Kilak, Aswa River, Zoka and Opit Forest Reserves

Biodiversity Report

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THE REPUBLIC OF UGANDA

FOREST DEPARTMENT

Foreword

Biodiversity is a word that has only entered common usage during the past few years, gaining particular prominence since the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. It is a useful term, describing the variety of life at all levels of organisation from ecosystems to species and genes. Nevertheless, despite the new terminology, many of the concepts it embodies and the principles involved in its conservation have remained fundamentally unchanged.

The Uganda Forest Department has long been aware of the need to protect representative examples of different forest communities in an undisturbed state, in order to safeguard the survival of their associated flora and fauna. Forest Nature Reserves were first established in many of the larger forests during the 1950's and others have been added subsequently. However, with the development of conservation science and the benefit of hindsight, we now know that these early reserves were mostly too small to remain viable in the long-term, and larger areas are consequently in need of preservation. Accordingly, at the time of the Forest Policy revision in 1988, a decision was taken to set aside 20% of the country's forest estate as new forest Nature Reserves, primarily to ensure adequate protection for our forest biodiversity.

Clearly such a policy decision must be implemented on the basis of a sound technical understanding of the issues concerned and a comprehensive knowledge of the biological resources in our custody. Selecting an appropriate national network of sites to protect the full range of biodiversity is a complex task and it has taken some time to complete the first stage in that process, namely an inventory of biological resources in our major forests. We have been fortunate to receive tremendous support for this work from the European Community, the Global Environment Facility and Voluntary Service Overseas, and I take this opportunity to thank all those concerned. Along with others in the series, this report describes the extensive work carried out by the inventory teams, which I have been following closely over the past few years and which I commend to you as being work of very high quality. The results of this research will prove indispensable as we set about the process of selecting our Nature Reserves and will provide a much-needed baseline against which to monitor any future ecological change within our forests.

In September 1993, the Uganda Government ratified the Convention on Biological Diversity, thereby undertaking to ensure the conservation and sustainable use of the country's biodiversity. As one of the most biodiverse countries in the world, Uganda recognises that it has a special responsibility in this regard. An important task under the terms of Article 7 of the Convention is to identify and monitor components of biological diversity and maintain and organise relevant data. The work described in this series of reports goes a long way towards meeting these objectives and provides a very sound basis for future work.

E.D. Olet
Commissioner for Forestry

Kampala, 1996

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A great many people contributed to this work. The biological inventory programme is an activity of the Department's Natural Forest Conservation Section, designed and managed by Fred Kigenyi and Peter Howard, with assistance from David Duli, David Hafashimana and (until January 1994) Robert Nabanyumya.

The fieldwork and the compilation of this series of reports was supervised and co-ordinated by Tim Davenport, Michael Baltzer, Christopher Dickinson and Roger Matthews. Data handling and the layout and production of the reports was carried out by the Biodiversity Database Unit, under the supervision and management of Isaac Kapalaga and Paolo Viskanic, with assistance from Justine Mwanje, Josephine Birabwa, Margaret Kibumba, Constance Namirembe and Anne Mpendo. The report series was edited by Peter Howard and Tim Davenport.

Much of the fieldwork was carried out over a period of 27 months between January 1993 and March 1995 by teams of forest rangers, including C. Andama, A. Chale, S. Chemusto, H. Dumba, C. Kabaseke, D. Mijumbi, S. Nsengiyunva, P. Nsubuga, K. Odrale, R. Oduko, J. Tagaba, F. Tinkasimiire, W. Wandwasi, and T. Williams. In addition, J. Kasangaki, S. Kirya and D. Nkuutu were engaged on the programme throughout 1993, and J. Adriko, H. Alule, U. Ndyanabo and L. Omoya between January 1994 and March 1995. The fieldwork could not have been carried out without the support of the Department's field staff throughout the country, and members of the communities surrounding the forests who served as guides, field assistants and porters. Their assistance is very gratefully acknowledged.

The scientific integrity of the information contained in these reports has been considerably enhanced by the expertise of various plant and animal taxonomists who have assisted with the identification of specimens. In particular, many of the more difficult plant identifications were made by A. Katende (Makerere University), and most of the mammal specimens were identified by R. Kityo (Makerere University). Makerere University herbarium was used extensively and the assistance of E. Kakudidi and O. Maganyi is gratefully acknowledged. At Forest Department headquarters, a new herbarium has been established under this programme, where field specimens have been mounted, catalogued and stored under the supervision of R. Badaza, with assistance from S. Kifuku, J. Mukunya and A. Namukwaya.

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The success of the field programme owes much to the high standards of initial training in biological inventory techniques provided to the field teams at Makerere University Biological Field Station and nearby forests between May and August 1992. Particular thanks are extended to J. Ahrens, R. Nabanyumya, D. Pomeroy, A. Johns, J. Kasenene and G. Basuta for overall co-ordination, and to the many technical experts who participated including C. Dranzoa, J. Goodman, P. Ipulet, C. Kanzig, A. Katende, A. Kisubi, R. Kityo, J. Lwanga, J. Obua and J. Omoding.




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Any programme of this kind depends on strong administrative support and the efforts of R. Nabanyumya, J. Kizito (GEF), A. Sinton and M. Serwadda (EC) are gratefully acknowledged. Secretarial and other support services have been very ably provided by R. Babirye, P. Bafirawala, M. Kibumba, S. Nakachwa and C. Namirembe.

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Finally, this programme would not have been possible without a strong commitment on behalf of government and donors based on a recognition of the importance of Uganda's biodiversity. The personal interest of the Commissioner for Forestry, E. Olet and his predecessor, L. Kiwanuka has proven invaluable, as has the commitment of Chief Technical Advisors, D. Earl, R. Murtland, and A. Rodgers.

Contents

Tables

Figures

Chapter 1

Summary

1.1 SUMMARY

Kilak, Aswa River, Zoka and Opit Forest Reserves cover some 299 km^2 (102 km^2, 85 km^2, 61 km^2, and 51 km^2, respectively) in Gulu, Kitgum and Moyo districts of northern Uganda. With altitudinal ranges of 880-1390, 680-880, 900-970 and 1080-1180, metres above sea level, the reserves may be broadly classified as *Butyrospermum* savanna in Kilak, dry *Combretum* savanna in Aswa River, medium altitude moist semi-deciduous forest and mixed savanna in Zoka and *Terminalia* woodland in Opit. The flora and fauna of these reserves is not especially diverse, nor characterised by rare and/or restricted-range species.

Kilak, Aswa River, Zoka and Opit were surveyed in June, Noveber and December 1993, as part of a national forest biodiversity inventory programme. Species lists were compiled for biological indicator taxa by different teams of Forest Department staff over a total period of two weeks. Regional insecurity meant that a number of taxa were poorly sampled in relation to other forests visited during the programme.

The main body of this report provides detailed accounts of work carried out on the trees and shrubs; birds; small mammals; butterflies and large moths of the reserves, with each group the subject of a largely self-contained chapter. The areas where work was carried out are described and mapped, and a detailed account of sampling procedures and effort is provided alongside the results. Each chapter was provisionally compiled before comparable data from other sites were largely available. Subsequently, however, it has been possible to carry out some preliminary analysis of the results from all 65 forests investigated under the programme, so as to provide an indication of the importance of Kilak, Aswa River, Zoka and Opit for biodiversity conservation relative to other Ugandan forests.

Tables 1.1 to 1.4 provide summaries of the information gathered on the indicator taxa from Kilak, Aswa River, Zoka and Opit. For each taxon, the total number of species known is given compared with the totals recorded during the Forest Department inventory. Very little previous work has been carried out in these reserves and consequently the inventory has contributed greatly to our biological knowledge of these forests. However, the comparatively short survey periods mean that further work is likely to add many more species to the lists.

Compared with other Ugandan forests, Kilak, Aswa River, Zoka and Opit are not particularly biodiverse, with species diversity (an index of species richness per unit area, as recorded by the current inventory and then adjusted for sampling intensity) being average or below average for all taxa investigated. The exceptions being the trees and shrubs and small mammals in Zoka which are above average. In terms of the ‘conservation value’ of the species represented (based on knowledge of their world-wide distributions and occurrence in Ugandan forests), all forests are average or below average for all taxa investigated. As a basis for further comparison with other sites, 6, 13, 22 and 4 species may be classified as restricted-range (recorded from no more than five Ugandan forests) in Kilak, Aswa River, Zoka and Opit, respectively.

The information collected from Kilak, Aswa River, Zoka and Opit is now being used in an analysis of national conservation priorities and the development of a representative system of forest Nature Reserves.

Table 1.1 Summary of biodiversity and conservation importance of the two indicator taxa surveyed in Kilak

	Trees and Shrubs	Butterflies
N°. of species now known from forest	74	27
N°. of restricted-range species (known from ≤5 forests)	5	1
N°. of regional endemics	0	0
N°. of species recorded by current inventory	74	27
Species diversity	✶✶	✶
Species conservation value	✶✶	✶

Star ratings indicate values relative to the other 64 Ugandan forests investigated under this programme: ✶✶✶✶ top 10% of sites; ✶✶✶ top 11-25% of sites; ✶✶ mid-ranking 26-74% of sites; ✶ bottom 25% of sites. Regional endemics refer to species restricted to Uganda, the Albertine Rift and/or the Somali-Masaai region.

Table 1.2 Summary of biodiversity and conservation importance of the four indicator taxa surveyed in Aswa River

	Trees and Shrubs	Birds	Small Mammals	Butterflies
N°. of species now known from forest	127	51	3	40
N°. of restricted-range species (known from ≤5 forests)	9	2	0	2
N°. of regional endemics	0	0	0	1
N°. of species recorded by current inventory	43	51	2	40
Species diversity	✶✶	✶✶	✶	✶
Species conservation value	✶✶	✶	✶✶	✶✶

Star ratings indicate values relative to the other 64 Ugandan forests investigated under this programme: ✶✶✶✶ top 10% of sites; ✶✶✶ top 11-25% of sites; ✶✶ mid-ranking 26-74% of sites; ✶ bottom 25% of sites. Regional endemics refer to species restricted to Uganda, the Albertine Rift and/or the Somali-Masaai region.

Table 1.3 Summary of biodiversity and conservation importance of the five indicator taxa surveyed in Zoka

	Trees and Shrubs	Birds	Small Mammals	Butterflies	Large Moths
N^{o}. of species now known from forest	188	107	12	27	10
N^{o}. of restricted-range species (known from ≤5 forests)	6	15	1	0	0
N^{o}. of regional endemics	1	0	1	0	0
N^{o}. of species recorded by current inventory	119	26	5	27	10
Species diversity	✶✶✶	✶	✶✶✶	✶	✶✶
Species conservation value	✶✶	✶✶	✶✶	✶	✶

Star ratings indicate values relative to the other 64 Ugandan forests investigated under this programme: ✶✶✶✶ top 10% of sites; ✶✶✶ top 11-25% of sites; ✶✶ mid-ranking 26-74% of sites; ✶ bottom 25% of sites. Regional endemics refer to species restricted to Uganda, the Albertine Rift and/or the Somali-Masaai region.

Table 1.4 Summary of biodiversity and conservation importance of the three indicator taxa surveyed in Opit

	Trees and Shrubs	Butterflies	Large Moths
N^{o}. of species now known from forest	62	73	14
N^{o}. of restricted-range species (known from ≤5 forests)	1	2	1
N^{o}. of regional endemics	0	0	0
N^{o}. of species recorded by current inventory	62	73	14
Species diversity	✶	✶✶	✶
Species conservation value	✶	✶	✶

Star ratings indicate values relative to the other 64 Ugandan forests investigated under this programme: ✶✶✶✶ top 10% of sites; ✶✶✶ top 11-25% of sites; ✶✶ mid-ranking 26-74% of sites; ✶ bottom 25% of sites. Regional endemics refer to species restricted to Uganda, the Albertine Rift and/or the Somali-Masaai region.

Chapter 2

Introduction

2.1 GENERAL INTRODUCTION

This report is one of a series of Biodiversity Reports on Uganda's forests and is aimed at providing a comprehensive account of the present state of knowledge of the flora and fauna of Kilak, Aswa River, Zoka and Opit forest reserves in Kitgum, Gulu and Moyo districts of northern Uganda. Since no previous biological survey work has been documented from these reserves, this report is based entirely on the results of biological surveys carried out by the Forest Department in June, November and December 1993.

The full series of reports describes the flora and fauna of 65 of Uganda's major reserved forests, which together account for three quarters of the 1.2 million hectares of land managed by government as a permanent forest estate. The reports are aimed at evaluating sites in terms of their importance for biodiversity conservation and guiding decisions on the establishment of new forest Nature Reserves. More specifically, government has taken a policy decision to set aside 20% of the forest estate to be preserved in an intact state, primarily for this purpose. The work described provides much of the technical information necessary to guide decisions over how this 20% should be allocated between forests at a national level. However, little attempt is made at this stage, to synthesise the information and make comparisons between sites; this will follow in subsequent reports.

The Biodiversity Reports are detailed technical documents aimed primarily at forestry planners and the scientific community. They provide some of the basic information necessary for the development of sound, integrated multiple-use forest management systems. They represent a contribution to a broader planning process; a 'staging post', rather than an end in themselves. As these reports go to press, the planning process to which they contribute is well under way and a 'Masterplan for a National System of Forest Nature Reserves' is in preparation. This Masterplan will provide a synthesis of the detailed information contained in the 33 Biodiversity Reports, showing the significance of the findings and integrating the information on forest biodiversity with other considerations in forestry planning. The objective will be to define a strategy for the zonation of the country's reserved forests that maximises the social, environmental and economic benefits they provide. Thus the Masterplan will provide a more holistic perspective on forest biodiversity issues and appeal to a wider constituency of forestry and conservation professionals, policy-makers and other interest groups.

Similarly, a holistic approach to biodiversity conservation planning in Uganda requires consideration of all protected areas not just Forest Reserves. It would clearly not be efficient to designate major areas within the forest estate as Nature Reserves if the same suite of species were already better protected within an existing National Park or other protected area. Unfortunately, it was beyond the mandate and resources of the programme to carry out inventory work in any of the older savanna National Parks (Queen Elizabeth, Murchison Falls, Kidepo Valley and Lake Mburo) or Game Reserves. However, at the time of the programme's inception all protected forests fell under Forest Department jurisdiction, and were therefore included in the programme. When six important reserves (Rwenzori Mountains, Bwindi Impenetrable, Mgahinga, Mount Elgon, Kibale and Semliki) subsequently became National Parks, the decision was taken to continue the inventory work in most of these areas. This enables a comprehensive approach to be taken in respect of planning for the conservation of biodiversity in forested environments.

There are 33 reports in the series (listed at the back of this report), covering 65 forests. A map of these is provided on the inside back cover (forest N^{o} 33, Kyamboga was not surveyed). In general, each of the major forests (i.e. those exceeding 100 km^2) are treated individually in a single report. Several smaller reserves are often considered together however, where they are located close to one another in the same administrative district, or are ecologically similar forests characterised by the same broad vegetation type (according to the definitions of Langdale-Brown *et al*., 1964).

There are more than 700 forest reserves in Uganda. For financial, logistical and technical reasons it has not been possible to investigate all these sites during the present biodiversity inventory programme. Instead a decision was taken to survey only the larger reserves (those exceeding 5000 ha), together with a number of smaller reserves representing particular vegetation types that do not occur in the larger reserves. This decision is technically defensible, since the larger reserves are those most likely to sustain viable populations of most species in the long term. However, it would clearly be desirable to extend the work to include the smaller reserves at a later stage.

There has been little investigation of the biodiversity values of Uganda's forests prior to this departmental programme. Langdale-Brown *et al.*. (1964) described and mapped the vegetation of Uganda at a scale of 1:500,000, identifying 86 distinct vegetation communities. Each of these communities has been described in broad phytosociological terms and important members of the plant community have been listed. Species lists of

various plant and animal taxa have been compiled for a number of sites, but these have generally arisen incidentally as a result of some other ecological investigation. Budongo, Kibale and Bwindi Impenetrable, for example, are much better known biologically than other Ugandan forests, as a result of years of ecological studies carried out at these sites. Kingdon's (1971-1975) extensive work on East African mammals provides the best available atlas of species distributions for any group. Important plant distribution details, compiled from herbarium records, are given comprehensive coverage in the Flora of Tropical East Africa (Polhill *et al.,* from 1954), which now covers about two thirds of the region's higher plant families. Britton (1980) provides an excellent review of knowledge concerning the distribution and status of East African birds, detailing specific site records for many of the rarer species.

Unfortunately, the existing information is of limited value in determining conservation priorities because previous field records were collected by a limited number of workers distributed very unevenly in space and time. A more systematic sampling regime was clearly necessary, and the present programme was designed to address this need.

The programme was conceived in 1988, as a survey to document the conservation values of Uganda's twelve principal forest reserves was drawing to a close (Howard, 1991). The idea was to extend this initial work to cover the majority of the forest estate, and ensure that biodiversity values were assessed by standardised methods that would allow direct comparisons between sites. Thus it was decided to concentrate the inventory on a relatively small number of 'indicator' taxa, that could be sampled intensively with minimal effort. This would ensure that sampling effort was standardised between sites so that incomplete species lists from different forests were, at least, comparable.

Some ornithological and botanical work was initiated in 1991, but it was not until May 1992 that the programme could be fully implemented. Thirty Forest Rangers were selected from different parts of Uganda, to undertake a specially designed one-month basic course in biological inventory techniques. At the end of this course, the 18 participants who had performed best were provided with a further two months of intensive field training, with ten specialising in botany, four in ornithology, and four in mammalogy/entomology. These 18 rangers were then divided into four teams, each comprising two (or three) botanists, one ornithologist and one mammalogist/entomologist. Once in the field, the teams were provided with a vehicle and other necessary equipment, and were thus capable of operating independently. Overall supervision was provided both from Forest Department headquarters and in the field by four full-time expatriate biologists.

The programme was initiated under the EC-financed Natural Forest Management and Conservation Project, with additional funding from April 1993 through the Global Environment Facility's regional project 'Institutional Support for the Protection of East African Biodiversity', financed through UNDP/FAO.

2.2 USE OF BIOLOGICAL INDICATORS

Assessing the relative importance of forest reserves in terms of species conservation, must involve the study of taxa whose survival is linked closely to the existence of natural forest habitats. For the purposes of this programme, a number of taxa were selected for investigation, based largely on their suitability as biological 'indicators'. There is still debate over the value of indicators and their ability to provide an accurate assessment of biodiversity within a particular site. However, practical factors compel their use, and thus much importance is placed on the selection of appropriate indicator groups.

A number of criteria were used in the selection of taxa for this project (see Howard, 1991) such as ease of sampling and the availability of resources necessary for their study. Plants and animals that are as taxonomically different as possible were selected so that the overall evaluation was not biased in favour of one group. For example, representatives from flying and non-flying taxa were chosen, as they may demonstrate disparate patterns of distribution due to differing dispersal abilities. Similarly, examples from both vertebrate and invertebrate phyla were included.

A major consideration, however, was the availability of information about the taxa to be used, as well as the probability of acquiring reasonably complete species lists, so that the data could be analysed comprehensively and comparatively. Therefore, on the basis of the above criteria, five taxa were selected for study. These were woody plants, five families of small mammals, birds, butterflies and two families of large moths. These taxa are described in more detail in chapters 3 to 7 of this report.

An important consideration in the selection of indicator taxa is the need to obtain reliable species identification. The ideal candidate taxa are well-known groups with published identification guides describing all species, and

local expertise available to provide advice on difficult species. To some extent our indicator taxa satisfied these criteria, but there was nevertheless a need to establish clear procedures to ensure that reliable identifications were obtained, and appropriate verification procedures instituted. In principle, the work on all taxa involved the collection of specimens of all species from each site and identification (or confirmation) of these specimens by experts for each taxonomic group. Furthermore, specimens have been retained and are available at Forest Department headquarters or Makerere University should there be a need to re-examine them. The only group for which records were accepted without the collection and expert examination of specimens was the birds. In this case the ranger ornithologists were trained to submit full written field descriptions of all species encountered, including notes on calls, behaviour and habitat. These descriptions were used as a basis for species identification and/or verification.

Within each of our indicator taxa there are particular assemblages of closely related species that are notoriously difficult to distinguish. Whilst every possible effort has been taken to avoid mis-identification, some errors are inevitable in a programme of this magnitude, involving several hundred thousand individual records. For these, the authors of the relevant chapters accept full responsibility. Whilst highly regrettable, any such errors are unlikely to affect the broad conclusions of the work which is concerned with the application of conservation biology to forest management, rather than being a taxonomic treatise.

The purpose of sampling each of the indicator taxa was to compile as complete a species list as possible for each site, to enable comparison between sites and the identification of conservation needs and priorities. In particular it was expected that each taxonomic group would facilitate:

a) a broad assessment of the relative value of different sites for biodiversity conservation, based on general consideration of species richness and diversity, and the conservation value (i.e. distribution, abundance, ecological characteristics, degree of threat) of the species present at each site;

b) the identification of specific conservation needs, highlighted by the discovery of localities for species of special conservation concern.

In practise, it is rarely possible to compile complete lists of species for any given site, even for the most conspicuous groups of plants and animals. For comparative purposes, therefore, it is essential to ensure that the data collected from different sites are either; (i) derived from equivalent standardised samples; (ii) collected in such a way as to enable the extraction of standardised sub-samples of data or; (iii) collected in such a way as to enable the statistical prediction of the size of a complete flora or fauna. There is extensive literature on this subject (see for example, Margurran, 1987; Soberon and Llorente, 1993; Colwell and Coddington, 1994), and widespread debate as to the efficacy of the various statistical techniques available for data handling. There is no universally accepted approach to the problem, so in these reports full data are presented to enable subsequent re-analysis of the data. The approach used in the design of this programme has been to allocate field time in proportion to the size of each reserve (thus standardising as far as possible on sampling) and to maintain strict field recording procedures so as to track the rate of new species accumulation with increased sampling effort. Thus, in these reports, the rate at which new species of woody plants, small mammals, birds, butterflies and moths were discovered during the course of fieldwork at each forest is plotted. This will facilitate later comparison between sites using modelled/predicted species totals for given levels of sampling.

The rate at which new species were 'discovered' at each forest was monitored constantly throughout the fieldwork phase of the programme. It had originally been the intention to collect sufficient information on all taxa to enable broad between-forest comparisons of biodiversity values by the end of the first year of intensive fieldwork. In practise it became clear that insufficient data had been collected at this stage and return visits were made to most forests during 1994 and the early part of 1995. Where possible, these return visits took place at a different time of year and involved a different team of inventory rangers, so as to control as much as possible for these variables.

2.3 ECOLOGICAL CHARACTERISTICS

Once species lists have been compiled it is important that they are considered qualitatively as well as quantitatively, such that the forests may be judged on their individual conservation merits and compared with other sites. A great diversity of habitat types and levels of human disturbance were surveyed across the country during this programme. Therefore, an indication of the nature of the species sampled from each site is essential in order to facilitate a more accurate analysis of the data. For example, a heavily disturbed forest environment may yield a greater number of species of some taxa, by virtue of the presence of colonising species in addition to

forest-dependent ones. The species list for such a forest may be large, although the site may have comparatively little conservation value.

As far as possible, all species within each of our indicator taxa have therefore been assigned to one of a number of 'ecological type' categories. These types are defined largely in terms of habitat preference and three major divisions are used:

- **Forest-dependent species** (designated as F-species) are those characteristic of closed-canopy forest habitats, which are rarely encountered elsewhere
- **Forest non-dependent species** (designated as f-species) are those which may occur in closed-canopy forests but are not dependent upon it, and are more often encountered in a variety of forest-edge, degraded forest and woodland habitats
- **Non-forest species** are those which occur in a variety of more open habitats including grasslands, savannas, arid habitats and wetlands

By considering species in this way it becomes possible to make broad comparisons across taxa and across sites, in terms of their importance for certain groups of species which may be of particular concern.

2.4 THREATENED, RARE, ENDEMIC AND RESTRICTED-RANGE SPECIES

Clearly conservation efforts should be targeted towards species that are threatened with extinction, especially where this is the result of human activities such as changes in land-use or timber extraction. The identification of such species is a major task of conservation biologists who have produced the well-known international Red Data Books of threatened plants and animals listing the species concerned and what is known about them (e.g. Collar and Stewart, 1985; Collins and Morris, 1985; Lee, Thornbach and Bennett, 1988; Groombridge, 1993).

In this series of reports we have attempted to draw attention to species which are known to be threatened internationally, or may be of concern because they are rare. In doing this, we have been severely handicapped by the lack of information on most of the species under consideration. Thus, whilst we have been able to refer to a defined set of internationally threatened birds (the best-known of our indicator taxa), our consideration of other groups has focused, for purely practical reasons, on species which we encountered infrequently during our surveys. These we have called 'restricted-range' species, defined as any species that is known from no more than five of the 65 forests investigated.

These lists of restricted-range species should, however, be treated with some caution because species that were recorded infrequently from the country's forest reserves under this programme, are not necessarily rare. Their inclusion as restricted-range species may simply reflect the fact that our sampling methods were inadequate in detecting them as with, for example, diurnal or crepuscular moth species that are rarely caught in light traps, even though they may be extremely common. Similarly, migratory species of widespread occurrence are sometimes included in the restricted-range lists because they are encountered infrequently in forests during short periods of the year when they are on migration. The lists also include species not typically found in forest habitats (such as fish-eating birds), although they may be common elsewhere. Thus, although the tables of restricted-range species are valuable in drawing attention to species that may be of special conservation concern, not all those listed fall into this category. For clarification, the animals and plants listed are distinguished on the basis of their ecological characteristics in order to identify those species, particularly of migratory habit and widespread occurrence, which may appear on the restricted-range tables by virtue of their ecology or behaviour.

In addition, attempts have been made to provide some indication of the known distributions of restricted-range species across the continent, as a further indication of their conservation value. This is particularly helpful in identifying species that are localised within a restricted geographical area, such as Uganda, the Albertine Rift or the Somali-Maasai region of North East Africa (country and regional endemics). Uganda has a special responsibility in protecting these species.

2.5 SITE DESCRIPTIONS

2.5.1 Introduction

Kilak, Aswa River, Zoka and Opit are forest reserves situated in northern Uganda in Kitgum, Gulu and Moyo districts on the eastern side of the river Nile. They lie between 02º 37' and 01º 03' N and 31^0 40' and 31º 34' E (Fig. 2.1). The climate receives a severe dry season from mid-Novmber to mid-March with well distributed rains throughout the rest of the year. The highest rainfall months are usually May and August. Despite the relatively large distances between the reserves, Kilak, Aswa River, Zoka and Opit are considered in this one report, although results are detailed separately as well as in a combined manner.

2.5.2 Kilak Forest Reserve

Kilak Forest Reserve lies in Pabbo county and covers an area of 102 km^2, with an altitudinal range of 880 - 1390 m. The reserve is situated about 50 km east of the Nile and is covered by the Uganda Department of Lands and Surveys map sheet 14/3 (series Y732) at 1:50,000.

2.5.3 Aswa River Forest Reserve

Aswa River Forest Reserve is situated in Kitgum district and straddles the Aswa River as it flows north into Sudan. The international border is just 20 km north of the forest. The reserve covers 85 km^2 and ranges in altitude from 680 -880 m. It is covered by Uganda Department of Lands and Surveys map sheet 14/11 (series Y732) at 1:50,000.

2.5.4 Zoka Forest Reserve

Zoka is situated in East Madi county of Moyo district about 10 km east of the Nile and 25 km south of Adjumani. The Zoka river flows through the northern part of the reserve. The reserve covers 61 km^2 with an altitudinal range of 900 - 970 m. The forest contains approximately 5 - 10 km^2 of high forest dominated by *Khaya*, the remaining portion of the reserve consists of *Combretum* savanna woodland and bush. The forest is covered by Uganda Department of Lands and Surveys map sheet 13/2 (series Y732) at 1:50,000.

