Bwindi Impenetrable National Park

Biodiversity Report

Edited by

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July, 1996

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

Acknowledgements

The Forest Department acknowledges the support provided for this programme by the EC-financed 'Natural Forest Management and Conservation Project' (No. 6100.37.42.015) and the project of 'Institutional Support for the Protection of East African Biodiversity' (UNO/RAF/006/GEF), financed through UNDP/FAO by the Global Environmental Facility.

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.

Outside Uganda, invaluable assistance was provided with the identification of difficult bird specimens by L. Bennun, C. Jackson and staff of the ornithology department of the National Museums of Kenya; and by L. Fishpool and B. Finch. Some of the more difficult mammal specimens were identified by J. Kerbis (Field Museum, Chicago); problematical butterflies by S. Collins (Monsanto, Nairobi) and Saturniid moths by A. McCrae (CAB International, Oxford).

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.




A draft version of the first in this report series was circulated for review and comments and subsequent volumes have benefited from suggestions made by A. Balmford, L. Bennun, I. Francis, J. Hall, A. Hamilton, R. Howard, F. Kayanja, J. Kerbis, J. Kingdon, C. Long, T. Lee, A. M^{C}Crae, E. Mupada, H. Osmaston, A. Plumtre, D. Pomeroy, V. Reynolds, A. Rodgers, D. Sivell and L. Stewart.

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.

The work has been supported in various ways through collaboration with other agencies and institutions and particular thanks are due to the Directors and staff of Uganda National Parks; Game Department; Makerere University's Institute of Environment and Natural Resources and Biological Field Station in Kibale Forest; Budongo Forest Project; and the Institute of Tropical Forest Conservation in Bwindi Impenetrable. The Programme Co-ordinators received invaluable support from the VSO field office in Kampala, and the help provided by Field Director P. Ackland and his staff, and the flexibility shown by headquarters in London is very gratefully acknowledged. The maps included in this report were originally digitised under the National Biomass Survey project, funded by NORAD through the Norwegian Forestry Society; the assistance of all project staff and especially C. Hedberg has been invaluable. The Italian Government funded Paolo Viskanic, through FAO, from January 1994. The British Government's Darwin Initiative provided funds to support J. Lwanga's involvement in the programme since August 1994, through the Institute of Zoology (London) and Sheffield University. J. Ahrens was supported (May 1992 - May 1993) by the United States Peace Corps. The assistance of the United States Agency for International Development (USAID) in providing grant support to the new Departmental herbarium is also gratefully acknowledged. The printing of this report has been sponsored by the Government of the Province of Bolzano and carried out by the "Landesberufsschule für Handel und Grafik" in Bolzano, Italy. Particular thanks are extended to the director, A. Steiner and staff, H. Reinstadler and J. Gritsch.

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.

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Summary

1.1 SUMMARY

Bwindi Impenetrable National Park was managed as a forest reserve from 1932 to 1961, and as an animal sanctuary and forest reserve from 1961 to 1991, under both Game and Forest Departments' jurisdiction. The forest was ultimately afforded National Park status in 1991. Covering some 321 km^2 in Rukungiri, Kabale and Kisoro districts in the Kigezi highlands of south-western Uganda, the park exhibits an altitudinal range of 1190 to 2607 metres above sea level, encompassing a wide variety of vegetation types broadly classified as medium-altitude moist evergreen forest and high-altitude forest. Approximately 40% of the park is occupied by rich to medium-rich mixed forest. Three other communities tend toward single species dominance, dependent on altitude. At the lower altitude around 1500 metres, *Parinari excelsa* dominates approximately 10% of the forest. A further 11% is dominated by *Newtonia buchananii* at around 2000 metres, and 8% by *Chrysophyllum gorungosanum* around 2200 metres. A small area of bamboo (*Arundinaria alpina*) occupies less than 1% of the park and the remaining 30% supports various communities of poor, hill and colonising forest.

The flora and fauna of Bwindi is exceptionally diverse and the park supports many species of extreme conservation importance, products of the unbroken nature of the forest across a broad altitudinal range, and its location within the Albertine Rift.

Bwindi was surveyed in February and September 1994 as part of a national forest biodiversity inventory programme. Species lists were compiled for five biological indicator taxa by different teams of Forest Department staff over a period of three weeks. Logistical difficulties meant that the forest was very poorly sampled in relation to others visited during the programme. However, fieldwork was carried out in a broad range of sites throughout the forest, incorporating lowland, medium-altitude and highland communities.

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 reserve, 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 Bwindi for biodiversity conservation relative to other Ugandan forests.

Table 1.1 provides a summary of the information gathered on the five indicator taxa from Bwindi. For each taxon, the total number of species known is given compared with the totals recorded during the Forest Department inventory. A considerable amount of previous work has been carried out, so it is not surprising that a few species recorded previously were not encountered during the short survey period. Nevertheless, significant numbers of new records were made, indicating that further work is likely to add even more.

Compared with other Ugandan forests, Bwindi is exceptionally biodiverse, with species diversity (an index of species richness per unit area, as recorded by the current inventory and then adjusted for sampling intensity) in the top 10% of the 65 sites visited for butterflies, large moths and birds, and above average for trees and shrubs. It is probable that the small

mammal fauna is similarly diverse, but the lack of sampling for this taxon may have reduced the efficacy of extrapolation.

In terms of the 'conservation value' of the species represented (based on knowledge of their world-wide distributions and occurrence in Ugandan forests), Bwindi is in the top 10% of sites for all taxa, clearly demonstrating the national and international conservation significance of the forest. As a basis for further comparison with other sites, a high number of species (173) may be classified as being of restricted-range (recorded from no more than five Ugandan forests).

The information collected from Bwindi 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 five indicator taxa surveyed in Bwindi

	Trees and Shrubs	**Birds**	**Small Mammals**	**Butterflies**	**Large Moths**
N^{o}. of species now known from forest	324	348	34	310	87
N^{o}. of restricted-range species (known from ≤5 forests)	46	75	6	36	10
N^{o}. of regional endemics	-	23	4	12	3
N^{o}. of species recorded by current inventory	252	146	9	162	81
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 Bwindi Impenetrable National Park in Rukungiri, Kisoro and Kabale districts of south-western Uganda. Bwindi is biologically one of the best known forests in the country with much existing literature. Where appropriate therefore, previous records are documented with the results of the floristic and faunal surveys carried out by the Forest Department in February and September 1994.

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

Bwindi Impenetrable National Park is situated in the Kigezi highlands overlooking the western rift valley in south-western Uganda, between 0°53' and 1°08' S, 29°35' and 29°50' E (Fig. 2.1). It lies approximately 25 km north west of Kabale and 17 km north of Kisoro. Approximately 5 km of the park's western boundary is contiguous with Zaire.

2.5.2 Bwindi Impenetrable National Park

Bwindi lies in Kinkiizi county in the administrative district of Rukungiri, Bufumbira county in Kisoro district and Rubanda county in Kabale district. It covers an area of 321 km^2, with an altitudinal range of 1,190 - 2,607 m. Approximately 1 km^2 of the forest lies below 1,250 m, 35 km^2 at 1,250 - 1,500 m, 68 km^2 at 1,500 - 1,750 m, 56 km^2 at 1,750 - 2,000 m, 119 km^2 at 2,000 - 2,250 m, 41 km^2 at 2,250 - 2,500 m, and 1 km^2 above 2,500 m. The forest is situated in rough terrain characterised by numerous steep-sided hills and narrow valleys with a steep general incline from the south-eastern corner (lying above 2,250 m) to the north and western parts (lying below 1,750 m). Much of the forest drains into the Ishasha and Ivi rivers which flow out onto the plains of the rift valley to the north-west.

Geologically the area is associated with upwarping of the western rift valley, and its underlying rocks are generally phyllites and shales, with some quartz, quartzite and granitic outcrops of the Karagwe-Ankolean system. The soils are predominantly humic red loams, moderately to highly acidic and deficient in bases. The climate is tropical with two rainfall peaks from March to May and September to November. Annual mean temperature range has a minimum of 7 - 15^{o} C, and a maximum of 20 - 27^{o} C. Annual rainfall is between 1,400 and 1,900 mm.

The forest is covered by the Uganda Department of Lands and Surveys map sheets 84/3, 84/4, 93/1 and 93/3 (series Y732) at 1:50,000.

2.6 DATES, LOCATIONS AND PERSONNEL

Bwindi Impenetrable National Park was visited for two weeks in February and one week in September 1994, by two different inventory teams. Personnel, dates and camp locations for the inventories are summarised in Table 2.1.

Table 2.1 Personnel, dates and areas sampled in Bwindi

	Bwindi		
Campsite locations (UTM)	RJ092838	QJ913907	QJ995906
Altitude (m)	2315	1490	1670
Ranger botanists	J. Tagaba W. Wandwasi	J. Tagaba W. Wandwasi	U. Ndyanabo W. Tenywa
Ranger ornithologists	C. Kabaseke	C. Kabaseke	S. Nsengiyunva
Ranger zoologists	F. Tinkasimiire	F. Tinkasimiire	D. Mijumbi
Co-ordinator	T. Davenport	T. Davenport	M. Baltzer
Dates	7-11.2.94	13-18.2.94	29-2.9.94
Vegetation type (Langdale-B.)	B1	C3	C3

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 Park. 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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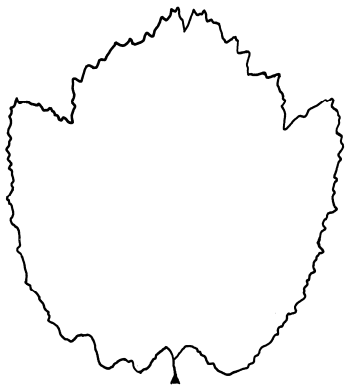

3.1 SUMMARY

The trees and shrubs of Bwindi Impenetrable were sampled for 15 days during 1994. Two hundred and fifty-two out of the 324 tree and shrub species known to occur in this forest were recorded by the inventory teams. The remaining 72 species cited in this report are records from Howard (1991) and A. Katende (Unpublished data). The species accumulation curve generated did not reach an asymptote, indicating that the species list compiled for this reserve was incomplete. Of the trees and shrubs now known in this forest, 46 were uncommon and have been recorded from not more than five of the 65 forests covered by the present inventory. Bwindi is undoubtedly of extreme importance in terms of the conservation of Uganda's flora.

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

The trees of Bwindi were inventoried and ealier work reviewed by Howard (1991) during the mid 1980's. In his study, 159 tree species were recorded from the forest. Further botanical information has been supplied by A. Katende (pers comm).

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 Bwindi

	Bwindi		
Campsite location (UTM)	RJ092838	QJ913907	QJ995906
Altitude (m)	2315	1490	1670
Ranger botanists	J. Tagaba W. Wandwasi	J. Tagaba W. Wandwasi	W. Tenywa U.Ndyanabo
Co-ordinator	T. Davenport	T. Davenport	M. Baltzer
Dates	7-11/2/94	13-18/2/94	29/8-2/9/94
Sampling period (days)	5	5	5
Vegetation type (Langdale-Brown)	B1	C3	C3
Total transect length (km)		> 43.3	
No. (%) of 1km^2 cells sampled		> 44 (15)	
Altitude sampled (m)		1200-2500*	

* = Survey route for 17 February 1994 not included

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 species recorded from Bwindi Impenetrable is presented in Appendix 3.1. The inventory teams recorded 252 out of the 324 tree and shrub species known to inhabit this forest. The remaining 72 species were recorded by Howard (1991) and A. Katende (Unpublished data).

Altitude in Bwindi ranges from about 1190 to 2600 m, however, 13 plant species that have previously only been known outside this altitudinal range were recorded in this forest (Table 3.3). Similarly, 14 tree and shrub species that had never been recorded from Floral Region U2 before, were recorded from Bwindi (Table 3.4).

Forty-six restricted-range species (known from not more than five forests of the 65 sampled) were recorded from Bwindi (Table 3.5). Of these, six were found only in this forest among all sites sampled during this inventory. Twenty-six of the restricted-range species recorded from this forest were forest-dependent plants. The remainder were either not in the Flora of Tropical East Africa or were not typical forest species.

3.4.2 Ecological characteristics

The classification of plant species according to their ecological affinities (Table 3.2) revealed that 58% (188 species) of the species recorded from Bwindi were forest-dependent (FF-species). Forest non-dependent (Fn-species) i.e. species that occupy forest habitats, as well as non-forest habitats, accounted for 31% (101 species).

3.4.3 Daily records

A daily species list for Bwindi is presented in Appendix 3.2. Transect routes followed by the inventory teams are presented in Fig. 3.1. The cumulative total number of plant species recorded on a daily basis from this forest (Fig. 3.2) did not reach an asymptote.

3.5 DISCUSSION

Containing about 26% (324 species) of Uganda's known tree and shrub species, Bwindi is considered extremely rich florally. Of these, 46 are uncommon, occurring in not more than five of the 65 reserves covered during the present inventory. Six of these species are not known in any other reserve, thus making Bwindi a forest of significant importance in the conservation of a complete assemblage of Uganda's floral diversity.

Species such as *Allanblackia kimbiliensis*, *Brazzia longipecellata*, *Dicranolepis incisa*, *Milletia psilopetala* and *Sapium leonardii-crispi* need special attention because they are found in only one other country in addition to Uganda. *Allanblackia kimbiliensis,* D. *incisa* and *S. leonardii-crispi* have been recorded from Zaire in additon to Uganda, while *B. longipecellata* and *M. psilopetala* have been recorded from Congo (the Flora of Tropical East Africa). The presence of these species suggest the extension of the Guineo-Congollan phytochoria into Uganda.

In summary, Bwindi Impenetrable National Park is of extreme importance for the conservation of Uganda's plant diversity. Because the forest has been afforded National Park status, it is assumed that all plant species, including rarer ones will receive adequate protection.

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3.7 TABLES

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

	Uganda Totals		Bwindi		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**%of Ug. Tot.**
F	234	19	106	33	45
f	38	3	20	6	53
r	16	1	2	1	13
df	5	< 1	4	1	80
fg	132	11	56	17	42
Total FF	**425**	**34**	**188**	**58**	**44**
Total Fn	**323**	**26**	**101**	**31**	**31**
wo	52	4	2	1	4
g	13	1	0	0	0
ro	6	< 1	0	0	0
t	13	1	1	<1	8
Sc	2	< 1	0	0	0
S	8	< 1	1	<1	13
m	15	1	2	1	13
Og	127	11	4	1	3
Total O	**236**	**19**	**10**	**3**	**4**
Total Ud	**267**	**21**	**25**	**8**	**9**
TOTAL	**1251**	**100**	**324**	**100**	**26**

FF Forest-dependent types, including:
F Forest interior
f Forest edge
fg Forest generalists (occur in more than one of the above)
r Riverine/ lakeshore forest
df Dry forest

O Open habitats types, including:
wo Woodland
g Grassland
ro Rocky places
t Bush/ thickets
Sc Dry scrub
S Swamp
m Moorland
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

Category	**Species**	**Previous Altitudinal Range (m)**
Lower altitude species	*Discoglypremna caloneura*	1067-1067
	Drypetes ugandensis	1140-1140
	Greenwayodendron suaveolens	1100-1100
	Irvingia gabonensis	900-1170
	Lannea welwitschii	1100-1100
	Mammea africana	1050-1050
	Memecylon jasminoides	1080-1170
	Mildbraediodendron excelsum	790-1000
	Monanthotaxis littoralis	1080-1170
	Musanga cecropioides	750-900
	Rinorea beniensis	750-1150
	Thecacoris lucida	700-1160
Higher altitude species	*Philippia johnstonii*	2700-4000

Table 3.4 Tree and shrub recorded in Bwindi but not previously known from floral region U2

Species	**Previous Known Distribution in Uganda (FTEA Region)**
Allophylus abyssinicus	1,3
Cassipourea malosana	1
Clutia robusta	3
Dovyalis abyssinica	1,3,4
Ficus conraui	4
Ficus exasperata	4
Garcinia buchananii	3,4
Memecylon myrianthum	4
Monanthotaxis buchananii	1,3,4
Myrianthus arboreus	4
Pauridiantha viridiflora	4
Podocarpus gracilior	1,3
Rinorea dentata	4
Xylopia aethiopica	4

Table 3.5 Restricted-range trees and shrubs recorded from Bwindi

Species	Ecol. Type	No. of Ugandan forests where species has been recorded	Other forests where species has been recorded	Known Distribution No of EA Floral Regions	Known Distribution No of African Countries
Brazzeia longipedicellata	Fn	1	None	1	2
Cyathea camerooniana	Fn	1	None	Not in FTEA	≥1
Loranthus brunneus	Ud	1	None	Not in FTEA	≥1
Ocotea kenyensis	F	1	None	Not in FTEA	≥1
Polygala ruwenzoriensis	Ud	1	None	Not in FTEA	≥1
Xylopia staudtii	F	1	None	1	widespread
Allanblackia kimbiliensis	Fn	2	Agoro-Agu	1	2
Artabotrys monteiroae	Fn	2	Mt. Kei	9	9
Bertiera globiceps	Fn	2	Kasyoha-Kitomi	1	5
Dicranolepis incisa	F	2	Budongo	2	2
Discoglypremna caloneura	F	2	Budongo	1	widespread
Kotschya aeschynomenoides	Fn	2	Mafuga	12	9
Mammea africana	F	2	Budongo	1	widespread
Melchiora schliebenii	F	2	Kasyoha-Kitomi	3	5
Mimulopsis solmsii	Ud	2	Rom	Not in FTEA	≥1
Sapium leonardii-crispi	F	2	Kalinzu-Maramagambo	1	2
Strombosiopsis tetrandra	F	2	Kasyoha-Kitomi	1	widespread
Whitfieldia elongata	Ud	2	Budongo	Not in FTEA	≥1
Baphia capparidifolia	Fn	3	Kalinzu,Semliki	2	widespread
Desmodium salicifolium	Fn	3	Mafuga, West Bugwe	14	widespread
Millettia psilopetala	F	3	Semliki, Matiri	1	2
Musanga leo-errerae	f	3	Kalinzu-Maramagambo, Kasyoha-Kitomi	Not in FTEA	≥1
Philippia johnstonii	m	3	Rwenzori, Kalinzu-Maramagambo	Not in FTEA	≥1
Phyllanthus inflatus	Fg	3	Budongo, Kalinzu-Maramagambo	7	6
Rutidea orientalis	Fn	3	Kalinzu-Maramagambo, Kasyoha-Kitomi	10	9
Tricoscypha ulugurensis	F	3	Kalinzu-Maramagambo, Kasyoha-Kitomi	5	8
Arundinaria alpina	F	4	Mt. Elgon, Rwenzori, Echuya	11	9
Chrysophyllum pruniforme	F	4	Budongo, Kadam, Itwara	2	widespread
Clutia robusta	Fg	4	Mt. Elgon, Kalinzu-Maramagambo, Kasyoha-Kitomi	7	6
Dasylepsis racemosa	F	4	Kalinzu-Maramagambo, Kibale, Itwara	1	6
Dichaetanthera corymbosa	F	4	Kalinzu-Maramagambo, Kibale, Kashoya-Kitomi	1	5
Ficus populifolia	Fg	4	Kalinzu-Maramagambo, Kasyoha-Kitomi, Mpigi	9	widespread
Heinsenia diervilleoides	F	4	Mt. Elgon, Kalinzu-Maramagambo, Agoro-Agu	13	9
Lasianthus kilimandsharicus	F	4	Mt. Elgon, Rwenzori, Mafuga	11	9
Leptactina platyphylla	Fn	4	Rwenzori, Kalinzu-Maramagambo, Sesse Islands	9	11
Maesobotrya floribunda	Fn	4	Rwenzori, Kasyoha-Kitomi, Mpigi	1	6
Myrica kandtiana	Fn	4	Kalinzu-Maramagambo, Sango Bay, Echuya	Not in FTEA	≥1
Brillantisia arborescensis	Ud	5	Rwenzori, Morungole, Echuya, Mafuga	Not in FTEA	≥1
Cola bracteata	F	5	Kalinzu-Maramagambo, Kibale, Kasyoha-Kitomi Itwara	Not in FTEA	≥1
Ficalhoa laurifolia	Fg	5	Rwenzori,Kashoya-Kitomi, Echuya, Mafuga	6	8
Leplaea mayombensis	F	5	Budongo, Kalinzu-Maramagambo, Kasyoha-Kitomi, Mpigi	Not in FTEA	≥1
Ocotea usambarensis	F	5	Rwenzori, Kalinzu-Maramagambo, Kibale, Kasyoha-Kitomi	Not in FTEA	≥1
Pauridiantha callicarpoides	F	5	Kalinzu-Maramagambo, Kibale, Kasyoha-Kitomi, Itwara.	1	5
Philippia benguelensis	Og	5	Rwenzori, Kalinzu-Maramagambo, Kasyoha-Kitomi, Itwara	Not in FTEA	≥1
Podocarpus gracilior	F	5	Mt. Elgon, Moroto, Agoro-Agu, Sango Bay	7	6
Triumfetta tomentosa	Ud	5	Kibale, Nyangea-Napore, Mt. Kei, Napak	Not in FTEA	≥1

