	257200	0.4370	1
13	Coastal Palmstands	55500	0.0943	0
14	Permanent Swamp	64800	0.1100	2
15	Freshwater Lakes	1218100	2.0694	1
16	Alkaline Lakes	23100	0.0392	2
17	Marine Beaches and Dunes	27000	0.0458	0
18	Mangroves	98500	0.1674	3
19	Coral Reefs and Islands	58500	0.0993	9
20	Agricultural Land	10589900	17.9902	
21	Barren Land	254800	0.4329	
22	Not Determined	2870800	4.8770	
	TOTAL	58863700	99.9984	98


Kenya: Biotic Communities by % Area
% Land Area
50
40
30
20
10
0
41.65
16.83
4.738
3.1437
2.0694
2.0454
1.529
1.412
1.2502
0.437
0.3981
0.1787
0.1674
0.1556
0.1423
0.11
0.0995
0.0993
0.0943
0.0543
0.0392
8 9 6d 6c 15 2 11 5 1 12 4 7 18 6b 10 14 3 19 13 6a 16
Biotic Community Number

MAP 1h.1 BIOTIC COMMUNITIES OF KENYA



KEY TO MAP 1h.1

UNEP BIODIVERSITY GUIDELINES ANNEX 1i: PRIVATE WILDLIFE SANCTUARIES

The following questions/requests appear in the UNEP guidelines to Annex1i.

1. Does your country encourage privately-owned wildlife sanctuaries?
   Answer: Yes.

   Historically, private wildlife sanctuaries have been created in Kenya with little Government involvement and their contribution to biodiversity conservation has been rather piecemeal. But in the last 10 years a number of private ranches have become major contributors to national efforts to conserve the black rhino. These sanctuaries have invested heavily in fencing and other security measures to maintain small breeding populations of rhino (eg. Lewa Downs Rhino Sanctuary has received over $500,000 of funds donated by a private individual). These internationally important conservation sites have highlighted, to both Government and general public, the potential role of private institutions in conservation programmes.

   The Kenyan Government has a vigorous policy promoting conversion of group and trust land to private individual ownership. In the light of this trend, KWS has developed a programme encouraging private involvement in wildlife conservation, both for tourism and some forms of wildlife utilisation, but excluding trophy hunting or ivory trading. A critical factor with respect to the conservation of Kenya's highly mobile animal populations will be the success of this programme in finding innovative mechanisms to prevent land division into small fenced plots incompatible with wildlife movements.

2. Indicate the names and sizes of the sanctuaries in the table below and supply the information regarding their biodiversity value, species diversity/endemism requested.

   Data on the size, species representation and finances of private sanctuaries in Kenya were not readily available and few details can be reported.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.I
Private Wildlife Sanctuaries

Name of Sanctuary	Total Area (ha)	Animal Species	Plant Species	Endemic species	Biodiversity Value/ Role/Function
Lewa Downs	1600	>20	not known	not known	black rhino sanctuary
Ol Jogi	not known	not known	not known	not known	black rhino sanctuary
Ol Pejerta	not known	not known	not known	not known	black rhino sanctuary
Laikipia	not known	not known	not known	not known	black rhino sanctuary
Ngulia	not known	not known	not known	not known	black rhino sanctuary
Solio	not known	not known	not known	not known	black rhino sanctuary
Mt. Kenya Game Ranch	not known	>30	not known	not known	rare animal protection
Bamburi Sanctuary	not known	not known	not known	not known	ecological restoration
Sheldrick Elephant Shelter	not known	not known	not known	not known	rare animal protection
Galana Ranch	67000	not known	not known	not known	wildlife ranching
Taita Hills	not known	not known	not known	not known	rare species conservation

UNEP BIODIVERSITY GUIDELINES ANNEX 1j: STATUS OF EX-SITU INSTITUTIONS/FACILITIES

As mentioned in Annex 1i, most ex-situ facilities in Kenya are privately-owned and details of species kept have proved difficult to obtain. In this Annex some difficulty was experienced with institutions which serve several purposes, eg. combined snake farms and aquaria. In these cases, the facilities have been listed under both headings, giving a slightly inflated overall number.

Some further details of individual sites are given in the Ex-situ conservation appendix which accompanies this report.

The number of ex-situ conservation facilities required will be determined, fairly obviously, by both the number of species needing ex-situ care and the size and efficiency of the facility. The former is not easily predicted, but will be determined by the success or failure of in-situ conservation measures. The latter will be determined, not just by the funds available, but also by the availability of suitably qualified staff to maintain them. Where possible, experts have been asked to commit themselves to numbers, but little importance should be attached to them until more detailed appraisal of real needs can be completed. Numbers estimated may be lower than number existing because of the assumption that high quality facilities would replace less efficient existing sites.

UNEP BIODIVERSITY GUIDELINES: ANNEX 1.j
Status of Ex-Situ Institutions/Conservation Facilities

Institution	Number Existing	Number Required	Number of Plants	Number of Animals	Number of Microbes	Comments
Zoological Gardens	18					no real need for traditional zoo
Botanical Gardens	8	4				one for each phytogepgraphical zone
Arboreta	9	4				as above
Museums	6	10				i.e. 4 additional new museums
Herbaria	10	1				East African Herbarium extended
Aquaria	>3	1				National Aquarium at Mombasa
Aviaries	6					scientifically unimportant
Seed Banks	9	3				forestry/crops/indigenous plants
Germplasm Banks	2					
Gene Banks	1					
Data Banks		1				national biodiversity databank
Microbial Culture Collections	16	6				one of each main major taxon
Others	5					plants: 4; artificial insemination unit: 1

Total numbers for these groupings cannot be reported. Some data for isolated institutions is available in the Ex-Situ Conservation Annex.

UNEP BIODIVERSITY GUIDELINES ANNEX1k: SPECIES IN NATIONAL EX SITU CONSERVATION FACILITIES

Records of the species held in national ex-situ conservation facilities were difficult to collect in the time available. For animal species, this is because the majority of the ex-situ facilities for animals are privately-owned and detailed species lists and records of breeding are not in the public domain. For plant species, the lack of detail is due to the present condition of ex-situ sites, most of which are poorly maintained with little active breeding and poor documentation of past activity, with the exception of the recently upgraded Kenya Forestry Seed Centre (part of KEFRI). A significant amount of private horticultural plant breeding (eg. orchids and African Violets) is being completed in Kenya. Some further details of these facilities are given in the ex-situ conservation report which accompanies this report.

It is likely that ex-situ facilities will play an increasingly important role of Kenya's national and international conservation effort. Equally important will be the role ex-situ facilities will play in providing the link between natural biological resources and their use through biotechnology. Future funding and investment in this type of facilities in Kenya will only be forthcoming if present facilities can demonstrate the contribution they are already making.

UNEP BIODIVERSITY GUIDELINES: ANNEX1.k
Species In National Ex-Situ Conservation Facilities

Species Category	Total No. of species held	No. of Species acquired by accessions	No. of plants bred	No. of animals bred	Biodiversity Value/Role/Function
Endangered	4	1	not known	1	RSS/E/T/R
Vulnerable	3	1	not known	1	RSS/E/T/R
Rare	1	0	not known	1	RSS/E/T/R
Insufficiently Known					
Exotic/Alien					

DATA FOR PLANT SPECIES WERE NOT AVAILABLE

RSS = RARE SPECIES SURVIVAL
E = EDUCATION
T = TOURISM
R = RESEARCH

CHAPTER 4

ECONOMIC DEVELOPMENT AND BIODIVERSITY IN KENYA

4.1 INTRODUCTION

As the last three chapters have shown, Kenya is a country richly endowed in natural resources and in biodiversity. Without being one of the world's key depositories of genetic material, it contains some resources that are of international importance and many that are of considerable domestic value. However, it is also a country where the natural resource base is essential for some aspects of the country's future development, and in conflict with it for other aspects. For example Kenya earns a considerable income from tourism, much of which is almost entirely dependent on the wildlife and the coastal resources. On the other hand, the demands of agriculture, industry and urban development are damaging the habitats of animals and coral reefs which are a key feature of the coastal areas. This struggle between the needs for conservation and the imperative of economic development is being won by the latter in way that is incompatible with the longer term interests of the country. In other words, Kenya is not practising sustainable development and the damage to the resource base will result in due course (to some extent it is already happening) in lower output from the agricultural sector and in damage to the tourism industry on which the country is so dependent.

In this chapter we look at the reasons why the country is suffering the loss of its biodiversity and ask what changes in policies and what additional resources will be needed to arrest these trends. The broad categories of causes of biodiversity loss can be summarised as follows:

(a) demographic pressures;

(b) inappropriate incentives for conservation. These in turn can be divided into microeconomic policies, macroeconomic policies, social/legal polices, and education policies;

(c) institutional failures.

Each of these is considered in turn below. As a general remark it should be noted that one cannot fault a policy (whether it is social, economic, legal, or any other) on the grounds that it results in a loss of some of the country's biodiversity resource base. In some cases such a loss may be justified. But it is only justified if the long term benefits arising from the loss are greater than the long term costs. Unfortunately it

is too often the case that the calculus of costs and benefits on which decisions are taken does not include the longer term costs, and often is also ignores the indirect costs, or the costs that do not have, associated with them, a monetary flow.

This chapter provides a general discussion of the reasons for biodiversity loss and of the sorts of policy and resource allocation changes necessary to reduce that loss where we believe it is incompatible with sustainable development. In the next chapter we look at specific policy and investment programs (many of which are already being proposed by the Government of Kenya) which are needed to move to a more conservation conscious path of economic development.

4.2 DEMOGRAPHIC PRESSURES AND BIODIVERSITY

Population pressure is arguably the most important source of damage to the natural resource base in Kenya. From a population at independence of 8.2 million, the country has seen the numbers increase to 15.1 million by 1979 and an estimated 22 million in 1987. World Bank projections estimate that by 2000 there will be 37 million Kenyans and by 2025 83 million. The stationary population for the country, on the basis of present trends, is a staggering 196 million, to be reached in 2050.

The immediate consequence of this growth is an increase in the demand for land for cultivation, livestock and woodfuel. The extent of conversion of forest land to agriculture is not known as there has been no forest inventory, but estimates have been made of the rate of loss of indigenous forest. These indicate that over the period 1963 to 1989 about 229 Km^2 of gazetted indigenous forest were lost, partly to agricultural encroachment and partly to degradation from other uses and conversion to woodland[2]. This represents an annual rate of loss of 880 hectares, or about 0.6 percent of the gazetted natural forest area of the country. Another estimate indicates that as a percentage of all forests (gazetted and ungazetted), losses were running in the 1970s at 6,000 hectares annually to agriculture. Given that total forest area is at most 2.2 million hectares, this amounts to a loss rate of 2.7 per cent per annum. In addition to affecting forest land, agricultural expansion has also affected savannah grasslands which occupy over 80,000 Km^2. It is estimated that since 1975 over 10 percent of this kind of land has been converted to wheatland, in some cases to be abandoned later as productivity falls. Finally virtually all the known swamps and marshes are in danger from agricultural encroachment, irrespective of whether they are protected areas or not.

[2] Department of Resource Survey and Remote Sensing, Government of Kenya.

The Food and Agriculture Organisation's Study on Land Carrying Capacity (1984) has shown that even with high level farming inputs the country could not feed more than 51 million people from its land resources. As noted in Chapter 2, agricultural production growth has averaged only 3.5 percent in the 1980s, below the population growth of 4.0 percent. As a result, per-capita agricultural output has been falling: with an index of 100 in 1976-78 it dropped to 87 in 1985 and has been declining since. To maintain the present level of per-capita grain production, production must be doubled during the next 18 years.

A main reason why agricultural production has been declining is that the environmental support base has been overloaded by the fast rising human numbers. Despite a strong soil-conservation effort, most farmland areas have suffered soil erosion to some degree; in several densely populated areas, potential food output could eventually decline by as much as 50 percent if soil loss cannot be reversed.

The pressure from the increasing population for more land will continue for the foreseeable future. It can be mitigated, however, if agricultural yields from existing lands can be increased, if more of the population can derive income from non-farm sources that do not endanger the natural resource base, if forest resources can be used to generate income in a sustainable way, so that there is less incentive to convert them to agriculture, and if some of the products such as woodfuel can be obtained from other sources. The policies that would help achieve one or more of these objectives are discussed below. One general point worth noting here, however, is that simply declaring forest or any other areas as protected is not enough. Whatever products or services were being drawn from that area have to be replaced for the population that was dependent on them. Otherwise the pressure to encroach will remain and the costs of protection will be too high to be sustained for very long.

It is also worth noting that the momentum of population growth is diminishing. Although it will be a long time before its impacts are felt, there are some encouraging signs. Data from the 1989 Kenya Demographic and Health Survey indicate that desired family size has declined. The proportion of married women desiring fewer children has also gone up, and the total fertility rate has fallen from 7.7 in 1984 to 6.7. Thus, although there is a long way to go, a start is being made.

4.3 INCENTIVES FOR CONSERVATION

As indicated above, biodiversity is affected by polices that are seemingly unrelated to it, such as the growth of the non-farm sector, and improvements in agricultural output; as well as policies that are clearly of relevance, such as the utilization of natural products on a sustainable basis, and the protection of other key resources. It was also

pointed out that for such policies to succeed they must be **incentive compatible**, that is to say, other agents who are affected by them must see them as being in their interest to support the policy. This is because no government will ever have the resources or the stamina to enforce a policy in this area when the affected population wishes it to be otherwise. It may succeed in the short term, but in the long run the cost of enforcement will simply be too large. The areas to be covered and the costs of policing have been proven to be extremely large.

The polices that are of relevance can be classified according to the area in which they act, or according to a socio-economic taxonomy. The cross classification is presented below in matrix form in Table 4.1. The economic polices are separated into microeconomic policies that act at the level of the farm or individual forest, land area or water body; and macroeconomic policies that act at the national or regional level. Both may involve the allocation of investment resources in some cases and very little in others. In addition, there are social and legal polices that are of considerable importance. These are concerned with making it possible for individuals to share in the benefits of a sustainable exploitation of the natural resource base. They range from changes in the farmer and breeder rights that apply to new varieties of seeds, to institutional arrangements that permit local groups to participate forest and wildlife management. The last category is that of research and training, which has many facets. There is an immense need to increase our knowledge of how local ecosystems function and evolve, and how they have been affected by human activity. Some of the most basic information on trends is missing and needs to be compiled. Research efforts can also help in a better understanding of the demands for biodiversity-based activities such as tourism. This kind of socio-economic research can be of great benefit in designing successful policies. Finally there is the issue of research in local technology that allows a better utilisation of the country's biological resources. Areas of particular relevance here are biotechnology and development of better local varieties.

In the remainder of this section we look at the policies by area of impact, which will permit a closer integration of the discussion of the material with that of the first three chapters. It will also set the agenda for the construction of the conservation programmes that are examined in the next chapter.

4.3.1 Forestry

Forest resources are important in Kenya for the supply of timber and fuelwood that they provide, as well as the indirect benefits that they confer. The latter include protection of soil from erosion, refuge for wildlife in the dry season, protection of major water catchment areas and the provision of natural forest products. Forests act as wind breaks, reducing the impact of heavy tropical rains on the soil surface with their canopy and holding the soil particles together through their rooting network. In

TABLE 4.1
POLICIES FOR A MORE BIODIVERSITY-CONSERVATION-CONSCIOUS DEVELOPMENT POLICY

POLICIES	Forestry/ Arid Lands	Agriculture	Wetland/Marine	Wildlife/ Other
Microeconomic	(a) develop markets for forestry products (medicines, butterflies, other products) (b) increase alternative sources of woodfuel including private sector (c) energy efficiency and pricing of energy	improve inputs (b) develop horticulture (c) develop biological control methods (c) increase irrigation where appropriate (d) make alternative land use attractive	(a) improve sustainable yields (b) polluter pay on effluent treatment /release	(a) control tourism to be compatible with ecology (b) reduce settlement in dispersal areas (c) increase wildlife utilisation (d) private sector/NGO participation
Macroeconomic	(a) forestry policy framework (b) use of ex-situ conservation where appropriate	(a)increase off-farm income opportunities (b) review agricultural policy for self-sufficiency (c) macro employment policy	(a) control mariculture (b) encourage private sector sustainable use of resources	(a) trans-location, captive breeding (b) exchange rates/ tourism pricing
Socio-Legal	(a) land use reforms, benefit sharing (b) legal reforms for exploiting natural products (c) exploiting indigenous knowledge	legal rights to local materials and indigenous knowledge	exploit indigenous knowledge	increased involvement of local communities in wildlife management
Research/ Training	forest inventory, silviculture, biotechnology, awareness	extension, biotechnology, seed research, better germplasm collection (gene bank) facilities	research on ecosystems esp wetland ecology. Surveys, inventories needed. Fish breeding.	research on tourism demand determinants, awareness programmes

terms of wildlife, many of the game reserves, such as Shimba Hills, Mt. Kenya, Mt. Elgon, Aberdares, and Kakamega National Reserve, are located in the gazetted forests, where the conservation of the forest is essential for the survival of wildlife. In terms of water resources, the major rivers in Kenya originate in the gazetted forests where the forest cover is essential for the continued regular supply of water. Finally there are the natural forest products that have considerable economic value, although their commercial value may be more limited. These include herbal medicines, species of potential importance in pharmaceutical and biotechnology research, and harvesting the products of bees and butterflies.

Microeconomic Policies

As shown in Table 4.1 the microeconomic polices of relevance here are those that would encourage the sustainable use of forest products, and those that would provide alternative sources of fuelwood and other products that people seek from the forests. Under the new World Bank/ODA project schemes are under way to increase conservation activities in three indigenous forests - Arabuko Sokoke in Kilifi District, Coast Province, South West Mau in Kericho, Nakuru and Narok Districts, and Kakamega Natural Forest in Kakamega District. For Arbuko Sokoke District, there is a plan to develop butterfly farming and in South West Mau a plan to develop bee-keeping with extensive local involvement.

On fuelwood, there is a major crises in Kenya. Without any further intervention, the gap between the sustainable supply and demand for fuelwood in Kenya is expected to increase from its 1985 level of 11 million cubic meters, to 32 million cubic meters by 2000.[3]. To fill the gap, it is estimated that 2.7 million ha of savannah and 450,000 ha of closed forest will be lost. A number of polices are required at the microeconomic level to address this problem. First, incentives to increase the supply of fuelwood from plantations and on farmland have to be increased. This in turn will require a rise in the price of charcoal (which used price controlled). Then, measures to increase energy efficiency are also important. These include the introduction of fuel efficient stoves and charcoal kilns. Finally there is scope for replanting some of the degraded forest land. Under the current proposals all these measures are being undertaken. Encouragement of the private sector to be involved in plantation development is being given. Government plantations are involved, and incentives depend on stumpage rates which, though recently raised, still only yield about 40 percent of the value of timber removed. Increasing actual collections will help plantation output. Extension services with better trained staff, and seedling production at the local level (with NGO support) is being carried out in the pilot areas mentioned.

[3] Word Bank Staff Approaisal Report, Geothermal Development Project, 1988.

Finally there are improvements in equipment and staff that are being provided for the Forestry Department and that should improve the management of the forests. In particular, availability of vehicles and rehabilitation of forest roads is part of the ongoing forestry programme.

Macroeconomic Policies

At the macroeconomic level, there is need to prepare a forestry policy framework, so that an overall picture can be made of the changes to this sector. This includes the preparation of a complete forest inventory, a forestry masterplan, and an ongoing evaluation of the projects and programmes in this sector. Again donor resources are being channelled into these activities, which should result in an improvement in the management of the country's forest resources over the next five years.

In overall terms, however, the sheer size of the problem remains large. For example, the present World Bank/ODA forestry project, which is one of the main programmes to be undertaken over the next six years, covers about 241,000 ha, which is about 14 per cent of the country's gazetted forests. The proposed activities for this area amount to Ksh. 114 million over three years (or about $1.36 million a year). Extending that to the whole country would amount, on a *pro rata* basis, to $9.7 million a year.

One of the most difficult decisions that have to be made is to decide when a forest area, which is under threat, cannot be saved. In that case, it is necessary to remove all valuable genetic material and put it under *ex-situ* conservation. In Kenya, no detailed analysis of this issue has been undertaken. At the same time small but valuable forests are being lost irretrievably. Proper facilities for seed collection from these areas, as well as the removal of other material should be made. Among the forest areas which **might** come under this category are the remaining coastal Kayas (about 8,000ha), and maybe even the North and South Nandi forests in the Western Region (about 24,600ha). It should also be noted that a decision to take out genetic material can be seen as an 'insurance' against likely loss, rather than an abandonment of any commitment to save such forest areas. Funding for *ex situ* conservation needs to be substantially increased in Kenya, an issue that is taken up in the next Chapter.

Social And Legal Policies

At the individual forest level, polices have been enacted to protect indigenous forests such as a ban on the felling of certain species of all indigenous trees, including valuable timber species such as *Juniperous procera* (East African Pencil Cedar). Unfortunately it has been very difficult to enforce these bans, with the existing forest administration service. Part of the revamping of the Forest Department is concerned with precisely that - i.e. the strengthening of the forest management and protection services. The World Bank/ODA project covering the next six years envisages increased and better trained staff at the headquarters, as well as additional foresters

and field officers. The deployment of 750 more conservation guards, who would have broader functions, including interacting with local communities is included. Over the next six years, around $12.7 million are allocated for human resources for institutional strengthening and conservation and protection. Of this $8 million is in aid from the EC and IDA.

At the legal level access to Kenya's genetic resources has been fairly liberal. Various national and international organisations have had access to the country's plant genetic resources, some of which have been deposited in gene banks abroad. These organisations include the IBPGR (International Board for Plant Genetic Resources), ICRISAT (International Crops Research Institute for Semi-Arid Tropics, IRI (International Rice Institute); Kew Gardens in the UK; the Centre for African Studies in Kyoto, Japan; and the NCI (National Cancer Institute) and the NSSL (National Seed Storage Laboratory) in the USA. In 1972 alone the NCI collected 27.2 tonnes of *Maytenus buchananii* from the Shimba Hills for testing for medicinal purposes.

The only limitation on access to the country's genetic resources is contained in the Forests Act (Cap. 385). However, it limits access only to protected areas (gazetted forests), where access is granted under licence from the Chief Conservator of Forests. Resources outside the protected areas can be collected freely and exported. Changes in the law to control the export of any plant material should be an important amendment to the legislation in this area.

In addition there are gaps in the legal framework as regards indigenous knowledge. Where such knowledge relates to genetic resources in the state of nature it is not protected by patent, as it is regarded as a 'product of nature'. National organisations can help indigenous experts in this regard either by isolating the components of a plant variety thereby facilitating the patenting of the material, and by evolving new products which can then form the subject matter for a patent grant. KEMRI (the Kenya Medical Research Institute) is actively involved in collaborating with traditional doctors in identifying and isolating components of medicinal plants, with a view to the traditional doctor and KEMRI jointly applying for a patent. However, the component of KEMRI's research given to traditional medicine is small and could certainly be increased.

The other area of relevance is that of rights for materials found in the wild or being cultivated on a limited scale by some local communities. Under the Plant Breeders Rights (PBRs) limited rights can be granted for such items, thus offering some protection to varieties for which beneficial properties are known to their communities. In that case, however, an individual may appropriate to himself the benefits of the heritage of a whole community. It may be necessary to devise mechanisms for the protection of the interests of local communities with respect to their special

knowledge. Current international efforts are in two directions. The FAO is trying to move towards extended "farmers' rights" which are calculated to compensate through creation of an international fund, farmers in developing countries whose knowledge has been the source of important improvements in plant varieties (UNCTAD, 1991:17; FAO, 1991:11).

Similar institutional arrangements could be established at the national level where payments arising from access to the special knowledge of specific communities are deposited for their benefit. This would distribute the benefits arising from scientific exploitation of indigenous knowledge. The UNESCO and WIPO have promulgated a model law on folklore to protect the cultural heritage of native peoples. This is the Model Provisions for National Laws on the Protection of Expressions of Folklore Against Illicit Exploitation and other Prejudicial Actions. In Kenya, the relevant legislation, the Copyright Act (Cap. 130), restricts folklore to literary, artistic and musical aspects thereby excluding other aspects of our cultural heritage (medicines, foods etc.) from protection. In any case, the Act is concerned with personal rather than communal interests. It cannot therefore constitute a regime for the protection of indigenous knowledge relating to genetic resources from unauthorised exploitation. Appropriate amendments to this statute may be necessary to facilitate a more comprehensive protection of the country's cultural heritage.

Research and Training

The gaps in our knowledge of forest resources and their functions in Kenya is very large indeed. As has already been pointed there is no forest inventory at the national level. Carrying out one is a matter of priority. At the ecosystem level, understanding of the ecological functions of forests in watersheds, and the changes that are being brought about, particularly to the riverine forests as a result of water regulation through dams, is very limited. There is need to study these systems in much greater detail. Other relevant areas of research relate to the long term Strategic Plan of KEFRI (the Kenya Forestry Research Institute), which plans to service the Forestry Department, wood based industries, and farmers undertaking tree planting. Focus in the near future will be on the conservation of natural forest ecosystems, the protective functions of trees in soil and water conservation, energy production from wood, and farm forestry utilisation. The EC is funding this component of the World Bank Forestry Project with a grant of $8.6 million over six years.

In Chapter 5 we identify the additional research needs of forestry in Kenya more fully. In addition to the points made above, the following gaps are identified:

(a) information on the genetic diversity of introduced exotic species in their areas of origin;

(b) basic cytogenic and biotechnology studies in an expanded research programme on indigenous slow growing hardwood species;

(c) expansion of the forest zoology programme in KEFRI to study the interactions between forest fauna and flora;

(d) socio-cultural research on factors involved in forest conservation and utilization; and

(e) increased priority of research programmes in the ASALs, to develop technologies for the sustainable management of wooden species in these ecosystems.

The institutions involved in the research include KEFRI, the botany department of the University of Nairobi (medicinal plants), KEMRI (the Kenya Medical Research Institute), KIRDI (the Kenya Industrial Research Institute) and NMK (National Musuems of Kenya).

Training is so closely tied into so many of the Forestry Department and KEFRI's activities that it is impossible to isolate them. All extension schemes, some forest management and industrial plantation work involves training of people. More formal eduction activities are being supported by the EC in providing overseas fellowships at the M.Sc. and Ph.D. level, as well as local short courses for most professional and technical staff. Much of the required taxonomic training that is required for this research can only be provided by institutions active in the field, such as NMK.

The additional trained personnel required for this sector over the next four years are identified as 26 scientists and 52 technicians. Of the scientists, half will be trained abroad, as local university postgraduate facilities are limited. The remainder can be trained at the country's five university level institutions: Nairobi University, Moi University, Egerton University, Kenyatta University and the Jomo Kenyatta University College for Agriculture and Technology.

4.3.2 Agriculture

Microeconomic Policies

Although some of the activities related to agriculture may seem far removed from the issues of biodiversity, it is clear that in Kenya the two are inextricably tied together. If the biotic communities are to survive, the pressure for agricultural land expansion must be reduced in key areas. At present the economics dictate that the private returns to converting savannah or forest land to agriculture are greater than the retruns to holding it as a natural habitat, for wildlife and plant species.

This can be illustrated by looking at some of the data on the conversion of land in the dispersal areas to livestock rearing and wheat cultivation. Such areas are increasingly being fenced for these activities, which limits the ability of wildlife to move around and results in farmers killing animals, thereby reducing their numbers. Although much of the recent research has shown that livestock rearing and wildlife can be profitably carried out alongside each other, it is the fencing of land and the growing of crops that creates conflicts of land use.

There are no estimates of the marginal value of land for wildlife but, looking at the direct commercial benefits, one can arrive at a partial estimate of the average benefits derived. Figures from KWS review indicate that the Maasai Mara were approximately Ksh444 million in 1987. This amounts to about Ksh1110/ha and represent a 'rent' collected from the operation of the area as a wildlife reserve, after deducting operating costs. Of this total, local individuals received Ksh2.8 million and the county council Ksh23 million. If all the county council revenue were to be shared among local people, it would generate a net income of Ksh164/ha. However it is not equally shared. The return from wheat farming in the marginal Mara areas can be as low as Ksh80 per hectare, when the figures in better land areas are rarely less than Ksh2000/ha. Thus if wheat farming is being undertaken, it would not need a large shift in income to discourage it, and make activity compatible with wildlife attractive.

Another example of the attraction of land for agricultural use is shown in the box below where tea growing is compared with industrial timber plantation. Although the net present value returns are similar, the fact that the gestation period is much shorter for tea favours the latter. To change the equation, needs the external benefits of conservation to be internalised, so that **conservation pays.**

There are several measures that can be taken to achieve the desired increase in the conservation benefits from land, the most important of which is to ensure that a larger proportion of the surplus accrues to local communities in a way that individuals can identify with and derive benefits from. Local community sharing of benefits through traditional management regimes is often not stressed enough. In addition, there is scope for improving the returns to certain activities such as tree growing (agroforestry) and unfenced livestock management. The range of instruments that would help include targeted subsectoral credit, better compensation for wildlife damage and benefit sharing in wildlife management.

Agricultural productivity from small subsistence and commercial farms can be increased by increasing use of indigenous crop varieties, such as cowpeas. Developing these resources should be an important part of any sustainable agricultural policy for Kenya. A joint programme to promote the use of indigenous food plants is being carried out under the direction of NMK/KENGO/World Freedom from Hunger.

Agriculture also generates damage to the biological resources of the country through agricultural runoff and soil erosion. Damage from runoff has been documented for Lakes Naivasha and Nakuru where, along with domestic sewerage and industrial effluent, it is causing serious ecological damage to the aquatic and bird life. Addressing this problem requires the implementation of the Polluter Pay Principle, so that farmers are made to pay for the measures that have to be taken to correct the damage caused. In the face of such changes they will have an incentive to modify their agricultural practices, to reduce the damage. Unfortunately, such measures cannot be adopted until the magnitude of the damage is assessed, and this preliminary step has still to be undertaken.

THE ECONOMICS OF TEA VS TIMBER IN KENYA

Comparing the use of land for tea, against planting a cypress plantation, one finds the following returns, based on data given in Amadi (1990). In the case of tea, expenses are incurred for three years before harvesting. In the first year costs amount to Ksh.6668 per hectare for ploughing, planting, fertilizer etc. In year two the costs are Ksh.2,950 and in year three they are Ksh.3662.5. At the end of three years the harvest is worth Ksh.81,510. If we discount costs and benefits back to year one at 8.5 per cent (a discount rate used the forestry department to value projects), the net return per hectare is Ksh.51,317 from the tea plantation. In the case of cypress, there is a period of thirty years to consider. The forestry department has calculated the present value of costs over that period, using the 8.5 per cent discount rate, as Ksh.11,200 per hectare. The revenues arise from thinning in years 13, 18, 23 and finally in year 30 when the trees are clear felled. The present value of these, assuming that real prices of timber rise at 2.5 per cent per annum, is Ksh66,390. Hence the net return is Ksh.55,190.

Clearly the two sets of returns are very similar, with cypress in fact having a better return. Individuals, however, facing capital markets constraints will tend to prefer the tea option because the period over which one has to finance the plantation is much shorter. From a social point of view, however, timber plantations, especially for woodfuel have external benefits. They can reduce the pressure for foraging and collecting from forests where the environmental damage can be substantial. How can this be factored into the calculations? One might be to provide low interest loans for woodfuel plantations. Another would be decontrol the price of charcoal so that the relative returns to timber are improved.

The impact of agriculture on soil erosion and thereby on biodiversity, cannot be over-emphasized in Kenya. One link is through the colonisation of marginal lands on slopes which were previously under forest cover. One study in the Upper Tana River found sediment yields to be only 0.2 tonnes/hectare/year from undisturbed forests but up to 10 tonnes/hectare/year from grazed pastures and 30 tonnes/hectare/year from steep cultivated slopes.

In another study carried out in the high agricultural potential areas of Kiambu and Muranga a difference in erosion rates was noticed between areas under food crops, such as maize and beans, and those under cash crops, such as coffee. The erosion rates for plots under food crops exceeded the generally accepted threshold of 10 tonnes/hectare/year (Ikiara and Kabando (1991)).

In arid and semi arid lands (ASALS) the problem is even more severe. In the Baringo district, much of the land is degraded, with severe soil erosion in the Lake Baringo catchment area. As a result, soils have been deposited into the lake, decreasing its depth by 2m and converting 5 percent of its surface area into land. The implications of the disappearing lake on the ecological balance of the area have been serious.

At the microeconomic level these problems can be partly addressed by controlling land use more carefully, so that crops appropriate for the soils are planted, and by providing incentives for the adoption of farming techniques that reduce erosion in fragile soils (see Conway and Barbier (1988)). In designing and implementing these measures, and in allocating resources for them, account should be taken of the ecological benefits that they bring, a factor that is too often neglected in the formulation of agricultural policy.

Macroeconomic Policies

In terms of the macroeconomic options, Kenya needs to reexamine its policies towards promoting crop production, particularly wheat. Since the 1980s wheat production has been increasing at an average annual rate of 2.8 per cent, while demand has been growing at 60 per cent. In line with internal self-sufficiency objectives, expansion in wheat farming has always been encouraged. By 1986 wheat farming had taken all the traditional wheatlands. Among the areas identified for further wheat growing was the Narok district, which resulted in a massive influx of people into traditional pasture and rangeland and set in motion one of the greatest ecological imbalances in the country. The environmental implications have been very adverse for the region. The Masai-Mara Game reserve has been seriously affected as the movement of wild animals is increasingly restricted, and as they are killed (legally) by farmers when they threaten to destroy crops or livestock. Thus there is already a trade-off between the objective of food self-sufficiency and that of tourism development. The Government needs to examine the options at the macro level, so that the impacts of alternative policies on

the external and government budget accounts can be evaluated. Such analysis may demonstrate that the increased importation of wheat and the conservation of rangeland is desirable at the broader economic level. Doing this, however, requires the integration of macroeconomic and environmental planning to an extent that is still lacking in Kenya. In fact the methodologies for doing it are just being developed and implemented elsewhere (Markandya, Richardson and Bishop (1991)).

In a similar vein a macroeconomic analysis needs be carried out in the dispersal areas such as Athi-Kapiti where pressure for urban and agricultural development is threatening wildlife. Unfortunately it is all too easy to assume that taking away small parcel of land will not affect the wildlife. But this argument applies all the way down to line, until the cumulative impact is substantial. To carry out the marginal comparison requires a proper modelling of the wildlife sector, both in terms of the cost function and the benefit function. Such functions identify the marginal value of inputs, such as land, in terms of wildlife; and need the application of sophisticated statistical and economic techniques which are generally missing from the planning appartus of the Ministry of Planning, or that of KWS[4].

If an analysis can been carried out in a framework where the environmental damages are capable of qualification (as they are where tourism losses are involved) it should reveal the limits to land encroachment. However, where the losses are not quantifiable, or only partially quantifiable, it may be necessary to impose a 'sustainability-criterion' to argue the case for limiting development. This criterion is applied on the grounds that the environmental resources to be damaged are so important as to threaten sustainable development. Naturally, it can only be involved in extreme basis. For a discussion of how and where it might be used see Pearce, Markandya and Barbier (1990).

The pressure on agricultural land will decline if alternative sources of employment can be found for the rural population, which are less land intensive and which make use of the natural resource base on a sustainable basis. One of the most promising developments in this regard is horticulture, which has grown remarkably over the last few years and is now responsible for the growing employment and export earnings of $133mn in 1990, the largest after tourism, tea and coffee. As a largely private sector activity it places little burden on the public budget. It also offers scope for the sustainable exploitation and development of domestic species.

[4] An initial attempt at marginal valuation of specific wildlife benefits has been carried out for elephants in Kenya (Brown and Wes (1989). It indicates the kind of modelling needed for the analysis referred to and is dealt with in Section 4.3.4.

In terms of economy-wide employment opportunities, the picture is not a bright one. Accordingly to the GOK Sessional Paper No. 1 of 1986 the number of people seeking jobs by 2000 will be 14 million, 6.5 million more than in 1989. If Kenya maintains its current investment rate of 25 per cent of GDP, there will be about Ksh 460 billion to invest in productive employment generating activities by the year 2000. The estimated cost of each non-agricultural job is Ksh 310,000, implying that these resources will only be able to create 1.4mn more new jobs, leaving in gap 5 million to remain to be absorbed in agriculture. Even these calculations are proving to be optimistic, as the growth rates of the economy on which they are based have not been attained in the late 1980s.

In view of this, the pressure to expand agriculture will remain very strong. It is therefore all the more important from a biodiversity point of view that the expansion take place through increases in efficiency and yields, rather than the conversion of forest and rangeland. In addition, the role of lowering the costs of job creation in the non-agricultural sector must not be ignored. Services have a lower cost per job than manufacturing, and small scale industry a lower cost than large scale industry.

Finally, there are the issues of poverty and income distribution. Although there is no simple link between poverty and environmental degradation (Jaganathan (1989)), the implementation of conservation policies is made that much more difficult, other things being equal, when the group they affect is so poor that it operates on the shortest of time horizon. Furthermore, it is very difficult to apply many of the financial incentives for conservation to these groups, such as changes in commodity prices or charges for the provision of better inputs, because they operate only to a very limited extent outside the subsistence sector.

In Kenya the problem of poverty has been a serious one and remains so. Data from the 1981-82 CBS household survey indicate that, if the poverty level is defined as $370 per capita (World Bank standard) about 70 percent on rural and 30 percent of urban households are below that level. In the rural group it is the small holder population and pastoralist that dominate. By international standards, Kenya has a highly skewed income distribution. World Bank estimates, show out that, of 31 countries for which consistent data are available for the 1970s and 1980s, Kenya had the second lowest share of total income going to the poorest 20 percent of population at 2.6 percent. The Côte D'Ivoire had the lowest share. (Ikiara and Kabando (1991)).

Given the seriousness of the poverty issue, it is all the more important for any policies for biodiversity conservation to recognize the impacts on these groups. Measures such as fencing of lands, protecting forest resources more effectively, or encouraging private sector participation, while all desirable in their own rights, can reduce the access of the poorest groups to the resource base which is also their survival base.

It is imperative, therefore, for any conservation program that impacts in land use (legal or illegal) to address the issue of rural poverty and to include measures that protect the interests of such vulnerable groups. Often in the past, failure to take account of them has resulted in a failure of the program in general.

Social and Legal Policies

The much needed increases in agricultural yields are heavily dependent on the application of technology, both foreign and indigenous. The framework for the introduction of foreign technology is generally good in Kenya, which is a signatory to the Paris Convention to protect industrial projects, the World Intellectual Property Organization and the African Regional Industrial Property Organization. In institutional terms, GoK has established the National Council for Science and Technology (NCST) to act as a focal point for science and technology policy formulation, especially their application for national development. In spite of all these positive aspects, however, there remains some disquiet over the costs of acquiring this technology and of its adaptability to local needs (Thitai, Karue and Murkara (1991)).

Local or indigenous technology has made major contributions to agricultural development in the country. Examples include hybrid seeds for maize, coffee research, pyrethrum *in vitro* propagation, biological nitrogen fixation and biological control of pests. However, the diffusion issue of this technology is hindered by a number of problems such as inadequate education of extension offices, poor extension services, biased provision of loans and inadequate capital.

Patent rights for new seed varieties are governed by the Plant Breeders Rights (PBR) System. The implementing authority in Kenya is the Minister for Agriculture who has wide discretionary powers under the Seed and Plant Varieties Act for the specification of species for which PBRs shall be granted, and the maintenance of register of the names of plants varieties so selected. However, the legislation has remained inoperational because neither a scheme nor the regulations have been promulgated under it. A draft scheme was presented to the Attorney General's Office in 1989 but to date no action has been taken by that office. This absence of a functioning PBR system has discouraged foreign institutions from establishing themselves in a country. There is a report that a French company had to reconsider the establishment of a plant breeding complex because of lack of protection. Most potential applicants who have approached the Ministry are mainly foreigners.

Research and Training

Research and training in agriculture has played an important role in Kenya. Institutions such as KARI, the commodity research foundations, and KETRI are in the forefront of research into methods for improving agricultural efficiency and output. Recently the focus has shifted from concentrating on the economic and monetary

contribution of the research to looking at environmental sustainability and integrating socio-economic criteria more closely into the research program. The collection, conservation, evaluation and utilization of crop and animal generic material now receives high research priority.

The leading institution in the field is KARI which covers a wide range of commodity, factor and livestock research. On the commodity side, most of its research stations are involved in crop genetic resources, with some centres carrying out work on the maintenance varietal evaluation and acquisition of germplasm. Livestock research has been categorized into three related areas, namely animal health, animal production and range management.

KARI is generally regarded as one of the better funded research institutions in the country (the budget for 1991/92 was Ksh614 or $22 mn). However, as one of the leading institutions working on biodiversity conservation and the rational utilisation of plants and animals, its activities can be expanded. A full list of the proposals is included in the next chapter with one area that is particularly weak being socio-economic research. (Majisu and Mugera (1991)).

Within the Ministry of Agriculture a bee-keeping research programme was set up in 1971 but has languished, despite the presence of modern physical laboratories facilities, due to a lack of qualified technical and research personnel. Most of the staff are engaged in bee-keeping extension services, with only 5 scientists actually undertaking research work. The biology of bees in Kenya is an under-researched area.