2.5.5 Opit Forest Reserve

Opit is situated in the administrative district of Gulu and lies some 25 km from Gulu Town. It covers an area of 51 km^2 with an altitudinal range of 1080 - 1180 m. The forest is covered by Uganda Department of Lands and Surveys map sheet 22/4 and 23/3 (series Y732) at 1:50,000.

2.6 DATES, LOCATIONS AND PERSONNEL

Aswa River was visited in June 1993, Kilak, Zoka and Opit were visited in November and December 1993. Regional insecurity and the associated logistical difficulties lead to some forests being better studied than others in this part of the country. Rebel activity in Aswa, for example, during the inventory team's visit meant that bird mist-nets and moth-traps could not be used and certain parts of the reserve could not be visited.

Personnel, dates and camp locations for the inventories are summarised in Table 2.1.

Table 2.1 Personnel, dates and areas sampled in Kilak, Aswa River, Zoka and Opit

	Kilak	Aswa River	Zoka	Opit	
Campsite locations (UTM)	US858392	VU334696	UU522457	UT425895	UT425895
Altitude (m)	1090	760	915	1150	1150
Ranger botanists	S.Kirya D.Nkuutu	S.Kirya D.Nkuutu	S.Kirya D.Nkuutu	S.Kirya D.Nkuutu	S.Kirya D.Nkuutu
Ranger ornithologists	-	C.Andama	C.Andama	-	-
Ranger zoologists	D.Nkuutu	J.Kasangaki	J.Adriko	-	-
Co-ordinator	-	T.Davenport	C.Dickinson	-	-
Dates	30/11-3/12/93	2-6/6/1993	18-21/11/1993	24-27/11/1993	4-8/12/1993
Vegetation type (Langdale-B.)	L3/N5	N4	D2/N5/L3	H2	H2

2.7 PROCEDURES

In view of the objective of sampling as many species as possible from the indicator taxa, the broad approach of the inventory teams was to explore the full range of habitats and altitude. This necessitated careful selection of campsites, ideally located as widely as possible within the reserve. The aim was to ensure maximum complementarity by selecting sites as different as possible from one another in terms of geographical location, habitat type and altitude. From these campsites, each specialist member of the team carried out his own work, as described in the chapters that follow.

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Chapter 3

Trees and Shrubs

Compiled by

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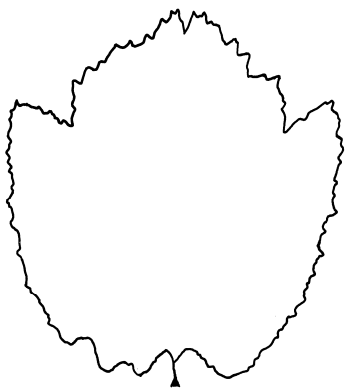

3.1 SUMMARY

The trees and shrubs of Kilak, Aswa River, Zoka, and Opit Forest Reserves were sampled during June, November and December 1993. A total of 287 species (including those recorded by other researchers), 23% of Uganda's total was recorded from the four reserves, with 74 species from Kilak, 127 from Aswa River, 188 from Zoka and 62 from Opit. *Calodendrum capense* and *Ficus capreifolia* were unique to Aswa River, *Calycosiphonia spathicalyx*, *Oxyanthus ugandensis* and *Pycnocoma chevalieri* were unique to Zoka and *Mundulea sericea* was unique to Opit.

3.2 INTRODUCTION

3.2.1 Aims and rationale

Trees and shrubs offer potential advantages over other taxa as biodiversity indicators. Firstly, because they are the primary producers their abundance and diversity is likely to influence the species richness of organisms belonging to higher trophic levels. As such, they might provide a suitable surrogate for all these groups and provide a good measure of overall diversity. Secondly, listing plants is fairly inexpensive and straight forward, requiring no sophisticated equipment. Thirdly, species identification is relatively easy since field guides are available, and there are extensive herbarium collections in addition to some local expertise in plant taxonomy.

The purpose of the woody plant inventory work was to compile as complete a species list as possible for each forest. This will facilitate the identification of forest reserves that are of high conservation value for plants, and draw attention to those supporting species that need special consideration. In some cases, it may be possible to determine that a species has become locally less abundant or less widely distributed, by comparing new records with previous ones. The programme also aimed to provide baseline data to enable future long-term monitoring of woody plant communities in each reserve. This may be particularly useful for evaluating the effectiveness of management programmes, especially where the species concerned is subject to harvesting, or other human activities.

3.2.2 Previous work

Previous records for Aswa River and Zoka are from Katende (pers. comm.) and three and 11 records respectively, in the Flora of Tropical East Africa. There are no known old records for Kilak and Opit.

3.3 METHODS

3.3.1 Field methods

The fieldwork involved a team of two or three field botanists travelling on foot throughout the reserve along a series of transects, observing and searching for new species of trees and shrubs. The transects used took advantage of existing roads and footpaths to gain access to all distinct vegetation communities and forest types; to traverse the full range of altitude represented in the reserve; to visit slopes of different aspect, and all different habitat features, such as rock outcrops, ridges, gullies, water courses and swamps. The area to be visited on successive days of the inventory exercise was planned at the beginning of the session by reference to aerial photographs and 1:50,000 topographic maps. This was modified as fieldwork proceeded to take advantage of field conditions, local knowledge and access routes encountered. The transects followed each day were mapped at 1:50,000.

Whilst following a transect, the botanists observed broad patterns of species composition, so as to compile a 'day list' of the trees and shrubs encountered, together with an evaluation of abundance for each species using the DAFOR acronym (where D = Dominant; A = Abundant; F = Frequent; O = Occasional and R = Rare, see box below). Thus, the field records generated by each day's fieldwork comprised a map showing the transect route taken, a corresponding list of species encountered and an abundance rating for each species. A broad definition of trees and shrubs has been used so as to include sub-shrubs and climbing/scrambling shrubs, but excluding woody climbers and woody herbs. Under this definition, 1251 species are known from Uganda, as listed by Howard (1994).

Description of abundance ratings used in the botanical survey

D = **DOMINANT**, meaning a species which occurs at a density of at least one tree per hectare and is amongst the five commonest species encountered.

A = **ABUNDANT**, meaning a species that is encountered at least once every 15 minutes during a survey (once every 500 m along a survey trail), but which is not sufficiently common to be described as dominant.

F = **FREQUENT**, meaning a species that is encountered 10 to 20 times during the course of a day's survey, is widespread and encountered in small numbers over a wide area.

O = **OCCASIONAL**, meaning a species that is encountered 4 to 9 times during the course of a day's survey, perhaps because of its narrow habitat requirements which limit its distribution.

R = **RARE**, meaning a species that is only encountered once, or up to three times, during a day's survey.

3.3.2 Specimen collection and identification

To minimise errors in identification two voucher specimens and a full written description of every species encountered (including common ones) were collected. Each pair of voucher specimens was given a unique specimen number and specimens were mounted and stored together with the corresponding field descriptions at the Forest Department's herbarium. Identifications were then confirmed independently by the herbarium curator. Details of species that could not be identified in the field were recorded by reference to the specimen number, and identification obtained at a later stage by reference to herbarium materials at the Forest Department or Makerere University. In a few cases, it was necessary to send voucher specimens and corresponding descriptions to the East African Herbarium, Nairobi, or the Royal Botanical Gardens, Kew.

Once the majority of specimens had been identified and entered on the database, a search of the resulting species list was carried out to identify (a) species recorded outside their previously known altitudinal limits or geographical range (FTEA floral regions); and (b) restricted-range species known from no more than five sites surveyed by the inventory programme. The relevant specimens were then re-examined by A. Katende (Makerere University) to verify their identification.

3.3.3 Personnel, dates and areas sampled

Table 3.1 presents a summary of the work carried out, including details of personnel involved in the botanical work; the duration and dates of sampling; the intensity achieved (proportion of 1 km^2 cells sampled) and altitudinal range covered.

Table 3.1 Personnel, dates, and areas sampled in Kilak, Aswa River, Zoka and Opit

	Kilak	Aswa River	Zoka	Opit	
Campsite location (UTM)	US858392	VU334696	UU522457	UT425895	UT425895
Altitude (m)	1090	760	915	1150	1150
Ranger botanists	S. Kirya D. Nkuutu	S. Kirya D. Nkuutu	S. Kirya D. Nkuutu	S. Kirya D. Nkuutu	S. Kirya D. Nkuutu
Co-ordinator	-	T. Davenport	C. Dickinson	-	-
Dates	30/11-3/12/93	2-6/6/93	18-21/11/93	24-27/11/93	4-8/12/93
Sampling period (days)	2	1	4	4	2
Vegetation type (Langdale-Brown)	L3/N3	N4	D2/N5/L3	H2	H2
Total transect length (km)	6	--	14	34.5	
No. (%) of 1km^2 cells sampled	6(6)	--	12(21)	24(52)	
Altitude sampled (m)	1090-1180	--	≅ 940	1080-1160	

3.3.4 Data analysis

Three separate analyses were carried out on the plant field records:

a) Compilation of species lists. This enabled comparison with other forests, and provided a basis for highlighting species that are of biogeographical and conservation significance. In examining the species lists particular attention was paid to records from outside a species' previously known altitudinal range, or where a species is recorded from one of Uganda's four 'floral regions' (as described in the Flora of Tropical East Africa) for the first time.

b) Ecological characteristics. Based on the habitat requirements of each species recorded in the Flora of Tropical East Africa, Eggeling and Dale (1952), Hamilton (1981), and summarised in Howard (1994), each of the species recorded was assigned to one of three major ecological types, and 15 sub-types.

- **Forest-dependent species** (FF-species) include all species that occur in one of the following forest habitats: forest interior (F), forest edge (f), dry forest (df) and riverine/lakeshore forest (r), or are forest generalists (fg) occupying more than one of these categories;
- **Forest non-dependent species** (Fn-species) are plants that occupy at least one of the forest types mentioned above and at least one non-forest habitat such as:
- **Non-forest (open habitat) species** (O-species) are species that occur in one of the following non-forest habitats: woodland (wo), grassland (g), rocky places (ro), bush/thickets (t), dry scrub (Sc), swamp (S), and moorland (m), or are open habitat generalists occupying more than one of these categories.

Thus, whilst many species occur in a range of habitats each has been assigned to a single 'ecological type', supplying a broad indication of its habitat requirements. These ecological types provide a basis for comparisons with other taxa, which have been treated in a similar way.

c) Species accumulation rates. Using the daily records of species encountered, the cumulative total number of species recorded on successive days of the sampling period was plotted in order to estimate the extent to which further field sampling would add to the species list, and to facilitate comparisons of species richness between forests for any given level of sampling effort.

3.4 RESULTS

3.4.1 Species list

An annotated checklist of tree and shrub species recorded from Kilak, Aswa River, Zoka and Opit Forest Reserves is presented in Appendix 3.1. In Kilak, 74 tree and shrub species were recorded during the present inventory, whilst 43 species were recorded in Aswa River and 84 species were old records. In Zoka, 119 species were recorded during the present inventory while 69 were old records. Sixty-two species were recorded in Opit

during the present inventory. The combined total number of tree and shrub species recorded from the four reserves was 287, about 23% of Uganda's total.

Altitude in the four reserves ranges from about 880 to 1390 m for Kilak, from 680 to 880 m for Aswa River, from 900 to 970 m for Zoka and from about 1080 to 1180 m for Opit. However, some species were recorded below or above their usual altitudinal ranges in each reserve (Table 3.3 - 3.6). Tables 3.7 to 3.10 show plant species that had never been recorded from Floral Region U1 before but were recorded from Kilak, Aswa River, Zoka and Opit respectively, during the present inventory (all four reserves are found U1).

Restricted-range species (known from no more than five forests of the 65 sampled) recorded from Kilak, Aswa River, Zoka and Opit are presented in Tables 3.11 to 3.14.

3.4.2 Ecological characteristics

The classification of plant species recorded in Kilak, Aswa River, Zoka and Opit according to their ecological characteristics is presented in Table 3.2.

3.4.3 Daily records

Daily species list for Kilak, Aswa River, Zoka and Opit Forest Reserves are presented in Appendices 3.2 to 3.5. Transects surveyed in Kilak, Zoka and Opit are presented in Figs. 3.1 to 3.3, respectively. Transects surveyed in Aswa River were not mapped. The cumulative total number of plant species recorded on a daily basis from Kilak, Zoka and Opit are shown in Figs. 3.5 to 3.7, respectively. The species accumulation curve for Aswa River was not plotted because the reserve was sampled for only one day. The species accumulation curves for Kilak, Zoka and Opit did not attain asymptotic values.

3.5 DISCUSSION

All four forest reserves contained at least one restricted-range species, however, all restricted-range species recorded from Kilak have been recorded from at least one other Ugandan forest suggesting that all species recorded from Kilak can also be conserved elsewhere. On the other hand, Aswa River, Zoka and Opit each hosted at least one unique species. Therefore, Aswa River, Zoka and Opit are essential to the conservation of a complete assemblage of Uganda's known woody plant species.

Because this study concentrated on forest habitats, species that predominantly occupy non forest habitats may be recorded as restricted-range species when they occur in forest habitats. However, some of these species e.g. *Calodendrum capense* and *Combretum capituliflorum*, from Aswa River and *Calycosiphonia spathicalyx*, *Oxyanthus ugandensis*, *Pycnocoma chevalieri*, *Ficus artocarpoides* and *Linociera nilotica*, from Zoka were forest-dependent species, hence they are not likely to be found in great abundance outside forest reserves where they have been recorded. It is therefore prudent to conclude that their future survival will depend on how well the forests where they have been recorded are managed.

Of all species recorded in Zoka Forest Reserve, *Oxyanthus ugandensis* is worthy of special note, being endemic to Uganda. During the present inventory, the species was recorded in Zoka only. This observation suggests that the future of *O. ugandensis* depends greatly on the management of Zoka Forest Reserve. It should be pointed out that the species was formally known to occupy the interior of forests found in Floral Region U2 (western Uganda) only. However, *O. ugandensis* was not recorded in any of the western Uganda forests during this inventory, instead it was only recorded in northern Uganda (Floral Region U1).

In summary, basing on the available data Aswa River, Zoka, and Opit are essential to the conservation of a complete assemblage of all Uganda's known woody plant species within the forest reserve system because they host unique species. On the other hand, all woody plant species recorded from Kilak can be conserved elsewhere.

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3.7 TABLES

Table 3.2 The ecological characteristics of trees and shrubs recorded from Kilak, Aswa River, Zoka and Opit. Figures represent the number of species of each ecological type, shown as a percentage of the site's flora and as a percentage of Uganda's total within each group

	Uganda Totals		Kilak			Aswa River			Zoka			Opit		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**%of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**%of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**%of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**%of Ug. Tot.**
F	234	19	10	14	4	13	10	6	51	27	22	6	10	3
f	38	3	1	1	3	2	2	5	11	6	29	6	10	16
r	16	1	0	0	0	3	2	19	2	1	13	0	0	0
df	5	< 1	0	0	0	0	0	0	1	1	20	0	0	0
fg	132	11	10	14	8	4	3	3	35	19	27	2	3	2
Total FF	**425**	**34**	**21**	**28**	**5**	**22**	**17**	**5**	**100**	**53**	**24**	**14**	**23**	**3**
Total Fn	**323**	**26**	**25**	**34**	**8**	**43**	**34**	**13**	**50**	**27**	**15**	**27**	**44**	**8**
wo	52	4	13	18	25	24	19	46	19	10	37	11	18	21
g	13	1	0	0	0	1	1	8	1	1	8	0	0	0
ro	6	< 1	0	0	0	2	2	33	0	0	0	0	0	0
t	13	1	0	0	0	0	0	0	1	1	8	0	0	0
Sc	2	< 1	0	0	0	0	0	0	0	0	0	0	0	0
S	8	< 1	0	0	0	1	1	13	0	0	0	0	0	0
m	15	1	0	0	0	0	0	0	0	0	0	0	0	0
Og	127	11	10	14	8	25	20	20	9	5	7	7	11	6
Total O	**236**	**19**	**23**	**31**	**10**	**53**	**42**	**22**	**30**	**16**	**13**	**18**	**29**	**8**
Total Ud	**267**	**21**	**5**	**7**	**2**	**9**	**7**	**3**	**8**	**4**	**3**	**3**	**5**	**1**
Total	**1251**	**100**	**74**	**100**	**6**	**127**	**100**	**10**	**188**	**100**	**15**	**62**	**100**	**5**

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats
Ud Undetermined types, about which little is known concerning habitat characteristics

Table 3.3 Trees and shrubs recorded outside their previously known altitudinal range in Kilak

Category	**Species**	**Previous Altitudinal Range (m)**
Higher altitude species	*Nuxia congesta*	1800-2700

Table 3.4 Trees and shrubs recorded outside their previously known altitudinal range in Aswa River

Category	Species	Previous Altitudinal Range (m)
Higher altitude species	*Acacia gerrardii*	900-2130
	Acacia kirkii	1140-1980
	Afzelia africana	1220-1370
	Albizia malacophylla	1100-1310
	Albizia schimperiana	1130-2130
	Albizia zygia	915-1370
	Baikiaea insignis	1140-1250
	Boswellia papyrifera	1200-1500
	Bridelia brideliifolia	1200-2440
	Butyrospermum paradoxum	950-1500
	Calodendrum capense	1200-2400
	Craibia brownii	1100-2200
	Daniellia oliveri	1060-1530
	Dombeya goetzenii	1800-3200
	Ficus amadiensis	950-2100
	Ficus dicranostyla	900-1100
	Ficus platyphylla	950-1170
	Ficus sansibarica	1050-1200
	Gardenia erubescens	1300-1300
	Greenwayodendron suaveolens	1100-1100
	Hexalobus monopetalus	1050-1290
	Lannea barteri	900-1200
	Lannea fulva	900-1600
	Lonchocarpus laxiflorus	1020-1890
	Manilkara dawei	1100-1600
	Manilkara multinervis	900-1050
	Olax gambecola	1140-1340
	Pterocarpus lucens	1080-1200
	Teclea nobilis	900-2600
	Terminalia glaucescens	1000-1800

Table 3.5 Trees and shrubs recorded outside their previously known altitudinal range in Zoka

Category	Species	Previous Altitudinal Range (m)
Higher altitude species	*Afzelia africana*	1220-1370
	Alchornea cordifolia	1150-1500
	Alchornea floribunda	1170-1200
	Aningeria altissima	1000-1700
	Baphiopsis parviflora	1110-1310
	Bersama abyssinica	1140-2400
	Calamus deeratus	1000-1500
	Cassipourea gummiflua	1200-1500
	Craibia brownii	1100-2200
	Dombeya nairobensis	2200-3000
	Drypetes gerrardii	1150-2300
	Drypetes ugandensis	1140-1140
	Fagaropsis angolensis	1000-2250
	Ficus sansibarica	1050-1200
	Gardenia erubescens	1300-1300
	Greenwayodendron suaveolens	1100-1100
	Hallea stipulosa	1050-1200
	Lannea welwitschii	1100-1100
	Lonchocarpus laxiflorus	1020-1890
	Macaranga monandra	1130-1525

Maerua duchesnei	1050-1350
Mimusops bagshawei	1100-2400
Neoboutonia melleri	1140-1850
Ochna holstii	2000-2000
Olea hochstetteri	1500-2610
Protea madiensis	1600-2300
Pycnocoma chevalieri	1000-1000
Rinorea dentata	1200-1300
Rinorea oblongifolia	1150-1450
Tarenna pavettoides	1125-1600
Terminalia glaucescens	1000-1800
Uvaria angolensis	1140-1350
Uvariopsis congensis	1080-1650

Table 3.6 Trees and shrubs recorded outside their previously known altitudinal range in Opit

Category	Species	Previous Altitudinal Range (m)
Higher altitude species	*Acacia abyssinica*	1500-2300

Table 3.7 Trees and shrubs recorded in Kilak but not previously known from floral region U1

Species	Previous Known Distribution in Uganda (FTEA Region)
Allophylus ferruginea	2
Greenwayodendron suaveolens	2,4
Hugonia platysepala	2,4
Monanthotaxis littoralis	2,3,4
Oxyanthus unilocularis	2,4
Staudtia kamerunensis	2,4
Symphonia globulifera	2,4

Table 3.8 Trees and shrubs recorded in Aswa River but not previously known from floral region U1

Species	Previous Known Distribution in Uganda (FTEA Region)
Allophylus macrobotrys	2,3,4
Baikiaea insignis	2,3,4
Bridelia brideliifolia	2
Calodendrum capense	2,4
Craibia brownii	2,3,4
Ficus polita	2,4
Ficus sansibarica	2,4
Greenwayodendron suaveolens	2,4
Harrisonia abyssinica	2,3,4
Mallotus oppositifolius	2,4
Morus mesozygia	2,4
Ochna bracteosa	2,3,4
Olax gambecola	3,4
Vernonia auriculifera	2,3,4

Table 3.9 Trees and shrubs recorded in Zoka but not previously known from floral region U1

Species	Previous Known Distribution in Uganda (FTEA Region)
Acanthus arborescens	2,3,4
Aeglopsis eggelingii	2
Albizia gummifera	2,3,4
Albizia versicolor	2
Alchornea cordifolia	2,3,4
Alchornea floribunda	2,4
Baphiopsis parviflora	2,3,4
Blighia unijugata	2,3,4
Blighia welwitschii	2,4
Calamus deeratus	2,4
Cassipourea gummiflua	2,4
Celtis durandii	2,3,4
Celtis mildbraedii	2,3,4
Celtis zenkeri	2,4
Citropsis articulata	2,4
Craibia brownii	2,3,4
Drypetes gerrardii	2,3,4
Drypetes ugandensis	2,4
Ehretia cymosa	2,3,4
Fagaropsis angolensis	2,3,4
Ficus artocarpoides	4
Ficus mucuso	2,3,4
Ficus natalensis	2,4
Ficus polita	2,4
Ficus sansibarica	2,4
Funtumia elastica	2,4
Garcinia buchananii	3,4
Glyphaea brevis	2,4
Greenwayodendron suaveolens	2,4
Isolona congolana	2
Lannea welwitschii	2,4
Lasiodiscus mildbraedii	2,3,4
Lecaniodiscus cupanioides	2
Lindackeria schweinfurthii	2,4
Macaranga monandra	2,4
Mallotus oppositifolius	2,4
Mimusops bagshawei	2,3,4
Ochna membranacea	2,4
Oxyanthus ugandensis	2
Oxyanthus unilocularis	2,4
Pachystela brevipes	2,4
Parkia filicoidea	2,4
Pycnanthus angolensis	2,3,4
Raphia farinifera	2,4
Rawsonia lucida	2,3
Rinorea beniensis	2
Rinorea dentata	4
Rinorea ilicifolia	2
Rinorea oblongifolia	2,4
Symphonia globulifera	2,4
Tarenna pavettoides	2,3,4
Teclea eggelingii	2,4
Treculia africana	2,4
Trichilia martineaui	2,4
Turraea robusta	2,3,4
Turraea vogelii	2,4
Turraea vogelioides	2,4
Uvariopsis congensis	2,4

Table 3.10 Trees and shrubs recorded in Opit but not previously known from floral region U1

Species	Previous Known Distribution in Uganda (FTEA Region)
Acanthus arborescens	2,3,4
Ficus pseudomangifera	2,4
Harungana madagascariensis	2,3,4
Maesopsis eminii	2,3,4
Ochna membranacea	2,4

Table 3.11 Restricted-range trees and shrubs from Kilak

Species	Ecol. Type	No. of Ugandan forests where species has been recorded	Other forests from which species has been recorded	Known Distribution	
				No of EA Floral Regions	No of African Countries
Canthium rubrocostatum	F	4	Aswa River, Kamusenene, Mpigi	Not in FTEA	≥ 1
Xylopia parviflora	Fn	4	Kalinzu-Maramagambo, Bugoma, Semliki	7	widespread
Daniellia oliveri	wo	5	Aswa River, Era, Mt. Kei, Otzi	1	widespread
Entada africana	Ud	5	Mt. Kei, Otzi, Timu, West Bugwe	1	widespread
Hymenodictyon parvifolium	Og	5	Aswa River, Era, Mt. Kei, Otzi	12	10

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats

Ud Undetermined types, about which little is known concerning habitat characteristics

Table 3.12 Restricted-range trees and shrubs from Aswa River

Species	Ecol. Type	No. of Ugandan forests where species has been recorded	Other Forests from which species has been recorded	Known Distribution	
				No of EA Floral Regions	No of African Countries
Calodendrum capense	F	1	None	10	6
Ficus capreifolia	Fn	1	None	8	widespread
Celtis integrifolia	Fn	3	Otzi, Rom	1	widespread
Amblygonocarpus andongensis	wo	4	Era, Mt. Kei, Otzi	3	12
Canthium rubrocostatum	F	4	Kamusenene, Kilak, Mpigi	Not in FTEA	≥ 1
Crateva adansonii	Fn	4	Era, Labwor Hills, Otzi	9	widespread
Combretum capituliflorum	r	5	Budngo, Era, Mt. Kei, Otzi	2	5
Daniellia oliveri	wo	5	Era, Kilak, Mt. Kei, Otzi	1	widespread
Hymenodictyon parvifolium	Og	5	Era, Kilak, Mt. Kei, Otzi	12	10

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats
Ud Undetermined types, about which little is known concerning habitat characteristics

Table 3.13 Restricted-range trees and shrubs from Zoka

Species	Ecol. Type	No. of Ugandan forests where species has been recorded	Other forests from which species has been recorded	Known Distribution	
				No of EA Floral Regions	No of African Countries
Calycosiphonia spathicalyx	F	1	None	6	13
Oxyanthus ugandensis	F	1	None	1	1
Pycnocoma chevalieri	F	1	None	1	4
Albizia versicolor	wo	2	Otzi	9	widespread
Khaya senegalensis	Fn	3	Mt. Kei, Otzi	Not in FTEA	≥ 1
Linociera nilotica	Fg	5	Era, Labwor Hills, Mt. Kei, Otzi	6	10

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats
Ud Undetermined types, about which little is known concerning habitat characteristics

Table 3.14 Restricted-range trees and shrubs from Opit

Species	Ecol. Type	No. of Ugandan forests where species has been recorded	Other forests from which species has been recorded	Known Distribution	
				No of EA Floral Regions	No of African Countries
Mundulea sericea	Fn	1	None	11	wide spread

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats

Ud Undetermined types, about which little is known concerning habitat characteristics