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

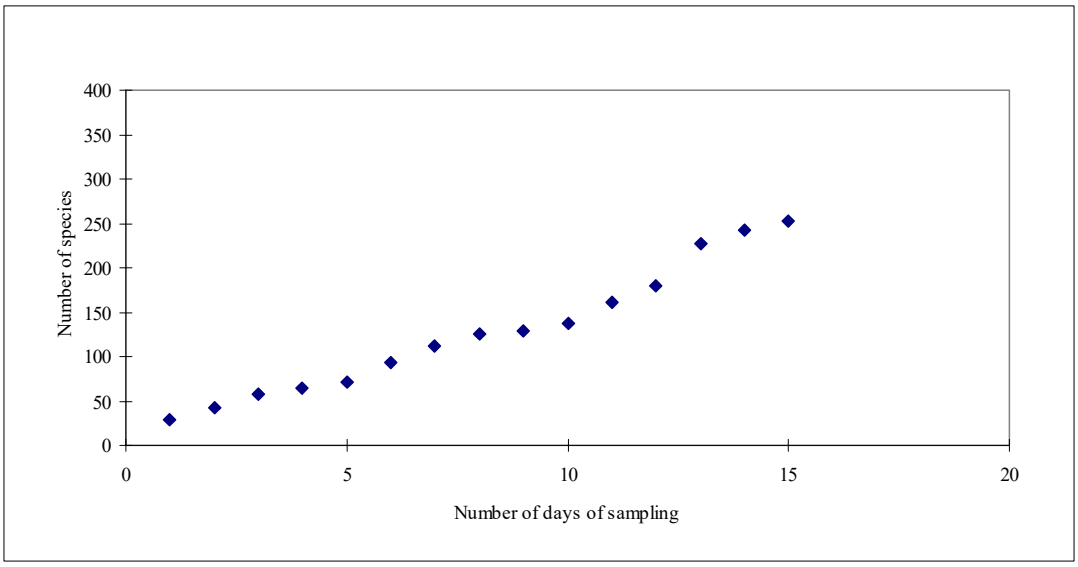

Fig. 3.2 Species accumulation rates for trees and shrubs from Bwindi

3.9 APPENDICES

Appendix 3.1 Species list of trees and shrubs recorded from Bwindi (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
Acacia brevispica (pennata) (437) (Es) (LEG; 1,2,3,4; t; 170-1830m)	S/ST	t
Acanthus arborescens (pubescens) (Es) (ACA; 2,3,4; f)	WH/S	f
Aeglopsis eggelingii (167) (E) (RUT; 2; f,r; 900-1500m)	S/ST	Fg
Agauria salicifolia (261) (E) (ERI; 1,2,3; F; 1800-3200m)	ST	F
Aidia micrantha (Randialucidula) (326) (Es) (RUB; 2,4; F,t,r; 1140-1800m)	S/ST	Fn
Alangium chinense (111) (E) (ALA; 2,3; f; 750-2000m)	ST	f
Albizia adianthifolia (445) (E) (LEG; 2,4; F,wo,g; 30-1680m)	T	Fn
Albizia coriara (442) (E) (LEG; 1,2,3,4; wo,r; 850-1680m)	TT	Fn
Albizia glaberrima (eggelingii) (443) (Es) (LEG; 1,2; F; 790-1370m)	ST	F
Albizia grandibracteata (446) (E) (LEG; 1,2,3,4; F,r,g,f)	TT	Fn
Albizia gummifera (444) (E) (LEG; 2,3,4; F,f,r; 0-2440m)	TT	Fg
Albizia zygia (447) (E) (LEG; 1,2,3,4; F,r,wo; 915-1370m)	TT	Fn
Alchornea cordifolia (102) (E) (EUP; 2,3,4; f,r; 1150-1500m)	CS/S/ST	Fg
Alchornea floribunda (172) (E) (EUP; 2,4; f,r; 1170-1200m)	S/ST	Fg
Alchornea hirtella (173) (E) (EUP; 2,4; f,r,t; 900-2500m)	S/ST	Fn
Allanblackia kimbiliensis (floribunda) (282) (E) (GUT; 2; F,ro; 1500-1500m)	TT	Fn
Allophylus abyssinicus (351) (E) (SAP; 1,3; F; 1400-2500m)	ST	F
Allophylus dummeri (353) (E) (SAP; 2,4; F; 900-1200m)	ST	F
Allophylus macrobotrys (352) (E) (SAP; 2,3,4; F,s)	ST	Fn
Alstonia boonei (267) (E) (APO; 2,3,4; F,r,f)	TT	Fg
Aningeria adolfi-friederici (36) (E) (SAP; 1,2,3; F; 1430-2500m)	TT	F
Aningeria altissima (35) (E) (SAP; 1,2,3,4; F,r; 1000-1700m)	TT	Fg
Anthocleista schweinfurthii (inermis, insulana) (291) (E,Es) (LOG; 2,4; F,f; 1200-1400m)	ST	Fg
Anthocleista vogelii (nobilis) (290) (Es) (LOG; 1,2,4; F,s; 1200-1400m)	ST	Fn
Anthocleista zambesiaca (pulcherima) (289) (Es) (LOG; 1,2,3,4; F,s,r; 0-2300m)	TT	Fn
Antiaris toxicaria (56) (E) (MOR; 1,2,3,4; F,wo,r; 10-1700m)	TT	Fn
Antidesma laciniatum (245) (E) (EUP; 2,4; F,f,; 975-1200m)	ST	Fg
Antidesma membranaceum (meiocarpum) (246) (E,Es) (EUP; 2,3,4; f,r,t,wo; 10-1530m)	S/ST	Fn
Aphania senegalensis (420) (E) (SAP; 1,2,3,4;)	ST	Ud
Artabotrys monteiroae (nitidus) (ANN; 2,3,4; f,t,wo,r; 900-1800m)	C/S/ST	Fn
Arundinaria alpina (17) (E) (GRA; 2,3; F; 2400-3000m)	S	F
Baphia capparidifolia (multiflora, polygalaceae) (231) (Es) (LEG; 2; F,r,g; 650-1200m)	CS	Fn
Baphiopsis parviflora (stuhlmannii) (232) (Es) (LEG; 2,3,4; F,s; 1110-1310m)	S/ST	Fn
Beilschmiedia ugandensis (Tylostemon) (204) (Es) (LAU; 1,2,4; F,s,r)	TT	Fn
Belonophora hypoglauca (glomerata) (315) (Es) (RUB; 1,2,4; F,wo,r; 1050-1560m)	S/ST	Fn
Bersama abyssinica (380) (E) (MEL; 1,2,3,4; F,wo,g,t,r; 1140-2400m)	ST	Fn
Bertiera globiceps (RUB; 2; F,ro; 1524-1524m)	S	Fn
Blighia unijugata (Phialodiscusunijugata) (419) (E,Es) (SAP; 2,3,4; f)	ST/(TT)	f
Bombax buonopozense (reflexum) (363) (Es) (BOM; 2; F; 900-1200m)	TT	F
Brazzeia longipedicellata (126) (E) (SCY; 2; F,ro; 1200-1500m)	ST	Fn
Bridelia brideliifolia (244) (E) (EUP; 2; f,t; 1200-2440m)	S/ST/TT	Fn
Bridelia micrantha (243) (E) (EUP; 1,2,3,4; f,t,r; 50-2300m)	S/ST	Fn
Bridelia scleroneura (E) (EUP; 1,2,3,4; wo,t; 775-2400m)	S/ST	Og
Brillantisia arborescensis (ACA)	S	Ud
Brillantisia kirungae (ACA)	S	Ud
Canarium schweinfurthii (389) (E) (BUR; 1,2,3,4; f,r; 1000-1600m)	TT	Fg
Canthium vulgare (325) (E) (RUB; 1,2,3,4; f)	S/ST	f
Capparis tomentosa (CAP; 1,2,3,4; t,g,r; 0-2500m)	CS/ST	Fn
Carapa grandiflora (397) (E) (MEL; 2,4; F; 1200-1800m)	ST	F
Carpabolia alba (Securidacalongipedunculata) (Es) (POL; 1,2,3,4; wo)	S/ST	wo
Casearia battiscombei (208) (E) (FLA; 2,3; F; 1125-2440m)	ST/TT	F
Casearia runssorica (engleri) (207) (Es) (FLA; 2,4; F,s; 850-2100m)	ST/TT	Fn
Cassia petersiana (E) (LEG; 1,2,3,4; f,wo,t,; 12-2130m)	S/ST	Fn
Cassine aethiopica (Mystroxylon) (160) (Es) (CEL; 1,2,3,4; f,wo; 0-2400m)	S/ST	Fn
Cassipourea congensis (300) (E) (RHI; 2; F; 1300-1950m)	S/ST	F
Cassipourea gummiflua (ugandensis) (301) (Es) (RHI; 2,4; F,s; 1200-1500m)	TT	Fn
Cassipourea malosana (abyssinica, elliottii) (298) (Es) (RHI; l; df)	TT	df
Cassipourea ruwensorensis (299) (E) (RHI; 2,3,4; F; 1200-1700m)	ST	F
Catha edulis (330) (E) (CEL; 1,2,3; f; 1500-2500m)	ST	f

Celtis africana (kraussiana) (89) (Es) (ULM; 1,2,3,4; F,df,r; 30-2400m)	TT	Fg
Celtis durandii (88) (E) (ULM; 2,3,4; F; 300-2000m)	TT	F
Celtis zenkeri (87) (E) (ULM; 2,4; F; 250-1200m)	TT	F
Chaetacme aristata (252) (E) (ULM; 1,2,3,4; f,r; 900-2100m)	S/ST	Fg
Chrysophyllum albidum (40) (E) (SAP; 1,2,3,4; F; 900-1700m)	TT	F
Chrysophyllum gorungosanum (fulvum) (42) (Es) (SAP; 1,2; F; 1300-2250m)	TT	F
Chrysophyllum muerense (C.sp.nov.) (39) (Es) (SAP; 1,2,4; F; 750-1400m)	TT	F
Chrysophyllum pruniforme (46) (E) (SAP; 2; F; 1500-1500m)	TT	F
Clausena anisata (377) (E) (RUT; 1,2,3,4; f,t,wo; 1-2450m)	S/ST	Fn
Clerodendrum rotundifolium (VER)	S	Ud
Clutia abyssinica (EUP; 1,2,3,4; f,t,wo,r)	WH/S/ST	Fn
Clutia robusta (EUP; 3; f,r)	S	Fg
Cnestis ugandensis (422) (E) (CON; 2,4; F; 900-1300m)	ST	F
Coffea canephora (robusta) (314) (E) (RUB; 1,2,3,4; F; 700-1400m)	S/ST	F
Coffea eugenioides (arabica) (327) (ERUB; 1,2,3,4; F; 1050-2100m)	S	F
Cola bracteata (117) (E) (STE; 2; F)	ST	F
Cola gigantea (cordifolia) (116) (Es) (STE; 1,2,4; F)	TT	F
Connarus longistipitatus (421) (E) (CON; 2,4; f,F; 1100-1500m)	C/S/ST	Fg
Cordia millenii (112) (E) (BOR; 1,2,4; F; 900-1650m)	TT	F
Craibia brownii (429) (E) (LEG; 2,3,4; F,r; 1100-2200m)	ST	Fg
Crassocephalum afromontanum (171) (COM)	S	m
Crassocephalum mannii (171) (E) (COM; 1,2,3,4; f; 0-2000m)	S/ST	f
Craterispermum schweinfurthii (laurinum) (310) (Es) (RUB; 1,2,3,4; r,t,df; 1050-1500m)	S/ST	Fn
Croton macrostachyus (106) (E) (EUP; 1,2,3,4; f,r; 200-2300m)	S/ST	Fg
Croton megalocarpus (109) (E) (EUP; 2,4; F; 1200-2400m)	TT	F
Croton sylvaticus (bukobensis, oxypetalus) (107108) (E,Es) (EUP; 1,2,4; f,r; 60-1800m)	S/ST	Fg
Cyathea cameroonіana (3) (CYA; 2,4; F,s,r)	ST	Fn
Cyathea manniana (deckenii) (1) (Es) (CYA; 2,3,4; r,F; 1000-2500m)	ST	Fg
Cynometra alexandri (428) (E) (LEG; 2)	TT	Ud
Dalbergia lactea (LEG; 1,2,3,4; f,t,g; 540-2400m)	S/ST	Fn
Dasylepsis eggelingii (137) (E) (FLA; 2,4; F; 1400-1525m)	S/ST	F
Dasylepsis racemosa (leptophylla) (138) (Es) (FLA; 2; F; 1280-2440m)	ST	F
Deinbollia fulvo-tomentella (410) (E) (SAP; 2,4; F)	ST	F
Desmodium salicifolium (LEG; 1,2,3,4; f,r,s,g; 550-2100m)	WH/SS/S	Fn
Dichaetanthera corymbosa (Sakersialaurentii) (296) (Es) (MEL; 2; F; 1450-1950m)	ST	F
Dicranolepis incisa (THY; 2,4; F; 1200-1300m)	S/ST	F
Dictyandra arborescens (316) (E) (RUB; 2,4; F; 1050-1500m)	S/ST	F
Diospyros abyssinica (Maba) (211) (Es) (EBE; 1,2,3,4; F,f,df)	T	Fg
Discoglypremna caloneura (110) (EUP; 2; F; 1067-1067m)	TT	F
Discopodium penninervium (E) (SOL; 1,2,3,4; F)	S/ST	F
Dodonea viscosa (E) (SAP; 2,3,4; f,g,t; 1700-2200m)	S/ST	Fn
Dombeya goetzenii (120) (E) (STE; 1,2,3; F; 1800-3200m)	ST	F
Dombeya mukole (119) (E) (STE; 2,3,4; f)	ST	f
Dovyalis abyssinica (engleri) (145) (E,Es) (FLA; 1,3,4; F,df,r,wo; 1500-3000m)	S/ST	Fn
Dovyalis macrocalyx (glandulosissima) (144) (E,Es) (FLA; 1,2,3,4; F,df,r,t,wo; 0-2600m)	S	Fn
Dracaena afromontana (13) (E) (AGA; 1,2,3; F; 1800-2450m)	ST	F
Dracaena fragrans (14) (AGA)	S	Ud
Dracaena laxissima (15) (AGA; 2,4; r)	CS/S	r
Drypetes bipindensis (185) (E) (EUP; 2; F; 1200-1520m)	S/ST	F
Drypetes gerrardii (sp. aff. D. battiscombei) (182) (Es) (EUP; 2,3,4; F,r,ro; 1150-2300m)	S/ST/TT	Fn
Drypetes ugandensis (D.sp.) (183184) (E,Es) (EUP; 2,4; F; 1140-1140m)	S/ST	F
Ehretia cymosa (sylvatica) (114) (E,Es) (BOR; 2,3,4; F,t,g; 960-2250m)	S/ST	Fn
Ekebergia capensis (rueppeliana) (391) (Es) (MEL; 1,2,3; df; 1800-2500m)	TT	df
Ekebergia senegalensis (E.sp.; E.sp.nr.E.velutina) (390) (E,Es) (MEL; 1,2,3,4; f)	ST	f
Entada abyssininca (E) (LEG; 1,2,3,4; wo; 430-2290m)	ST	wo
Entandrophragma angolense (401) (E) (MEL; 2,4; F; 0-1220m)	TT	F
Entandrophragma cylindricum (400) (E) (MEL; 2,3,4; F; 0-1500m)	TT	F
Entandrophragma excelsum (402) (E) (MEL; 2,3,4; F; 1280-2150m)	TT	F
Entandrophragma utile (399) (E) (MEL; 1,2,4; F; 0-1830m)	TT	F
Erythrina abyssinica (E) (LEG; 1,2,3,4; g,wo,t,f,ro; 200-2100m)	ST	Fn
Erythrococca bongensis (EUP; 1,2,3,4; f,t,r; 200-2400m)	S/ST	Fn
Erythrococca trichogyne (hirta, stolziana) (EUP; 1,2,3,4; F,f,t,r; 1140-2750m)	CS	Fn
Euadenia eminens (alimensis) (354) (Es) (CAP; 2; F; 1300-1650m)	S/ST	F
Eugenia bukobensis (341)		Ud
Faurea saligna (arborea) (259) (E,Es) (PRO; 1,2,3; F; 1200-3200m)	ST	F
Ficalhoa laurifolia (187) (E) (THE; 2; F,r; 1350-2400m)	TT	Fg
Ficus asperifolia (urceolaris) (68) (Es) (MOR; 1,2,4; F,wo,f,r; 650-1850m)	S	Fn
Ficus barteri (MOR; 2,4; F; 1000-1200m)	S/ST	F
Ficus conraui (stipulifera) (79) (Es) (MOR; 4; F; 1200-1500m)	T	F
Ficus craterostoma (pilosula) (81) (Es) (MOR; 2,4; F,r; 300-2100m)	S/ST	Fg
Ficus cyathistipula (77) (E) (MOR; 1,2,3,4; F,r,ro,.; 700-1800m)	ST	Fn
Ficus exasperata (63) (E) (MOR; 4; F,f,ro,r; 0-1200m)	TT	Fn
Ficus natalensis (82) (E) (MOR; 2,4; F,r,wo; 10-2200m)	TT	Fn
Ficus ottoniifolia (lucanda) (70) (E,Es) (MOR; 2,4; F,r; 900-1500m)	C/S/ST	Fg