Since the 1960s a number of missions have been mounted to collect various crop species. They have been sponsored by IBPGR, FAO and other foreign agencies, in collaboration with the Kenya National Gene Bank, which houses a rich collection of material on:

- wild and forage sorghum germplasm
- fibre grass germ plasm
- indigenous rice germplasm
- cucurbits and other vegetable germplasm
- other germplasm including pasture.

In addition to the above, the National Gene Bank also caters for the long term conservation of the duplicate world collection of *Sesamum* and the African collection of Mulberry.

Although a large amount of material has been collected, there is still a great deal to be done in this area. An intensive collection effort for indigenous food legumes, fruits

and nuts, and cereals from ASAL areas is recommended.

The facilities for conserving germplasm are improving but could be strengthened with more cold storage facilities (See Chapter 5). From a research point of view, the Gene Bank needs to strengthen its data documentation centre, so that it can perform its role of disseminating information related to crop germplasm (including the viability and characterisation of its accessions). In fact one of the major problems with research relating to biodiversity in Kenya is that of proper documentation and dissemination. Material is scattered in various research systems and is not readily available to end-users. Allocating more resources to this would be an important part of an enhanced biodiversity plan.

Another agricultural research institute that has been identified for additional resources is the Kenya Trypanosomiasis Research Institute (KETRI)[5]. Trypanosomiasis, which is caused by the protozoan parasite of the genus *Trypanosoma*, infects cattle, sheep and other animals. KETRI, in conjunction with the International Laboratory for Research on Animal Diseases (ILRAD), and the University of Nairobi is researching this disease through DNA probes and monoclonal anti-bodies Although KETRI has good research facilities, it still lacks qualified personnel in such fields as taxonomy and genetics.

Finally one should not forget the role of universities in biodiversity research. Although it is less programmed than that of the research institutions, it is nevertheless important, especially in the medium to long term. Special programmes of importance in Kenya include:

- The Microbiological Research Centre (MIRCEN)
  (Faculty of Agriculture, University of Nairobi)
- Natural Products Research
  (Department of Chemistry, University of Nairobi)
- Medicinal Plants
  (Department of Botany, University of Nairobi)
- Vegetable, Oil and Protein Systems (VOPS)
  (Egerton University)

[5] The direction of the relevance of research in this area to biodiversity has been questioned. Clearly, control of trypanosomiasis could increase livestock productivity but could also lead to expansion of livestock into wildlife areas. In Chapter 5 the criteria for inclusion of programmes is discussed more fully.

Relevant research is also carried out in the Departments of zoology, botany, geography, veterinary sciences and biochemistry. In general, university research programmes are grossly underfunded, with only Ksh560,000 ($20,000) being made available from the university budget in 1991/92 to all the five universities (the above programmes may get funds from other sources). This represents 0.8 per cent of the university budget. Clearly increased funds will be needed if these institutions are to perform their research functions.

In Chapter 5 we identify the biodiversity research needs of agriculture fully. In addition to the points made above, the following gaps have been identified:

(a) information from the centres of origin of the genetic diversity of imported varieties of cereals, vegetables, fruits and nuts, root and tuber crops, herbs and species;

(b) increased application of biotechnology to pyrethrum, tea and coffee;

(c) application of tissue culture to large scale, long term storage of germplasm for sugar cane; and

(d) better understanding of the role of lower animal biodiversity in sustainable agricultural production (nutrient cycling).

The training needs of the proposed programme are 42 additional scientists and 84 technicians required for the additional programme over the next four years. It is assumed that some of the training can be done in the five local universities (Nairobi. Moi, Egerton, Kenyatta, and the Jomo Kenyatta University College for Agriculture and Technology). They could provide most of the diploma, certificate and short courses. However, the additional postgraduate training will have to be carried out abroad, as it is not possible to expand capacity within Kenya in time. As a longer term strategy, the postgraduate budget of the Kenyan universities needs to be increased from its current level of 1.6 per cent, to about 5 per cent.

4.3.3 Marine and Inland Water Resources

Although marine and inland water resources are of considerable importance to Kenya, they have been less emphasised in government development and conservation policy than forestry, agriculture and wildlife. The coastal resources are of value in terms of tourism, fisheries and as depositories of a rich marine biodiversity, particularly along the coral reef, which is second only to the Great Barrier Reef as an international marine biological resource. In terms of tourism, visitors to Kenya spend around half per cent of their nights in the coastal resort areas, which must account for a similar

percentage of the foreign exchange earnings that they bring into the country ($444 million in 1990/91). The marine fisheries sector is small but generates important employment and income opportunities to the coastal communities. The total value of production (inland and marine) has risen by dramatically in recent years. In 1989, the total declared value of the catch of Ksh820 million ($36 million).

Inland water resources are concentrated in Lakes Victoria, Turkana, Naivasha, Baringo, Bogoria, Nakuru, Elementaita, Jipe and Magadi, covering 10,479 Km^2. However 90 per cent of the fresh water fish caught are from the first four. The resources are important for inland fisheries, as habitat for birds and as sources of water supply for the surrounding communities.

The environmental damage that is being done to these resources is thorough unregulated effluent being dumped into the water bodies, through soil erosion for some of the lakes, thorough overfishing and inappropriate fishing practices, and through land drainage and the introduction of mariculture in some wetlands. The issues of soil erosion and agricultural runoff have already been discussed in the previous section. In addition, industrial and domestic effluent are also causing serious problems. In the coastal areas untreated sewerage (and abuse by tourists) is damaging the coral reef. In the lakes of Nakuru and Naivasha, chemicals from the industrial and agricultural activities in the surrounding areas are resulting in damage to the bird and aquatic life that is dependent on them. Lake Victoria is suffering from water based pollutants coming from coffee processing, sugar, textile, cotton seed oil mills in Kisii, Bungoma and Nandi and the Kisumu Municipality. Measured levels of biological oxygen demand, acidity and heavy metals are in excess of national standards (Ikiara and Kabando (1991)).

River resources are suffering from siltation and, in some cases, industrial pollution. Monitoring of pollution is weak, but data collected have shown that some of the rivers, such as the Athi River Basin has excessive levels of biochemical oxygen demand, sulphides, sulphates, cyanide and other prohibited substances. Similar findings have been reported in the Kasat River, The Nzioa River and the Nyando River.

Drainage of wetlands for mariculture or crop production has a high environmental cost, as has been pointed out in Chapter 3.

Existing conservation measures are concentrated in the four marine national parks (Malindi, Watamu, Kisite and Mombasa) and the five marine national reserves (Malindi Watamu, Mpunguti, Mombasa and Kiunga). The parks cover 54 Km^2, and are managed by the Kenya Wildlife Service. The fauna and flora are fully protected and the introduction of species is prohibited. The reserves, covering 706 Km^2, are

administered by the county councils, with traditional fishing being allowed within them.

Micro and Macroeconomic Policies

Micro and macroeconomic polices to conserve the water-based ecological resources of the country have to concentrate on the application of the polluter pay principle to the polluters. An assessment of the damage being done has to be made and the costs of the appropriate action to mitigate the damage have then to be raised from the polluters. In some cases this will involve prior treatment of the waste; in others a ban on the introduction of certain items into the water body. Whether the activities are carried out in the private or public sectors depends on the nature of the measures taken. Sewerage treatment is generally though not exclusively regarded as a local public sector activity. Prior treatment and materials recovery in industries such as tanning are the responsibility of the firms involved. The appropriate mix of different measures should emerge from an overall assessment of the costs of alternative methods of meeting water quality standards. As noted in Chapter 6, some assistance with such a programme may be offered by the donors.

The sustainable utilisation of fish resources requires various measures to improve and regulate activities in this sector. In general there is a need for better monitoring of fish stocks, and of a control of overfishing. This is particularly a problem in Lake Turkana where catches are down from 7324 tons to 990 tons over the five years 1985-1989; and Lake Victoria (where loss of endemic species, probably due to the introduced Nile Perch, is a continuing problem). Improved regulation requires the declaration of more protected areas and regulation zones and the stipulation and policing of mesh size. Management strategies have to be designed with an awareness of the constraints on the ability of the authorities to police the resources, the funding for which has to be increased substantially in any event.

Decisions on investments in mariculture or in land drainage for agriculture are taken without a proper appreciation of the value of the wetlands as habitats and as providers of water quality regulation. It may be justified in some cases for land to be drained, but that will depend on the a comparison of the benefits of conservation against the benefits of the proposed use. Methodologies for valuing wetlands have been developed and applied in some countries (Barbier (1991)). They can and should be applied in Kenya to arrive at a rational policy for declaring wetlands, including the Yala Swamp where a further 6000 ha. are scheduled for drainage. If the benefits, principally in terms of Lake Victoria fisheries, can be shown to be sufficient, a stalling order might be granted against the proposed action.

There is an identifiable role for the private sector in some of the conservation activities, particularly those with a tourist potential. In this regard, Lake Elementaita,

which is an important flamingo habitat ground should be mentioned. The land around the lake is privately owned. A plan to develop the area as a tourist attraction with government help in controlling the inflow would be an appealing option.

As mentioned earlier, Lake Baringo is silting up. It needs a management plan to revive the fisheries (500 families are dependent on fishing in the area) by reducing sediment loads.

Social and Legal Policies

Marine and inland fisheries are under the control of the Fisheries Department. They regulate fishing through controlling the composition of the catch and the amount of each catch. However, the management capability of the department is weak as is the effectiveness of the regulation. Strengthening this must be a major priority.

Research and Training

Although the Fisheries Department has a limited adaptive research capability, the bulk of the relevant research is carried out at the Kenya Marine and Fisheries Institute (KEMFRI). The institute has two medium sized laboratories, one for marine and the other for fresh-water research. In addition there are three field stations, on Lake Victoria, Lake Baringo and Lake Turkana. Compared to laboratories in developed countries, KEMFRI's research facilities cannot be regarded as adequate. This is especially so, since the declaration of the Exclusive Economic Zone (200 nautical miles from the coast line) for which Kenya is responsible. Research is conducted in areas such as: population dynamics for important species, the impact of pollution, mangrove ecosystems, and physical and chemical oceanography. A joint project involving the institute, FAO and DANIDA has completed a fish identification project covering the Western Indian Ocean and a 5 volume identification manual has been published. The EC is supporting a Research Project on Lake Victoria, the Belgium government has collaborated on an Oyster Culture Project, and UNESCO is involved in an information exchange programme.

Gaps in the research picture are substantial. Knowledge on the marine and fresh water resources only covers about 20 per cent of these resources. Research has concentrated on fisheries with commercial value rather than on the biodiversity, which needs to be much better understood. No inventory has been made of the status and composition of marine ecosystems. There is a strong need for more collaborative research on the interaction between human activities, especially tourism, and marine systems. Knowledge of marine microbes and their functions is very poor (about 90 percent are unknown). Basic studies have to be carried out to create an inventory. Technology is needed to collect microbial resources for storage. The Exclusive Economic Zone needs to be thoroughly explored. Aqua culture research to identify sites suitable for brine shrimp, seaweeds and oysters will need technology transfer and donor assistance.

For fresh water ecosystems, the existing inventories are inadequate, as is the understanding of pollution on fish resources. There is a need for baseline studies and continuous monitoring of lake level changes, including pollution and sedimentation of freshwater resources. Virtually no information is available on viruses and bacteria in fresh water or alkaline/saline systems, and very little is known about other microbes.

For the wetlands, an inventory of their ecological significance is required; i.e. as water storage, habitat for fauna and flora and as watering points for terrestrial animals. Their potential for fisheries and other economic uses has to be assessed, as does the threat to them from human encroachment. As mentioned earlier under forests, the impacts of changes in water flows on riverine forests and wetlands needs to be more closely studied.

It is clear that the unmet research agenda in this area is enormous. An estimated 54 additional scientists and 108 technicians will be needed to fulfill it. Details of the additional resources, and of the programme are given in the next two chapters.

4.3.4 Wildlife

The importance of wildlife to the Kenyan economy has already been underscored. It is the largest earner of foreign exchange and a major employer. Of all tourism earnings, abut 40 per cent are attributed to wildlife. On that basis it is assumed to have earned Kenya Ksh4 billion ($174 mn). If one looks at the net foreign exchange earnings (i.e. after allowing for how much has to be spent on exports or is paid out abroad) the share of wildlife would be even larger.

At the same time the conflicts of wildlife and other economic needs are also strong and have been discussed. The sustainable use of wildlife resources is dependent on resolving these conflicts in a clear way so that where a decision to conserve land use for wildlife is made it is adhered to. KWS, with substantial donor support is now putting together a management strategy and an implementation plan that should go a long way towards these goals.

Microeconomic Policies

The 'pricing' of wildlife in Kenya is an understudied area. Should tourists be asked to pay more or less for visits to game parks? Are present numbers excessive, so that the 'wilderness experience' is lost and how much does this matter? The determinants of the demand for tourism were last studied in an extensive way in the late 1970s. Since then the external factors as well as the nature of tourism demand has changed substantially and the subject should be reexamined at a highly sophisticated level (see research below). Park revenues in this context should be determined by a combination of revenue maximising and park protection objectives.

Where there is a conflict of land use, fencing and keeping out local pastoralists may not be the best policy. The need to share the benefits of wildlife with local users so that they do not see it as a nuisance and a threat has already been mentioned under agricultural land use. In some cases local knowledge can be harnessed successfully and used for wildlife management. The box below indicates a case where this is the case.

Wildlife is more likely to survive and flourish when it is utilized in a sustainable manner. This includes marketing meat and animal products where that can be done without threatening animal numbers. Kenya has been slow to encourage wildlife utilisation. Private or local county council animal sanctuaries that utilize wildlife are fewer in number than they could be. The wildlife sanctuaries run by county councils are in game reserves. Local communities are allowed to practice cattle ranching and the proceeds from tourist revenue are shared among the local inhabitants. In principle this arrangement should work well but there have been problems in its implementation. Local communities complain that they see few of the benefits which appear to be more widely diffused.

In the private sector, there is an Ostrich farm at Oltepsi (about 50 km from Nairobi), and X private rhino sanctuaries, including the one at Ol Pejata and Lewa Downs. Detailed accounts have not been made available, but the general impression is that these organisations are successful, both from a private profit as well as a captive breeding point of view. Increased use of private sanctuaries should therefore be an important component of a biodiversity plan for Kenya.

Macroeconomic Policies

At the macroeconomic level, decisions on land use have to be taken with the full costs and benefits of alternative uses being evaluated. In the section on agriculture we looked at polices of food self-sufficiency and their impacts on settlement in dispersal areas. These polices should be reexamined, and decisions on settlements in dispersal areas should be reevaluated in a broader cost-benefit framework.

The allocation of funds to KWS fr its management and conservation programme are substantial, given the proposed World Bank led donor programme for the sector, which will provide about $321 million for:

- improved anti-poaching
- research on wildlife conservation and management
- translocation of certain species from threatened dispersal areas to parks and reserves to keep an overall ecological balance, and to promote tourism
- special protection for endangered species such as the rhino, elephant, Grevy's zebra, Hunter's Hartebeest, the leopard and cheetah

INDIGENOUS KNOWLEDGE AND WILDLIFE CONSERVATION

The following is taken from Clarfield (1991)
In a recent article listing Kenya's remaining indigenous forests the Turkwell riverine forest is not mentioned. The Turkwell has its source in the highlands of the Central Rift Valley and empties itself into Lake Turkana. It is estimated that on either side of the river is a thick forest, which at places is up to five miles wide.

The Nkebotok are Turkana speakers, living in the Northern Kenyan Rift Valley within and along the narrow riverine forest of the Turkwell River. The first account about them describes a small group of successful hunters, gatherers and farmers living in the southern Turkwell forest surrounded by more powerful and aggressive pastoral tribes. These hunter-gatherer farmers seem to have a steadier food supply than most of their neighbouring plains-dwelling nomadic pastoralist. The growing evidence suggests that they sustainably managed the forest and adjacent plains to meet their own needs, while acting as guardians of the system.

Symbiosis with Neighbouring Pastoralist
They have a complex and as yet little understood symbiotic relationship with a large section of these Turkana pastoralist, the Hsinyoka, who live to the east of them. The Nsinyoka raise camels, cattle, sheep, goats and donkeys. Household move frequently and independently. The system is not random and there is a tendency to follow a yearly migratory route within their home area: an area filled with wildlife. The pastoralists avoid the river due to livestock disease vectors including tsetse flies in the dense bush and gallery forests. The Hsinyoka, utilize this area only for watering livestock or if there are no other forage resources available (Ellia et al. 1987).

The Nkebotok and Nsingyoka have been trading for decades. The Nkebotok provide grain in exchange for small stock. This trade may have helped the Nsinyoka avoid depending on government relief during recent droughts. The Nsinyoka look down upon the Nkebotok whom they consider as poor. However, the Nkebotok live their life by the river unconcerned about the low social status that comes from not having herds. To them honey is preferable to milk, wild game is better than livestock and the forest is more desirable than the plains.

Core Elements of Success
Nomadic pastoralists must migrate to maximize access to the few grass and browse species need by their main asset, livestock. The Nkebotok rely instead on a large variety of species, thus attaining greater food security and social stability without disruptive relocation.

Utilized Species
Wildlife is attracted to Nkebotokland from the two nearby game reserves by the presence of an intact indigenous forest, ripening crops and continuous flowing water. At least 30 species of mammals are residents of the area. So far 64 plants are known to be used for medicine, food, fodder, or construction material. Of these, 65% are eaten by humans, 14% are medicinal, 36% are used for utensils, 37% for construction and 28% are appreciated for their shade. Other uses include ceremonial functions, toothbrush twigs, fuel, fibre and condiments. Informants report that 30 species are consumed by 18 different wild animals including bees and termites. Part of this varied consumption contributes to the human food web, as honey, termites and game meat.

Farming

The Nkebotok have farmed indigenous and introduced crops along the river banks for over 100 years. 17 documented varieties of sorghum are grown; each with an individual local name and distinctive traits. Grain stores are identified by the particular mix of sorghum varieties grown by each farmer. Farmers experiment with neighbour's seeds when they need to farm a new plot due to river flooding. Maize, green grams (mung beans), pumpkins and a variety of vegetables are also grown. Trade in goods, mostly through barter, provides variety and additional stability to the overall economic system.

Hunting

A number of animals threaten farmers' crops. Elephants have to be chased every night during the rainy seasons. Those animals that are found destroying someone's crops are themselves killed and eaten, with the exception of elephants who are only scared away unless they become too persistent a menace (perhaps one per year is killed). Traps are set in known animal paths to secure the fields and to obtain wild meat. Smaller animals are actively hunted as food, but with moderate frequency. One informant reported that he had hunted 16 different species at one time or another. These included dik dik, gazelle, impala, baboon, monkey, zebra (five years ago), buffalo, eland, squirrel, rabbit, giant forest squirrel and a sand cat. Birds slain in the sorghum fields are roasted and given to children to eat.

Mining, Livestock and Wage Labour

Other economic activities include keeping livestock, mining gold and exchanging services, locally for barter and for wages outside the area. Nkebotok keep livestock in small numbers. Individual animals are often received as compensation for goods and services supplied to pastoral neighbours. Alluvial gold has been mined in the area since 1967. It is a reliable income supplement to traditional economic activities. Income from fold is equitably available for any able bodied man or woman since earnings are proportional to invest labour.

Respect for the Forest

Use of the forest is non-destructive except in times of severe hardship. Even then damage is restricted. Mainly branches are cut to avail fodder to the few livestock. Entire trees are infrequently cut to make charcoal. In these cases there is usually a dual purpose, such as clearing a new field for crops or discouraging elephants (which favour certain trees). The 'echoke' fig (*Ficus sycamorus*), is spared even when an entire field surrounding it is cleared because its fruits are eaten by all Nkebotok and its upper reaches are used for building platforms that store food. Respect for the forest and its products is ingrained in the land use behaviour of the Nkebotok. This is clearly seen in the way wooded lands are returned to tree cover through fallowing.

Hunting Peaks

Hunting is often a response to stress and competition. Food shortages during times of drought prompt active pursuit of game as a food supplement. Otherwise game is only hunted or trapped when animals become a "threat to the shamba (field)". Therefore, hunting fluctuates seasonally within a given year, and probably has a periodicity over the years that correlates to drought cycles, although this has not been investigated. Animals are <u>not</u> killed for sport, sale or barter.

Kinds of Cooperation

The relationship between human and wildlife populations shows one kind of symbiosis since wildlife habitat is left intact, even actively protected by the Nkebotok. It is a mutualistic relationship in that both wildlife and human populations gain advantage from the activities of the other.

Two Examples of the System's Dynamic Equilibrium

Interactions with wildlife, other human groups and the surrounding vegetation have regulatory impacts on all parts of the system, though these are not yet well understood. One example includes the existence of ecological symbiosis between the Nkebotok and wildlife.

Wildlife compete with humans for cultivated crops. While wild animals are entirely consumptive towards crops, humans provide labour to assure the success of the plants. By hunting, the Nkebotok recapture a portion of the energy lost to these competing consumers, while reducing the competition. Wildlife also gain from human cropping activity. They are provided with a rich supply of highly nutritious fodder, mainain in a concentrated area by the labours of Nkebotok cultivators.

Another example of symbiosis at work here, consists of humans protecting the habitat occupied by medicinal and other useful plants, while many of the plant species meet human survival needs. The large fraction of plants that are edible or have other important uses leads to the question: to what extent are Nkebotok forest management techniques responsible for the current configuration of species? Has there been selective cutting of forest trees to favour the survival of useful species and reduce the number of undesirable trees? We do not yet know.

Private Ownership and the Maintenance of Equity

Only the most romantic social scientist would miss the centrality of private property in Nkebotok society. For example, honey hives, termite mounds and agricultural plots are all owned by their users. Ownership is generally inherited from father to son. Yet inequality has been reduced to a minimum because people's needs are satisfied through a variety of activities, through sharing and access to ample available resources.

Wild game belongs to those who are part of the hunt and the meat is shared out among close kin. Farm plots are also owned by individuals and families but often people with extra time or sons or daughter can work on other people's plots to be paid in kind. There is much conviviality and sharing within a village and the evidence that is available so far is that there is little economic differentiation among the Nkebotok.

In short Nkebotok society is characterized by a marked degree of equality where families have comparable opportunities and all have access to the resources of the ecological niche that they exploit. Such a system of social relations is commonly found among hunter-father societies thronghout the world.

Conclusions

Perhaps the most viable means of protecting the biological diversity of the Turkwell River Forests is to set them under legal management of the Nkebotok community. They are the most knowledgeable caretakers available. Furthermore they have a vested interest in the maintenance of the forest and they have proven their ability at keeping this environment intact over the past century.

- training of wildlife conservation and anti-poaching personnel
- reviewing of reward and remuneration schemes for wildlife and tourism related staff
- physical measures such as digging of trenches and mounting of electrified fences
- educating the public on the continuing importance of wildlife.

In financial terms the 'package' is also attractive. With KWS as a parastatal that can keep its much of its revenues, the income generated from the activities would pay back any investments in a relatively short period. The investment programme is discussed more fully in the next chapter.

It should be noted that these revenues are closely related to macroeconomic variables, such as the exchange rate. In years when tourists pounds, dollars and marks will buy more Kenyan goods, tourist numbers are increased. In 1990 for example, tourists numbers improved slightly in spite of the unfavourable international atmosphere, with international arrivals up 9 per cent compared to 1989, and visitors to game parks up 22 per cent. This increase is largely attributed to the steady devaluation of the Kenyan Shilling against the European currencies. This underscores the point made earlier that tourism pricing is a critical variable in the wildlife sector's planning and management strategy. Integrating it requires closer coordination between financial planning and wildlife management, something that is still weak.

Another set of external parameters that influence wildlife strategy are the terms of trade in endangered species. Kenya benefits from a ban on the trade in ivory because its numbers were being severely depleted and it could not contain the anti-poaching activities. Since the ban the price of ivory has fallen and the relative attractiveness of poaching has declined. At the same time the anti-poaching unit has been revamped. the combination has resulted in a dramatic arresting of numbers lost. Between 1973 and 1989 numbers fell from 130,000 to around 16,000, a loss of some 7000 a year. In the last two years, however, only about 50 elephants have been lost in this way. Thus the ban has clearly helped Kenya but is not so favoured by countries that have excessive numbers of elephants that they are forced to cull. Any changes in the agreement could have a major impact on the situation in Kenya.

Social and Legal Policies

The changes in institutional terms that were made when KWS was set up have been very important in the management of wildlife in Kenya. KWS was established in 1989 when it took over from the Wildlife Conservation and Management Department. Under the latter wildlife losses were large and overall international confidence in Kenya's conservation and tourism polices was being eroded. Since its establishment, KWS has taken several bold measures. Anti-poaching has been strengthened, and

revenue leakages have been stopped. Better qualified staff have been hired, a strong training programme has been introduced and overmanning has been reduced. Given the revenue arrangements under which KWS is funded, it should not face the funding problems that bedeviled WCMS.

In legal terms the importance of CITES on the international front has already been mentioned. On the domestic front changes in regulations that permit controlled exploitation of wildlife for meat and products would encourage private sector activities.

Finally the conflict of land use between farmers and wildlife is exacerbated by the current institutional arrangements under which farmers are permitted to kill animals that damage their property or threaten to do so. Where crops or livestock are endangered, the numbers killed can be very large. One estimate indicates that over 3,000 animals were killed to protect an area of 400 hectares (Ikiara and Kabando (1991). If, however, physical barriers were provided, or if compensation schemes for loss of livestock or crops were better implemented, losses of this kind could be avoided.

As stated earlier when discussing agriculture, effective local community involvement is critical to the success of any conservation policy. The majority of Kenya's wildlife is not to be found in the National Parks or Game Reserves. If the treatment of the wildlife outside the parks and reserves is not improved, the success of the conservation strategy will be in jeopardy.

Research and Training

As has been pointed out in the introduction to this section, a major research effort is needed into the benefits of wildlife in Kenya. We do not know what the willingness to pay for particular to see particular species is, or what the value of preserving species is, outside and inside Kenya. One study that has looked at the demand for elephant viewing came up with an estimate of $23-27 mn per year from foreign tourists, around $100 per tourist (Gardner and Wes (1989)). Such information can be used in planning expenditures on elephant conservation. Similar studies on the impact of quality (as measured by the number of visitors) on the willingness to pay needs to be carried out.

Research and Training are a major part of KWS's agenda for the next five years. Planned activities in conservation management, personnel training and public education. Of the proposed KWS programme for the next 4 years, $2.9 mn are allocated to these activities. In addition, items proposed under a wider research agenda include an inventory of research already carried out on wildlife biodiversity; on the understanding of the interaction between ecosystems and the wildlife that is

found in them, including the role of socio-economic factors; and the closer collaboration of the DRSRS in the monitoring of animal populations. The budget for these activities is expected to around $1.7 mn., involving 36 scientists and 44 technicians.

4.4 CONCLUSIONS

This chapter has been concerned with the linkages between biodiversity and economic development and change in Kenya, which is a country that puts much of its biological resources to commercial use. At the same time there is a conflict between development and conservation, such that the resource base on which development depends is being eroded. This is against the long term interests of the country, even though it may be in the short term interests of some people now. The chapter identifies the reasons for the pressure on the resource base as being: demographic, market and government failures of appropriate incentives, and institutional failures. Section 4.3 deals with the demographic factors, and section 4.3 with the government, market and institutional issues.

The demographic forces are undoubtedly one of the most important (if not the most important) in the loss of biodiversity in Kenya. The population has close to trebled from 8.7 million since independence, and is certain to rise to around 37 million by 2000. This has created an increase in the demand for land and for resources such as woodfuel and forage, which have resulted in massive deforestation and soil erosion. The predictions are that this pressure will continue for the foreseeable future. It can be mitigated if agricultural yields from existing lands can be increased, if more of the population can derive income from non-farm sources that do not endanger the natural resource base, if forest resources can be used to generate income in a sustainable way, so that there is less incentive to convert them to agriculture, and if some of the substitutes for forest woodfuel can be obtained from other sources.

Section 4.3 looks at polices that would be consistent with, and encourage these changes. It is clear from much of the Kenyan and other country experience that simply declaring a zone as a conservation zone and even policing it will not save it from encroachment. The relevant polices that have to bring about a change in land use are divided into microeconomic; macroeconomic; and social, legal and institutional; and those related to research and training. Microeconomic policies act at the level of the farm or individual forest, land area or water body; and macroeconomic policies act at the national or regional level. Social, institutional and legal polices are concerned with making it possible for individuals to share in the benefits of a sustainable exploitation of the natural resource base. They range from changes in the farmer and breeder rights that apply to new varieties of seeds, to institutional arrangements that permit local groups to participate forest and wildlife management.

On forestry, the economic polices at the micro level have to make private fuelwood supply more attractive, to increase energy efficiency, and to undertake replanting. At the macro level, programmes to inventory and monitor resource use are being undertaken, but more needs to be done. In some cases, the damage is so great, and the possibility of saving the forests so small that increased *ex-situ* conservation activities are required. On the socio-legal/institutional front, strengthening the management of the forests is an imperative. Changes in the legal framework, so that indigenous knowledge can be more effectively exploited by local groups are explored, as are issues relating to access to genetic resources in international collections. Finally on research and training, the focus is on a better understanding of the ecological functions of forests in water sheds and for soil conservation, and inventories and collection and classification of data and material from forests.

On agriculture, the microeconomic issues relate to making conservation uses of marginal land more attractive, by raising the returns to forestry and wildlife-compatible activities. This needs a reexamination of commodity prices, as well as a more effective sharing of the benefits of wildlife, so that it is in the interests of agro-pastoralists not to cultivate land in key dispersal areas. Controlling soil erosion through incentives such as the polluter pay principle should be considered. The macroeconomic issues are much broader. We need to look at the whole policy of wheat self-sufficiency and analyse what conflicts it creates with land conservation for wildlife. Where development is being permitted, the valuation of alternative uses of land needs to be more complete, allowing for indirect benefits. We also need to look at the macroeconomic picture in terms of employment creation and see how future employment demand can be met with efficient use of the land/forest resource base. Finally policies that impinge on poverty are important. Kenya has an inequitable income distribution, even among developing countries. Alleviating poverty can reduce the resource pressure directly and can allow fiscal incentives to be adopted, which have an indirect effect. On the social and legal front, the framework seems to be appropriate, although some of the legislation such as that governing PBRs is not in place and should be implemented. On research, all activity that increases agricultural efficiency is important and relevant to biodiversity conservation in so far as it reduces the pressure for land expansion. In this regard the collection and development of indigenous material is of importance. Proper storage and documentation of the germplasm is required.

The marine and inland water resources of Kenya are the least studied of the natural environments. They are important for tourism, fisheries, and as sources of water. The policies needed to conserve, and sustainably exploit the biodiversity in them include control of pollution into the lakes and marine coastal areas; better regulation and monitoring of inland fisheries; and a more careful evaluation of decisions to set up mariculture in wetlands and to drain swamps. The socio-institutional aspect that needs

strengthening is the capability of the Fisheries Department. Finally the research agenda in this area is very long. Information on the marine and inland water resources needs to be collected and analysed in virtually every area.

The wildlife resources of the country are of crucial importance to Kenya. Much is being done to protect them but decisions are taken without much knowledge of the true economic value of species and of the different habitats. More use of economic valuation methods is required, particularly on the demand for tourism and on the impact of overuse of parks on the willingness to pay for a visit. As mentioned earlier, sharing the benefits with local communities, and using their indigenous knowledge is important for the success of wildlife conservation. On the legal front, the framework for compensation for wildlife damage needs to be reviewed. The institutional changes made by setting up KWS are encouraging and should help conservation in this sector. The resources available for investment are also substantial and should not be an impediment to a successful conservation policy.

Biodiversity conservation is as much (if not more) about the right policies and incentives as it is about physical conservation. That is a key message from this chapter.

CHAPTER 5

CONSERVATION PROGRAMMES FOR KENYA

5.1 INTRODUCTION

The preceding chapter has provided an overview of the pressures that Kenya's biological diversity is under. Clearly, there is need for further programmes to promote the conservation and sustainable utilisation of Kenya's biological resources. This fact is well recognised by GoK as will be seen by the proposed programmes that the relevant ministries intend to pursue over the next three years.

This chapter presents the proposed and additional programmes needed to meet the requirements of biodiversity in Kenya. The **proposed** programmes are based on Government of Kenya plans for the next three years, as well as those of the key NGOs involved in the private sector. The **additional** programs refer to the resource investments that have been identified by the study team as being necessary in addition to the GoK and other planned investments if the goals of biodiversity conservation are to be achieved. A period of three years has been chosen because detailed government data are available for this period, and because it is possible to make relatively firm proposals for such a short term. In Chapter 6 we discuss how this can be converted into an estimated annual requirement in dollar terms. No dollar values are given for the programmes in this chapter, where the purpose is to identify the actions required in greater detail.

The central question of what constitutes a relevant item for the conservation programme is not easy to answer. Within the UNEP guidelines a number of categories have been defined and we have tried to adhere to those definitions. However even within this framework there are problems of definition, especially in a country such as Kenya where many biological resources are so closely related to the environment. In this respect we have taken a relatively broad definition of what is 'biodiversity relevant'. The criterion used has been that if an activity has: (a) any direct impacts on the biological diversity of the country or (b) if it has any indirect impacts that are immediate and important, it is to be included. The following provides examples of 'marginal cases' that have been included:

(a) all cereal and food legume research;
(b) all horticultural research;
(c) research in varieties of cash crops such as coffee, tea and pyrethrum;
(d) all animal livestock species research;
(e) research in animal and plant diseases;
(f) tree research in exotic species;

The inclusion of agricultural research is justified on the grounds that improvement in agricultural efficiency may indirectly benefit biodiversity conservation through a reduced pressure on the land resources, other things being equal[1].

Other items that have been excluded from the relevant list are:

(a) expenditures on animal health and veterinary programmes;
(b) expenditures and investments in agricultural and horticultural infrastructure.

5.1.1 Institutional Coordination

The lack of institutional coordination in relation to biological resources is a major problem in Kenya. This is perhaps not surprising, given the diverse nature of biological resources and the many sectoral activities that impact on, and utilise, these resources. These institutions comprise government departments, NGOs, private sector concerns and individuals. Among thse the National Museums of Kenya, a parastatal institution, is currently the only institution attempting to seriously address consevration of biodiveristy at the scientific level and in its broadest sense.

The following Sections of this chapter highlight the proposed and additional programmes that are recommended to promote the conservation of biodiversity. The institutions involved with each programme are also discussed. However, there is a need for a greater degree of **overall coordination** and cooperation between these institutions. Each of these institutions was established with a specific mandate, and while that mandate might touch on aspects of biodiversity, there is no institution whose responsibility os to keep an overview of all problems relating to biodiversity conservation and rational utilisation of biological resources. Hence many of them work independently of each other, which may lead not only to a duplication of effort but also to conflicts in programme objectives and a neglect of vital aspects of biodiversity altogether.

The National Biodiversity Unit, located in the NMK, was established as the facilitating agency for the present study. There is an important role for this institution to act as the central coordinating body for biodiversity related activity in Kenya. Although its role in this respect is not mentioned in each programme in the following sections, it is assumed that it will function in this capacity, and the costs of the overall programme given in Chapter 6 include the costs of running the NBU.

[1]It must be noted that increasing agricultural efficiency may lead to a reduction in biodiversity eg. by increasing the economic returns from clearing land for agricultural expansion, or by the substitution of traditional multi-cropping practices by monocropping. However, it is always possible to address these impacts directly, and that must be the correct option.

5.2 INVESTMENT PROGRAMMES

In this section the proposed and additional programmes are outlined in the same categories that are given in Annex 9 of the UNEP guidelines. The items are as classified as follows:

(a) Surveys, Inventories, Identification and Authentification of Biodiversity;

(b) Research, Training, Education and Public Awareness;

(c) Preparation and Implementation of Conservation Management Strategies and Plans;

(d) Monitoring of World Status of Biodiversity;
Meeting Terms of Existing Legal Requirements;

(e) National Capacity for Biotechnology and Transfer of Technology.

For each of the above categories, a set of Tables has been prepared, detailing what the proposed activities are, and in what respects they need to be enhanced and strengthened.

5.2.1 Surveys, Inventories, Identification and Authentification of Biodiversity

Table 5.1 summarises the proposed and additional activities in the areas of surveying that have been identified.

Forestry

The degradation and depletion of Kenya's forest resources (highlighted in Chapter 4) is a major cause for concern. The FD is responsible for the conservation and sustainable management of these resources and clearly it has been unable to effectively carry out its task. To this end a major Forestry Sector Programme has been initiated by GoK, with funding from the multilateral and bilateral donors, to enable the FD to have sufficient resources and information with which to carry out its duties. One key area of research is that of **forestry inventories and socio-economic surveys** (Activities 1 and 2). At present there is no detailed knowledge of forest resources, their rates of degradation and depletion, and their socio-economic causes. To this end, both forest inventories and socio-economic surveys of communities living around the forests and utilising its products are being carried out as part of the proposed programmes of FD. The inventories which have been carried out by NMK as FD lacks the necessary expertise, focus on compilation of species, species composition and rates of depletion; the socio-economic surveys focusing on the uses and methods of extraction of forest products, competing land-uses and demographic pressure, economic incentives/ market distortions that lead to the degradation of these resources.

TABLE 5.1

PROPOSED AND ADDITIONAL SURVEYS AND INVENTORIES FOR BIODIVERSITY CONSERVATION

	Area of Activity	Reasons for Programme	Measures Proposed
	Forestry		
1.	World Bank Forestry Project.	Data on forest resources and their evolution is lacking.	Project proposes inventory of ecological, hydrological,timber and non-timber studies, inc. fauna for Kakamega, Trans Mau and Arabuko-Sokoke.
2.	Socio-Economic Surveys	Detailed information regarding the exploitation and economic incentive regimes of local communities is lacking.	FD project proposes to undertake such surveys in 3 pilot areas (listed in 1 above).
3.	More Socio-Economic Surveys	As above	Extend to all communities utilising forests in Kenya over 10 years
4.	Floristic Surveys in All Ecological Zones.	The coastal forest floristic survey undertaken by NMK is the only one to date. Similar data are required for the whole country.	Additional programme of 6 floristic surveys throughout Kenya.
	Agriculture		
5.	Further Proposed Inventories.	Indigenous cereals, legumes, fruits and nuts have not been subject to detailed attention in terms of collection and characterization.	To parallel the surveying of indigenous knowledge more needs to be done on collecting, inventorying and characterising the products themselves, being proposed by NMK.
	Aquatic: Marine & Freshwater		
6.	Fisheries Surveys.	Monitoring of fish stocks and catches.	Fisheries Stations carry out regular surveys.
7.	Proposed Fish Surveys.	There is a big gap in terms of the knowledge of existing species in marine and fresh water.	Additional surveys to prepare a proper inventory of fish resources.
8.	Estuarine, Wetland, Mangrove Ecosystems.	No inventory has been done on these ecosystems.	An inventory needs to be carried out on their status and composition. NMK has established a wetlans working group to address this issue.

TABLE 5.1 (contd.)

PROPOSED AND ADDITIONAL SURVEYS AND INVENTORIES FOR BIODIVERSITY CONSERVATION

Area of Activity		Reasons for Programme	Measures Proposed
9.	Marine and Fresh Water. Microbes.	Unknown species constitute at least 80% of such species in the marine case. Hardly anything is known about fresh water microbes.	An inventory of all marine microbes, including their status, abundance and ecological significance. Part of NMKs 5 year plan
10.	Aquaculture Sites.	Evaluation of coast line to identify specific areas suitable for aquaculture.	Baseline studies of the Kenyan coast line.
11.	Freshwater Ecosystems	To study the impact of lake level changes on resources.	Baseline studies on lake level and water quality changes.
	<u>Wildlife/Other</u>		
12.	Proposed Research Inventory.	To avoid repetition of research effort and to assist future researchers.	An inventory and detailed review of past research in Kenya and neighbouring countries.
13.	Surveying and Monitoring.	Management and conservation of wildlife resources depend on effective ecological monitoring. Previous surveys have not been used effectively to identify research needs for improved management of wildlife resources.	Close collaboration with DRSRS will be necessary for this activity. Surveying and monitoring of marine ecosystems requires special attention and new skills which should be preceded by appropriate training.
14.	Socioeconomic Surveys Relating to Wildlife	Formulate policies that will lead to the active participation of local communities in conserving wildlife resources.	Surveys collecting data on perceived benefits and costs of wildlife in order to derive appropriate conservation strategies.
15.	Data Bank on Biodiversity in Kenya.	To assist in research and monitoring of changes in biodiversity.	A Biological Resources Programme at the NMK with a central computer system and a databank manager to integrate information from diverse sources.
16.	Additional Biodiversity Surveys.	To supplement the existing and proposed surveys where the material is of specific interest to conservationists.	Under the above Biological Resources Programme at the NMK, some field survey work for verification and additional information will be carried out.

These developments represent a major advance in the FD's drive to reverse and alleviate the pressures that forests are under. Presently, these projects are being conducted at the pilot stage, in three selected forests - Arabuko-Sokoke, Trans Mau Complex and Kakemega, which are representative of contrasting ecological and socio-economic zones in Kenya. Therefore they will provide important results which will indicate the overall state of Kenya's forests. However, because of the intense pressure many forest areas are experiencing and their degradation it is recommended that the expansion of the pilot project to all forest areas in Kenya is incorporated as part of the additional programmes that are required over the next 10 years (Activity 3).