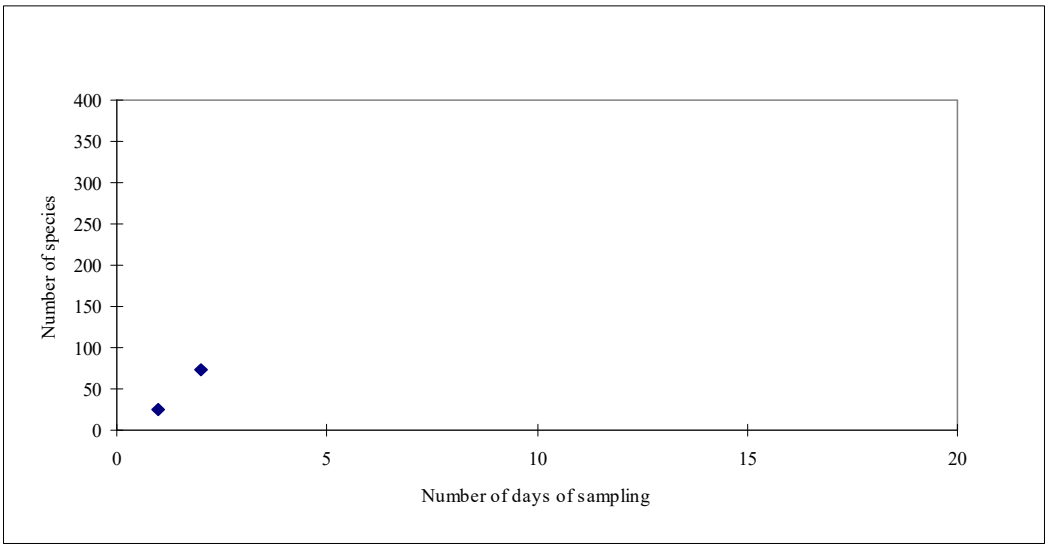

Fig. 3.5 Species accumulation rates for trees and shrubs from Kilak

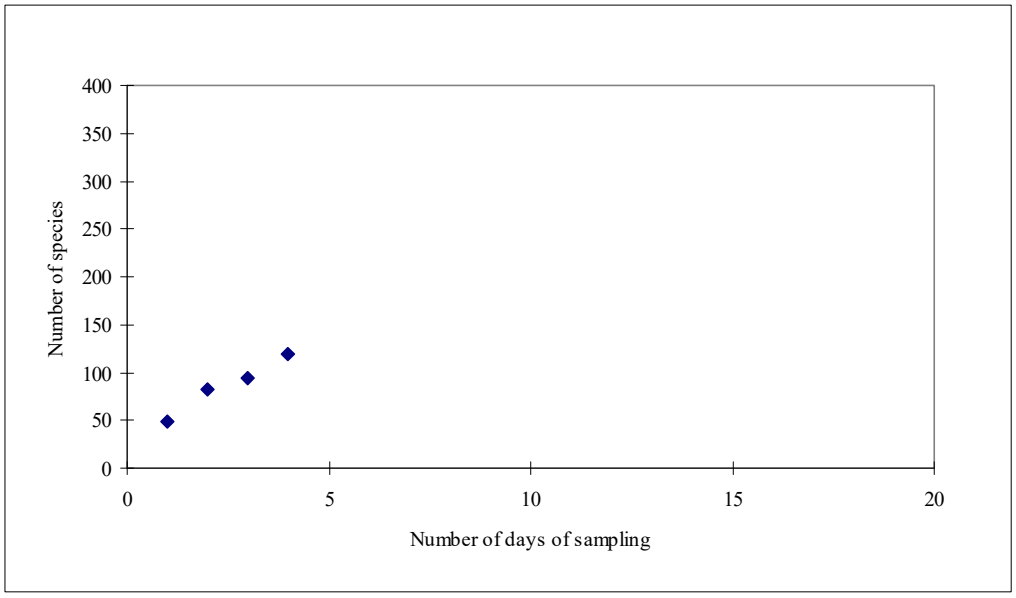

Fig. 3.6 Species accumulation rates for trees and shrubs from Zoka

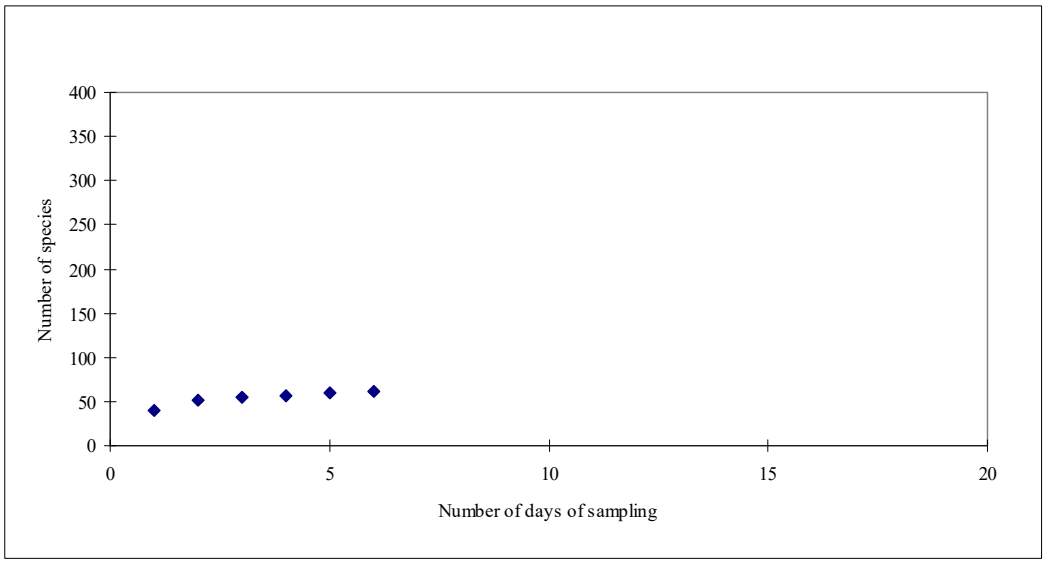

Fig. 3.7 Species accumulation rates for trees and shrubs from Opit

3.9 APPENDICES

Appendix 3.1 Species list of trees and shrubs recorded from Kilak, Aswa River, Zoka and Opit (for key to information provided by each entry see box at end of Appendix)

Species (and synonyms, field guide information, family and known distribution)	Growth Form	Ecol. Type	Kilak	Aswa River	Zoka	Opit
Acacia abyssinica (xiphocarpa) (E,Es) (LEG; 1,2,3; wo,g; 1500-2300m)	ST	Og	0	0	0	1
Acacia brevispica (pennata) (437) (Es) (LEG; 1,2,3,4; t; 170-1830m)	S/ST	t	0	0	1	0
Acacia gerrardii (hebecladoides) (Es) (LEG; 1,2,3,4; wo; 900-2130m)	S/ST	wo	0	1	0	0
Acacia hecatophylla (E) (LEG; 1; g,ro; 600-1370m)	ST	Og	1	0	0	0
Acacia hockii (LEG; 1,2,3,4; wo; 0-2300m)	S/ST	wo	0	1	1	1
Acacia kirkii (mildbraedii) (437) (Es) (LEG; 1,2,4; r; 1140-1980m)	ST	r	0	1	0	0
Acacia polyacantha (camplyacantha) (Es) (LEG; 1,2,3,4; wo,t,r; 0-1830m)	ST	Fn	0	1	1	1
Acacia senegal (E) (LEG; 1,2,3,4; wo,t; 120-1680m)	ST	Og	0	1	0	0
Acacia sieberiana (E) (LEG; 1,2,3,4; wo,r; 0-1220m)	ST	Fn	0	1	1	1
Acalypha neptunica (104) (EUP; 1,2,3,4; f,t,r; 0-1700m)	S/ST	Fn	0	1	1	0
Acalypha ornata (105) (EUP; 1,2,3,4; f,wo,t,r,ro; 0-2000m)	WH/S	Fn	1	1	1	1
Acanthus arborescens (pubescens) (Es) (ACA; 2,3,4; f)	WH/S	f	0	0	1	1
Aeglopsis eggelingii (167) (E) (RUT; 2; f,r; 900-1500m)	S/ST	Fg	0	0	1	0
Afzelia africana (E) (LEG; 1,2; wo; 1220-1370m)	TT	wo	0	1	1	0
Albizia coriara (442) (E) (LEG; 1,2,3,4; wo,r; 850-1680m)	TT	Fn	0	0	0	1
Albizia grandibracteata (446) (E) (LEG; 1,2,3,4; F,r,g,f)	TT	Fn	0	0	1	0
Albizia gummifera (444) (E) (LEG; 2,3,4; F,f,r; 0-2440m)	TT	Fg	0	0	1	0
Albizia malacophylla (E) (LEG; 1,3,4; wo; 1100-1310m)	ST	wo	0	1	0	0
Albizia schimperiana (maranguensis) (E,Es) (LEG; 1; df,t,r; 1130-2130m)	ST	Fn	1	1	0	1
Albizia versicolor (E) (LEG; 2; wo; 0-1680m)	T	wo	0	0	1	0
Albizia zygia (447) (E) (LEG; 1,2,3,4; F,r,wo; 915-1370m)	TT	Fn	1	1	1	1
Alchornea cordifolia (102) (E) (EUP; 2,3,4; f,r; 1150-1500m)	CS/S/ST	Fg	0	0	1	0
Alchornea floribunda (172) (E) (EUP; 2,4; f,r; 1170-1200m)	S/ST	Fg	0	0	1	0
Alchornea laxiflora (103) (E) (EUP; 1,2,3,4; F,t; 10-1600m)	S/ST	Fn	0	0	1	0
Allophylus africanus (E) (SAP; 1,2,3,4; wo)	S/ST	wo	0	1	1	0
Allophylus ferruginea (E) (SAP; 2; F)	ST	F	1	0	0	0
Allophylus macrobotrys (352) (E) (SAP; 2,3,4; F,s)	ST	Fn	0	1	0	0
Amblygonocarpus andongensis (obtusangulus) (Es) (LEG; l; wo; 0-1370m)	ST	wo	0	1	0	0
Aningeria altissima (35) (E) (SAP; 1,2,3,4; F,r; 1000-1700m)	TT	Fg	1	0	1	0
Annona senegalensis (chrysophylla) (E,Es) (ANN; 1,2,3,4; g,wo,t; 0-1800m)	S/ST	Og	1	1	1	0
Antiaris toxicaria (56) (E) (MOR; 1,2,3,4; F,wo,r; 10-1700m)	TT	Fn	1	1	1	1
Antidesma venosum (EUP; 1,2,3,4; f,t,wo; 0-1830m)	S/ST	Fn	0	1	0	0
Aphania senegalensis (420) (E) (SAP; 1,2,3,4;)	ST	Ud	1	0	1	0
Argomuellera macrophylla (174) (EUP; 1,2,3,4; F; 700-1260m)	WH/SS/ST	F	0	0	1	0
Baikiaea insignis (minor) (427) (Es) (LEG; 2,3,4; F; 1140-1250m)	TT	F	0	1	0	0
Balsamocitrus dawei (346) (E) (RUT; 1,2,4; F; 900-1500m)	ST	F	0	0	1	0
Baphia wollastonii (230) (E) (LEG; 1,2; f; 600-1350m)	S	f	0	0	1	0
Baphiopsis parviflora (stuhlmannii) (232) (Es) (LEG; 2,3,4; F,s; 1110-1310m)	S/ST	Fn	0	0	1	0
Beilschmiedia ugandensis (Tylostemon) (204) (Es) (LAU; 1,2,4; F,s,r)	TT	Fn	1	0	1	0
Bersama abyssinica (380) (E) (MEL; 1,2,3,4; F,wo,g,t,r; 1140-2400m)	ST	Fn	1	0	1	0
Blighia unijugata (Phialodiscusunijugata) (419) (E,Es) (SAP; 2,3,4; f)	ST/(TT)	f	0	0	1	0
Blighia welwitschii (wildemaniana) (415) (Es) (SAP; 2,4; F)	TT	F	0	0	1	0
Borassus aethiopum (10) (E) (PAL; 1,2,3,4; g,s; 0-1200m)	TT	Og	1	1	1	0
Boscia salicifolia (E) (CAP; 1; wo,t,g; 300-1800m)	ST	Og	0	1	0	0
Boswellia papyrifera (E) (BUR; 1; wo,ro; 1200-1500m)	ST	Og	0	1	0	0
Bridelia brideliifolia (244) (E) (EUP; 2; f,t; 1200-2440m)	S/ST/TT	Fn	0	1	0	0
Bridelia micrantha (243) (E) (EUP; 1,2,3,4; f,t,r; 50-2300m)	S/ST	Fn	1	0	1	1
Bridelia scleroneura (E) (EUP; 1,2,3,4; wo,t; 775-2400m)	S/ST	Og	1	1	1	1
Butyrospermum paradoxum (parkii) (Es) (SAP; 1,3,4; wo; 950-1500m)	ST	wo	1	1	0	0
Calamus deeratus (PAL; 2,4; F,r; 1000-1500m)	CS	Fg	0	0	1	0
Calodendrum capense (E) (RUT; 2,4; F; 1200-2400m)	ST	F	0	1	0	0
Caloncoba crepiniana (schweinfurthii) (132) (Es) (FLA; 1,2,4; f,r,wo; 850-1500m)	S/ST	Fn	1	0	1	0
Calycosiphonia spathicalyx (Coffeaspathicalyx) (Es) (RUB; 1,2; F; 250-915m)	CS/ST	F	0	0	1	0
Canarium schweinfurthii (389) (E) (BUR; 1,2,3,4; f,r; 1000-1600m)	TT	Fg	1	0	0	0
Canthium rubrocostatum (325) (E) (RUB; 1,3; F)	ST	F	1	1	0	0
Canthium vulgare (325) (E) (RUB; 1,2,3,4; f)	S/ST	f	1	0	1	0
Capparis tomentosa (CAP; 1,2,3,4; t,g,r; 0-2500m)	CS/ST	Fn	0	1	1	1
Carissa edulis (APO)	S	Ud	0	1	1	1
Carpabolia alba (Securidacalongipedunculata) (Es) (POL; 1,2,3,4; wo)	S/ST	wo	0	1	1	0
Cassia mannii (424) (E) (LEG; 1,2; F; 850-1370m)	ST/TT	F	0	0	1	0
Cassia petersiana (E) (LEG; 1,2,3,4; f,wo,t,; 12-2130m)	S/ST	Fn	1	1	0	0

Cassia singueana (E) (LEG; 1,3; wo,g; 0-2130m)	S/ST	Og	0	1	0	0
Cassine aethiopica (Mystroxylon) (160) (Es) (CEL; 1,2,3,4; f,wo; 0-2400m)	S/ST	Fn	0	1	0	0
Cassine buchananii (Elaeodendron) (329) (Es) (CEL; 1,2,3,4; F; 0-2300m)	ST/(TT)	F	0	1	0	0
Cassipourea gummiflua (ugandensis) (301) (Es) (RHI; 2,4; F,s; 1200-1500m)	TT	Fn	0	0	1	0
Celtis durandii (88) (E) (ULM; 2,3,4; F; 300-2000m)	TT	F	0	0	1	0
Celtis integrifolia (E) (ULM; 1; r,wo; 600-1200m)	TT	Fn	0	1	0	0
Celtis mildbraedii (soyauxii) (86) (Es) (ULM; 2,3,4; F; 300-1600m)	TT	F	0	0	1	0
Celtis zenkeri (87) (E) (ULM; 2,4; F; 250-1200m)	TT	F	0	0	1	0
Chaetacme aristata (252) (E) (ULM; 1,2,3,4; f,r; 900-2100m)	S/ST	Fg	0	0	1	0
Chrysophyllum albidum (40) (E) (SAP; 1,2,3,4; F; 900-1700m)	TT	F	0	0	1	0
Chrysophyllum muerense (C.sp.nov.) (39) (Es) (SAP; 1,2,4; F; 750-1400m)	TT	F	0	0	1	0
Citropsis articulata (378) (RUT; 2,4; F; 650-1550m)	S/ST	F	0	0	1	0
Clausena anisata (377) (E) (RUT; 1,2,3,4; f,t,wo; 1-2450m)	S/ST	Fn	0	0	1	1
Cleistopholis patens (214) (E) (ANN; 1,2; F,r; 750-1110m)	TT	Fg	1	0	1	0
Clerodendrum myricoides (VER)	S	Ud	0	1	0	0
Coffea canephora (robusta) (314) (E) (RUB; 1,2,3,4; F; 700-1400m)	S/ST	F	0	0	1	0
Coffea liberica (excelsa) (309) (E) (RUB; 1,2; F; 790-1220m)	ST/(S)	F	1	0	1	0
Cola gigantea (cordifolia) (116) (Es) (STE; 1,2,4; F)	TT	F	0	0	1	0
Combretum capituliflorum (COM; l; r; 800-800m)	C/CS	r	0	1	0	0
Combretum collinum (binderanum, verticillatum) (E,Es) (COM; 1,2,3,4; wo; 50-2300m)	ST	wo	1	1	1	0
Combretum molle (gueinzii) (E,Es) (COM; 1,2,3,4; wo; 30-2300m)	ST	wo	0	1	1	1
Cordia africana (abyssinica) (113) (Es) (BOR; 1,2,3,4; f,wo; 450-2100m)	ST	Fn	0	0	1	0
Cordia millenii (112) (E) (BOR; 1,2,4; F; 900-1650m)	TT	F	0	0	1	0
Craibia brownii (429) (E) (LEG; 2,3,4; F,r; 1100-2200m)	ST	Fg	0	1	1	0
Craterispermum schweinfurthii (laurinum) (310) (Es) (RUB; 1,2,3,4; r,t,df; 1050-1500m)	S/ST	Fn	1	0	0	0
Crateva adansonii (E) (CAP; 1,2,3,4; wo,g,r; 600-1400m)	S/ST	Fn	0	1	0	0
Crossopteryx febrifuga (E) (RUB; 1,2,3,4; wo,ro; 0-1350m)	ST	Og	0	1	0	0
Cussonia arborea (E) (ARA; 1,3,4; wo,g; 300-2470m)	ST	Og	0	0	0	1
Dalbergia melanoxylon (E) (LEG; 1,2,3; wo,ro; 0-1350m)	S/ST	Og	0	1	0	0
Daniellia oliveri (E) (LEG; 1; wo; 1060-1530m)	TT	wo	1	1	0	0
Desmodium velutinum (LEG; 1,2,3,4; f,wo,g; 0-1300m)	WH/S/SS	Fn	0	1	0	0
Dichrostachys cinerea (glomerata, nyassana) (438) (Es) (LEG; 1,2,3,4; wo,t; 0-1710m)	S/ST	Og	0	1	1	0
Diospyros abyssinica (Maba) (211) (Es) (EBE; 1,2,3,4; F,f,df)	T	Fg	1	1	1	0
Diospyros mespiliformis (E) (EBE; 1,2,3,4; wo,sc,ro)	T	Og	0	1	0	0
Dombeya bagshawei (E) (STE; 1,2,4; wo)	S/ST	wo	1	0	0	0
Dombeya dawei (E) (STE; 1,2,3,4; wo)	S/ST	wo	1	0	1	0
Dombeya goetzenii (120) (E) (STE; 1,2,3; F; 1800-3200m)	ST	F	0	1	0	0
Dombeya nairobensis (E) (STE; 1,2,3; F; 2200-3000m)	S/ST	F	0	0	1	0
Dombeya rotundifolia (E) (STE; 1,2,3,4; wo)	S/ST	wo	0	1	1	0
Dovyalis macrocalyx (glandulosissima) (144) (E,Es) (FLA; 1,2,3,4; F,df,r,t,wo; 0-2600m)	S	Fn	0	1	0	0
Dracaena fragrans (14) (AGA)	S	Ud	1	0	1	0
Drypetes gerrardii (sp. aff. D. battiscombei) (182) (Es) (EUP; 2,3,4; F,r,ro; 1150-2300m)	S/ST/TT	Fn	0	0	1	0
Drypetes ugandensis (D.sp.) (183184) (E,Es) (EUP; 2,4; F; 1140-1140m)	S/ST	F	0	0	1	0
Ehretia cymosa (sylvatica) (114) (E,Es) (BOR; 2,3,4; F,t,g; 960-2250m)	S/ST	Fn	0	0	1	0
Entada abyssininca (E) (LEG; 1,2,3,4; wo; 430-2290m)	ST	wo	0	0	1	0
Entada africana (sudanica) (Es) (LEG; 1)	S/ST	Ud	1	0	0	0
Entandrophragma utile (399) (E) (MEL; 1,2,4; F; 0-1830m)	TT	F	0	0	1	0
Erythrina abyssinica (E) (LEG; 1,2,3,4; g,wo,t,f,ro; 200-2100m)	ST	Fn	1	0	0	1
Erythrococca bongensis (EUP; 1,2,3,4; f,t,r; 200-2400m)	S/ST	Fn	0	1	0	0
Erythrophleum suaveolens (guineense) (433) (Es) (LEG; 1,2,3,4; F; 0-1110m)	TT	F	1	0	1	0
Erythroxylum fischeri (257) (E) (ERY; 1,2,3,4; F,f,t,r,s; 450-1340m)	SS/S/ST	Fn	0	0	1	0
Euclea divinorum (E) (EBE; 1,2,3,4; ro)	S/ST	ro	0	1	0	0
Euclea schimperi (EBE)	T	Ud	0	1	0	0
Euphorbia candelabrum (E) (EUP; 1,2,3,4; wo,g,ro)	ST	Og	0	1	0	0
Euphorbia tirucalli (E) (EUP; 1,2,3,4; g,wo; 0-2000m)	S/ST	Og	0	1	0	0
Fagaropsis angolensis (372) (E) (RUT; 2,3,4; F,df,f; 1000-2250m)	ST	Fg	0	0	1	0
Ficus amadiensis (kitubalu) (Es) (MOR; 1,2,3,4; wo,r,t; 950-2100m)	ST	Fn	0	1	0	0
Ficus artocarpoides (kisantuensis) (78) (Es) (MOR; 4; F,f; 800-1200m)	ST	Fg	0	0	1	0
Ficus asperifolia (urceolaris) (68) (Es) (MOR; 1,2,4; F,wo,f,r; 650-1850m)	S	Fn	1	0	0	1
Ficus capreifolia (MOR; 1,3; r,t; 0-1450m)	S	Fn	0	1	0	0
Ficus dicranostyla (E) (MOR; 1,3; wo,ro; 900-1100m)	S/ST	Og	1	1	0	1
Ficus glumosa (sonderi) (E,Es) (MOR; 1,3,4; ro,wo; 500-2000m)	ST	Og	0	1	0	0
Ficus ingens (73) (E) (MOR; 1,3,4; ro,f,wo; 0-2600m)	ST	Fn	0	1	0	0
Ficus mucuso (66) (E) (MOR; 2,3,4; F; 300-1200m)	TT	F	0	0	1	0
Ficus natalensis (82) (E) (MOR; 2,4; F,r,wo; 10-2200m)	TT	Fn	0	0	1	0
Ficus ovata (brachypoda) (71) (Es) (MOR; 1,2,3,4; wo,r; 750-2100m)	ST	Fn	1	1	1	1
Ficus platyphylla (E) (MOR; 1,3; wo,ro; 950-1170m)	ST	Og	0	1	0	0
Ficus polita (74) (E) (MOR; 2,4; F; 0-1200m)	ST/(TT)	F	0	1	1	0
Ficus pseudomangifera (85) (E) (MOR; 2,4; F; 1050-1200m)	ST	F	0	0	0	1

Ficus sansibarica (brachylepis, ugandensis) (72) (Es) (MOR; 2,4; F,r; 1050-1200m)	ST/(TT)	Fg	0	1	1	0
Ficus saussureana (eriobotryoides, dawei) (75) (Es) (MOR; 1,2,4; F,f,r; 900-1600m)	ST	Fg	0	0	1	0
Ficus sur (capensis) (69) (Es) (MOR; 1,2,3,4; F,r,wo; 0-2300m)	TT	Fn	1	0	1	1
Ficus sycomorus (gnaphalocarpa) (64) (Es) (MOR; 1,2,3,4; f,r,ro; 0-2200m)	TT	Fn	0	1	1	0
Ficus thonningii (dekdekena,rhodesica) (83) (E,Es) (MOR; 1,2,3,4; F,wo,r,ro; 350-2500m)	ST/(TT)	Fn	0	1	1	0
Ficus trichopoda (congensis) (67) (Es) (MOR; 1,2,4; F,r,s; 50-1200m)	S	Fn	0	0	1	1
Ficus vallis-choudae (65) (E) (MOR; 1,2,4; r; 450-1800m)	ST	r	0	0	1	0
Flacourtia indica (141) (E) (FLA; 1,3,4; wo,t,r; 0-2400m)	S/ST	Fn	0	1	0	0
Flueggea virosa (EUP; 1,2,3,4; f,t,ro; 0-2300m)	S/ST	Fn	1	1	1	1
Funtumia africana (latifolia) (271) (Es) (APO; 1,2,3,4; F)	TT	F	0	0	1	0
Funtumia elastica (272) (E) (APO; 2,4; F)	TT	F	0	0	1	0
Garcinia buchananii (huillensis) (280) (E) (GUT; 3,4; F,r,t,wo; 60-1800m)	S/ST	Fn	0	0	1	0
Gardenia erubescens (E) (RUB; 1; wo; 1300-1300m)	S/ST	wo	0	1	1	0
Gardenia ternifolia (jovis-tonantis) (Es) (RUB; 1,2,3,4; g,wo,t; 0-2100m)	S/ST	Og	1	1	1	0
Glyphaea brevis (lateriflora) (127) (Es) (TIL; 2,4; f,r)	S/ST	Fg	0	0	1	0
Greenwayodendron suaveolens (Polyalthia) (213) (Es) (ANN; 2,4; F; 1100-1100m)	TT	F	1	1	1	0
Grewia mollis (E) (TIL; 1,2,3,4; wo)	S/ST	wo	0	1	1	1
Hallea stipulosa (Mitragyna) (303) (Es) (RUB; 1,2,4; F,r; 1050-1200m)	TT	Fg	0	0	1	0
Harrisonia abyssinica (382) (E) (SIM; 2,3,4; F)	ST	F	0	1	0	0
Harungana madagascariensis (281) (E) (GUT; 2,3,4; F; 0-1800m)	ST/TT	F	0	0	0	1
Hexalobus monopetalus (E) (ANN; 1; wo,g,f; 1050-1290m)	S/ST	Fn	1	1	0	0
Holoptelea grandis (93) (E) (ULM; 1,2,3,4; F,r; 750-1200m)	TT	Fg	0	0	1	0
Hugonia platysepala (159) (LIN; 2,4; F,r,f; 1050-1220m)	C/S/ST	Fg	1	0	0	0
Huslondia opposita (LAB)	S	Ud	0	1	0	0
Hymenocardia acida (mollis) (E) (EUP; 1,2,3,4; wo,r; 600-1700m)	S/ST	Fn	1	1	0	1
Hymenodictyon parvifolium (scabrum) (E) (RUB; 1; wo,t,ro; 600-1320m)	S	Og	1	1	0	0
Indigofera arrecta (LEG; 1,2,3,4; f,t; 300-2700m)	WH	Fn	0	1	0	1
Indigofera emarginella (LEG; 1,2,3,4; f,wo,g; 500-2250m)	WH/S	Fn	0	1	1	0
Isolona congolana (215) (E) (ANN; 2; F)	TT	F	0	0	1	0
Khaya grandifoliola (404) (E) (MEL; 1,2; f,r)	TT	Fg	1	0	1	1
Khaya senegalensis (E) (MEL; 1; r,wo)	TT	Fn	0	0	1	0
Kigelia africana (aethiopica, moosa lanceolata) (371) (Es) (BIG; 1,2,3,4; F,s,wo; 0-2150m)	ST	Fn	0	1	1	1
Lannea barteri (kerstingii) (Es) (ANA; 1,2,3; wo,f,r; 900-1200m)	ST	Fn	1	1	1	1
Lannea fruticosa (E) (ANA; 1,3; wo,ro; 900-1800m)	S/ST	Og	0	0	1	0
Lannea fulva (E) (ANA; 1,2; wo,ro,t,f; 900-1600m)	S/ST	Fn	0	1	0	0
Lannea humilis (E) (ANA; 1; wo,t; 750-1700m)	S/ST	Og	0	1	0	0
Lannea welwitschii (387) (E) (ANA; 2,4; F; 1100-1100m)	TT	F	0	0	1	0
Lasiodiscus mildbraedii (302) (E) (RHA; 2,3,4; F; 0-1600m)	S/ST	F	0	0	1	0
Lecaniodiscus cupanioides (414) (E) (SAP; 2;)	ST	Ud	0	0	1	0
Lindackeria schweinfurthii (136) (FLA; 2,4; F,r; 600-1200m)	S/ST	Fg	0	0	1	0
Linociera nilotica (E) (OLE; 1,3,; F,r; 300-1650m)	S/ST	Fg	0	0	1	0
Lonchocarpus laxiflorus (LEG; 1,2,3,4; wo; 1020-1890m)	ST	wo	0	1	1	1
Macaranga monandra (96) (E) (EUP; 2,4; f,r,s; 1130-1525m)	ST	Fn	0	0	1	0
Maerua duchesnei (Capparisafzelii) (233) (Es) (CAP; 1,2,4; F,f; 1050-1350m)	CS/ST	Fg	0	0	1	0
Maesa lanceolata (164) (E) (MYR; 1,2,3,4; f,t; 360-2550m)	S/ST	Fn	0	0	1	0
Maesopsis eminii (189) (E) (RHA; 2,3,4; F; 800-1200m)	TT	F	0	0	0	1
Majidea fosteri (409) (E) (SAP; 1,2,4; F)	TT	F	0	0	1	0
Mallotus oppositifolius (297) (E) (EUP; 2,4; f,t,r; 0-1650m)	S/ST	Fn	0	1	1	0
Manilkara dawei (52) (E) (SAP; 1,2,3,4; F; 1100-1600m)	TT	F	0	1	0	0
Manilkara multinervis (schweinfurthii) (49) (E,Es) (SAP; 1; wo,r; 900-1050m)	TT	Fn	0	1	0	0
Margaritaria discoideus (Phyllanthus) (247) (Es) (EUP; 1,2,3,4; F,f,wo,t; 20-1900m)	S/ST	Fn	1	1	1	1
Markhamia platycalyx (369) (E) (BIG; 1,2,3,4; f)	ST	f	0	0	1	1
Maytenus heterophylla (Gymnosporia) (162) (CEL; 1,2,3,4; f)	ST	f	0	0	0	1
Maytenus ovata (Gymnosporia) (CEL)	S	Ud	0	0	1	0
Maytenus senegalensis (Gymnosporia) (CEL)	ST	Ud	0	1	1	0
Maytenus undata (Gymnosporia) (161) (CEL; 1,2,4; f; 0-2500m)	ST	f	0	0	1	1
Mildbraediodendron excelsum (423) (E) (LEG; 1,2,4; F; 790-1000m)	TT	F	0	0	1	0
Milicia excelsa (Chlorophora) (59) (Es) (MOR; 1,2,4; F,r; 0-1350m)	TT	Fg	1	0	1	0
Mimosa pigra (asperata) (LEG; 1,2,3,4; r,s; 2-1520m)	S	Fn	0	1	1	0
Mimusops bagshawei (47) (E) (SAP; 2,3,4; F; 1100-2400m)	TT	F	0	0	1	0
Mimusops kummel (sp.nar., warneckii) (48) (E,Es) (SAP; 1,2,3; F,r,df,wo,ro; 500-2100m)	TT	Fn	0	1	0	0
Monanthotaxis littoralis (ANN; 2,3,4; F,f,t; 1080-1170m)	S	Fn	1	0	0	0
Morus mesozygia (lactea) (58) (Es) (MOR; 2,4; F; 450-1600m)	TT	F	0	1	0	0
Mundulea sericea (LEG; 1; f,t,ro,wo; 10-1950m)	S/ST	Fn	0	0	0	1
Neoboutonia melleri (africana; N.sp.nr.N.mannii) (101) (E,Es) (EUP; 1,2,3,4; F,r; 1140-1850m)	ST	Fg	0	0	1	0
Nuxia congesta (Lachnopylis) (264) (Es) (LOG; 1,2,3; F; 1800-2700m)	ST	F	1	0	0	0
Ochna bracteosa (156) (E) (OCH; 2,3,4; F)	S/ST	F	0	1	0	0
Ochna holstii (158) (E) (OCH; 1,3; F; 2000-2000m)	TT	F	0	0	1	0
Ochna membranacea (155) (E) (OCH; 2,4; F)	ST	F	0	0	1	1
Ocimum suave (LAB)	S	Ud	0	0	0	1