Ficus ovata (brachypoda) (71) (Es) (MOR; 1,2,3,4; wo,r; 750-2100m)	ST	Fn
Ficus populifolia (E) (MOR; 1,2,4; F,r; 50-1200m)	S/ST	Fg
Ficus pseudomangifera (85) (E) (MOR; 2,4; F; 1050-1200m)	ST	F
Ficus sansibarica (brachylepis, ugandensis) (72) (Es) (MOR; 2,4; F,r; 1050-1200m)	ST/(TT)	Fg
Ficus saussureana (eriobotryoides, dawei) (75) (Es) (MOR; 1,2,4; F,f,r; 900-1600m)	ST	Fg
Ficus sur (capensis) (69) (Es) (MOR; 1,2,3,4; F,r,wo; 0-2300m)	TT	Fn
Ficus thonningii (dekdekena,rhodesica) (83) (E,Es) (MOR; 1,2,3,4; F,wo,r,ro; 350-2500m)	ST/(TT)	Fn
Ficus vallis-choudae (65) (E) (MOR; 1,2,4; r; 450-1800m)	ST	r
Flueggea virosa (EUP; 1,2,3,4; f,t,ro; 0-2300m)	S/ST	Fn
Funtumia africana (latifolia) (271) (Es) (APO; 1,2,3,4; F)	TT	F
Funtumia elastica (272) (E) (APO; 2,4; F)	TT	F
Galiniera saxifraga (coffeoides) (320) (E) (RUB; 1,2,3,4; F)	S/ST	F
Garcinia buchananii (huillensis) (280) (E) (GUT; 3,4; F,r,t,wo; 60-1800m)	S/ST	Fn
Glyphaea brevis (lateriflora) (127) (Es) (TIL; 2,4; f,r)	S/ST	Fg
Greenwayodendron suaveolens (Polyalthia) (213) (Es) (ANN; 2,4; F; 1100-1100m)	TT	F
Grewia mildbraedii (131) (E) (TIL; 2; F; 1750-1900m)	TT	F
Guarea cedrata (405) (E) (MEL; 2,4; F)	TT	F
Hagenia abyssinica (381) (E) (ROS; 1,2,3; F,t; 2400-3600m)	ST	Fn
Hallea rubrostipulata (Mitragyna) (304) (Es) (RUB; 1,2,4; F,r; 900-2190m)	ST	Fg
Hallea stipulosa (Mitragyna) (303) (Es) (RUB; 1,2,4; F,r; 1050-1200m)	TT	Fg
Hannoa longipes (Odyendea) (383) (Es) (SIM; 2; F)	TT	F
Harungana madagascariensis (281) (E) (GUT; 2,3,4; F; 0-1800m)	ST/TT	F
Heinsenia diervilleoides (324) (E) (RUB; 2,3,4; F; 375-2400m)	S/ST	F
Hugonia platysepala (159) (LIN; 2,4; F,r,f; 1050-1220m)	C/S/ST	Fg
Huslondia opposita (LAB)	S	Ud
Ilex mitis (165) (E) (AQU; 1,2,3,4; F,df,t; 900-2850m)	S/ST	Fn
Irvingia gabonensis (210) (E) (IXO; 2,4; F; 900-1170m)	TT	F
Kigelia africana (aethiopica, moosa lanceolata) (371) (Es) (BIG; 1,2,3,4; F,s,wo; 0-2150m)	ST	Fn
Kotschya aeschynomenoides (Smithia) (Es) (LEG; 2; m,wo,df,t; 1350-2550m)	S	Fn
Lannea barteri (kerstingii) (Es) (ANA; 1,2,3; wo,f,r; 900-1200m)	ST	Fn
Lannea schweinfurthii (stuhlmannii) (Es) (ANA; 1,2,3,4; wo,t,df; 1-1820m)	S/ST	Fn
Lannea welwitschii (387) (E) (ANA; 2,4; F; 1100-1100m)	TT	F
Lantana trifolia	S	Ud
Lasianthus kilimandsharicus (sp.nr.L.k.) (Es) (RUB; 2; F; 1710-2400m)	S	F
Lepidotrichilia volkensii (Trichilia) (396) (Es) (MEL; 1,2,3,4; F; 1200-2750m)	ST	F
Leplaea mayombensis (398) (MEL; 2; F)	ST	F
Leptactina platyphylla (RUB; 2,4; F,t,wo; 45-1650m)	CS/S/ST	Fn
Leptaulus daphnoides (238) (E) (ICA; 2,4; F,r; 1050-1225m)	S/ST	Fg
Leptonychia mildbraedii (multiflora) (121) (E,Es) (STE; 2,4; F)	ST	F
Lindackeria bukobensis (bequartii, mildbraedii) (133134135) (Es) (FLA; 2,4; F,f; 900-1525m)	S/ST	Fg
Lindackeria mildbraedii (135) (E)	T	Ud
Linociera johnsonii (336) (E) (OLE; 2,4; F; 1000-1200m)	S/ST	F
Loranthus brunneus (LOR)	S	Ud
Lovoa swynnertonii (407) (E) (MEL; 2,3,4; F)	TT	F
Lovoa trichilioides (brownii) (406) (Es) (MEL; 2,4; F,r)	TT	Fg
Lychnodiscus cerospermus (412) (E) (SAP; 1,2,4; F)	ST	F
Macaranga barteri (lancifolia) (98) (Es) (EUP; 2,4; F,r; 1140-1650m)	TT	Fg
Macaranga kilimandscharica (99) (E) (EUP; 1,2,3; f,r; 1310-3000m)	ST/TT	Fg
Macaranga monandra (96) (E) (EUP; 2,4; f,r,s; 1130-1525m)	ST	Fn
Macaranga schweinfurthii (94) (E) (EUP; 2,4; F,r; 1050-1280m)	ST/TT	Fg
Maesa lanceolata (164) (E) (MYR; 1,2,3,4; f,t; 360-2550m)	S/ST	Fn
Maesobotrya floribunda (purseglovei) (177) (Es) (EUP; 2; F,ro; 1280-1520m)	ST	Fn
Maesopsis eminii (189) (E) (RHA; 2,3,4; F; 800-1200m)	TT	F
Mammea africana (283) (E) (GUT; 2; F; 1050-1050m)	TT	F
Manilkara dawei (52) (E) (SAP; 1,2,3,4; F; 1100-1600m)	TT	F
Margaritaria discoideus (Phyllanthus) (247) (Es) (EUP; 1,2,3,4; F,f,wo,t; 20-1900m)	S/ST	Fn
Markhamia platycalyx (369) (E) (BIG; 1,2,3,4; f)	ST	f
Maytenus acuminata (Gymnosporia) (163) (Es) (CEL; 2; F; 1500-3200m)	ST	F
Maytenus undata (Gymnosporia) (161) (CEL; 1,2,4; f; 0-2500m)	ST	f
Melchiora schliebenii (Adinandra) (188) (Es) (THE; 2; F; 1900-2350m)	TT	F
Memecylon jasminoides (294) (E) (MEL; 2,4; F,s; 1080-1170m)	S/ST	Fn
Memecylon myrianthum (342) (E) (MEL; 4; F; 1100-1200m)	ST	F
Mildbraediodendron excelsum (423) (E) (LEG; 1,2,4; F; 790-1000m)	TT	F
Millettia dura (drastica) (430) (E,Es) (LEG; 2,4; f; 1200-1650m)	S/ST	f
Millettia psilopetala (432) (E) (LEG; 2; F; 750-1800m)	S/ST	F
Mimulopsis arborescens (E) (ACA; 2; f,s; 2250-2600m)	S	Fn
Mimulopsis solmsii (ACA)	S	Ud
Mimusops bagshawei (47) (E) (SAP; 2,3,4; F; 1100-2400m)	TT	F
Monanthotaxis buchananii (ANN; 1,3,4; F,t,ro,g; 100-1290m)	C/S/ST	Fn
Monanthotaxis littoralis (ANN; 2,3,4; F,f,t; 1080-1170m)	S	Fn
Monodora myristica (219) (E) (ANN; 2,3,4; F,r; 1140-1800m)	S/TT	Fg
Morinda lucida (312) (E) (RUB; 2,3,4; f,g,t; 756-1290m)	ST/(S)	Fn
Musanga cecropioides (366) (E) (CEC; 2; F,f,s; 750-900m)	TT	Fn
Musanga leo-errerae (367) (CEC; 2; f; 1350-1350m)	TT	f

Myrianthus arboreus (364) (E) (CEC; 4; F,s,r; 700-1200m)	S/ST	Fn
Myrianthus holstii (365) (E) (CEC; 2; F,f,r; 900-2100m)	ST	Fg
Myrica kandtiana (166) (E) (MYR; 1,2,4; r,s)	ST	Fn
Myrica salicifolia (258) (E) (MYR; 1,2,3; f,wo; 2000-3000m)	ST	Fn
Neoboutonia macrocalyx (100) (E) (EUP; 2,3; f; 1100-2700m)	ST	f
Newtonia buchananii (Piptadenia) (435) (Es) (LEG; 2,4; F,r; 600-2130m)	TT	Fg
Nuxia congesta (Lachnopylis) (264) (Es) (LOG; 1,2,3; F; 1800-2700m)	ST	F
Nuxia floribunda (Lachnopylis) (265) (Es) (LOG; 2; f; 1200-2000m)	ST	f
Ochna membranacea (155) (E) (OCH; 2,4; F)	ST	F
Ocimum suave (LAB)	S	Ud
Ocotea kenyensis (viridis; sp.nov.) (206) (Es) (LAU; 1,2; F; 2000-2500m)	ST	F
Ocotea usambarensis (205) (E) (LAU; 2; F)	TT	F
Olea chrysophylla (africana) (355) (OLE; 1,2,3; wo,F; 1320-3150m)	(S)/ST	Fn
Olea hochstetteri (334) (E) (OLE; 1,2; df; 1500-2610m)	ST	df
Olea welwitschii (Steganthus, Linociera) (333) (Es) (OLE; 2,4; F,df; 750-1950m)	TT	Fg
Olinia rachetiana (usambarensis) (338) (Es) (OLI; 1,2,3; df,t,g; 1680-3000m)	S/ST	Fn
Oncoba routledgei (143) (E) (FLA; 2,3; F,r; 900-2440m)	S/ST	Fg
Oncoba spinosa (142) (E) (FLA; 1,2,3,4; f,t,r,wo; 0-1800m)	S/ST	Fn
Ouratea hiernii (bukobensis) (154) (Es) (OCH; 2,4; F)	ST	F
Oxyanthus speciosus (317) (E) (RUB; 1,2,3,4; F; 750-2300m)	S/ST	F
Pachystela brevipes (Chrysophyllum stuhlmannii) (53) (E,Es) (SAP; 2,4; F,r; 0-1500m)	ST	Fg
Pancovia sp nr turbinata (417) (E) (SAP; 2,4; F)	ST	F
Parinari excelsa (holstii) (200) (E,Es) (ROS; 1,2,4; F,r; 1000-2100m)	TT	Fg
Parkia filicoidea (440) (E) (LEG; 2,4; F,r; 250-1370m)	TT	Fg
Pauridiantha callicarpoides (307) (E) (RUB; 2; F; 1050-1650m)	ST	F
Pauridiantha viridiflora (Pamphlethantha) (308) (Es) (RUB; 4; F,f; 1140-1400m)	ST	Fg
Pavetta molundensis (insignis) (318) (RUB; 1,2,4; F; 750-1200m)	S/ST	F
Peddiea fischeri (256) (E) (THY; 2,3,4; F,f,t,r; 950-2400m)	S/ST	Fn
Philippia benguelensis (30) (E) (ERI; 2; g,ro; 1500-4000m)	S	Og
Philippia johnstonii (29) (E) (ERI; 2; m; 2700-4000m)	ST	m
Phoenix reclinata (8) (E) (PAL; 1,2,4; r,s,ro; 0-3000m)	ST	Fn
Phyllanthus inflatus (polyanthus) (248) (E,Es) (EUP; 2,3; f,r; 750-1830m)	S/ST	Fg
Phyllanthus ovalifolius (guineensis, floribundus, lalambensis) (Es) (EUP; 1,2,4; f,r,t; 350-2000m)	CS/S/ST	Fn
Phytolacca dodecandra (PHY; 1,2,3,4; wo,t,g,f; 500-2400m)	CS	Fn
Piper capensis (PIP)	S	Ud
Piptadeniastrum africanum (Piptadenia) (434) (Es) (LEG; 2,4; F,r; 1100-1220m)	TT	Fg
Pittosporum mannii (ripicola) (253) (Es) (PIT; 1,2,3,4; F,f,r,t,wo; 1140-2100m)	S/ST	Fn
Pittosporum spathicalyx (254) (E) (PIT; 2; F,r,ro,df; 1200-2400m)	S/ST	Fn
Pleiocarpa pycnantha (270) (E) (APO; 2,4; F)	ST	F
Podocarpus gracilior (5) (E) (POD; 1,3; F; 1500-2400m)	TT	F
Podocarpus milanjianus (4) (E) (POD; 1,2,4; F; 900-3150m)	TT	F
Polygala ruwenzoriensis (POL)	S	Ud
Polyscias fulva (384) (E) (ARA; 2,3,4; F,r,g; 1180-2160m)	TT	Fn
Premna angolensis (266) (E) (VER; 1,2,3,4; f)	ST	f
Prunus africana (Pygeum) (199) (Es) (ROS; 1,2,3,4; F,wo; 900-3000m)	TT	Fn
Pseudospondias microcarpa (385) (E) (ANA; 1,2,3,4; f,r,s; 900-1700m)	TT	Fn
Psychotria mahonii (321) (RUB; 2,4; F,f,r,t; 1140-2700m)	S/ST	Fn
Pterygota mildbraedii (sp.nov.) (115) (Es) (STE; 1,2,4; f)	TT	f
Pycnanthus angolensis (202) (E) (MYR; 2,3,4; F,f,r)	TT	Fg
Rapanea melanophloeos (rhododendroides, pulchra) (262) (Es) (MYR; 1,2,3,4; F,wo,t; 900-3750m)	S/ST	Fn
Raphia farinifera (monbuttorum) (9) (Es) (PAL; 2,4; F,s; 0-2500m)	TT	Fn
Rauvolfia oxyphylla (268) (E) (APO; 1,2,3,4; f)	ST	f
Rauvolfia vomitoria (269) (E) (APO; 2,3,4; f)	ST	f
Rawsonia lucida (ugandensis) (139) (Es) (FLA; 2,3; F,df,r; 50-1900m)	S/ST	Fg
Rhamnus prinoides (168) (E) (RHA; 1,2,3,4; F,t; 700-3700m)	S/ST	Fn
Rhus natalensis (E) (ANA; 1,2,3,4; wo,t,f; 1-3000m)	S/ST	Fn
Rhus ruspolii (bequartii) (Es) (ANA; 1,2,3; df)	S/ST	df
Rhytigynia bugoyensis (RUB)	S	Ud
Rhytigynia butanguensis (RUB)	S	Ud
Rhytigynia rwenzoriensis (RUB)	S	Ud
Rinorea beniensis (ardisiaeflora) (149) (Es) (VIO; 2; F; 750-1150m)	S/ST	F
Rinorea dentata (151) (E) (VIO; 4; F,s; 1200-1300m)	S/ST	Fn
Rinorea oblongifolia (152) (E) (VIO; 2,4; F; 1150-1450m)	S/ST	F
Ritchiea albersii (355) (E) (CAP; 1,2,4; F,f,t; 1100-2400m)	S/ST	Fn
Rothmannia urcelliformis (Randia) (322) (E,Es) (RUB; 1,2,3,4; F; 850-2400m)	S/ST	F
Rothmannia whitfieldii (Randiamalleifera) (323) (Es) (RUB; 1,2,4; F; 700-1675m)	S/ST	F
Rubus apetalus (ROS; 2,3,4; f,t; 1275-2100m)	CS	Fn
Rutidea orientalis (syringoides) (RUB; 2,3,4; F,f,t; 800-2250m)	C/S	Fn
Sapium ellipticum (179) (E) (EUP; 1,2,3,4; f,r; 150-2130m)	ST/TT	Fg
Sapium leonardii-crispi (180) (EUP; 2; F; 1280-1830m)	ST	F
Schefflera barteri (urostachya, goetzenii) (360) (Es) (ARA; 2,4; F; 900-2000m)	CS/C/ST	F
Scolopia rhamniphylla (140) (E) (FLA; 2,3,4; F,df,t,r; 1000-2000m)	S/ST	Fn
Sida rhombifolia	S	Ud
Solanum aculeastrum (E) (SOL; 2,3; wo,t,sc)	S/ST	Og

Solanum indicum (SOL)	S	Ud
Spathodea campanulata (370) (E) (BIG; 1,2,3,4; f)	ST	f
Spondianthus preussii (241) (E) (EUP; 2,4; s,F; 1140-1220m)	ST	Fn
Sterculia dawei (118) (E) (STE; 2,3,4; F)	TT	F
Strombosia scheffleri (123) (E) (OLA; 1,2,3,4; F; 80-2500m)	TT	F
Strombosiopsis tetrandra (124) (OLA; 2; F; 1200-1200m)	T	F
Symphonia globulifera (279) (E) (GUT; 2,4; F,r; 840-2550m)	TT	Fg
Syzygium cordatum (340) (E) (MYR; 1,2,3,4; r,s)	ST	Fn
Syzygium guineense (339) (E) (MYR; 1,2,3,4; F; 0-2500m)	TT	F
Tabernaemontana holstii (Conopharyngia) (273) (Es) (APO; 2,3,4; F; 0-2200m)	ST	F
Tabernaemontana odoratissima (276) (APO; 2; F)	ST	F
Tabernaemontana usambarensis (Conopharyngia) (275) (Es) (APO; 2,3,4; F; 0-1500m)	ST	F
Tarenna graveolens (E) (RUB; 1,2,3,4; t,ro; 0-2130m)	S/ST	Og
Tarenna pavettoides (319) (RUB; 2,3,4; f,t,wo; 1125-1600m)	S/ST	Fn
Teclea grandifolia (348) (E) (RUT; 2,3,4; F,r; 900-1650m)	S/ST	Fg
Teclea nobilis (simplicifolia) (347) (E,Es) (RUT; 1,2,3,4; F,r,wo; 900-2600m)	ST	Fn
Tetrorchidium didymonstemon (242) (E) (EUP; 2,4; f,r; 1127-1686m)	S/CS/ST	Fg
Thecacoris lucida (249) (E) (EUP; 2,4; F; 700-1160m)	S/ST	F
Trema orientalis (guineensis) (92) (Es) (ULM; 1,2,3,4; f,r; 0-2100m)	S/ST	Fg
Trichilia dregeana (splendida, sp. 2) (392) (Es) (MEL; 1,2,3,4; F)	TT	F
Trichilia martineaui (393) (Es) (MEL; 2,4; F)	TT	F
Trichilia rubescens (395) (E) (MEL; 1,2,4; F,r)	ST	Fg
Tricoscypha ulugurensis (submontana) (386) (E) (ANA; 2; F; 1500-1800m)	ST/TT	F
Trilepisium madagascariensis (Bosqueiaphoberos) (61) (Es) (MOR; 2,4; F,r; 1800-1800m)	TT	Fg
Triumfetta tomentosa (TIL)	S	Ud
Turraea vogelioides (heterophylla) (229) (Es) (MEL; 2,4)	S/ST	Ud
Uvaria angolensis (bukobensis) (222) (Es) (ANN; 1,2,3,4; f,t; 1140-1350m)	C/CS/ST	Fn
Uvaria welwitschii (223) (E) (ANN; 2,3,4; F,ro; 1170-1500m)	C/S/ST	Fn
Vangueria apiculata (311) (E) (RUB; 1,2,3,4; f)	S/ST	f
Vernonia adoensis (COM)	S	Ud
Vernonia amygdalina (E) (COM; 1,2,3,4; f,wo,t)	S/ST	Fn
Vernonia auriculifera (E) (COM; 2,3,4)	S/ST	Ud
Vernonia conferta (170) (E) (COM; 2,4; F,s)	ST	Fn
Voacanga thouarsii (obtusa) (278) (E,Es) (APO; 1,2,3,4; s)	ST	s
Whitfieldia elongata	S	Ud
Xylopia aethiopica (eminii) (216) (Es) (ANN; 4; F,s,wo; 800-1200m)	TT	Fn
Xylopia staudtii (217) (ANN; 2; F; 1500-1800m)	TT	F
Xymalos monospora (328) (E) (MON; 1,2,3,4; F,df; 900-2700m)	S/ST	Fg
Zanha golungensis (416) (E) (SAP; 1,2,3,4; F)	ST	F
Zanthoxylum gilletii (Fagaramacrophylla) (373) (Es) (RUT; 1,2,3,4; F; 900-2400m)	TT	F
Zanthoxylum leprieurii (Fagara angolensis) (375) (Es) (RUT; 1,2,4; F; 900-2000m)	ST	F
Zanthoxylum mildbraedii (Fagarasp.nr., angolensis) (376) (Es) (RUT; 2,4; F; 900-1900m)	TT	F
Zanthoxylum rubescens (Fagara melanacantha) (374) (Es) (RUT; 2,4; F,r; 900-1800m)	ST	Fg

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 parentheses 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 south-western 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 Bwindi