The NMK (as part of its Biological Resources Programme for the next five years) has recently completed a Coastal Forest Survey with special reference to the flora. This project investigated the floristic composition of the isolated pockets of coastal forest remaining in Kenya, including the Kayas (coastal forest with cultural/ religious significance), which were found to be high in plant species endemism (see Appendix 3, Annex 1e). As an additional programme it is recommended that a further six floristic surveys be carried out. (Activity 4).

As an extension to the floristic surveys it is recommended that socio-economic surveys are also conducted in communities that utilise these resources so as to identify the specific human and economic causes of the degradation and depletion of the resource base. A vital component of these surveys should be the collection of data relating to indigenous knowledge of flora and fauna. This information, along with the floristic survey, will enable effective management strategies to be formulated thereby promoting the conservation and sustainable utilisation of these resources (Activity 4).

Agriculture

There are several institutions with proposed programmes of ethnobotanical surveys of indigenous fruits and vegetables: NMK, KENGO, Kenya Freedom From Hunger and KIRDI. KIRDI has completed the first phase of its Indigenous Fruit and Vegetable Crops Project (IFVC). This phase comprised of ethnobotanical surveys in two areas of Kenya: eastern and the lake region in western Kenya. Socio-economic surveys have also been conducted in these two areas on indigenous methods of management, production and utilisation of vegetables. It is recommended as part of additional programmes that these institutions, in collaboration with each other, conduct ethnobotanical and socio-economic surveys be conducted in the other regions of Kenya (Activity 5).

Aquatic: Marine and Freshwater

Wetlands are coming under increasing threat most notably from competing demands for the land ie. agriculture. Whilst it is undoubtedly true that some wetlands will be converted to agriculture it is important to identify their key ecological functions that thereby selecting those that should be protected in order to maintain the environmental functions and services that they provide (eg. as bird breeding grounds and for water

purification). Therefore additional programmes of ecological surveying are recommended (Activity 8). Those wetlands that are surrounded by agricultural activity need to be monitored for the impacts of agricultural runoff, siltation and sedimentation.

Aquaculture is an important economic activity along the coast which is being carried out in an unsustainable manner; ie. it is leading to degradation of the resource base and a decline in coastal biodiversity. Banning aquaculture on the coast is not a feasible solution to the problem because of the high economic returns and relatively large population density. Therefore, emphasis should be on improving the methods of utilisation of coastal resources. This requires ecological surveys to identify those areas where aquaculture is suitable and those where it is not (Activity 10). Additional programmes are also required in conjunction with the local communities to derive the most effective methods of aquaculture that will ensure a balance between long-term ecological objectives and financial returns from exploitation.

A number of Kenya's inland lakes are exposed to pollution which is suspected as having an adverse impact on the potential of the lakes to maintain their level of biodiversity functions, either as fish breeding grounds or their function as breeding grounds for migratory birds. Presently, the Ministry of Water Development are responsible for monitoring inputs of effluent discharged into streams and rivers that feed lakes and regulating the emissions standards set for industry by GoK. There is anecdotal evidence that agricultural runoff, increased sedimentation, siltation and industrial effluent discharge is having detrimental impacts on the ecology of the lakes, particularly Lakes Victoria, Nakuru and Baringo. Therefore it is strongly recommended that additional programmes include comprehensive pollution and water monitoring surveys to assess the extend of the problem (Activity 11).

Wildlife

The proposed programmes in the Wildlife Sector focus mainly on institutional strengthening and improving management capabilities (see Section 5.2.3 below). It is recommended as an additional programme that surveys and inventories are given relatively greater weight than envisaged in the proposed programme for this sector. The areas of particular priority are as follows:

(a) compilation of all existing survey material and data relating to the wildlife sector. Many Studies have been undertaken by a variety of institutions (ie. academic - PhD and MSc theses; NGO and Government). The information from these should be collated onto a computerised database (Activity 12);

(b) there should be greater co-ordination and co-operation between KWS and the DRSRS, which, at present, provides an early warning service of drought and pest outbreaks (eg. locusts). These activities should be expanded to monitor wildlife migratory patterns with the aid of remote sensing (Activity 13);

(c) A major problem in wildlife conservation in Kenya is the lack of understanding of how people perceive and utilise natural resources including wildlife. More attention needs to be paid to these socio-economic issues. We need to gain a greater understanding of local communities' attitudes towards wildlife and the perceived costs and benefits of wildlife conservation. This information will lead to the formulation of improved management strategies that will include the active participation of local communities, thus leading to increased chance of successful long-term conservation. Innovative survey techniques will need to be designed and applied to derive such data. (Activity 14).

Other

A set of data banks is being proposed by NMK for the systematic and coherent assembly of information on Kenya's biodiversity, for monitoring and analysis. An important aspect of the data bank programme would be the easy access to information, using modern data storage and retrieval methods. As part of the data bank, a small facility to carry out surveys to complement existing field work is also proposed. NMK also has a number of proposals for additional surveys that are of specific interest to conservationists but that are not covered elsewhere (Activities 15 and 16).

5.2.2 Research, Training, Education and Public Awareness

As has been highlighted in Chapters 3 and 4, research, training, education and raising public awareness are the key components of any policy which aims to conserve the environment and its biodiversity in the long-term.

Research and Training (R&T) related to biodiversity is scattered across several government Ministries and national research institutions. Ongoing R&T in forestry, agriculture, marine environments and wildlife has been discussed in Chapter 4. Tables 5.2.1 to 5.2.4 describe the present situation and further research needs in greater detail. They are largely self explanatory, with the additional points below needing to be made.

Forestry

The details are given in Table 5.2.1. Biodiversity research in this area is undertaken by KEFRI and NMK, and to a lesser extent by KIRDI. In addition, the UoN and KEMRI are working on medicinal plants. The Biological Resources Programme at NMK has a number of related activities. These are carried out in its Plant Conservation and Plant Ecology Projects, as well as under the Coastal Forests and Tana River Projects. Activities include, apart from the surveys already mentioned, research in tree propagation techniques, and critical forest ecosystems; as well as general awareness and eduction. The training needs for the entire set of proposals are given in 4.3.1 (page 93).

Agriculture

The details are given in Table 5.2.2. Key research institutions are KARI, KETRI, The Ministry of Agriculture and the special programmes at the universities (eg. MIRCEN and VOPS). The training needs for the additional research that is proposed are given in 4.3.2 (page 102).

Marine and Inland Water Resources

The details are given in Table 5.2.3. As pointed out earlier this is one of the most understudied areas in Kenya. Research institutes include KEMFRI, The Fisheries Department and NMK. The last of these has an Aquatic Botany Project which, in addition to surveys and inventory work, will prepare management guidelines for rivers, lakes, swamps, floodplain and the coastal zones. NMK also has an active education programme in this and other areas relating to biological resources. The training needs for this area are given in 4.3.3 (page 106).

Wildlife

The details are given in Table 5.2.4. KWS is the institution most heavily involved with training and education in this area. Its research policy is to collaborate with institutions such as Universities, KARI, NMK, DRSRS and NGOs (eg. AWF). NMK has an active research programme on indigenous knowledge that is relevant to wildlife conservation and more research will have to be commissioned on the economic costs and benefits of wildlife, as discussed in 4.3.4 and Table 5.1, Activity 14. The training needs of the additional research are also given there.

TABLE 5.2.1

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Forestry Biodiversity Programme)

Area of Activity	Reasons for Programme	Measures Proposed
1. Tree Research (Exotic species)	Past research has concentrated on the introduction, testing and improvement of fast maturing softwood species grown commercially in plantations. With the exception of a few cases, introduction was done without a close understanding of the species diversity in the areas of origin.	Efforts should be made to gather more information on the genetic diversity of exotic species in the areas of origin and maximum variability.
2. Indigenous species	Slow growing indigenous hardwood species have not until relatively recently received adequate research attention. Previous efforts emphasised in situ conservation under various legislations and enforcement regulations.	Basic cytogenetic, biotechnological and physiological studies, should be incorporated into the recently initiated research programmes on indigenous trees and other woody vegetation.
3. Other Forest Flora	Traditionally, the institutions responsible for forestry research have restricted activities to economically important tree species. Little is therefore known of the total forest floral biodiversity of both higher and lower plants.	There is need to strengthen forest taxonomic botany and genetics, and to involve ethnobotanists to increase knowledge of the total floral composition of forests (see also Activity 3, in Table 5.1).
4. Forest Fauna	Apart from destructive species of animals, principally insect pests, exploration and study of forest fauna has been excluded from the forest research programmes. As a consequence little is known of interactions between forest flora and fauna, eg. seed dispersal and disease transmission.	The scope of the present forest zoology programme in KEFRI and NMK should be expanded to incorporate all animal life in forest ecosystems. This will facilitate effective collaboration with KWS. Zoologists and veterinary scientists are needed in this effort.
5. Forest Ecology	General ecology as an integral part of forestry research programmes is a recent development. Much information has yet to be accumulated on biological, chemical and physical composition of the forest detritus.	Basic research in forest ecology is needed to generate the knowledge required for the sustainable management of the various forest ecosystems.
6. New Products	Economically, forests have been viewed as sources of a variety of wood products. Exploratory research to identify sources of non-wood products such as medicines, pharmaceutical, ornamental crops, new fruits, vegetables and animal products is in its infancy. Such research could contribute to the conservation of forest ecosystems as potential sources of future economically important products.	The initiative by KEFRI to mount a research programme to explore the potential of tree species and woody vegetation, the production of non-wood product should be supported along side the promotion of efficient processing technologies for the production of wooden goods.

TABLE 5.2.1 (contd.)

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Forestry Biodiversity Programme)

Area of Activity	Reasons for Programmes	Measures Proposed
7. Socio-cultural	It is known that some societies conserve forests either as a whole or in part through cultural beliefs, rites and other values. Research has not contributed to an understanding of the socio-cultural factors involved in conservation and utilization of forests.	Biological approaches to forestry research should be supplemented by socio-cultural research. (An area of particular importance in this respect is the Tana Primate Reserve). Social scientists and anthropologists will be required for this purpose. NMK is proposing to establish the Centre for Indigenous Resource Conservation in Africa (CIRCA).
8. Forestry in Arid and Semi-Arid Lands (ASALs)	ASALs comprise 80% of Kenya's land surface containing 20% of the human population, 50% of cattle, 55% of goats, 75% of sheep and all of the country's camel population and wildlife. In spite of the importance, ASALs have received little research attention on woody species and their interactions with human, livestock and wildlife activities.	Forestry research programmes being formulated for the ASALs should receive high priority. The programmes should aim at developing technologies for the sustainable management of wooden species in the ASAL ecosystems. Research in ASAL afforestation will required coordinated inputs by KEFRI, KARI NMK, KWS and DRSRS.

TABLE 5.2.2

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Agricultural Biodiversity Programmes)

Area of Activity	Reasons for Programmes	Measures Proposed
Crop Research		
1. Cereals (exotic)	Most important cereals (maize, rice, wheat) are exotic, accordingly little or no knowledge of their genetic diversity in their areas of origin is available to local scientists.	Urgent need to have up-to-date information from centres of origin with geographical conditions similar those in Kenya is needed.
2. Cereals (indigenous)	Sorghum, finger millet, bulrush millet, teff and small cereals originated in the savanna areas of Eastern Africa. In spite of this, they have not become important economically, since the introduction of exotic cereals early this century. Moreover, they have received little attention in terms of biodiversity research.	More research in biodiversity is needed. Intensive collection in semi-arid and arid areas is needed, including characterization, for both landrace and wild relatives. The application of biotechnology could greatly improve the value of these cereals e.g. improvement of bread making qualities.
3. Food Legumes	Most important commercially grown foods legumes are species non-indigenous.	Up-to-date information on biodiversity from the areas of their origins with geographical conditions similar to those in Kenya is needed.
	Indigenous Food Legumes, e.g. cowpeas, have not received much biodiversity research.	Intensive collection, including characterization for both landraces and wild relatives is needed.
4. Vegetable (exotic)	All commercially grown vegetables are exotic species. Their genetic base is narrow since they are produced from a few varieties bred commercially outside Kenya.	Up-to-date information on their biodiversity in areas of origin is needed.
5. Vegetables (indigenous)	Indigenous vegetables, have received very little attention in terms of collection, conservation and utilization.	More biodiversity research is urgently needed, including intensive collection, conservation and characterization of landraces.
6. Fruits and Nuts	All commercially grown fruits and nuts are exotic species (temperate, sub-tropical and tropical).	Information on their biodiversity in the areas of origin is needed.
	Potential of indigenous fruits in various ecological zones of Kenya have not yet been subjected to systematic biodiversity research.	Systematic bio-diversity research is needed and also intensive collection, conservation, characterization and evaluation of indigenous fruits in all ecological zones.
7. Edible Oil Crops	Most commercial sources of edible oil are from exotic crops, with palm oil providing the biggest source of semi-processed imported raw material. Genetic diversity of locally adapted oil crops both indigenous and exotic has not been fully explored.	High priority should be given to establishing a collection centre for indigenous and exotic material with high biodiversity potential

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Agricultural Biodiversity Programmes)

Area of Activity	Reasons for Programmes	Measures Proposed
8. Industrial Oil Crops	Indigenous oil crops such as castor have not received much attention. Potential also exists for finding new industrial oil producing crops from the indigenous flora.	Biodiversity research, backed up by laboratory analytic services are required to identify new candidate oil crops.
9. Root and tuber crops	All of the most economically important root and tuber crops (cassava, sweet potato and Irish potato) were originally introduced from New World. Their biodiversity representation in Kenya is a small proportion of what is available in the centre of origin.	There is need to intensify biodiversity exploration in the centre of origin and to widen the genetic base of these crops in Kenya. Tissue culture techniques should be developed to facilitate germplasm importation and ex-situ conservation.
10. Herbs, Spices and aromatic plants	All commercially grown species are exotic. Little is known of their genetic diversity in their areas of origin. Exploration of the local plants to identify new herbs and spices has not been carried out.	Explore further centres of origin, introduce and conserve new germplasm. Mount new programme to explore, conserve and utilize new local herbs, spices and aromatic plants.
11. Ornamental and floricultural plants	The floricultural industry (cut flowers) is dependent on imported plants, some of which were/are weedy in their areas of origin. Exploration of the local flora to identify possible new flori-cultural material has not been undertaken.	Explore, conserve and evaluate local plants with ornamental/ floricultural potential, inc. indigenous ornamental trees (eg. *Giga syphon Macro Syphon*).
12. Fibre crops	Indigenous plants (eg. *Hibiscus* spp) used in the past to make traditional fibres have declined without evaluation of their bio-diversity and commercial potential.	Indigenous fibre crops should form part of applied biodiversity research in agriculture. Further research should be done to identify their biodiversity status and occurrence.
13. Sugarcane	Application of tissue culture for large scale long-term storage of germplasm.	Development of tissue culture methods should greatly increase availability of genetic variability for future use.
14. Pyrethrum	Need to expand genetic base through germplasm introduction and application of modern methods of breeding, e.g. somatic hybridization and haploid technology.	Develop highly focused plant improve programme based on modern biotechnology.
15. Tea and Coffee	These crops are internationally sensitive in economic terms. It is feared, therefore that they will be the target for genetic engineering research in industrialized countries. Kenya lacks capability for such research initiative.	As a strategic measure, tea and coffee research scientists should monitor closely ongoing or planned biotechnological research on these crops in industrialized countries.

TABLE 5.2.2 (contd.)

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Agricultural Biodiversity Programmes)

Lower Plants 16. Fungi	Work is limited to species of important pathogenic fungi. Indigenous species of edible fungi have not been explored and conserved, nor have their potential use as a source of pharmaceutical been investigated.	As well as pathogenic species, research to conserve and utilize lower plants positively in agriculture should be initiated. Potential for the production of antibiotics should also be assessed.
Microbes 17. Protozoa Bacteria Algae Micro-algae Micro-fungi Viruses	Knowledge of microbes is currently limited to pathogenic species of crops and livestock. Microbes useful to man, animals and plants are little known. Generally microbial biology and systematics does not receive much attention. There is no work on blue green algae in spite of their potential in nitrogen fixation, soil fertility, production of proteins, vitamins and pharmaceuticals.	Strength research into microbial diversity with special attention to conservation and utilization in agriculture.
Animal Research Livestock Species 18. Cattle Sheep Goats Camels Poultry Pigs	Livestock production systems depend on a few domesticated species of which the exotic breeds have received research attention. Indigenous species/breeds are little known in terms of genetic diversity and physiological adaptation. In particular, there is little work on livestock species reared in ASAL ecosystems which they share with wildlife species. Some research has been done on possibility of domesticating wild animals as an option for rational utilization of biodiversity (eg. by KARI and the Galana Ranch).	Much remains to be done in characterizing and evaluating indigenous livestock species in relation to their habitats (rangelands). Research into live-stock production systems in rangelands is needed as part and parcel of bio-diversity conservation and utilization programme in these areas. Further research is needed on the inter actions between wildlife and livestock species and their impact on the environment.
19. Apiculture	Little is known about genetic diversity of bees and what influence this has on products such as honey and beeswax. Bees also serve an important pollination function, and hence the genetic diversity of agricultural crops and flora in natural habitats.	Research into the links between genetic diversity and products is required, with regard to commercial exploitation. Research into the role of bees in pollination is also required.
Lower Animals 20. Insects Other Invertebrates Nematodes Platyhelminth Earthworms, etc.	Research is restricted to disease carriers/causing lower animals, both in plants and livestock. Generally, disease causing/ carrying invertebrates are better known in livestock than in plants. There is little information on other lower animals, e.g. earthworms, swamp worms, etc. which play an important role in maintaining the ecosystem.	Agricultural zoology research geared to a better understanding of the role of lower animal, biodiversity in sustainable agricultural production should be strengthened. More attention is needed for non-destructive species (biological control).

TABLE 5.2.3

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Marine and Aquatic Biodiversity Programmes)

Area of Activity	Reasons for Programmes	Measures Proposed
Marine Ecosystems		
1. Fisheries Research Programmes: Fisheries stock assessment Biology of the coral reef fish Collection of sea shells, lobsters and crabs. Marketing structure of fisheries resources and socio-economics of fishing communities.	Only about 20% of all the marine and fresh water resources are known. Research on biodiversity has not been addressed fully since there is greater desire to meet demands for fisheries products.	There is need for further research determine the unknown species biological diversity and the soc economic needs of the local communiti
2. Environmental Research Programme: Ecological studies of estuaries, wetlands, mangrove ecosystems, sea-grass beds, coral reefs, environmental changes due to siltation and pollution, over exploitation of marine and aquatic resources, fishing methods and human impacts.	No inventory has been done on the status and composition of marine ecosystems.	There is need for further research on t impacts of human activities on the mari ecosystems.
	Other studies not done include: ecological and biological studies, impact of human activities, tourism, environmental impact assessment of marine ecosystems, baseline studies and research on ecosystem functioning.	There is need for collaborative resear monitoring and assessment at regional a international levels in order to safegua biological resources of marine origin.
Primary production and source of biomass.	Study of ecology of the introduced species and impact due to development activities.	Need to strengthen the existing region bilateral and multilateral arrangements all costs.
Nutrient recycling.		
Composition, structure and effects of pollution on coastal and marine ecosystems.		Establishment of an aquarium Mombasa operated by KWS/NMK. feasibility study has been completed.
3. Marine microbes: Includes virus, bacteria, cynobacteria, bacillariophyta, protozoa, microfungi and diatoms.	The unknown species, their ecology, behaviour and unknown consequences and levels of pollution on marine ecosystems represents about 80%.	This calls for urgent research programm of biodiversity.
	Need to determine microbiologically unexplored forms which could be beneficial or harmful ones along the coastal areas.	There is need for basic studies and furth research in order to attempt to create inventory of all marine microb including their status abundance a ecological significance of marine microb and their possible use in biotechnolog
	About 90% of all marine microbes are unknown.	There is need to strengthen knowledge their status and behaviour.
		Research on the relationship betwe microbial uses on the environment a development.
		Need for technology for collection stora and preservation of microbial resource

TABLE 5.2.3 (contd.)

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Marine and Aquatic Biodiversity Programmes)

Area of Activity	Reasons for Programmes	Measures Proposed
4. Natural Products Resources Programmes:		
Study the chemical and biochemical composition of specific marine organisms for possible extraction of ingredients (including microbes) which are of nutritional and medicinal value, e.g. algae and chitin.	Identification of chemical and biochemical composition of marine algae, seaweeds and other marine organisms (flora and fauna).	There is need for thorough exploration the coastal line including 200 nauti miles exclusive economical zones (EE
	Identification and inventory of all marine organisms.	Regional and international cooperatior required for offshore research.
5. Aqua - Culture Research Programme:		
Evaluation of the coastal line in order to determine specific areas suitable for undertaking aquacultural research, e.g., *Antamesia*, oyster and seaweeds.	Lack of inventory and baseline studies of the Kenyan coastline.	Need for further research and technolo transfer in aquaculture research.
		This is an area requiring further readdr in order to meet enough fisheries produ for growing tourism industry.
Fresh Water Ecosystems		
6. Fisheries Research Programme: Study the decline of fish catches and number of original fish species.	Inventory of the fisheries stock is necessary.	Need for proper inventory of fisher resources.
Trends of exploitation of Lake Victoria in terms of fisheries products (classified as fully exploited).	Lack of improved fishing methods and technology.	Further research on ecological status fisheries resources.
Establishment of quantities of fisheries products that can be exploited at any given time (sustainable exploitation).	Lack of ecological and biological research studies.	Institute environmental impact assessm to determine the levels of exploitation a pollution of fresh water resources.
Study the composition of fish species within the rivers draining into Lake Victoria and the impacts of exotic species.	Impact of human activities on fresh water ecosystems.	Research on conservation measures control erosion and siltation of fresh wa resources.
Impact of lake level changes and sedimentation effects on fresh water resources.	Eutrophication and levels of pollution.	There is need for baseline studies a continuous monitoring of lake le changes including pollution a sedimentation of freshwater resources.
Study of the ecology, biology, feeding and breeding behaviour of fish, including fishing activities.	Lack of knowledge on levels of fisheries consumption and production.	

TABLE 5.2.3 (contd.)

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Marine and Aquatic Biodiversity Programmes)

Area of Activity	Reasons for Programmes	Measures Proposed
7. Wetlands Research Programme:	Need for inventory of their ecological significance e.g. as water storage, habitats for both flora and fauna or as watering points for terrestrial animals.	Further study and research in this area i required.
Saline and freshwater lakes Isolated swamps Internal drainage plains Flood plains e.g. Kano Brackish or salt water High mountain lakes and springs Coastal temporary lakes including shallow lagoons Artificial dams and irrigated areas	Need to assess their fisheries potential and other economic uses.	Environment impact assessment of th wetlands ecosystem is necessary.
	Impacts of human activities and threat due to human encroachment	Need for proper management strategie and conservation policies.
	Lack of baseline studies	Study the degree of biodiversity containe within wetland ecosystems.
	Inventory and identification of species composition	Further research in hydrology paleolimnology, plant regeneratio phenomena, etc.
	Lack of continued ecological monitoring and stock taking.	Need for further ecological studies for al wetlands.
8. Freshwater microbes (Freshwater, lakes and dams) e.g. bacteria, viruses, cyanobacteria, phytoplankton and zooplankton, bacillariophyta, chlorophyta and diatoms.	No information is available on viruses and bacteria	Need for further research in identificatio of fresh water microbes.
	Less information is available on other freshwater microbes.	Establish relationship between microbe and fisheries.
Alkaline-saline microbes types of microbes: viruses, bacteria, archaeobacteria, cynobacteria, chlorophyta, bacillariophyta, etc..	No information is available on viruses.	Further research in this area is necessary
	Little information is available on other types of microbes.	

TABLE 5.2.4

RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS
(Wildlife and Other Research)

Areas of Activity	Reasons for Programme	Measures Proposed
1. Wildlife Habitats/Ecosystems	The savanna, highland and lowland forests, lakes, wetlands and marine ecosystems are known for their high biodiversity, though little has been done to characterize and evaluate this natural resource. In particular, there is need to monitor closely animal species that are listed.	An effective research programme for a good understanding of these ecosystems and habitats must be inter-institutional and multidisciplinary. Most of Kenya's research institutes will need to be involved in a coordinated manner in this research.
2. Wildlife Ecosystems	As rare, endangered or endemic and to assure their survival.	Additional research is needed for restoration and conservation of these types of wildlife ecosystems.
3. Biological Factors in Conservation	Human activities in Kenya has expanded substantially resulting in the fragmentation, isolation and marginalization of wildlife. The effects of these changes on the breeding capabilities and vigour of the species are little understood. The loss of biodiversity owing to disease agents is also not well studied.	Basic biological studies on the behaviour of wildlife in small population or under confinement are needed to determine the extent of genetic erosion and the effect of inbreeding on the survival of populations.
4. Wildlife Diseases	Diseases such as rinderpest have in the past decimated species including the buffalo. In spite of this toll, pathogens and parasites have not been studied adequately in relation to their impact on the biodiversity of wildlife.	Revitalization of research in wildlife biodiversity should have beneficial implications for research into economically important livestock and human diseases. Close collaboration with KARI, ILRAD, IPR and ICIPE.
5. Socio-Economic Research	For a rational utilsation policy in this sector much more needs to be known about the demand for wildlife from tourists, as well as attitudes of local people.	A range of socioeconomic studies invlving anthropologists, environmental economists and wildlife experts. NMK, with KWS, the universities ands NGOs should be involved.

5.2.3 PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS

There are two distinct strategies that are being advocated internationally to conservation biodiversity:

(a) to protect areas of endemism and high biological diversity by excluding any exploitation or use of biological resources in a well-defined area ie. the creation of National Parks **and** ex-situ conservation.

(b) promoting management and exploitation strategies that will enable local communities to utilise biological resources in a sustainable manner.

Whilst the two approaches are derived from different philosophies, both strategies will need to be employed in order to optimally conserve Kenya's biodiversity. It has already been noted (see Chapter 4) that the conflicts between economic development and environmental conservation goals are many and varied. It will be shown in this Section, that in some instances the only feasible method of conserving species of fauna and flora is either by protecting their habitats or conserving them in ex-situ facilities. In other instances the pressures of population density and the need to utilise the natural resource base to sustain livelihoods, require a rational utilisation policy that involves local community participation. The success that Kenya has in meeting its goal of conserving biological resources will depend on achieving the right balance between these two approaches.

Table 5.3 highlights the proposed and additional programmes that are recommended in each of the sectors (forestry, agriculture, aquatic and wildlife/other).

Forestry

As part of the proposed programmes being undertaken by the FD (Activity 1), the main emphasis is on improving the infrastructural facilities available to FD personnel enabling them to carry out their duties more effectively. These proposals include the: rehabilitation of vehicles and acquisition of new ones; rehabilitation of roads; training of fieldstaff in extension and farm forestry methods. It is envisaged that the results from the pilot surveys and inventories will facilitate the formulation of effective management plans for the three forests under study. A general framework for a forestry management plan will then be formulated and applied to other forest areas in Kenya. The additional programmes recommended focus on the implementation of the results of the inventories and surveys. These objectives are as follows:

(a) to strength the capacity of FD to effectively manage these reserves.

(b) Conservation education of FD staff.

TABLE 5.3

PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS

Area of Activity	Reasons for Programme	Measures Proposed
Forestry: Proposed Activities		
1. Indigenous Forest management	Existing management is weak. Community participation needs strengthening	Covers Kakamega, Trans Mau and Arabuko Sokoke under World Bank Forestry Project. On a pilot scale this is being undertaken in the three areas listed above.
2. Strengthening Forest Department	FD has been a weak department with little effective control. Collaboration with KWS needs to be improved.	
Forestry: Additional Conservation Schemes		
3. Extensions of the Pilot Project to More Areas	Current project only covers 17% of Kenya's gazetted forests and forests reserves.	Proposed plan is for a ten year extension to cover all forests, with priority given to some areas such as Taita Hills.
4. Increased protection for ecologically sensitive areas	(a) Kenya has an obligation to protect biotic communities (b) Threatened habitats where endangered fauna are breeding (c) Catchment areas where degradation is very severe	Additional Areas to be protected are: (a) Mt. Kenya (1000 km^2) (b) Cherangni Hills (1250 km^2) (c) Mt Elgon (396 km^2) (d) Tana Riverine Forest (RAMSAR site) (e) Aberdare (100 km^2 on the East & 20 km^2 on the North West). (f) Kasigau Gazetted Forest (20 km^2)
Marine and Freshwater		
5. Enforcement of pollution regulations	Current water quality does not meet standards	Management and policing strengthening. Revision of existing emissions standards.
6. Increased Protection of Inland Water Resources	Capture more aquatic biodiversity	(a) Lake Turkana (3 km^2 central island) & for the South Island. (b) Lake Victoria (100 km^2) (c) Lake Baringo (150 km^2)
7. Controlling in situ breeding grounds for fisheries	Over-exploitation of fish stocks	Lake Victoria extension and better enforcement of breeding grounds.
8. Increased Regulation of Fishing	Over-exploitation of fish stocks	Stricter regulations and strengthening of enforcement capabilities
9. Protection of Wetlands	Conversion of wetlands to agriculture	RAMSAR status and protection.
Agriculture		
10. Production of indigenous fruit and vegetable products	To utilise indigenous products sustainably	Diversify utilisation of these products - juices, jams etc. Ensuring continued supply. Establishing sustainable management. KIRDI will carry out the project

TABLE 5.3 (contd.)

PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS

Area of Activity	Reasons for Programme	Measures Proposed
Ex Situ: Additional Activities		
11. Kaya Coastal Forests	Areas of cultural and endemic importance which are losing biodiversity material.	Plan is for collection and storage of important material from this area. Herbarium/arboretum at NMK is included in cost.
12. North and South Nandi Forests	Guineo-Congolian forest, not internationally important being lost at an irrecoverable rate.	Ex Situ protection of important material. Establishment of further arboreta and herbaria for both 8. and 9, and other ex situ conservation.
13. Ex-Situ Conservation of Endemic Fish in Lake Victoria	Fisheries stocks are declining and need support from breeding programmes.	Existing breeding programme should be extended through the use of larger ponds. NMK would set up and manage facility in Mombasa.
Ex-situ conservation of marine life	Research and tourism	
Wildlife		
14. Management Strengthening	KWS characterised by several inherent weaknesses	Increased training of staff and rehabilitation of infrastructure
15. Establishment of a community Wildlife Programme	Local communities have derived relatively little benefit from wildlife conservation.	Increase community benefits and provide community wildlife extension services.
16. Land-Use Conflict	Conflicts arise between development and conservation goals	Formulate and implement rational land-use policies
17. Increased Private Sector Involvement	There is potential for this sector to expand its activity in this areas	Changes in law to allow exploitation of game and economic incentives
18. Setting up of coordinating unit (NBU)	To act as an overall review of needs of biodiversity in Kenya	NBU to be set up in collaboration with NMK.
19. Microbial collection facility	Knowledge in this area is weak and research facilities poor	To set up a research centre, collection centre and conservation lab.

(c) conservation education of local communities and school children;

(d) community participation in management of forest eg. community zones eg. woodlots, to provide incentives not to use forest maybe community policing and community management utilisation. Provide some substitution for forestry products for commercial and subsistence needs by eg. on-farm planting, citrus promotion, fuel-savings technologies, wood carving substitution;

(e) increase tourism to provide income opportunities and boost awareness of the local communities as to the value and potentially lucrative nature of their indigenous natural resources;

(f) to create job opportunities in the plantations that are run by the FD;

(g) instigate changes in the existing licensing system and bring in forest zoning system: protected zones, plantation zones and utilisation zones.

It is recommended that the FD is provided with the necessary financial and logistic support to continue its conservation management programme, not only in the three pilot forests but also in other forest areas of Kenya (Activity 3). This represents a positive development and welcome shift in conventional policy directions of FDs in general and Kenya FD in particular, from one of protection and exclusion of local communities from forest areas to one of community participation and the promotion of sustainable utilisation of forest products.

KWS controls protected areas in forests (eg. Arabuko-Sokoke) and has additional proposals to increase areas of protection and created protected areas in other forests (see below). Clearly, there will be circumstances in which protection of a forest area and the exclusion of the local community from exploiting the resources will be appropriate. However, these programmes have to be thought out carefully and integrated with community participatory programmes. It is therefore recommended that institutional links between KWS and FD are strengthened and there is much closer coordination between them when formulating strategies for the conservation and sustainable utilisation of biological resources in the forests (Activity 2).

There are several ecologically sensitive areas in the forests of Kenya, ie. those where biologically diverse areas are seriously degraded, those where threatened fauna breed and those where Kenya has an international obligation to protect representative biotic communities. These programmes (Activity 4) may be regarded as proposed activities (by KWS) although funding for them is in the process of being secured from multilateral and bilateral donors (Activity 4). It is highly recommended that before levels of protection are increased that socio-economic surveys are conducted in the areas in question to assess the feasibility of community participatory programmes and

the use of economic incentives which will encourage local people to utilise forest products in a sustainable manner. This type of strategy should be carried out jointly by KWS and FD, as part of the additional FD programmes.

Agriculture

The Kenya Industrial Research and Development Institute (KIRDI) has instigated a programme aimed at promoting the utilisation of indigenous fruits and vegetables. This area is regarded as being of importance in the programme of conserving and sustainably utilising Kenya's biodiversity for several reasons: there are at least 150 species of indigenous fruits in Kenya which are known to local communities and traditionally have been an important component of diet and medicine. However, due to changing lifestyles and destruction of habitat these plants have declined in significance and are threatened with extinction. Furthermore, the indigenous knowledge that communities have as to the properties of these species is disappearing without being passed on to the younger generation. There has been no emphasis or encouragement of growing indigenous fruit and vegetables on farm as the economic incentives (such as a market for the produce) have never existed.

The component of this programme that has already been undertaken has been one of inventories and socio-economic surveys. Ethnobotanical data has been collected from the users and consumers in the semi-arid regions of eastern Kenya and in the lake region in western Kenya. Data on 113 fruit tree species and 45 vegetable species has been collected through 15 field surveys (KIRDI, 1990). Two surveys have been conducted in the same areas to collect information on indigenous methods of management, production and utilisation of vegetables. The project has also aimed at establishing links with institutions ranging from research institutes to community groups. It is expected that community groups will play a significant role especially in extension activities.

It is proposed that this project is continued and extended (KIRDI, 1990), with the explicit objectives as follows:

(a) to diversify the utilisation of indigenous fruits and vegetables through the production of products such as juices, jams, pastes and powders

(b) to guarantee and ensure their continued supply, by stabilising supply which is prone to heavy losses through post-harvest losses, and establishment of a sustainable management regime

(c) to promote the utilisation of these products through publications, seminars and training.

Neither of these phases has secured funding and it is recommended that funding is made available to KIRDI allowing the Institute to carry out this project. The estimated financial costs of the first phase of the project (over two years) are detailed in the following chapter (Activity 10).

Aquatic: Marine and Freshwater

The adverse impact that effluent discharge is apparently having on inland water resources has led to the recommendation in 5.2.1 that surveys are undertaken to assess the nature and cause of the emission of effluent into waterways. It is recommended (Activity 5) that existing emission standards are strictly enforced which undoubtedly will require additional funding for the pollution control task force situated in the Ministry of Water Development, ie. an additional programme. Once the surveys and research regarding the impact of effluent levels on aquatic biodiversity have been carried out, tightening the emission standards may be required. It can be strongly argued that there is a case to increase the emission standards immediately, although this may cause significant increases in costs for industry.

KWS has put forward proposed programmes aimed at conserving both marine and freshwater environments. These proposals focus on protection of these areas, thereby excluding all extractive use of these resources (Activity 6).

Over-fishing both on the coast and inland is causing declines in fish stocks. In some cases the policy to be pursued will involve protection of the aquatic environment as in Activity 6. In other cases it will need changes in fishing practices and a greater degree of regulation of the industry. In Lake Victoria it is proposed that 100 km^2 is protected, thereby creating an in-situ breeding ground (Activity 7). In parallel with this policy an additional programme (that should be implemented by the Fisheries Department) is stricter regulations regarding methods of fishing, such as mesh sizes and times of year that fishing is permitted. However, at present this Department does not have the resources required to enforce existing regulations. Therefore, this additional programme would involve strengthening its enforcement capabilities ie. increases in manpower and equipment such as patrol boats (Activity 8).

There are two wetland areas that have been identified as of major significance in terms of their role and function regarding biodiversity: Tana Delta Mangrove and Yala swamp. Regarding Tana riverine forest there is a proposed programme to give it RAMSAR status thereby enhancing its profile in the international community which it is hoped will afford a greater degree of protection from agricultural development. Yala swamp is scheduled to be drained and converted into agriculture. ?? ha of this swamp has already been drained and agricultural production is being undertaken on the land. The remaining swamp area measures 6000ha and it is strongly recommended that plans to drain these areas are suspended and further investigations (ie. and Environmental Impact Assessment) are carried out to determine the impact drainage would have on bird breeding patterns and water purification function (Activity 9).

Ex-Situ Facilities

In some parts of Kenya certain species (of both flora and fauna) are seriously threatened with extinction. In these cases the only viable option is to conserve them in ex-situ facilities. As previously mentioned one of the findings of the Coastal Forest floristic survey is the occurrence of endemic plant species in several of the Kayas. These fragments of coastal forest are under such threat from encroachment that the habitats for these plants may well disappear. Therefore, it is strongly recommended that an additional programme of ex-situ conservation is implemented (Activity 10). A similar threat is faced by endemic flora in the North and South Nandi Forests and a further additional programme of ex-situ conservation measures are taken here. (Activity 12).

In the case of Lake Victoria, the threat to endemic fish species does not come so much from the disappearance of habitat but rather from the introduction of the Nile perch, which is a predator to the much smaller indigenous fish in the lake. Eradicating the Nile perch is not an option and it is therefore recommended that an additional programme of ex-situ conservation is implemented by transferring these species to ponds. Such ponds have already been constructed with the assistance of the Lake Basin Development Authority (approximately 7,000). However, these are small-scale ponds and used only for one species - *Oreochromius nilotica*. Larger scale ponds should be constructed to facilitate other endemic species. (Activity 12).

An important programme for Kenya is to establish a marine aquarium. This would provide an important research facility as well as earning tourism revenue. Located at Mombasa, it would attract many visitors, and could prove to be an attractive investment (Activity 14).

An important point to note regarding ex-situ conservation is that the option of rehabilitating degraded and abandoned sites that once provided habitats for flora (and fauna) is possible. If the species that once existed in these habitats are conserved in ex-situ facilities the potential is there to reestablish them in their natural environment.

Wildlife

There are two strategies that may be employed to conserve Kenya's wildlife: enclosing game in NPs by fencing the areas, such is the case in Lake Naivasha NP, or allowing game to migrate to and from the NPs. Enclosure of NPs will require intense management in maintaining population numbers at their optimal levels; allowing migration requires the maintenance of dispersal areas in which the game may move freely.

There is a pressing need for strengthening of the Wildlife Sector management capacity. KWS is constrained by several inherent weaknesses (World Bank, 1991) which include:

(a) weak linkages between implementation units;

(b) absence of medium and long-term corporate planning and of a system linking planning, budgeting and management information;

(c) low awareness of institutional objectives, particularly amongst lower-level staff;

(d) a lack of commercial orientation in its operations.

In light of these weaknesses KWS have proposed programmes which focus on providing funds to hire skilled personnel, train existing and new personnel and develop management systems. Under this programme vehicles and office equipment would be purchased and an effective radio communications network would be established between headquarters and field stations (Activity 14).

It has been well recognised that the lack of financial/ economic incentives of local communities has led in many instances to hostility and lack of co-operation of these communities that are situated around NPs. These areas (dispersal areas) are crucial in sustaining wildlife density in the parks and by their function as migratory routes during the rainy season. In the past local communities have received very little compensation from the damage to crops that wildlife causes and they have lost benefits accruing from utilising game products which presently banned. The proposed programme in this regard includes: direct sharing of park or reserve revenues, small-scale community development projects and financial and technical assistance. However, a component that is lacking from this programme is the possibility of communities deriving benefits from hides, skins and meat of game. Traditionally, these communities have utilised these products and are likely to be regarded as one of the most important economic benefits derived from conserving wildlife. Addressing this issue may well provide solutions to both local community hostility and the problems that occur in NP when the carrying capacity of certain species is exceeded. This is particularly the case in Amboseli where elephant density has led to the degradation of the environment. It is therefore recommended that aspects of wildlife conservation are included as additional programmes in this sector.

The conflict between development and conservation of dispersal areas is a major issue in Kenya. Dispersal areas for Maasi Mara NP are increasing encroached for settled agriculture (notably wheat cultivation) and the demands for urban development eg. in the Ngong, Kitengela and Athi-River urban centre have encroached on the dispersal area of Nairobi National Park (see Section 3.4.2, P.30). It is recommended that as an additional programme, priorities are established for each of the land-use conflict areas and viable solutions to these problems are found. (Activity 16).

A further extension to the proposed programmes in this Sector should be the closer involvement of the private sector in conserving and sustainably utilising game resources. Presently, there are several game ranches and rhino sanctuaries but their numbers are relatively small. The private sector should be encouraged to expand its activity in this area with the use of policy instruments such as changes in the legal aspects to allow exploitation and utilisation of game products as well as macro-economic tools to provide the economic incentives to undertake such enterprises (Activity 17).