Olax gambecola (OLA; 3,4; F,r; 1140-1340m)	S	Fg	0	1	0	0
Olea hochstetteri (334) (E) (OLE; 1,2; df; 1500-2610m)	ST	df	0	0	1	0
Oncoba spinosa (142) (E) (FLA; 1,2,3,4; f,t,r,wo; 0-1800m)	S/ST	Fn	0	0	1	0
Oxyanthus speciosus (317) (E) (RUB; 1,2,3,4; F; 750-2300m)	S/ST	F	0	0	1	0
Oxyanthus ugandensis (RUB; 2; F; 750-1050m)	S	F	0	0	1	0
Oxyanthus unilocularis (306) (E) (RUB; 2,4)	S/ST	Ud	1	0	1	0
Oxytenanthera abyssinica (E) (GRA; 1; wo)	S	wo	1	0	0	0
Pachystela brevipes (Chrysophyllum stuhlmannii) (53) (E,Es) (SAP; 2,4; F,r; 0-1500m)	ST	Fg	0	0	1	0
Pandanus ugandaensis (chiliocarpus) (11) (Es) (PAN; 1,2,3; s,r)	S	Fn	0	0	1	0
Parinari curatellifolia (E) (ROS; 1,2,4; wo,t; 0-2070m)	ST	Og	0	1	0	0
Parkia filicoidea (440) (E) (LEG; 2,4; F,r; 250-1370m)	TT	Fg	0	0	1	0
Pavetta oliveriana (RUB; 1,2,3,4; F,g,r,ro,t; 900-2300m)	S/ST	Fn	0	0	1	0
Phoenix reclinata (8) (E) (PAL; 1,2,4; r,s,ro; 0-3000m)	ST	Fn	0	0	1	1
Phyllanthus ovalifolius (guineensis, floribundus, lalambensis) (Es) (EUP; 1,2,4; f,r,t; 350-2000m)	CS/S/ST	Fn	1	1	0	1
Piliostigma thonningii (Bauhinia) (E) (LEG; 1,2,3,4; wo,t; 0-1830m)	ST	Og	1	1	1	1
Premna angolensis (266) (E) (VER; 1,2,3,4; f)	ST	f	0	0	1	0
Protea madiensis (E) (PRO; 1,2,3,4; g,ro; 1600-2300m)	S/ST	Og	0	0	1	0
Pseudarthria hoockeri (LEG; 1,2,3,4; g,t,s; 0-2100m)	WH/SS	Og	0	1	0	0
Pseudocedrela kotschyi (E) (MEL; 1,3,4; wo)	ST	wo	0	1	0	1
Pseudospondias microcarpa (385) (E) (ANA; 1,2,3,4; f,r,s; 900-1700m)	TT	Fn	0	0	1	0
Psorospernum febrifugum (campestre) (E,Es) (GUT; 1,2,3,4; wo; 50-1950m)	S/ST	wo	0	1	0	1
Pterocarpus lucens (abyssinicus) (Es) (LEG; 1,2; wo,ro; 1080-1200m)	ST	Og	1	1	0	1
Pterygota mildbraedii (sp.nov.) (115) (Es) (STE; 1,2,4; f)	TT	f	0	1	0	0
Pycnanthus angolensis (202) (E) (MYR; 2,3,4; F,f,r)	TT	Fg	0	0	1	0
Pycnocoma chevalieri (EUP; 1; F; 1000-1000m)	S	F	0	0	1	0
Raphia farinifera (monbuttorum) (9) (Es) (PAL; 2,4; F,s; 0-2500m)	TT	Fn	0	0	1	0
Rauvolfia oxyphylla (268) (E) (APO; 1,2,3,4; f)	ST	f	0	0	1	0
Rawsonia lucida (ugandensis) (139) (Es) (FLA; 2,3; F,df,r; 50-1900m)	S/ST	Fg	0	0	1	0
Rhus natalensis (E) (ANA; 1,2,3,4; wo,t,f; 1-3000m)	S/ST	Fn	1	1	0	1
Rhytigynia butanguensis (RUB)	S	Ud	1	0	0	0
Rinorea beniensis (ardisiaeflora) (149) (Es) (VIO; 2; F; 750-1150m)	S/ST	F	0	0	1	0
Rinorea brachypetala (poggei) (150) (E,Es) (VIO; 1,2,4; F; 850-1900m)	S/ST	F	0	0	1	0
Rinorea dentata (151) (E) (VIO; 4; F,s; 1200-1300m)	S/ST	Fn	0	0	1	0
Rinorea ilicifolia (148) (E) (VIO; 2; F; 0-1800m)	S/ST	F	0	0	1	0
Rinorea oblongifolia (152) (E) (VIO; 2,4; F; 1150-1450m)	S/ST	F	0	0	1	0
Rothmannia urcelliformis (Randia) (322) (E,Es) (RUB; 1,2,3,4; F; 850-2400m)	S/ST	F	0	0	1	0
Rothmannia whitfieldii (Randiamalleifera) (323) (Es) (RUB; 1,2,4; F; 700-1675m)	S/ST	F	1	0	1	0
Sapium ellipticum (179) (E) (EUP; 1,2,3,4; f,r; 150-2130m)	ST/TT	Fg	1	0	1	1
Schrebera arborea (macrantha) (332) (Es) (OLE; 1,2,4; F; 780-1200m)	TT	F	0	0	1	0
Sesbania sesban (E) (LEG; 1,2,3,4; r; 100-2200m)	ST	r	0	1	1	0
Solanum incanum (SOL)	S	Ud	0	1	0	1
Spathodea campanulata (370) (E) (BIG; 1,2,3,4; f)	ST	f	0	0	1	1
Staudtia kamerunensis (203) (E) (MYR; 2,4; F)	TT	F	1	0	0	0
Steganotaenia araliacea (E) (UMB; 1,2,3,4; wo)	ST	wo	1	1	1	1
Sterculia setigera (E) (STE; 1,2,4; ro)	ST	ro	0	1	0	0
Stereospermum kunthianum (E) (BIG; 1,2,3,4; wo)	ST	wo	1	1	1	1
Strychnos innocua (E) (LOG; 1,2,3,4; wo; 0-1400m)	S/ST	wo	1	1	0	0
Strychnos mitis (292) (E) (LOG; 1,2,4; F,r; 0-2300m)	TT	Fg	0	0	1	0
Suregada procera (181) (EUP; 1,2,4; F,f,r; 850-1830m)	S/ST	Fg	0	0	1	0
Symphonia globulifera (279) (E) (GUT; 2,4; F,r; 840-2550m)	TT	Fg	1	0	1	0
Syzygium guineense (339) (E) (MYR; 1,2,3,4; F; 0-2500m)	TT	F	1	1	1	0
Tamarindus indica (E) (LEG; 1,2,3; wo,t; 0-1520m)	ST	Og	0	1	0	0
Tapura fischeri (234) (E) (DIL; 1,2,3; F,r; 0-1200m)	S/ST	Fg	0	0	1	0
Tarenna graveolens (E) (RUB; 1,2,3,4; t,ro; 0-2130m)	S/ST	Og	1	0	1	0
Tarenna pavettoides (319) (RUB; 2,3,4; f,t,wo; 1125-1600m)	S/ST	Fn	0	0	1	0
Teclea eggelingii (Diphasiaangolensis, T.sp.nov.1) (350) (Es) (RUT; 2,4; F; 900-1600m)	S/ST	F	0	0	1	0
Teclea nobilis (simplicifolia) (347) (E,Es) (RUT; 1,2,3,4; F,r,wo; 900-2600m)	ST	Fn	0	1	1	0
Terminalia brownii (E) (CM; 1,2,3; wo,r; 730-2000m)	ST	Fn	1	1	0	0
Terminalia glaucescens (velutina) (Es) (COM; 1,2,3,4; wo; 1000-1800m)	ST	wo	1	1	1	1
Terminalia macroptera (E) (COM; 1,3; wo; 770-1400m)	ST	wo	1	0	1	0
Tetrapleura tetraptera (439) (E) (LEG; 1,2,4; F; 80-1220m)	TT	F	0	0	1	0
Treculia africana (60) (E) (MOR; 2,4; F,r; 0-1200m)	TT	Fg	0	0	1	0
Trema orientalis (guineensis) (92) (Es) (ULM; 1,2,3,4; f,r; 0-2100m)	S/ST	Fg	1	0	1	0
Trichilia dregeana (splendida, sp. 2) (392) (Es) (MEL; 1,2,3,4; F)	TT	F	0	1	1	0
Trichilia martineaui (393) (Es) (MEL; 2,4; F)	TT	F	0	0	1	0
Trichilia prieureana (394) (E) (MEL; 1,2,3,4; F,wo)	ST	Fn	1	0	1	1
Turraea robusta (227) (E) (MEL; 2,3,4; f)	ST	f	0	0	1	0
Turraea vogelii (228) (E) (MEL; 2,4; F,r)	S/ST	Fg	0	0	1	0
Turraea vogelioides (heterophylla) (229) (Es) (MEL; 2,4)	S/ST	Ud	0	0	1	0
Uvaria angolensis (bukobensis) (222) (Es) (ANN; 1,2,3,4; f,t; 1140-1350m)	C/CS/ST	Fn	0	0	1	0
Uvariopsis congensis (sp.nov.) (212) (Es) (ANN; 2,4; F; 1080-1650m)	ST	F	0	0	1	0

Vangueria acutiloba (E) (RUB; 1,2,3,4; f,t)	S/ST	Fn	0	0	1	0
Vangueria apiculata (311) (E) (RUB; 1,2,3,4; f)	S/ST	f	0	1	1	1
Vernonia adoensis (COM)	S	Ud	0	1	0	0
Vernonia amygdalina (E) (COM; 1,2,3,4; f,wo,t)	S/ST	Fn	0	1	1	1
Vernonia auriculifera (E) (COM; 2,3,4)	S/ST	Ud	0	1	0	0
Vernonia brachycalyx (COM)	S	Ud	0	1	0	0
Vitex amboniensis (368) (E) (VER; 1,2,4; F)	ST	F	1	0	1	1
Vitex doniana (E) (VER; 1,2,3,4; wo)	ST	wo	1	1	1	1
Vitex madiensis (E) (VER; 1,4; wo)	S/ST	wo	0	1	0	0
Voacanga thouarsii (obtusa) (278) (E,Es) (APO; 1,2,3,4; s)	ST	s	0	1	0	0
Ximenia americana (E) (OLA; 1,2,3,4; wo,t; 50-1950m)	S/ST	Og	0	1	0	1
Xylopia parviflora (218) (E) (ANN; 1,2,3; F,r,f,wo,t; 50-1200m)	ST	Fn	1	0	0	0
Zanha golungensis (416) (E) (SAP; 1,2,3,4; F)	ST	F	0	0	1	1
Zanthoxylum leprieurii (Fagara angolensis) (375) (Es) (RUT; 1,2,4; F; 900-2000m)	ST	F	0	0	1	0
Ziziphus abyssinica (E) (RHA; 1,3,4; g; 400-2200m)	S/ST	g	0	1	1	0
Ziziphus mucronata (E) (RHA; 1,2; wo; 0-2000m)	S/ST	wo	1	1	1	1

KEY TO INFORMATION PROVIDED BY EACH ENTRY:

Each entry is divided into five parts, as illustrated by the following example:

Species name			Form	Ecol. Type
Acacia brevispica (pennata)	(437) (Es)	(LEG; 1,2,3,4; t; 170-1830m)	S/ST	t
(Part one)	(Part two)	(Part three)	(Part four)	(Part five)

Part One: Species name (and synonym)

The current name, according to the Flora of Tropical East Africa is shown, followed in parentheses by any commonly used synonym. In most cases, synonyms provided are those used by Eggeling and Dale (1952). Where the generic name only has been changed, the old name is included in parantheses between the current generic and specific names.

Part Two: Field guide information sources

Immediately after the name, species that are described in Hamilton (1971) or Eggeling and Dale (1952) are identified by a short entry in parentheses. Numbers refer to species numbers used by Hamilton; an (E) is used to denote species listed under the checklist name by Eggeling and Dale; and (Es) is used to denote species that are described under a synonym in Eggeling and Dale.

Part Three: Family and known distribution

After each species name, the final part of the entry is divided by semi-colons into as many as four components, enclosed in parentheses. The first component is a three letter abbreviation, comprising the first three letters of the family name. Note that information provided for the 82 families covered by the existing parts of the Flora of Tropical East Africa is more comprehensive and reliable than that provided for the other 50 families. The second component details which of the four (FTEA) regions of the country the species has been recorded from. The third component lists the habitats in which the species occurs (see below for details of abbreviations used); and the fourth shows the range of altitude at which it has been recorded. Where distribution information is based on one or two (perhaps anomalous) records, an entry is included in parentheses: For example, if a species is known to occur throughout southwestern Uganda (region 2), with a single record from Mabira (region 4), the corresponding entry would be shown as 2, (4);

FTEA regions

1 Northern Uganda from West Nile through Acholi and Lango to Karamoja
2 Southern Uganda, including Kigezi, Toro, Bunyoro and West Ankole
3 South-eastern Uganda, east of the Nile including Teso, Sebei, Bugisu, Bukedi and Busoga
4 South-central Uganda, including Buganda, Mubende, Kibaale District and East Ankole

Habitat abbreviations:

F	Forest interior	wo	savanna woodland	ro	rocky places	S	swamp
f	forest edge	g	grassland	t	bush/thicket	m	moorland
df	(upland) dry (evergreen) forest	r	riverine/lakeshore	sc	dry scrub		

Part Four: Growth Form

The following abbreviations are used:

TT	tall tree (greater than 25m)	S	shrub	CS	climbing shrub	WH	woody herb
ST	short tree (up to 25m)	SS	subshrub	C	woody climber		

Part Five: Ecological Type

The following abbreviations are used:

FF Forest-dependent types, including:

F	Forest interior	r	Riverine/ lakeshore forest
f	Forest edge	df	Dry forest
fg	Forest generalists (occur in more than one of the above)		

O Open habitats types, including:

wo	Woodland	Sc	Dry scrub
g	Grassland	S	Swamp
ro	Rocky places	m	Moorland
t	Bush/ thickets		
Og	Open habitat generalists (occur in more than one of above)		

Fn Forest non-dependent types occur in forested and open habitats

Ud Undetermined types, about which little is known concerning habitat characteristics

Appendix 3.2 Daily record of trees and shrubs sampled from Kilak

Month (1993)	**11**	**12**
Date	**30**	**1**
Transect length (km)	**4**	**2**
Species		
Acacia hecatophylla	A	A
Acalypha ornata	A	A
Albizia schimperiana		1
Albizia zygia	A	A
Allophylus ferruginea		1
Aningeria altissima		O
Annona senegalensis	A	A
Antiaris toxicaria		A
Aphania senegalensis		1
Beilschmiedia ugandensis		O
Bersama abyssinica		O
Borassus aethiopum		A
Bridelia micrantha	A	A
Bridelia scleroneura		A
Butyrospermum paradoxum		O
Caloncoba crepiniana		F
Canarium schweinfurthii		O
Canthium rubrocostatum	O	
Canthium vulgare		1
Cassia petersiana		1
Cleistopholis patens		A
Coffea liberica		O
Combretum collinum	A	A
Craterispermum schweinfurthii		1
Daniellia oliveri	A	
Diospyros abyssinica		A
Dombeya bagshawei		1
Dombeya dawei		O
Dracaena fragrans		A
Entada africana		1
Erythrina abyssinica		O
Erythrophleum suaveolens		A
Ficus asperifolia		1
Ficus dicranostyla	O	
Ficus ovata		1
Ficus sur		1
Flueggea virosa		A
Gardenia ternifolia	A	A
Greenwayodendron suaveolens	O	O
Hexalobus monopetalus		O
Hugonia platysepala		1
Hymenocardia acida	A	A
Hymenodictyon parvifolium	O	
Khaya grandifoliola		1
Lannea barteri	1	
Margaritaria discoideus		A
Milicia excelsa		O
Monanthotaxis littoralis		1
Nuxia congesta		1
Oxyanthus unilocularis		1
Oxytenanthera abyssinica	A	A
Phyllanthus ovalifolius	A	A
Piliostigma thonningii	A	A
Pterocarpus lucens	1	
Rhus natalensis		O
Rhytigynia butanguensis	O	
Rothmannia whitfieldii		A
Sapium ellipticum		O
Staudtia kamerunensis		A
Steganotaenia araliacea		1
Stereospermum kunthianum	1	
Strychnos innocua		1
Symphonia globulifera		O
Syzygium guineense	A	A

Tarenna graveolens		1
Terminalia brownii		1
Terminalia glaucescens	A	A
Terminalia macroptera	O	O
Trema orientalis		1
Trichilia prieureana		O
Vitex amboniensis		A
Vitex doniana	A	A
Xylopia parviflora		1
Ziziphus mucronata	A	A
Total records	**25**	**66**
Cumulative records	**25**	**91**
New species	**25**	**49**
Cumulative species	**25**	**74**

Appendix 3.3 Daily record of trees and shrubs sampled from Aswa River

Month (1993)	**6**
Date	**5**
Species	
Acacia gerrardii	1
Acacia hockii	1
Acacia sieberiana	1
Acalypha neptunica	1
Albizia schimperiana	1
Allophylus macrobotrys	1
Annona senegalensis	1
Antiaris toxicaria	1
Baikiaea insignis	1
Butyrospermum paradoxum	1
Calodendrum capense	1
Canthium rubrocostatum	1
Cassia petersiana	1
Cassine aethiopica	1
Combretum molle	1
Dalbergia melanoxylon	1
Dichrostachys cinerea	1
Dombeya goetzenii	1
Euclea divinorum	1
Euphorbia candelabrum	1
Ficus dicranostyla	1
Ficus polita	1
Flueggea virosa	1
Gardenia ternifolia	1
Greenwayodendron suaveolens	1
Grewia mollis	1
Harrisonia abyssinica	1
Huslondia opposita	1
Indigofera arrecta	1
Indigofera emarginella	1
Kigelia africana	1
Lannea barteri	1
Maytenus senegalensis	1
Pterygota mildbraedii	1
Rhus natalensis	1
Stereospermum kunthianum	1
Tamarindus indica	1
Teclea nobilis	1
Terminalia brownii	1
Terminalia glaucescens	1
Vitex doniana	1
Ziziphus abyssinica	1

Ziziphus mucronata	1
Total records	**43**
Cumulative records	**43**
New species	**43**
Cumulative species	**43**

Appendix 3.4 Daily record of trees and shrubs sampled from Zoka

Month (1993)	**11**	**11**	**11**	**11**
Date	**18**	**19**	**20**	**21**
Transect length (km)	**3**	**3**	**5**	**3**
Species				
Acacia hockii	A	A	A	A
Acacia sieberiana				A
Acalypha neptunica		1		
Acalypha ornata		A	A	A
Acanthus arborescens				A
Albizia grandibracteata				A
Albizia zygia	A	A	A	A
Alchornea cordifolia		O		
Alchornea laxiflora		A	A	A
Aningeria altissima	A	A	A	A
Annona senegalensis	A	A	A	A
Antiaris toxicaria		O	O	
Aphania senegalensis		A	A	A
Argomuellera macrophylla		A	A	A
Balsamocitrus dawei		O	O	A
Baphia wollastonii	F		O	O
Beilschmiedia ugandensis	A	O	A	A
Bersama abyssinica	O			
Blighia unijugata	O	O	O	O
Blighia welwitschii		O	R	R
Borassus aethiopum			A	A
Bridelia micrantha	A	A	A	A
Caloncoba crepiniana	F	F	F	F
Canthium vulgare	O		O	O
Capparis tomentosa		A	A	A
Cassia mannii		F		O
Cassipourea gummiflua		O	O	O
Chrysophyllum albidum	O	O	O	O
Chrysophyllum muerense		O		
Citropsis articulata		O	O	O
Clausena anisata		F	F	F
Cleistopholis patens	F	F	F	
Coffea canephora			A	
Coffea liberica	O	O	F	F
Cola gigantea	A	A	A	A
Combretum molle	A	A	A	A
Cordia africana			O	O
Diospyros abyssinica	O	A	A	A
Dombeya dawei				1
Dracaena fragrans		A	A	A
Drypetes ugandensis	O	O	O	O
Erythrophleum suaveolens	A	A	A	
Erythroxylum fischeri	A	A	A	A
Fagaropsis angolensis		O		
Ficus mucuso		O		O
Ficus polita			O	
Ficus saussureana		1		
Ficus sur	O		O	
Ficus thonningii				1
Ficus trichopoda	1			

Ficus vallis-choudae	F		O	
Flueggea virosa	A	A		O
Funtumia africana		O		O
Gardenia ternifolia				O
Glyphaea brevis				O
Greenwayodendron suaveolens			A	O
Grewia mollis	A			A
Hallea stipulosa				O
Holoptelea grandis	A	A	A	A
Indigofera emarginella	A	A	A	
Khaya grandifoliola	A	A	A	A
Kigelia africana		O		O
Lannea fruticosa				F
Lannea welwitschii		1		
Lecaniodiscus cupanioides				O
Lindackeria schweinfurthii			F	F
Maerua duchesnei				O
Margaritaria discoideus	O	A	A	A
Markhamia platycalyx			O	
Maytenus undata		O		
Mildbraediodendron excelsum				O
Milicia excelsa	O	O	O	
Mimosa pigra				O
Neoboutonia melleri		A	A	O
Ochna holstii	O	A		O
Olea hochstetteri	O	O		O
Oncoba spinosa	O	O		O
Oxyanthus speciosus		A	A	A
Oxyanthus ugandensis				O
Oxyanthus unilocularis	O	A	A	O
Pachystela brevipes	A	A	A	A
Pandanus ugandaensis			A	A
Parkia filicoidea	O	A	A	A
Pavetta oliveriana			O	O
Phoenix reclinata	A	O		O
Piliostigma thonningii	A	A	A	A
Premna angolensis				O
Pseudospondias microcarpa	A	A	A	A
Pycnanthus angolensis	A	A	A	A
Rauvolfia oxyphylla	A	A	A	A
Rawsonia lucida				O
Rinorea beniensis				O
Rinorea brachypetala		1		
Rinorea dentata				1
Rinorea ilicifolia				O
Rothmannia urcelliformis		O	O	A
Sapium ellipticum				O
Spathodea campanulata	A	A		
Stereospermum kunthianum	A	A	A	A
Strychnos mitis		O		A
Suregada procera		O		
Symphonia globulifera				O
Syzygium guineense	A	A	A	A
Tapura fischeri	O	O	O	
Tarenna graveolens			O	O
Teclea eggelingii		O	O	
Terminalia glaucescens	A	A	A	
Tetrapleura tetraptera		A		A
Treculia africana		A		A
Trema orientalis			O	
Trichilia prieureana	A	A	A	A
Turraea vogelii		O	O	O
Uvaria angolensis	A	O		O
Uvariopsis congensis				O
Vangueria apiculata	O	O	O	O
Vitex amboniensis				O
Vitex doniana				A
Zanha golungensis		O	A	O
Ziziphus mucronata				A
Total species	**49**	**76**	**68**	**93**
Cumulative records	**49**	**125**	**193**	**286**
New species	**49**	**34**	**11**	**25**

Cumulative species	**49**	**83**	**94**	**119**

Appendix 3.5 Daily record of trees and shrubs sampled from Opit

Month (1993)	**11**	**11**	**11**	**11**	**12**	**12**
Date	**24**	**25**	**26**	**27**	**5**	**6**
Transect length (km)	**11**	**2.5**	**2**	**8**	**-**	**11**
Species						
Acacia abyssinica	1					
Acacia hockii	A	A	A	A		
Acacia polyacantha				A	A	A
Acacia sieberiana			A	A	A	A
Acalypha ornata	A	A	A	A	A	A
Acanthus arborescens	A	A				
Albizia coriara	A	A	A	A	A	O
Albizia schimperiana			O			
Albizia zygia	A	A	A	A	A	A
Antiaris toxicaria	A	A			O	O
Bridelia micrantha	A	O	O		A	A
Bridelia scleroneura		A	A	A	A	A
Capparis tomentosa						O
Carissa edulis	A					
Clausena anisata	A	A				
Combretum molle	A	A	A	A	A	A
Cussonia arborea	O	A			O	
Erythrina abyssinica	A	A			A	A
Ficus asperifolia	A		A			
Ficus dicranostyla		O			A	O
Ficus ovata						1
Ficus pseudomangifera					O	O
Ficus sur		A		A	O	O
Ficus trichopoda	A	O	A	A		
Flueggea virosa	A	A		O	A	A
Grewia mollis	A	A	A	A	A	A
Harungana madagascariensis				A	A	A
Hymenocardia acida		O				
Indigofera arrecta	A	A	A		O	O
Khaya grandifoliola	A		A		A	A
Kigelia africana	A	A		A	A	A
Lannea barteri	1					
Lonchocarpus laxiflorus	1					
Maesopsis eminii						1
Margaritaria discoideus	A	O	A	A	A	A
Markhamia platycalyx	O					
Maytenus heterophylla		O			O	O
Maytenus undata		1				
Mundulea sericea		O				
Ochna membranacea	A	O				
Ocimum suave	O					
Phoenix reclinata	A	O		A	A	A
Phyllanthus ovalifolius	A	A	A	A	A	A
Piliostigma thonningii	A	A	A	A	A	A
Pseudocedrela kotschyi	A	A		A	A	A
Psorospernum febrifugum		1				
Pterocarpus lucens		O				
Rhus natalensis		O			A	O
Sapium ellipticum				O	A	A
Solanum incanum			O	O	A	O
Spathodea campanulata					A	A
Steganotaenia araliacea	A	A	A		A	A
Stereospermum kunthianum	A				A	A
Terminalia glaucescens	A	A	A	A	A	A
Trichilia prieureana	A		A			
Vangueria apiculata	A	O				
Vernonia amygdalina	A	A	A	A	A	A
Vitex amboniensis	A	A	A	A		
Vitex doniana	A	A		A	A	A
Ximenia americana	1					
Zanha golungensis	1					
Ziziphus mucronata		A		A	A	A

Total records	**40**	**39**	**23**	**26**	**36**	**38**
Cumulative records	**40**	**79**	**102**	**128**	**164**	**202**
New species	**40**	**11**	**3**	**3**	**2**	**3**
Cumulative species	**40**	**51**	**54**	**57**	**59**	**62**

Chapter 4

Birds

Compiled by

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4.1 SUMMARY

The birds of Aswa River and Zoka Forest Reserves were sampled for a combined total of seven man-days using observation, with the addition of 4140 metre-net-hours of mist-netting at Zoka. Kilak and Opit were not visited by ornithologists. A combined total of 67 species was recorded (130 with previous records), with 51 species from Aswa River and 26 species from Zoka (107 with previous records). This represents one of the poorer areas sampled during the inventory programme. A high proportion of open habitat birds was recorded.