Site	**RJ092838**					**QJ913907**					**QJ995906**				
Habitat	**B1**					**C3**					**C3**				
Month (1994)	**02**	**02**	**02**	**02**	**02**	**02**	**02**	**02**	**02**	**02**	**08**	**08**	**08**	**09**	**09**
Date	**7**	**8**	**9**	**10**	**11**	**13**	**14**	**15**	**16**	**17**	**29**	**30**	**31**	**1**	**2**
Transect length (km)	**1**	**3**	**3**	**2**	**2**	**1**	**2.8**	**4**	**5.5**	**?**	**2.7**	**4.3**	**4.3**	**3.5**	**4.3**
Species															
Acacia brevispica												O			
Acanthus arborescens								O		O	O				F
Aeglopsis eggelingii													O		
Agauria salicifolia															A
Aidia micrantha														O	
Alangium chinense		O	O	O	O	O	O		O	O	F	O	A	F	O
Albizia coriara													O		
Albizia glaberrima											F	F	F	F	O
Albizia gummifera		O	O	O	O	O	O		O	O					
Albizia zygia													O		
Alchornea cordifolia													O		
Alchornea hirtella							1								
Allanblackia kimbiliensis															F
Allophylus abyssinicus											1				
Allophylus dummeri													A		
Allophylus macrobotrys											O	F	O	O	
Alstonia boonei										1					
Aningeria adolfi-friederici								O	O	O					
Aningeria altissima														O	
Anthocleista vogelii											F	A	F	F	
Anthocleista zambesiaca						F	O	O	O	O					
Antiaris toxicaria							O		O	O			O	F	
Antidesma laciniatum													O		
Artabotrys monteiroae													1		
Arundinaria alpina													1		
Baphia capparidifolia							O			O					
Baphiopsis parviflora												O		O	
Beilschmiedia ugandensis														O	O
Belonophora hypoglauca													O		
Bersama abyssinica	O	O	O	O						O				O	R
Bertiera globiceps												1			
Blighia unijugata							O			F			O		
Bombax buonopozense													1		
Bridelia brideliifolia					O	O									
Bridelia micrantha						O		O	O	O	F	F	O	O	O
Bridelia scleroneura											R				
Canarium schweinfurthii													O		
Canthium vulgare													O	R	
Capparis tomentosa														1	
Carapa grandiflora	O	O	O	O	O	O	O	O	O	O	A	A		F	F
Casearia battiscombei	1														
Casearia runssorica													O		
Cassia petersiana											O				
Cassipourea ruwensorensis		A	O		O				O						
Catha edulis														1	
Celtis africana													O	O	
Celtis durandii						O		O	O	R	F	O		O	
Chaetacme aristata														O	
Chrysophyllum albidum							O		O						
Chrysophyllum gorungosanum	D	D	A	O	O							R			O
Chrysophyllum muerense											O				
Clausena anisata									O				F	F	
Clerodendrum rotundifolium											O	O		O	
Cnestis ugandensis							O					R			
Coffea canephora													O		
Coffea eugenioides													O	F	
Cola gigantea													1		
Connarus longistipitatus			O			O	O			O	O	F	O	O	
Cordia millenii													R		
Craibia brownii												1			
Crassocephalum mannii													1		
Craterispermum schweinfurthii													O		

Croton macrostachyus		O			O	O		O	O	O	O	F	F	O	
Croton sylvaticus										R				R	
Cyathea manniana	O	O	O	O	O	O	O	O	O		F	A			O
Dalbergia lactea	O		O	O	O							O		O	
Dasylepsis eggelingii										O					
Dasylepsis racemosa												1			
Deinbollia fulvo-tomentella													1		
Desmodium salicifolium															1
Dichaetanthera corymbosa						O	O				R				
Dicranolepis incisa									1						
Dictyandra arborescens													O		
Diospyros abyssinica													O	O	
Discopodium penninervium														1	
Dodonea viscosa				O	O								O		A
Dombeya goetzenii			O		O										
Dovyalis abyssinica								1							
Dovyalis macrocalyx								O		O					
Dracaena afromontana				O											
Dracaena fragrans						O		O							
Dracaena laxissima	O	O	O		O			O	O	O		O	F	O	O
Drypetes gerrardii		A	O		O					O			O	O	
Drypetes ugandensis							O	O		O	1				
Ekebergia capensis				O									R		
Ekebergia senegalensis	O	O	O												
Entada abyssininca													R		
Entandrophragma angolense			O		O					O	F	F	F	O	O
Entandrophragma utile													R		
Erythrina abyssinica					O					O	O	R			
Erythrococca bongensis			1												
Erythrococca trichogyne			1												
Eugenia bukobensis														F	
Faurea saligna	D	D	F	F	O										
Ficalhoa laurifolia	F	F	A	O	O				O						
Ficus asperifolia													O	O	
Ficus barteri						1									
Ficus conraui								O	O						
Ficus craterostoma					O										
Ficus cyathistipula						O	O	O	O	O					
Ficus exasperata						O				O					
Ficus natalensis					1										
Ficus ovata											O				O
Ficus populifolia												1			
Ficus pseudomangifera												1			
Ficus sansibarica												1			
Ficus saussureana						O	O			O	R				
Ficus sur						O			O	O	O	O	O		R
Ficus thonningii														1	
Ficus vallis-choudae								O	O	O			R		
Funtumia africana						O	O		O	O	F	F	F	F	F
Galiniera saxifraga			O	O		O	O			O				1	
Garcinia buchananii							O		O						
Glyphaea brevis												1			
Greenwayodendron suaveolens							1								
Grewia mildbraedii							1					1			
Guarea cedrata														1	
Hagenia abyssinica	A	A	O	O	O										
Hallea rubrostipulata										R					
Hallea stipulosa													R		
Harungana madagascariensis			R			F		O	O	O	O	O		F	O
Heinsenia diervilleoides	1														
Hugonia platysepala													F	O	
Huslondia opposita													1		
Ilex mitis		O	O	O			O		O						
Irvingia gabonensis												1			
Kigelia africana								O	O	O			O	O	
Lannea welwitschii														1	
Lantana trifolia										O	O	O	F		O
Lasianthus kilimandsharcus											1				
Lepidotrichilia volkensii			O		O	O	O	O	O	O		O		F	
Leplaea mayombensis						O	F	O	O	O	A	A		O	A
Leptactina platyphylla													1		
Leptaulus daphnoides								O	O	O				1	
Lindackeria bukobensis			O					O	O	O			O	A	F
Linociera johnsonii								O					O	F	

Loranthus brunneus												1					
Lovoa trichilioides							O				O		O	O	O		
Lychnodiscus cerospermus													R				
Macaranga barteri												F	F	O			
Macaranga kilimandscharica	O	O	F	F	A				O	O	O			F			
Macaranga monandra							O				F	A	F	F	F		
Macaranga schweinfurthii													R				
Maesa lanceolata	O	O	O	F	O			O		O	A	F	F	O	F		
Maesopsis eminii										O	F	O	O	O			
Mammea africana											F			F	F		
Margaritaria discoideus						O	O		O	O		O		O	F		
Markhamia platycalyx							O			O	F	F	O	F			
Maytenus acuminata		O			O								1				
Maytenus undata														1			
Memecylon jasminoides											O	R					
Mildbraediodendron excelsum													O				
Millettia dura							O	O	O	O				F			
Mimulopsis arborescens		F	F	F	O	F	F	F		F							
Mimusops bagshawei													F	O			
Monodora myristica						O		O					O	F			
Morinda lucida													1				
Musanga cecropioides						O	O			O							
Musanga leo-errerae											A	A			A		
Myrianthus holstii			R		O	O											
Myrica salicifolia															F		
Neoboutonia macrocalyx											F	F	O				
Newtonia buchananii		O			O	F					F	O		O			
Nuxia congesta	O		O	O											R		
Ochna membranacea													R				
Ocimum suave													O		O		
Ocotea kenyensis					1												
Ocotea usambarensis												F			R		
Olea hochstetteri	O	O	O	O	O												
Olea welwitschii														O			
Oncoba spinosa										1							
Oxyanthus speciosus												F					
Pachystela brevipes								O	O				O		O		
Pancovia sp nr turbinata							O	O	O	O			F	F	A		
Parinari excelsa					O	O	O	O	O	O	D	D		F	A		
Parkia filicoidea										O			O	O			
Pauridiantha viridiflora													F	O	O		
Pavetta molundensis	1																
Peddiea fischeri												O	A	O	F		
Philippia benguelensis	O	F	F	O	O												
Philippia johnstonii															A		
Phyllanthus ovalifolius											O	O		O			
Phytolacca dodecandra											O	O	O				
Piper capensis										O	O	O			O		
Piptadeniastrum africanum													F	O			
Pittosporum mannii			O	O		O	O				O	O			F		
Pittosporum spathicalyx	O	O	O		O												
Pleiocarpa pycnantha			F					O	O	O					O		
Podocarpus gracilior	O	F	F		O												
Polyscias fulva	A	A	F	O	O	O		O	O	O	A	F		F	O		
Premna angolensis													O	O			
Prunus africana		O	O	O	O		O	O		O	F	F		F	O		
Pseudospondias microcarpa		O	O							O			O	O			
Pycnanthus angolensis													1				
Rapanea melanophloeos	O	O	F	F	A												
Raphia farinifera						1											
Rauvolfia oxyphylla								O		O							
Rauvolfia vomitoria													O				
Rawsonia lucida													F	F			
Rhus natalensis					O					O							
Rhus ruspolii	1																
Rhytigynia bugoyensis															O		
Rhytigynia butanguensis															1		
Rhytigynia rwenzoriensis					1												
Rinorea beniensis	1																
Rinorea dentata														O			
Rinorea oblongifolia												1					
Ritchiea albersii		A	F				O			O		O		O			
Rothmannia urcelliformis			R		O								F	F	O		
Rothmannia whitfieldii		O								O							

Rutidea orientalis											1				
Sapium ellipticum						O		O	O	O	O	O		O	
Schefflera barteri											O	O			
Scolopia rhamniphylla													O	O	F
Sida rhombifolia													1		
Solanum aculeastrum															1
Solanum indicum				O						O					
Spathodea campanulata								O	O				R		
Spondianthus preussii														1	
Strombosia scheffleri	A	A	O		A	O	O	F	R		F	F	F	F	O
Symphonia globulifera			O		O		O	O		O	A	A	A		
Syzygium guineense		O			O					O	F			F	O
Tabernaemontana holstii	O	O	F	F	A	O	O	O		A		F	O	F	O
Tabernaemontana usambarensis											1				
Tarenna graveolens				1											
Tarenna pavettoides								1							
Teclea grandifolia															1
Teclea nobilis		O	F		O		O	O	O	O			F		O
Tetrorchidium didymonstemon							O			O	O	F	A	F	
Thecacoris lucida												1			
Trema orientalis				O		O				O	O	O	O		O
Trichilia dregeana							O	O	F	O	F		O	O	
Trichilia rubescens						O		O	F						
Tricoscypha ulugurensis							1							1	
Trilepisium madagascariensis							O	O	O	O	A	F	A	A	A
Triumfetta tomentosa											1				
Turraea vogelioides						O				F			O	O	
Uvaria angolensis													1		
Uvaria welwitschii													F	O	
Vangueria apiculata											O	O			
Vernonia adoensis											O				
Vernonia amygdalina						O				O	O				
Vernonia auriculifera											O		O		F
Vernonia conferta			O	O		O	O			O	A	A		F	
Voacanga thouarsii													O		
Xylopia aethiopica														R	
Xylopia staudtii									1						
Xymalos monospora	O	O	F	F	O		O	O		R	O	O	O	O	O
Zanthoxylum gilletii												R		R	R
Zanthoxylum leprieurii									1						
Zanthoxylum mildbraedii	1														
Zanthoxylum rubescens						O	O	O		O					
Total records	**28**	**35**	**47**	**31**	**45**	**41**	**47**	**46**	**46**	**74**	**64**	**70**	**98**	**91**	**58**
Cumulative records	**28**	**63**	**110**	**141**	**186**	**227**	**274**	**320**	**366**	**440**	**504**	**574**	**672**	**763**	**821**
New species	**28**	**15**	**15**	**6**	**8**	**21**	**19**	**13**	**4**	**9**	**23**	**18**	**48**	**16**	**9**
Cumulative species	**28**	**43**	**58**	**64**	**72**	**93**	**112**	**125**	**129**	**138**	**161**	**179**	**227**	**243**	**252**

Chapter 4

Birds

Compiled by

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4.1 SUMMARY

The birds were sampled for a total of 15 man-days using observation and 12,342 metre-net-hours of mist-netting. A total of 146 species was recorded, giving an overall total of 348 when previous records are included. This represents one of the richest forests in the country. A very high number of forest-dependent birds have been recorded, as have a large number of rarely encountered and uncommon species. Twenty-three of Uganda's 24 Albertine Rift Endemic species are known to occur here, as are four globally threatened Vulnerable species; African Green Broadbill (*Pseudocalyptomena graueri*), Grauer's Rush Warbler (*Bradypterus graueri*), Chapin's Flycatcher (*Muscicapa lendu*) and Shelley's Crimson-wing (*Cryptospiza shelleyi*), and four near-threatened species. Of the 75 restricted-range species (known from no more than five Ugandan forests), 11 have been recorded in no other site in the Ugandan part of their ranges, 19 in one other.

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

The avifauna of Bwindi is one of the best known in Uganda. There were a number expeditions prior to its gazetting as a National Park in 1991 and it is now considered one of the top ornithological sites in Africa. Previous records have come from Keith *et al.* (1969), Friedmann and Williams (1970), Britton (1980), Keith (1980), Francis and Penford (1991a), Howard (1991) and Butynski and Kalina (1993). Since the last checklist for Bwindi was published (Butynski and Kalina, 1993) up to ten additional species have been recorded. They are

not forest species, remain unpublished to date and are thus not included here (T. Hanson and T. Davenport, pers. comm.).

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

Clovis Kabaseke, Tim Davenport, Simon Nsengiyunva, and Michael Baltzer were responsible for ornithological survey work in Bwindi. Details of personnel, dates and areas sampled are given in Table 4.1.

Sampling was carried out around Buhoma, Kitahurira, and Ruhija. Mist-netting was carried out at all three sites (Fig. 4.1).

Table 4.1 Personnel, dates and areas sampled in Bwindi

	Bwindi		
Campsite locations (UTM)	RJ092838	QJ913907	QJ995906
Altitude (m)	2315	1490	1670
Ranger ornithologists	C.Kabaseke	C.Kabaseke	S.Nsengiyunva
Co-ordinator	T.Davenport	T.Davenport	M.Baltzer
Dates	7-11.2.94	13-18.2.94	29-2.9.94
Sampling periods (days)	5	5	5
Vegetation type (Langdale-B.)	B1	C3	C3

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 from Bwindi Impenetrable is presented as Appendix 4.1. This is divided into previous (P) and inventory records. Inventory records are sub-divided into sites and the mode of detection

(*i.e.* caught (C), observed (O)) is indicated, caught taking precedence over observed. Observed incorporates records that were seen or heard, or both seen and heard. One hundred and forty-six species were recorded during the current inventory which when combined with previous records produces an overall total of 348.

4.4.2 Specimen list

Twenty-five specimens were collected from Bwindi and these are documented in Appendix 4.2.

4.4.3 Trapping and observation analysis

A total of 12,342 metre-net-hours (mnh) of mist-netting caught 156 individual birds of 40 species, producing a capture rate of 0.013 birds caught per mnh. This figure is higher than the overall capture rate for the programme of 0.012. It is lower than those achieved by Francis and Penford (1991b), Buckley and McNeilage (1989) and Buckley *et al.* (1989) who mist-netted in a number of Uganda's western and southern closed forests. All found exactly the same overall average capture rate of 0.027 birds per mnh. 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 in Bwindi Impenetrable, and their respective ecological characteristics is given in Table 4.3. Thirty-three percent of the species recorded are forest-dependent specialists (FF) representing 61% of the country's total, and 26% are forest-dependent generalists (F) representing 71% of the country's total. This means that 59% of the species present are forest-dependent (FF + F), 65% of the Uganda total for this group. A further 15% are forest non-dependent visitors (f), 58% of the country total for this group. Ten lowland and sixty-two highland species have been recorded. Bwindi is home to 84% of the country's highland forest-dependent specialists and 81% of highland forest-dependent generalists. When these two categories are combined, 83% of Uganda's highland forest-dependent species are represented.

4.4.5 Species accumulation rates

Fig. 4.2 shows the species accumulation curves for the combined observation and mist-netting data throughout the sampling period. Cumulative mist-netting totals are shown in Fig. 4.3 in relation to the number of individuals caught. 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

Table 4.4 presents a list of restricted-range species, known from Bwindi and no more than four other Ugandan forests. The other forests in which they are known to occur are given. Also listed are species classified as globally threatened or near-threatened (Collar *et al.*, 1994), and national, Albertine Rift or regional endemics (Dowsett and Forbes-Watson, 1993).

4.5 DISCUSSION

A total of 146 bird species were recorded in the forest which when combined with previous records produces a total of 348. This qualifies it as one of the richest forests in the country. A more comprehensive evaluation of its importance at a national level will have to await full analysis of the country-wide data.

The ecological requirement data are consistent with a rich, relatively undisturbed, moist tropical high-forest environment, with a very high proportion of forest-dependent species represented. Indeed, in terms of forest-dependent species it holds the second highest number in the country after Semliki, and a higher proportion of the country's highland forest-dependent species than any other forest.

Seventy-five restricted-range species have been recorded, 11 of which are found in no other forest in Uganda, and 19 at only one other. Fifty-three are forest-dependent species, 31 of which are confined predominantly to

highland forest, and a number of internationally restricted-range species inhabit the forest. For example, four globally threatened species, all categorised as Vulnerable are known to occur, namely African Green Broadbill (*Pseudocalyptomena graueri*), Grauer's Rush Warbler (*Bradypterus graueri*), Chapin's Flycatcher (*Muscicapa lendu*).and Shelley's Crimson-wing (*Cryptospiza shelleyi*). African Green Broadbill is known from only two areas in eastern Zaire and Bwindi in Uganda. In Bwindi it inhabits upper portions of undergrowth at 1760 to 2480 m (Collar *et al.*, 1994). Grauer's Rush Warbler is restricted to a small number of highland swamps inside forest in eastern Zaire, south-western Uganda, Rwanda and northern Burundi, and remains in danger from swamp drainage. Chapin's Flycatcher is known from two areas in eastern Zaire, two forests in western Kenya and Bwindi in Uganda, all of which are under threat. Shelley's Crimson-wing, an Albertine Rift endemic, confined to highland forests in eastern Zaire, Rwanda, northern Burundi and Bwindi in southwestern Uganda, appears to have suffered a dramatic decline since the 1970s for reasons unknown. Four globally near-threatened species are also known namely Dwarf Honeyguide (*Indicator pumilio*), Forest Ground Thrush (*Zoothera oberlaenderi*), Kivu Ground Thrush (*Zoothera tanganjicae*) and Lagden's Bush Shrike (*Malaconotus lagdeni*),.

Also worthy of mention are Handsome Forest (*Francolinus nobilis*), Red-fronted Parrot (*Poicephalus gulielmi*), Rwenzori Turaco (*Tauraco johnstoni*), Red-throated Alethe (*Alethe poliophrys*), Montane Masked Apalis (*Apalis personata*), Evergreen Forest Warbler (*Bradypterus barratti*), White-bellied Crested Flycatcher (*Trochocercus albiventris*), and Dusky Crimson-wing (*Cryptospiza jacksoni*) and a number of other species also known only from Bwindi in Uganda; Fraser's Eagle Owl (*Bubo poensis*), White-bellied Robinchat (*Cossytha roberti*), Grauer's Warbler (*Graueria vittata*), and Short-tailed Warbler (*Hemitesia neumanni*). In contrast to many restricted-range lists for other forests, the-majority of species on the Bwindi list are forest species. Even the non-forest species in many cases have extremely limited ranges in Uganda (Britton, 1980).