The coordinating function in the field of biodiversity has been allocated to the NBU. However, this body does not have any long term funding. Its role is essential in the short as well as the long term, and it would be a mistake for it to be allowed to be closed down after the initial interest in the subject.

Finally there is a proposal for a centre for microbial research within the universities. This would include a collections centre, a research institute and a conservation laboratory. For a field that is recognized to be of increasing importance it is also recognized that funding in Kenya has been low. This would help fill an important gap.

5.3.4 National Capacity For Biotechnology And Transfer Of Technology

Much of the relevant research relating to biotechnology for Kenya is being carried out by institutions such as KARI, KEMRI, KETRI, ICIPE AND ILRAD. The national priority areas for biotechnology work are:

(i) Micropropagation for crops and trees (KARI, KEFRI and NMK);

(ii) Tissue culture for cleaning plant stock of pathogens (KARI and KEFRI);

(iii) Nitrogen and phosphorous fixation for both crops and trees (KARI, KEFRI and NMK).

(iv) Development of genetically engineered vaccines for important animal and human diseases (KARI, KETRI, KEMRI and IPR);

(v) Design and development of new diagnostic techniques (eg. DNA probes) for important animal and human diseases (KARI, KETRI and KEMRI);

(vi) Breeding for environmental stresses for crops, trees and animals (KARI and KEFRI);

(vii) Production of energy from biomass (KIRDI and KEFRI).

(viii) Development of biochemical engineering, ie. the production of organic chemicals and related enzymes and vitamins (KIRDI);

(ix) Microbial treatment of environmental pollutants (KIRDI);

(x) Improvement of fish genetics especially *Tilapia* species and *Labeo victorianus* (KEMFRI);

(xi) Improvement of fish feed quality with special references to *Armetua* species (KEMFRI);

(xii) Development of genetic markers for use in tissue typing (KEMRI);

(xiii) Mapping genetic diversity in wildlife species such as rhino, elephants (MNK, IPR).

It has not been possible to separate out a programme of research for biotechnology as such. However, in the cost figures given in Chapter 6, and in the research programme detailed in Tables 5.2.1 to 5.2.4, the biotechnology items listed above have been included.

CHAPTER 6

THE COSTS OF BIODIVERSITY CONSERVATION IN KENYA

6.1 INTRODUCTION

In this chapter we look at the costs of existing projects, and planned projects that are part of the existing programme of expenditure on biodiversity, by GoK as well as NGOs. We also cost the additional programmes that have been identified in the last Chapter. Both the identification of existing programmes and that of costing the additional programmes are not straightforward, and a number of approximations have had to be made. Taking the existing programmes first, comprehensive data are only available in detail for government Ministries and related departments and institutes. Some more limited data are available from NGOs and we have included them where available. Furthermore, as was pointed out in Chapter 5, the expenditures of some institutes cannot be broken down in sufficient detail for the "biodiversity" component to be identifiable. In such cases we have, after discussions with the institutions involved, taken a percentage of their budgets. The percentages for the organizations involved are given below:

Institution	Percentage of Budget Taken for Biodiversity
KEMRI	5
KETRI	5
KEMFRI	
KEFRI (Product Research)	5
MINISTRY OF REGIONAL DEVELOPMENT	
(Turkana Integrated Development Project)	60
LAKE BASIN DEVELOPMENT AUTHORITY	
(Horticultural Programme)	5
KIRDI	15
KARI	
(National Horticultural Res. Programme)	50
(Seed Quality Control Services)	25
(Animal Production Research)	20
(Veterinary Research (exc. biotechnology)	20
MINISTRY OF LIVESTOCK DEVELOPMENT	
(Animal Health Training Institute)	8
(Range Management Improvement)	90
NATIONAL COUNCIL	
FOR SCIENCE AND TECHNOLOGY	25

In all other cases the entire budget of the relevant department activity has been taken as biodiversity relevant, with the exception of administrative budgets. For each of the Ministries we took a percentage of the administrative budget based on the share of the Ministries total non-administrative spending that was considered as biodiversity-relevant.

An important biodiversity institution that carries out work in collaboration with GoK is NMK. Its activities are only listed in the government accounts as a block grant. We have isolated those items that went for non-biological support, and taken the balance. However, the expenditures of NMK are much larger than that. Where additional programmes are involved, they have been examined under the 'additional' programmes.

Costs for additional programmes must necessarily be regarded as rough. There has not been time to provide a detailed costing of the kind that would be made even at a pre-feasibility level for most of the programmes. In some cases the information was taken from existing unfunded projects, but in most cases it is only a first attempt at the costs.

The data are reported for the current year and for the next three years. The latter cover the period 1992-1995. The primary reason for choosing this short period was that the GoK data were available for that period. However, such a short period would not permit all the desired activities to be carried out. Where a longer period is considered as required, we have taken a percentage of the cost of that programme (eg if it is a ten year proposed programme costing $x, and take 0.3X as the cost for the three year period.

Virtually no data could be collected from the private sector. Where they had activities in the field, such as private ranching, there was a reluctance to provide cost and revenue information.

This Chapter is organised as follows. In Section 6.2 we look at the existing and proposed government expenditures, by category of expenditure as given in the UNEP guidelines (Annex 9). The detailed Tables answering the questions in that Annex are given in an Annex to this chapter. In section 6.3 we look at the proposed expenditures by NGOs. Section 6.4 evaluates the additional programmes as given in Chapter 5. Not all the proposals in that Chapter involve major expenditures. Others that do involve expenditures do not have any data available. However most of the expenditure-related programmes in that chapter have had an estimate of the costs.

6.2 GOVERNMENT BUDGETS FOR BIODIVERSITY

Table 6.1 lists the Ministries and department or institution in each Ministry that undertakes biodiversity work, and gives the UNEP code, as set out in Annex 9 of the UNEP guidelines for the activity that is carried out. The activity itself is briefly described. The UNEP codes are as follows:

1. Surveys, Inventories, Identification and Authentification of Biodiversity
   - 1.1 National Parks
   - 1.2 Forest Reserves
   - 1.3 Other Threatened Habitats
   - 1.4 Other Ecosystems
   - 1.5 *Ex-situ* Facilities
   - 1.6 Species
     - 1.6.1 Animals
     - 1.6.2 Plants
     - 1.6.3 Microbes
   - 1.7 Acquiring and Developing Technology
2. Research, Training, Education and Public Awareness
   - 2.1 Biodiversity Research
     - 2.1.1 Animals
     - 2.1.2 Plants
     - 2.1.3 Microbes
     - 2.1.4 Other Ecosystems
   - 2.2 Socioeconomic Research
   - 2.3 Education/Training
   - 2.4 Technical Training
   - 2.5 Public Awareness
3. Preparation and Implementation of Conservation Management Strategies and Plans
   - 3.1 National Parks
   - 3.2 Forest Reserves
   - 3.3 Other Threatened Habitats
   - 3.4 Other Ecosystems
   - 3.5 *Ex-situ* Facilities
   - 3.6 Species
     - 3.6.1 Animals
     - 3.6.2 Plants
     - 3.6.3 Microbes
   - 3.7 Planning and Other Activities
4. Monitoring of World Status of Biodiversity
   - 4.1 Ecological Monitoring
8. National Capacity for Biotechnology and Transfer of Technology
   - 8.1 Development of Technology

TABLE 6.1

BIODIVERSITY EXPENDITURE: UNEP CODES BY MINISTRY

CODE	MINISTRY	DEPARTMENT	ITEM
1.1	TOURISM AND WILDLIFE	Wildlife Conservation and Wildlife Services	Satellite Imagery
1.2	ENVIRONMENT	Forestry	Planned Inventory
1.3	MINISTRY OF PLANNING	Department of Resource Surveys and Remote Sensing	Resource Surveys and Remote Sensing
1.6.1	REGIONAL DEVELOPMENT	Fisheries Development	Fisheries Surveys
2.1.1	TOURISM AND WILDLIFE	Wildlife Conservation and Wildlife Services	Wildlife Research
	REGIONAL DEVELOPMENT	Fisheries Development	Fisheries Status
			Fisheries Research & Hatcheries Stations
	RESEARCH SCIENCE & TECHNOLOGY	Marine & Fisheries Research	Kenya Marine and Fisheries Institute
		Kenya Agricultural Research Institute	Veterinary Research exc. Animal Biotechnology
			Animal Production Research
2.1.2	RESEARCH SCIENCE & TECHNOLOGY	Kenya Forestry Research Institute	Silviculture & Tree Improvement
			Forest Protection & Conservation
			Department of Forest Products Research
		Kenya Agricultural Research Institute	National Horticultural Research Programme
			Seed Quality Control Services
2.1.3	RESEARCH SCIENCE & TECHNOLOGY	Kenya Trypanosomiasis Research Institute	Trypanosomiasis Research

TABLE 6.1

BIODIVERSITY EXPENDITURE: UNEP CODES BY MINISTRY

CODE	MINISTRY	DEPARTMENT	ITEM
2.1.4	RESEARCH SCIENCE & TECHNOLOGY	National Council of Science & Technology	Ecosystem Biodiversity Research
		Kenya Agricultural Research Institute	Soil & Water Management Research
			Range & Arid Land Research
2.2			
2.3	TOURISM & WILDLIFE	Wildlife Conservation & Management Services	Education & Extension Services
			Naivasha Wildlife & Fisheries Training Institute
	REGIONAL DEVELOPMENT	Turkana Integrated development Programme	Livestock Development project
	LIVESTOCK DEVELOPMENT	Livestock Education & Extension Services	Livestock Information Centre
	ENVIRONMENT & NATURAL RESOURCES	Forestry development	Rural Afforestation Extension Schemes
2.4	LIVESTOCK DEVELOPMENT	Livestock Education & Extension Services	Animal Health Training Institute
	REGIONAL DEVELOPMENT	Fisheries Development	Fisheries Training Institute
	ENVIRONMENT & NATURAL RESOURCES	Forestry Development	Forestry Training Centre, Londiani
3.1	TOURISM & WILDLIFE	Wildlife Conservation & Management Services	Anti-Poaching Unit Services
			National Park Sevices
			District Wildlife Services
			Grants to County Councils

TABLE 6.1

BIODIVERSITY EXPENDITURE: UNEP CODES BY MINISTRY

CODE	MINISTRY	DEPARTMENT	ITEM
3.2	OFFICE OF THE PRESIDENT	Presidential Commission on Soil Conservation & Afforestation	
	ENVIRONMENT & NATURAL RESOURCES	Forestry Development	World Bank Forestry Project
			Local Afforestation Schemes
			Road Construction Unit
3.3	ENVIRONMENT & NATURAL RESOURCES	National Environmental Protection Department	National Plan to Combat Desertification
		Forestry Development	Machakos Integrated Development Project
	RECLAMATION & DEVELOPMENT OF ARID, SEMI-ARID AND WASTELAND	Whole Ministry	
3.4	LIVESTOCK DEVELOPMENT	Rangeland Development Services	Range Management & Improvement
3.5	RESEARCH, SCIENCE & TECHNOLOGY	National Horticultural Research Programme	Genebank
	HOME AFFAIRS	National Museums	Grants in Aid to Nairobi, Kitele, Institute of Primate Research, Herbarium, Kobi-Fora, Lois-Leakey Memorial Building
	LOCAL GOVERNMENT	Nairobi City Commission	Arboretum
3.6.1	REGIONAL DEVELOPMENT	Turkana Development Authority	Livestock Management
		Lake Basin Development Authority	Fish Project in Lake Victoria
			Fisheries
			Beekeeping
		Fisheries Development	Fisheries Stations
			Fisheries Regional Centres
	LIVESTOCK	Vetinerary Services	Hides & Skins Improvement
			Vetinary Investigation Lab Services

TABLE 6.1

BIODIVERSITY EXPENDITURE: UNEP CODES BY MINISTRY

CODE	MINISTRY	DEPARTMENT	ITEM
3.6.2	REGIONAL DEVELOPMENT	Lake Basin Development Authority	Horticultural Programme
	AGRICULTURE	Crop Development	Pesticide Product Control Board Services
3.6.3	LIVESTOCK DEVELOPMENT	Vetinary Services	Tsetse Control Diease & Pest Control Services
3.7	RESEARCH SCIENCE & TECHNOLOGY	General Administration & Planning	Proportion Related to Biodiversity
	LIVESTOCK DEVELOPMENT		
	REGIONAL DEVELOPMENT		
	AGRICULTURE		
	ENVIRONMENT & NATURAL RESOURCES		
	TOURISM & WILDLIFE		
		Wildlife Planning Unit	All Expenditure
4.1	REGIONAL DEVELOPMENT	Fisheries Development	Deep Sea Fish Monitoring
7.2	ENVIRONMENT & NATURAL RESOURCES	Forestry development	Arid & Semi-Arid Forestry Development
8.2	RESEARCH SCIENCE & TECHNOLOGY	Kenya Agricultural Research Institute	Vetinary Research: Animal Biotechnology

These are the only categories for which expenditure items were recovered. This does not mean that other items, such as 'ecological research' (priority area 4.2 in the guidelines) is absent. Rather there is a problem of allocating some items between categories, and a problem of separating out some expenditures into finer categories.

The results of the mapping of government expenditures into the above categories is summarised in Table 6.2 below and given in detail in Annex Tables 1-4. The main findings from these Tables are:

(i) The total current expenditure on biodiversity for the last year for which actual disbursement records are available (1989/1990) was $39 mn. Of this $24 mn was in the development budget (i.e. as investment); and $15 mn. was for recurrent items. For the next three years (i.e. from 1990/91 to 1992/93) the proposed budget is $235 mn, of which $239 mn is development. The total recurrent budget is negative, which means that income from government services exceeds expenditure in total. This is almost entirely due to the income from KWS, which expects to earn around $76 mn from wildlife services and management of parks;

(ii) the big items in the development biodiversity budget are related to forest and wildlife resources (items 1.2, 2.1, 2.2, 3.1, 3.2, 3.7). Other items of monetary significance are research on horticulture (item 2.1); and ASAL reclamation and development (item 3.3). All of these have a prospective cash economic benefit, which is not an accident - governments see their priorities in terms of the visible returns;

(iv) items that are under funded are socioeconomic research and inventories/monitoring of habitats, for which no specific allocations could be found for this item. There is virtually nothing in the universities on socioeconomics and biodiversity, and the government's research focus has not been in this area. Some of the research done by the institutions listed has an element of this but it was not possible to isolate it. Surveys for identification are being undertaken and are probably under reported in these Tables. Much of the relevant work is being carried out by NMK, whose activities are listed in the additional programmes category in Section 6.4 below. Nevertheless there is scope to increase it, as has been pointed out below;

(v) The support for biodiversity from external sources almost dried up in 1989/90,when the total actual disbursements under the categories amounted to around $5 mn. However, it is expected that this will have increased substantially in the period 1990/1993. The estimated total for that period is $55 mn or an annual rate of $18 mn. This would come equally from bilateral and multilateral sources.

TABLE 6.2: SUMMARY OF PROPOSED GoK FINANCIAL SUPPORT FOR BIODIVERSITY

ALL FIGURES ARE IN THOUSANDS OF US$ (1991 PRICES).

PRIORITY AREA	DEVELOPMENT EXPENDITURE		OF 1991/93 PROPOSED:			NET RECURRENT EXPENDITURE		TOTAL		TOTAL GoK
	1990	1991/93	GoK	BI-LATERAL	MULTI	1990	1991/93	1990 DEVT + RECURRENT	1991-1993	
1.1	0	18	0	0	0	0	0	0	18	0
1.2	0	8777	0	0	0	0	442	0	9219	442
1.3	0	0	0	0	0	623	2260	623	2260	2260
1.4	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	0
1.6	3	19	3	0	0	0	0	3	19	3
1.7	0	0	0	0	0	0	0	0	0	0
TOTAL FOR 1	3	8814	3	0	0	623	2702	626	11516	2705
2.1	3026	26975	24818	858	1298	8593	39151	11619	66126	63969
2.2	0	0	0	0	0	0	0	0	0	0
2.3	2772	14709	14709	0	0	87	157	2859	14866	14866
2.4	410	412	412	0	0	590	1996	1000	2409	2409
2.5	0	0	0	0	0	1757	6325	1757	6325	6325
TOTAL FOR 2	6208	42096	39939	858	1298	11027	47629	17235	89726	87569
3.1	192	76643	15607	26704	34333	2820	-44188	3012	32455	-28582
3.2	10024	52903	47913	3747	1243			10024	52903	47913
3.3	1378	11560	3195	6162	2203	967	3474	2345	15034	6669
3.4	290	6372	708	1232	4432	170	867	460	7239	1574
3.5	48	1160	103	392	665	621	2492	669	3652	2595
3.6	5271	19270	13692	2803	2775	2035	11835	7306	31104	25527
3.7	1311	21344	4169	10960	6215	6992	18496	8303	39840	22666
TOTAL FOR 3	18514	189252	85387	51999	51866	13605	-7025	32118	182227	78362
4.1	0	0	0	0	0	2	239	2	239	239
8.1	0	79	74	0	0	0	0	0	79	74
TOT. OTHERS	0	79	74	0	0	2	239	2	317	312
GRAND TOTAL	24725	240240	125403	52858	53164	25257	43545	49982	283785	168948

6.3 NGO BIODIVERSITY EXPENDITURE

The expenditure data from NGOs was less complete. All relevant organisations were approached and most offered some information. This is summarised in Table 6.3 below. Total expenditure in 1989/90 amounted to $12.6 mn, of which the largest share by far was that of ICRAF ($11.5 mn). It was also committed to socio-economic research in the area of biodiversity, which is an identified gap in government activity in this area. WWF and WCI have a budget of around $570,000 and $210,000 respectively. The expected budget for the next three years is not increased over the 1989/90 figures. The limited projections indicate an amount of $38 mn, which is the same on an annual basis as the current figure. However, this must be regarded as only a guess - most interviewees did not now how much would be available and assumed that similar amounts would continue.

6.4 PROPOSED ADDITIONAL PROGRAMMES

The programmes identified in Chapter 5 have been costed, with few exceptions, in Tables 6.4 to 6.6 below. The fields of activity that emerged as important in terms of the UNEP guidelines were surveys and monitoring ($12 mn), research and training ($7 mn) and conservation programmes (55 mn). The above figures refer to a three year programme, with longer programmes taken on a *pro rata* basis. Together they come to $73.8 mn, or $24.6 per annum. The breakdown between recurrent and development is: $32.6 recurrent, $41.2 development. Many of the projects included are being considered as part of Kenya's future expenditures in this area, and some may have tentative funding. The recurrent figures are taken as net of any cost recovery.

Large budgets are allocated to forestry surveys, which are expensive to conduct and need to cover large areas. Ideally more should be spent on the surveying of ecosystems, but the costs of some of the surveys could not be estimated.

In terms of education and public awareness additional budgets (reported in Table 6.5) have been proposed for several institutions, including universities. The activities they support are referenced to Tables 5.2.1 to 5.2.4. They also include the costs of additional training. More details on the training component are given in the Annex to this Main Report that deals with Research and Training (see contents).

The staff needed to conduct the work will not all be available in Kenya and expatriates will also be required. There has been no assessment of manpower needs for the programmes as such, although that should be carried out. This would especially be true on the socio-economic surveys.

Table 6.6 covers activities in forestry, water resources, *ex-situ* conservation and microbial collections. Nothing is proposed for wildlife where it is felt that absorbtive capacity has been reached for the time being. The large programmes are in

TABLE 6.3: BIODIVERSITY EXPENDITURE BY NGOs

ALL VALUES ARE IN THOUSANDS OF US DOLLARS (1991). RECURRENT AND DEVELOPMENT EXPENDITURES

CATEGORY	NGO	{CURRENT EXPENDT} 1989/90	ADDITIONAL EXPENDT 1990/93	SOURCE OF FUNDING		
				PRIVATE	BILATERAL	MULTI LATERAL
1.4 OTHER ECOSYSTEMS	KFFH	40	140	X	X	
1.6 SPECIES						
1.6.1 ANIMALS	WWF	30	90	X	X	
1.6.1 ANIMALS	WCI	30	90	X		
1.6.2 PLANTS	ACTS (a)	70	180	X	X	X
2.1 BIODIVERSITY RESEARCH						
2.1.1 ANIMALS	WCI	130	420	X		
2.1.1 ANIMALS (ALSO 3.6.1)	WCK (a)	70	510	X		
2.1.2 PLANTS	ACTS (a)	40	120	X	X	X
2.2 SOCIOECONOMIC RSCH. (ALSO 2.4)	ICRAF	7680	23040	X	X	X
2.5 PUBLIC AWARENESS	WWF	170	510			
2.5 PUBLIC AWARENESS	KFFH	40	170	X	X	
2.5 PUBLIC AWARENESS	KGG (a)	30	90	X	X	
3.3 OTHER THREATENED HABITATS	ICRAF	3840	11520	X	X	X
3.4 OTHER ECOSYSTEMS	KFFH	30	120	X	X	
3.6 SPECIES						
3.6.1 ANIMALS	WCI	60	180	X		
3.6.1 ANIMALS	WWF	370	1110	X	X	
3.6.2 PLANTS	ACTS (a)	30	90	X	X	X
		12660	38380			

(a) ALSO RECEIVES FUNDS FROM GoK AND OTHER NGOS

TABLE 6.4: ADDITIONAL FUNDING REQUIREMENTS FOR THE NEXT THREE YEARS
ALL FIGURES ARE IN THOUSANDS OF US$ (1991 PRICES).

SURVEYS AND INVENTORIES FOR BIODIVERSITY CONSERVATION

ACTIVITY NO a/	DESCRIPTION	AGENCY	FUNDING REQUIRED			SOURCE/NOTES
			DEVLPMNT	RECRNT	TOTAL	
3	SOCIO-ECONOMIC SURVEYS b/	FD	6953	1766	8719	WB FORESTRY SECTOR REPORT EXTRAPOLATED
4	FLORISTIC SURVEYS	NMK	68	230	298	BRP OF NMK - PLANT ECOLOGY
5	ETHNOBOTANCIAL SURVEYS	NMK/KIRDI	59	144	203	BRP OF NMK - ETHNOBOTANY
7	ADDITIONAL FISHERIES SURVEYS	NMK	67	201	267	BRP OF NMK - ICHTHYOLOGY
8	ESTAURINE MANGROVE ECOSYSTEMS		NA	NA	NA	
9	MARINE AND FESHWATER MICROBES		NA	NA	NA	
10	AQUACULTURE SITES SURVEYS		NA	NA	NA	
11	FRESHWATER ECOSYSTEMS	WWF	39	NA	39	LAKE NAKURU MONITORING SYSTEM
12	PROPOSED RESEARCH INVENTORY ON WILDLIFE	KWS	70	43	113	OWN ESTIMATES
13	REMOTE SENSING FOR WILDLIFE MONITORING	KWS/DRSRS				NOT SEPARATED OUT - SEE RESEARCH SECTION
14	SOCIOECONOMIC SURVEYS RELATING TO WILDLIFE	NMK/KWS/NGO	250	500	750	OWN ESTIMATES
15	DATA BANK ON BIODIVERSITY IN KENYA	NMK	560	440	1000	OWN ESTIMATES
16	OTHER BIOLOGICAL SURVEYS	NMK	377	128	505	BRP OF NMK - AQUATIC BOTANY/HERPETOLOGY
	TOTAL		8443	3451	11894	

Notes: a: The activity number refers to Table 5.1

TABLE 6.5: ADDITIONAL FUNDING REQUIRMENTS FOR THE NEXT THREE YEARS

ALL FIGURES ARE IN THOUSANDS OF US$ (1991 PRICES).

RESEARCH TRAINING EDUCTATION AND PUBLIC AWARENESS

ACTIVITY AS GIVEN IN TABLES 5.2.1 TO 5.2.4				AGENCY	FUNDING REQUIRED		
5.2.1	5.2.2	5.2.3	5.2.4		DEVLPMNT	RECRNT	TOTAL
8	1-14,18		4	KARI	1449	533	1982
	16,17	3,8		KEMRI	22	47	69
	18		4	KETRI	8	16	24
		1-8		KEMFRI	91	277	368
4,8		2	1,5	KWS	710	290	1000
1-6, 8			1	KEFRI	193	117	310
7,8	20	2,6,4	2,4	NMK	1233	468	1701
				MET. R & T	0	24	24
8		2		DRSRS	507	148	655
	19			MOA	0	69	69
	15			CRF	0	10	10
	15			TRF	0	1	1
	7,16,17,18	1,3,7,8	5	UNIVERSITIES	0	277	277
				NCST (a)	0	41	41
8				DROUGHT M. CENTRE	0	5	5
			TOTAL		4212	2323	6535

TABLE 6.6: ADDITIONAL FUNDING REQUIRMENTS FOR THE NEXT THREE YEARS
ALL FIGURES ARE IN THOUSANDS OF US$ (1991 PRICES).

PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS

ACTIVITY NO a/	DESCRIPTION	AGENCY	FUNDING REQUIRED DEVLPMNT	RECRNT	TOTAL	SOURCE/NOTES
3	EXTENSIONS TO INDIGENOUS FORESTRY	FD	3861	9072	12933	ASSUMES ALL FORESTS ARE COVERED OVER 10 YRS
4	PROTECTION OF ECOLOGICALLY SENSITIVE FOREST AREAS (b)	FD/KWS	981	2306	3287	BASED ON KWS ESTIMATES OF COSTS OF PROTECTION
6	INCREASED PROTEC'N OF INLAND WATER RESOURCE	KWS	NA	NA	755	AS NO 4 FOR LAKES TURKANA, VICTORIA AND BARINGO
7,8	PATROLLING IN SITU FISH BREEDING GROUNDS	FISHERIES DEPT	71	154	226	LAKE VICTORIA BREEDING GROUNDS. TEAM DATA
9	PROTECTION OF WETLANDS FROM DEVELOPMENT	MOA	0	4143	4143	OPPORTUNITY COST OF CULTIVATION (YALA)
10	PROD'N AND MKT'ING OF INDIGENOUS FRUITS/VEG.	KIRDI	96	164	260	2 YEAR PROJECT
11	EX SITU CONSERVATION OF PLANTS SPECIES	NMK/FD	258	172	429	NMK COSTS OF HERBARIUM
12	EX SITU CONSERVATION OF TREE SPECIES	FD	2506	701	3207	COSTS OF 100 HA EX-SITU FACILITY
13	EX SITU CONSERVATION OF ENDEMIC FISH IN LAKE VICTORIA (b)	LAKE BASIN DEV. AUT.	57	122	179	COST OF LARGE SCALE FISH POND
	AQUARIUM AT MOMBASA (c)	NMK	14000	-900	13100	NMK'S ESTIMATES
18	SETTING UP OF COORDINATING UNIT (NBU)	NMK	500	900	1400	TEAM ESTIMATES
19	1 MICROBIAL CULTURE COLLECTION CENTRE	UNIVERSITY	1990	3540	5530	DETAILS IN MICROBES ANNEX
19	MICROBIAL RSRCH INSTITUTE	UNIVERSITY	3250	6060	9310	DETAILS IN MICROBES ANNEX
19	WILDLIFE MICROBES CONSERVATION LAB.	UNIVERSITY	260	393	653	DETAILS IN MICROBES ANNEX
	TOTAL		27830	26827	55412	

Notes: a: The activity number refers to Table 5.3
b: in these cases no breakdwn of costs between recurrent and capital was not available.
For completeness a percentage breakdown for similar projects was taken
Where a number in Table 5.3 is not referred to here it is because there are no data, or there is no programme.

indigenous forestry, the setting up of an aquarium and microbial collection centres. The protection of one wetland from development has been valued in terms of the cost of the lost output. This is not a financial cost, but assumes that GoK would set aside a similar amount for the employment investment of the people who would have used that land. In general the costs do not include opportunity costs as such, but in most programmes where there is any relocation of people, or where access to land resources is to be limited, there is an element of provision of assistance to the groups involved.

6.5 CONCLUSIONS

This Chapter has attempted to answer the UNEP guidelines on the costs of biodiversity conservation. The answers are incomplete for reasons of lack of data and time available to collect that which exists. Nevertheless there are some interesting findings. Expenditure on biodiversity related items is expected to run at around $91 mn, of which $12.6 mn would be by NGOs and the balance by GoK. The role of the private sector could not be quantified, although some effort in that direction in the future would be worthwhile. In the opinion of the team, an additional expenditure of $24.6 mn per annum is needed for the next three years. Of this about $14 mn is development, and could be funded directly under donor assistance or increased foreign NGO activity. The remainder would make a major claim on a limited GoK budget and is unlikely to be forthcoming. Hence if the requirements of a biodiversity convention are to be met, some of this recurrent cost funding will have to be sought from outside Kenya.

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA I: SURVEYS, INVENTORIES, IDENTIFICATION AND AUTHENTIFICATION OF BIODIVERSITY. DEVELOPMENT EXPENDITURES

TABLE 1A: DEVELOPMENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXP'TURE GOK	FUNDING FOR GOK EXPENDITURE BI-LATERAL	MULTI-LATERAL	NATIONAL	PROP. BUDGET 1991-1993 GOK	FUNDING FOR PROPOSED EXP. GOK	BI-LATERAL	MULTI-LATERAL
1.1 NATIONAL PARKS	Satellite Imagery		0	0	0	0	17642	17642	0	0
1.2 FOREST RESERVES	Planned Inventory	Environment	0	0	0	0	8777298	482751	8294546	0
1.3 OTHER THREATENED HABITATS	Resource Surveys & Remote Sensing	Planning	0							
1.4 OTHER ECOSYSTEMS										
1.5 EX-SITU FACILITIES										
1.6 SPECIES										
1.6.1 ANIMALS	Fisheries Surveys	Regional Dev.	2694	0	0	2694	19357	19357	0	0
1.6.2 PLANTS										
1.6.3 MICROBES										
1.7 ACQUIRING/DEVELOPING TECHNOLOGY										
TOTAL			2694	0	0	2694	8814297	519750	8294546	0

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA I: SURVEYS, INVENTORIES, IDENTIFICATION AND AUTHENTIFICATION OF BIODIVERSITY. DEVELOPMENT EXPENDITURES

TABLE 1B: RECURRENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXPENDITURES			1991-1993 PROPOSED NET BUDGET		
			GROSS GOK EXP.	REVENUE	NET EXP. BY GOK	GROSS EXP.	REVENUE	NET EXP. BY GOK
1.1 NATIONAL PARKS	Satellite Imagery	Wildlife	0	0	0	0	0	0
1.2 FOREST RESERVES	Planned Inventory	Environment				442202	0	442202
1.3 OTHER THREATENED HABITATS	Resource Surveys & Remote Sensing	Planning	633509	10712	622797	2260071	0	2260071
1.4 OTHER ECOSYSTEMS								
1.5 EX-SITU FACILITIES								
1.6 SPECIES								
1.6.1 ANIMALS								
1.6.2 PLANTS								
1.6.3 MICROBES								
1.7 ACQUIRING/DEVELOPING TECHNOLOGY								
TOTAL			633509	10712	622797	2702273	0	2702273

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA II: RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS.

TABLE 2A: DEVELOPMENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	EXP'TURE 1990	FUNDING FOR GOK EXPENDITURE			PROP. BUDGET 1991-1993	FUNDING FOR PROPOSED EXP.		
			GOK	BI-LATERAL	MULTI-LATERAL	NATIONAL	GOK	GOK	BI-LATERAL	MULTI-LATERAL
2.1 BIODIVERSITY RESEARCH										
2.1.1 ANIMALS	Wildlife Research	Wildlife	0	0	0	0	4316000	863200	1510600	1942200
	Fisheries Status	Regional Dev.	13169	0	0	13169	41442	41442	0	0
	Marine & Fish Research	Research S&T	120343	0	0	120343	785728	579095	0	206633
	Vet. Research (KARI)	Research S&T	16018	0	0	16018	687368	312352	360636	14379
	Animal Prod. Research	Research S&T	25137	0	2349	22788	666341	439096	146956	80289
2.1.2 PLANTS	Forest Rsrch. (KEFRI)	Research S&T	569757	0	0	569757	4947269	1297997	0	3649272
	Horticulture Research	Research S&T	958439	1384	49365	907690	6143884	3842178	1030467	1271240
	Seed Quality Control	Research S&T	15356	6999	0	8357	159476	25031	134445	0
	Medical Research	Research S&T	29996	0	0	29996	153244	61784	91460	0
	Indigenous Fruit & Veg	Research S&T	47914	0	16371	31544	923976	113582	0	810394
2.1.3 MICROBES	Trypanosomiasis Rsrch	Research S&T	214290	0	0	214290	426332	426332	0	0
2.1.4 OTHER ECOSYSTEMS	Nat. Council Of S & T	Research S&T	0	0	0	0	0	0	0	0
	Soil & Water Research	Research S&T	489325	73442	408000	7883	5193152	1475471	845162	2872519
	Range/Arid Land Rsrch	Research S&T	52640	24333	28270	37	2667721	471571	0	2196150
2.2 SOCIOECONOMIC RSCH.										
2.3 EDUCATION/TRAINING	Education & Extension	Wildlife	11031	0	0	11031	5477000	1095400	1916950	2464650
	Livestock Information	Livestock Dev.	0	0	0	0	0	0	0	0
	Afforestation Extension	Ministry	2761303	0	0	2761303	9231137	9231137	0	0
2.4 TECHNICAL TRAINING										
	Naivasha Training Inst.	Wildlife	403932	0	0	403932	412381	412381	0	0
	Animal Health Training	Livestock Dev.	5980	0	0	5980	34278	34278	0	0
2.5 PUBLIC AWARENESS										
TOTAL			5734630	106158	504355	5124117	42266728	20722326	6036676	15507726

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA II: RESEARCH, TRAINING, EDUCATION AND PUBLIC AWARENESS.

TABLE 2B: RECURRENT EXPENDITURE. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXPENDITURES			1991-1993 PROPOSED NET BUDGET		
			GROSS GOK EXP.	REVENUE	NET EXP. BY GOK	GROSS EXP.	REVENUE	NET EXP. BY GOK
2.1 BIODIVERSITY RESEARCH								
2.1.1 ANIMALS	Wildlife research	Wildlife	107310	0	107310	3016000	0	3016000
	Fisheries Research	Regional Dev.	150086	14442	135644	428663	83277	345386
	Marine & Fish Research	Research S&T	1656762	8357	1648405	5181368	3698	5177670
	Vet. Research (KARI)	Research S&T	261087	4465	256621	4338824	56232	4282592
	Animal Prod. Research	Research S&T	254230	28802	225428	3918218	367774	3550444
2.1.2 PLANTS	Forest Conservation	Research S&T	8900	0	8900	30222	0	30222
	Silviculture	Research S&T	7988	0	7988	34457	0	34457
	Horticulture Research	Research S&T	2160682	126298	2034385	6930217	293623	6636594
	Seed Quality Control	Research S&T	78032	27882	50151	1124548	75006	1049542
	Forest Research	Research S&T	1951318	12536	1938782	6057424	32130	6025294
	Forest Prdts Research	Research S&T	291	0	291	16655	0	16655
	Medical Research	Research S&T	174882	510	174372	450074	1446	448628
	Indigenous Fruit & Veg	Research S&T	141199	0	141199	397767	865	396902
2.1.3 MICROBES	Trypanosomiasis Rsrch	Research S&T	986500	2298	984202	3251996	8785	3243211
2.1.4 OTHER ECOSYSTEMS	Nat. Council Of S & T	Research S&T	87301	0	87301	249915	0	249915
	Soil & Water Research	Research S&T	333080	954	332126	1041749	2765	1038984
	Range/Arid Land Rsrch	Research S&T	480590	21532	459058	1710707	58544	1652163
2.2 SOCIOECONOMIC RSCH.								
2.3 EDUCATION/TRAINING	Education & Extension	Wildlife	76832	0	76832	1956000	0	1956000
	Livestock Information	Livestock Dev.	10410	0	10410	157080	0	157080
	Afforestation Extension	Environment	0	0	0	0	0	0
2.4 TECHNICAL TRAINING	Naivasha Training Inst.	Wildlife	293896	22507	271389	996026	67762	928264
	Animal Health Training	Livestock Dev.	74801	5439	69362	263764	3829	259935
	Fisheries Training Inst.	Regional Dev.	47281	0	47281	114865	0	114865
	Forestry Training Inst.	Environment	220919	18804	202115	698957	5764	693193
2.5 PUBLIC AWARENESS	O/seas Tourism Prom.	Wildlife	1577888	0	1577888	5213526	0	5213526
	Domestic Tourism Prom	Wildlife	177554	0	177554	1103548	0	1103548
	Wildlife Trustee Board	Wildlife	2000	0	2000	8348	0	8348
TOTAL			11321818	294825	11026993	48690918	1061500	47629418

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA III: PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS.

TABLE 3A: DEVELOPMENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	FUNDING FOR GOK EXPENDITURE				PROP. BUDGET	FUNDING FOR PROPOSED EXP.		
			GOK	BI-LATERAL	MULTI-LATERAL	NATIONAL	1991-1993 GOK	GOK	BI-LATERAL	MULTI-LATERAL
3.1 NATIONAL PARKS	Grants to County Cncls	Wildlife	28832	0	0	28832	347332	347332	0	0
	District W'life Services	Wildlife	64734	0	0	64734	16100000	3220000	5635000	7245000
	Management of Parks	Wildlife	90490	0	0	90490	46467000	9293400	16263450	20910150
	Anti-Poaching Unit	Wildlife	8236	0	0	8236	13729000	2745800	4805150	6178050
3.2 FOREST RESERVES	Forestry Plantation Dev	Environment	8833932	0	205	8833727	25360398	23738502	1621896	0
	HQ Forestry Dvpment	Environment	0	0	0	0	23498582	18544146	3747257	1207179
	Local Aforestn Schemes	Environment	987469	0	0	987469	3427041	3427041	0	0
	Road Constn Unit	Environment	202799	0	0	202799	616680	580966	0	35714
3.3 THREATENED HABITATS	Machakos Intg Project	Environment	13763	0	0	13763	452865	0	0	452865
	Ntnl Anti-Desertification	Environment	68830	0	0	68830	664854	416009	0	248845
	Reclamation/Dev. ASAL	ASAL	1295249	1049519	38069	207661	10441879	2778752	6161941	1501186
3.4 OTHER ECOSYSTEMS	Rngelnd Dev. Services	Livestock Dev.	32940	0	0	32940	2237317	117403	1232375	887539
	ASAL Forestry Dev.	Environment	257154	0	0	257154	4134905	590434	0	3544471
3.5 EX-SITU FACILITIES	Genebank	Research S&T	0	0	0	0	474374	82777	391597	0
	National Museums Grnt	Home Affairs	47889	0	39466	8423	685624	20470	0	665154
	Arboretum	Local Govt								
3.6 SPECIES										
3.6.1 ANIMALS	Livestock Dev. Project	Regional Dev.	28313	0	28313	0	31628	0	0	31628
	Lake Basin Dev. Auth. (Fish and Bee Keeping)	Regional Dev.	25071	0	0	25071	1383041	456161	530262	396618
	Fisheries Stations	Regional Dev.	125322	0	0	125322	2715649	780241	1935408	0
	Fisheries Reg. Centres	Regional Dev.	7420	0	0	7420	28194	5694	22500	0
	Hides & Skins Imp.	Livestock Dev.	0	0	0	0	360247	0	0	360247
	Vet. Investigation Labs	Livestock Dev.	342221	0	281471	60750	880318	264619	264924	350775
	Animal Health Rehab.	Livestock Dev.	3486224	0	2482168	1004056	8301346	6954203	0	1347143
3.6.2 PLANTS	Horticultural Prog.	Regional Dev.	6268	0	0	6268	128125	43911	50019	34195
3.6.3 MICROBES	Pest Control	Livestock Dev.	1249967	0	27523	1222444	5441176	5155462	0	285714
3.7 PLANNING AND OTHER ACTIVITIES	Administration & HQ	Research S&T	0	0	0	0	0	0	0	0
	Administration & HQ	Livestock Dev.	440338	0	297154	143184	562282	424871	15026	122385
	Administration & HQ	Regional Dev.	122	0	0	122	322	322	0	0
	Administration & HQ	Environment	9383	0	0	9383	6589	6589	0	0
	Forestry Master Plan	Environment	0	0	0	0	5509301	0	5509301	0
	Administration & HQ	Home Affairs	10	0	0	10	405	405	0	0
	Administration & HQ	Wildlife	96546	0	0	0	3167261	1317681	1200916	648664
	W'life Cons. & Mngmnt.	Wildlife	764250	0	394179	370071	12098000	2419600	4234300	5444100
TOTAL			18513772	1049519	3588548	13779159	173986474	79995510	48186106	45804858

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREA III: PREPARATION AND IMPLEMENTATION OF CONSERVATION MANAGEMENT STRATEGIES AND PLANS.