4.2 INTRODUCTION

4.2.1 Aims and rationale

Birds are arguably the best known, most conspicuous and in many ways most easily studied inhabitants of tropical forest, and are therefore well suited to the role of biological indicators. Their taxonomy is well known and stable, and their ecology comparatively well understood. They occur across a broad geographical range and in a large number of habitat types; and some species specialise within narrow habitat bands and are thus sensitive to habitat change. Practically, birds are readily observed in the field and relatively easy to capture. They are easily appreciated by politicians and members of the public and tend to attract a sympathetic attitude (Pearson and Cassola, 1992).

Uganda's location at a zone of convergence of seven major biogeographic regions or phytochoria (White, 1983), together with its proximity to the hypothetical Pleistocene forest refugium of eastern Zaire (Hamilton, 1981) accounts for its total of 1011 species (D. Turner, pers. comm.), an impressively high figure given Uganda's relatively small size (Pomeroy, 1993). This compares with about 1850 species recorded on the African mainland as a whole (Brown *et al.,* 1982). This high diversity is, however, countered by low levels of endemism. Only two country endemic species of bird occur, a similarly limited pattern being exhibited in most other vertebrate taxa.

The purpose of sampling the bird fauna (as with other taxa) was to compile as complete a species list for each site as possible, to enable comparison between sites and identify conservation needs and priorities.

There are a number of human and environmental variables which may have an adverse effect on objective comparisons between sites and which were considered in the design of the sampling regime, and are important in the interpretation of data. These include observer skill and effort, as well as habitat type and season. Because of the expected variability in observer ability, considerable emphasis was placed on mist-netting, which (in some respects) provides the most reliable basis for comparison. The factors influencing our results will be considered in more detail in subsequent publications, once the data from all sites has been fully collated and analysed. For now, it is sufficient to note these difficulties and present a comprehensive record of the results.

4.2.2 Previous work

As far as can be ascertained no previous ornithological survey work has been carried out in Aswa River Forest Reserve, and Zoka was surveyed briefly for the first time in February 1992 (Forbes-Watson, 1992).

4.3 METHODS

4.3.1 Field methods

Effort was divided between observation and mist-netting.

Observation. Observations were made using 8 x 30 and 10 x 40 binoculars. Effort was made to visit as many habitats as possible with maximum coverage occurring in the early morning and towards evening.

Mist-netting. Birds were caught using mist-nets in order to sample the less conspicuous species of the lower shrub/ground layers within the forest habitats, and to confirm the identification of 'difficult' or previously unrecorded species. Twenty mist-nets each of 9 m x 3 m were used. Nets were usually opened between 0630 h and 0800 h and closed between 1800 h and 1930 h. They were sited to maximise the catch, usually in pairs, and half were moved to a different habitat type every day or every other day.

4.3.2 Specimen collection, identification and taxonomy

Wherever possible identification was carried out in the field. Birds were identified using Williams and Arlott (1980), Mackworth-Praed and Grant (1957, 1960), Guggisburg (1986), Sinclair *et al.* (1993), and *Birds of Africa* (1982-1992). Bird calls were identified using compilation tapes taken from a number of sources, predominantly East African species recorded in West Africa. Order and nomenclature follow Britton (1980), Carswell and Pomeroy (1984) and the most recent revisions made by the Ornithological Sub-Committee of the East Africa Natural History Society (D. Turner, pers. comm.).

Ranger ornithologists were trained to make detailed field descriptions of their observations, including notes on the appearance, calls and behaviour of birds and the habitats in which they were observed. Each ranger was provided with a shortlist of (generally common, unmistakable) species that did not require verification, but records of any other species were only accepted where a full field description was submitted to the author for verification. Rangers were provided with printed forms on which to make these descriptions.

In the case of mist-netting, a (different) shortlist of species that did not require independent confirmation was provided to each ranger ornithologist and acceptance of any other mist-netting records were subject to submission of one (or preferably two) voucher specimens of each species. During the course of the programme a comprehensive reference collection has been made at Forest Department headquarters. Any difficult specimens were taken to the National Museums of Kenya, Nairobi, or the Zoological Museum at Tring, UK for identification.

4.3.3 Personnel, dates and areas sampled.

Charles Andama and Tim Davenport were responsible for the ornithological survey work carried out in the two forest reserves. Details of personnel, dates and areas sampled are given in Table 4.1.

During the inventory teams brief visit to Aswa River security in the area was very poor due to rebel activity within the reserve. As a consequence the camp was sited outside the forest reserve and only limited sampling was carried out within. Mist-netting was not possible. Observation was restricted to the immediate periphery and a longer excursion to the Aswa River itself (Fig. 4.1). In Zoka the security situation was also very poor and ornithological observation and the small amount of mist-netting carried out was restricted to the northeastern corner (Fig. 4.2).

Table 4.1 Personnel, dates and areas sampled in Aswa River and Zoka

	Aswa River	Zoka
Campsite locations (UTM)	VU334696	UU522457
Altitude (m)	760	915
Ranger ornithologists	C.Andama	C.Andama
Co-ordinator	T. Davenport	C.Dickinson
Dates	2-6.6.93	18-21.11.93
Vegetation type (Langdale-B.)	N4	D2/N5/L3

4.3.4 Data analysis

The bird field records were analysed in three ways:

a) Compilation of species lists. This enabled comparison with other forests and provided a basis for highlighting species that are of particular biogeographical or conservation significance.

b) Ecological characteristics. Each species was assigned an ecological (or habitat) type. This is designed to assist in classifying forests, and also to assess the importance of an individual forest to a defined group of bird species with a known habitat requirement. It has been adapted from Bennun *et al*., (in prep.) and Pomeroy (in prep.) largely using Britton (1980) and *Birds of Africa* (1982-1992). As the study was concerned primarily with forest, the emphasis was placed particularly on forest habitat-type divisions. The birds have been split into the following three categories:

- **Forest-dependent species** (FF-species) are the 'true' forest birds (at least for part of the year) most characteristic of the interior of undisturbed forest, although they may also persist in secondary forest and forest patches. These 'specialists' are usually less common at the forest edge and are rarely seen in non-forest habitats. A distinction is made between these and the F-species, the 'generalists', which are typically birds of forest edges and gaps; they are likely to be more common there, and in secondary forest, than in the interior of intact forest.
- **Forest non-dependent species** (f-species) are birds which are not infrequently recorded in forest but are not dependent on it; they are usually more common in non-forest habitats where they are most likely to breed (Bennun *et al*., in prep.).
- **Non-forest (open habitat) species.** The divisions of species found in non-forest habitats is less fine-grained with several habitats being lumped together. For example open woodland, bushland, and grassland are all grouped under the single heading of open habitats (O). Two other ecological type categories are distinguished; species confined to aquatic/swamp habitats (A), and species of widespread occurrence (W) that are likely to be found in more than one habitat type.

Where possible each of these ecological type categories has been further divided into highland (H) and lowland (L) species. Certain species are migratory (M), only being present in Uganda's forests for part of the year. A degree of caution needs to be exercised if including these species in analysis as their inclusion on a forest list may depend more on the time of year that the forest was visited than their actual presence or absence.

c) Species accumulation rates. As an aid to assessing the completeness of the data, species accumulation rates were examined in relation to the number of days of sampling and the number of birds caught in mist-nets.

4.4 RESULTS

4.4.1 Species list

A checklist of all the species recorded at Aswa River and Zoka is presented as Appendix 4.1. This is divided into previous (P) and inventory records. Inventory records are sub-divided into site lists, and the mode of detection (*ie* caught (C), observed (O)) is indicated, caught taking precedence over observed. Observed incorporates records that were seen or heard, or both seen and heard. Fifty-one species were recorded at Aswa

River and 26 at Zoka (107 with previous records). The two forests combined produce a total of 67 species and when this is added to previous records produces a total of 130.

4.4.2 Specimen list

Three specimens were collected from Zoka and these are documented in Appendix 4.2.

4.4.3 Trapping and observation analysis

In Zoka, 4140 metre-net-hours (mnh) of mist-netting caught 33 individual birds of nine species, producing a capture rate of 0.009 birds caught per mnh. This figure is slightly lower than the overall capture rate for the programme of 0.012. Observation and mist-netting analysis data is summarised in Table 4.2. A daily record of mist-net captures is given in Appendix 4.3.

4.4.4 Ecological characteristics

A summary of the number of bird species recorded in Aswa River and Zoka, and their respective ecological characteristics is given in Table 4.3. These two forests are sufficiently distinct from each other that combining ecological requirements is not a useful exercise. In Aswa River, 4% of the species recorded are forest-dependent specialists (FF) representing 1% of the country's total, and 8% are forest-dependent generalists (F) representing 3% of the country's total. This means that 12% of the species present are forest-dependent (FF + F), 2% of the Uganda total for this group. A further 31% are forest non-dependent visitors (f), 18% of the country total for this group. In Zoka, 2% of the species recorded are forest-dependent specialists (FF) representing 1% of the country's total, and 10% are forest-dependent generalists (F) representing 9% of the country's total. This means that 12% of the species present are forest-dependent (FF + F), 4% of the Uganda total for this group. A further 24% are forest non-dependent visitors (f), 29% of the country total for this group. One lowland and one highland species have been recorded.

4.4.5 Species accumulation rates

Figs. 4.3 and 4.4 show the species accumulation curves for each reserve. It is clear from the graphs that there was little decline in the rate that new species were being recorded.

4.4.6 Restricted-range, endemic and threatened species

Tables 4.4 and 4.5 present lists of restricted-range species found within each reserve. A restricted-range species is defined as occurring in five or less forests. The other forests in which they are known to occur are given.

4.5 DISCUSSION

A total of 51 species were recorded in Aswa River and 26 in Zoka (107 with previous records) which produces a total of 130 species in the two forests. This qualifies it as one of the poorer areas sampled during the inventory programme, but this needs to be balanced against the short sampling period and adverse security situation at each forest. A more comprehensive evaluation of their importance at a national level will have to await full analysis of the country-wide data. Due to their distance apart and differing vegetation types it is important to evaluate their importance separately as well as a unit.

The ecological requirement data are consistent with a relatively disturbed, savanna woodland environment, containing a low proportion of forest-dependent species. Zoka contains a forest-dependent component.

Seventeen restricted-range species have been recorded, two in Aswa River and 15 in Zoka. The majority of these, while known only from five or fewer forests, are non-forest species and occur widely elsewhere in Uganda (Britton, 1980). Species of note from Zoka include White-breasted Cuckoo Shrike (*Coracina pectoralis*), Pygmy Sunbird (*Anthreptes platurus*) and Grey-headed Olive-back (*Nesocharis capistrata*) a

lowland forest-dependent species. No globally threatened or national/regional endemic species were recorded (Collar *et al.*, 1994, Dowsett and Forbes-Watson, 1993).

Species accumulation data indicate that the species lists derived from this short sampling period are likely to be far from complete.

In conclusion, Aswa River and Zoka Forest Reserves can be considered to be poor forests in terms of their avifauna. They support a high percentage of non-forest birds. The species lists may increase substantially with more survey time.

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4.7 TABLES

Table 4.2 Mist-netting and observation data summary for Aswa River and Zoka

	Aswa River	Zoka	Combined Total
Man-days	4	3	7
Metre-net-hours (mnh)	0	4140	4140
No. individual birds caught	0	33	33
No. species caught	0	9	9
Birds caught per mnh	-	0.008	0.008
Inventory total	51	26	67
Previous known list	0	100	100
No. species new to forest	51	7	30
% of total list recorded	100	24	52
Forest total	51	107	130

Table 4.3 The ecological characteristics of bird species recorded from Aswa River and Zoka. Figures represent the number of species of each ecological type, shown as a percentage of the site's fauna and as a percentage of Uganda's total within each group

	Uganda Totals		Aswa-River			Zoka		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
FF	97	10	2	4	2	2	2	2
FFH	37	4	0	0	0	0	0	0
FFL	55	5	0	0	0	0	0	0
Total FF	**189**	**19**	**2**	**4**	**1**	**2**	**2**	**1**
F	80	8	4	8	5	10	9	13
FH	32	3	0	0	0	1	1	3
FL	15	1	0	0	0	0	0	0
Total F	**127**	**13**	**4**	**8**	**3**	**11**	**10**	**9**
FM	5	0	0	0	0	0	0	0
Total FF+F	**316**	**31**	**6**	**12**	**2**	**13**	**12**	**4**
f	82	8	16	31	20	25	23	30
fH	5	0	0	0	0	0	0	0
fL	2	0	0	0	0	1	1	50
Total f	**89**	**9**	**16**	**31**	**18**	**26**	**24**	**29**
fM	10	1	0	0	0	2	2	20
O	327	32	24	47	7	47	44	14
OH	13	1	0	0	0	0	0	0
OM	60	6	0	0	0	9	8	15
A	103	10	0	0	0	2	2	2
AM	66	7	0	0	0	1	1	2
W	19	2	5	10	26	6	6	32
WM	3	0	0	0	0	1	1	33
TOTAL	**1011**	**100**	**51**	**100**	**5**	**107**	**100**	**11**

Key:						
	FF	Forest specialists	f	Forest visitors	OM	Open habitat migrants
	FFH	Highland forest specialists	fH	Highland forest visitors	WM	Widespread migrants
	FFL	Lowland forest specialists	fL	Lowland forest visitors	FM	Forest generalist migrants
	F	Forest generalists	A	Aquatic/swamp species	fM	Forest visitor migrants
	FH	Highland forest generalists	O	Open habitat species	AM	Aquatic migrants
	FL	Lowland forest generalists	OH	Highland open habitat species	W	Widespread species

Table 4.4 Restricted-range birds recorded from Aswa River

Britton No.	Species	Ecol.Type	No. of Ugandan forests where species has been recorded	Other forests where species has been recorded
132	Dark Chanting Goshawk	O	4	Moroto, Semliki, Kasagala
483	Red-throated Bee-eater	O	2	Otzi

Key:						
	FF	Forest specialists	f	Forest visitors	OM	Open habitat migrants
	FFH	Highland forest specialists	fH	Highland forest visitors	WM	Widespread migrants
	FFL	Lowland forest specialists	fL	Lowland forest visitors	FM	Forest generalist migrants
	F	Forest generalists	A	Aquatic/swamp species	fM	Forest visitor migrants
	FH	Highland forest generalists	O	Open habitat species	AM	Aquatic migrants
	FL	Lowland forest generalists	OH	Highland open habitat species	W	Widespread species
	Conservation significance:					
	RE	Regional endemic (East Africa)	VU	Vulnerable (international threat category)		
	ARE	Albertine Rift endemic	nt	near-threatened (international threat category)		
			DD	Data deficient (international threat category)		

Table 4.5 Restricted-range birds recorded from Zoka

Britton No.	Species	Ecol.Type	No. of Ugandan forests where species has been recorded	Other forests where species has been recorded
46	Woolly-necked Stork	A	2	Sango Bay
100	Short-toed Snake Eagle	O	2	Otzi
114	Steppe Eagle	OM	3	Otzi, Sango Bay
119	Grasshopper Buzzard	OM	2	Mt. Kei
121	Red-necked Buzzard	OM	2	Mt. Kei
164	Blue Quail	O	3	Bwindi, Luunga
440	Standard-winged Nightjar	O	5	Labwor Hills, Semliki, Kasagala, Kisangi
487	Carmine Bee-eater	OM	2	Budongo
695	White-breasted Cuckoo Shrike	O	4	Mt. Kei, Otzi, Era
769	Rock Thrush	OM	2	Mt. Kei
779	Pied Wheatear	OM	1	
870	Red-pate Cisticola	O	3	Mt. Kei, Otzi
1086	Pygmy Sunbird	O	3	Mt. Kei, Otzi
1244	Grey-headed Olive-back	fL	4	Budongo, Kibale, Mt. Kei
1257	Red-winged Pytilia	O	5	Budongo, Nyangea-Napore, Otzi, Lokung

Key:						
	FF	Forest specialists	f	Forest visitors	OM	Open habitat migrants
	FFH	Highland forest specialists	fH	Highland forest visitors	WM	Widespread migrants
	FFL	Lowland forest specialists	fL	Lowland forest visitors	FM	Forest generalist migrants
	F	Forest generalists	A	Aquatic/swamp species	fM	Forest visitor migrants
	FH	Highland forest generalists	O	Open habitat species	AM	Aquatic migrants
	FL	Lowland forest generalists	OH	Highland open habitat species	W	Widespread species
	Conservation significance:					
	RE	Regional endemic (East Africa)	VU	Vulnerable (international threat category)		
	ARE	Albertine Rift endemic	nt	near-threatened (international threat category)		
			DD	Data deficient (international threat category)		

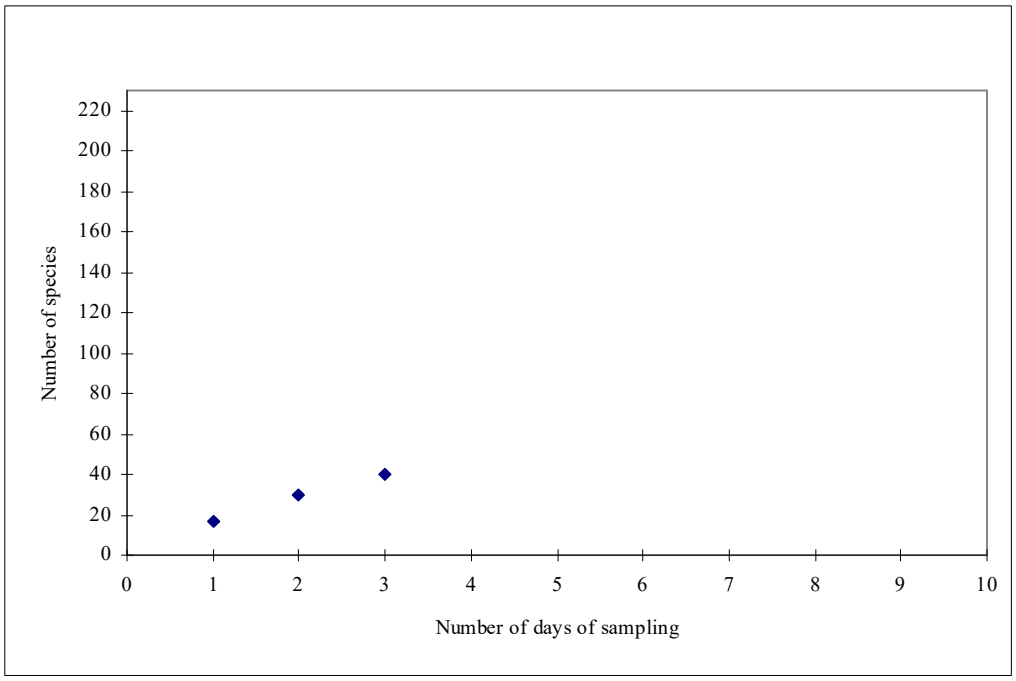

Fig. 4.3 Species accumulation rates for birds recorded (by observation) in Aswa River

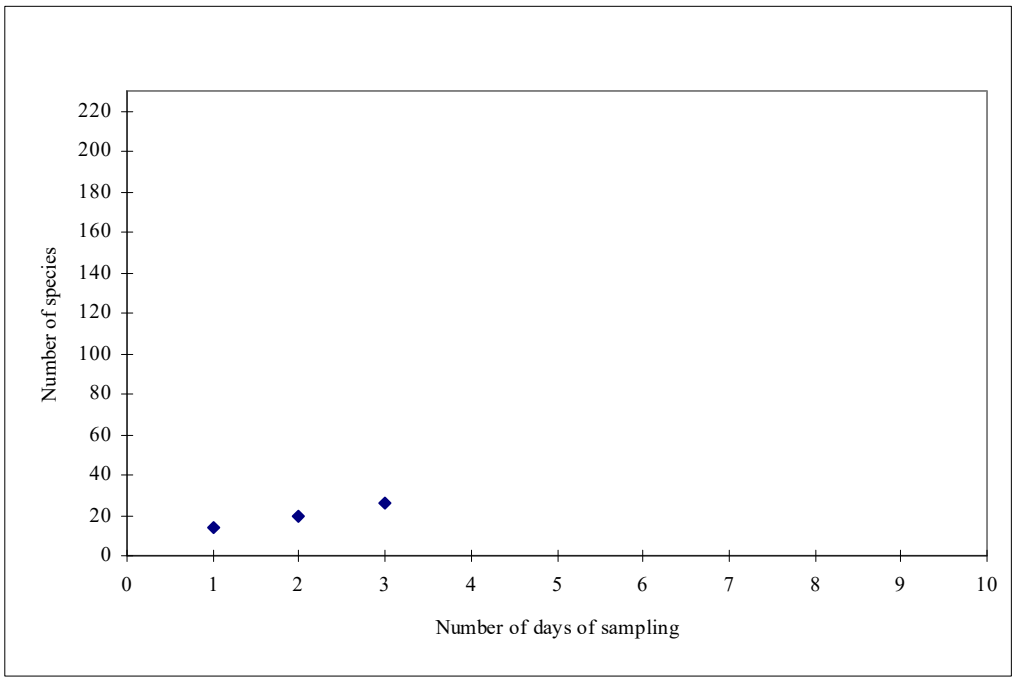

Fig. 4.4 Species accumulation rates for birds recorded (by observation and mist-netting) in Zoka

4.9 APPENDICES

Appendix 4.1 Species list of birds recorded in Aswa River and Zoka

Britton No.	Species	Common Name	Ecol. Type	Aswa River	Zoka
46	*Ciconia episcopus*	Woolly-necked Stork	A		O
51	*Bostrychia hagedash*	Hadada	W		O
87	*Neophron monachus*	Hooded Vulture	f		P
98	*Circaetus cinereus*	Brown Snake Eagle	O		P
100	*Circaetus gallicus*	Short-toed Snake Eagle	O		P
101	*Terathopius ecaudatus*	Bateleur	O	O	P
114	*Aquila nipalensis*	Steppe Eagle	OM		P
118	*Aquila wahlbergi*	Wahlberg's Eagle	OM		P
119	*Butastur rufipennis*	Grasshopper Buzzard	OM		P
120	*Buteo augur*	Augur Buzzard	O		O
121	*Buteo auguralis*	Red-necked Buzzard	OM		P
129	*Kaupifalco monogrammicus*	Lizard Buzzard	f		P
130	*Lophaetus occipitalis*	Long-crested Eagle	f	O	P
132	*Melierax metabates*	Dark Chanting Goshawk	O	O	
134	*Polemaetus bellicosus*	Martial Eagle	O		P
138	*Milvus migrans*	Black Kite	W		P
164	*Coturnix chinensis*	Blue Quail	O		P
184	*Francolinus squamatus*	Scaly Francolin	F		O
190	*Numida meleagris*	Helmeted Guineafowl	O		P
211	*Sarothrura elegans*	Buff-spotted Pygmy Crake	FF	O	
345	*Oena capensis*	Namaqua Dove	O	O	
346	*Streptopelia capicola*	Ring-necked Dove	f	O	O
350	*Streptopelia semitorquata*	Red-eyed Dove	f	O	
355	*Turtur afer*	Blue-spotted Wood Dove	f		P
357	*Turtur tympanistria*	Tambourine Dove	F	O	O
358	*Treron australis*	Green Pigeon	F		O
376	*Crinifer zonurus*	Eastern Grey Plantain Eater	W	O	O
381	*Tauraco leucolophus*	White-crested Turaco	f	O	O
388	*Chrysococcyx caprius*	Didric Cuckoo	O	O	
389	*Chrysococcyx cupreus*	Emerald Cuckoo	F	O	
391	*Chrysococcyx klaas*	Klaas' Cuckoo	f	O	P
396	*Cuculus clamosus*	Black Cuckoo	FF	O	
405	*Centropus senegalensis*	Senegal Coucal	f	O	O
416	*Strix woodfordii*	African Wood Owl	F	O	P
424	*Otus senegalensis*	African Scops Owl	O		P
440	*Macrodipteryx longipennis*	Standard-winged Nightjar	O		P
452	*Cypsiurus parvus*	Palm Swift	O		O
459	*Colius striatus*	Speckled Mousebird	O	O	P
462	*Apaloderma narina*	Narina's Trogon	F		P
466	*Alcedo cristata*	Malachite Kingfisher	A		P
472	*Halcyon chelicuti*	Striped Kingfisher	O		P
474	*Halcyon malimbica*	Blue-breasted Kingfisher	F		C
475	*Halcyon senegalensis*	Woodland Kingfisher	O	O	P
478	*Ispidina picta*	Pygmy Kingfisher	f		C
483	*Merops bulocki*	Red-throated Bee-eater	O	O	
485	*Merops hirundineus*	Swallow-tailed Bee-eater	O		P
487	*Merops nubicus*	Carmine Bee-eater	OM		P
491	*Merops pusillus*	Little Bee-eater	O	O	
494	*Merops variegatus*	Blue-breasted Bee-eater	O		P
500	*Eurystomus glaucurus*	Broad-billed Roller	f	O	P
502	*Upupa epops*	Hoopoe	O	O	P
505	*Phoeniculus cyanomelas*	Scimitarbill	O		P
508	*Phoeniculus purpureus*	Green Wood Hoopoe	O	O	P
513	*Bycanistes subcylindricus*	Black and White Casqued Hornbill	F		P
524	*Tockus nasutus*	Grey Hornbill	O	O	O
527	*Bucorvus abyssinicus*	Abyssinian Ground Hornbill	O		P
537	*Lybius guifsobalito*	Black-billed Barbet	O		P
552	*Pogoniulus pusillus*	Red-fronted Tinkerbird	O		P
566	*Indicator minor*	Lesser Honeyguide	f	O	P
581	*Campethera caroli*	Brown-eared Woodpecker	F	O	
587	*Dendropicos poecilolaemus*	Uganda Spotted Woodpecker	O		P
623	*Delichon urbica*	House Martin	OM		P
624	*Hirundo abyssinica*	Striped Swallow	W	O	P
634	*Hirundo rustica*	Eurasian Swallow	WM		P