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

In conclusion, Bwindi can be considered to be one of the richest forests in the country in terms of its avifauna. It supports a very high percentage of forest-dependent birds, and a large number of species with a limited range in Uganda, and eight species considered to be globally threatened or near-threatened, and 23 species endemic to the Albertine Rift area.

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4.7 TABLES

Table 4.2 Mist-netting and observation data summary for Bwindi

	Bwindi
Man-days	15
Metre-net-hours (mnh)	12,342
No. individual birds caught	156
No. species caught	40
Birds caught per mnh	0.013
Inventory total	146
Previous known list	348
No. species new to forest	0
% of total list recorded	42
Forest total	348

Table 4.3 The ecological characteristics of bird species recorded from Bwindi. 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		**Bwindi**		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
FF	97	10	76	22	78
FFH	37	4	31	9	84
FFL	55	5	8	2	15
Total FF	**189**	**19**	**115**	**33**	**61**
F	80	8	62	18	78
FH	32	3	26	7	81
FL	15	1	2	1	13
Total F	**127**	**13**	**90**	**26**	**71**
FM	5	0	4	1	80
Total FF+F	**316**	**31**	**205**	**59**	**65**
f	82	8	50	14	61
fH	5	0	2	1	40
fL	2	0	0	0	0
Total f	**89**	**9**	**52**	**15**	**58**
fM	10	1	6	2	60
O	327	32	39	11	12
OH	13	1	3	1	23
OM	60	6	10	3	17
A	103	10	9	3	9
AM	66	7	4	1	6
W	19	2	14	4	74
WM	3	0	2	1	67
M Total	**144**	**14**	**26**	**7**	**18**
TOTAL	**1011**	**100**	**348**	**100**	**34**

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 from Bwindi

Britton No	Species	Ecol.Type	No. of Ugandan forests where species has been recorded	Other forests where species has been recorded	Cons. Significancee
109	Ovampo Sparrowhawk	O	1	none	
110	Rufous Sparrowhawk	FH	2	Echuya	
122	Common Buzzard	OM	4	Budongo, Kibale, Semliki	
127	Booted Eagle	OM	2	Otzi	
128	African Hawk Eagle	O	4	Mt. Kei, Mabira, Otzi	
140	Honey Buzzard	FM	3	Budongo, Kibale	
148	Lanner Falcon	O	1	none	
160	Hobby	OM	5	Mt. Elgon, Budongo, Semliki, Mafuga	
164	Blue Quail	O	3	Luunga, Zoka	
179	Handsome Francolin	FFH	3	Rwenzori, Echuya	ARE
214	Red-chested Pygmy Crake	A	1	none	
256	Wood Sandpiper	AM	5	Kibale, Semliki, South Busoga, Sesse Islands	
258	Green Sandpiper	AM	5	Budongo, Kibale, Bugoma, Semliki	
343	Western Bronze-naped Pigeon	FF	3	Kalinzu-Maramagambo, Semliki	
366	Red-fronted Parrot	FF	2	Mt. Elgon	
368	Brown-necked Parrot	f	1	none	
380	Rwenzori Turaco	FFH	3	Rwenzori, Kalinzu-Maramagambo	ARE
386	Barred Long-tailed Cuckoo	FFH	4	Rwenzori, Echuya, Mafuga	
395	Eurasian Cuckoo	OM	4	Kibale, Mabira, Semliki	
415	Fraser's Eagle Owl	FF	1	none	
430	Eurasian Nightjar	OM	2	Kalinzu-Maramagambo	
448	Horus Swift	OH	4	Rwenzori, Mafuga, West Bugwe	
463	Bar-tailed Trogon	FFH	3	Mt. Elgon, Kibale	
550	Western Green Tinkerbird	FFH	5	Rwenzori, Kibale, Kasyoha-Kitomi, Echuya	
568	Dwarf Honeyguide	FF	2	Semliki	ntARE
570	Willcocks' Honeyguide	FF	5	Budongo, Kalinzu-Maramagambo, Kibale, Semliki	
591	Olive Woodpecker	FFH	3	Rwenzori, Echuya	
595	African Green Broadbill	FFH	1	none	VUARE
651	Golden Oriole	fM	3	Mt. Elgon, Semliki	
662	Stripe-breasted Tit	FFH	4	Rwenzori, Echuya, Mafuga	ARE
672	Grey-chested Illadopsis	FF	3	Mt. Elgon, Rwenzori	
702	Shelley's Greenbul	FFH	4	Mt. Elgon, Kalinzu-Maramagambo, Kasyoha-Kitomi	
724	Yellow-streaked Greenbul	FF	2	Mafuga	
725	Icterine Greenbul	FFL	5	Budongo, Bugoma, Semliki, Sango Bay	
737	Red-throated Alethe	FFH	2	Rwenzori	ARE
754	White-bellied Robin Chat	FF	1	none	
757	Archer's Ground Robin	FH	2	Rwenzori	ARE
800	Forest Ground Thrush	FFL	2	Semliki	ntARE
803	Kivu Ground Thrush	FFH	1	none	ntARE
823.1	Montane Masked Apalis	FFH	2	Rwenzori	ARE
827	Collared Apalis	FF	5	Rwenzori, Kibale, Echuya, Mafuga	ARE
833	Evergreen Forest Warbler	FFH	2	Rwenzori	
836	Grauer's Rush Warbler	A	2	Echuya	VUARE
853	Carruthers' Cisticola	A	3	Mabira, Semliki	
882	Grauer's Warbler	FF	1	none	ARE
884	Short-tailed Warbler	FF	1	none	ARE
905	Red-faced Woodland Warbler	FFH	5	Rwenzori, Kibale, Echuya, Mafuga	ARE
907	Wood Warbler	FM	5	Budongo, Kalinzu-Maramagambo, Mabira, Sango Bay	
930.1	Semi-collared Flycatcher	OM	3	Budongo, Morungole	
932	Yellow-eyed Black Flycatcher	F	2	Mafuga	ARE
943	Chapin's Flycatcher	FF	1	none	VU
948	Rwenzori Batis	FH	4	Rwenzori, Echuya, Mafuga	ARE
962	White-tailed Blue Flycatcher	F	2	Mafuga	
969	White-bellied Crested Flycatcher	FFH	2	Kibale	
970	White-tailed Crested Flycatcher	FFH	4	Mt. Elgon, Rwenzori, Semliki	
971	Crested Flycatcher	FF	5	Kibale, Kasyoha-Kitomi, Sango Bay, Itwara	
993	Cape Wagtail	W	4	Rwenzori, Kalinzu-Maramagambo, Kasyoha-Kitomi	
1009.1	Montane Sooty Boubou	FH	4	Rwenzori, Echuya, Mafuga	
1015	Doherty's Bush Shrike	F	5	Mt. Elgon, Kasyoha-Kitomi, Echuya, Mafuga	
1016	Lagden's Bush Shrike	FFH	2	Rwenzori	nt
1030	Red-backed Shrike	OM	5	Budongo, Kalinzu-Maramagambo, Kibale, Sesse	

				Islands	
1042	Red-billed Helmet Shrike	FFL	3	Bugoma, Semliki	
1066	Slender-billed Chestnut-winged Starling	FH	3	Mt. Elgon, Rwenzori	
1090	Blue-headed Sunbird	FFH	4	Rwenzori, Kibale, Mafuga	ARE
1117	Purple-breasted Sunbird	FH	5	Rwenzori, Kalinzu-Maramagambo, Semliki , Mafuga	ARE
1118	Regal Sunbird	FH	4	Rwenzori, Echuya, Mafuga	ARE
1157	Strange Weaver	F	3	Rwenzori, Mafuga	ARE
1220	Dusky Twinspot	fH	2	Mafuga	
1222	Dusky Crimson-wing	FH	4	Rwenzori, Echuya, Mafuga	ARE
1223	Red-faced Crimson-wing	FH	4	Rwenzori, Kibale, Agoro-Agu	
1225	Shelley's Crimson-wing	FH	2	Rwenzori	VUARE
1227	Black-headed Waxbill	FH	4	Mt. Elgon, Echuya, Mafuga	
1273	Golden-breasted Bunting	O	5	Kalinzu-Maramagambo, Moroto, Kijanabolola, Matiri	
1279	Oriole Finch	FH	2	Mt. Elgon	
1280	Yellow-rumped Seed-eater	O	5	Kalinzu-Maramagambo, Moroto, Kasyoha-Kitomi Sango Bay	

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)		

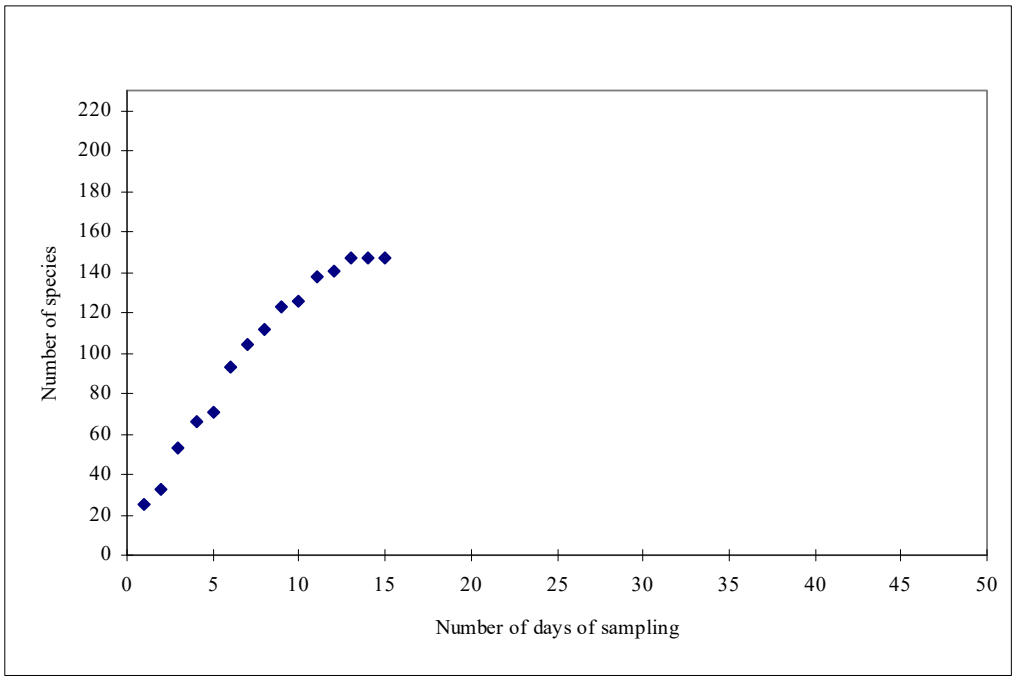

Fig. 4.2 Species accumulation rates for birds recorded (by observation and mist-netting) in Bwindi

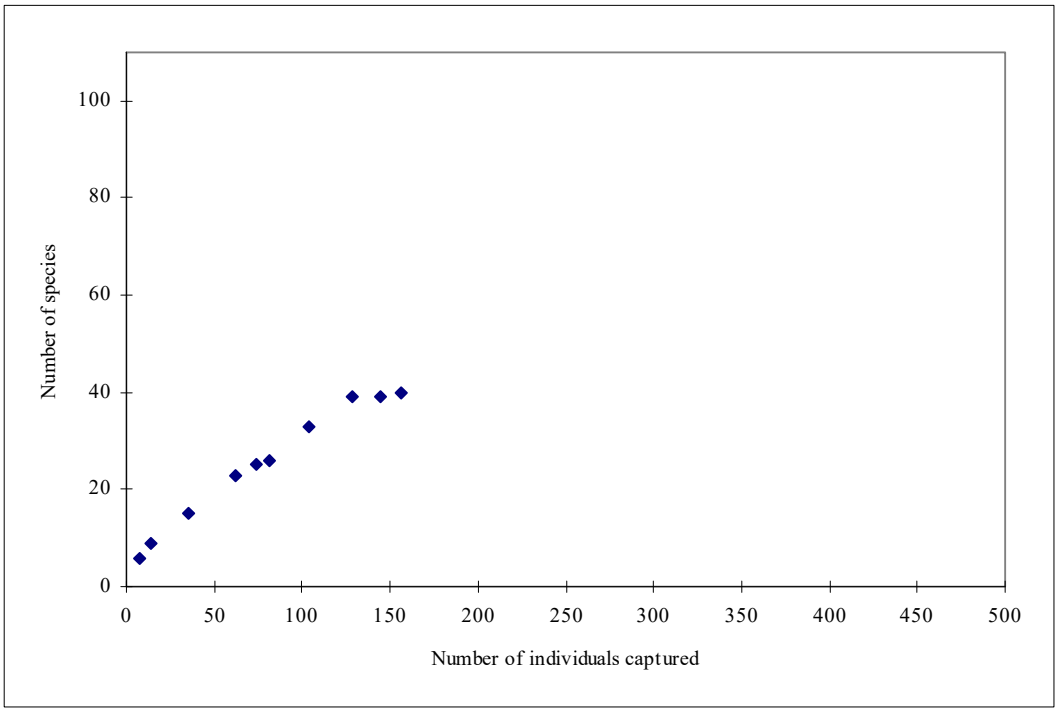

Fig. 4.3 Species accumulation rates for bird mist-netting in Bwindi

4.9 APPENDICES

Appendix 4.1 Species list of birds recorded in Bwindi

Britton No.	Species	Common Name	Ecol.Type	Record
27	*Ardea melanocephala*	Black-headed Heron	W	P
32	*Bubulcus ibis*	Cattle Egret	W	P
42	*Scopus umbretta*	Hamerkop	A	P
51	*Bostrychia hagedash*	Hadada	W	O
70	*Anas sparsa*	African Black Duck	A	P
84	*Gypohierax angolensis*	Palm-nut Vulture	O	P
96	*Polyboroides radiatus*	Harrier Hawk	f	P
98	*Circaetus cinereus*	Brown Snake Eagle	O	P
101	*Terathopius ecaudatus*	Bateleur	O	O
102	*Accipiter badius*	Shikra	f	P
106	*Accipiter melanoleucus*	Great Sparrowhawk	F	O
107	*Accipiter minullus*	Little Sparrowhawk	f	P
109	*Accipiter ovampensis*	Ovampo Sparrowhawk	O	P
110	*Accipiter rufiventris*	Rufous Sparrowhawk	FH	P
111	*Accipiter tachiro*	African Goshawk	F	C
118	*Aquila wahlbergi*	Wahlberg's Eagle	OM	P
120	*Buteo augur*	Augur Buzzard	O	O
122	*Buteo buteo*	Common Buzzard	OM	P
124	*Buteo tachardus*	Mountain Buzzard	FFH	P
125	*Spizaetus africanus*	Cassin's Hawk Eagle	FF	P
126	*Hieraaetus dubius*	Ayres' Hawk Eagle	F	P
127	*Hieraaetus pennatus*	Booted Eagle	OM	P
128	*Hieraaetus spilogaster*	African Hawk Eagle	O	P
130	*Lophaetus occipitalis*	Long-crested Eagle	f	O
134	*Polemaetus bellicosus*	Martial Eagle	O	P
135	*Stephanoaetus coronatus*	Crowned Eagle	FF	O
138	*Milvus migrans*	Black Kite	W	P
139	*Aviceda cuculoides*	Cuckoo Hawk	FM	P
140	*Pernis apivorus*	Honey Buzzard	FM	P
143	*Macheiramphus alcinus*	Bat Hawk	F	P
147	*Falco ardosiaceus*	Grey Kestrel	O	P
148	*Falco biarmicus*	Lanner Falcon	O	P
152	*Falco cuvieri*	African Hobby	F	P
158	*Falco peregrinus*	Peregrine Falcon	O	P
160	*Falco subbuteo*	Hobby	OM	P
164	*Coturnix chinensis*	Blue Quail	O	P
179	*Francolinus nobilis*	Handsome Francolin	FFH	O
184	*Francolinus squamatus*	Scaly Francolin	F	O
188	*Guttera edouardi*	Crested Guineafowl	F	O
194	*Balearica regulorum*	Crowned Crane	O	P
201	*Limnocorax flavirostra*	Black Crake	A	P
211	*Sarothrura elegans*	Buff-spotted Pygmy Crake	FF	P
213	*Sarothrura pulchra*	White-spotted Pygmy Crake	F	P
214	*Sarothrura rufa*	Red-chested Pygmy Crake	A	P
256	*Tringa glareola*	Wood Sandpiper	AM	P
258	*Tringa ochropus*	Green Sandpiper	AM	P
337	*Aplopelia larvata*	Lemon Dove	FF	C
339	*Columba arquatrix*	Olive Pigeon	FF	P
343	*Columba malherbii*	Western Bronze-naped Pigeon	FF	O
344	*Columba unicincta*	Afep Pigeon	FF	O
348	*Streptopelia lugens*	Dusky Turtle Dove	f	P
350	*Streptopelia semitorquata*	Red-eyed Dove	f	O
355	*Turtur afer*	Blue-spotted Wood Dove	f	O
357	*Turtur tympanistria*	Tambourine Dove	F	C
358	*Treron australis*	Green Pigeon	F	O
363	*Agapornis pullaria*	Red-headed Lovebird	f	P
366	*Poicephalus gulielmi*	Red-fronted Parrot	FF	P
368	*Poicephalus robustus*	Brown-necked Parrot	f	P
371	*Psittacus erithacus*	Grey Parrot	FF	O
372	*Corythaeola cristata*	Great Blue Turaco	F	O
377	*Musophaga rossae*	Ross's Turaco	F	O
380	*Tauraco johnstoni*	Rwenzori Turaco	FFH	O
384	*Tauraco schuetti*	Black-billed Turaco	FF	O