TABLE 3B: RECURRENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXPENDITURES			1991-1993 PROPOSED NET BUDGET		
			GROSS GOK EXP	REVENUE	NET EXP. BY GOK	GROSS EXP.	REVENUE	NET EXP. BY GOK
3.1 NATIONAL PARKS	District W'life Services	Wildlife	1878389	0	1878389	9505000	20166486	-10661486
	Management of Parks	Wildlife	1641122	1164264	476858	22832000	56358689	-33526689
	Anti-Poaching Unit	Wildlife	464936	348	464588	12049000	0	0
3.2 FOREST RESERVES								
3.3 THREATENED HABITATS	Ntnl Anti-Desertification	Environment	227003	0	227003	1115666	0	1115666
	Reclamation/Dev. ASAL	ASAL	739806	0	739806	2358639	0	2358639
3.4 OTHER ECOSYSTEMS	Rngelnd Dev. Services	Livestock Dev.	55806	449	55357	423566	1735	421831
	Presd ntl Commission	Office of Psdnt	114294	0	114294	444731	0	444731
3.5 EX-SITU FACILITIES	National Museums Grnt	Home Affairs	621324	0	621324	2491626	0	2491626
	Arboretum	Local Govt						
3.6 SPECIES								
3.6.1 ANIMALS	Fisheries Reg. Centres	Regional Dev.	339001	0	339001	690393	38429	651964
	Hides & Skins Imp.	Livestock Dev.	413842	4222	409620	2770177	87087	2683090
3.6.2 PLANTS	Pesticide Pdt. Control	Agriculture	46478	100	46378	318576	73287	245289
3.6.3 MICROBES	Tsetse & Pest Control	Livestock Dev.	1402693	162689	1240004	9351637	1097313	8254324
3.7 PLANNING AND OTHER ACTIVITIES	Administration & HQ	Research S&T	259874	0	259874	715414	0	715414
	Administration & HQ	Livestock Dev.	560436	4935	555501	1089609	975	1088634
	Administration & HQ	Regional Dev.	269212	0	269212	267637	0	267637
	Administration & HQ	Agriculture	45885	2358	43527	154731	359	154372
	Administration & HQ	Environment	739973	61801	678172	2241557	42005	2199552
	Forestry Master Plan	Environment	0	0	0	473699	0	473699
	Administration & HQ	Home Affairs	18436	0	18436	52023	0	52023
	Administration & HQ	Wildlife	1313951	14261	1299690	4025382	25171	4000211
	W'life Cons. & Mngmnt.	Wildlife	2312904	0	2312904	2830000	0	2830000
TOTAL			13465365	1415427	12049938	76201063	77891536	-1690472

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREAS IV: MONITORING OF WORLD STATUS OF BIODIVERSITY

TABLE 4: RECURRENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXPENDITURE			1991-1993 PROPOSED NET BUDGET		
			GROSS GOK EXP.	REVENUE	NET EXP. BY GOK	GROSS EXP.	REVENUE	NET EXP. BY GOK
4.1 ECOLOGICAL MONITORING	Deep Sea Monitoring	Regional Dev.	2187	0	2187	238839	0	238839
TOTAL			2187	0	2187	238839	0	238839

ANNEX IX: CURRENT MULTILATERAL BILATERAL AND NATIONAL FINANCIAL SUPPORT FOR BIODIVERSITY CONSERVATION AND UNMET FINANCIAL NEEDS IN RESPECT OF PRIORITY AREAS.

PRIORITY AREAS VIII: NATIONAL CAPACITY FOR BIOTECHNOLOGY AND TRANSFER OF TECHNOLOGY

TABLE 5: DEVELOPMENT EXPENDITURES. ALL VALUES ARE IN CURRENT DOLLARS (1991).

CATEGORY	MEASURES	MINISTRY	1990 EXP'TURE GOK	FUNDING FOR GOK EXPENDITURE BI-LATERAL	MULTI-LATERAL	NATIONAL	PROP. BUDGET 1991-1994 GOK	FUNDING FOR PROPOSED EXP. GOK	BI-LATERAL	MULTI-LATERAL
8.1 DEVELOPMENT OF TECHNOLOGY	Biotech. Vet Research	Research S&T	0	0	0	0	78497	73497	0	5000
TOTAL			0	0	0	0	78497	78497	0	5000

CHAPTER 7

BENEFITS OF BIODIVERSITY CONSERVATION

7.1 INTRODUCTION

Chapter 6 has presented the net financial costs (incorporating direct revenues from the projects, where applicable) of implementing additional programmes outlined in Chapter 5. The purpose of this Chapter is to highlight the wider economic benefits of such programmes.

In the time allocated for this study no attempt to value the economic benefits from the implementation of the additional programmes outlined in Chapter 5 has been possible. Therefore, the discussion focuses on the various types of benefits relevant to each programme and the issues that these involve. As a result of the non-quantification of benefits, Annex 10 of the UNEP guidelines could not be completed.

Two general points are worthy of note at this stage:

(a) What is important for Kenya in terms of conserving biological diversity may not be the same as for the rest of the world. For example, the North and South Nandi forests represent remnants of Guinean-Congolian forests of which this is one of the few surviving examples remaining in Kenya. However, this type of forest is also found in abundance in Uganda, so the loss of this biodiversity is not serious from an international perspective. Kenya could lose all its forest of this type and, from an international point of view it would not be a problem. Therefore, what is a priority for Kenya may not turn out to be a priority for the world. The same applies, to some extent to the conservation of much of the charismatic megafauna, that attracts many visitors to the country;

(b) there is a growing consensus that attempting to value the wider economic benefits of conserving biological resources is not an necessary condition for securing funding for such projects. The Tana River Biodiversity Project is a case in point. The GEF have stated that a cost benefit analysis of the environmental aspects are not a prerequisite for funding for the project.

7.2 TYPES OF ECONOMIC BENEFITS FROM BIODIVERSITY

The benefits generated from biodiversity can be divided into those that relate to the current use of the services that biodiversity provides, those that relate to future use, and those that flow from the mere existence of these resources. In technical terms the

first categories is called current user values, the second future user values and the third existence values. In the first two categories, it is necessary to distinguish between user values that generate a flow of income or expenditure, and those that do not.

Where there are income flows associated with benefits, the measures proposed should generate changes in these flows. Thus if, for example, one benefit of a conservation policy is to increase the numbers of wildlife, which in turn will lead to increased tourism revenue, those benefits are measured in terms of the net income generated. Although this is possible in principle, it cannot be done accurately without more information on the determinants of the demand for tourism. However, in those cases where GoK has estimated (albeit in a rough way) revenues they have been taken into account in calculating the net costs of the programmes (this applies principally to wildlife benefits). In other words, the costs reported are net of any identifiable revenues that biodiversity conservation might generate. Areas where there should be benefits of this kind, but which ave not been estimated include forestry (increased forest products), horticulture, and research in the utilisation of indigenous and exotic plants and animals within the country (including biotechnology). However, it is difficult to value such benefits in monetary terms. The best that can, and has been, attempted is an indication of the likely importance of different programmes in judgmental terms.

In the case of future values, one needs to distinguish between the present money value of future benefits, and the expected net incomes that will be generated by the activities in the future, discounted back to the present. Thus saving a tropical forest may generate revenue in the form of future forest products. There is some uncertainty about the size of these benefits, and it is frequently the practice that an expected or average value is taken both with and without a conservation programme. However, the present value of these benefits could be more than just this average value because of the uncertainty that is avoided if the resource is preserved. The difference between the expected future value and the amount that people would be willing to pay to conserve the forest now is the option value. Where it arises, it should be taken into account.

Benefits that do not generate direct cash revenues, are even more difficult to measure. In some cases there are related economic benefits, and they can be measured. This is the case for example with conservation measures that reduce erosion, or measures that increase fish yields. In other cases the benefits are less easily identified but nevertheless real. An example would be protection of habitats, where the linkages with economic activities are much more difficult to identify.

Finally there are the existence benefits. Research in other countries has shown that the size of these benefits, which relate to the intrinsic value of objects, can be very large. They can be partially estimated by questionnaire (or contingent valuation) methods, asking people what they are willing to pay to conserve something that they

will never use or enjoy by visiting the site. (Pearce, Barbier and Markandya (1991)). Furthermore much of the value os in the developed countries for resources that exist in developing countries such as Kenya. The difficulty with this approach is that (a) the estimates are only partial and not available for most countries and species, (b) there are conceptual problems in isolating the value of individual species and measures for conservation in this way.

This study has not been able to do more than indicate the nature of the benefits that arise in the measures proposed. This does not mean that in future an attempt at quantification should not be made; rather it shows the need for such quantification. Listed below are some of the likely benefits from the proposed activities.

7.3 BENEFITS OF PROPOSED ACTIVITIES

7.3.1 Surveys, Inventories and Authentification of Biodiversity

The major objective of this group of programmes is to provide the relevant information with which to formulate conservation management strategies and plans (Priority Area III). The economic benefits of such programmes therefore will be realised by the implementation of management strategies that are based on information gathered from these activities.

The additional programmes may be split into two types:

(a) those that focus on inventories of species of flora and fauna that occur in Kenya;

(b) those that focus on gathering information on the socio-economic dimensions of utilisation and indigenous knowledge of biological resources.

Inventories

Valuing knowledge of the types of fauna and fora and the genetic diversity of species is impossible to quantify. However, it clearly has value and increasing ecological knowledge may be regarded as an increase in intellectual capital. This capital may then be drawn upon in the future and so has a supply side option value (UNEP Guidelines, P.36). The use of increased knowledge may not be known or realised at present but rather at some point in the future.

In the case of the monitoring product proposed for Lake Nakuru, the future option value is succinctly stated in the project proposal document:

> The potential it holds for scientific research and the advancement of knowledge, especially in the fields of saline lake ecology, geology and wildlife management have yet to be exploited.

Socio-Economic and Indigenous Knowledge Surveys

The results of such surveys will provide information on the perceived benefits that local communities have for their natural resources. These will comprise direct use values as well as future option values. This information is invaluable when formulating conservation management strategies that involve the participation of these communities.

The forestry inventories may have economic benefits in terms of the discovery of new species of flora and fauna that may yield direct use values. Given the uncertainty associated with these benefits, much of the value resides in the options that are opened up in the future. Hence option value is an important component of this activity.

Similar remarks apply to the socio-economic surveys may well have wide reaching economic benefits in the long-term. The results of such surveys will promote the formulation of programmes that will ensure participation and co-operation of communities involved with such projects. This will lead to long-term viability and possibly equity both intra and inter generations.

7.3.2 Research, Training, Education and Public Awareness

Investing in research increases the opportunity of future option values being realised, as new methods of exploitation and new applications can be discovered from research into properties of species and ecosystems. This will lead to a greater understanding of the ecological processes which will improve criteria on which to base decisions as how we can modify and alter the natural world to yield us economic returns whilst still continuing to function and provide environmental services. Hence there are future user and option values involved.

7.3.3 Preparation and Implementation of Conservation Management Strategies and Plans

Forestry

Conserving Kenya's remaining forest resources will yield important long-term economic benefits. A large proportion of this forest is water catchment forest and the deforestation of these areas would lead to soil erosion, increased runoff, siltation and sedimentation of rivers and lakes. This would have significant economic costs on the ecology of these aquatic systems.

Whilst the economic returns from extracting timber and converting forest land to agriculture may be high in the short-term, the use of these fragile soils for agricultural production often leads to the depletion of soil nutrients and fertility. These limitations may be overcome by the introduction of more intensive methods of farming (chemical fertilisers) but in Kenya this is unlikely to occur because of lack of supply and credit for such inputs. What often happens is that when yields decline farmers abandon the plot and move to other areas.

In the long-term, conserving the forest is expected to yield much greater economic user benefits. As well as continuing to provide environmental services, policies of conservation that include the local participation and management of local communities, allow these communities to use the renewable forest resources in a sustainable manner. This has wider economic benefits for Kenya as a whole. Maintaining the integrity of traditional rural lifestyles and providing income generating opportunities from the utilisation of forests eg. the proposed butterfly farm in Arabuko-Sokoke, assists in preventing migration away from rural to urban areas.

The economic costs of not extracting timber or converting land to agriculture may appear to be greater than conserving the existing habitat and allowing the harvesting of natural resource products. Leaving aside the issue of other economic benefits of conserving habitats such as option values and consumptive and non-consumptive use values the conversion to agriculture may only provide economic returns for a limited number of years, after which the land becomes severely eroded and lacking in nutrients. At this stage the increased costs of production in terms of inputs of energy intensive fertilisers etc may be prohibitive or as is often the case in LDCs where the supply of these inputs is not available or farmers do not have credit or capital to purchase them the land is abandoned and so economic returns cease. Whilst direct use benefits from traditional land-uses may yield less financial rewards per annum, considering that these may continue indefinitely the benefits are very attractive, both from an environmental perspective as well as inter-generational perspective.

There are also important and potentially large option and existence values conserving forests. Internationally, many tourists will have the option of coming to Kenya at some point in the future to visit these indigenous forests, for nature trails, bird watching, butterflies and other flora and fauna. By conserving these resources the option is there for these to be visited in the future. Many people in developed countries would put a price on this future demand-side option value and mechanisms to assess this value may be the first phase of a programme to transfer resources from such countries to Kenya to assist with the costs of conserving these resources.

Marine and Freshwater

Stricter enforcement of pollution regulations (Table 5.3, Activity 5) will have direct economic costs for industries that presently discharge their effluent into rivers and lakes. This increase in cost will no doubt be passed on to consumers of the products. However, the current levels of pollution into the aquatic environment is having detrimental impacts on its genetic resources.

The protection of wetlands from conversion from agriculture has direct economic costs in terms of the revenue foregone from agricultural output (eg. Yala Swamp, see Table 6.6, Activity 9). The economic benefits from maintaining the swamp in terms of conserving biodiversity relates to the role that wetlands play in providing breeding grounds for migratory birds. As well as the intrinsic value of conserving species of

birds, some species will generate non-consumptive use value, eg. flamingoes and pelicans which breed in Lake Elementaita. Tourist revenue is generated from the existence of these birds as many people come to Kenya to see them. (This is also the case of bird species in general). However, despite breeding in Lake Elementaita flamingoes spend most of the time in Lake Nakuru where the cyanophyte blue-green, Spirulina platensis is the main food of the flamingoes. Consequently, the benefits to Kenya from the presence of these birds do not accrue to those who carry out economic activity around Lake Elementaita particularly farming. This activity is putting pressure on the lake's ecology from siltation and sedimentation as well as agricultural runoff, thereby altering the ecology and perhaps a decline in flamingo numbers. Until such benefits are transferred to farmers there will continue to be pressure on the resource.

There are wider "biodiversity" benefits of conserving wetlands (as highlighted in Chapter 3.4.6) including their role as nurseries for aquatic reproduction and wildlife refuges for sitaunga, hippos and crocodiles.

As well as the direct "biodiversity" benefits that accrue from conserving wetlands, there are other indirect benefits from the conservation of these habitats. Wetlands provide an important environmental service by purifying water and runoff regulation.

Ex-Situ

The economic benefits accruing from the conservation of biological resources in ex-situ facilities are mainly in the area of future use and option values. *Ex-situ* conservation has future option values in that the species preserved may be used at some point in the future for rehabilitating original sites, thereby creating the possibility of recreating habitats.

Wildlife

Kenya, as noted in Chapter 3, is not characterised by abundant biodiversity compared with other countries. However, wildlife biodiversity is particularly lucrative in terms of revenues generated from its exploitation, particularly tourist revenue. Therefore, it is potentially easier for Kenya to conserve these resources as the direct use values are so great and consequently justification for conservation doesn't have to rely on intangibles such as option and existence values as the only justification for conserving these biological resources.

Despite the potential revenues that could accrue to Kenya from game, these resources are coming under intense pressure and densities as well as habitats are declining at an alarming rate. This is partly due to the fact that those people and communities whose activities have a direct bearing on maintaining these ecosystems do not share fully in the economic benefits that they yield.

The pressures that dispersal areas are coming under from encroachment for agriculture (eg. wheat in the Maasi Mara dispersal area), will lead to a loss of economic benefit:

directly in terms of loss of revenue generated from tourism and the loss of a species diversity if these animals become extinct.

7.4 CONCLUSIONS

In the case of future values, one needs to distinguish between the present money value of future benefits, and the expected net incomes that will be generated by the activities in the future, discounted back to the present. Thus saving a tropical forest may generate revenue in the form of future forest products. There is some uncertainty about the size of these benefits, and it is frequently the practice that an expected or average value is taken. However, the present value of these benefits could be more than just this average value because of the uncertainty that is avoided if the resource is preserved. The difference between the expected future value and the amount that people would be willing to pay to conserve the forest now is the option value. Where it arises, it should be taken into account.

Benefits that do not generate direct cash revenues, are even more difficult to measure. In some cases there are related economic benefits, and they can be measured. This is the case for example with conservation measures that reduce erosion, or measures that increase fish yields. In other cases the benefits are less easily identified but nevertheless real. An example would be protection of habitats, where the linkages with economic activities are much more difficult to identify.

Finally there are the existence benefits. Research in other countries has shown that the size of these benefits, which relate to the intrinsic value of objects, can be very large. They can be partially estimated by questionnaire methods, asking people what they are willing to pay to conserve something that they will never use or enjoy by visiting the site. (Pearce, Barbier and Markandya (1991)). Furthermore much of the value os in the developed countries for resources that exist in developing countries such as Kenya. The difficulty with this approach is that (a) the estimates are only partial and not available for most countries and species, (b) there are conceptual problems in isolating the value of individual species and measures for conservation in this way.

This study has not been able to do more than indicate the nature of the benefits that arise in the measures proposed. This does not mean that in future an attempt at quantification should not be made; rather it shows the need for such quantification. In the absence of such estimates, a judgmental priority has to be made for the programmes proposed. In the team's view, the priorities indicated by the relative costs and benefits of the programmes is the following:

(i) the formulation of conservation strategies that incorporate local communities, and that make the necessary policy changes that are so essential for the success

of these programmes. The internationally important resources that need preservation are the coral reefs, which form a biodiversity hot spot second only to tropical rain forests; the regulation of areas high in endemism, such as the Kayas and the Tana River Primate Reserve; and the protection of the biotic communities. However, these are largely international concerns and the resources for their conservation should properly come from the international community;

(ii) from an international perspective, and a domestic point of view, many of the activities identified for data collection, surveying and monitoring are critical. Included in this group would be the floristic and wetland ecosystem inventories;

(ii) from a more domestic point it is important to increase the sustainable use of forests and to protect the catchment forests that are so important to sustainable agriculture. It is also important to increase knowledge of indigenous flora, and the enthno-botanical surveys address that. Finally the commercial exploitation of Kenya's biodiversity should not be forgotten. Often this conflicts with other development needs (eg wildlife and agriculture).

REFERENCES

This reference list is incomplete. A more complete list will be added to the final draft.

Asava, W.W.
Marine parks in Coastal Resources Management. Paper presented to a workshop on Management of Coastal and Offshore Resources in East Africa. IDS, Nairobi, 1977.

Barrow, ECG, (1991)
"Turkana Tree Rights. Issues of Natural resource Management and Policy Potentials and Conflicts". Mimeo.

Beentje, H. J., 1990, "The Forests of Kenya", In: Proceedings of the 12th plenary Meeting of AETFAT; Symposium II, Mitt. Inst. Allg. Bot. Hamburg, Band 23a, Hamburg. Pp. 265-286.

Bellhouse Mwangi Ernest and Young (1991)
"Kenya Wildlife Service:Revenue Sources Study." Nairobi.

Bilder, R.B. (1980),
"International Law and Natural Resources Policies", Natural Resource Journal, Vol20.

Casanelli. V. Lee
The Shaping of Somalia Society. University of Pennsylvania Press, USA. (1982)

Chambers, Robert (1983)
Rural Development: Putting the Last First. Longman Scientific and Technical. UK.

Daily Nation, Wednesday, December 4, 1991.p11.

Donella, H Meadows
Harvesting One Hundredfold (1989)

Douglas Hamilton, I and Associates (1988),
"Identification Study for the Conservation and Sustainable Use of the Natural Resources in the Kenya Portion of the Mara-Serengeti Ecosystem." Final Report funded by the European Economic Community.

Dutch Government (1991)
"The Impact of Intellectual Property Protection in Biotechnology and Plant Breeding on Developing Countries". Study Committee on biotechnology and intellectual property rights with respect to developing countries, The Netherlands.

FAO (1989)
Interpretation of the International Undertaking on Plant Genetic Resources, Food and Agriculture Organisation, Rome.

FAO (1991)
Biotechnology and Plant Genetic Resources and Elements of a Code of Conduct of Biotechnology, Commission on Plant Genetic Resources. Food and Agriculture Organisation,. Rome.

Fitzgerald, P.J., ed., (1966)
Salmond on Jurisprudence 12th Edition, Sweet and Maxwell, London.

Government of Kenya.
Country Paper for Eastern and Kenya Southern Africa Regional Consultation on Education for All, 1990, Nairobi.

Government Printers, 1983
Kenyan Government Development Plan, 1984 - 1988

Hammel, Charles, (1977)
Education Today for the Worlds of Tomorrow, UNESCO, Switzerland,

Hawksworth, D. L., 1991, The fungal dimension of biodiversity: magnitude, significance, and conservation. Mycological Research, 95, p641-655.

Hawksworth, D. L., 1992, Biodiversity Databases: The Crucial Significance of Collections. In "The Biodiversity of Microorganisms and Invertebrates: Its Role in Sustainable Agriculture". Ed. D. L. Hawksworth, CAB Intrnational.

Juma, C., (1989 (a))
The Gene Hunters: Biotechnology and the Scramble for Seeds, Zed Books, London and Princeton University Press, NJ, USA.

Juma, C., (1989 (b))
"Intellectual Property Rights for Biological Innovations", in
Juma, C., and Ojwang, J.B. eds., Innovation and Sovereignty: The Patent Debate in African Development, African Centre for Technology Studies, Nairobi, Kenya.

Juma, C., (1989(c))
Biological Diversity and Innovation: Conserving and Utilizing genetic resources in Kenya, African Centre for Technology Studies, Nairobi, Kenya.

Juma, C., and J.B.Ojwang, eds., (1989)
Innovation and Sovereignty: The Patent Debate in African Development, African Centre for Technology Studies, Nairobi, Kenya.

Kariithi, Nixon (1991),
"Wildlife Tourism Earns Sh5b for Kenya-Leakey." in Daily Nation. May 18, 1991.

Kenya Government, 1986
General Regulations and Syllabuses for Diploma Teacher Colleges, Ministry of Education, Kenya Institute of Education.

Kenya Wildlife Fund Trustees and United Nations Environment Programme (1988), People, Parks and Wildlife: Guidelines for Public Participation in Wildlife Conservation, Case Studies in Kenya. Nairobi.

Kenya Wildlife Service, 1990, A Policy Framework and Development Programme: 1991-1996, KWS, Nairobi.

Lange, P., (1985),
"The Nature of Plant Breeders' Rights (Plant Variety Protection Law) and their Demarcation from Patentable Innovations", Plant Variety Protection Gazette and Newsletter, No.44, pp. 1-27.

Marekia, Njeri (1990),
"Land Tenure and Wildlife Conservation: A Status Review. " Nairobi: African Centre for Technology Studies. Memographed.

Mathai, Wangari.
The Green Belt Movement

Ministry of Education, 1990.
Development of Education 1989 to 1990. Country report Kenya, presented at the International Conference on Education, Geneva 3 - 8 September 1990.

Ministry of Environment and Natural Resources.
Report of the GOK/UNEP/UNDP Project on Environment and Development 1981.

Ministry of Finance, Programme Review and Forward Budge, 1990/91 -1992/93.

Ministry of Regional Development, Fisheries Statistical Bulletin, Various Issues.

National Environment Secretariat, 1987:
Environmental Activities for Schools and Colleges in Kenya.

Njenga, Peter and Jenny Shepherd (1991),
"Kenya's Rhino Sanctuary is an example for Africa." in Daily Nation, Thursday, December 1991.

Nyamango, I.K. and Mutoro, H.W.
Culture and Environment , An Overview Unpublished paper presented at the Environment 2000 Conference Organised by KENGO, Nairobi, (1990)

Nyaga, Crispus R. J., 1991. Kenyan experiences in forest management: dry tropical forest. Technical Workshop to explore options for global forestry management. April, Bangkok 1991. Proceedings. p118.

Ojwang, J.B., (1989)
"A Regime for Protecting Inventions and Innovations", in Juma, C., and Ojwang, J.B., eds., Innovation and Sovereignty: The Patent Debate in African Development, African Centre for Development Studies, Nairobi, Kenya.

Pearce, David W. and R. Kerry Turner (1990),
Economics of Natural Resources and the Environment. Baltimore: The Johns Hopkins University Press.

Pearce, D.W. and J. Rose, eds (1975),
The Economics of Natural Resource Depletion. London and Basingstoke: The Macmillan Press Ltd.

Posey, D.A. (1991)
"Intellectual Property Rights for Native Peoples: Challenges to Science, Business and International Law" Mimeo.

Republic of Kenya, The Report of the National Committee of Educational Objectives and Policies, Government Printer, Nairobi, 1976.

Republic of Kenya, Development Plan, 1979 - 1983. Government Printers, Nairobi,(1979).

Republic of Kenya (1986),
Sessional Paper No 1 of 1986 on Economic Management for Renewed Growth. Nairobi: Government Printers.

Republic of Kenya, Development Plan, 1989/93. Economic Management for Renewed Growth, Sessional Paper No 1 of 1986. Statistical Abstract, Various Issues.

Republic of Kenya (1989),
Development Plan 1989 - 1993. Nairobi: Government Printers.

Republic of Kenya (1990),
Statistical Abstract, 1990. Nairobi: Government Printers.

Republic of Kenya (1991),
The Appropriation Accounts, Other public accounts and the Accounts of the Funds, for the Year 1989/90. Volume III. Nairobi: Government Printers.

Schoorl, J and Visser, N. Towards sustainable Coastal Tourism. Discussion Paper, June 1991.

Thibodeau, Francis R and Hermann H Field, eds.(1984),
Sustaining Tomorrow: A Strategy for World Conservation and Development. Hanover and London: University Press of New England.

UNCAT (1991),
Trade and Development Aspects and Implications of New and Emerging Technologies: The case of Biotechnology, United Nations Conference on Trade and Development , Geneva,

Switzerland.

UNCTAD (1975)
The Role of the Patent System in the Transfer of Technology to Developing Countries, United Nations Conference on Trade and Development , Geneva, Switzerland.

UNEP (1987)
Kenya National State of the Environment Report.

UNEP (1988)
People, Parks and Wildlife, Guidelines for Public Participation in Wildlife Conservation.

United Nations Environment Programme, 1991, Guidelines for the Preparation of Country Studies on Costs, Benefits and Unmet Needs of Biological Diversity Conservation within the Framwork of the Planned Convention on Biological Diversity.

UNEP (1990)
Relationship between Intellectual Property Rights and Access to Genetic Resources and Biotechnology, United Nations Environment Programme, Geneva, Switzerland.

UNEP (1991)
Third revised Draft Convention on Biological Diversity, United Nations Environment Programme, Geneva, Switzerland.

State of the Environment Report.
UNESCO
Environmental Education in the Light of the Tbilisi Conference, Paris 1980.

UNESCO, UNEP, KSTC.
National Workshop on Teacher Training in Environmental Education and Rational Utilization of Natural Resources 4-8 August 1986, Nairobi, Kenya.

United Nations Environment Programme (1991),
"Guidelines for the Preparation of Country Studies on Costs, Benefits and Unmet Needs of Biological Diversity Conservation within the Framework of the Planned Convention of Biological Diversity." UNEP/Bio.Div./Guidelines.

Vederaman, S., (1971),
"Patents: Recent Developments and Future Prospects On the National Level in India", WIPO Lectures, Montreaux.

Wildlife Conservation and Management Department (1988),
Tsavo Elephant Count 1988. Nairobi: Ministry of Tourism and Wildlife.

Worlds Bank (1991),
"Kenya: Protected Areas and Wildlife Services Project." Nairobi.

World Bank,

"Kenya Protected Areas and Wildlife Services Project", 1991.

Yankey, Sipa-Adpah G., (1987),
International Patents and Technology Transfer to Less Developed Countries, Atheneum Press Ltd., Newcastle-Upon-Tyne.

APPENDIX 1

THREATENED AND ENDEMIC ANIMAL AND PLANT SPECIES

Appendix 1: Threatened Animal Species.

Extinct Animal Species:

	EXTINCT		
Group	**Family**	**Species**	**Common Name**
	Cichlidae	*Oreochromis variabilis*	Cichlid
		Oreochromis melanopleura	Cichlid
	Centrarchidae	*Lepomis macrochirus*	Sunfish
	Characinidae	*Alestes victorianus*	Tigerfish
		Hydrocynus forskalii	Tigerfish
	Bovidae	*Kobus kob*	Kob
		Alcelaphus buselaphus lelwel	Lelwel Hartebeest

Endangered Animal Species:

Group	**Order/Family**	**Species**	**Common Name**
Invertebrata	Acarina	*Amblyomma rhinocerotis*	
		Amblyomma tholoni	
	Strombidae	*Strombus labiatus*	
Insecta	Lepidoptera		
		Papilo desmondi teita	Taita Blue-banded Papilo
Fish	Cichlidae	*Oreochromis esculentus*	cichlid
	Bagridae	*Bagrus bayad*	catfish
		Bagrus degeni	
		Bagrus docmac	
		Bagrus urostigma	
	Characinidae	*Alestes affinis*	tigerfish
		Alestes baremose	
		Alestes dentex	
		Alestes imberi	
		Alestes minutus	
		Alestes nurse	
		Alestes sadleri	
		Alestes terox	
		Citharinus citharinus	
		Citharinus intermedius	
		Distochodus niloticus	
		Hydrocynus lineatus	
		Petersius tangeris	
	Clariidae	*Clarias alluaudi*	mudfish
		Clarias anguillaris	
		Clarias lazera	
		Clarias mossambicus	
		Clarias carsonii	
		Clarias werneri	
		Xenoclarius sp.	
	Cyprinidae	*Barbus altianalis*	barbels/minnows/carps

		Barbus altianalis radcliffi	
		Barbus amphigramma	
		Barbus apleurogramma	
		Barbus bynni rudolfianus	
		Barbus doggetti	
		Barbus erlangeri	
		Barbus gregorii	
		Barbus hindii	
		Barbus paludinosus	
		Barbus percivali	
		Barbus perplexicants	
		Labeo cylindricus	
		Labeo gregorii	
		Labeo horie	
		Labeo victorianus	
	Morymyridae	*Gnathonemus longibarbis*	Elephant snout-fish
		Gnathonemus victoriae	
		Gymnarchus niloticus	
		Morymyrops deliciosus	
		Morymyrops kannume	
		Morymyrops tenuirostria	
		Morcusenius grahami	
	Machokidae	*Synodontis afrofischeri*	Talking fish
		Synodontis frontisus	
		Synodontis geledensis	
		Synodontis schall	
		Synodontis victoriae	
		Synodontis zambensis	
	Protopteridae	*Protopterus aethiopicus*	Lungfish
		Protopterus annectens	
		Protopterus amphibia	
	Schilbeidae	*Schilbe mystus*	Butterfish
		Schilbe uranoscopus	
		Entropins depressirostris	
Amphibia		*Leptopelis modestus*	
		Afrixalus sylvaticus	
Reptilia	Cheloniidae	*Chelonia mydas*	Green turtle
		Eretochelys imbricata	Hawksbill turtle
		Lepidochelys olivacea	Olive Ridley turtle
	Dermochelyidae	*Dermochelys coriacea*	Leatherback turtle
	Ophidiae	*Hormonotus sp.*	
	Colubridae	*Hapsidophrys sp.*	
		Thrasops aethiopissa	
		Boiga sp.	
	Elapidae	*Dreudohaje sp.*	
	Veperidae	*Causus lichtensteni*	

		Bitis gabonica	
Aves	Otididae	*Otus ireneae*	Sokoke Scops Owl
	Turdidae	*Turdus helleri*	Taita Thrush
	Ploceidae	*Ploces golandi*	Clarke's Weaver
Mammalia	Bovidae	*Hippotragus niger*	Sable
	Rhinocerotidae	*Diceros bicorni michaeli*	Black Rhinocerus
		Ceratotherium simium simum	Southern White Rhinocerus
	Equidae	*Equus grevi*	Grevy's Zebra
	Canidae	*Lycaon pictus*	African Wild Dog
	Viverridae	*Bdeogale crassicauda*	Bushy-tailed mongoose
	Cercopithecidae	*Cercocebus galeritus galeritus*	Tana River Crested Mangabey
		Colobus badius rufomitratus	Tana River Red Colobus
		Cercopithicus neglectus	De Brazza's monkey

Vulnerable Animal Species

Group	Order/Family	Species	Common Name
Inverts	Syngenodrilidae	*Syngenodrilis sp.*	molluscs
		Pleucoplaca trapezium	
		Narpa amoretta	
	Tonnidae	*Tonna perdix*	
	Strombidae	*Lambis pseudoscorpio*	
		Lambis lambis	
	Conidae	*Conus coelinae*	
		Conus depressa	
		Conus diluculum	
		Conus monera	
	Cypraeidae	*Cypraea arabica*	
		Cypraea histrio	
	Vasidae	*Vasium turbinellus*	
Insecta	Nymphalidae	*Charaxes xiphares desmondi*	
		Cymothes teita	
Osteichthyes	Anguillidae	*Anguilla bicolor bicolor*	Eels
		Anguilla mossambica	
		Anguilla nebulosa labiata	
	Cyprinidae	*Labeo victorianus*	barbel
	Abudefdufidae	*Adudefduf sp.*	Sergent-major
	Amphiprionidae	*Amphiprion sp.*	Clownfish
	Callyodontidae	*Callyodon guttatus*	Parrotfish
Reptilia	Crocodylidae	*Crocodylus niloticus*	Nile crocodile
	Cheloniidae?	*Coretta cararetta*	Loggerhead turtle
Aves		*Turdoides hindei*	Hinde's Pied Babbler
		Anthus sokokensis	Sokoke Pipit
		Cinnyricinclus femoralis	Abbot's Starling

Mammalia	Chrysochloridae	*Chrysochloris stuhlmanni*	Stuhlmann's Golden Mole
	Macroscelididae	*Rhynchocyon chrysopygus*	Golden Rumped Elephant Shrew
	Bovidae	*Cephalophalus adersi*	Ader's Duiker
		Damaliscus hunteri	Hunter's Hartebeest
	Elephantidae	*Loxodonta africana*	African Elephant
	Dugongidae	*Dugong dugong*	Dugong
	Felidae	*Acinonyx jubatus*	Cheetah
		Panthera pardus	Leopard
	Lorisidae	*Galago z. zanzibaricus*	Zanzibar bushbaby
		senegalensis subspecies?	

Rare Animal Species:

Group	Family	Species	Common Name
Inverts	Lycosidae	Pardosa sp.	
	Strombidae	Strombus olei	
Insecta	Acrididae	Mecostibus stellatus	
		Pristorhypha sp.	
	Mormotomyiidae	Mormotomyia hirsuta	
	Lepidoptera	Graphium almansor	
		Eresina bilinea	
		Aphnaeus coronae littoralis	
		Aphnaeus flarescens williamsi	
		Spindasis auriko	
		Lolans mermis	
		Lolanus maritimus maritimus	
		Hypolycaena liara obscura	
		Actis perigrapha baginei	
		Hypokopelatus ugandae	
		Hypokopelates sp.	
		Copy cuprens	
		Anthene bjoernstadi	
		Oborania guessfeldi	
		Henotesia peithis	
		Charaxes bohemani	
		Charaxes zelica depuncta	
		Pseudacrae deludens echerioides	
		Mallika jackson	
		Borso kaka	
		Charaxes xiphares desmondi	
		Cymothoe taita	
		Dapilio antimachus	

Fish	Cichlidae	Haplochromis argentius****	Tilapia
		Haplochromis bayoni****	
		Haplochromis chilotes****	
		Haplochromis cinereus****	
		Haplochromis dentex****	
		Haplochromis dischrourus****	
		Oreochromis leucositictus	
		Oreochromis variabilis*****	
		Tilapia zillii	
		Barbus labiatus	
		Barbus longicuda	
		Barbus megalenae	
		Barbus meneliki	
		Barbus minchini	
	Mastacembelidae	Mastacembelus frenatus	Spiny eel
	Anabontidae	Citenopoma murier	
Amphibia		Schistometopum sp.	
Reptilia	Ophidia	Boiga sp.	
		Ambylodiposas sp.	
		Polemon sp.	
Aves		Aquila heliaca	Imperial Eagle
		Falco naumanni	Lesser kestrel
		Falco peregrinus	Peregrine Falcon
		Crex crex	Corncrake
		Sherppadiu gunningi	East Coast Akalat
		Turdus (Zoothera) fischeri	Spotted ground thrush
		Chloropeta gracilirostris	Papyrus yellow warbler
		Eremomela turneri	Turner's Eromomela
		Muscicapa lendu	Chapin's Flycatcher
		Anthreptes pallidigaster	Amani sunbird
Mammalia	Viverridae	Bdeogale nigripes	Black-legged mongoose
		Helogale hirtula	Somali Dwarf Mongoose
	Emballonuridae	Taphozous mauritianus	Tomb bat
	Leporidae	Lepus crawshayi	Savannah Hare
	Orycteropodidae	Orycteropus afer	Aardvark
	Bovidae	Tragolephus eurycerus	Bongo
		Tragolephus spekii	Sitatunga
		Cephalophus monticola	Blue Duiker
		Cephalophus nigrifrons	Black-fronted Duiker

		Cephalophus silvicultor	Yellow-backed Duiker
		Cephalophus weynsi	Weyns' Duiker

Insufficiently Known Animals:

Group	Order/Family	Species	Common Name
Inverts	Cypaeidae	Cypraea scurra	
		Cypraea cribraria	
	Strombidae	Lambis digitata	
		Strombus pipus	
		Strombus lentiginosus	
		Strombus plicatus columba	
		Strombus aurisdianae aurisdianae	
	Cassididae	Phalium areola	
	Thaididae	Thais carinifera	
		Duipa ricina	
	Melongeridae	Busycon contrarium	
	Vasidae	Vasium rhinoceros	
	Harpidae	Harpa major	
		Harpa harpa	
Fish	Amphiliidae	Amphilius grandis	amphiliids
		Amphilius oxyrhynchus	
	Ariidae	Arius africanus	catfish
	Malapteruridae	Malapterurus electricus	Electric catfish
	Osteroglossidae	Heterotis niloticus	bony tongues
	Polypteridae	Polypterus bichir	birchirs
		Polypterus senegalus	
	Tetrodontidae	Tetraodon fahaka	Puffers
Aves		Cisticola restricta	Tana River Cisticola
Mammalia	Bovidae	Oryx gazella annectens	Gemsbok
		Oryx gazella callus	Oryx
		Oryx gazella gallarum	Oryx
		Oryx.gazella callotis	Fringe-eared Oryx
		Ourebia ourebi	Oribi
	Emballonuridae	Taphozous perforatus	tomb bat
	Hipposideridae	Asselia tridens	Bat
		Hipposideros comersoni	Leaf bat
		Hipposideros caffer	Leaf bat
		Hipposideros megalotis	Leaf bat
		Hipposideros rubber	Leaf bat
	Mollosidae	Platymops sitier sitier	Flat-headed bat
		Otomops martinsseni	Otomops bat
		Tadarida aegyptica	Egyptian Free-tailed bat
		Tadarida africana	Giant African Free-tailed bat
	Rhinolophidae	Rhinolophus clivoris	Geoffroy's bat

		Rhinolophus hildebrandti	Hildebrandt's horsehoe bat
	Vespertilionidae	Nycticeius schlieffeni	Schlieffen's bat
		Scotophilus leucogaster	House bat
		Scotophilus nigrita	Greater brown bat
	Macroscelididae	Petrodromus tetradactylus sultan	Four-toed Elephant Shrew
	Leporidae	Lepus capnesis	Cape Hare
	Manidae	Manis termmincki	Cape pangolin
	Cercopithicidae	Erythrocebus patus pyrrhonotus	Patas Monkey
	Bathyergidae	Heliophabius argenteocinereus	Silver Blesmole
		Heterocephalus glaber	Naked Mole-rat
	Cricetidae	Beamys hindei hindei	Lesser pouched mouse
	Muridae	Gerbillus harwoody	Egyptian Gerbil
		Gerbillus pusillus	Egyptian Gerbil
		Praomys delectorum	Mlanje rat
		Praomys famatus	African meadow rat
		Praomys pernanus	
	Hystricidae	Atherurus africanus turneri	Brush-tailed Porcupine
	Muridae	Acomys subspinosus	Spiny Mouse
		Grammomys dilichurum????	Thicket rat
		Thallomys paedulcus	Acacia rat
	Muscaridae	Graphiurus murinus	African Dormouse
	Rhizomomydae	Tachyoryc(e)tes splendens	East African root rat
	Scuiridae	Funisciurus paraxerus ganana	Squirrel
		Funisciurus paraxerus aurescensis	Squirrel
		Funisciurus paraxerus electus	Squirrel
		Heliosciurus gambianus rufobrachium	Red-legged Sun squirrel
		Heliosciurus kaniae	Squirrel
		Heliosciurus mutabilis	Squirrel
		Heliosciurus rufobrachium	Red-legged sun squirrel
		Heliosciurus udulus	Squirrel
		Protoxerus stangeri	Slender-tailed giant/Stander's squirrel
		Xerus erythropus leucombrinus	Geoffroy's/Western ground squirrel
		Xerus erythropus microdon	Squirrel
		Xerus ritulus dorsalis	Unstriped/spiny ground Squirrel
		Xerus rufifrons	Squirrel
		Xerus ritulus saturlus	Squirrel

Endemic Animal Species:

Group	Order/Family	Species	Common Name
Insecta	Orthoptera	*Mecostibus sellatus*	
	Diptera	*Mormotomyia hirsuta*	
	Lepidoptera	*Metisella kakamega*	
Fish	Characinidae	*Alestes victorianus*	Tiger fish
		Alestes sp.	
	Anguillidae	*Anguilla bicolora*	Eels
	Centropomidae	*Lates rudolfianus*	Nile Perch
	Cichlidae	*Haplochromis argentieus*	Tilapia
		Haplochromis bayoni	"
		Haplochromis chilotes	"
		Haplochromis ciroreus	"
		Haplochromis dentex	"
		Haplochromis dischrourus	"
		Haolochromis gestri	"
		Haplochromis quiarti	"
		Haplochromis humilior	"
		Haplochromis ishmaeli	"
		Haplochromis longirostris	
		Haplochromis macrognathus	
		Haplochromis martini	
		Haplochromis macilipima	
		Haplochromis mento	
		Haplochromis malanopus	
		Haplochromis micreden	
		Haplochromis multicolor	
		Haplochromis nubilus	
		Haplochromis obesus	
		Haplochromis rudolfianus	
		Oreochromis a. grahami	
		Tilapia nigra	
	Clariidae	*Clarias carsinii*	Mud-catfish
		Clarias mossabicus	"
		Clarias alluandi	"
		Xenoclarias	"
	Cyprinidae	*Barbus alfianalis*	Barbels
		Barbus radcliffi	"
		Barbus sp. x 8	"
		Labeo cylindricus	
		Labeo gregorii	
		Labeo horie	
		Labeo victorianus	
		Rastrineobola argenteus	
	Mormyridae	*Gnathonemus longibarbis*	
		Gnathonemus victoriae	
	Muchokidae	*Synodontis victoriae*	
		Synodontis sp.	