636	*Hirundo senegalensis*	Mosque Swallow	W		P
639	*Psalidoprocne albiceps*	White-headed Rough-wing	f		P
643	*Riparia riparia*	Sand Martin	AM		P
644	*Dicrurus adsimilis*	Drongo	f	O	
649	*Oriolus larvatus*	Black-headed Oriole	f	O	
684	*Turdoides plebejus*	Brown Babbler	O		P
695	*Coracina pectoralis*	White-breasted Cuckoo Shrike	O		P
718	*Phyllastrephus albigularis*	White-throated Greenbul	FF		C
732	*Pycnonotus barbatus*	Common Bulbul	f	O	O
751	*Cossypha heuglini*	White-browed Robin Chat	f	O	
753	*Cossypha niveicapilla*	Snowy-headed Robin Chat	F		C
769	*Monticola saxatilis*	Rock Thrush	OM		P
771	*Myrmecocichla nigra*	Sooty Chat	O		P
779	*Oenanthe pleschanka*	Pied Wheatear	OM		P
783	*Saxicola rubetra*	Whinchat	OM		P
793	*Turdus abyssinicus*	Northern Olive Thrush	FH		C
837	*Camaroptera brachyura*	Grey-backed Camaroptera	f	O	C
857	*Cisticola erythrops*	Red-faced Cisticola	O		P
864	*Cisticola lateralis*	Whistling Cisticola	O		O
866	*Cisticola natalensis*	Croaking Cisticola	O		P
870	*Cisticola ruficeps*	Red-pate Cisticola	O		P
908	*Phylloscopus trochilus*	Willow Warbler	fM		P
913	*Prinia subflava*	Tawny-flanked Prinia	f	O	P
915	*Sphenoeacus mentalis*	Moustached Warbler	O	O	P
921	*Sylvietta brachyura*	Northern Crombec	O	O	
928	*Bradornis pallidus*	Pale Flycatcher	O		P
946	*Myioparus plumbeus*	Lead-coloured Flycatcher	f		C
960	*Platysteira cyanea*	Wattle-eye	f		P
968	*Terpsiphone viridis*	Paradise Flycatcher	f	O	C
981	*Anthus novaeseelandiae*	Richard's Pipit	O		P
984	*Anthus trivialis*	Tree Pipit	fM		P
988	*Macronyx croceus*	Yellow-throated Longclaw	O		P
991	*Motacilla aguimp*	African Pied Wagtail	W	O	
1000	*Dryoscopus gambensis*	Northern Puffback	F		P
1003	*Laniarius barbarus*	Black-headed Gonolek	O	O	
1004	*Laniarius ferrugineus*	Tropical Boubou	f	O	P
1012	*Malaconotus blanchoti*	Grey-headed Bush Shrike	O		P
1022	*Tchagra australis*	Brown-headed Tchagra	O	O	
1025	*Tchagra senegala*	Black-headed Tchagra	O		O
1026	*Corvinella corvina*	Yellow-billed Shrike	O	O	
1048	*Cinnyricinclus leucogaster*	Violet-backed Starling	f		P
1056	*Lamprotornis chloropterus*	Lesser Blue-eared Glossy Starling	O		P
1059	*Lamprotornis purpureus*	Purple Glossy Starling	O		P
1080	*Anthreptes collaris*	Collared Sunbird	F		P
1082	*Anthreptes longuemarei*	Violet-backed Sunbird	f		P
1086	*Anthreptes platurus*	Pygmy Sunbird	O		P
1112	*Nectarinia olivacea*	Olive Sunbird	FF		C
1122	*Nectarinia senegalensis*	Scarlet-chested Sunbird	f		P
1133	*Zosterops senegalensis*	Yellow White-eye	f		P
1146	*Euplectes hordeaceus*	Black-winged Red Bishop	O	O	
1148	*Euplectes macrourus*	Yellow-mantled Widowbird	O	O	P
1172	*Ploceus luteolus*	Little Weaver	O		P
1177	*Ploceus ocularis*	Spectacled Weaver	f		P
1184	*Ploceus superciliosus*	Compact Weaver	f		P
1191	*Quelea cardinalis*	Cardinal Quelea	O	O	O
1216	*Vidua macroura*	Pin-tailed Whydah	W	O	
1231	*Estrilda paludicola*	Fawn-breasted Waxbill	O	O	P
1237	*Lagonosticta rara*	Black-bellied Firefinch	O		P
1239	*Lagonosticta rubricata*	African Firefinch	O	O	
1241	*Lagonosticta senegala*	Red-billed Firefinch	O		P
1244	*Nesocharis capistrata*	Grey-headed Olive-back	fL		P
1257	*Pytilia phoenicoptera*	Red-winged Pytilia	O		O
1261	*Uraeginthus bengalus*	Red-cheeked Cordon-bleu	O	O	
1266	*Lonchura cucullata*	Bronze Mannikin	W	O	P
1290	*Serinus mozambicus*	Yellow-fronted Canary	O	O	P
1293	*Serinus sulphuratus*	Brimstone Canary	O	O	

Key:	FF	Forest specialists	f	Forest visitors	OM	Open habitat migrants
	FFH	Highland forest specialists	fH	Highland forest visitors	WM	Widespread migrants
	FFL	Lowland forest specialists	fL	Lowland forest visitors	FM	Forest generalist migrants
	F	Forest generalists	A	Aquatic/swamp species	fM	Forest visitor migrants
	FH	Highland forest generalists	O	Open habitat species	AM	Aquatic migrants
	FL	Lowland forest generalists	OH	Highland open habitat species	W	Widespread species

Species records					
C	Caught	O	Observed (heard and/or seen)	P	Previous record

Appendix 4.2 Bird specimens collected in Zoka

Specimen No.	Species	Date	GRID
718/45/1	White-throated Greenbul	20/11/93	UU520460
753/45/1	Snowy-headed Robin Chat	21/11/93	UU520460
946/45/1	Lead-coloured Flycatcher	20/11/93	UU520460

Appendix 4.3 Daily record of mist-net captures of birds (number of individuals) from Zoka

Site		**UU522457**			
Habitat		**D2/N5/L3**			
Month (1993)		**11**	**11**	**11**	
Date		**19**	**20**	**21**	**Total**
Metre net hours (mnh)		**900**	**1584**	**1656**	**4140**
Code	**Species**				
474	Blue-breasted Kingfisher	1			**1**
478	Pygmy Kingfisher	5	5	4	**14**
718	White-throated Greenbul	1	1	5	**7**
753	Snowy-headed Robin Chat	1		1	**2**
793	Northern Olive Thrush			1	**1**
837	Grey-backed Camaroptera		1	2	**3**
946	Lead-coloured Flycatcher		1		**1**
968	Paradise Flycatcher	1			**1**
1112	Olive Sunbird	1	1	1	**3**
Total individuals		**10**	**9**	**14**	**33**
Cumulative individuals		**10**	**19**	**33**	
Total species		**6**	**5**	**6**	
New species		**6**	**2**	**1**	**9**
Cumulative species		**6**	**8**	**9**	
Cumulative mnh		**900**	**2484**	**4140**	

Chapter 5

Small Mammals

Compiled by

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and

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5.1 SUMMARY

The small mammals were sampled using a combination of breakback, Sherman and pitfall traps. A total of 320 trap-nights were set at Aswa River and Zoka, and 12 animals captured. No trapping was undertaken at Kilak and Opit Forest Reserves. A total of six species were recorded during the inventory with five from Zoka (two rodents and three shrews) and two rodents from Aswa River. In addition, three rodents and three shrews are known from old records.A total of twelve small mammal species are now known. The list includes one restricted-range and regional endemc species, *Crocidura pasha*, which has been recorded from just three forests during the course of the natiowide project. The reserves were greatly undersampled compared with other sites visited during the programme.

5.2 INTRODUCTION

5.2.1 Aims and rationale

The purpose of sampling the small mammals, as with the other taxa, was to compile as complete a species list as possible to enable comparison between sites and assist with the identification of conservation needs and priorities in Uganda's forests. Uganda supports an extremely high number of mammal species, second to Zaire in Africa and ranked ninth in the world (McNeely *et al;* 1990). Over 125 species from the mammalian orders Insectivora, Macroscelidea and Rodentia (excluding families Sciuridae, Anomaluridae and Hystricidae) are recorded from Uganda (Davies and Vanden Berghe, 1994); including three national and twelve Albertine Rift endemic species.

The present distribution of Uganda's small mammals has arisen due to fluctuations in the extent of forest cover over the millennia. Forest cover has sometimes been reduced to small refugia (Rodgers *et al*., 1982; Grubb, 1983; Howell and Kingdon, 1993), and these areas represented important sources for the dispersal of forest-dependent species when climatic conditions subsequently improved, allowing the expansion of forests. Ecologically adaptable and mobile species can spread rapidly but small ground-dwelling mammals are likely to be amongst the poorest colonisers (Kingdon, 1971-74; Rodgers *et al.,* 1982; Grubb, 1983; Howell and Kingdon, 1993). Small mammals were the only non-flying animal group sampled during the course of this project. This was considered an important attribute that may provide a unique ecological perspective, highlighting sites of biogeographic and ecological importance in a manner not possible for the more mobile taxa.

As an alternative to the sampling of small mammals, other groups of non-flying and less mobile fauna such as amphibians, molluscs or soil organisms may provide an effective means of site evaluation. However, successful inventory and sampling of these taxa pose numerous problems of a practical and taxonomic nature, which limit their value as indicators. This is in contrast to small mammal trapping which is a well known and relatively effective sampling technique; since trapping strategies can be designed and successfully implemented under field conditions, and trapping effort is easily quantifiable. In addition, previous studies in Uganda by Delany (1975) and Kingdon (1971-74), although not exhaustive, may assist with the interpretation and analysis of the data providing a baseline for comparison. The existence of taxonomic references and keys makes them a relatively accessible group requiring only a limited amount of taxonomic expertise.

The degree to which the small mammal survey results will assist in ranking forests according to their conservation value, has not yet been fully determined. It is beyond the scope of this report to discuss this in detail, the aim being to present the field data with the minimum of discussion and interpretation.

5.2.2 Previous work

A previous inventory undertaken by the Forest Department and conducted by Robert Kityo (pers. comm.) was carried out at Zoka, these prevous records are presented in Appendix 5.1. In addition one previous record is known from Aswa River.

5.3 METHODS

5.3.1 Field methods

Field methods were aimed at obtaining qualitative rather than quantitative data, with emphasis on species richness, rather than on population densities. Therefore a combination of trap types was used, including Sherman, Longworth, pitfall and breakback traps. The latter included locally made rat traps (18 x 8 cm), Museum Specials (14 x 7 cm), and large and small commercially available breakback traps from the USA (18 x 8 cm and 10 x 4 cm respectively).

Pitfall traps were used with the particular intention of collecting shrews. These traps consisted of a drift fence constructed from metal wire mesh (mesh size 5 mm x 5 mm) approximately 30 cm in height and 20 to 25 metres in length. The fence acted as a barrier to foraging animals, guiding them into sunken 5 litre plastic buckets (20 cm diameter x 25 cm depth) situated every five metres. The pitfall fences were situated in a variety of forest habitats concentrating on undisturbed forest and sites in close proximity to streams.

In order to establish a degree of uniformity and enable comparison of data between sites, a standardised trapping regime was adopted at each site. A variety of bait types was used in order to catch the full range of rodent and shrew species, and traps were set in a range of different habitat types and locations, ten metres apart according to the following guidelines:

- Fifty percent of traps were set at ground level in a variety of habitats, including disturbed and open areas. Two-thirds of these were baited with peanut butter and oatmeal or termites and one-third with rehydrated fish.
- Forty percent of traps were set near streams or close to the water's edge, where possible. Of these traps, half were baited with rehydrated fish and half with peanut butter and oatmeal, or peanut butter and termites. If there were no streams in the vicinity of the trapping area the traps were set as detailed above, in a variety of different habitat types.
- Ten percent of traps were situated 1-6 metres above ground level in trees. Half of these traps were baited with mashed banana and the other half with peanut butter and oatmeal.

5.3.2 Specimen collection, identification and taxonomy

Preliminary identification of the rodents was undertaken by John Kasangaki and Joel Adriko in the field, following the taxonomic nomenclature in Delany (1975). It was not possible to identify most shrews in the field, so these were prepared and retained as specimens. Each specimen was identified, where possible, weighed (to the nearest gram), sexed, the state of the vagina or position of the testes noted, and the following measurements taken: head and body length, tail, hind foot, and ear length (to the nearest millimetre).

Specimen identifications were confirmed by Robert Kityo following the taxonomic nomenclature of Dollman (1915-16), Meetser and Setser (1971-79) and Wilson and Reeder (1993), which provide the basis for the Checklist of the Mammals of East Africa (Davies and Vanden Berghe, 1994). Members of five families were considered, namely the shrews (Soricidae), Cricetid rats (Cricetidae), mice and rats (Muridae), gerbils (Gerbillidae) and dormice (Myoxidae) of which there are 35 shrews and 74 rodents listed for Uganda (Davies and Vanden Berghe, 1994). To this list were added four shrews (*Crocidura ludia, C. macarthuri, C. somalica* and *C. sp. cf. denti*) and three rodents (*Arvicanthis testicularis, Dendromys mesomelas* and *Saccostomus campestris*). Two introduced species (*Rattus rattus* and *Mus musculari*s) were not considered. Thus, a total of 114 species (39 shrews and 75 rodents) was considered.

Three groups of rodents presented particular problems taxonomically, which have not been satisfactorily resolved during the present programme. The first comprises the pygmy mice, where eight species are listed for

Uganda of which five are virtually indistinguishable on external characteristics; these we have attributed to *Mus minutoides* accepting that we may have overlooked *Mus mahomet, Mus musculoides, Mus setulosus* and *Mus sorella*. The second difficult group is the dormice of which three species are listed for Uganda, where we have distinguished one (*Graphiurus murinus*). Finally the taxonomy of the *Grammomys/Thamnomys* group of rats remains uncertain and we have been unable to place several specimens from NE Uganda (Moroto, Nyangea-Napore, Kadam, Morungole and Timu) which appear taxonomically distinct and are significantly larger than *Grammomys dolichurus* (which also occurs in these forests). All specimens have been retained at Makerere University Zoology Museum for further examination and reference.

5.3.3 Personnel, dates and areas sampled

Table 5.1 Personnel, dates and areas sampled in Aswa River and Zoka

	Aswa River	**Zoka**
Campsite locations (UTM)	VU334696	UU522457
Altitude (m)	760	915
Ranger zoologist	J. Kasangaki	J. Adriko
Co-ordinator	T. Davenport	C. Dickinson
Dates	2-6.6.93	18-21.11.93
Samping periods (days)	3	3
Vegetation type (Langdale-B.)	N4	D2/N5/L3

Figs 5.1 and 5.2 show the location of the camps and the areas where mammal trapping was undertaken.

5.3.4 Data analysis

The small mammal records were analysed in three ways:

a) Compilation of species lists. This enabled comparison with other forests and provided a basis for highlighting species that are of particular biogeographical or conservation significance.

b) Ecological characteristics. All the small mammal species currently known from Uganda were classified according to their habitat requirements using Rosevear (1969), Kingdon (1971-74), Delany (1975), Hutterer (1987) and Skinner and Smithers (1990). This form of analysis assists in classifying forests and also in determining the importance of an individual forest to a defined group of species with a known habitat requirement. As this study is concerned mainly with forest habitats, the emphasis was placed particularly on forest habitat-type divisions, whilst non-forest habitats tended to be grouped under one classification as open habitat. The following ecological type categories are distinguished:

   - **Forest-dependent species** (F-species) are largely confined to closed-canopy forest and would be unlikely to tolerate any form of major large-scale habitat modification, although they may persist in secondary forest and isolated forest fragments.
   - **Forest non-dependent species** (f-species) are not restricted to closed-canopy forest and may occur in forest edge, gallery forest and dense savanna woodland.
   - **Non-forest (open habitat) species** are characteristic of open grasslands and semi-arid environments (O), aquatic or swamp habitats (A) or occur in a wide range of habitats (W).

   Species are further classified according to whether they occur only in highland areas above 1500 m (H) or lowland areas below 1500 m (L). The lack of knowledge concerning the ecological requirements of many of the small mammal species, particularly the shrews, makes it impossibleto classify all species and nine shrews and four rodents remain of unknown ecological type (U).

c) Species accumulation rates. Using the daily trapping records, species accumulation rates were examined in order to estimate the extent to which further trapping would add to the species list, and facilitate comparisons of species richness between forests for any given level of sampling effort.

5.4 RESULTS

5.4.1 Species lists

Species lists for rodents and shrews recorded at Aswa River and Zoka are presented as Appendices 5.1 and 5.2, previous records are also listed here. A total of six species were recorded during the inventory with five from Zoka (two rodents and three shrews) and two rodents from Aswa River. In addition, three rodents and three shrews are known from old records.

5.4.2 Specimen list

Appendices 5.3 and 5.4 provide details of all the specimens taken at Aswa River and Zoka, including identification numbers and capture site details. Specimens are retained at the Museum of Zoology, Makerere University and further information can be obtained from Robert Kityo, Museum Curator, Makerere University, PO Box 7062, Kampala, Uganda.

5.4.3 Trapping analysis

Appendices 5.5 and 5.6 show the number of trap-nights set and animals captured at the two reserves. A combined total of 320 trap-nights were set, with 12 animals trapped. A trap capture success rate of 3.75 animals per 100 trap-nights was recorded.

5.4.4 Ecological characteristics

A total of twelve small mammal species are now known from Aswa River and Zoka. The ecological characteristics data are showm in Tables 5.2 and 5.3. Six species (50%) are widespread and just three (25%) are forest-edge animals. Surprisingly, only one open habitat species, *Aethomys hindei*, was recorded

5.4.5 Species accumulation rates

The species accumulation rate for Zoka is shown in Fig. 5.3. Little, however, can be deduced from the data.

5.5 DISCUSSION

Six shrew and six rodent species are now known from Aswa River and Zoka Forest Reserves. Species of note included the restricted-range species *Crocidura pasha*, recorded from just three Forest Reserves during the course of the nationwide inventory project. This animal is a regional endemic, known only from Sudan, Ethiopia and northen Uganda.

The mammal fauna largely consisted of widespread and common species. Both sites, however, were sampled inadequately and trap effort and sample size were too small to make any reliable comment.

5.6 REFERENCES

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5.7 TABLES

Table 5.2 The ecological characteristics of mice, rats and gerbil species recorded from Aswa River and Zoka. Figures represent the number of species of each ecological type,shown as a percentage of the site's fauna and as a percentage of Uganda's total within each group

	Uganda Totals		Aswa River			Zoka		
Ecological Type	**No. of Spp.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	2	3	0	0	0	0	0	0
FL	3	4	0	0	0	0	0	0
FH	7	9	0	0	0	0	0	0
f	9	12	1	33	11	2	33	22
fH	3	4	0	0	0	0	0	0
A	1	1	0	0	0	0	0	0
AF	3	4	0	0	0	0	0	0
AO	2	3	0	0	0	0	0	0
AH	2	3	0	0	0	0	0	0
O	26	35	1	33	4	1	17	4
OH	3	4	0	0	0	0	0	0
W	10	13	1	33	10	3	50	30
U	4	5	0	0	0	0	0	0
TOTAL	**75**	**100**	**3**	**100**	**4**	**6**	**100**	**8**

Key:					
F	Closed forest	FL	Closed forest (lowland)	FH	Closed forest (highland)
f	Forest edge	fH	Forest edge (highland)	A	Aquatic/swamp
AF	Swamp forest	AO	Swamp open habitats	AH	Aquatic/swamp (highland)
AFH	Swamp forest (highland)	O	Open/grassland	OH	Open/grassland (highland)
W	Widespread	U	Unknown status		

Table 5.3 The ecological characteristics of shrew species recorded from Aswa River and Zoka. Figures represent the number of species of each ecological type,shown as a percentage of the site's fauna and as a percentage of Uganda's total within each group

	Uganda Totals		Aswa River			Zoka		
Ecological Type	**No. of Spp.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	4	10	0	0	0	0	0	0
FH	6	15	0	0	0	0	0	0
f	3	8	0	0	0	1	20	33
AF	2	5	0	0	0	0	0	0
AFH	1	3	0	0	0	0	0	0
O	6	15	0	0	0	0	0	0
W	8	21	0	0	0	3	60	38
U	9	23	0	0	0	1	20	11
TOTAL	**39**	**100**	**0**	**0**	**0**	**5**	**100**	**13**

Key:					
F	Closed forest	FL	Closed forest (lowland)	FH	Closed forest (highland)
f	Forest edge	fH	Forest edge (highland)	A	Aquatic/swamp
AF	Swamp forest	AO	Swamp open habitats	AH	Aquatic/swamp (highland)
AFH	Swamp forest (highland)	O	Open/grassland	OH	Open/grassland (highland)
W	Widespread	U	Unknown status		

Table 5.4 Restricted-ange small mammals recorded from Zoka

Species	Ecol .Type	No. of Ugandan forests where species has been recorded	Other forests where species has been recorded	Status and Distribution in Africa
Shrews				
Crocidura pasha	U	3	Kadam, Otzi	Sudan and Ethiopia

Key:						
	F	Closed forest	FL	Closed forest (lowland)	FH	Closed forest (highland)
	f	Forest edge	fH	Forest edge (highland)	A	Aquatic/swamp
	AF	Swamp forest	AO	Swamp open habitats	AH	Aquatic/swamp (highland)
	AFH	Swamp forest (highland)	O	Open/grassland	OH	Open/grassland (highland)
	W	Widespread	U	Unknown status		

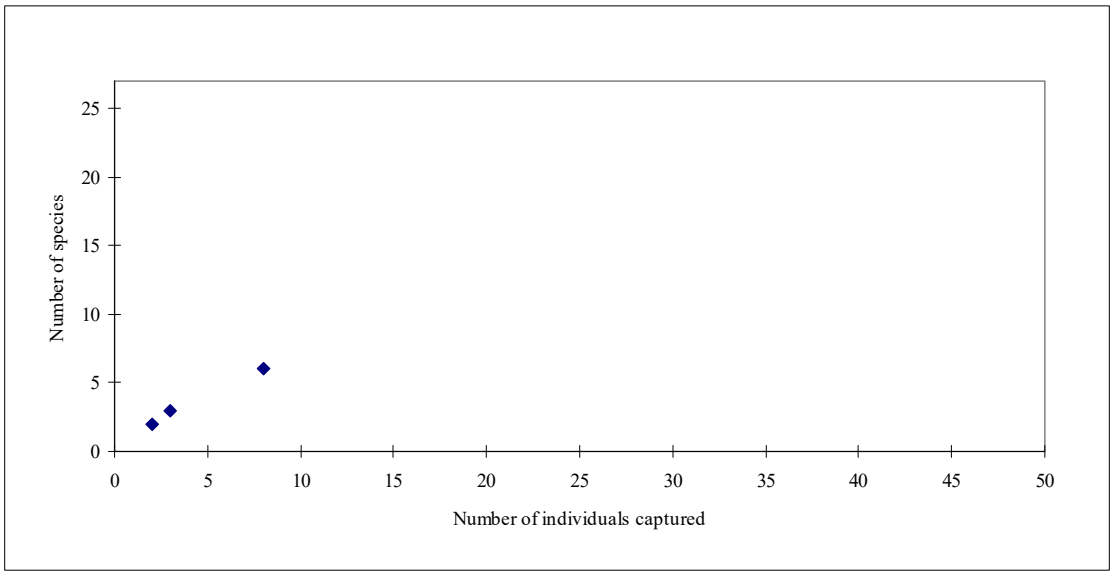

Fig. 5.3 Species accumulation rates for small mammals from Zoka

5.8 APPENDICES

Appendix 5.1 List of rodent species recorded from Aswa River and Zoka

Species	Ecol. Type	Aswa River	Zoka
Aethomys hindei	O	1	1
Grammomys dolichurus	f		1
Graphiurus murinus	W		1
Lemniscomys striatus	W	2	2
Mastomys hildebrandtii	W		2
Praomys jacksoni	f	2	1

Key:	Ecological type					
	F	Closed forest	FL	Closed forest (lowland)	FH	Closed forest (highland)
	f	Forest edge	fH	Forest edge (highland)	A	Aquatic/swamp
	AF	Swamp forest	AO	Swamp open habitats	AH	Aquatic/swamp (highland)
	AFH	Swamp forest (highland)	O	Open/grassland	OH	Open/grassland (highland)
	W	Widespread	U	Unknown status		
	Species records					
	1	Previous	2	Present inventory	3	Previous and present

Appendix 5.2 List of shrew species recorded from Zoka

Species	Ecol. Type	Zoka
Crocidura gracilipes	W	1
Crocidura hildegardeae	W	1
Crocidura jacksoni	U	2
Crocidura olivieri	W	2
Crocidura pasha	U	1
Crocidura turba	f	2

Key:	Ecological type					
	F	Closed forest	FL	Closed forest (lowland)	FH	Closed forest (highland)
	f	Forest edge	fH	Forest edge (highland)	A	Aquatic/swamp
	AF	Swamp forest	AO	Swamp open habitats	AH	Aquatic/swamp (highland)
	AFH	Swamp forest (highland)	O	Open/grassland	OH	Open/grassland (highland)
	W	Widespread	U	Unknown status		
	Species records					
	1	Previous	2	Present inventory	3	Previous and present

Appendix 5.3 List of mammal specimens collected from Aswa River

Specimen No.	Species	Date	UTM
ASWA33	*Lemniscomys striatus*	04/06/93	VU294692
ASWA34	*Praomys jacksoni*	04/06/93	VU294692
ASWA35	*Praomys jacksoni*	04/06/93	VU294692

Appendix 5.4 List of mammal specimens collected from Zoka

Specimen No.	Species	Date	UTM
1167	*Crocidura olivieri*	18/11/93	UU520480
1168	*Mastomys hildebrandtii*	18/11/93	UU520480
1169	*Aethonys sp*	19/11/93	UU520480
1170	*Crocidura jacksoni*	20/11/93	UU520460
1171	*Crocidura turba*	20/11/93	UU520460
1172	*Aethomys sp*	20/11/93	UU520460
1173	*Lemniscomys striatus*	20/11/93	UU520460
1174	*Mastomys hildebrandtii*	20/11/93	UU520460

Appendix 5.5 Daily record of small mammals captured in Aswa River

Site	VU334696			
Month (1993)	**6**	**6**	**6**	
Day	**4**	**5**	**6**	**Total**
TRAPTYPE/Species				
BREAKBACK TRAPS SET:	**0**	**0**	**0**	**0**
Total breakback captures	**0**	**0**	**0**	**0**
LONGWORTH TRAPS SET:	**8**	**8**	**8**	**24**
Total longworth captures	**0**	**0**	**0**	**0**
PITFALL TRAPS SET:	**0**	**0**	**0**	**0**
Total pitfall captures	**0**	**0**	**0**	**0**
SHERMAN TRAPS SET:	**13**	**13**	**13**	**39**
Lemniscomys striatus	1			1
Praomys jacksoni	2			2
Unconfirmed (Rodent)	1			1
Total sherman captures	**4**	**0**	**0**	**4**
Total captures	**4**	**0**	**0**	**4**
Cumulative captures	**4**	**4**	**4**	
Total traps set	**21**	**21**	**21**	**63**
Cumulative traps set	**21**	**42**	**63**	
Total species*	**2**	**0**	**0**	
New species*	**2**	**0**	**0**	
Cumulative species*	**2**	**2**	**2**	

Appendix 5.6 Daily record of small mammals captured in Zoka

Site	UU522457			
Month (1993)	**11**	**11**	**11**	
Day	**18**	**19**	**20**	**Total**
TRAPTYPE/Species				
BREAKBACK TRAPS SET	**69**	**69**	**69**	**207**
Aethomys sp		1	1	**2**
Crocidura jacksoni			1	**1**
Crocidura olivieri	1			**1**
Lemniscomys striatus			1	**1**
Mastomys hildebrandtii	1		1	**2**
Total Breakback captures	**2**	**1**	**4**	**7**
LONGWORTH TRAPS SET	**0**	**0**	**0**	**0**
PITFALL TRAPS SET	**0**	**10**	**10**	**20**
SHERMAN TRAPS SET	**10**	**10**	**10**	**30**
Crocidura turba			1	**1**
Total Sherman captures			**1**	**1**
Total captures	**2**	**1**	**5**	**8**
Cumulative captures	**2**	**3**	**8**	
Total traps set	**79**	**89**	**89**	**257**
Cumulative traps set	**79**	**168**	**257**	
Total species*	**2**	**1**	**5**	
New species*	**2**	**0**	**3**	**5**
Cumulative species*	**2**	**2**	**5**	

Chapter 6

Butterflies

Compiled by

Tim Davenport BSc(Hons), PhD

6.1 SUMMARY

The butterflies of Kilak, Aswa, Zoka and Opit were sampled through the systematic use of sweep nets and baited traps for a total of 3, 7, 4 and 7 man-days, respectively. Species lists were compiled for each reserve and basic analysis performed. In Kilak, 27 species were registered; 1 Papilionidae, 2 Pieridae, 4 Lycaenidae, 19 Nymphalidae and 1 Hesperiidae. A relatively small proportion (33%) of the total were forest-dependent butterflies and just 1 restricted-range species, recorded from no more than five forests during the programme, was noted. In Aswa, 40 species were registered; 3 Papilionidae, 8 Pieridae, 5 Lycaenidae, 23 Nymphalidae and 1 Hesperiidae. A very small proportion (5%) of the total were forest-dependent butterflies and just 2 restricted-range species were noted. In Zoka, 27 species were registered; 2 Pieridae, 1 Lycaenidae and 24 Nymphalidae. A relatively high proportion (67%) of the total were forest-dependent butterflies, but no restricted-range species were was noted. In Opit, 73 species were registered; 3 Papilionidae, 10 Pieridae, 9 Lycaenidae, 45 Nymphalidae and 6 Hesperiidae. A reasonable proportion (37%) of the total were forest-dependent butterflies and just 2 restricted-range species were noted. One species, the Blue Pied Pierrot (*Zintha hintza)*, taken in Kilak, is a new record for Uganda.