385	*Cercococcyx mechowi*	Dusky Long-tailed Cuckoo	FF	O
386	*Cercococcyx montanus*	Barred Long-tailed Cuckoo	FFH	O
387	*Cercococcyx olivinus*	Olive Long-tailed Cuckoo	FF	P
388	*Chrysococcyx caprius*	Didric Cuckoo	O	O
389	*Chrysococcyx cupreus*	Emerald Cuckoo	F	O
391	*Chrysococcyx klaas*	Klaas' Cuckoo	f	O
394	*Clamator levaillantii*	Levaillant's Cuckoo	fM	O
395	*Cuculus canorus*	Eurasian Cuckoo	OM	P
396	*Cuculus clamosus*	Black Cuckoo	FF	O
399	*Cuculus solitarius*	Red-chested Cuckoo	F	O
401	*Ceuthmochares aereus*	Yellowbill	F	P
404	*Centropus monachus*	Blue-headed Coucal	A	O
406	*Centropus superciliosus*	White-browed Coucal	O	O
415	*Bubo poensis*	Fraser's Eagle Owl	FF	P
416	*Strix woodfordii*	African Wood Owl	F	O
420	*Glaucidium tephronotum*	Red-chested Owlet	FF	P
430	*Caprimulgus europaeus*	Eurasian Nightjar	OM	P
436	*Caprimulgus pectoralis*	Fiery-necked Nightjar	F	P
437	*Caprimulgus poliocephalus*	Montane Nightjar	FH	O
441	*Macrodipteryx vexillarius*	Pennant-winged Nightjar	O	P
444	*Apus apus*	Eurasian Swift	WM	P
447	*Apus caffer*	White-rumped Swift	W	P
448	*Apus horus*	Horus Swift	OH	P
449	*Apus melba*	Alpine Swift	O	P
453	*Schoutedenapus myoptilus*	Scarce Swift	FH	P
457	*Telacanthura ussheri*	Mottle-throated Spinetail	FL	P
459	*Colius striatus*	Speckled Mousebird	O	O
462	*Apaloderma narina*	Narina's Trogon	F	O
463	*Apaloderma vittatum*	Bar-tailed Trogon	FFH	O
464	*Ceryle maxima*	Giant Kingfisher	A	P
468	*Alcedo quadribrachys*	Shining-blue Kingfisher	FFL	P
473	*Halcyon leucocephala*	Chestnut-bellied Kingfisher	f	P
474	*Halcyon malimbica*	Blue-breasted Kingfisher	F	O
475	*Halcyon senegalensis*	Woodland Kingfisher	O	P
478	*Ispidina picta*	Pygmy Kingfisher	f	P
479	*Merops albicollis*	White-throated Bee-eater	fM	P
480	*Merops apiaster*	Eurasian Bee-eater	fM	P
484	*Merops gularis*	Black Bee-eater	FF	O
488	*Merops oreobates*	Cinnamon-chested Bee-eater	F	O
491	*Merops pusillus*	Little Bee-eater	O	O
500	*Eurystomus glaucurus*	Broad-billed Roller	f	O
501	*Eurystomus gularis*	Blue-throated Roller	FF	O
503	*Phoeniculus bollei*	White-headed Wood Hoopoe	FF	O
504	*Phoeniculus castaneiceps*	Forest Wood Hoopoe	FF	O
505	*Phoeniculus cyanomelas*	Scimitarbill	O	P
511	*Bycanistes cylindricus*	White-thighed Hornbill	FF	O
513	*Bycanistes subcylindricus*	Black and White Casqued Hornbill	F	O
515	*Tockus alboterminatus*	Crowned Hornbill	f	O
529	*Buccanodon duchaillui*	Yellow-spotted Barbet	FF	O
533	*Gymnobucco bonapartei*	Grey-throated Barbet	F	C
534	*Lybius bidentatus*	Double-toothed Barbet	f	O
538	*Lybius hirsutus*	Hairy-breasted Barbet	F	O
548	*Pogoniulus bilineatus*	Yellow-rumped Tinkerbird	F	C
550	*Pogoniulus coryphaeus*	Western Green Tinkerbird	FFH	C
553	*Pogoniulus scolopaceus*	Speckled Tinkerbird	F	C
555	*Pogoniulus subsulphureus*	Yellow-throated Tinkerbird	FF	O
556	*Trachylaemus purpuratus*	Yellow-billed Barbet	F	O
561	*Indicator conirostris*	Thick-billed Honeyguide	FF	P
562	*Indicator exilis*	Least Honeyguide	FF	C
563	*Indicator indicator*	Black-throated Honeyguide	f	P
566	*Indicator minor*	Lesser Honeyguide	f	P
568	*Indicator pumilio*	Dwarf Honeyguide	FF	P
569	*Indicator variegatus*	Scaly-throated Honeyguide	f	P
570	*Indicator willcocksi*	Willcocks' Honeyguide	FF	C
572	*Prodotiscus insignis*	Cassin's Honeybird	FF	P
581	*Campethera caroli*	Brown-eared Woodpecker	F	O
582	*Campethera nivosa*	Buff-spotted Woodpecker	F	C
584	*Campethera tullbergi*	Fine-banded Woodpecker	FFH	P
585	*Dendropicos fuscescens*	Cardinal Woodpecker	O	P
589	*Mesopicos elliotii*	Elliot's Woodpecker	FF	P
590	*Mesopicos goertae*	Grey Woodpecker	f	P
591	*Mesopicos griseocephalus*	Olive Woodpecker	FFH	P
592	*Mesopicos xantholophus*	Yellow-crested Woodpecker	FF	P
595	*Pseudocalyptomena graueri*	African Green Broadbill	FFH	P

596	*Smithornis capensis*	African Broadbill	FF	O
599	*Pitta reichenowi*	Green-breasted Pitta	FFL	P
623	*Delichon urbica*	House Martin	OM	P
624	*Hirundo abyssinica*	Striped Swallow	W	P
627	*Hirundo angolensis*	Angola Swallow	W	P
630	*Hirundo daurica*	Red-rumped Swallow	OH	P
632	*Hirundo fuligula*	African Rock Martin	O	P
634	*Hirundo rustica*	Eurasian Swallow	WM	P
635	*Hirundo semirufa*	Rufous-chested Swallow	O	P
636	*Hirundo senegalensis*	Mosque Swallow	W	O
637	*Hirundo smithii*	Wire-tailed Swallow	W	P
639	*Psalidoprocne albiceps*	White-headed Rough-wing	f	O
640	*Psalidoprocne pristoptera*	Black Rough-wing	f	O
643	*Riparia riparia*	Sand Martin	AM	P
645.1	*Dicrurus modestus*	Velvet-mantled Drongo	F	P
646	*Oriolus auratus*	African Golden Oriole	fM	P
647	*Oriolus brachyrhynchus*	Western Black-headed Oriole	F	O
651	*Oriolus oriolus*	Golden Oriole	fM	P
652	*Oriolus percivali*	Montane Oriole	FFH	P
653	*Corvus albicollis*	White-necked Raven	OH	O
654	*Corvus albus*	Pied Crow	W	P
662	*Parus fasciiventer*	Stripe-breasted Tit	FFH	O
664	*Parus funereus*	Dusky Tit	FF	O
671	*Alcippe abyssinica*	African Hill Babbler	FFH	P
672	*Kakamega poliothorax*	Grey-chested Illadopsis	FF	P
674	*Trichastoma albipectus*	Scaly-breasted Illadopsis	FF	C
675	*Trichastoma fulvescens*	Brown Illadopsis	FF	O
676	*Trichastoma pyrrhopterum*	Mountain Illadopsis	FFH	P
688	*Campephaga flava*	Black Cuckoo Shrike	f	P
689	*Campephaga petiti*	Petit's Cuckoo Shrike	FF	P
690	*Campephaga phoenicea*	Red-shouldered Cuckoo Shrike	O	P
693	*Coracina caesia*	Grey Cuckoo Shrike	FFH	O
697	*Andropadus curvirostris*	Cameroon Sombre Greenbul	FF	C
698	*Andropadus gracilirostris*	Slender-billed Greenbul	FF	C
699	*Andropadus gracilis*	Little Grey Greenbul	FF	P
701	*Andropadus latirostris*	Yellow-whiskered Greenbul	F	C
702	*Andropadus masukuensis*	Shelley's Greenbul	FFH	P
704	*Andropadus tephrolaemus*	Mountain Greenbul	FFH	C
705	*Andropadus virens*	Little Greenbul	F	C
706	*Baeopogon indicator*	Honeyguide Greenbul	FF	P
708	*Bleda syndactyla*	Bristlebill	FF	C
709	*Chlorocichla flavicollis*	Yellow-throated Leaflove	f	P
714	*Criniger calurus*	Red-tailed Greenbul	FF	C
716	*Nicator chloris*	Nicator	F	P
719	*Phyllastrephus hypochloris*	Toro Olive Greenbul	FF	P
720	*Phyllastrephus cabanisi*	Cabanis' Greenbul	FF	C
724	*Phyllastrephus flavostriatus*	Yellow-streaked Greenbul	FF	C
725	*Phyllastrephus icterinus*	Icterine Greenbul	FFL	P
732	*Pycnonotus barbatus*	Common Bulbul	f	O
734	*Alethe diademata*	Fire-crested Alethe	FF	O
736	*Alethe poliocephala*	Brown-chested Alethe	FF	P
737	*Alethe poliophrys*	Red-throated Alethe	FFH	C
743	*Cercotrichas hartlaubi*	Brown-backed Scrub Robin	f	P
750	*Cossypha cyanocampter*	Blue-shouldered Robin Chat	F	P
752	*Cossypha natalensis*	Red-capped Robin Chat	F	O
753	*Cossypha niveicapilla*	Snowy-headed Robin Chat	F	P
754	*Cossypha roberti*	White-bellied Robin Chat	FF	C
757	*Cossypha archeri*	Archer's Ground Robin	FH	P
761	*Cossypha poliopterus*	Grey-winged Ground Robin	FF	P
772	*Neocossyphus poensis*	White-tailed Ant Thrush	FFL	P
782	*Pogonocichla stellata*	White-starred Forest Robin	FH	P
783	*Saxicola rubetra*	Whinchat	OM	P
784	*Saxicola torquata*	Stonechat	O	O
785	*Sheppardia aequatorialis*	Equatorial Akalat	FF	C
790	*Stizorhina fraseri*	Rufous Thrush	FFL	P
793	*Turdus abyssinicus*	Northern Olive Thrush	FH	P
800	*Zoothera oberlaenderi*	Forest Ground Thrush	FFL	P
801	*Turdus pelios*	African Thrush	f	P
803	*Zoothera tanganjicae*	Kivu Ground Thrush	FFH	P
817	*Apalis cinerea*	Grey Apalis	FFH	P
819	*Apalis jacksoni*	Black-throated Apalis	FF	P
823.1	*Apalis personata*	Montane Masked Apalis	FFH	P
824	*Apalis porphyrolaema*	Chestnut-throated Apalis	FH	P
826	*Apalis rufogularis*	Buff-throated Apalis	FF	P

827	*Apalis ruwenzori*	Collared Apalis	FF	C
829	*Bathmocercus cerviniventris*	Black-faced Rufous Warbler	FF	O
833	*Bradypterus barratti*	Evergreen Forest Warbler	FFH	P
835	*Bradypterus cinnamomeus*	Cinnamon Bracken Warbler	FH	O
836	*Bradypterus graueri*	Grauer's Rush Warbler	A	P
837	*Camaroptera brachyura*	Grey-backed Camaroptera	f	C
838	*Camaroptera chloronota*	Olive-green Camaroptera	FF	C
841	*Camaroptera superciliaris*	Yellow-browed Camaroptera	FFL	P
843	*Chloropeta natalensis*	Yellow Warbler	O	P
844	*Chloropeta similis*	Mountain Yellow Warbler	FH	P
853	*Cisticola carruthersi*	Carruthers' Cisticola	A	P
855	*Cisticola chubbi*	Chubb's Cisticola	F	O
857	*Cisticola erythrops*	Red-faced Cisticola	O	P
860	*Cisticola galactotes*	Winding Cisticola	A	P
875	*Eminia lepida*	Grey-capped Warbler	f	P
882	*Graueria vittata*	Grauer's Warbler	FF	P
884	*Hemitesia neumanni*	Short-tailed Warbler	FF	P
889	*Hylia prasina*	Green Hylia	F	P
905	*Phylloscopus laetus*	Red-faced Woodland Warbler	FFH	P
907	*Phylloscopus sibilatrix*	Wood Warbler	FM	P
908	*Phylloscopus trochilus*	Willow Warbler	fM	P
910	*Prinia bairdii*	Banded Prinia	F	C
911	*Prinia leucopogon*	White-chinned Prinia	F	O
913	*Prinia subflava*	Tawny-flanked Prinia	f	P
917	*Sylvia atricapilla*	Blackcap	FM	P
923	*Sylvietta leucophrys*	White-browed Crombec	FF	C
924	*Sylvietta virens*	Green Crombec	F	P
930.1	*Ficedula semitorquata*	Semi-collared Flycatcher	OM	P
932	*Melaenornis ardesiaca*	Yellow-eyed Black Flycatcher	F	O
933	*Melaenornis chocolatina*	White-eyed Slaty Flycatcher	FH	O
936	*Muscicapa adusta*	Dusky Flycatcher	F	O
938	*Muscicapa caerulescens*	Ashy Flycatcher	F	P
939	*Muscicapa cassini*	Cassin's Grey Flycatcher	F	P
940	*Muscicapa comitata*	Dusky Blue Flycatcher	F	P
942	*Muscicapa griseigularis*	Grey-throated Flycatcher	FF	P
943	*Muscicapa lendu*	Chapin's Flycatcher	FF	P
946	*Myioparus plumbeus*	Lead-coloured Flycatcher	f	P
948	*Batis diops*	Rwenzori Batis	FH	C
951	*Batis molitor*	Chin-spot Batis	O	O
955	*Bias musicus*	Black and White Flycatcher	f	P
956	*Megabyas flammulata*	Shrike Flycatcher	FF	O
957	*Platysteira blissetti*	Jameson's Wattle-eye	FF	O
958	*Platysteira castanea*	Chestnut Wattle-eye	FF	P
960	*Platysteira cyanea*	Wattle-eye	f	O
962	*Erannornis albicauda*	White-tailed Blue Flycatcher	F	P
963	*Erannornis longicauda*	Blue Flycatcher	f	O
967	*Terpsiphone rufiventer*	Red-bellied Paradise Flycatcher	FF	O
968	*Terpsiphone viridis*	Paradise Flycatcher	f	O
969	*Trochocercus albiventris*	White-bellied Crested Flycatcher	FFH	P
970	*Trochocercus albonotatus*	White-tailed Crested Flycatcher	FFH	P
971	*Trochocercus cyanomelas*	Crested Flycatcher	FF	P
972	*Trochocercus nigromitratus*	Dusky Crested Flycatcher	F	C
991	*Motacilla aguimp*	African Pied Wagtail	W	O
993	*Motacilla capensis*	Cape Wagtail	W	O
994	*Motacilla cinerea*	Grey Wagtail	FH	P
995	*Motacilla clara*	Mountain Wagtail	FH	O
996	*Motacilla flava*	Yellow Wagtail	AM	P
998	*Dryoscopus angolensis*	Pink-footed Puffback	FF	P
1000	*Dryoscopus gambensis*	Northern Puffback	F	P
1008	*Laniarius luehderi*	Luhder's Bush Shrike	F	O
1009.1	*Laniarius poensis*	Montane Sooty Boubou	FH	O
1013	*Malaconotus bocagei*	Grey-green Bush Shrike	F	P
1015	*Malaconotus dohertyi*	Doherty's Bush Shrike	F	O
1016	*Malaconotus lagdeni*	Lagden's Bush Shrike	FFH	P
1017	*Malaconotus multicolor*	Many-coloured Bush Shrike	FF	O
1022	*Tchagra australis*	Brown-headed Tchagra	O	P
1029	*Lanius collaris*	Fiscal	O	O
1030	*Lanius collurio*	Red-backed Shrike	OM	P
1035	*Lanius mackinnoni*	Mackinnon's Shrike	f	O
1042	*Prionops caniceps*	Red-billed Helmet Shrike	FFL	P
1048	*Cinnyricinclus leucogaster*	Violet-backed Starling	f	P
1049	*Cinnyricinclus sharpii*	Sharpe's Starling	FFH	P
1058	*Lamprotornis purpureiceps*	Purple-headed Glossy Starling	F	O
1061	*Lamprotornis splendidus*	Splendid Glossy Starling	F	P

1066	*Onychognathus tenuirostris*	Slender-billed Chestnut-winged Starling	FH	P
1067	*Onychognathus walleri*	Waller's Chestnut-winged Starling	FFH	O
1069	*Poeoptera lugubris*	Narrow-tailed Starling	FF	P
1070	*Poeoptera stuhlmanni*	Stuhlmann's Starling	FFH	O
1080	*Anthreptes collaris*	Collared Sunbird	F	C
1081	*Anthreptes fraseri*	Grey-headed Sunbird	FF	C
1087	*Anthreptes rectirostris*	Green Sunbird	FF	P
1090	*Nectarinia alinae*	Blue-headed Sunbird	FFH	C
1094	*Nectarinia chloropygia*	Olive-bellied Sunbird	F	O
1097	*Nectarinia cyanolaema*	Blue-throated Brown Sunbird	FF	O
1099	*Nectarinia famosa*	Malachite Sunbird	FH	P
1103	*Nectarinia kilimensis*	Bronze Sunbird	fH	P
1112	*Nectarinia olivacea*	Olive Sunbird	FF	C
1115	*Nectarinia preussi*	Northern Double-collared Sunbird	FH	P
1117	*Nectarinia purpureiventris*	Purple-breasted Sunbird	FH	P
1118	*Nectarinia regia*	Regal Sunbird	FH	C
1120	*Nectarinia rubescens*	Green-throated Sunbird	F	P
1122	*Nectarinia senegalensis*	Scarlet-chested Sunbird	f	P
1125	*Nectarinia superba*	Superb Sunbird	FL	P
1128	*Nectarinia venusta*	Variable Sunbird	f	O
1130	*Nectarinia verticalis*	Green-headed Sunbird	F	O
1133	*Zosterops senegalensis*	Yellow White-eye	f	O
1134	*Amblyospiza albifrons*	Grosbeak Weaver	f	P
1141	*Euplectes capensis*	Yellow Bishop	O	P
1155	*Malimbus rubricollis*	Red-headed Malimbe	FF	O
1157	*Ploceus alienus*	Strange Weaver	F	P
1159	*Ploceus baglafecht*	Stuhlmann's Weaver	f	P
1169	*Ploceus insignis*	Brown-capped Weaver	FFH	P
1174	*Ploceus melanogaster*	Black-billed Weaver	FF	O
1175	*Ploceus nigerrimus*	Vieillot's Black Weaver	f	O
1176	*Ploceus nigricollis*	Black-necked Weaver	f	O
1184	*Ploceus superciliosus*	Compact Weaver	f	O
1186	*Ploceus tricolor*	Yellow-mantled Weaver	FF	P
1189	*Ploceus xanthops*	Holub's Golden Weaver	O	P
1206	*Passer griseus*	Grey-headed Sparrow	O	O
1211	*Hypochera chalybeata*	Red-billed Firefinch Indigobird	O	P
1216	*Vidua macroura*	Pin-tailed Whydah	W	P
1220	*Clytospiza cinereovinacea*	Dusky Twinspot	fH	P
1222	*Cryptospiza jacksoni*	Dusky Crimson-wing	FH	C
1223	*Cryptospiza reichenovii*	Red-faced Crimson-wing	FH	C
1224	*Cryptospiza salvadorii*	Abyssinian Crimson-wing	FH	C
1225	*Cryptospiza shelleyi*	Shelley's Crimson-wing	FH	P
1226	*Estrilda astrild*	Waxbill	O	O
1227	*Estrilda atricapilla*	Black-headed Waxbill	FH	P
1229	*Estrilda melanotis*	Yellow-bellied Waxbill	f	P
1230	*Estrilda nonnula*	Black-crowned Waxbill	f	P
1242	*Mandingoa nitidula*	Green-backed Twinspot	FF	P
1243	*Nesocharis ansorgei*	White-collared Olive-back	f	P
1246	*Nigrita canicapilla*	Grey-headed Negrofinch	F	P
1247	*Nigrita fusconota*	White-breasted Negrofinch	F	P
1252	*Parmoptila woodhousei*	Red-fronted Antpecker	FF	C
1259	*Spermophaga ruficapilla*	Red-headed Bluebill	F	P
1265	*Lonchura bicolor*	Black and White Mannikin	f	O
1266	*Lonchura cucullata*	Bronze Mannikin	W	P
1273	*Emberiza flaviventris*	Golden-breasted Bunting	O	P
1278	*Emberiza tahapisi*	Cinnamon-breasted Rock Bunting	O	P
1279	*Linurgus olivaceus*	Oriole Finch	FH	C
1280	*Serinus atrogularis*	Yellow-rumped Seed-eater	O	P
1281	*Serinus burtoni*	Thick-billed Seed-eater	FFH	P
1282	*Serinus canicollis*	Yellow-crowned Canary	FH	O
1283	*Serinus citrinelloides*	African Citril	f	P
1292	*Serinus striolatus*	Streaky Seed-eater	f	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 Bwindi