	Protopteridae	*Protopterus annecteus*	Lung fishes
		Protopterus amphibia	
	Polypteridae	*Polypterus bichir*	Bichirs
		Polypterus senegalus	
Amphibia	Rainidae	*Hyperolius cystocandicans*	
		Hyperolius montanus	
		Hyperolius rubrovermiculatus	
		Hyperolius scheldricki	
		Afrixalus sylvaticus	
		Arthropleptides dutoiti	
		Phrynobatrachus kinangopensis	
		Phrynobatrachus sp.	
	Cacelidae	*Afrocaecilia changamwensis*	
		Afrocaecilia taitana	
	Bufonidae	*Bufo regularis*	
		Bufo sp.	
		Xenopus borealis	WCMC listed
Reptilia	Viperida	*Vipera viper*	Montane viper
		Atheris desaixi	Mt. Kenya Bush viper
		Bitis worthingtoni	Kenya Horned Viper
	Chamaelonidae	*Chamaeoleo fisheri excubitor*	Kenya hornless Chameleon
		Chamaeoleo fisheri tavetanus	
		Chamaeleo jacksonii xantholopus	
		Hemidactylus funaiolii	WCMC listed spp.
		H. modestus	
		Lygodactylus grandisonae	
		L. scheffleri	
		Agama caudospinosa	
		Chamaeleo schubotzi	
		Panapsis thomasi	
		Leptotyphlops boulengeri	
		Amblyodipsas tetiana	
		Aparallactus turneri	
		Atheris hindii	
Aves	Endemic	*Francolinus jacksoni*	Jackson's Francolin
		Otus ireneae	Sokoke Scops Owl
		Phoeniculus granti	Violet Wood Hoopoe
		Cisticola aberdare	Aberdare Cisticola
		Cisticola restricta	Tana River Cisticola
		Turdoides hindei	Hinde's Pied Babbler
		Mirafra williamsi	William's Bush Lark
		Turdus helleri	Taita Thrush
		Macronyx sharpei	Sharp's Longclaw

		Ploceus golandi	Clarke's Weaver
	Near Endemics	*Tauraco hartlaubi*	Hartlaub's Turaco
		Campethera mombassica	Mombasa Woodpecker
		Trachyphonus usambiro	Usambiro Barbet
		Parus fringillinus	Red-throated Tit
		Anthus melindae	Malindi Pipit
		Turdoides hypoleucus	Northern Pied Babbler
		Cisticola hunteri	Hunter's Cisticola
		Cisticola bodessa	Boran Cisticola
		Peoptera kenricki	Kenrick's starling
		Spreo hildebrandti	Hildebrandt's starling
		Pleceus castoneiceps	Taveta Golden Weaver
		Anthreptes pallidigaster	Amani Sunbird
		Anthus sokokensis	Sokoke Pipit
		Cinnyricinclus femoralis	Abbot's Starling
		Steptopelia reichenowi	White-winged Dove
		Prionps poliolopha	Grey-crested Helmet Shrike
		Euplectes jacksoni	Jackson's Widowbird
	End sub-spp.	*Apalis thoracica fascigularis*	(Taita) Bar-Throated Apalis
		Zosterops poliogastra silvanus	(Taita) Montane White Eye
		Andropadus ansorgei kavirondesis	Ansorge's Greenbul
	Near End sub-spp.	*Sheppardia gunningi sokokoensis*	East Coast Akalat
Mammalia	Macroscelidae	*Rhinchocyon cirnei chrysopygus*	Chequered Elephant Shrew
	Cercopithecidae	*Carcebus galeritus galeritus*	Tana Crested Mangabey
		Cercopithecus mitis kobli	Syke's Monkey (White-throated)
		Colobus badius rufomitratus	Tana river Red Colobus
		Glauconycteris kenyacola	WCMC listed
		Crocidura macarthuri	
		C. macowi	
		C. raineyi	
		Myosorex norae	
		M. polulus	
		Gerbillus cosensi	
		Grammomys caniceps	
		G. gigas	
		Heliophobius spalax	

Introduced Animal Species:

Group	Order/Family	Species	Common Name
Inverts		*Procrambus clarki*	Crayfish
	Ixodidae	*Mononchyllus tanajoa*	Cassava green mite
Insecta	Hemiptera	*Icerya purchasi*	Cushiony cotton scale insect
		Diuraphis noxia	Russian wheat aphid
		Teleonemia scrupulosa	Lace bug
		Aleurocanthus spiniferus	Spring black fly
		Aleurocanthus woglumi	Citrus blackfly
		Pineus sp.	Pine wooly aphid
		Phenacoccus manhole	Cassava mealybug
		Eulanchnus rileyi	Pine needle aphid
		Cinara cupressi	Cypress aphid
		Eriosoma lanigerum	Wooly aphid
		Dactylopius ceylonicus	Plant bug
	Isoptera	*Cryptotermes dudleyi*	
		Cryptotermes brevis	
		Coptotermes formosanus	
	Diptera	*Liriomyza trifolii*	American serpentine leafminer
	Lepidoptera	*Bombyx mori*	Silkmoth
		Cactoblastis cactorum	Prickly Pear moth
		Hypena strigata	
	Coleoptera	*Rodolia cardinalis*	ladybird
		Cryptolaemus montrouzieri	ladybird
		Gonipterus scutella	Eucalyptus snout beetle
		Cosmopolites solidus	Banana weevil
		Hypothenemus hampei	
		Tribolium castaneum	
		Prostephanus truncatus	Large Grain Borer
		Cryptobagous salviniae	Water weevil
	Hymenoptera	*Epidinocarsis lopezi*	
		Anagyrus sp. near kivuensis	
		Pauridia peregrina	
		Patasson nitens	
		Prorops nasuta	
		Leptomastix bifasciatus	
		Pseudaphycus sp.	
Fish	Centrarchidae	*Lepomis macrichirus*	Blue Gill Sun fish
		Micropterus salmoides	Black Bass
	Centropomidae	*Lates niloticus*	Nile Perch
		Lates longispinus	
	Cichlidae	*Oreochromis niloticus*	Nile Tilapia
		Oreochromis leucostictus	
		Tilapia zillii	

		Oreochromis andersonii	Anderson's tilapia
		Oreochromis aureus	Blue Tilapia
	Cyprinidae	*Cyprinus carpio*	carp
		Cyprinus idela	
		Gambusia/Poecilia/Lebistes	
		Salmo gairdneri	Rainbow Trout
		Salmo trutta	Brown trout?
Aves		*Carvus splendens*	Indian House Crow
		Passer domesticus	House Sparrow
		Agapornis personata fischeri	Hybrid lovebirds
		Columba livia	Feral Pigeon
Mammalia	Rhinocerotidae	*Ceratotherium simum*	White Rhinocerus
		Equus cabalis	Horse
			Donkey

Domesticated Animal Species:

Status	**Family**	**Species**	**Common Name**
Insecta	Lepidoptera	*Bombyx mori*	Silkmoth
	Hymenoptera	*Apis mellifera*	Honeybee
Aves		*Anas platyrhynchos*	Domestic Duck
		Cairina moschata	Muscovy Duck
		Anser sp hybrid	Domestic Goose
		Gallus gallus	Domestic Chicken
		Meleagris gallopavo	Domestic Turkey
		Columba livia	Domestic Pigeon
Mammalia	Felidae	*Felis sylvestris*	African wildcat
		Felix catus	Domestic cat
	Canidae	*Canis familiaris*	Domestic dog
	Bovidae	*Bos taurus*	Cow
		Sapra hircus	Goat
		Ovis aries	Sheep
	Suidae	*Sus serofa*	pig
	Camelidae	*Camelus dromeldarius*	
	Equidae	*Equus caballus*	Horse
		Equus arsinus	Donkey
	Caviidae	*Cavia percellus*	guinea pig
	Muridae	*Rattus rattus*	Norwegian Rat (laboratory)
	Leporidae	*Oryctolagus cuniculus*	Rabbit

1

Species	PTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
FAMILY:						
FAMILY: ØØ CYCA						
Cycas thuarsii Gaud.	K7	ØCCØC	R	3	KTSL	
Encephalartos bulbalinus Melville	K6		RV		BA	Ngurumam
Encephalartos hildebrandtii A.Br. & Bouche var hildebrandtii	K7	ØCØØØ	T	2	CFS	
Encephalartos kisambo Faden & Beentje	K7		RVE	E	BA	Sagalla
Encephalartos powysiorum Beentje	K4		V	E	KTSL	Kijegge
Encephalartos tegulaneus Melville	K7		R		KTSL	Lolokwe
FAMILY: ØØØ ADIA						
Adiantum comorense (Tard.)Verdc. ined ? syn A. confine	K7	ØØØØØ		3	CFS	
Adiantum reniforme	K1				PTEA	
Negripteris scioana	K1				PTEA	
Negripteris tricholepifera	K1				PTEA	also Eth
Pellaea boivinii	K6				PTEA	
Pellaea dura	K7				PTEA	
FAMILY: ØØØ ASPL						
Asplenium adamsii	K3,4				PTEA	also T2
Asplenium albersii	K7				PTEA	also T3,6
Asplenium angolense	K5				H	
Asplenium barteri	K7				PTEA	also U2
Asplenium buettneri Hieron. var hildebrandtii Hieron.	K4,7	ØØCØØ			PTEA	only?
Asplenium cornutum	K5				PTEA	also U2
Asplenium lunulatum var serrato-dentatum	K4				PTEA	also T2
Asplenium mossambicense	K5				PTEA	only?
Asplenium simii	K7				PTEA	also T6
FAMILY: ØØØ CYAT						
Cyathea humilis	K4				PTEA	also T2,3,6,7
FAMILY: ØØØ DENN						
Blotiella sp A	K4				PTEA	
Blotiella sp B	K4				PTEA	
Blotiella stipitata	K4,7				PTEA	also T3,6
FAMILY: ØØØ DRYO						
Dryopteris callolepis	K4				PTEA	
Dryopteris kilimensis	K4,?5				PTEA	also T2,6
Dryopteris schimperiana	K4				PTEA	?= D.pentheri (T6)
Dryopteris squamiseta	K4				PTEA	also T2,6,7
Hypodematium crenatum	K5		R		PTEA	
Megalastrum lanuginosum	K4				PTEA	also T2,3,6
Polystichum setiferum	K4				PTEA	?= P.fuscopaleaceum
Polystichum volkensii	K?3,4				PTEA	also T2
Tectaria puberula (Desv.)C.Chr.	K7	HHOCO		!	CFS	
FAMILY: ØØØ GRAM						
Grammitis nanodes	K7				PTEA	also T3,6
Xiphopteris strangea	K4,7		R		PTEA	also T3,6
FAMILY: ØØØ HYMS						
Hymenophyllum sibthorpioides	K7				PTEA	also T2,3,6,7
Hymenophyllum tunbrigense	K4				PTEA	also T2,3,6
Microgonium erosum (Willd.)Copel. var aerugineum (v.d.B.)Pichi Serm.	K4				PTEA	also T3,6
FAMILY: ØØØ ISOE						

Species	PTEA area	CFS (37) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Isoetes tenuifolia	X4				PTEA	only?
Isoetes welwitschii	X4				PTEA	only?
FAMILY: ØØØ LCMA						
Elaphoglossum angulatum	X4				PTEA	also T2,6
Elaphoglossum mildbraedii	X5				PTEA	also T6
Elaphoglossum spathulatum	X3				PTEA	also T6,7,8
Elaphoglossum subcinnamomeum	X3,4				PTEA	also T2
FAMILY: ØØØ LYCO						
Huperzia verticillata	X7		3		PTEA	also T6,7
Lycopodium aberdaricum	X3				PTEA	only?
FAMILY: ØØØ MARS						
Marsilea botryocarpa Ballard	X7	OOØOH		3	CFS, PTEA	
Marsilea fadeniana Launert	X7	HOØOO		2	CFS	
Marsilea farinosa	X4				PTEA	also T2
FAMILY: ØØØ OLEA						
Nephrolepis cordifolia	X4				PTEA	
FAMILY: ØØØ OPHI						
Ophioglossum gomezianum A. Br. var latifolium Prantl	X7	HOCHO		1	CFS	
Ophioglossum sp A	X4				PTEA	
FAMILY: ØØØ POLY						
Platycerium alcicorne Desv. ?syn P. vassei	X7	ØØOOC		2	CFS	
FAMILY: ØØØ PTER						
Pteris buchananii	X4,5		R		PTEA	also T & U
Pteris intricata	X5				PTEA	only?
FAMILY: ØØØ SALV						
Salvinia hastata Desv.	X7	COOHC		3	CFS, PTEA	also T7
FAMILY: ØØØ SELA						
Selaginella imbricata	X1				PTEA	only?
Selaginella yemensis	X1,3				PTEA	
FAMILY: ØØØ THEL						
Christella friensii	X3				PTEA	also T4,7
Christella shimbae Holttum	X7	HCOCO		1	CFS	
Pneumatopteris usambarensis	X7				PTEA	also T3,6,7
Pseudophegopteris aubertii	X4,5				PTEA	only?
Sphaerostephanos arbuscula (Willd.)Holttum ssp africanus Holttum	X7	HCOOO		3	CFS, PTEA	also T3,6,7
FAMILY: ØØØ VITT						
Vittaria isoetifolia	X7		R		PTEA	also T3,6,7
FAMILY: ØØØ WOOD						
Athyrium schimperi	X3,4				PTEA	also T4,7
Diplazium hylophilum	X4,5				PTEA	also T6
Diplazium nemorale	X4,5				PTEA	also T3,6,7
FAMILY: ØØØ ANNO						
Artabotrys likimensis	X5				H	
Artabotrys modestus Diels ssp macranthus Verdc.	X7	ØØCCO		2	H	
Artabotrys monteiroae Oliv.	X7	ØCOCO		4	CFS	
Artabotrys sp	X7	HOOOO		1	H	
Artabotrys sp cf brachypetalus Benth.	X7	ØØCØO		4	CFS	
Asteranthe asterias (S.Moore)Engl. & Diels ssp asterias	X7	ØØOØO		2	CFS	
Isolona cauliflora Verdc.	X7	ØØOOO	RV	2	BA	Mangea, Shimbas
Lettowianthus ? stellatus Diels	X7	ØCOOO	R	1	CFS	Shimbas, Kaya Ukunda
Mkilua fragrans Verdc.	X7	ØØOØO		2	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Monanthotaxis faulknerae Verdc.	K7	00C00		2	E	
Monanthotaxis fornicata (Baill.)Verdc.	K7	0000		2	CFS	
Monanthotaxis trichocarpa (Engl. & Diels)Verdc.	K7	0200C		2	CFS	
Monodora junodii Engl. & Diels	K7	00C00		4	CFS	
Ophrypetalum odoratum Diels	K7	00CC		2	CFS	
Polyathia stuhlmannii (Engl.)Verdc.	K7	0000		2	CFS	
Polyceratocarpus sp ? nov	K7	0000C		1	CFS	
Sphaerocoryne gracilis (Engl. & Diels)Verdc.	K7	0000		2	E	
Toussaintia orientalis Verdc.	K7	00000		2	CFS	
Uvaria acuminata Oliv. forma?	K7	2CCC		!	CFS	
Uvaria faulknerae Verdc.	K7	00CCC		2	CFS	
Uvaria kirkii Hook.f.	K7	0EC2C		2	CFS	
Uvaria leptocladon Oliv. ssp leptocladon	K7	EC000		2	CFS	
Uvaria lucida Benth. ssp lucida	K7	2220H		2	CFS	
Uvaria lucida Benth. vergens ad U. angolensis = D & H 3860	K7	0000		1	CFS	
Uvariodendron anisatum	K4		R?V		BA	
Uvariodendron gorgonis Verdc.	K7	2CCC	RVE	2	BA	
Uvariodendron kirkii Verdc.	K7	00C0C		2	CFS	
Uvariodendron sp nov !	K7	2CCCC		!	CFS	
Uvariodendron sp nov 2 = Hawthorne 1422B	K7	CCCCC		2	CFS	
Uvariodendron sp nov 3	K7	0C000		!	CFS	
Xylopia aethiopica (Dunal)A.Rich.	K7	0CCCC		4	E	
Xylopia arenaria Engl.	K7	2CCC		2	CFS	
FAMILY: 011 LAUR						
Ocotea argylei Robyns & Wilczek	K5		V	E	KTSL	
FAMILY: 013 HERN						
Gyrocarpus hababensis Chiov. var	K7	COEC0		?	CFS	
FAMILY: 014 MYRI						
Cephalosphaera usambarensis (Warb.)Warb.	K7	2CCCC		2	CFS	
FAMILY: 015 RANU						
Clematis sigensis Engl.	K7	00000	V	2	CFS, KTSL	
FAMILY: 023 MENI						
Albertisia undulata (Hiern)Forman = Vollesen 4224 (T8)	K7	00000	V	2	CFS, KTSL	
Anisocycla blepharosepala Diels ssp tanzaniensis Vollesen	K7	0000		2	CFS	
Tiliacora kenyensis	K5			E	BF	
Tinospora oblongifolia (Engl.)Troupin	K7	00C0C		2	CFS	
FAMILY: 026 HYDN						
Hydnora ? africana Thunb.	K7	EC?C0		?1	CFS	
FAMILY: 034 TURN						
Loewia tanaensis Urb.	K7	CC0C	R	?1X	CFS, KTSL	
Tricliceras xylorhizum Verdc.	K7	H0HC0		?1	CFS	
Turnera thomasii (Urb.)Story	K7	CCOHC		2X	CFS	
FAMILY: 036 CAPP						
Boscia kenienis Beentje	K7	0OH00	R	2	CFS, KTSL	
Boscia nimifolia Chiov.	K1			H		2sheets, also Eth & S
Boscia sp B of KTSLTS = Greenway 9813	K7	HCCCC		3	CFS	
Boscia sp cf mossambicensis Klotzsch = Greenway 10,435	K7	0000		?	CFS	
Boscia sp cf pruinosa Chiov.	K7	OCH00		1X	CFS	
Boscia tomentella Chiov.	K1			H		Locally common?
Cadaba barbigera Gilg	K7	00E0C		2X	CFS	
Cadaba gillettii R.A.Graham	K7	00H00		2X	CFS	
Cadaba longifolia DC.	K1					1sheet but Eth, S, Ar
Cadaba parvula Polhill	K1		?X	E	KTSL	Isiolo
Cadaba ruspolii Gilg	K7	00000H		2X	CFS	
Cleome allamanii Chiov.	K7	00H00		2X	CFS	
Cleome parvipetala R.A.Graham	K7	00H0H		2X	CFS	
Maerua denhardtiorum Gilg	K7	H000H		2X	CFS	
Maerua endlichii Gilg & Bened.	K7	H0E0H		2X	CFS	
Maerua glauca Chiov.	K7	0000		2X	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Maerua mungalli Beentje	K7	CØ?CC		2X	CFS	
Maerua sessiliflora Gilg	K7	CCHCC		2X	CFS	
FAMILY: Ø37 MORI						
Moringa arborea Verdc.	K1		RV		BA, KTSL	
Moringa borziana Mattei	K7	COHOH		2	CFS	
Moringa rivae Chiov. ssp ?	K1			?3	S	
Moringa sp (Gillett 21313)	K1				FTEA	Only 1 collection
FAMILY: Ø4Ø VIOL						
Hybanthus enneaspermus (L.)F.Muell. var ? densifolius Grey-Wilson	K7	CO?CC		2X	CFS	
Hybanthus enneaspermus (L.)F.Muell. var diversifolius Grey-Wilson	K7	HØOOO		1	CFS	
Hybanthus fasciculatus Grey-Wilson	K4			B	KTSL	
Rinorea convallariodes (Bak.f.)Eyles ssp marsabitensis Grey-Wilson	K1		R	B	BA, KTSL	
Rinorea sp ? nov	K7	ØOCCO		1	CFS	
Rinorea sp nr beniensis Engl. (cf R. sp A of FTEA)	K7	Ø?OOO		2	CFS	
Rinorea sp nr ferruginea Engl.	K7	ØOOCO		1	CFS	Infl axillary.
Rinorea squamosa (Tul.)Baill. ssp kaessneri (Engl.)Grey-Wilson	K7	ØØCØO		2	CFS	
FAMILY: Ø41 RESE						
Caylusea latifolia P.Tayl.	K1			B	H	1sheet
Reseda oligomeroides Schinz	K1				H	3sheets, also S
FAMILY: Ø42 POLY						
Carpolobia sp aff goetzei Guerke	K7	CØOOO		1	CFS	Flws ALL WHITE.
Polygala myrlantha	K5				H	1sheet
Polygala onlendorfiana	K3,K6				H	
Polygala sp = Gillett 18,885 (Meru Park)	K7	CCØCC		2X	CFS	
Polygala sp nr linifiora Boj.	K7	ØCCCC		?1	CFS	
Polygala vatkeana Exell vel sp aff	K7	CCHCH		2	CFS, H	3sheets
FAMILY: Ø45 CRAS						
Kalanchoe aubrevillei	K6			3	H	2sheets, same loc
Kalanchoe ballyi Cuf.	K7	ØØOOC		1	CFS	
Kalanchoe boranae	K1			3	H	Øsheets
Kalanchoe fadeniorum Raadts	K7	HCCCC		1	CFS	
Kalanchoe lateritia Engl. var prostrata Raadts	K7	ØØCCO		2	CFS	
Kalanchoe lateritia Engl. var pseudolateritia Raadts	K7	HHOCC		2X	CFS	
Kalanchoe obtusa Engl.	K7	ØØCCC		2	CFS	
Kalanchoe sp ? nov aff bipartita Chiov.	K7	CCØCC		1	CFS	
Kalanchoe sp B of FTEA	K7	CCCØO		2	CFS	
Kalanchoe sp cf glaucescens/rotundifolia hybrid	K7	ØØCCC		?1X	CFS	
FAMILY: Ø47 VAHL						
Vahlia somalensis Chiov. ssp somalensis	K7	OOØOC		2X	CFS	
FAMILY: Ø53 CARY						
Polycarpaea grahamii Turrill	K7	OØHOO		1/1X	CFS	
Polycarpaea tenuistyla Turrill	K7	OHOOO		1	CFS	
FAMILY: Ø54 AIZO						
Limeum praetermissum Jeffrey	K7	OOØOO		2X	CFS	
Trianthema ceratosepala Volkens & Irmsch.	K7	OHOOH		2X	CFS	
FAMILY: Ø56 PORT						
Calyptrotheca somalensis Gilg	K7	OCØOH		2X	CFS	
Calyptrotheca taitensis (Pax & Vatke)Brenan	K7	CØØOH		2X	CFS	
Portulaca ? ciferrii Chiov.	K7	OOCHO		2X	CFS	
Portulaca ? sp B of UKWP 2	K7	OCHCC		2X	CFS	
Portulaca ? sp nov = Greenway 9251	K7	CCHCO		1X	CFS	
Portulaca fascicularis Peter = Paden 74/1Ø38	K7	HCØOC		2X	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Portulaca grandis	K7				E	2sheets
Portulaca oblonga Peter e desc.	K7	00ØCO		2X	CFS	
Portulaca petersii von Poehn.	K7	0ØØOH		?2X	CFS	
Portulaca sp aff foliosa Ker-Gawl.	K7	CØOOO		1	CFS	
Portulaca wightiana Wight & Arn.	K7	HOØOH		2X	CFS	
FAMILY: Ø57 POLY						
Oxygonum sagittatum R.Grah.	K7	OOOHO		2X	CFS	
Oxygonum sp A of UKWF (? O.limbatum Agnew ined)	K7	OOHCO		2X	CFS	
FAMILY: Ø61 CHEN						
?Suaeda sp nr vermiculata J.F.Gmel.	K7	CCCHC		?	CFS	Diff FTA descr.
Atriplex farinosa Forssk. var keniensis Brenan	K7	CHCØO		1	CFS	
Fadenia zygophylloides	K1				E	Several also Eth
Gyroptera gillettii Botsch.	K7	OOHOO		2X	CFS	
Salsola dendroides Pall. var africana Brenan	K7	OCHOO		2X	CFS	
FAMILY: Ø63 AMAR						
?Rosifax sabuletorum C.C.Townsend	K7	CØØCO		?2X	CFS	
Allmaniopsis fruticulosa Suesseng.	K7	CCHCO		2X	CFS	
Celosia fadeniorum C.C.Townsend	K7	CCHCC		2X	CFS	
Celosia hastata Lopr.	K7	ØØCØØ		2	CFS	
Cyathula braunii Schinz	K7	HCCCC		2	CFS	
Cyathula coriacea Schinz	K7	CCØCH		2X	CFS	
Hermstaedtia gregoryi C.B.Cl.	K7	OHHCC		1	CFS	
Psilotrichum cyathuloides Suesseng. & Launert	K7	HCØHO		2	CFS	
Psilotrichum fallax C.C.Townsend	K7	HØOCO		2	CFS	
Pupalia lappacea (L.)A.Juss. var argyrophylla C.C.Townsend	K7	ØHCØC		2	CFS	
Pupalia lappacea (L.)A.Juss. var glabrescens C.C.Townsend	K7	HOØHO		2	CFS	
Pupalia sp aff micrantha Hauman	K7	OOØOO		?1	CFS	
Sericocomopsis pallida (S.Moore)Schinz	K7	HHØOH		2	CFS	
FAMILY: Ø71 BALS						
Impatiens digitata Warb. ssp phlyctidoceras (Bullock)Grey-Wilson				E	FTEA	also U3, Endemic Elgon
Impatiens engleri Gilg ssp pubescens Grey-Wilson	K7			E	UTAF	
Impatiens fischeri Warb.	K3,4			E	FTEA	
Impatiens meruensis Gilg ssp septentrionalis Grey-Wilson	K1				FTEA	also Sudan
Impatiens mildbraedii Gilg ssp telekii (T.C.E.Fries)Grey-Wilson	K?3, K4			E	FTEA	
Impatiens miniata Grey-Wilson	K3,5			E	FTEA	also U3, Endemic Elgon
Impatiens nana Engl.	K7				FTEA	also T2,3,6,7
Impatiens percodata Grey-Wilson ssp newbouldiana Grey-Wilson	K1			E	E	Øsheets
Impatiens raphidothrix Warb.	K5				FTEA	also T3
Impatiens teitensis Grey-Wilson ssp teitensis Grey-Wilson	K7		R	E	UTAF	
Impatiens tinctoria A.Rich. ssp elegantissima (Gilg)Grey-Wilson	K2,3,4,5				FTEA	also U3
Impatiens tweediae E.A.Bruce	K3,5			E	FTEA	also U3, Endemic Elgon
FAMILY: Ø72 LYTH						
Ammania sarcophylla Hiern	K5				E	1sheet
Nesaea pedicellata Hiern = D&H 35ØØ (T3)	K7	COCHO		2	CFS	
Nesaea sp = Gillett et al 25,216 (Somalia)	K7	CCØCC		2X	CFS	
Nesaea sp = Parker GM/5Ø1/H	K7	CCØOH		2X	CFS	
Nesaea sp Unmatched in BA	K7	COOHC		?X	CFS	
Nesaea sp nr heptamera Hiern = Polhill & Paulo 533 (Kurawa)	K7	OHØCO		?4	CFS	
Rotala repens	K5				E	also U & Eth
Woodfordia uniflora	K2,3				E	also U, S, Eth
FAMILY: Ø77 ONAG						
Ludwigia sp nr stolonifera (Guill. & Perr.)Raven	K7	ØOCCO		?1	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
FAMILY: Ø77 TRAP						
Trapa natans L. var africana Brenan	K5				FTEA	?Endemic L.Victoria
FAMILY: Ø81 THYM						
Dicranolepis usambarica Gilg	K7		R		BA	Endemic E.Arc Mtns
Synaptolepis alternifolia Oliv.	K7	ØØØCC		3	CFS	
Synaptolepis kirkii Oliv.	K7	ØØØØØ		2	CFS	
FAMILY: Ø83 NYCT						
Boerhavia sp	K7	CCCHC		?	CFS	
Pisonia grandis R.Br.	K7	CHCCC		5	CFS	
FAMILY: Ø84 PROT						
Faurea sp ? nov	K4				H	also T6 (?F.saligna)
FAMILY: Ø85 DILL						
Tetracera boiviniana Baill.	K7	ØØCCC		2	CFS	
Tetracera litoralis Gilg	K7	ØØCCC		2	CFS	
FAMILY: Ø93 FLAC						
Dasylepis integra	K7				UTAF	Endemic -E.Arc Mtns
Dovyalis sp A of FTEA	K7	HHCCC	RV?E	?	CFS, BA	
Grandidiera boivinii Jaub.	K7	ØØØØØ		2	CFS	
Homalium longistylum Mast.	K7	?HCCC		4	CFS	
Lindackeria bukobensis Gilg	K7	CCCHC		4	CFS	
Xylotheca tettensis (Klotzsch)Gilg var kirkii (Oliv.)Wild	K7	HCCCC		2	CFS	
FAMILY: Ø95 CANE						
Warburgia stuhlmannii Engl.	K7	ØØCCC	RV	2	CFS, BA	
FAMILY: 1Ø1 PASS						
Adenia aculeata (Hook.f.)Engl. ssp aculeata	K1				FTEA	also Eth & S
Adenia aculeata (Hook.f.)Engl. ssp manganiana (Chiov.)de Wilde	K7	CCCHC		2X	CFS	
Adenia globosa Engl. ssp globosa	K7	HHØCH		2X	CFS	
Adenia inermis de Wilde(de Wilde)	K1				FTEA	also Eth & S
Adenia lindiensis Harms	K7	ØCCCC		2	CFS	
Adenia petriosiphon	K4,6		R	E	FTEA, KTSL	
Adenia sp = Jeffery K569 cf A.kirkii	K7	CØCCC		?3	CFS	
Adenia sp cf kirkii (Mast.)Engl. = Brenan et al 14,659	K7	ØHCCC		?3	CFS	
Adenia sp nr panduriformis Engl.	K7	?ØCØC		?1	CFS	
Adenia volkensii Harms	K7	CCHCC		2X	CFS	
Basananthe scabrifolia	K5				FTEA	also ?U & T1,2
Basananthe subsessilicarpa Gillett ined	K7	CCHCH		2X	CFS	
Basananthe zanzibarica (Mast.)de Wilde	K7	ØCCCC		2	CFS	
Schlecterina mitostemmatoides Harms	K7	ØØHØC		2	CFS	
FAMILY: 1Ø3 CUCU						
?Coccinia sp	K7	CHCCC		?1	CFS	
?Coccinia sp (= Jarman 66)(sp E of FTEA)	K1,7	ØCCCC		3	CFS	
?Coccinia sp cf trilobata (Cogn.)C.Jeffrey	K7	CHCCC		?2X	CFS	
?Momordica sp Unmatched in BA	K7	ØCCCC		1	CFS	
Cephalopentandra ecirrhosa (Cogn.)C.Jeffrey	K7	CCHCH		2X	CFS	
Coccinia grandiflora Cogn.	K7	ØCCCH		2	CFS	
Coccinia begarrhiza	K1			3	FTEA	
Coccinia microphylla Gilg	K7	HCHCH		2X	CFS	
Coccinia sp A of FTEA	K1			3	FTEA	
Coccinia sp B of FTEA	K7	H?CCC		2	CFS	
Coccinia sp C cf FTEA	K1			3	FTEA	
Corallocarpus ? sp B of FTEA	K7	CCCØC		?2	CFS	
Corallocarpus ellipticus Chiov.	K7	CHØØC		2	CFS	
Cucumella kelleri	K1				FTEA	also Eth, S
Cucumis sp A of FTEA	K1,7	CCØCC		2X	CFS	
Diplocyclos schliebenii	K4				FTEA	also T2,3,6
Diplocyclos tenuis (Klotzsch)C.Jeffrey	K7	ØHCCC		2	CFS	
Eureiandra cogniauxii	K1				FTEA	also S
Eureiandra sp A of FTEA	K7	ØØCCC		2	CFS	
Gerrardanthus grandiflorus Cogn.	K7	HCCCC		2	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Kedrostis abdallai A.Zimm.	K7	CCCØC		?	CFS	
Kedrostis heterophylla A.Zimm.	K7	ØØCCO		2	CFS	
Kedrostis pseudogijef	K1,2,4,7				FTEA	also T3
Momordica leiocarpa Gilg	K7	HØCCC		2	CFS	
Momordica littorea Thulin (sp B of FTEA)	K7	OOCHC		2X	CFS	
Momordica peteri A.Zimm.	K7	ØØCCO		2	CFS	
Momordica sessilifolia	K1				FTEA	also Eth, S
Momordica spinosa (Gilg)Chiov.	K7	COØOH		2X	CFS	
Myrmecosicyos messorius	K3,6			E	FTEA	
Orecsyce sp A of FTEA	K7	COOHO		1X	CFS	
Trochomeria sp A of FTEA	K2,7	CCHOC		2X	CFS	
Trochomeria stefaninii	K1				FTEA	also S
Zenneria sp A of FTEA	K3			E	FTEA	
Zenneria sp aff minutiflora (Cogn.)C.Jeffrey	K7	CØCCC		?1	CFS	
Zenneria sp nr eminensis (Bak.)Keraudren	K7	ØCOCC		?1	CFS	
FAMILY: 114 OCHN						
Ochna ? macrocalyx Cliv. (= Burtt 5025 from T6)	K7	ØCOØC		?4	CFS	
Ochna holtzii Gilg	K7	HØCCC		2	CFS	
Ochna mossambicensis Klotzsch	K7	ØØØØH		2	CFS	
Ochna sp ? nov = L&B 1674	K7	ØØCCO		?	CFS	
Ochna sp A of KTSL	K7	CCOHC	R	1X	CFS, KTSL	
Ochna thomasiana Engl. & Gilg	K7	ØØØØO		2	CFS	
Ochna thomasiana Engl. & Gilg vergens ad O.kirkii Oliv.	K7	ØOOCC		2	CFS	
Ouratea sacleuxii (van Tiegh.)Beentje	K7	ØCCOC	R	2	CFS, BA	
Ouratea schusteri Engl.	K7		R, V		BA, KTSL	also E.arc Mtns
FAMILY: 115 ANCI						
Ancistrocladus robertsoniorum Leonard	K7	ØCCCC		?	CFS	
FAMILY: 118 MYRT						
Eugenia sp ? = Graham 2314	K7	CØCCC		?1	CFS	Flws solitary
Eugenia sp Taxon A of KTSL	K4			E	BF	
Eugenia sp Taxon C of KTSL = E. sp nr malangensis (O.Hoffm.)Niedenzu	K7	ØØOOO		?1	CFS	
Eugenia sp Taxon E of KTSL	K7	ØØØØO		1	CFS	
Eugenia sp Taxon F & Taxon D of KTSL (prob E.capensis ssp aeschersoniana)	K7	ØØØØO		?2	CFS	
FAMILY: 120 MELA						
Memecylon ? schliebenii Markgraf	K7	??OOO		?2	CFS	
Memecylon amaniense (Gilg)A. & R.Fernandes var A of KTSL	K7	ØØOCO		?1	CFS	
Memecylon amaniense (Gilg)A. & R.Fernandes var amaniense	K7	ØOOOO		2	CFS	
Memecylon buxoides Wickens	K4		?X	E	BA	
Memecylon fragrans A. & R.Fernandes	K7	ØØCCO	V	1	CFS, KTSL	
Memecylon mouririifolium Brenan	K7	ØØOØC		2	CFS	
Memecylon sansibaricum Taub. var "maritimum"	K7	CCCØO		2	CFS	
Memecylon sansibaricum Taub. var "melindense"	K7	CØCCC		1	CFS	
Memecylon sansibaricum Taub. var sansibaricum	K7	ØØCOC		2	CFS	
Memecylon sp aff mouririifolium Brenan	K7	ØCCCO		1	CFS	Anthers sessile?
Memecylon taitense Wickens	K7		RV	E	BA	
Memecylon verruculosum Brenan	K7	ØCCOC		2	CFS	
FAMILY: 121 COMB						
Combretum butyrosum (Bertol.f.)Tul.	K7	HOØHO		2	CFS	
Combretum chionanthoides Engl. & Diels	K7	ØØOOO	R	2	CFS, KTSL	
Combretum contractum Engl. & Diels	K7	HØHOH		2X	CFS	
Combretum exalatum Engl.	K7	ØCCOH		2X	CFS	
Combretum hereroense Schinz ssp volkensii (Engl.)Wickens var parvifolium (Engl.)Wickens	K7	OHØOH		2X	CFS	
Combretum illairii Engl.	K7	ØØØØO		2	CFS	
Combretum molle G.Don variant B of FTEA	K7	HØHOH		2X	CFS	
Combretum sp Not matched in BA	K7	ØOOOO		1	CFS	
Combretum sp ? nov aff apiculatum Sond. (Unmatched in BA)	K7	ØOOOO		?1	CFS	
Combretum sp aff tenuipetiolatum Wickens	K7	OØOOO		?1	CFS	