6.2 INTRODUCTION

6.2.1 Aims and rationale

Butterflies (Rhopalocera) have been the focus of both amateur and professional interest for centuries and thus more is known about their biology than any other major insect group. They are ubiquitous insects as likely to be encountered in an arid desert environment as a wet tropical forest, and they fulfil many of the conventional criteria used in the selection of indicator groups (Kremen, 1992; 1994; Sparrow *et al* 1994; Beccaloni and Gaston, 1995; Daily and Ehrlich, 1995).

Complex sampling methods and poor systematic knowledge can impede the acquisition of complete species lists for many insect groups from a given area. Butterflies, however, are conspicuous, taxonomically tractable and diurnal in habit, all factors which greatly facilitate their study, and contribute to their status as one of the few taxa of invertebrates for which relatively complete data may be obtainable. They comprise distinct communities which may be specific not only to geographical sub-regions, but also to disparate ecological conditions. Moreover, the explicit environmental requirements of many species means that they can have considerable value as indicators of community or habitat health. Butterflies are known to respond to environmental changes and there has been much data collected on how particular species contend with alterations in land-use.

As a taxon, butterflies are diverse enough to permit the collection of statistically quantifiable data, whilst remaining within parameters acceptable for relatively complete assessments to be made. In Uganda, some 1245 species of butterflies have been recorded (Davenport, 1993) from a variety of habitats and it is thus feasible to evaluate the butterfly fauna of a region, as well as deriving reasonably accurate comparisons of data between different sites.

The influence of seasonality and ecology must be taken into consideration during more detailed analyses. However, the collection of butterfly data from forested areas permits the compilation of species lists, which may be used both qualitatively and quantitatively, to facilitate a broad comparison of sites and subsequently identify conservation requirements.

6.2.2 Previous work

As far as can be ascertained no previous work has been carried out to investigate the butterfly fauna of any of these reserves.

6.3 METHODS

6.3.1 Field methods

The butterfly fauna was sampled with baited traps and the intensive use of sweep nets. Twelve fine-mesh cylindrical traps (approx. 70 cm x 40 cm diameter) were set at a range of heights above ground level (1-10 m) for the duration of the survey. Emphasis was placed on sampling different sites with respect to habitat types, altitude and shade. In addition, a variety of baits was used; fermenting banana, dog faeces, chicken offal, urine, and locally distilled alcohol. Traps were checked regularly and specimens of each species collected. For those species not usually attracted to traps, sweep netting was carried out on a daily basis in a range of habitat types within the forest. Weather conditions on each sampling day were recorded and all data were collected within the gazetted boundary of the forest reserve.

6.3.2 Specimen collection, identification and taxonomy

Specimens of every species (and suspected species) were collected, dried and stored in labelled envelopes for subsequent processing in Kampala. All specimens were identified by the author with reference to a number of guides including Carcasson (1961; 1963; 1975), D'Abrera (1980), Henning (1988), Kielland (1990) and Larsen (1991), as well as the collections at the Kawanda Agricultural Research Station, Kampala, the Department of Zoology, Makerere University, Kampala and the National Museums of Kenya, Nairobi. Any specimens of doubtful identification were verified by S. Collins of Nairobi, Kenya.

Butterfly classification, as with all taxonomy, is open to subjective interpretation and frequent modification. For the purposes of this study however, the classification of Ugandan Rhopalocera is based largely on the phylogeny of the Kenyan butterflies, synthesised by Vane-Wright and Ackery (1984). Whilst conservative, this classification largely conforms to current opinions. Five families are recognised; Papilionidae, Pieridae, Lycaenidae (including the subfamily Riodininae), Nymphalidae (including the subfamilies Danainae, Satyrinae, Charaxinae, Nymphalinae, Acraeinae and Libytheinae), and Hesperiidae.

6.3.3 Personnel, dates and areas sampled

John Kasangaki, Tim Davenport, David Nkuutu and Joel Adriko were responsible for the collection of butterfly data from the these reserves. Further details of the personnel, dates and sites are given in Table 6.1.

Table 6.1 Personnel, dates and areas sampled in Aswa River and Zoka

	Kilak	Aswa River	Zoka	Opit	
Campsite locations (UTM)	US858392	VU334696	UU522457	UT425895	UT425895
Altitude (m)	1090	760	915	1150	1150
Ranger zoologist	D. Nkuutu	J. Kasangaki	J. Adriko	D. Nkuutu	D. Nkuutu
Co-ordinator	-	T. Davenport	C. Dickinson	-	-
Dates	30/11-3/12/93	2-6.6.93	18-21.11..93	24-27/11/93	4-8/12/93
Sampling periods (man-days)	3	7	4	7	
Man-days/km²	0.03	0.08	0.07	0.14	
Vegetation type (Langdale-B.)	L3/N5	N4	D2/N5/L3	H2	H2

6.3.4 Data analysis

Butterfly records were analysed in three ways:

a) Compilation of species lists. A species list of Ugandan Rhopalocera (totalling 1245 species) was compiled (Davenport, 1993), based primarily on the literature as well as local, national and international collections. This list, which forms the basis for the appendices, deals with all butterflies and therefore includes both superfamilies; the Papilionoidea (the so-called "true butterflies") and the Hesperioidea. As far as possible the arrangement conforms to the taxonomic sequences cited in the literature. The subfamilies Riodininae, Danainae, Satyrinae, Charaxinae, Nymphalinae, Acraeinae and Libytheinae have previously been promoted to family level by many taxonomists. Ascribing them subfamily status, as suggested by Larsen (1991), has necessitated the inclusion of all subfamilies in the list in order to avoid confusion and retain consistency. Similarly, the nomenclature largely corresponds to that employed by Larsen (1991), taken from Carcasson (in press). As such, it is hoped that it conforms with the majority of contemporary opinion.

b) Ecological characteristics. Each species has been assigned to one of nine ecological types (Davenport, 1993) based on habitat preferences cited in the literature and personal observations made in the field. The emphasis for these types was placed on forest habitats, based on the assumption that species belonging exclusively to closed forest are more appropriate as indicators of forest condition. As for the other taxa, the ecological types recognised for the butterflies belong to three major categories, namely:

   - **Forest-dependent species** (F-species) are those characteristic of closed canopy forest habitats. Where appropriate, species that occur only in highland forests (above 1500 m) are designated as FH-species and those that are limited to lowland forests (below 1500 m), are designated as FL-species.
   - **Forest non-dependent species** (f-species) are butterflies which may be recorded in closed-canopy forest but are not dependent upon it, and are more often encountered in a variety of forest edge, degraded forest and woodland habitats.
   - **Non-forest (open habitat) species** (O-species) include those characteristic of a range of open savanna, grassland and arid habitats (O) or swamp/wetland habitats (S).

   Where species occur in a wide range of habitats, they are described as widespread (W) and those known to be migratory are classified as such (M). About 4% of Uganda's butterflies are insufficiently known to be able to assign them to any particular ecological type and these have been classified as unknown (U).

   From this information, the number of species and the percentage from each ecological type was determined in order to demonstrate the composition of the species list in terms of habitat preference. Moreover, the number of species from each group was calculated as a percentage of the Ugandan total. The resultant values permit a quantitative comparison of all sampled forest reserves.

c) Species accumulation rates. To facilitate data interpretation, species accumulation rates were calculated for three of the five recognised families, namely the Papilionidae, the Pieridae and the Nymphalidae. These families were selected as representative of the total butterfly fauna sampled, by virtue of their percentage of the Ugandan total (46%), their wide distribution within forest habitats, their comparative ease of capture and probability of being sampled by both trap and sweep net. Accumulation rates were then plotted to indicate the extent of completion of the species lists derived from the limited sampling periods.

6.4 RESULTS

6.4.1 Species list

Detailed species lists for the butterflies recorded from Kilak, Aswa, Zoka and Opit Forest Reserves are given in Appendix 6.1. A total of 27 species from Kilak; 1 Papilionidae, 2 Pieridae, 4 Lycaenidae, 19 Nymphalidae and 1 Hesperiidae; 40 species from Aswa; 3 Papilionidae, 8 Pieridae, 5 Lycaenidae, 23 Nymphalidae and 1 Hesperiidae; 27 species from Zoka; 2 Pieridae, 1 Lycaenidae and 24 Nymphalidae; 73 species from Opit; 3 Papilionidae, 10 Pieridae, 9 Lycaenidae, 45 Nymphalidae and 6 Hesperiidae were registered.

Details of the number of species taken from each family, and each subfamily in the case of the Papilionidae, Pieridae and Nymphalidae, are provided in Table 6.2. It can be seen that Kilak, Aswa, Zoka and Opit support at least 2.2%, 3.2%, 2.2% and 5.9% respectively of Uganda's Rhopaloceran fauna.

6.4.2 Ecological characteristics

A summary of the number of butterfly species recorded from the forests and their respective ecological characteristics is given in Table 6.3. Some 5, 1, 10 and 13 species recorded from Kilak, Aswa, Zoka and Opit are associated with closed forest habitats (F,FH,FL) and an additional 4, 1, 8 and 14 with forest edge ecology (f). This represents approximately 33%, 5%, 67% and 37%, respectively of the sampled butterfly fauna from these reserves.

6.4.3 Species accumulation rates

The species accumulation rates for Papilionidae, Pieridae and Nymphalidae (Fig 6.5 -6.8), demonstrate little decline in the rate at which new species were recorded, thus indicating that the lists from all reserves are likely to be incomplete.

6.4.4 Sampling effort

Details of the areas within each reserve that were sampled for their butterfly fauna are illustrated in Figs 6.1 - 6.4 A total of 3, 7, 4 and 7 man-days were carried out in Kilak, Aswa, Zoka and Opit forests respectively. The effort expressed as a function of forest area, for each site, is given in Table 6.1, with 0.03, 0.08, 0.07 and 0.14 man-days per km^2 undertaken in each of the reserves.

6.4.5 Restricted-range species

Species of restricted-range (those recorded in no more than five sites during the programme) and details of the other forests from which they were also recorded are listed in Table 6.4 to 6.6. Some 1, 2, 0 and 2 such species were recorded from Kilak, Aswa, Zoka and Opit respectively, one species of which from Opit was recorded in no other reserve during the programme.

6.5 DISCUSSION

No attempt has been made at this stage to undertake a detailed and comparative synthesis of the results, or to include quantitative information regarding previous records. Rather, this report presents the raw data derived from the inventory programme, with some elementary and qualitative analysis, aimed at providing an initial cursory description of the sampled Rhopaloceran fauna of the reserve.

The paucity of data from the Lycaenidae and Hesperiidae families is consistent with results from other forest reserves. This may be attributed to the rarity of a number of the family members and the elusive behavioural characteristics of many species, such as the large numbers of high-canopy dwelling and markedly seasonal Lycaenidae. Moreover, species from these two families are very rarely caught in traps and most are small, inconspicuous and easily overlooked. For these reasons, it is probable that these two families will have been undersampled. As a consequence, the emphasis for the data analysis and interpretation, particularly species accumulation rates, was placed on the Papilionidae, Pieridae and Nymphalidae, more than 80% of which have been sampled during the course of the programme.

Whilst every effort was made to sample each site for a length of time approximately proportional to its area, for logistical reasons this was not always possible. The calculation of effort, therefore, attempts to quantify the degree of sampling carried out in each forest (Table 6.1). In comparison with other sites (mean 0.21 man-days/km^2), Kilak (0.0.03 man-days/km^2), Aswa (0.08 man-days/km^2), Zoka (0.07 man-days/km^2) and Opit (0.14 man-days/km^2) were all undersampled. Whilst the unit of effort employed is titled 'man-days', it is important to note that this does not necessarily correspond to a full day's entomological work.

Of the species recorded in these reserves, those of particular interest included the distinctive Blue Pied Pierrot, *Zintha hintza*. Considered to be scarce with low population densities (Larsen, 1992), no Ugandan records for this insect can be traced, although the range from southern Africa to Kenya is pertinent. This may, therefore, represent a new record for the country.

The aptly named Yellow Splendour, *Colotis protomedia*, taken in Aswa, is restricted to dry habitats and was only registered also in Labwor and Napak during the programme. *Chondrolepis nero*, meanwhile, from Opit, was taken in no other forest. It is a little known and very patchily distributed butterfly with records only from Cameroon, Nigeria, Zaire and Uganda.

Zoka is of interest owing to its closed forest vegetation, despite its geographical position in the North West of the country. A number of closed forest specalists were recorded, including *Cymothoe caenis*, *Charaxes tiridates* and *Aterica galene*.

In conclusion, neither Kilak, Aswa, Zoka or Opit may be considered rich in terms of their butterfly fauna. Zika, however, supports a relatively high percentage of forest-dependent butterflies. All of the reserves were undersampled and require further work for realistic diagnoses to be made. Very few restricted-range species were taken, although two butterflies, *Zintha hintza* and *Chondrolepis nero* are of some conservation importance.

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6.7 TABLES

Table 6.2 Species numbers recorded in Kilak, Aswa River, Zoka and Opit from each family and from Papilionidae, Pieridae and Nymphalidae subfamilies

Family Subfamily	Uganda Total	Kilak Forest Total	Kilak % Uganda Total	Aswa River Forest Total	Aswa River % Uganda Total	Zoka Forest Total	Zoka % Uganda Total	Opit Forest Total	Opit % Uganda Total
Papilionidae	**31**	**1**	**3**	**3**	**10**	**0**	**0**	**3**	**10**
Papilioninae	31	1	3	3	10	0	0	3	10
Pieridae	**100**	**2**	**2**	**8**	**8**	**2**	**2**	**10**	**10**
Coliadinae	10	2	20	2	20	2	20	5	50
Pierinae	90	0	0	6	7	0	0	5	6
Lycaenidae	**460**	**4**	**1**	**5**	**1**	**1**	**0**	**9**	**2**
Nymphalidae	**447**	**19**	**4**	**23**	**5**	**24**	**5**	**45**	**10**
Danainae	13	0	0	1	8	0	0	4	31
Satyrinae	71	5	7	4	6	11	15	9	13
Charaxinae	65	3	5	5	8	5	8	8	12
Apaturinae	1	0	0	0	0	0	0	0	0
Nymphalinae	195	9	5	10	5	7	4	19	10
Acraeinae	101	2	2	3	3	1	1	5	5
Libytheinae	1	0	0	0	0	0	0	0	0
Hesperiidae	**207**	**1**	**< 1**	**1**	**< 1**	**0**	**0**	**6**	**3**
TOTAL	**1245**	**27**	**2.2**	**40**	**3.2**	**27**	**2.2**	**73**	**5.9**

Table 6.3 The ecological characteristics of butterfly species recorded from Kilak, Aswa River, Zoka and Opit. Figures represent the number of species of each ecological type, shown as a percentage of the sites's fauna and as a percentage of Uganda's total within each group

	Uganda Totals		Kilak			Aswa River			Zoka			Opit		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	561	45	5	19	1	0	0	0	8	30	1	12	16	2
FH	53	4	0	0	0	0	0	0	0	0	0	0	0	0
FL	33	3	0	0	0	1	3	3	2	7	6	1	1	3
f	197	16	4	15	2	1	3	1	8	30	4	14	19	7
0	176	14	6	22	3	12	30	7	1	4	1	6	8	3
M	42	3	6	22	14	14	35	33	0	0	0	9	12	21
S	11	1	0	0	0	0	0	0	0	0	0	0	0	0
W	128	10	5	19	4	11	28	9	8	30	6	29	40	23
U	44	4	1	4	2	1	3	2	0	0	0	2	3	5
TOTAL	**1245**	**100**	**27**	**100**	**2.2**	**40**	**100**	**3.2**	**27**	**100**	**2.2**	**73**	**100**	**5.9**

Key:						
	F	Forest-dependent species	FH	Highland closed forest species	FL	Lowland closed forest species
	f	Forest edge/woodland species	O	Open habitat species	M	Migratory species
	S	Swamp/wetland species	W	Widespread species	U	Unknown habitat preference

Table 6.4 Restricted-range butterflies recorded from Kilak

Species	Common Name	Ecol. Type	No. of Ugandan forests from which species was recorded	Other forests where species has been recorded
Zintha hintza	Blue Pied Pierrot	O	2	Nyangea-Napore

Key:						
	F	Forest-dependent species	FH	Highland closed forest species	FL	Lowland closed forest species
	f	Forest edge/woodland species	O	Open habitat species	M	Migratory species
	S	Swamp/wetland species	W	Widespread species	U	Unknown habitat preference

Table 6.5 Restricted-range butterflies recorded from Aswa-River

Species	Common Name	Ecol. Type	No. of Ugandan forests from which species was recorded	Other forests where species has been recorded
Colotis protomedia	Yellow Splendour	O	3	Labwor Hills, Napak
Axiocerces harpax	Common Scarlet	W	5	Kalinzu, Kijanabalola, Kamusenene, Kisangi

Key:						
	F	Forest-dependent species	FH	Highland closed forest species	FL	Lowland closed forest species
	f	Forest edge/woodland species	O	Open habitat species	M	Migratory species
	S	Swamp/wetland species	W	Widespread species	U	Unknown habitat preference

Table 6.6 Restricted-range butterflies recorded from Opit

Species	Common Name	Ecol. Type	No. of Ugandan forests from which species was recorded	Other forests where species has been recorded
Bicyclus kenia	Kenyan Bush Brown	F	2	Kibeka
Chondrolepis nero		U	1	*none*

Key:						
	F	Forest-dependent species	FH	Highland closed forest species	FL	Lowland closed forest species
	f	Forest edge/woodland species	O	Open habitat species	M	Migratory species
	S	Swamp/wetland species	W	Widespread species	U	Unknown habitat preference

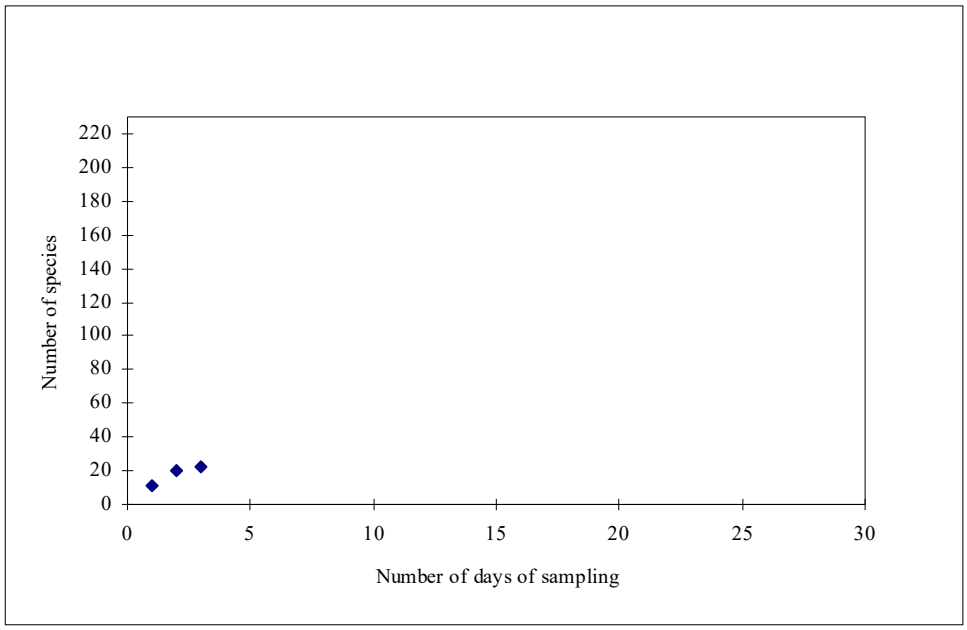

Fig. 6.5 Special accumulation rates for Papilionidae, Pieridae and Nymphalidae butterflies from Kilak

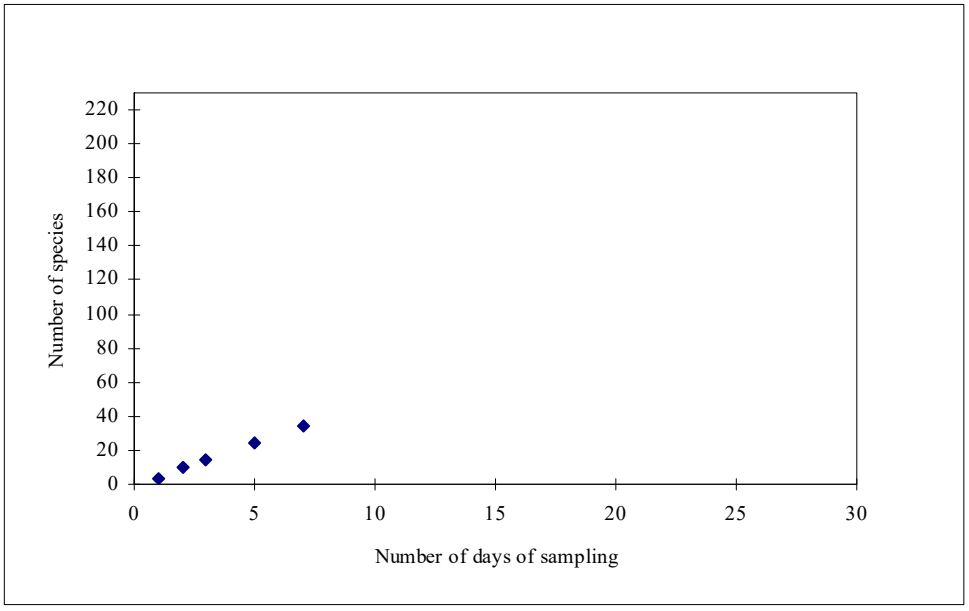

Fig. 6.6 Species accumulation rates for Papilionidae, Pieridae and Nymphalidae butterflies from Aswa River

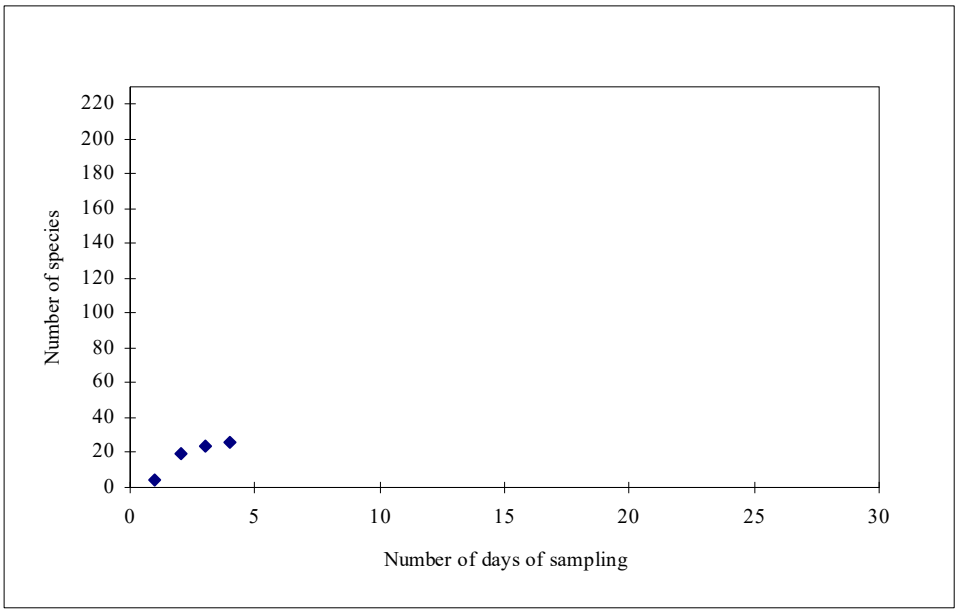

Fig. 6.7 Species accumulation rates for Papilionidae, Pieridae and Nymphalidae butterflies from Zoka