Specimen Number	Species	Date Collected	UTM
111/19/1	African Goshawk	15/2/94	RJ906907
553/19/1	Speckled Tinkerbird	15/2/94	RJ906907
562/19/1	Least Honeyguide	30/8/94	RJ995906
570/19/1	Willcocks' Honeyguide	30/8/94	RJ995906
582/19/1	Buff-spotted Woodpecker	2/9/94	RJ995906
698/19/1	Slender-billed Greenbul	31/8/94	RJ995906
704/19/1	Mountain Greenbul	11/2/94	RJ085837
704/19/2	Mountain Greenbul	31/8/94	RJ995906
705/19/1	Little Greenbul	31/8/94	RJ995906
714/19/1	Red-tailed Greenbul	30/8/94	RJ995906
720/19/3	Cabanis' Greenbul	30/8/94	RJ995906
720/19/2	Cabanis' Greenbul	15/2/94	RJ906907
720/19/4	Cabanis' Greenbul	1/9/94	RJ995906
720/19/1	Cabanis' Greenbul	10/2/94	RJ085837
737/19/1	Red-throated Alethe	30/8/94	RJ995906
754/19/1	White-bellied Robin Chat	31/8/94	RJ995906
785/19/1	Equatorial Akalat	30/8/94	RJ995906
827/19/1	Collared Apalis	9/2/94	RJ085837
910/19/1	Banded Prinia	30/8/94	RJ995906
1081/19/1	Grey-headed Sunbird	30/8/94	RJ995906
1118/19/1	Regal Sunbird	11/2/94	RJ085837
1222/19/1	Dusky Crimson-wing	11/2/94	RJ085837
1223/19/1	Red-faced Crimson-wing	31/8/94	RJ995906
1252/19/1	Red-fronted Antpecker	15/2/94	RJ906907
1279/19/1	Oriole Finch	31/8/94	RJ995906

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

Site		**RJ092838**			**QJ913907**			**QJ995906**				
Habitat		**B1**			**C3**			**C3**				
Month (1994)		**2**	**2**	**2**	**2**	**2**	**2**	**8**	**8**	**9**	**9**	
Date		**9**	**10**	**11**	**15**	**16**	**17**	**30**	**31**	**1**	**2**	**Total**
Metre-net-hours (mnh)		**1224**	**1262**	**1836**	**1512**	**1368**	**698**	**1316**	**1519**	**378**	**1229**	**12342**
Code	**Species**											
111	African Goshawk				1		1					**2**
337	Lemon Dove								1			**1**
357	Tambourine Dove				1		1					**2**
533	Grey-throated Barbet				1							**1**
548	Yellow-rumped Tinkerbird			2	2	1		1			1	**7**
550	Western Green Tinkerbird								1	1		**2**
553	Speckled Tinkerbird				1							**1**
562	Least Honeyguide							1				**1**
570	Willcocks' Honeyguide							1				**1**
582	Buff-spotted Woodpecker										1	**1**
674	Scaly-breasted Illadopsis							1				**1**
697	Cameroon Sombre Greenbul				1							**1**
698	Slender-billed Greenbul								1			**1**
701	Yellow-whiskered Greenbul	1	1	8	7	3	1	2	6	2	3	**34**
704	Mountain Greenbul			1	1	1			1	1		**5**
705	Little Greenbul					1				3	1	**5**
708	Bristlebill					1						**1**
714	Red-tailed Greenbul							1				**1**
720	Cabanis' Greenbul		1		3			1		4	1	**10**
724	Yellow-streaked Greenbul	1										**1**
737	Red-throated Alethe			1				3	1	1		**6**
754	White-bellied Robin Chat							1	2			**3**
785	Equatorial Akalat			1	2					1		**4**
827	Collared Apalis	1		1								**2**
837	Grey-backed Camaroptera		2									**2**
838	Olive-green Camaroptera	2	1		2	1	2		1			**9**
910	Banded Prinia							1				**1**
923	White-browed Crombec				1	1		1	1			**4**
948	Rwenzori Batis	1										**1**
972	Dusky Crested Flycatcher				2							**2**
1080	Collared Sunbird			3						1	1	**5**
1081	Grey-headed Sunbird							2	1			**3**
1090	Blue-headed Sunbird								1			**1**
1112	Olive Sunbird						2	7	2	2	3	**16**
1118	Regal Sunbird	1		2	1				1			**5**
1222	Dusky Crimson-wing			1		1						**2**
1223	Red-faced Crimson-wing								2			**2**
1224	Abyssinian Crimson-wing		1	1		2						**4**
1252	Red-fronted Antpecker				1							**1**
1279	Oriole Finch								1	1		**2**
	Cisticola sp.	1										**1**
	Flycatcher sp.								1			**1**
Total individuals		**8**	**6**	**21**	**27**	**12**	**7**	**23**	**24**	**17**	**11**	**156**
Cumulative individuals		**8**	**14**	**35**	**62**	**74**	**81**	**104**	**128**	**145**	**156**	
Total species		**7**	**5**	**10**	**15**	**9**	**5**	**13**	**16**	**10**	**7**	
New species		**6**	**3**	**6**	**8**	**2**	**1**	**7**	**6**	**0**	**1**	**40**
Cumulative species		**6**	**9**	**15**	**23**	**25**	**26**	**33**	**39**	**39**	**40**	
Cumulative mnh		**1224**	**2486**	**4322**	**5834**	**7202**	**7900**	**9216**	**10735**	**11113**	**12342**	

Chapter 5

Small Mammals

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5.1 SUMMARY

The small mammals were sampled using a combination of breakback, Sherman and pitfall traps. A total of 397 trap-nights were set and 48 animals were captured. Nine small mammal species (two shrew and seven rodent) were recorded; and a further 25 species are known from previous records. Of the total list for the forest, 6 species are of restricted-range (known from 5 or less forests visited during the programme), and four are Albertine Rift endemics, including Delany's Swamp Mouse (*Delanymys brooksi*), known only from highland swamps in Rwanda, eastern Zaire and south-western Uganda, and the Rwenzori Mouse Shrew (*Myosorex blarina*) previously known only from the Rwenzori mountains. Bwindi is of extreme importance in the conservation of Uganda's small mammal fauna.

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 number of workers have documented the small mammal fauna of Bwindi (see reviews in Delany, 1975; Kingdon 1971-74; Butynski, 1984, and additional data from Kityo, pers. comm.). J. Kerbis and P. Austin carried

out an extensive survey of Bwindi's small mammal fauna in March 1996, after fieldwork on the current inventory was completed (Kerbis, pers. comm.).

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 Deo Mijumbi and Francis Tinkasimiire 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 muscularis*) 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 Bwindi

	Bwindi		
Campsite locations (UTM)	RJ092838	QJ913907	QJ995906
Altitude (m)	2315	1490	1670
Ranger zoologist	F.Tinkasimiire	F.Tinkasimiire	D.Mijumbi
Co-ordinator	T.Davenport	T.Davenport	M.Baltzer
Dates	7-11.2.94	13-18.2.94	29-2.9.94
Sampling periods (days)	4	5	4
Vegetation type (Langdale-B.)	B1	C3	C3

Figure 5.1 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 from Bwindi are presented as Appendix 5.1. A total of nine small mammal species (2 shrew and 7 rodent) was recorded, and an additional 25 species (5 shrews and 20 rodents) are known from previous records.

5.4.2 Specimen list

Appendix 5.2 provide details of all the specimens taken at Bwindi, including identification numbers and capture site details. Specimens are retained at Makerere University and further information can be obtained from Robert Kityo, Curator, Museum of Zoology, Makerere University, PO Box 7062, Kampala, Uganda.

5.4.3 Trapping analysis

Table 5.2 shows a summary of the number of trap-nights set and animals captured at Bwindi. A total of 397 trap-nights were set, with 48 animals captured. The trap capture success rate was approximately 12.1 animals per 100 trap-nights.

5.4.4 Ecological characteristics

A total of 34 small mammal species (7 shrews and 27 rodents) are now known from Bwindi. The ecological characteristics of the species are shown in Table 5.3. Not surprisingly, a high proportion of the rodents and shrews in Bwindi are forest-dependent species (61%), including over 40% which are dependent on closed forest habitats. Exactly 50% of the Uganda's closed forest specialists are now known from Bwindi, as are 41% of the country's highland specialist species.

5.4.5 Species accumulation rate.

Appendix 5.4 shows the daily record of trapping effort and capture success at Bwindi and Fig. 5.2 shows species accumulation rates plotted against the number of captures. Unsurprisingly, given the inadequate number of trap-nights, the species accumulation curve indicates that an asymptote had not been reached.

5.5 DISCUSSION

A total of 9 small mammal species (2 shrew and 7 rodent) was recorded during the short survey period carried out by the inventory teams and an additional 25 species (5 shrews and 20 rodents) are known from previous records. A high proportion of the species list were forest-dependent species, accounting for 61% of the total.

Four Albertine Rift endemics are known from Bwindi; *Lophuromys woosnami* (Woosnam's brush-furred rat), *Myosorex blarina* (Ruwenzori mouse shrew), *Delanymys brookski* (Delany's swamp mouse), and *Thamnomys venustus* (Montane forest rat) with the latter two species known only from previous records. *Delanymys brookski* is a rare and relict Albertine Rift endemic which is restricted to high-altitude swamps in Kigezi, Rwanda and eastern Zaire. It was not recorded by the inventory teams at Bwindi and is considered to be a trap-shy animal Kingdon (1971-74) describes this species as a 'living fossil', and it is certainly an animal of great conservation concern. Further work should be undertaken to establish it's status at Bwindi and elsewhere in south-west Uganda.

Myosorex blarina is of interest as it was previously considered to be restricted to the Rwenzori mountains only. It was also recorded both in the Rwenzori and in Mafuga during the current inventory. Meanwhile, *Mus bufo* and *Hylomyscus denniae*, whilst not Albertine Rift endemics, are restricted to East African highland areas.

The species accumulation curve demonstrates the lack of sampling at Bwindi, however, the forest is clearly diverse in terms of its small mammal fauna and of considerable conservation importance.

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5.7 TABLES

Table 5.2 The ecological characteristics of mice, rats and gerbil species recorded from Bwindi. 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		**Bwindi**		
Ecological Type	**No. of Spp.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	2	3	2	7	100
FL	3	4	0	0	0
FH	7	9	4	15	57
f	9	12	6	22	67
fH	3	4	0	0	0
A	1	1	0	0	0
AF	3	4	3	11	100
AO	2	3	1	4	50
AH	2	3	1	4	50
O	26	35	2	7	8
OH	3	4	2	7	67
W	10	13	6	22	60
U	4	5	0	0	0
TOTAL	**75**	**100**	**27**	**100**	**36**

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 Bwindi. 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		**Bwindi**		
Ecological Type	**No. of Spp.**	**% of Ug. Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	4	10	1	14	25
FH	6	15	1	14	17
f	3	8	1	14	33
AF	2	5	2	29	100
AFH	1	3	1	14	100
O	6	15	0	0	0
W	8	21	1	14	13
U	9	23	0	0	0
TOTAL	**39**	**100**	**7**	**100**	**18**

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-range small mammals recorded from Bwindi

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				
Myosorex blarina	AFH	3	Rwenzori, Mafuga	Albertine Rift endemic (Rwenzori only)
Rodents				
Delanymys brooksi	AH	1	none	Albertine Rift endemic
Dendromus mesomelas	f	4	Rwenzori, Kibale, Echuya	Central, eastern and southern Africa
Hylomyscus denniae	FH	3	Rwenzori, Bugoma	Relict species on central African highlands and eastern arc mountains (Kenya, Uganda, Tanzania, Rwanda, Burundi, E Zaire)
Lophuromys woosnami	FH	5	Rwenzori, Kasyoha-Kitomi, Echuya, Mafuga	Albertine rift endemic
Thamnomys venustus	FH	3	Rwenzori, Echuya	Albertine rift endemic

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		

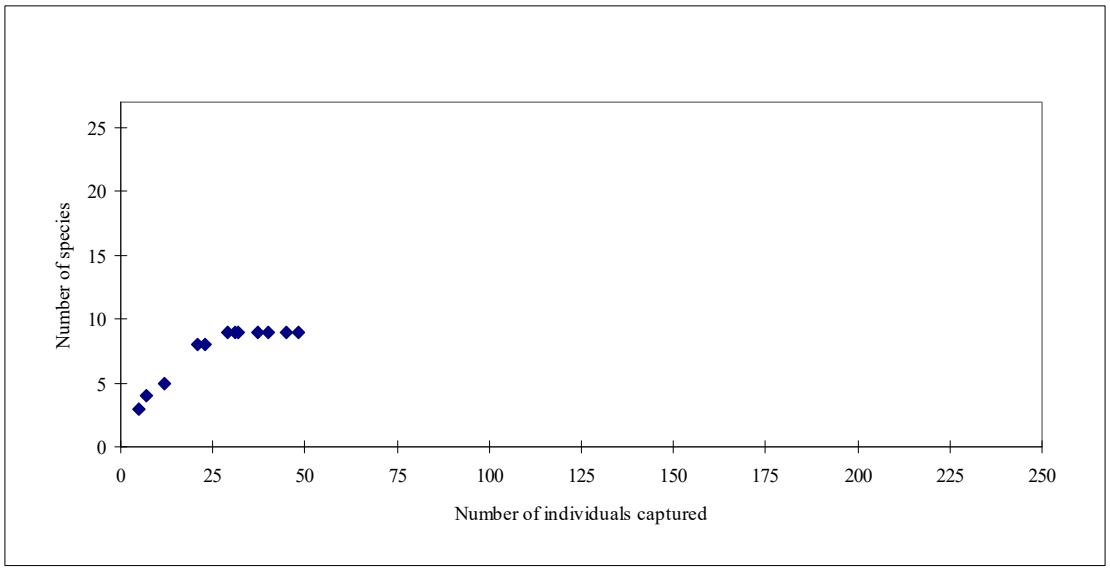

Figure 5.2 Species accumulation rates for small mammals from Bwindi

5.9 APPENDICES

Appendix 5.1 List of rodent species recorded from Bwindi

Species	Ecol. Type	Bwindi
Arvicanthis niloticus	O	1
Colomys goslingi	AF	1
Cricetomys gambianus	W	1
Dasymys incomtus	AO	1
Delanymys brooksi	AH	1
Dendromus melanotis	f	1
Dendromus mesomelas	f	1
Dendromus mysticalis	f	1
Deomys ferrugineus	AF	1
Grammomys dolichurus	f	1
Graphiurus murinus	W	2
Hybomys univittatus	F	3
Hylomyscus denniae	FH	1
Hylomyscus stella	F	2
Lemniscomys striatus	W	1
Lophuromys flavopunctatus	W	3
Lophuromys sikapusi	W	1
Lophuromys woosnami	FH	3
Malacomys longipes	AF	2
Mus bufo	FH	1
Mus minutoides	W	1
Mus triton	O	1
Oenomys hypoxanthus	f	1
Otomys denti	OH	1
Otomys typus	OH	1
Praomys jacksoni	f	3
Thamnomys venustus	FH	1

Appendix 5.2 List of shrew species recorded from Bwindi

Species	Ecol. Type	Bwindi
Crocidura dolichura	f	1
Crocidura maurisca	AF	1
Crocidura montis	FH	1
Crocidura olivieri	W	2
Myosorex blarina	AFH	2
Scutisorex somereni	AF	1
Sylvisorex granti	F	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 5.3 List of mammal specimens collected from Bwindi

Specimen No.	Species	Date	UTM
2250	*Myosorex blarina*	09/02/94	RJ097838
2251	*Lophuromys woosnami*	09/02/94	RJ089840
2252	*Graphiurus murinus*	09/02/94	RJ089840
2253	*Lophuromys woosnami*	10/02/94	RJ089840
2254	*Hybomys univittatus*	10/02/94	RJ089840
2255	*Lophuromys woosnami*	11/02/94	RJ095835
2256	*Praomys jacksoni*	11/02/94	RJ095835
2257	*Praomys jacksoni*	12/02/94	RJ095835
2258	*Lophuromys flavopunctatus*	12/02/94	RJ095835
2259	*Hylomyscus stella*	12/02/94	RJ095835
2260	*Crocidura olivieri*	12/02/94	RJ095835
2261	*Malacomys longipes*	17/02/94	QJ907906
3783	*Lophuromys flavopunctatus*	30/08/94	QJ993913
3784	*Lophuromys flavopunctatus*	30/08/94	QJ993913
3785	*Praomys jacksoni*	30/08/94	QJ994915
3786	*Hybomys univittatus*	30/08/94	QJ994915
3787	*Lophuromys flavopunctatus*	31/08/94	QJ993913
3788	*Lophuromys flavopunctatus*	31/08/94	QJ994915
3789	*Lophuromys flavopunctatus*	31/08/94	QJ994915
3790	*Hylomyscus stella*	01/09/94	QJ995923
3791	*Malacomys longipes*	01/09/94	QJ995923
3792	*Praomys jacksoni*	01/09/94	QJ995923
3793	*Praomys jacksoni*	01/09/94	QJ997923
3794	*Praomys jacksoni*	01/09/94	QJ994915
3795	*Praomys jacksoni*	02/09/94	QJ995923
3796	*Hybomys univittatus*	02/09/94	QJ995923
3797	*Lophuromys flavopunctatus*	02/09/94	QJ995923

Appendix 5.4 Daily record of small mammals in Bwindi

Site	RJ092838				QJ913907					QJ995906				
Month (1994)	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**8**	**8**	**9**	**9**	
Day	**8**	**9**	**10**	**11**	**12**	**14**	**15**	**16**	**17**	**30**	**31**	**1**	**2**	**Total**
TRAPTYPE/Species														
BREAKBACK TRAPS SET	**3**	**14**	**14**	**14**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**23**	**23**	**82**
Hybomys univittatus			1											1
Hylomyscus stella					1									1
Lophuromys flavopunctatus					2								1	2
Lophuromys woosnami		2	1											3
Praomys jacksoni				1	1							1		3
Total breakback captures	**0**	**2**	**2**	**1**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**11**
PITFALL TRAPS SET	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**130**
Myosorex blarina		1												1
Praomys jacksoni												1		1
Total pitfall captures	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	2
SHERMAN TRAPS SET	**14**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**11**	**11**	**11**	**11**	**162**
Crocidura olivieri					1									1
Graphiurus murinus		1												1
Hybomys univittatus										1			1	2
Hylomyscus stella					1	2	3					1		7
Lophuromys flavopunctatus										3	3			6
Lophuromys woosnami		1		4	2									7
Malacomys longipes							2	1	1			1		5
Praomys jacksoni					1		1	1		1		1	1	6
Total Sherman captures	**0**	**2**	**0**	**4**	**5**	**2**	**6**	**2**	**1**	**5**	**3**	**3**	**2**	**35**
Total captures	**0**	**5**	**2**	**5**	**9**	**2**	**6**	**2**	**1**	**5**	**3**	**5**	**3**	**48**
Cumulative captures	**0**	**5**	**7**	**12**	**21**	**23**	**29**	**31**	**32**	**37**	**40**	**45**	**48**	
Total traps set	**27**	**37**	**37**	**37**	**37**	**23**	**23**	**23**	**23**	**21**	**21**	**44**	**44**	**397**
Cumulative traps set	**27**	**64**	**101**	**138**	**175**	**198**	**221**	**244**	**267**	**288**	**309**	**353**	**397**	
Total species*	**0**	**3**	**2**	**2**	**5**	**1**	**3**	**2**	**1**	**3**	**1**	**3**	**3**	
New species*	**0**	**3**	**1**	**1**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**9**
Cumulative species*	**0**	**3**	**4**	**5**	**8**	**8**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	

Chapter 6

Butterflies

Compiled by

Tim Davenport BSc(Hons), PhD

6.1 SUMMARY

The butterflies of Bwindi Impenetrable were sampled through the systematic use of sweep nets and baited traps, for a total of 24 man-days. A species list was compiled for the reserve and basic analysis performed. A total of 162 species was registered; 12 Papilionidae, 18 Pieridae, 19 Lycaenidae, 97 Nymphalidae and 16 Hesperiidae. A relatively high proportion (76%) of the total were forest-dependent butterflies and approximately 36% of Uganda's highland forest specialists were registered. Some 36 restricted-range species, recorded in no more than five sites during the programme, were noted, as were more than half of the country's Albertine Rift Endemics. Species of particular interest included the Snow Horned Skipper (*Chondrolepis telisignata*), which represents a new record for Uganda, previously known only from the highlands of eastern Kenya, Tanzania and Malawi The data have contributed greatly to the forest total which now stands at 310 species.

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

A number of workers have investigated the butterfly fauna of Bwindi Impenetrable (see Jackson, 1951; Carcasson, 1961; 1963; 1975; D'Abrera, 1980; Henning, 1988; Howard, 1991; Omoding, 1994; Davenport, 1995).