Species	FTEA area	CFS (X?) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Combretum tanaense J.G.Clark	X4		V	E	KTSL	
Combretum tenuipetiolatum Wickens	X7	CØCCC	RVE	2	CFS, BA	
Pteleopsis petraptera Wickens	X7	ØØØØC	R	2	CFS, BA	
Quisqualis littorea (Engl.)Exell	X7	ØØCCC		2	CFS	
Terminalia orbicularis Engl. & Diels	X7	OCHOH		2X	CFS	
Terminalia parvula Pampan.	K7	CHØCH		2X	CFS	
Terminalia polycarpa Engl. & Diels	X1			E		
Terminalia sp aff spinosa Engl.	X7	CØØCC		1	CFS	
FAMILY: 122 RHIZ						
Cassipourea celastroides Alston	K4,7	CØCOH		E	CFS	
Cassipourea euryoides Alston	X7	ØØØØC		2	CFS	
FAMILY: 126 GUTT						
Garcinia sp aff volkensii Engl.	X7	ØOOOO		1	CFS	Stigma 3-lobed.
Hypericum afromontanum Bullock	K3			E	H	Endemic to Elgon
Hypericum sp A of FTEA	X6			E	H	
Vismia orientalis Engl.	X7	ØØØOO		2	CFS	
FAMILY: 128 TILI						
Corchorus fasicularis Lam.	X7	CCØOO		2X	CFS	
Corchorus gillettii Bari	X7	OOHOO		2X	CFS	
Grewia calymmatosepala K.Schum.	X7	ØØOOO		2	CFS	
Grewia ectasicarpa S.Moore	X7	ØØØHO		2	CFS	
Grewia holstii Burret	X7	ØØOØO		2	CFS	
Grewia nematopus K.Schum.	X7	OHOOØ		2X	CFS	
Grewia plagiophylla K.Schum.	X7	ØØØØO		2	CFS	
Grewia praecox K.Schum.	X7	OHØO?		3	CFS	
Grewia stuhlmannii K.Schum.	X7	ØØØØO		2	CFS	
Grewia tristis K.Schum.	X7	ØHØOH		2X	CFS	
Grewia vaughanii Exell	X7	ØØØØC		2	CFS	
Triumfetta heterocarpa Sprague & Hutch.	X7	OHØOO		2X	CFS	
Triumfetta longicornuta Hutch. & Moss	K4			E	FTEATS	
FAMILY: 130 STER						
Byttneria sp nov	X7	ØØCOC		2	CFS	
Cola clavata Mast.	X7	ØØØØO		2	CFS	
Cola greenwayi Brenan var keniensis Brenan	K4,5			E	KTSL, E	
Cola minor Brenan	X7	ØØCHO		2	CFS	
Cola octoloboides Brenan	X7	ØØCOC	RVE	1	CFS, BA	
Cola porphyrantha Brenan	X7	ØØCCO	RV?E	1	CFS, BA	
Cola uloloma Brenan	X7	ØØOOC	RV?E	2	CFS, BA	
Dombeya taylori Bak.f. syn D.praetermissa Dunkley	X7	ØØOØH		2	CFS	
Hermannia fischeri K.Schum.	X7	HECCO		2X	CFS	
Hermannia oliveri K.Schum.	X7	OCHOH		2X	CFS	
Melhania rotundata Mast.	X7	CØØCC		2X	CFS	
Melhania sp ? nov	X7	OOHHC		1	CFS	
Nesogordonia holtzii (Engl.)Capuron	X7	ØØCØC	R	2	CFS, BA	
Sterculia dawei Sprague	K5				FTEATS	also U2,4
Sterculia schliebenii Mildbr.	X7	ØØCOO		2	CFS	
FAMILY: 131 BOMB						
Bombax rhodognaphalon Engl.	X7	ØØOOO		2	CFS	
FAMILY: 132 MALV						
Abutilon engleranum Ulbr.	X7	OOHOO		2X	CFS	
Abutilon rotundifolia Mattei	X7	OOOHO		1X	CFS	
Abutilon sp aff pannosum (Forst.f.)Schlecht.	X7	OOØOO		I(5)	CFS	
Abutilon sp nr mauritianum (Jacq.)Medic.	X7	CCØOO		I(5)	CFS	
Abutilon sp nr wituense Bak.f.	X7	OOØOO		?	CFS	
Abutilon wituense Bak.f.	X7	ØOØOO		?	CFS	
Cienfugosia hildebrandtii Garcke	X7	HØOØO		2	CFS	
Gossypioides kirkii (Mast.)J.B.Hutch.	X7	ØØOØO		2	CFS	
Gossypium ? arboreum L.	X7	OOOHO		?	CFS	
Gossypium somalense (Guerke)J.B.Hutch.	X7	CCØHO		2X	CFS	
Hibiscus dictyocarpus Webb	X7	OHØOO		2X	CFS	
Hibiscus schizopetalus Hook.f.	X7	ØØOOO		2	CFS	
Hibiscus sp aff palmatus Forssk.	X7	OOHOO		2(4)	CFS	
Hibiscus sp aff rostellatus Guill. & Perr.	X7	ØØOCC		1(4)	CFS	
Hibiscus sp aff vitifolius L. = sp D of UKW?	X7	OØØCH		2X(5	CFS	Poss. not distinct from H.vit
Pavonia glechonifolia (A.Rich.)Garcke	X7	OHØOH		2X	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Pavonia hildebrandtii Guerke	K7	0#000		2X	CFS	
Pavonia leptocalyx (Scnd.)Ulbr. syn P.mollissima (Garcke)Ulbr.	K7	00000		2	CFS	
Pavonia propinqua Garcke	K7	0000H		2X	CFS	
Pavonia sp nr zeylanica (L.)Cav. syn P.triloba Webb non Guill. & Perr.	K7	00H00		1X(2	CFS	Poss not distinct from P.zeyla
Pavonia zeylanica (L.)Cav.	K7	0H00H		2X	CFS	
Sida sp aff ovata Forssk.	K7	00000		1(4)	CFS	
Sida tanaensis Vollesen	K7	00000		2X	CFS	
Urena sp cf sinuata L. = ARCHBOLD 1231 (T3)	K7	00000		1(5)	CFS	
FAMILY: 133 MALP						
Acridocarpus ballyi author?	K7	00000		1X	CFS	
Acridocarpus taitensis Beentje ined	K7		V	R	BP, KTSL	
Caucanthus albidus (Niedenzu)Niedenzu	K7	0HH0H		2X	CFS	
Flabellariopsis acuminata (Engl.)Wilczek	K7	00000		3	CFS	
Triaspis niedenzuiana Engl.	K7	H0H0H		2X	CFS	
Tristellateia africana S.Moore	K7	00000		2	CFS	
FAMILY: 135 ERYT						
Nectaropetalum kaessneri Engl. var kaessneri	K7	00000		2	CFS	
FAMILY: 135 LINA						
Hugonia castaneifolia Engl.	K7	00000		2	CFS	
FAMILY: 136 EUPH						
Acalypha bussei Hutch.	K7	HH000		2	CFS	
Acalypha echinus Pax & K.Hoffm.	K7	00000		2	CFS	
Acalypha engleri Pax	K7	00000		2	CFS	
Acalypha x koraensis A.R.-Sm.	K7	00H00		1X	CFS	Hybrid A.indica & A.crenata
Argomuellera sp nov = L&R 193	K7	00000		1	CFS	
Aristogeitonia monophylla Airy Shaw	K7	00000	RV	2	CFS, BA	
Bridelia taitensis Vatke & Pax	K1,4,7			3	KTSL	
Cavacoa aurea (Cavaco)J.Leon.	K7	00000		2	CFS	
Cleistanthus sp aff michelsonii J.Leon. excl. et desc.	K7	00000		2	CFS	
Croton alienus	K4,5		RV	3	BA	
Croton megalocarpoides Friis & Gilbert	K7	00000	R	2	CFS, BA	
Croton polytrichus Pax	K7	00000		3	CFS	
Croton schimperianus Muell.Arg.	K1				H	also Eth & Som
Croton talaeporos A.R.-Sm.	K7	H0000		2X	CFS	
Dalechampia scandens L. var hildebrandtii (Pax)Pax	K7	00000		2	CFS	
Drypetes natalensis (Harv.)Hutch. var leiogyna Brenan	K7	00000		2	CFS	
Drypetes usambarica (Pax)Hutch. var mrimae A.R.-Sm.	K7	00000	RVE	1	CFS, BA	
Drypetes usambarica (Pax)Hutch. var trichogyna A.R.-Sm.	K7	00000		2	CFS	
Drypetes usambarica (Pax)Hutch. var usambarica vergens ad var mrimae	K7	00000		2	CFS	
Erythrococca pentagyna A.R.-Sm. syn E. sp C of FTEA	K7	00000		1	CFS	
Erythrococca pubescens A.R.-Sm.	K7	00000		1	CFS, KTSL	
Erythrococca usambarica Prain	K7	00000		2	CFS	
Euphorbia actinoclada S.Carter	K1				H	also Eth
Euphorbia adjurana Bally & S.Carter	K1				H	also Eth
Euphorbia atroflora S.Carter	K1,4,7			3	H	
Euphorbia baioensis S.Carter	K1			R	H	Only type coll.
Euphorbia ballyana Rauh	K6			3	H	Only type coll
Euphorbia borenensis M.Gilbert	K1				H	also Eth
Euphorbia breviarticulata Pax var trunciformis S.Carter	K1				H	also ?U,Eth & Som
Euphorbia buruana Pax	K7				H	also T2,3
Euphorbia colubrina Bally & S.Carter	K1				H	also Eth
Euphorbia crotonoides Boiss. ssp narokensis S.Carter	K6			3	H	2 colls only
Euphorbia cryptospinosa Bally	K7	00H0H		2X	CFS	
Euphorbia cuneata Vahl ssp spinescens (Pax)S.Carter var pumilans S.Carter	K7	H000H		2X	CFS	
Euphorbia cuneata Vahl ssp spinescens (Pax)S.Carter var spinescens	K7	00H0H		2X	CFS	
Euphorbia cuneata Vahl ssp wajirensis S.Carter	K1				H	also Eth & ?Som
Euphorbia cuprispina S.Carter	K1			R	H	
Euphorbia cussonioides Bally	K4,6		RV?E	3	BA, KTSL	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Euphorbia dauana S.Carter	K1			E	H	
Euphorbia diminuta S.Carter	K7	OHHOO		2X	CFS	
Euphorbia ellenbeckii Pax	K1				H	also Eth & Som
Euphorbia erlangeri Pax	K1				H	also Som
Euphorbia fluminis S.Carter	K1,7	CCØCC		1X	CFS, KTSL	Doubtfully distinct frm E.gl
Euphorbia friesiorum (Hassler)S.Carter	K4		R	E	KTSL	
Euphorbia furcata N.E.Br.	K7	HOOOH		2X	CFS	
Euphorbia gemmea Bally & S.Carter	K1			E	H	
Euphorbia glochidiata Pax	K7	OOHOC		2X	CFS	
Euphorbia graciliramea Pax	K6				H	also T1,2,5
Euphorbia granulata Forssk. var dentata N.E.Br.	K7	OHHHO		2X	CFS	
Euphorbia heterochroma Pax ssp tsavoensis S.Carter	K7	ØCHOH		2X	CFS	
Euphorbia heterospina S.Cater ssp baringoensis S.Carter	K3				H	
Euphorbia heterospina S.Cater ssp heterospina	K2,3				H	also U1
Euphorbia intricata S.Carter	K1				H	also Eth
Euphorbia jatrophoides Pax	K1,7	OOHOH		2X	CFS, H	also Eth
Euphorbia joyae S.Carter	K1,4,7	OOØOH		1X	CFS, KTSL	
Euphorbia kalisana S.Carter	K7	OOHOO		2X	CFS	
Euphorbia kassneri Pax	K7	HØØOO		1	CFS	
Euphorbia laikipiensis S.Carter	K3			E	H	
Euphorbia lavicola S.Carter	K2			E	H	
Euphorbia marsabitensis S.Carter	K1			E	H	
Euphorbia meridionalis Bally & S.carter	K4,?6				H	also T2
Euphorbia nyikae Pax var neovolkensii (Pax)S.Carter	K7	ØØØØH		2	CFS	
Euphorbia nyikae Pax var nyikae	K7	OØOOO		2	CFS	
Euphorbia odontophora S.Carter	K1			E	H	
Euphorbia perangustifolia S.Carter	K1				H	also Eth
Euphorbia petricola Bally & S.Carter	K4,7			E	H	
Euphorbia polyantha Pax	K7	OHHOH		2X	CFS	
Euphorbia pseudoburuana Bally & S.Carter	K6				H	also T2
Euphorbia quadrispina S.Carter				E	H	
Euphorbia quinquecosta Volkens	K7	ØOOOH		2X	CFS	
Euphorbia rivae Pax	K4				H	also Sud & Eth
Euphorbia robecchii Pax	K7	OOØOH		2X	CFS	
Euphorbia samburuensis Bally & S.Carter	K1			E	H	
Euphorbia saxorum Bally & S.Carter	K4			E	H	
Euphorbia scarlatina S.Carter	K3,6			E	H	
Euphorbia scheffleri Pax	K7	COHOH		2X	CFS	
Euphorbia septentrionalis Bally & S.Carter	K1,2,3				H	also U1
Euphorbia shizacantha Pax	K1				H	also Eth & Som
Euphorbia similiramea S.Carter	K3,4,6				H	also T2
Euphorbia sp aff vittata S.Carter	K7	OOHOO		1X	CFS	
Euphorbia sp nr cryptospinosa Not Matched in BA	K7	OØOOO		1X	CFS	
Euphorbia subscandens Bally & S.carter	K1			E	H	
Euphorbia tanaensis Bally	K7	CCCCC	RVE	1	CFS, BA	
Euphorbia taruensis S.Carter	K7	HHOCO		1X	CFS	
Euphorbia tenuispinosa Gilli var robusta Bally & Carter	K1,4,7			E	H	
Euphorbia tenuispinosa Gilli var tenuispinosa	K4,7	HØHOH		3	CFS	Endemic to Kenya
Euphorbia turkanensis S.Carter	K1,2			E	H	
Euphorbia uhligiana Pax	K6				H	also T2,3
Euphorbia vittata S.Carter	K1			E	H	
Euphorbia vulcanorum S.Carter	K1			E	H	
Euphorbia wakefieldii N.E.Br.	K7	ØØOOO	RVE	1	CFS, BA, IUCN	
Euphorbia wellbyi N.E.Br.	K4				H	also T2 & Eth
Givotia gosai A.R.-Sm.	K7	OHØOH		2X	CFS	
Jatropha arguta Chiov.	K1				H	also Eth & Som
Jatropha dictar Macbar.	K7	OOØOH		2X	CFS	
Jatropha ellenbeckii Pax	K7	OOHOO		2X	CFS	
Jatropha hildebrandtii Pax var torrentis-lugardi A.R.-Sm.	K7	OØOOH		2X	CFS	
Jatropha microdonta A.R.-Sm.	K1				H	also T2
Jatropha mollis Pax	K7	OOHOO		2X	CFS	
Jatropha oblanceolata A.R.-Sm.	K7	OOHOO		2X	CFS	Poss = J.rivae ssp quercifoli
Jatropha pelargoniifolia Courbon var glabra (Muell.Arg.)A.R.-Sm.	K1				FTEA	also Yem & Som
Jatropha rivae Pax ssp quercifolia Gilbert & Thulin (syn J.parvifolia Chiov.)	K7	OOHOH		2X	CFS	
Jatropha stuhlmannii Pax	K7	OHØHO		2X	CFS	
Jatropha velutina Pax & K.Hoffm.	K7	ØØOOH		1X	CFS	
Macaranga conglomerata	K7		R		BA	also T3
Meineckia fruticans (Pax)Webster var engleri (Pax)Webster	K7	?ØO?O		2	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Meineckia phyllanthoides Baill. ssp somalensis (Pax)Webster	K7	CCCOC		2X	CFS	
Micrococca holstii (Pax)Prain	K4				H	also T3,6
Micrococca scariosa Prain	K7	ØCOOC	RV?E	2	CFS, BA	
Mildbraedia carpinifolia (Pax)Hutch. var carpinifolia	K7	ØCOØC		2	CFS	
Mildbraedia sp A of FTEA	K7	OHOOO		I	CFS	
Monadenium ellenbeckii N.E.Br.	K1				H	also Eth & Som
Monadenium guentheri Pax	K7			E	H	
Monadenium invenustum N.E.Br. var angustum Bally	K4,6			E	H	
Monadenium invenustum N.E.Br. var invenustum	K4,7	OØOOO		2X	CFS	
Monadenium montanum Bally	K6				H	also T2
Monadenium reflexum Chiov.	K1			E	H	
Monadenium renneyi S.Carter	K7	OOHOO		2X	CFS	
Monadenium rhizophorum Bally	K4			E	H	Only type coll.
Monadenium ritchiei Bally ssp marsabitense S.Carter	K1			E	H	
Monadenium ritchiei Bally ssp nyambense S.Carter	K4			E	H	
Monadenium ritchiei Bally ssp ritchiei	K4			E	H	
Monadenium rubellum (Bally)S.Carter	K4			E	H	
Monadenium stoloniferum (Bally)S.Carter	K6			E	H	
Monadenium trinerve Bally	K4,6			E	H	
Monadenium virgatum Bally	K7	OOØOC		2X	CFS	
Monadenium yattanum Bally	K4			E	H	Machakos Distr only.
Neoholstia tenuifolia (Pax)Rauschert var glabrata (Prain)A.R.-Sm.	K7	OØOOO		2	CFS	
Oldfieldia somalensis (Chiov.)Milne-Redh.	K7	ØCOØO		2	CFS	
Phyllanthus fluminis-athi A.R.-Sm.	K4			E	H	
Phyllanthus harrisii A.R.-Sm.	K7	HHØHC		2	CFS	
Phyllanthus kaessneri Hutch. var kaessneri	K7	ØHCOO		2	CFS	
Phyllanthus maderaspatensis L. var exasperatus A.R.-Sm. var nov ined	K7	CCØCO		1X	CFS	
Phyllanthus sacleuxii A.R.-Sm.	K7	ØCCCH		1	CFS	
Phyllanthus somalensis Hutch.	K7	OHØOH		2X	CFS	
Pycnocoma littoralis Pax	K7	ØØCCO		2	CFS	
Ricinodendron heudelotii (Baill.)Pierre ssp africanum (Muell.Arg.)J.Leon. var tomentellum (Hutch. & E.A.Bruce)A.R.-Sm.	K7	ØØCCC		2	CFS	
Sapium ? triloculare Pax & K.Hoffm.	K7	OØOOO		I(2)	CFS	
Savia fadenii A.R.-Sm.	K7	ØØOOO	RVE	1	CFS, BA	
Synadenium compactum N.E.Br. var compactum	K3,4,6,7		R	E	BA	
Synadenium compactum N.E.Br. var rubrum S.Carter	K3,4			E	H	
Synadenium pereskiifolium (Baill.)Guill.	K7	ØØOØO		2	CFS	
Synadenium volkensii Pax	K6				H	also T2, endemic Kilimanjaro
Thecacoris usambarensis Verdc.	K7	OØOOO	RVE	2	CFS, BA	
Tragia ceanothifolia A.R.-Sm.	K4			E	FTEA	Only Type collection
Tragia glabrescens Pax	K7	HHOOO		2	CFS	
Tragia sp Intermed. btwn T.benthamii, T.brevipes, T.impedita, T.insuavis vide A.R.-Sm. in FTEA I Pg 304 = Bally 7707	K7	OOØOO		2X	CFS	
Tragia ukambensis Pax var ukambensis	K4,7			E	H	
Zimmermannia ovata	K7		V	E	BF, UTAF	
FAMILY: 139 MONT						
Grevea madagascariensis Baill. ? ssp keniensis Verdc.	K7	ØOOOC		I	CFS	
FAMILY: 143 ROSA						
Rubus friesiorum ssp friesiorum	K3,4			E	KTSL	
Rubus keniensis	K3,4		R	E	BF, KTSL	
FAMILY: 144 DICH						
Dichapetalum arenarium Breteler	K7	ØØOOO		2	CFS	
Dichapetalum eickii Ruhl.	K7				FTEA	also T3,6
Dichapetalum fadenii Breteler	K7	ØØOOC	E	1	CFS, KTSL	
Dichapetalum madagascariense Poir. var brevistylum Breteler	K4				FTEA	also T2
Dichapetalum mossambicense (Klotzsch)Engl.	K7	ØOOOO		2	CFS	
Dichapetalum sp 1 = L&R 1235B	K7	OOØOO		1	CFS	
Dichapetalum sp 2 Not matched in EA	K7	ØCCCC		1	CFS	
Tapura fischeri Engl. pubescent form	K7	ØOOOO		2	CFS	(var pubescens Verdc. Not put

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
FAMILY: 146 CAES						
Bauhinia mombassae Vatke	K7	ØØOOO	E	1	CFS, KTSL	
Bauhinia taitensis Taub.	K1,4,7	OHHCØ		5	CFS, KTSL	
Caesalpinia dauensis Thulin	K1		V		KTSL	
Caesalpinia insolita (Harms)Brenan & Gillett	K7	ØØCOC	R,V	3	CFS, BA	
Caesalpinia trothae Harms ssp trothae vergens ad ssp erlangeri (Harms)Brenan	K7	HØØOH		2X	CFS	
Cassia abbreviata Cliv. ssp kassneri (Bak.f.)Brenan	K7	ØØØOH		2X	CFS	
Cassia afrofistula Brenan var afrofistula	K7	ØØOØO		2	CFS	
Cassia sp B of FTEA	K4			3	H	Ol Doinyo Sapuk
Cynometra greenwayi Brenan	K7	ØØOOO		1	CFS	
Cynometra lukei Beentje	K7	CCØOO	R,V	2	CFS, BA	also T6
Cynometra suaheliensis (Taub.)Bak.f.	K7	ØØCOO		2	CFS	
Cynometra webberi Bak.f.	K7	ØØCOO		2	CFS	
Delonix baccal (Chiov.)Bak.f.	K1				FTEA	also Som, ?Eth
Dialium holtzii Harms	K7	ØØCOO		2	CFS	
Dialium orientale Bak.f.	K7	CØØØC		2	CFS	
Gigasiphon macrosiphon (Harms)Brenan	K7	ØCCCO	R,V?E	2	CFS, BA, IUCN	
Julbernardia magnistipulata (Harms)Troupin	K7	ØØCCC		2	CFS	
Oxystigma msoo Harms	K7	CØØOO	R,V?E	2	CFS, BA	
Parkinsonia anacantha Brenan	K1,2,4,7	COHOO		2X	CFS, KTSL	
Parkinsonia sciona	K1				H	Mandera, Wajir also Eth, Som
Scorodophloeus fischeri (Taub.)J.Leon.	K7	ØØCOO		2	CFS	
Senna alexandrina var obtusata	K1				H	Ramu-Benessa also Som
Senna baccarinii	K1				H	Mandera-Dandu also Som
Senna humifusa	K1			E	H	Nr Wajir
Senna longiracemosa (Vatke)Lock	K7	HHHOH		2X	CFS	
Senna ruspolii	K1				H	Dandu also Eth, Som
Tylosema humifusa	K1,4				H	Meru N.P, Ramu, also Som
FAMILY: 147 MIMO						
Acacia adenocalyx Brenan & Exell	K7	ØØØØO		2	CFS	
Acacia bussei SjØstedt	K7	ØØØOH		2X	CFS	
Acacia condyloclada	K1		R		BA	also Eth, S
Acacia dolichocephala	K3		R		BA	also T,U,Sud,Eth
Acacia elatior Brenan ssp elatior	K7	OHHOO		2X	CFS	
Acacia etbaica Schweinf. ssp platycarpa Brenan	K7	HØOOH		2X	CFS	
Acacia hamulosa Benth.	K7	OOHOO		2X	CFS	
Acacia horrida (L.)Willd. ssp benadirensis (Chiov.)Hillcoat & Brenan	K7	OOØCH		2X	CFS	
Acacia nilotica (L.)Del. ssp leiocarpa Brenan	K7	OHØØO		2	CFS	
Acacia nilotica (L.)Del. ssp subalata (Vatke)Brenan	K7	ØØØOH		2X	CFS	
Acacia reficiens Wawra ssp misera (Vatke)Brenan	K7	CØØCH		2X	CFS	
Acacia sp A of FTEA	K7	CHCCC		1	CFS	
Acacia thomasii Harms	K7	CHOOH		2X	CFS	
Acacia turnbulliana	K1			3	H	Wajir-Garissa area
Albizia gummifera (J.F.Gmel.)C.A.Sm. Glabrescent flw form	K7	OOØCC		1(5)	CFS	
Albizia tanganyicensis ssp adamsoniorum	K4		R	3	BA	
Calliandra gilbertii Thulin & Hinde	K7	OOHOO		2X	CFS	
Dichrostachys cinerea ssp wajirensis	K1			3	H	Wajir-El Wak etc
Entada leptostachya Harms	K7	ØØHØH		2X	CFS	
Newtonia erlangeri (Harms)Brenan	K7	OOØØC	R	2	CFS, BA	
Newtonia paucijuga (Harms)Brenan	K7	ØØCOO		2	CFS	
Pseudoprosopis euryphylla Harms ssp puguensis Brenan & Lock	K7	ØØCOO		2	CFS	
FAMILY: 148 PAPI						
Abrus sp A of FTEA	K7	HOOOO		1	CFS	
Aeschynomene gracilipes Taub. var brevistipitata Verdc.	K4			3	H	Mbooni Hills
Aeschynomene sp B of FTEA	K7	OOOHC		1	CFS	
Aeschynomene sp cf micrantha DC.	K7	OØOOO		?	CFS	
Alysicarpus glumaceus (Vahl)DC. ssp hispidicarpus (Fiori)J.Leon. var patulopedicellatus J.Leon.	K4			E	H	Nairobi
Alysicarpus glumaceus (Vahl)DC. ssp macalusoi (Mattei)Verdc.	K7	OOOØO		2X	CFS	
Alysicarpus vaginalis (L.)DC. var villosus Verdc.	K7	HOOOO		2	CFS	

Species	FTSA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Angylocalyx braunii Harms	K7	ØØØHC		2	CFS	
Argyrolobium ramosissimum	K3,5				FTEA	Cherangani H, Elgon, Mau also
Astragalus atropilosus var aberdaricus	K3,4			E	FTEA	Aberdares
Astragalus atropilosus var elgonensis	K3			E	FTEA	Elgon
Baphia keniensis Brummitt	K4		R?V	E	BA	Thika only?
Craibia brevicaudata (Vatke)Dunn ssp brevicaudata	K7	ØØØØH		2	CFS	
Craibia zimmermannii	K7			E	BF	
Crotalaria balliyi	K1,4			E	FTEA	N Wajir & Kiboko
Crotalaria barkae Schweinf. ssp taitensis (Sacl.)Polhill	K7	HCCOH		2X	CFS	
Crotalaria barkae Schweinf. ssp zimmermannii (Bak.f.)Polhill	K7	OHØHO		2	CFS	
Crotalaria boranica	K1				FTEA	Nr Ramu also Eth & Som
Crotalaria brevidens var parviflora	K3,4			E	FTEA	Embu, Muguga Nbi
Crotalaria deserticola Bak.f. ssp orientalis Polhill	K7	HHOHO		2	CFS	also T3,6
Crotalaria dumosa	K1				FTEA	Ramu-Mandera, Moyale also Eth
Crotalaria dumosa Franch.	K7	OOHOO		2X	CFS	
Crotalaria enarginata Benth.	K7	ØHOHO		2	CFS	Also T3,6,9
Crotalaria grata Polhill	K7	HØHOC		1	CFS	
Crotalaria jacksonii	K3,4			E	FTEA	Mau Forest, Kburu, SE Aberdar
Crotalaria jerokoensis Bak.f.	K1,7	OOHOO		E	CFS, FTEA	Jeroko
Crotalaria jubae Polhill vel sp aff	K7	OOØOO		2X	CFS	
Crotalaria laburnifolia L. ssp tenuicarpa Polhill	K7	HOHHH		2X	CFS	
Crotalaria laburnoides Klotzsch var nudicarpa Polhill	K7	OHOOO		2	CFS	also T3,6
Crotalaria lotiformis	K3,6			E	FTEA	Ngong Hills, Kajiado Rd
Crotalaria malindiensis Polhill	K7	OHOHO		1	CFS	Malindi
Crotalaria massaiensis Taub.	K7	HOHOH		2X	CFS	
Crotalaria patula Polhill	K7	HOOOH		2X	CFS	also T2
Crotalaria phillipsiae	K1				FTSA	Dandu, Mandera, El Wak also E
Crotalaria rhynchocarpa Polhill	K7	OHOØO		1	CFS	Sabaki, Lamu
Crotalaria rufocaulis	K1				FTSA	Dandu Mts, Moyale also Eth
Crotalaria scassellatii Chiov.	K7	HOO?H		2X	CFS	
Crotalaria serengetiana	K5				FTSA	Namanga-Nbi Rd, also T1,2
Crotalaria somalensis Chiov. ssp somalensis	K1,?	OCHCC		2X	CFS	also Som
Crotalaria sp C of FTEA	K1			E	FTSA	16Km S L.Turkana
Crotalaria tropeae	K1				FTEA	Dandu, Wajir also Som
Crotalaria tsavoana	K4,?				FTEA	Tsavo S N.P. also T2
Crotalaria ukambensis	K4,?				FTEA	Nbi-Garissa, Simba Stn also T
Dalbergia commiphorcides Bak.f.	K1				H	Samasa, also Eth & Som
Dalbergia erenicola Polhill	K1		R	E	KTSL	
Dalbergia melanoxylon Guill. & Perr.	K7	ØØØØH	?R	4	CFS, KTSL	OVER EXPLOITED
Dalbergia vacciniifolia Vatke	K7	ØØØOC		2	CFS	
Dicraeopetalum stipulare Harms	K1		R?V		BA	also Eth, S
Dolichos lutiola	K4,6				FTEA	Nairobi N.P, Ngong H also T2
Eriosema bogdanii	K4			E	FTEA	Mitunguu (Meru)
Eriosema scioanum var meruense	K6				FTEA	Chyulu S, also T2
Erythrina sacleuxii Hua	K7	ØØØØO		2	CFS	
Galactia argentifolia S.Moore	K7	ØHOHC		2	CFS	
Galactia tenuiflora (Willd.)Wight & Arn. interned. G.argentifolia S.Moore	K7	HOOHO		1(5)	CFS	
Galega battiscombei	K4			E	FTEA	Mt Kenya (Ragati P)
Indigofera cliffordiana Gillett	K7	OOHOO		2X	CFS	
Indigofera dauensis	K1			E	H	Ramu
Indigofera elwakensis Gillett	K1			E	H	Wajir, Madogashi-Garissa
Indigofera garissaensis Gillett	K7	OOHOH		2X	CFS	
Indigofera longimucronata Bak.f.	K7	ØØOØO		2	CFS	
Indigofera microcharoides Taub. var latistipulata Gillett	K7	HHOOH		2X	CFS	
Indigofera nairobiensis ssp viscida	K3				H	Moiben, Ol Joro Orok, T-falls
Indigofera schimperi Jaub. & Spach var crispidula Gillett	K2				H	Murua Nysigar also Ul & Sud
Indigofera sisalis Gillett	K7	ØHOOH		2X	CFS	
Indigofera sp nov = Gillett 21115	K7	OOHOO		1X	CFS	
Indigofera strobilifera (Hochst.)Bak. ssp lanuginosa (Bak.f.)Gillett	K7	ØHØHO		2	CFS	
Indigofera tanaensis Gillett	K7	OOHOO		1X	CFS	
Indigofera tanganyikensis Bak.f. var paucijuga Gillett	K7	HHØHH		1X	CFS	
Indigofera tanganyikensis Bak.f. var strigulosior Gillett	K3				H	Longonot, Elementeita also Et
Indigofera thikaensis Gillett	K4			E	H	Thika only
Indigofera volkensii Taub.	K7	HOHOH		2X	CFS	
Indigofera wajirensis Gillett	K1			E	H	
Indigofera wituensis Bak.f.	K7	CHOHC		2	CFS	
Indigofera zanzibarica Gillett	K7	ØCHØO		2	CFS	
Indigofera zavattarii Chiov.	K1,2				H	Lodwar, Murua Nysigar also Ul
Lonchocarpus kanurii Brenan & Gillett	?		RV		BA, KTSL	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Lonchocarpus sp cf bussei Harms	K7	000Ø0		1(3)	CFS	
Macrotyloma uniflorum (Lam.)Verdc. var benadirianum (Chiov.)Verdc.	K7	000HC		2X	CFS	Manda Is. also Som
Macrotyloma uniflorum (Lam.)Verdc. var verrucosum Verdc.	K7	ØØØØH		2	CFS	
Millettia lasiantha Dunn	K7	ØØ0Ø0		3	CFS	
Millettia leucantha Vatke	K4,6		RV?E		BA	
Millettia oblata Dunn ssp teitensis Gillett	K7		RV		BA	
Millettia tanaensis	K4		V	E	KTSL	
Ormocarpum keniense Gillett	K1,3,4,7	00H00		E	CFS	Lolokwe, Kora
Ormocarpum muricatum Chiov.	K1				H	Dandu also Eth & Som
Ormocarpum sennoides (Willd.)DC. ssp zanzibaricum Brenan & Gillett	K7	ØØ000		2	CFS	
Platycelyphium voense (Engl.)Willd.	K7	H0Ø0H		2X	CFS	
Pseudoeriosema borianii (Schweinf.)Hauman ssp longipedunculatum Verdc.	K7	0H000		2	CFS	Malindi also T3
Rhynchosia congensis Bak. ssp orientalis Verdc.	K7	0H000		2	CFS	also T3,8
Rhynchosia malacophylla (Spreng.)Boj.	K7	00Ø0H		2X	CFS	
Rhynchosia minima (L.)DC. var A of FTEA	K7	00Ø0H		2X	CFS	
Rhynchosia sp cf hirta (Andr.)Meikle & Verdc.	K7	Ø0Ø00		1(5)	CFS	
Rhynchosia speciosa	K1			S	FTEA	Mt Nyiru
Rhynchosia velutina Wight & Arn. var discolor (Bak.)Verdc.	K7	0H000		2	CFS	
Sesbania somalensis	K1				H	Banessa, Dugis, Laisamis also
Sesbania speciosa Taub.	K7	00ØH0		2	CFS	
Sophora inhambanensis Klotzsch	K7	0HØH0		2	CFS	
Spathionema kilimandscharicum Taub.	K7	ØØ0OH		2X	CFS	
Stylosanthes erecta P.Beauv. ? var	K7	CHH00		2	CFS	
Tephrosia polyphylla (Chiov.)Gillett	K7	00H00		2X	CFS	
Tephrosia subtriflora Bak. forma (T.graminifolia) = Greenway 10,461	K7	C0O0H		2X(5	CFS	
Teramnus sp cf nicans (Bak.)Bak.f.	K7	ØØCC0		1(4)	CFS	
Trifolium burchellianum var oblongum	K3,6				FTEA	Cheranganis, Elgon, Mau Narok
Trifolium cheranganiense	K2,3				FTEA	Murua Nysigar, Cherangani Hil
Trifolium lugardii	K3,5				FTEA	Also U1,3 (Elgon endemic)
Vigna friesiorum Harms var angustifolia Verdc.	K7	H0CC0		2X	CFS	
Vigna membranacea A.Rich. ssp hapalantha (Harms)Verdc.	K7	HH000		1	CFS	Likoni, A-Sokoke
Vigna parkeri Bak. ssp acutifoliola Verdc.	K7	H0?00		2	CFS	
Vigna praecox Verdc.	K7	ØØ0OH		2X	CFS	also T3
Vigna sp B of FTEA	K3			E	FTEA	Trans Nzoia Distr?
Zornia albolutescens Mohlenbr.	K4			S	H	Makueni
FAMILY: 154 BUXA						
Buxus obtusifolia (Mildbr.)Hutch.	K7	ØØCH0	R	2	BA	
FAMILY: 156 SALI						
Populus ilicifolia (Engl.)Rouleau	K1,4,7	00H0H	R	3	CFS, KTSL	
FAMILY: 167 MORA						
Dorstenia afromontana R.E.Fries	K3,4			3	FTEA	
Dorstenia barnimiana Schweinf. ? var nov	K7	0Ø000		1(5)	CFS	
Dorstenia ellenbeckiana Engl.	K1				FTEA	also Eth
Dorstenia goetzei Engl.	K7	0Ø00C		2	CFS	
Dorstenia hildebrandtii Engl. var hildebrandtii form a of FTEA	K7	ØØ0CH		2	CFS	
Dorstenia hildebrandtii Engl. var hildebrandtii form b of FTEA	K7	ØØC0O		2	CFS	
Dorstenia sp aff goetzei Engl.	K7	ØC0CC		1	CFS	
Dorstenia tayloriana Rendle var laikipiensis (Rendle)Hijman	K7	ØØ000		2	CFS	
Dorstenia tayloriana Rendle var tayloriana	K7	HØC00		2	CFS	
Dorstenia thikaensis Hijman	K4			S	FTEA	
Dorstenia warneckei Engl.	K7	ØØC00		2	CFS	
Ficus faulkneriana C.C.Berg	K7	ØC000		2	CFS	
Ficus lingua DeWild & Th.Dur. ssp depauperata (Sim)C.C.Berg	K7	ØØ0Ø0		2	CFS	
Ficus scassellatii Pamp. ssp thikaensis C.C.Berg	K4			E	FTEA	
Ficus tremula Warb. ssp tremula	K7	ØØ000		2	CFS	
FAMILY: 169 URTI						

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Australina flaccida (A.Rich.)Wedd.	K?				FTEA	also Sth
Pilea usambarensis Engl. var engleri (Rendle)Friis	K3,4				FTEA	also T2,3,6
Pilea usambarensis Engl. var veronicifolia (Engl.)Friis	K4				FTEA	also T3,6,7
Pouzolzia fadenii Friis & Jellis	K7	HØOHO		1	CFS	
Urera sansibarica Engl.	K7	ØØOOO		2	CFS	
FAMILY: 173 CELA						
Elaeodendron aquifolium (Fiori)Chiov.	K7	OHHOH			CFS	
Elaeodendron schlechteranum (Loes.)Loes.	K?	ØØØØH		2X?	CFS	
Elaeodendron schweinfurthianum (Loes.)Loes.	K7	ØØØØO		2	CFS	
Maytenus keniensis				3	BF	
Maytenus mossambicensis (Klotzsch)Blakelock var ambonensis (Loes.)N.Robson	K7	ØØOØH		2	CFS	
Maytenus sp ? nov nr heterophylla (Eckl. & Zeyh.)Robson = Msafiri & Wahome 346	K7	ØØOOO		1	CFS	
Pleurostylia africana Loes.	K7	ØØOØO			CFS	
FAMILY: 173 HIPP						
?Simirestis sp	K7	OOOHO			CFS	
Apodostigma pallens (Planch.)Wilczek var pallens	K7	ØØOOO			CFS	
Elachyptera ? parvifolia (Oliv.)N.Halle = Faden 71/750	K7	ØØOOO			CFS	
Elachyptera sp ? = Faden 71/684	K7	ØØOØO			CFS	
Loeseneriella crenata (Klotzsch)Wilczek	K7	OØØØO			CFS	
Pristimera andongensis (Welw.)Halle var volkensii (Loes.)Halle & Matthew	K7	ØØOOO			CFS	
Salacia elegans Oliv.	K7	ØØØØO			CFS	
Salacia erecta (G.Don)Walp.	K7	ØØØHO			CFS	
Salacia lehmbachii Loes. (?correct name S. leonensis Hutch. & Moss.)	K7	?ØOOO			CFS	
Salacia leptoclada Tul.	K7	ØØOOO			CFS	
Salacia madagascariensis (Lam.)DC.	K7	ØØOØO			CFS	
Salacia sp cf elegans Oliv. ? = Scheffler 46 (forma subintegra)	K7	ØOOOO			CFS	
Salacia sp cf erecta (G.Don)Walp. = Birch 62/222	K7	ØO?ØO			CFS	
Simirestis goetzei (Loes.)N.Halle	K7	O?OOH			CFS	
Simirestis scheffleri (Loes.)N.Halle	K7	OHOOO			CFS	
Simirestis sp	K7	ØOOOO			CFS	
FAMILY: 179 ICAC						
Iodes usambarica Sleumer	K7	ØOØØO		2	CFS	
FAMILY: 180 SALV						
Salvadora persica L. var cyclophylla (Chiov.)Cuf.	K7	HH?HO		2X	CFS	
FAMILY: 182 OLAC						
?Strombosiopsis sp	K7	ØOOOO		1	CFS	
FAMILY: 183 OPIL						
Pentarhopalopilia umbellulata (Baill.)Hiepko	K7	ØØØØH		2	CFS	
FAMILY: 185 LORA						
Emelianthe panganensis (Engl.)Danser	K7	ØØØOH			CFS	
Englerina ramulosa (Engl.)?	K7	OØOØO			CFS	
Erianthemum ambiguum (Engl.)Wiens & Polh.	K7	OOØOO			CFS	
Erianthemum curvirameum (Engl.)Wiens & Polh.	K7	ØØOØO			CFS	
Erianthemum dregei (Eckl. & Zeyh.)Tieghem ssp sodenii (Engl.)Wiens & Polh.	K7	ØØØØH			CFS	
Erianthemum sp	K7	HOOOO			CFS	
Erianthemum sp cf alveatum (Sprague)Danser = Msafiri 348	K7	HØOOO			CFS	
Helixanthera kirkii (Oliv.)Danser	K7	ØØØØH			CFS	
Oliverella hildebrandtii (Engl.)Tieghem	K7	HOHHH			CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Oncocalyx cordifolius Wiens & Polhill	K7	CCØØC			CFS	
Oncocalyx fischeri (Engl.)M.G.Gilbert ined	K7	COØØH			CFS	
Oncocalyx kelleri (Engl.)M.G.Gilbert ined	K7	OOØOO			CFS	
Oncocalyx rhamnifolius (Engl.)Tieghem	K7	ØØØHO			CFS	
Oncocalyx ugogensis (Engl.)Wiens & Polh..	K7	OØØOH			CFS	
Plicosepalus ? kalachariensis (Shinz)Danser	K7	?COOO			CFS	
Plicosepalus curviflorus (Benth.)Tiegh.	K7	OØØHH			CFS	
Plicosepalus meridianus (Danser)Polhill & Wiens	K7	OOØOH			CFS	
Plicosepalus sagittifolius (Engl.)Danser	K7	OHØ?H			CFS	
Tapinanthus aurantiacus (Engl.)Danser	K7	HØHOH			CFS	
Tapinanthus kayseri (Engl.)Danser	K7	HØØOO			CFS	
Tapinanthus sansibarensis (Engl.)Danser	K7	ØHØØO			CFS	
Tapinanthus subulatus (Engl.)Danser forma vel sp aff = Polhill & Paulo 777	K7	ØHOØO			CFS	
Taxillus wiensii Balle	K7	OØOOO			CFS	
FAMILY: 185 VISC						
Viscum hildebrandtii Engl.	K7	ØOHOH			CFS	
Viscum triflorum DC.	K7	HØOOO			CFS	
FAMILY: 186 SANT						
Thesium subaphyllum Engl.	K7	HOOOO			CFS	
FAMILY: 189 BALA						
Sarcophyte sanguinea Sparrman ssp piriei (Hutch.)B.Hansen	K7	?COOH			CFS	
FAMILY: 192 RHAM						
Lasiodiscus mildbraedii Engl. ssp ferrugineus (Verdc.)Faden	K7	ØØOØO	RV	1	CFS, BA	
Lasiodiscus pervillei Baill.	K7	ØCCCO		3	CFS	
Ziziphus hamur Engl.	K1				FTEA	also Eth, Som
Ziziphus sp nov	K7	ØCOOO		1	CFS	
FAMILY: 193 VITA						
Cissus quinquangularis Chiov.	K7			2?	CFS	
Cissus sciaphila Gilg	K7			2?	CFS	
Cyphostemma duparquetii (Planch.)Desc.				2?	CFS	
Cyphostemma jiguu Verdc.	K4			E	H	Thika, Embu
Cyphostemma sp nr pachyanthum (Gilg & Brandt)Desc.	K7			2?	CFS	
FAMILY: 194 RUTA						
Diphasia sp A of FTEA	K7		RVE	E	BA	
Diphasiopsis fadenii Kokwaro	K4/6,7		R	E	BA	
Teclea amaniensis Engl.	K7			2	CFS	
Teclea hanangensis Kokw. var uni	K4		R	E	BA	
Teclea sp = L&R 1755	K7			1	CFS	
Teclea sp nov	K7			1	CFS	New species?
Toddaliopsis sansibarensis (Engl.)Engl.	K7			2	CFS	
Vepris glandulosa (Hoyle & Leakey)Kokw.	K4		RVE	E	BA, IUCN	
Vepris samburuensis Kokw.	K1		R	E	BA	
Zanthoxylum paracanthum (Mildbr.)Kokwaro	K7			3	CFS	
FAMILY: 195 BALA						
Balanites wilsoniana Dawe & Sprague	K4,7		RV?E		BA	
FAMILY: 195 SIMA						
Brucea macrocarpa Stannard	K4		V	3	KTSL	
Brucea tenuifolia Engl. ssp keniensis ?	K4		RV	E	BA	
Odyendea zimmermannii Engl.	K7		R		BA	
FAMILY: 196 BURS						
Commiphora campestris ssp nagadiensis	K6				FTEA	also T2
Commiphora campestris ssp wajirensis	K1,7			E	FTEA	
Commiphora chaetocarpa Gillett	K1		R		BA	also S
Commiphora ciliata Vollesen	K1		R		BA	also Eth, S
Commiphora danduensis	K1			3	FTEA	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Commiphora holtziana ssp microphylla	K1,7				FTEA	also Som
Commiphora merkeri	K6				FTEA	also T2
Commiphora oblongifolia	K4,7			E	FTEA	
Commiphora ovalifolia	K4,6			E	FTEA	
Commiphora pseudopaolii Gillett	K7				CFS	
Commiphora sarandensis ssp moyaleensis	K1			E	FTEA	
Commiphora sp A of FTEA	K7				CFS	Female
Commiphora sp B of FTEA	K1			E	FTEA	
Commiphora sp C of FTEA	K1			E	FTEA	
Commiphora swynnertonii B.D.Burtt	K1		R		BA	also T5
FAMILY: 197 MELI						
Turraea barbata Sytles & F.White	K1,7			IX	FTEATS	
Turraea cornucopia Styles & F.White	K1,3,4,6		R	E	KTSL,FTEATS	
Turraea elephantina Styles & F.White	K7			IX	FTEATS	
Turraea kokwaroana	K1			E	FTEATS	
Turraea wakefieldii Oliv.	K7			2	CFS	
FAMILY: 198 SAPI						
Allophylus zimmermannii	K7		RV?E	2	BA	
Bottegoa insignis	K1				H	also Som
Camptolepis sp cf ramiflora (Taub.)Radlk.	K7			3?	CFS	
Chytranthus obliquinervis Engl.	K7		R	2	BA	
Chytranthus prieurianus Baill. ssp longiflorus (Verdc.)Halle	K7			2	CFS	
Haplocoelopsis africana F.G.Davies ined	K7		RV	3	BA, KTSL	
Haplocoelum inoploeum	K7			2	CFS	
Haplocoelum mombasense	K7		R?X i	2	BA	
Haplocoelum trigonocarpum	K7		R?V	2	BA	
Lecaniodiscus fraxinifolius Bak. ssp scassellatii (Chiov.)Fries	K7			2	CFS	
Macphersonia gracilis C.Hoffm. var hildebrandtii (O.Hoffm.)Capuron	K7			3	CFS	
Pancovia golungensis	K7			2	CFS	
Pancovia hildebrandtii	K7			2	CFS	
Stadmania oppositifolia Poir. ssp oppositifolia	K7			3	CFS	
FAMILY: 205 ANAC						
Lannea greenwayi Kokw.	K1,7				CFS	also Som
Lannea malifolia (Chiov.)Sacleux	K1		R		BA	also Eth, S
Lannea schweinfurthii (Engl.)Engl. var acutifoliolata (Engl.)Kokw.	K7			2	CFS	
Lannea welwitschii (Hiern)Engl. var ciliolata Engl.	K7			2?	CFS	
Rhus longipes var elgonensis	K3				H	also U1,3
Sclerocarya gillettii Kokw.	K1,7		R	E	BA	
FAMILY: 206 CONN						
Agelaea pentagyna (Lam.)Baill.	K7				CFS	
Cnestis mildbraedii Gilg	K5			E?	H	
Cnestis polyphylla Lam.	K7			E	CFS	
Connarus longistipitatus	K7		R		KTSL	
Ellipanthus hemandradenioides Brenan	K7		R	E	KTSL	
Rourea coccinea (Thonn.)Benth. ssp boivinianus (Baill.)Jongkind syn Byrsocarpus boivinianus	K7				CFS	
FAMILY: 212 ARAL						
Cussonia zimmermannii Harms	K7				CFS	
Polyscias kikuyuensis Summerh.	K3,4		RV	E	BA	
Polyscias stuhlmannii Harms var stuhlmannii	K7		R		BA	also T3,6
FAMILY: 213 UMBE						
Heracleum elgonense (H.Wolff)Bullock	K3,5				FTEA	also U3, Elgon endemic
Heracleum taylorii Norman	K3			E	FTEA	
Oreoschimperella aberdarensis	K3,5,6			E	FTEA	
Peucedanum englerianum H.Wolff	K3,4			E	FTEA	
Peucedanum friesiorum var bipinnatum	K3,4			E	FTEA	
Peucedanum friesiorum var friesiorum	K3,4			E	FTEA	
Peucedanum sp A of FTEA	K3			E	FTEA	
Pimpinella keniensis	K4,6				FTEA	also T2
Pimpinella oreophila var kilimandscharica	K3/4				FTEA	also T2