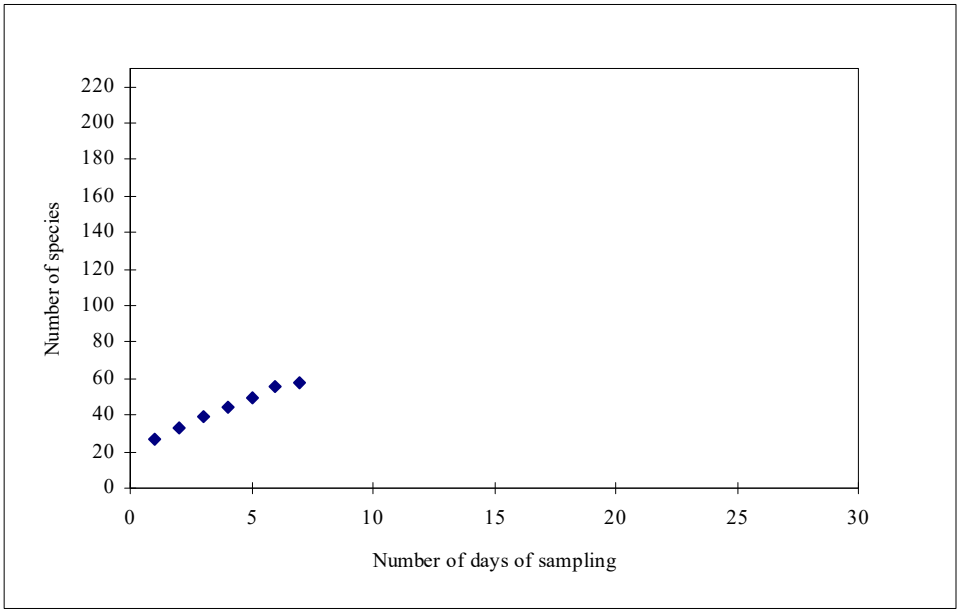

Fig. 6.8 Species accumulation rates for Papilionidae, Pieridae and Nymphalidae butterflies from Opit

6.9 APPENDICES

Appendix 6.1 Species list of butterflies recorded in Kilak

Species	Common Name	Ecol. Type
PAPILIONIDAE		
Papilioninae		
Graphium angolanus	Angolan White Lady	M
PIERIDAE		
Coliadinae		
Eurema brigitta	Small Grass Yellow	M
Eurema floricola	Malagasy Grass Yellow	F
LYCAENIDAE		
Polyommatinae		
Leptotes sp.		U
Tuxentius cretosus		O
Zintha hintza	Blue Pied Pierrot	O
Azanus jesous	African Babul Blue	M
NYMPHALIDAE		
Satyrinae		
Gnophodes betsimena	Banded Evening Brown	F
Melanitis leda	Common Evening Brown	W
Bicyclus mesogena		F
Bicyclus pavonis		O
Bicyclus sophrosyne		f
Charaxinae		
Charaxes achaemenes	Bush Charaxes	O
Charaxes epijasius	Sahel Charaxes	O
Charaxes varanes	Pearl Charaxes	W
Nymphalinae		
Hamanumida daedalus	Guineafowl	W
Pseudacraea lucretia	False Diadem	f
Neptis serena	River Sailer	W
Sallya garega		M
Byblia anvatara	African Joker	M
Ariadne enotrea	African Castor	F
Eurytela dryope	Golden Piper	W
Precis archesia	Garden Inspector	O
Phalanta eurytis	African Leopard Fritillary	M
Acraeinae		
Acraea cabira	Yellow Banded Acraea	f
Acraea sotikensis	Sotik Acraea	F
HESPERRIDAE		
Hesperiinae		
Zenonia zeno	Bellboy	f

Appendix 6.2 Species list of butterflies recorded in Aswa River

Species	Common Name	Ecol. Type
PAPILIONIDAE		
Papilioninae		
Papilio demodocus	Citrus Swallowtail	M
Papilio nireus	Narrow G-Banded Swallowtail	f
Graphium angolanus	Angolan White Lady	M
PIERIDAE		
Coliadinae		
Catopsilia florella	African Emigrant	M
Eurema hecabe	Common Grass Yellow	M
Pierinae		
Colotis antevippe	Large Orange Tip	O
Colotis danae	Scarlet Tip	W
Colotis eucharis	Sulphur Orange Tip	W
Colotis protomedia	Yellow Splendour	O
Belenois creona	African Caper	M
Belenois gidica	Pointed Caper	M
LYCAENIDAE		
Theclinae		
Axiocerces harpax	Common Scarlet	W
Hypolycaena philippus	Common Hairstreak	W
Polyommatinae		
Anthene amarah	Leaden Ciliate Blue	O
Pseudonacaduba sichela	African Line Blue	W
Zizula hylax	Tiny Grass Blue	W
NYMPHALIDAE		
Danainae		
Danaus chrysippus	African Queen	M
Satyrinae		
Melanitis leda	Common Evening Brown	W
Bicyclus milyas		O
Bicyclus pavonis		O
Ypthima sp.		U
Charaxinae		
Charaxes achaemenes	Bush Charaxes	O
Charaxes epijasius	Sahel Charaxes	O
Charaxes fulvescens	Forest Pearl Charaxes	FL
Charaxes picta	Viola Charaxes	O
Charaxes varanes	Pearl Charaxes	W
Nymphalinae		
Hamanumida daedalus	Guineafowl	W
Neptis morosa	Morose Sailer	W
Byblia anvatara	African Joker	M
Mallika jacksoni	Jackson's Leaf Butterfly	O
Hypolimnas misippus	Diadem	M
Junonia chorimene	Golden Pansy	O
Junonia hierta	Yellow Pansy	M
Junonia orithya	Blue Pansy	M
Vanessa cardui	Painted Lady	M
Phalanta phalantha	Common Leopard Fritillary	M
Acraeinae		
Acraea caldarena	Black Tip Acraea	O
Acraea pseudegina		W
Acraea pseudolycia		O
HESPERIIDAE		
Hesperiinae		
Pelopidas thrax	Millet Skipper	M

Appendix 6.3 Species list of butteflies recorded in Zoka

Species	Common Name	Ecol. Type
PIERIDAE		
Coliadinae		
Eurema floricola	Malagasy Grass Yellow	F
Eurema regularis	Regular Grass Yellow	W
LYCAENIDAE		
Lipteninae		
Pentila pauli	Spotted Pentila	f
NYMPHALIDAE		
Satyrinae		
Gnophodes betsimena	Banded Evening Brown	F
Melanitis leda	Common Evening Brown	W
Bicyclus angulosus		O
Bicyclus auricrudus		F
Bicyclus campus	Hill Bush Brown	f
Bicyclus golo		F
Bicyclus jefferyi	Jeffery's Bush Brown	f
Bicyclus mandanes		F
Bicyclus safitza	Common Bush Brown	W
Bicyclus sophrosyne		f
Bicyclus vulgaris		W
Charaxinae		
Charaxes brutus	White Barred Charaxes	f
Charaxes fulvescens	Forest Pearl Charaxes	FL
Charaxes numenes		f
Charaxes pollux	Black Bordered Charaxes	f
Charaxes tiridates		FL
Nymphalinae		
Cymothoe caenis	Migratory Glider	F
Aterica galene	Forest Glade Nymph	F
Neptis morosa	Morose Sailer	W
Neptis saclava	Small Spotted Sailer	W
Neptis serena	River Sailer	W
Salamis parhassus	Forest Mother-of-Pearl	f
Junonia terea	Soldier Commodore	W
Acraeinae		
Acraea sotikensis	Sotik Acraea	F

Appendix 6.4 Species list of butteflies recorded in Opit

Species	Common Name	Ecol. Type
PAPILIONIDAE		
Papilioninae		
Papilio dardanus	Mocker Swallowtail	W
Papilio demodocus	Citrus Swallowtail	M
Papilio nireus	Narrow G-Banded Swallowtail	f
PIERIDAE		
Coliadinae		
Catopsilia florella	African Emigrant	M
Eurema desjardinsi	Angled Grass Yellow	W
Eurema floricola	Malagasy Grass Yellow	F
Eurema hecabe	Common Grass Yellow	M
Eurema regularis	Regular Grass Yellow	W
Pierinae		
Colotis antevippe	Large Orange Tip	O
Belenois creona	African Caper	M
Dixeia pigea	Antheap White	W
Leptosia alcesta	African Wood White	W
Leptosia wigginsi	Opaque Wood White	F
LYCAENIDAE		
Lipteninae		
Pentila pauli	Spotted Pentila	f
Polyommatinae		
Anthene kersteni	Kersten's Ciliate Blue	W
Cupidopsis cissus	Meadow Blue	W
Leptotes sp.		U
Zizeeria knysna	African Grass Blue	W
Zizula hylax	Tiny Grass Blue	W
Azanus natalensis	Natal Babul Blue	W
Euchrysops barkeri		W
Euchrysops osiris	African Cupid	W
NYMPHALIDAE		
Danainae		
Danaus chrysippus	African Queen	M
Amauris niavius	Friar	W
Amauris tartarea	Monk	f
Tirumala petiverana	African Blue Tiger	M
Satyrinae		
Gnophodes betsimena	Banded Evening Brown	F
Melanitis leda	Common Evening Brown	W
Bicyclus campinus		f
Bicyclus jefferyi	Jeffery's Bush Brown	f
Bicyclus kenia	Kenyan Bush Brown	F
Bicyclus mandanes		F
Bicyclus safitza	Common Bush Brown	W
Bicyclus sandace		F
Henotesia phaea		f
Charaxinae		
Charaxes achaemenes	Bush Charaxes	O
Charaxes brutus	White Barred Charaxes	f
Charaxes castor	Giant Charaxes	W
Charaxes epijasius	Sahel Charaxes	O
Charaxes etesipe	Savannah Charaxes	f
Charaxes fulvescens	Forest Pearl Charaxes	FL
Charaxes picta	Viola Charaxes	O
Charaxes varanes	Pearl Charaxes	W
Nymphalinae		
Euphaedra medon	Common Forester	F
Hamanumida daedalus	Guineafowl	W
Aterica galene	Forest Glade Nymph	F

Neptis kiriakoffi		W
Neptis morosa	Morose Sailer	W
Neptis saclava	Small Spotted Sailer	W
Sallya boisduvali	Brown Tree Nymph	M
Byblia anvatara	African Joker	M
Ariadne enotrea	African Castor	F
Neptidopsis ophione	Scalloped Sailer	f
Eurytela dryope	Golden Piper	W
Salamis parhassus	Forest Mother-of-Pearl	f
Junonia chorimene	Golden Pansy	O
Junonia oenone	Dark Blue Pansy	W
Junonia terea	Soldier Commodore	W
Precis octavia	Gaudy Commodore	W
Precis pelarga	Fashion Commodore	f
Precis tugela	Eared Commodore	f
Catacroptera cloanthe	Pirate	O
Acraeinae		
Acraea cabira	Yellow Banded Acraea	f
Acraea egina	Elegant Acraea	W
Acraea encedon	Encedon Acraea	W
Acraea eponina	Orange Acraea	W
Acraea poggei	Pogge's Wanderer	F
HESPERIIDAE		
Pyrginae		
Tagiades flesus	Clouded Flat	F
Hesperiinae		
Pardaleodes incerta		F
Chondrolepis nero		U
Zenonia zeno	Bellboy	f
Borbo borbonica	Olive Haired Swift	M
Borbo gemella	Twin Swift	W

Chapter 7

Large Moths

Compiled by

Peter Howard BSc(Hons), MSc, PhD

7.1 SUMMARY

The moths of Zoka and Opit Forest Reserves were sampled with a mercury vapour light trap at one site in each reserve, during November and December 1993. Kilak and Aswa River were not investigated. Five nights of work at Zoka yielded 13 hawkmoths (Sphingidae) of eight species, and two silkmoths (Saturniidae) of two species, while seven nights at Opit produced 37 hawkmoths (13 species) and two silkmoths of a single species. These were predominantly common widespread species. One restricted-range hawkmoth (*Pemba jordani*) was recorded at Opit representing one of only five records of this species in East Africa.

7.2 INTRODUCTION

7.2.1 Aims and rationale

The purpose of sampling the moth fauna (as with other taxa) was to compile as complete a species list as possible for each site, to enable comparison between sites and identify conservation needs and priorities. In particular, it is hoped that the moth studies will facilitate:

- a broad assessment of the relative values of different sites for biodiversity conservation, based on general consideration of the diversity of moth faunas and conservation value (i.e. distribution, abundance, ecological characteristics, degree of threat) of the species represented
- identification of specific conservation needs highlighted by the discovery of populations of species of special conservation concern

The main advantage of sampling moths with a light trap, compared with the sampling of other taxa, is that the results are largely independent of the skill and experience of the field-worker. Thus, objective comparisons can be made between sites, without the need to consider these human variables. Furthermore, by selecting two well-known families of large moths (the hawkmoths and silkmoths) for investigation, reliable species identifications can be obtained. On the other hand, there are important environmental variables, notably season, rainfall and moon-phase, which influence capture success and have to be considered in the design of a sampling regime and interpretation of data. It is beyond the scope of this report to deliberate further on these factors, since it is intended here simply to present the field data, with a minimum of discussion and interpretation.

7.2.2 Previous work

As far as can be ascertained, no previous work has been carried out to investigate the moth faunas of any of these reserves.

7.3 METHODS

7.3.1 Field methods

Two families of moths (Sphingidae and Saturniidae) were sampled using a 125 Watt choked Mercury Vapour lamp, mounted in a “Skinner” box trap. The trap was powered by a portable generator and operated for approximately 11 hours each night between 1915 h and 0615 h. The trap is designed to retain all moths that enter it, alive, until they are sorted in the morning. Special attention was given to searching the area around the trap each morning for any moths that had been attracted to the light, but had not entered the trap and representatives of the required families were hand-collected.

7.3.2 Specimen collection, identification and taxonomy

All specimens of the families Sphingidae and Saturniidae were collected, dried and stored in paper envelopes with full data, prior to submission to the author for identification. To ensure that no representatives of the required families were inadvertently discarded, a set of photographs depicting most Ugandan species (including all genera) was provided to the moth-trap operator, and individual tuition provided on the characteristics of the families to be sampled.

All specimens were examined and identified (where possible) with reference to available literature (Gaede, 1927; Rougeot, 1962; Pinhey, 1972; Carcasson, 1976; D'Abrera, 1990) and the entomological reference collections at Forest Department headquarters, Kawanda Agricultural Research Station (Kampala), the National Museums of Kenya (Nairobi), and the private collection of Dr A. M^{c}Crae (Oxford, UK). Specimens of doubtful status were retained and examined subsequently by Dr A. M^{c}Crae.

7.3.3 Personnel, dates and areas sampled

Sampling of Zoka Forest Reserve took place between 17 and 21 November 1993 (involving five nights of sampling), and Opit was sampled over two short periods, from 24 to 26 November 1993 (3 nights), and 4 to 7 December 1993 (4 nights). There was one sampling site at each reserve (Table 7.1, Figs. 7.1, 7.2), corresponding with the camps used by the biological inventory teams.

Table 7.1 Personnel, dates and areas sampled in Zoka and Opit

	Zoka	**Opit**	
Moth-trap locations (UTM)	UU520460	UT425895	UT425895
Altitude	910	1140	1140
Moth-trap operator	C. Dickinson	D. Nkuutu	D. Nkuutu
Co-ordinator	-	C. Dickinson	C. Dickinson
Dates	17-21/11/93	24-26/11/93	4-7/12/93
Sampling period (days)	5	3	4
Vegetation type (Langdale-B)	D2/N5/L3	H2	H2

7.3.4 Data analysis

Three different approaches were adopted in the examination of the moth field records:

a) Compilation of species list. This enabled comparison with other forests and provided a basis for highlighting species that are of particular biogeographical or conservation significance.

b) Ecological characteristics. As for the other taxa, each species was (provisionally) assigned to one of three major ecological types (and a number of sub-types), based on existing knowledge of each species' ecology (Carcasson, 1976; A. M^{c}Crae, pers. comm.) and observations made during this programme. The categories recognised are:

- **Forest-dependent species** (F-species) are those characteristic of closed canopy forest habitats.
- **Forest non-dependent species** (f-species) are those which are not infrequently recorded in closed-canopy forest, but are not dependent on it, and are more often encountered in a variety of forest-edge, degraded forest and woodland habitats.
- **Non-forest (open habitat) species** (G-species) are those characteristic of a range of grassland, open savanna and arid habitats.

Within each of these major categories, species which occur only in highland areas (above 1500 m) are designated as 'H' and those limited to lowlands (below 1500 m) as 'L'. Species of hawkmoth that are known to be migratory (M) are distinguished and any species that occurs in a variety of forest and non-forest habitats is designated as widespread (W). The proportion of the total moth fauna belonging to each of these

distinct ecological types was then calculated, as a means of characterising the moth fauna, and facilitating comparison between sites.

c) Species accumulation rates. Based on the daily trapping records, the rate at which 'new' species were added to the forests' total was plotted as a function of the total number of individual moths captured. This provides a basis for comparing the moth fauna of different sites, by allowing samples of standard size (or equivalent sampling effort) to be examined; and enables the prediction, through extrapolation, of the total size of a moth fauna expected for each site.

7.4 RESULTS

7.4.1 Species lists

A daily record of the number of individuals of each hawkmoth species captured at Zoka is provided in Appendix 7.1, and equivalent data for Opit are included as Appendix 7.2. Overall, 13 Sphingids of eight species were captured at Zoka, while 37 individuals of 13 species were taken at Opit. There were too few Saturniids to warrant tabulation, with one specimen of *Tagaropsis flavinata* (on 18-11-93) and one specimen of *Bunaeopsis licharbas* (on 21-11-93) taken at Zoka, and two specimens of *Ludia orinoptena* taken (on 4-12-93) at Opit.

7.4.2 Ecological characteristics

Table 7.2 provides a breakdown of the hawkmoth faunas of the two reserves according to the ecological characteristics of their constituent members. The species recorded include a high proportion of common, widespread species, with a preponderance of migratory hawkmoths.

7.4.3 Restricted-range species

One restricted-range species was recorded at Opit, namely the hawkmoth *Pemba jordani*. Prior to this programme, the species was known in East Africa from just one record (at Tororo, Uganda; Carcasson, 1976), but it is now also recorded from Mt. Kei, Otzi and Era Forest Reserves in the extreme north-west of the country. Although known from suitable woodland habitats from Uganda to West Africa, it is apparently quite rare, and Opit may represent an important locality for it.

7.5 DISCUSSION

Clearly, the data presented here are very rudimentary, and provide little indication of the conservation values of any of these five sites. Not only were the sampling periods inadequate, but their timing (at the end of the rainy season in the north) was such that catches were rather small. The data are clearly insufficient to evaluate either the richness of the moth faunas, or the conservation value of individual species that might occur at any of the sites.

The paucity of data from Zoka is particularly regrettable, since this isolated fragment of closed canopy forest is clearly of considerable biogeographical interest. Priority for any future work should go to this area, since the results would not only be indicative of the nature of the moth faunas across large parts of north-central Uganda, but may also provide interesting evidence on the environmental history of the area, and ecology of specific forest-dependent species.

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7.7 TABLES

Table 7.2 The ecological characteristics of hawkmoth species recorded from Zoka and Opit. Figures represent the number of species of each ecological type, shown as a percentage of the site's fauna and as a percentage of Uganda's total within each group

	Uganda Totals		**Zoka**			**Opit**		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	38	33	0	0	0	0	0	0
FH	5	4	0	0	0	0	0	0
FL	6	5	0	0	0	0	0	0
FM	1	1	0	0	0	0	0	0
f	24	21	1	13	4	2	15	8
fH	0	0	0	0	0	0	0	0
fL	3	3	0	0	0	1	8	33
G	13	11	0	0	0	1	8	8
W	16	14	2	25	13	1	8	6
WM	9	8	5	63	56	8	62	89
TOTAL	**115**	**100**	**8**	**100**	**7**	**13**	**100**	**11**

Key:	F	Closed forest	FH	Closed highland forest	FL	Closed lowland forest
	FM	Closed forest migrant	f	Forest edge/woodland	fH	Highland forest edge
	fL	Lowland forest edge	G	Grassland/open habitat	W	Widespread occurrence
	WM	Widespread migrant				

7.9 APPENDICES

Appendix 7.1 Daily record of hawkmoths (number of individuals) captured at Zoka

	Site		UU520460				
	Vegetation type (Langadale-B)		D2/N5/L3				
	Month (1993)		11	11	11	11	Total
	Date		18	19	20	21	
Code	Species	Ecol. Type					
210	*Basiothia medea*	WM				1	**1**
220	*Euchloron megaera*	WM				1	**1**
223	*Herse convolvuli*	WM			3	1	**4**
227	*Hippotion eson*	WM				1	**1**
229	*Hippotion osiris*	WM		1	1		**2**
237	*Lophostethus demolini*	W	1				**1**
269	*Pseudoclanis postica*	W				1	**1**
272	*Rufoclanis rosea*	f			1	1	**2**
	Total individuals		**1**	**1**	**5**	**6**	**13**
	Cumulative individuals		**1**	**2**	**7**	**13**	
	Total species		**1**	**1**	**3**	**6**	
	New species		**1**	**1**	**2**	**4**	**8**
	Cumulative species		**1**	**2**	**4**	**8**	

Appendix 7.3 Daily record of hawkmoths (number of individuals) captured at Opit

	Site		UT425895			UT425895				
	Vegetation type (Langdale-B)		H2			H2				
	Month (1993)		11	11	11	12	12	12	12	
	Date		24	25	26	4	5	6	7	Total
Code	Species	Ecol. Type								
201	*Acherontia atropos*	WM			1					**1**
211	*Celerio lineata*	WM							1	**1**
218	*Deilephila nerii*	WM				1				**1**
220	*Euchloron megaera*	WM					1			**1**
223	*Herse convolvuli*	WM		1		10				**11**
225	*Hippotion balsaminae*	W				1				**1**
226	*Hippotion celerio*	WM		1		1	1	1		**4**
227	*Hippotion eson*	WM		1	1	3		1		**6**
229	*Hippotion osiris*	WM	1			1				**2**
241	*Neopolyptychus prionites*	fL				1				**1**
251	*Nephele peneus*	f	1							**1**
255	*Pemba jordani*	f				2				**2**
268	*Pseudoclanis molitrix*	G				2		3		**5**
	Total individuals		**2**	**3**	**2**	**22**	**2**	**5**	**1**	**37**
	Cumulative individuals		**2**	**5**	**7**	**29**	**31**	**36**	**37**	
	Total species		**2**	**3**	**2**	**9**	**2**	**3**	**1**	
	New species		**2**	**3**	**1**	**5**	**1**	**0**	**1**	**13**
	Cumulative species		**2**	**5**	**6**	**11**	**12**	**12**	**13**	

Appendix 7.3 Complete list of hawkmoth species known from Zoka and Opit and their ecological characteristics

Code	Species	Ecological Type	Zoka	Opit
201	*Acherontia atropos*	WM		2
210	*Basiothia medea*	WM	2	
211	*Celerio lineata*	WM		2
218	*Deilephila nerii*	WM		2
220	*Euchloron megaera*	WM	2	2
223	*Herse convolvuli*	WM	2	2
225	*Hippotion balsaminae*	W		2
226	*Hippotion celerio*	WM		2
227	*Hippotion eson*	WM	2	2
229	*Hippotion osiris*	WM	2	2
237	*Lophostethus demolini*	W	2	
241	*Neopolyptychus prionites*	fL		2
251	*Nephele peneus*	f		2
255	*Pemba jordani*	f		2
268	*Pseudoclanis molitrix*	G		2
269	*Pseudoclanis postica*	W	2	
272	*Rufoclanis rosea*	f	2	

Key:	Ecological types:					
	F	Closed forest	FH	Closed highland forest	FL	Closed lowland forest
	FM	Closed forest migrant	f	Forest edge/woodland	fH	Highland forest edge
	fL	Lowland forest edge	G	Grassland/open habitat	W	Widespread occurrence
	WM	Widespread migrant				
	Record					
	1	Previous	2	Forest Department Inventory	3	Previous and Forest Department

Appendix 7.4 Complete list of silkmoth species known from Zoka and Opit and their ecological characteristics

Code	Species	Ecological Type	Zoka	Opit
108	*Bunaeopsis licharbas*	f	2	
164	*Ludia orinoptena*	f		2
180	*Tagaropsis flavinata*	f	2	

Key:	Ecological types:					
	F	Closed forest	FH	Closed highland forest	FL	Closed lowland forest
	FM	Closed forest migrant	f	Forest edge/woodland	fH	Highland forest edge
	fL	Lowland forest edge	G	Grassland/open habitat	W	Widespread occurrence
	WM	Widespread migrant				
	Record					
	1	Previous	2	Forest Department Inventory	3	Previous and Forest Department

Chapter 8

Management Issues and Implications

Compiled by

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8.1 HUMAN ACTIVITIES

Evidence of various human activities was observed in Aswa River, Zoka and Opit. There was insufficient time spent in Kilak to comment on the situation there.

The reserves are all used by surrounding local communities as a source of fuelwood, building poles, bushmeat, medicines, granary materials and honey. The forests are, however, relatively isolated and with the exception of Opit, surrounded by low population densities. As a consequence it is believed that human pressure is not particularly high. There are many trees of commercial value, for example *Khaya spp.* and *Entandrophragma utile* mahoganies in Zoka and Kilak, but the relative isolation of the reserves makes their extraction economically impractical.

Agricultural encroachment was evident at Opit, particularly close to the reserve boundary (see Fig. 8.2) as also in Aswa River in the eastern and south-eastern regions of the reserve (see Fig 8.1). In addition, firewood collection and charcoal production was also encountered in Opit, largely for sale in Gulu.

The forests are an important source of bushmeat particularly around Zoka, although it is also probably of equal significance around Kilak. The reserves of Kilak and Zoka are surrounded by largely unexploited habitat and large populations of game animals are likely to exist; a small number of elephant and buffalo are said to live in and around Zoka. A hunting party was seen in Aswa and numerous animal snares were encountered near to the river.

There are considerable security problems in all of these forest reserves as they are used frequently by rebel forces of the Lords Resistance Army (LRA). Such activity is likely, somewhat ironically, to have a positive impact on the integrity of the forests concerned (see also Vol 21. Chapter 8), as such areas remain largely unvisited and hence unexploited. Conversely, in Aswa River, two army detachments are situated on the reserve boundary, and thus the areas of forest immediately adjacent are now degraded and encroached.

8.2 IMPORTANT SITES

The short sampling periods at each reserve have made it difficult to select important sites, however, the remaining areas of high forest in Zoka are of conservation concern.

8.3 THREATS

Human activity is not believed to be a major threat to forest integrity at Zoka, Kilak or Aswa River, primarily because of the sparse population and local insecurity. Opit is more threatened due too its proximity to centres of large population, including Gulu. Hunting pressure also poses problems to the populations of mammals in all areas.

8.4 CONSERVATION VALUE

As may be seen in section 1.1 and Tables 1.1 to 1.4, Kilak, Aswa River, Zoka and Opit are not of particular conservation importance, although there are a few individual species and habitat of some concern. Of the four reserves, Zoka is probably the most important, as the diversity of the forest's flora and mammalian fauna will testify to (see Table 1.3).

8.5 ADDITIONAL WORK

All four reserves were undersampled relative to other sites studied during the programme. As a consequence, each would benefit from further survey work. As alluded to in Chapter 7 and section 8.5 (above) the priority site would be Zoka, in particular the remaining areas of moist semi-deciduous forest.