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Trachyspermum aethusifolium var verruculosa	K1,7			E	FTEA	
FAMILY: 221 EBEN						
Diospyros amaniensis Guerke	K7				CFS	
Diospyros cornii Chiov.	K7				CFS	
Diospyros greenwayi F.White	K7		R		KTSL	
Diospyros kabuyeana F.White	K7		V		KTSL	
Diospyros kanuriі F.White	K1		V		KTSL	
Diospyros occulta F.White	K7			2	CFS	
Diospyros shimbaensis F.White	K7		V	1	KTSL	
Diospyros squarrosa Klotzsch	K7				CFS	
Diospyros usambarensis F.White ssp rufescens A.N.Caveney	K7				CFS	
Diospyros wajirensis F.White	K1		R		KTSL	
FAMILY: 222 SAPO						
Afrosersalisia kassneri (Engl.)J.H.Hemsl.	K7		RV	E	BA	
Manilkara sansibarensis (Engl.)Dubard	K7				CFS	
Manilkara sulcata (Engl.)Dubard	K7				CFS	
Minusops somaliensis Chiov.	K7		R		BA	
Pachystela Sp Taxon A of KTSL	K7		V	E	KTSL	
Pachystela subverticillata E.A.Bruce	K7		RV	S	BA	
Sideroxylon inerme L. ssp diospyroides (Bak.)Hemsl.	K7				CFS	
Vitellariopsis kirkii (Bak.)Dubard	K7		R		BA	
FAMILY: 223 MYRS						
Embelia keniensis R.E.Fries	K4		RV?	3	KTSL	
FAMILY: 228 LOGA						
Mostuea brunonis Didr. var brunonis	K7			2	CFS	
Mostuea microphylla Gilg	K7			2	CFS	
Strychnos madagascariensis Poir.	K7			2?	CFS	
Strychnos mellodora S.Moore	K7				CFS	
Strychnos panganensis Gilg	K7				CFS	
Strychnos scheffleri Gilg var scheffleri	K7				CFS	
Strychnos spinosa Lam. ssp volkensii (Gilg)E.A.Bruce	K7				CFS	
Strychnos xylophylla Gilg	K7				CFS	
FAMILY: 229 OLEA						
Jasminum punctulatum	K7				H	also Som
Olea woodiana Knobl.	K7			2?	CFS	
FAMILY: 230 APOC						
Ancylobotrys tayloris (Stapf)Pichon	K7			2	CFS	
Baissea myrtifolia (Benth.)Pichon	K7			2	CFS	
Carvalhoa campanulata K.Schum.	K7			3	CFS	
Landolphia ? watsoniana (nomen subnudum)	K7			2	CFS	
Schizozygia coffaeoides Baill.	K7			2	CFS	
Strophanthus mirabilis Gilg	K7			2X	CFS	
Strophanthus zimmermannianus Monach.	K7		V	2	CFS, KTSL	
Tabernaemontana elegans Stapf	K7			2	CFS	
FAMILY: 231 ASCL						
?Dregea sp = Muchiri 501	K7				CFS	
Brachystelma keniense K.Schum.	K4		RV?E	E	H, KB17	Kinangop, T-falls-Nanyuki
Brachystelma lineare A.Rich.	K4				H	Ruiru also U. Gilbert thinks
Brachystelma sp A of UKWP	K4			E	H	Langata
Caralluma arachnoidea (Bally)M.Gilbert var breviloba (Bally)M.Gilbert	K6				Gilbert	Olorgosailie also Bth
Caralluma foetida E.A.Bruce	K3				Gilbert	Baringo also U
Caralluma gracilipes K.Schum.	K4,7			E	CFS, Gilbert	Kitui
Caralluma longiflora M.Gilbert	K1				Gilbert	Ramu-Malka Mari Rd also Som
Caralluma peckii Bally	K1,3				Gilbert	Archers Post also Bth
Ceropegia albisepta var bruceana	K4				H, Newton	Ngong, Thika, Emali also TZ
Ceropegia ballyana	K1,4,7				H	Mathews, Mukatan, Taitas also
Ceropegia crassifolia Bruce & Bally var copleyae E.A.Bruce	K4		E?	E	H	Kiambu, no coll since 1953
Ceropegia decumbens	K4			E?	H	Chyulus
Ceropegia galeata Huber	K7		E?	E?	H	Kinango, no coll since 1957
Ceropegia powysii Field syn C.sp A of UKWP	K3			E	Newton	Mukutan

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Conomitra linearis Fenzl.	K1			E	H	Mandera, El Wak
Cryptolepis sinensis (Lour.)Merr. ssp africana Bullock	K7			2	H	Buda also T6
Cynanchum omissum Bullock	K7				CFS	also T?
Cynanchum sp nr hastifolium N.E.Br. = Hucks 272	K7				CFS	Kora, Dakawachu
Echidnopsis angustiloba Bruce & Bally	K1			E	H, Bruyns	Ngurunit, Archers Post, L
Echidnopsis archeri	K6				Bruyns	Ngurunan Esc., Ngongs als
Echidnopsis ericiflora	K7			E	Bruyns	Lali Hills
Echidnopsis malum	K1				Bruyns	Mandera also Eth
Echidnopsis scutellata ssp australis	K1			E	Bruyns	Ramu-El Wak
Echidnopsis sharpei ssp repens	K6,7				H, Bruyns	Nananga, Ilbisil, Maktau
Echidnopsis urceolata Bally	K1				H	Ramu-Malki Mari also Eth
Echidnopsis watsonii	K1,3,7				Bruyns	Mt Nyiru, Baringo, Lali H
Huernia archeri Leach	K7			I	CFS	Kilifi, Malungangi
Oxystelma bornouense R.Br.	K4,7				CFS	also Som
Pachycymbium baldratii (White & Sloane)M.Gilbert ssp subterraneum (Bruce & Bally)M.Gilbert	K7				Gilbert	Sagalla also T
Pachycymbium denboefii (Lavranos)M.Gilbert	K6			E	Gilbert	Oloitokitok
Pachycymbium distinctum (E.A.Bruce)M.Gilbert	K7		E	2X	IUCN, CFS, Gilb	Taitas, Galana also T3
Pachycymbium laikipiense M.Gilbert	K1,3			E	Gilbert	Rumuruti-Maralal Rd, Bari
Pachycymbium tubiforme (Bruce & Bally)M.Gilbert	K3		E		IUCN, H, Gilber	L.Baringo, Archers Post a
Pachycymbium wilsonii (Bally)M.Gilbert	K?				Gilbert	? also U
Raphionacme abyssinica	K1				Newton	also Eth
Raphionacme brownii	K1,4				H	Samburu, Langata also T3
Raphionacme jurensis (N.E.Br.)Elliott	K1			E	H	Boula
Raphionacme sp = Bock in EAH 16,047	K7				CFS	
Raphionacme sp cf jurensis N.E.Br. = Archer 520	K7				CFS	
Tylophora sp = Polhill & Paulo 863	K7				CFS	
Tylophora sp aff sylvatica Decne. ? = R&L 5308	K7				CFS	
Tylophora sp B of UKWF	K7				CFS	
Tylophora stenoloba (K.Schum.)N.E.Br.	K7			2	CFS	
Xysmalobium stocksii N.E.Br. (incl Saxymolobium sp A of UKWF)	K4,6,7			E	H	Kwale, Chyulu Hills, Emal
FAMILY: 232 RUBI						
Aidia sp A of FTEA = Procter 2813	K7			2	CFS	
Anthospermum herbaceum var villosicarpum	K1			E	H	Furroli
Canthium fadenii Bridson ined	K4		V	E	KTSL	Chania Gorge
Canthium glaucum Hiern ssp glaucum	K7		RV?E	2?	CFS, BA	
Canthium keniense	K4		R	E	BF,KTSL	
Canthium kilifiensis Bridson	K7		RV	1	CFS, KTSL, BA	
Canthium oligocarpum ssp friesiorum	K3,4,6			E	BF, FTEATS	
Canthium oligocarpum ssp intermedium	K7				FTEATS	Taita Hills also T2,3,6
Canthium peteri Bridson	K7			2	CFS	
Canthium pseudoverticillatum S.Moore ssp pseudoverticillatum	K7		R?V	2	CFS, BA	
Canthium setiflorum Hiern ssp telidosma (K.Schum.)Bridson	K7			2	CFS	
Chassalia discolor ssp taitensis	K7		R	E	BF, KTSL	
Chassalia kenyensis				E	BF	
Chassalia umbraticola Vatke ssp umbraticola	K7			2	CFS	
Chazaliella abrupta (Hiern)Petit & Verdc. var parvifolia Verdc.	K7			1	CFS	
Cladoceras subcapitatum (K.Schum. & K.Krause)Bren.	K7			2	CFS	
Coffea arabica L.	K1		T		BA	
Coffea fadenii Bridson	K7		RV	E	BA	
Coffea pseudozanguebariae Bridson	K7			2	CFS	
Coffea rhamnifolia (Chiov.)Bridson	K7		V	2X	CFS, KTSL	
Coffea sessiliflora Bridson ssp sessiliflora	K7			1	CFS	
Dibrachionostylus kaessneri	K4			E	H	Thika, Nairobi N.P.
Diodia aulacosperma K.Schum. var aulacosperma	K7			2	CFS	
Feretia apodanthera Del. ssp keniensis Bridson	K7			2	CFS	
Galium brenanii	K7				H	Taita Hills also T2,3,6
Galium glaciale var glaciale	K3,4				H	Elgon, Mt Kenya also T2
Galium glaciale var satimmae	K4			E	H	Aberdares
Gardenia fiorii Chiov.	K7			2X	CFS	
Gardenia transvenulosa Verdc.	K7			2	CFS	
Heinsia zanzibarica (Bojer)Verdc.	K7			2	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Ixora scheffleri K.Schum. ssp keniensis Bridson	K4			E	BA, KTSL	
Keetia zanzibarica (Klotzsch)Bridson ssp zanzibarica	K7			2	CFS	
Kohautia caespitosa var kitaliensis	K3			E	H	Kitali
Kohautia obtusiloba (Hiern)Bremek.	K7			2	CFS	
Kohautia prolixipea (S.Moore)Bremek.	K7			1X	CFS	
Kraussia kirkii (Hook.f.)Bullock	K7			2	CFS	
Kraussia speciosa Bullock	K7			2	CFS	
Lagynias pallidiflora Bullock	K7			2	CFS	
Lamprothamnus zanguebaricus Hiern	K7			2	CFS	
Mitriostigma greenwayi Bridson	K7			1	CFS	
Multidentia sclerocarpa (K.Schum.)Bridson	K7			2	CFS	
Multidentia sp cf sclerocarpa (K.Schum.)Bridson	K7			1(2)	CFS	
Mussaenda monticola Krause var monticola	K7			2	CFS	
Oldenlandia acicularis	K3			E	H	Kipkarren, type coll only
Oldenlandia borrerioides Verdc	K7			!	CFS	Kurawa
Oldenlandia fastigiata Bremek. var pseudopentodon Verdc.	K7			1	CFS	Garsen
Oldenlandia fastigiata Bremek. var somala (Bremek.)Verdc.	K7			2X	CFS	
Oldenlandia friesiorum	K4				H	Aberdares, Mt Kenya also T7
Oldenlandia ichthyoderma Cufod.	K7			2X	CFS	
Oldenlandia johnstonii (Oliv.)Engl. ssp A of FTEA	K7			2	CFS	
Oldenlandia richardsonioides (K.Schum.)Verdc. var gracilis Verdc.	K7			2	CFS	Kiunga
Oldenlandia richardsonioides (K.Schum.)Verdc. var richardsonioides	K7			2	CFS	Mkokoni, Oseni
Oldenlandia rosulata K.Scum. var littoralis Verdc.	K7			1	CFS	Ukunda
Otomeria oculata S.Moore	K7			2X	CFS	
Oxyanthus pyriformis (Hochst.)Skeels ssp brevitubus	K4,6		RV		BA	also T2
Oxyanthus pyriformis (Hochst.)Skeels ssp longitubus Bridson	K7		R	1	CFS, BA	
Oxyanthus zanguebaricus (Hiern)Bridson	K7			2	CFS	
Pachystigma gillettii (Tennant)Verdc.	K1,4		R	E	BA	
Pachystigma loranthifolium (K.Schum.)Verdc. ssp loranthifolium	K7			2	CFS	
Pachystigma loranthifolium (K.Schum.)Verdc. ssp salaense Verdc.	K7			1X	CFS	
Pachystigma schumannianum ssp mucronulatum	K4,7			E	FTEATS	Embu, Nzaui
Pachystigma schumannianum ssp schumannianum	K6				FTEATS	Ngong Hills also T2
Paederia pospischilii K.Schum.	K7			2X	CFS	
Parapentas battiscombei Verdc.	K4,7			E	H	Nyambeni H, S Mt Kenya, Taita
Pavetta abyssinica var lanurensis	K4			S	FTEA	Lanuru. Type coll only.
Pavetta abyssinica var prescottii	K4			S	FTEA	Nanyuki
Pavetta aethiopica Bremek.	K1				FTEA	Huri Hills. Also Eth
Pavetta crebrifolia Hiern var crebrifolia	K7			2	CFS	
Pavetta crebrifolia Hiern var pubescens Bridson	K7			1	CFS	
Pavetta elliotii K.Schum. & K.Krause var elliottii	K4			E		Ngong Rd Forest & Machakos
Pavetta elliotii K.Schum. & K.Krause var trichocalyx (Bremek.)Bridson	K4			S		Chuka
Pavetta hymenophylla Brem.	K4		R		KTSL	also T3,6,7,8, Mal
Pavetta linearifolia Brem.	K7		R	2	CFS, BA	
Pavetta sansibarica K.Schum. ssp trichosphaera (Bremek.)Bridson var trichosphaera	K7			2	CFS	
Pavetta sepium var glabra	K4			S	FTEA	Kibwezi, type coll only
Pavetta sphaerobotrys K.Schum. ssp tanaica (Bremek.)Bridson	K7		RV	1X	CFS,BA	
Pavetta stenosepala K.Schum. ssp stenosepala	K7			2	CFS	
Pavetta tarennoides S.Moore	K7		R	1	CFS, KTSL	
Pavetta teitana	K4,6,7		R	E	KTSL	
Pavetta uniflora Bremek.	K7			2	CFS	
Pentanisia longituba	K1				H	Furroli, Marsabit also ETH & S
Pentanopsis fragrans	K1				H	Dandu also Eth & Som
Pentas ? micrantha Bak. ssp wyliei (N.E.Br.)Verdc.	K7			3?	CFS	
Pentas foetida	K4				H	Limuru, Mt Kenya also T2
Pentas hindsioides var hindsioides	K4?,7				H	Nasigau, Taita Hills
Pentas parvifolia Hiern ? forma spicata Verdc.	K4,6,7			E	CFS	

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Pentas suswaensis	K6			3	FTEA	Suswa
Pentas zanzibarica var tenuifolia	K8			3	FTEA	Digon
Polysphaeria cleistocalyx Verdc. var cleistocalyx	K4				FTEA	also T2,5,6
Polysphaeria multiflora Hiern ssp multiflora	K7			2	CFS	
Polysphaeria multiflora Hiern ssp pubescens Verdc.	K7			2	CFS	
Pseudomussaenda sp nov	K7			1	CFS	
Psychotria alsophila	K7				BF, FTEA	also T2,3
Psychotria amboniana K.Schum. var amboniana	K7			2	CFS	
Psychotria amboniana K.Schum. var velutina (Petit)Verdc.	K7			2	CFS	
Psychotria crassipetala Petit	K7		RV	E	BA	
Psychotria holtzii (K.Schum.)Petit var holtzii	K7			2	CFS	
Psychotria holtzii (K.Schum.)Petit var holtzii var pubescens Verdc.	K7			2	CFS	
Psychotria leucopoda Petit	K7			2	CFS	
Psychotria petitii Verdc.	K7		RV?E	E	BA	
Psychotria pseudoplatyphylla Petit	K7		R		BA	
Psychotria punctata Vatke var minor Petit	K7			2	CFS	
Psychotria punctata Vatke var tenuis Petit	K7			1	CFS	
Psychotria schliebenii Petit var parvipaniculata Petit	K5,7			2	CFS	Gongoni
Psychotria schliebenii Petit var sessilipaniculata Petit	K7			2	CFS	
Psychotria sp B of FTEA	K7		?X	3	KTSL	
Psychotria sp C of FTEA	K5,6			3	BF	
Psychotria taitensis	K4,7		V	3	BF, KTSL	
Psydrax faulknerae Bridson	K7			2	CFS	
Psydrax kaessneri (S.Moore)Bridson	K7			2	CFS	
Psydrax polhillii Bridson	K7			2	CFS	
Psydrax recurvifolia (Bullock)Bridson	K7			2	CFS	
Psydrax robertsoniae Bridson	K7		R	1	CFS, KTSL	
Psydrax sp A of FTEATS	K7			1	CFS	
Pyrostria sp A of FTEATS	K4,6,7			2	FTEATS	Small Hill, Kasigau
Rothmannia macrosiphon (Engl.)Bridson	K7			2	CFS	
Rothmannia ravae (Chiov.)Bridson	K7			2	CFS	
Rytigynia decussata (K.Schum.)Robyns	K7			2	CFS	
Rytigynia eickii (K.Schum. & K.Krause)Bullock	K7			2X?	CFS	
Rytigynia induta	K4		RV		BA	
Rytigynia mrimaensis Verdc.	K7		V	1	CFS, KTSL	
Rytigynia parvifolia Verdc.	K7			2	CFS	
Rytigynia sp I of FTEATS	K7			1	CFS	
Rytigynia sp L of FTEATS	K7			1	CFS	
Spermacoce sp A of FTEA	K7			1X?	CFS	Mackinnon Rd
Spermacoce sp B of FTEA = Bally B8546	K7			1	CFS	Bamba
Tarenna drummondii Bridson	K7			2	CFS	
Tarenna graveolens (S.Moore)Bremek. var impolita Bridson	K7			1X?	CFS	
Tarenna kibuwae Bridson	K7		R	1X	CFS, KTSL	
Tarenna pavettoides (Harv.)Sim ? ssp friesiorum (K.Krause)Bridson	K7			2X	CFS	
Tennantia sennii (Chiov.)Verdc. & Bridson	K7			1X	CFS	
Tricalysia bridsoniana Robbrecht var bridsoniana	K7		R	1	CFS, KTSL	
Tricalysia microphylla Hiern	K7			2	CFS	
Tricalysia ovalifolia Hiern var taylorii (S.Moore)Brenan	K7			2	CFS	
Vangueria randii S.Moore ssp acuminata Verdc.	K7			2	CFS	

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Acanthospermum hispidum DC.	K7				CFS	
Achyrothalamus marginatus O.Hoffm.	K7				CFS	
Adenostemma perottetii DC.	K7				CFS	
Ageratum conyzoides L.	K7				CFS	
Aspilia kotschyi Benth.	K7				CFS	
Aspilia macrorrhiza Chiov.	K7				CFS	
Aspilia mossambicensis (Oliv.)Wild	K7				CFS	
Bidens biternata (Lour.)Merr. & Sherff	K7				CFS	
Bidens gracilior (O.Hoffm.)Sherff	K7				CFS	
Bidens holstii (O.Hoffm.)Sherff = Bally B8749	K7				CFS	
Bidens pilosa L.	K7				CFS	

Species	PTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Bidens schimperi Sch.Bip.	K7				CFS	
Bidens taylorii (S.Moore)Sherff	K7				CFS	
Blainvillea gayana Cass.	K7				CFS	
Blepharispermum lanceolatum Chiov. Spathulate lf form	K7				CFS	
Blepharispermum zanguebaricum Oliv. & Hiern	K7				CFS	
Blumea aurita DC.	K7				CFS	
Blumea brevipes Oliv. & Hiern	K7				CFS	
Blumea crispata	K7				CFS	
Blumea sp	K7				CFS	
Bothriocline somalensis O.Hoffm.	K7				CFS	
Brachylaena huillensis O.Hoffm.	K7				CFS	
Cornyza aegyptiaca (L.)Ait.	K7				CFS	
Cornyza bonariensis L.	K7				CFS	
Cornyza sumatrensis (Retz)E.H.Walker	K7				CFS	
Dicoma tomentosa Cass.	K7				CFS	
Dyssodia tenuiloba (DC.)Rob. var tenuiloba	K7				CFS	?Introduced
Eclipta prostrata L.	K7				CFS	
Emilia bellioides (Chiov.)C.Jeffrey	K7			2X	CFS	
Emilia somalensis (S.Moore)C.Jeffrey	K7			2X	CFS	
Emilia sp aff sonchifolia (L.)Wight	K7			?	CFS	
Erythrocephalum minus Oliv.	K7				CFS	
Ethulia gracilis Del.	K7				CFS	
Flaveria australasica Hook.f.	K7				CFS	Naturalised
Galinsoga parviflora Cav.	K7				CFS	
Geigeria acaulis (Sch.Bip.)Oliv. & Hiern	K7				CFS	
Gnaphalium luteo-album L.	K7				CFS	
Grangea maderaspatana Poir.	K7				CFS	
Gravanthus linearifolius (O.Hoffm.)Fayed	K7				CFS	
Gutenbergia cordifolia Oliv	K7				CFS	
Gutenbergia pembensis S.Moore	K7				CFS	
Gutenbergia polysephala ?	K7				CFS	
Gynura colorata F.G.Davies	K7			2	CFS	
Helichrysum glumaceum DC.	K7				CFS	
Hirpicium diffusum (Oliv.)O.Hoffm.	K7				CFS	
Kleinia breviflora C.Jeffrey	K7			2X	CFS	
Kleinia implexa (Bally)C.Jeffrey	K7			2X	CFS	
Kleinia petraea (R.E.Fries.)C.Jeffrey	K7			2X	CFS	
Lactuca capensis Thunb.	K7				CFS	
Lactuca serricola L.	K7				CFS	
Launea cornuta (Oliv. & Hiern)C.Jeffrey	K7				CFS	
Launea intybacea (Jacq.)Beauv.	K7				CFS	
Launea sarmentosa (Willd.)O.Kunth.	K7				CFS	
Melanthera biflora (L.)Wild	K7				CFS	
Microglossa hildebrandtii O.Hoffm.	K7				CFS	
Mikania chenopodiifolia Willd. syn M.cordata (Burm.f.)Robinson	K7				CFS	
Nicolasia nitens O.Hoffm.	K7				CFS	
Pluchea dioscoridis DC.	K7				CFS	
Pluchea ovalis DC.	K7				CFS	
Pluchea sordida (Vatke)Oliv. & Hiern	K7				CFS	
Psiadia punctulata (DC.)Vatke	K7				CFS	
Sclerocarpus africanus Herr.	K7				CFS	
Senecio johnstonii Oliv. ssp battiscombei (R.E. & T.C.E.Fries)Mabberly var battiscombei	K3,4		V	E	KTSL	
Senecio johnstonii Oliv. ssp battiscombei (R.E. & T.C.E.Fries)Mabberly var cherenganiensis (Cotton & Blakel.)C.Jeffrey	K3		V	E	KTSL	
Senecio johnstonii Oliv. ssp battiscombei (R.E. & T.C.E.Fries)Mabberly var dalei (Cotton & Blaket)C.Jeffrey	K3			E		
Senecio johnstonii Oliv. ssp elgonensis (T.C.E.Fries)Mabberly var elgonensis	K3,5		R	E	KTSL	
Senecio johnstonii Oliv. ssp elgonensis (T.C.E.Fries)Mabberly var ligulatus (Cotton & Blakel.)C.Jeffrey	K3		R	E	KTSL	
Senecio keniensis Bak. ssp brassiciformis (R.E. & T.C.E. Fries)C.Jeffrey	K3,4		R	E	KTSL	
Senecio keniensis Bak. ssp keniensis	K4		R	E	KTSL	
Senecio keniodendron R.E. & T.C.E. Fries	K4		R	E	KTSL	
Siegesbeckia orientalis L.	K7				CFS	
Sphaeranthus africanus L.	K7				CFS	
Sphaeranthus cyathuloides O.Hoffm.	K7				CFS	
Sphaeranthus kirkii Oliv. & Hiern	K7				CFS	
Sphaeranthus ukambensis Vatke & O.Hoffm.	K7				CFS	
Sphaeranthus zavattari Cuf.	K7				CFS	

Species	FTEA area	CPS (X7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Spilanthes mauritiana (Pers.)DC.	X7				CPS	
Synedrella nodiflora Gaertn.	X7				CPS	
Thymophylla tenuiloba (DC.)Small	X7				CPS	
Tridax procumbens L.	X7				CPS	
Vernonia aemulans Vatke	X7				CPS	
Vernonia amygdalina Del.	X7				CPS	
Vernonia cinerascens Sch.Bip.	X7				CPS	
Vernonia cinerea (L.)Less	X7				CPS	
Vernonia colorata (Willd.)Drake	X7				CPS	
Vernonia hildebrandtii Vatke	X7				CPS	
Vernonia homilantha S.Moore	X7				CPS	
Vernonia stenolepis Oliv.	X7				CPS	
Vernonia uncinata Oliv. & Hiern forma vel sp aff = Bally 16,858	X7				CPS	
Vernonia wakefieldii Oliv.	X7				CPS	
Vernonia zanzibarensis Loes.	X7				CPS	
FAMILY: 239 GENT						
Canscora decussata Roem. & Schultes	X7				CPS	
Chirona elgonensis Bullock	X3				K	Kitale, Kipkarren
Enicostema axillare (Lam.)A.Raynal ssp latilobum (N.E.Br.)A.Raynal	X7			2?	CPS	
Swertia scandens Th.Fr.jr.	X4			E?	UKWP	Mt Kenya
Swertia subnivalis Th.Fr.jr.	X3,4			E?	UKWP	Mt Elgon, Mt Kenya
Swertia uniflora Mildbr.	X3			E?	UKWP	Mt Elgon
FAMILY: 240 PRIM						
Lysmachia sp A of FTEA	X1					Mt Kulal
Lysmachia volkensii Engl.	X3,4,5,6					also T2
FAMILY: 241 PLUM						
Plumbago stenophylla Wilmot-Dear	X7			E	FTEA	Mida
FAMILY: 243 CAMP						
Campanula keniensis Thulin	X6			E	FTEA	Ngong Hills
FAMILY: 244 LOBE						
Lobelia bambuseti R.E. & T.C.E. Fries	X3,4		R	E	KTSL	Aberdares, Mt Kenya
Lobelia cheranganiensis Thulin	X3			E	FTEA	Cherangani Hills
Lobelia deckenii (Aschers.)Hemsl. ssp elgonensis (R.E. & T.C.E.Fries)Mabberley	X3				FTEA	also U3, endemic Elgon
Lobelia deckenii (Aschers.)Hemsl. ssp keniensis (R.E. & T.C.E.Fries)Mabberley	X4			E	FTEA	Mt Kenya
Lobelia deckenii (Aschers.)Hemsl. ssp sattimae (R.E. & T.C.E.Fries)Mabberley	X3,4			E	FTEA	Aberdares
Lobelia lindblomii Mildbr.	X3,4				FTEA	Elgon, Aberdares also U3
Lobelia telekii Schweinf.	X3,4				FTEA	Mt Kenya, Elgon (U3)
FAMILY: 248 HYDR						
Hydrolea sansibarica Gilg	X7			2	CPS	
FAMILY: 249 BORA						
?Ehretia sp	X7			1?	CPS	
Bourreria lyciacea Thulin	X7			2X	CPS	
Bourreria nemoralis (Guerke)Thulin	X7			2	CPS	
Bourreria teitensis (Guerke)Thulin	X7			2X	CPS	
Cordia faulknerae Verdc.	X7			2	CPS	
Cordia fischeri Guerke	X6?			E?	FTEA	
Cordia guineensis Thonn. ssp mutica Verdc.	X7			2	CPS	
Cordia longipetiolata Warfa	X1			E	FTEA	Dadaab-Wajir Rd
Cordia sp B of FTEA	X7			1	CPS	
Cordia torrei S.Martins	X7			2	CPS	
Cynoglossum aequinoctiale T.C.E.Fries	X2,3,4				FTEA	Elgon, Cheranganis, T-Falls a
Cynoglossum cheranganiense Verdc.	X2,3,6			E	FTEA	Cheranganis
Cynoglossum karamojense Verdc.	X2				FTEA	Mt Kachagalau also U1
Cystostemon virescens A.G.Miller & Riedl	X1				FTEA	Ramu-Malka Mari Rd also Eth
Echiochilon lithospermoides (S.Moore)I.M.Johnston	X1,3,6				FTEA	Banissa, Rumuruti, Amboseli a
Heliotropium applanatum Thulin & Verdc.	X1				FTEA	Wajir also Som
Heliotropium benadirense Chiov.	X7			2	CPS	
Heliotropium gorinii Chiov.	X7			2	CPS	
Heliotropium pectinatum Vaupel ssp pectinatum	X7			2X?	CPS	

Species	FTEA area	CFS (X?) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Heliotropium pectinatum Vaupel ssp septentrionale Verdc.	X1,2,7			1X	CFS	Turkana, Garissa
Heliotropium scotteae Rendle	X1,?3,4			3	FTEA	Mathews, Ol Doinyo Sapuk
Heliotropium sessilistigma Hutch. & Bruce	X7			2X	CFS	
Heliotropium sp A of FTEA	X7			1X	CFS	Tana Distr, 4Km N SKT 15
Myrsotis keniensis T.C.E.Fries	X4				FTEA	Mt Kenya also Eth (Mt Bale)
Trichodesma marsabiticum Brummitt	X1,4			E	FTEA	
FAMILY: 250 SOLA						
Physallis angulata L.	X7				CFS	
Solanum darassumense Dammer	X1				H	Dandu also ETH & Som
Solanum goetzei Dammer	X7				CFS	
Solanum panpaninii Chiov.	X7				CFS	
Solanum sp C	X4			E?	H	Mutha
Solanum sp cf monotanthus Dammer	X7				CFS	
Solanum sp I = Rawlins 226	X7				CFS	
Solanum sp J of UKWF	X4		V		KTSL	
Solanum zanzibarense Vatke	X7				CFS	
FAMILY: 251 CONV						
Astripomoea delamereana (Rendle)Verdc.	X1			E	FTEA	NFD? (Cantalla & Hadda) Type c
Astripomoea longituba Verdc.	X1			E	FTEA	Uaso Nyiro R, 38Km N of Isiolo
Astripomoea malvacea (Klotzsch)Meeuse var involuta (Rendle)Verdc.	X1			E	FTEA	Marsabit
Astripomoea tubiflora (Hall.f.)Verdc.	X1			E	FTEA	Irma 1893
Convolvulus jefferyi Verdc.	X7			2	CFS	
Convolvulus sp A of FTEA	X7			1X	CFS	
Ipomoea albivenia (Lindl.)Sweet	X7			2?	CFS	
Ipomoea cicatricosa Bak.	X7			2X	CFS	
Ipomoea donaldsonii Rendle	X7			2X	CFS	
Ipomoea garckiana Vatke	X7			2X	CFS	
Ipomoea hartmannii Vatke	X4,6,7			E	FTEA	Emali, Kibwezi, Tsavo R
Ipomoea hildebrandtii Vatke ssp orientalis Verdc.	X?			1X?	CFS	
Ipomoea irwinae Verdc.	X7			2	CFS	
Ipomoea lapidosa Vatke	X1,3,4,6			E	FTEA	Wamba, Baringo, Chyulus
Ipomoea paolii Chiov.	X1,?7			1X?	CFS	
Ipomoea sp nr urbaniana (Dammer)Hall.f. cf I.flavivillosa Schulze-Menz = Gillett 18,721	X7			2?	CFS	
Ipomoea tenuirostris Choisy ssp hindeana (Rendle)Verdc.	X4,6				FTEA	Machakos, Athi Plains also T2
Ipomoea tenuirostris Choisy ssp repens Verdc.	X7			2X	CFS	
Ipomoea ticcopa Verdc.	X7			2	CFS	
Merremia gorinii Chiov.	X1				FTEA	Yabichu also Som
Merremia hemmingiana Verdc.	X7			1X	CFS	
Merremia lobata Verdc.	X7			1X	CFS	
Merremia sp A of FTEA	X7			1X	CFS	
Merremia sp B of FTEA	X1			E	FTEA	El Wak
Merremia subpalmata Verdc.	X1				FTEA	Wajir also ?Ogaden
Merremia tridentata (L.)Hall.f. ssp pubescens Rendle	X7			2	CFS	
Seddera hirsuta Hall.f. var gracilis (Chiov.)Verdc.	X7			2X	CFS	
Seddera hirsuta Hall.f. var hirsuta	X2				FTEA	Loragumu also Eth
Stictocardia macalusoi (Mattei)Verdc.	X7			2	CFS	
FAMILY: 256 GESN						
Saintpaulia rupicola B.L.Burtt	X7			1	CFS	Kilifi Distr
Saintpaulia sp nov	X7			1	CFS	Kilifi Distr
Saintpaulia teitensis B.L.Burtt	X7			3	H	Taitas
Streptocarpus exertus	X?1,2			3	H	Chemorongit Mts, Ololokwe
FAMILY: 257 BIGN						
Fernandoa magnifica Seem	X7			2?	H	
FAMILY: 258 PEDA						
Josephinia africana Vatke	X1,7				FTEA, CFS	Voi, Kurawa also Som
Pterodiscus coeruleus Chiov.	X1				FTEA	Bura-Ijara Rd also Som
FAMILY: 263 VERB						
Chascanum moldenkei (Gillett)Sebsebe & Verdc.	X1			E	FTEATS	Mandera-El Wak Rd
Chascanum obovatum ssp obovatum	X1				FTEATS	Dandu, Mandera also ETH

Species	FTEA area	CFS (K7) Distrib.	RARITY Status	ENDEMIC Code	SOURCE	Comment
Chascanum rariflorum	K1				FTEATS	Mandera-Ramu also Eth
Chascanum sp A of FTEATS	K6			E	FTEATS	Athi Plains. 1 coll only
Clerodendrum johnstonii ssp marsabitensis	K1			E	FTEATS	Marsabit
Clerodendrum rupicola	K1,7			E	FTEATS	Meru, Zora, TPR
Clerodendrum tricholobum	K7			2	FTEATS	
Karomia gigas (Faden)Verdc.	K7		X		BA	Mwarakaya
Lantana humuliformis	K4,7				FTEATS	Kiboko-Kibwezi also T5
Lippia dauensis	K1				FTEATS	Banissa-Malka Mari Rd also S
Lippia somalensis	K1,?3/6				FTEATS	Marsabit also Som
Premna chrysoclada	K7			2	FTEATS	
Premna discolor Verdc. var dianiensis	K7			1	FTEATS	
Premna discolor Verdc. var discolor	K7			1	FTEATS	
Premna gracillima Verdc.	K7			2	FTEATS	
Premna maxima	K1,4		R?V	E	BA	Marsabit, Meru
Premna resinosa ssp holstii	K7			2	FTEATS	
Vitex fischeri	K7			2?	FTEATS	
Vitex keniensis	K4,5			E	BF	
Vitex zanzibarensis	K7		R	2	BA	Kaya Kinondo, Gongoni
FAMILY: 293 LILI						
Aloe ballyi	?		R		BA	
Aloe cheranganiensis Carter & Brandham	K2		V	E	KTSL	
Aloe nyeriensis Christian	K4		V	E	KTSL	
FAMILY: 315 PAND						
Pandanus murira Beentje ined	K4		RV?E	E	BA	