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 National Park.

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

Francis Tinkasimiire, Deo Mijumbi and Tim Davenport were responsible for the collection of butterfly data from the Park. Further details of the personnel, dates and sites are given in Table 6.1.

Table 6.1 Personnel, dates and areas sampled in Bwindi

	Bwindi		
Campsite locations (UTM)	RJO92838	QJ913907	QJ995906
Altitude (m)	2315	1490	1670
Ranger zoologist	F.Tinkasimiire	F.Tinkasimiire	D.Mijumbi
Co-ordinator	T. Davenport	T.Davenport	M.Baltzer
Dates	7-11.2.94	13-18.2.94	29-2.9.94
Sampling periods (man-days)		24	
Man-days/km^2		0.07	
Vegetation type (Langdale-B.)	B1	C3	C3

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

A detailed species list for the butterflies recorded from Bwindi Impenetrable is given in Appendix 6.1. A total of 162 species were registered; 12 Papilionidae, 18 Pieridae, 19 Lycaenidae, 97 Nymphalidae and 16 Hesperiidae.

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 at least 13% of Uganda's Rhopaloceran fauna, including 39% of the country's Papilionidae were recorded.

A complete butterfly list for Bwindi based on these data, previous records and personal observations made in the field now stands at 310 species (Davenport, 1995).

6.4.2 Ecological characteristics

A summary of the number of butterfly species recorded from Bwindi and their respective ecological characteristics are given in Table 6.3. Some 83 species recorded from the forest are associated with closed forest habitats (F,FH,FL) and an additional 39 with forest edge ecology (f), totalling approximately 76% of the sampled butterfly fauna. Approximately 36% of Uganda's forest highland (FH) butterfly fauna were recorded.

6.4.3 Species accumulation rates

The species accumulation rates for Papilionidae, Pieridae and Nymphalidae (Fig 6.4), demonstrate little decline in the rate at which new species were recorded, thus indicating that the list is likely to be incomplete.

6.4.4 Sampling effort

Details of the areas within the reserve that were sampled for their butterfly fauna are illustrated in Fig 6.1. A total of 24 man-days were carried out in the forest. The effort expressed as a function of forest area, is given in Table 6.5, with 0.07 man-days per km^2 undertaken.

6.4.5 Restricted-range species

Species of restricted-range (those recorded in five or less sites during the programme) and details of the other forests from which they were also recorded are listed in Table 6.6. Some 36 such species were recorded from Bwindi, 10 of which were recorded in no other reserves during the programme and 15 of which were highland closed forest specialists.

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), Bwindi was undersampled (0.07 man-days/km^2), a reflection of the large size of the park and the comparatively short sampling time carried out. 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.

Another indication of sampling effort, through spatial coverage can be derived from Figures 6.1. It can be seen that only moderate coverage of the forest was achieved, especially considering the great altitudinal range and breadth of vegetation types throughout the park.

Of the species recorded, those of particular interest included the Snow Horned Skipper *Chondrolepis telisignata*, which represents a new record to Uganda. This dense forest montane specialist is described by Larsen (1991) as scarce, with a disjunct distribution. It was previously known only from the highlands of eastern Kenya, Tanzania and Malawi.

Acraea burgessi and *Bicyclus neustetteri*, meanwhile, are both Ugandan endemics, which according to D'Abrera (1980) are restricted to montane forest of the Kigezi regon. Although no records for Zaire can be traced, a distribution so close to the border with Zaire suggests that these insects are unlikely to be limited to Uganda. Indeed, *Bicyclus neustetteri* were seen in some numbers within a few kilometres of the international border (pers obs.). That notwithstanding, they are undoubtedly species of a very limited distribution.

A number of butterflies endemic to the Albertine Rift were recorded including *Hypolycaena jacksoni*, *Harpendyreus reginaldi*, *Bicyclus aurivillii*, *Bicyclus matuta*, *Charaxes opinatus*, *Euriphene excelsior* and *Acraea amicitiae*. *Bicyclus matuta* is of particular interest as its nominate race is endemic to the country. In

addition, a male *Papilio leucotaenia* (listed as threatened in IUCN's Swallowtail Red Data Book) was seen near the Ruhija swamp on more than one occasion (pers. obs.).

As typifies many taxa confined to highland domains, much Rhopaloceran sub-speciation has occurred. This is particularly so in the mountains of the Albertine Rift with a number of races endemic to the area, such as *Papilio jacksoni ruandana*, *Pseudacraea dolomena kayonza* and *Acraea disjuncta kigeziensis*. The nominate (and only other) race of the latter, is known from the rest of Uganda and Kenya only (D'Abrera, 1980). Similarly, the Nymph *Issoria baumanni* has three clearly delineated montane sub-species; *baumanni* endemic to the Albert Rift, and which was not uncommon around Katonve; *excelsior* confined to the Rwenzoris; and *katangae* restricted to south-western Tanzania and the Shaba province of Zaire.

Charaxes dilutus is worthy of mention, not least because just one individual taken near Kitahurira, represents the only record throughout the entire programme. There remains, however, some confusion with the taxonomy of this particular species. Henning (1988) affords the sub-species *miotoni* a range in parts of Kenya and South West Uganda, however, Larsen (1991) disputes the Kenyan records and questions the validity of the species, claiming it merely as a race of *Charaxes eupale*.

Of the restricted-range species, a number of butterflies are worthy of mention. *Charaxes ansorgei* for example, is often considered to be an uncommon insect, and is limited to dense East African highland forest. As such it is under some degree of threat. Three other uncommon species have limited ranges; *Acraea ansorgei* the nominate race of which is found only in montane areas of Kenya and Uganda; *Thermoniphas kigezi* known only from the Kigezi region of Uganda and Cameroon; and *Antanartia abyssinica* confined to the highland areas of Ethiopia, Kenya, Tanzania and the Albertine Rift.

Mafuga Forest Reserve, once contiguous with Bwindi, is the only other site during the programme where *Aphysoneura pigmentaria* was recorded. This distinctive member of the Satyrinae subfamily, is generally considered to be very local (Larsen, 1991) and is confined to more open habitats in the vicinity of *Arundinaria* its larval foodplant.

These data have contributed greatly to the current butterfly list for Bwindi which now comprises some 310 species (Davenport, 1995), representing almost a quarter of Uganda's known butterfly fauna. Whilst not as species rich as Semliki, for example, Bwindi is still one of the richer sites sampled and is particularly notable for its high concentration of Albertine Rift endemic and restricted-range butterflies, all of particular conservation significance. The data are consistent with a rich, relatively undisturbed closed forest environment of broad altitudinal range.

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6.7 TABLES

Table 6.2 Species numbers recorded in Bwindi from each family and from Papilionidae, Pieridae and Nymphalidae subfamilies

Family Subfamily	Uganda Totals	Forest Total	% Uganda Total
Papilionidae	**31**	12	**39**
Papilioninae	31	12	39
Pieridae	**100**	**18**	**18**
Coliadinae	10	4	40
Pierinae	90	14	16
Lycaenidae	**460**	**19**	**4**
Nymphalidae	**447**	**97**	**22**
Danainae	13	5	38
Satyrinae	71	19	27
Charaxinae	65	14	22
Apaturinae	1	0	0
Nymphalinae	195	41	21
Acraeinae	101	18	18
Libytheinae	1	0	0
Hesperiidae	**207**	**16**	**8**
TOTAL	**1245**	**162**	**13.0**

Table 6.3 The ecological characteristics of butterfly species recorded from Bwindi. 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		Bwindi		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	561	45	61	38	11
FH	53	4	19	12	36
FL	33	3	3	2	9
f	197	16	39	24	20
O	176	14	6	4	3
M	42	3	10	6	24
S	11	1	0	0	0
W	128	10	23	14	18
U	44	4	1	1	2
TOTAL	**1245**	**100**	**162**	**100**	**13.0**

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 Bwindi

Species	Common Name	Ecol. Type	No. of Ugandan forests from which species was recorded	Other forests where species has been recorded
PAPILIONIDAE				
Papilio jacksoni	Jackson's Swallowtail	FH	3	Rwenzori, Echuya
Papilio leucotaenia	Cream Banded Swallowtail	FH	1	*none*
PIERIDAE				
Eurema mandarinula	Mandarin Grass Yellow	f	5	Kasyoha-Kitomi, Mujuzi, Kasana-Kasambya, Echuya
Belenois victoria	Victoria White	F	5	Mt. Elgon, Kibale, Mabira, Rom
Mylothris hilaria		F	1	*none*
LYCAENIDAE				
Hypolycaena jacksoni		FH	3	Rwenzori, Echuya
Anthene hobleyi	Hobley's Ciliate Blue	FH	4	Mt. Elgon, Rwenzori, Budongo
Harpendyreus reginaldi		O	1	*none*
Thermoniphas kigezi		F	1	*none*
Oboronia pseudopunctata		F	3	Budongo, Semliki
NYMPHALIDAE				
Amauris echeria	Chief	f	5	Rwenzori, Rom, Echuya, Mafuga
Aphysoneura pigmentaria	Painted Ringlet	O	2	Echuya
Bicyclus alboplagus		F	5	Bugoma, Semliki, Sango Bay, Itwara
Bicyclus aurivillii	Kigezi Bush Brown	FH	4	Rwenzori, Echuya, Mafuga
Bicyclus matuta		FH	3	Rwenzori, Mafuga
Bicyclus neustetteri		FH	1	*none*
Charaxes ansorgei	Ansorge's Charaxes	FH	3	Mt. Elgon, Rwenzori
Charaxes dilutus		F	1	*none*
Charaxes opinatus		FH	1	*none*
Euriphene excelsior		F	1	*none*
Bebearia sophus		F	4	Budongo, Kalinzu-Maramagambo, Bugoma
Euphaedra christyi		F	4	Rwenzori, Kibale, Kasyoha-Kitomi
Pseudacraea dolomena		F	3	Kasyoha-Kitomi, Zika
Neptis penningtoni	Pennington's Sailer	f	5	Labwor Hills, Kasyoha-Kitomi, Sango Bay, Igwe-Luvunya
Neptis woodwardi	Woodward's Sailer	FH	2	Mt. Elgon
Antanartia abyssinica	Abyssinian Admiral	FH	1	*none*
Issoria baumanni		W	4	Rwenzori, Semliki, Echuya
Acraea amicitiae		FH	4	Rwenzori, Echuya, Mafuga
Acraea ansorgei	Ansorge's Acraea	FH	3	Rwenzori, Echuya
Acraea burgessi		FH	3	Rwenzori, Echuya
Acraea cepheus		F	5	Bugoma, Mt. Kei, Otzi, Kitechura
Acraea disjuncta		F	3	Mt. Elgon, Rwenzori
HESPERIIDAE				
Eretis melania		W	5	Mt. Elgon, Labwor Hills, Rom, Echuya
Sarangesa astrigera		W	1	*none*
Sarangesa haplopa		W	5	Mt. Elgon, South Busoga, Echuya
Chondrolepis telisignata		FH	2	Echuya

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

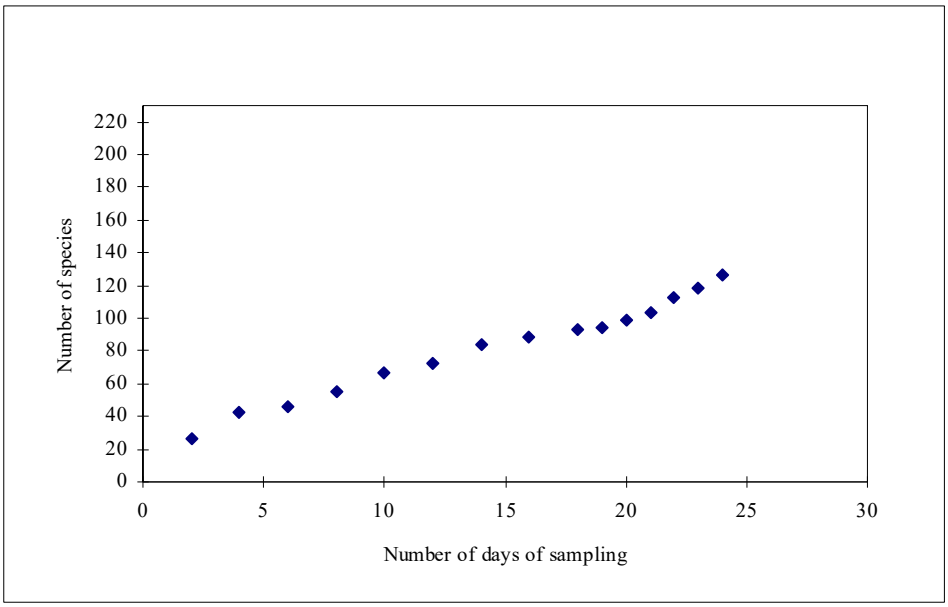

Fig. 6.2 Species accumulation rates for Papilionidae, Pieridae and Nymphalidae butterflies from Bwindi

6.9 APPENDICES

Appendix 6.1 Species list of butterflies recorded in Bwindi

Species	Common Name	Ecol. Type
PAPILIONIDAE		
Papilioninae		
Papilio cynorta		FL
Papilio dardanus	Mocker Swallowtail / Flying Handkerchief	W
Papilio demodocus	Citrus Swallowtail	M
Papilio hesperus	Black and Yellow Swallowtail	F
Papilio jacksoni	Jackson's Swallowtail	FH
Papilio leucotaenia	Cream Banded Swallowtail	FH
Papilio lormieri	Central Emperor Swallowtail	F
Papilio mackinnoni	MacKinnon's Swallowtail	FH
Papilio nireus	Narrow G-Banded Swallowtail	f
Papilio phorcas	Green Patch Swallowtail	F
Papilio rex	Regal Swallowtail	FH
Graphium policenes	Small Striped Swordtail	f
PIERIDAE		
Coliadinae		
Catopsilia florella	African Emigrant	M
Eurema desjardinsi	Angled Grass Yellow	W
Eurema mandarinula	Mandarin Grass Yellow	f
Eurema senegalensis	Forest Grass Yellow	F
Pierinae		
Nepheronia argia	Large Vagrant	F
Colotis elgonensis	Elgon Crimson Tip	FH
Belenois calypso	Calypso Caper White	F
Belenois raffrayi	Raffray's White	F
Belenois victoria	Victoria White	F
Belenois zochalia	Forest Caper White	M
Appias sabina	Sabine Albatross	F
Appias sylvia	Albatross	F
Mylothris agathina	Eastern Dotted Border	W
Mylothris continua		F
Mylothris hilaria		F
Mylothris jacksoni	Jackson's Dotted Border	f
Leptosia hybrida	Hybrid Wood White	F
Leptosia nupta	Immaculate Wood White	F
LYCAENIDAE		
Theclinae		
Hypolycaena antifaunus		F
Hypolycaena jacksoni		FH
Polyommatinae		
Anthene definita	Common Ciliate Blue	W
Anthene hobleyi	Hobley's Ciliate Blue	FH
Anthene larydas	Spotted Ciliate Blue	F
Lampides boeticus	Pea Blue	M
Uranothauma antinorii		f
Uranothauma nubifer	Black Heart	f
Phlyaria cyara		f
Cacyreus lingeus	Common Bush Blue	f
Cacyreus palemon	Water Geranium Blue	O
Harpendyreus marungensis	Central Mountain Blue	f
Harpendyreus reginaldi		O
Tuxentius margaritaceus		W
Zizula hylax	Tiny Grass Blue	W
Azanus mirza	Pale Babul Blue	W
Thermoniphas kigezi		F
Oboronia pseudopunctata		F
Riodininae		
Abisara neavei	Neave's Judy	F

NYMPHALIDAE		
Danainae		
Danaus chrysippus	African Queen	M
Amauris echeria	Chief	f
Amauris niavius	Friar	W
Amauris tartarea	Monk	f
Tirumala petiverana	African Blue Tiger	M
Satyrinae		
Gnophodes betsimena	Banded Evening Brown	F
Gnophodes chelys		F
Melanitis leda	Common Evening Brown	W
Aphysoneura pigmentaria	Painted Ringlet	O
Bicyclus alboplagus		F
Bicyclus aurivillii	Kigezi Bush Brown	FH
Bicyclus dentatus	Dentate Bush Brown	f
Bicyclus istaris		f
Bicyclus jefferyi	Jeffery's Bush Brown	f
Bicyclus mandanes		F
Bicyclus matuta		FH
Bicyclus mesogena		F
Bicyclus mollitia		F
Bicyclus neustetteri		FH
Bicyclus sandace		F
Bicyclus saussurei	Saussure's Bush Brown	F
Bicyclus sophrosyne		f
Bicyclus uniformis		U
Ypthima albida	Silver Ringlet	f
Charaxinae		
Charaxes ansorgei	Ansorge's Charaxes	FH
Charaxes anticlea	Small Flame-Bordered Charaxes	f
Charaxes brutus	White Barred Charaxes	f
Charaxes candiope	Green Veined Charaxes	W
Charaxes dilutus		F
Charaxes etheocles	Demon Charaxes	F
Charaxes eudoxus		f
Charaxes fulvescens	Forest Pearl Charaxes	FL
Charaxes numenes		f
Charaxes opinatus		FH
Charaxes smaragdilis	Western Blue Charaxes	F
Charaxes tiridates		FL
Charaxes varanes	Pearl Charaxes	W
Charaxes zoolina	Club Tailed Charaxes	O
Nymphalinae		
Harma theobene		F
Euriphene excelsior		F
Euriphene saphirina		F
Bebearia brunhilda		F
Bebearia sophus		F
Euphaedra christyi		F
Euphaedra harpalyce		F
Euphaedra medon	Common Forester	F
Pseudargynnis hegemone	False Fritillary	f
Catuna crithea		F
Pseudacraea dolomena		F
Pseudacraea lucretia	False Diadem	f
Neptis melicerta	Streaked Sailer	F
Neptis penningtoni	Pennington's Sailer	f
Neptis woodwardi	Woodward's Sailer	FH
Cyrestis camillus	African Map Butterfly	F
Sallya boisduvali	Brown Tree Nymph	M
Sallya garega		M
Neptidopsis ophione	Scalloped Sailer	f
Eurytela hiarbas	Pied Piper	f
Kallima rumia	African Leaf Butterfly	F
Hypolimnas dinarcha		F
Hypolimnas misippus	Diadem	M
Hypolimnas salmacis	Blue Diadem	F
Salamis parhassus	Forest Mother-of-Pearl	f
Salamis temora	Blue Mother-of-Pearl	F
Junonia chorimene	Golden Pansy	O

Junonia sophia	Little Commodore	W
Junonia stygia	Brown Pansy	f
Junonia terea	Soldier Commodore	W
Junonia westermanni	Blue Spot Pansy	F
Precis sinuata		f
Precis tugela	Eared Commodore	f
Vanessula milca	Lady's Maid	f
Antanartia abyssinica	Abyssinian Admiral	FH
Antanartia delius	Orange Admiral	F
Antanartia dimorphica	Dimorphic Admiral	F
Antanartia schaenia	Long Tail Admiral	F
Lachnoptera anticlia	Western Blotched Leopard	f
Phalanta eurytis	African Leopard Fritillary	M
Issoria baumanni		W
Acraeinae		
Acraea alicia		W
Acraea amicitiae		FH
Acraea ansorgei	Ansorge's Acraea	FH
Acraea asboloplintha	Black Winged Acraea	f
Acraea aurivilli	Aurivillius' Acraea	F
Acraea burgessi		FH
Acraea cepheus		F
Acraea disjuncta		F
Acraea epaea		F
Acraea eponina	Orange Acraea	W
Acraea johnstoni	Johnston's Acraea	f
Acraea peneleos		F
Acraea penelope	Penelope's Acraea	F
Acraea perenna		f
Acraea quadricolor	Four-Colour Acraea	FH
Acraea sotikensis	Sotik Acraea	F
Acraea uvui	Tiny Acraea	f
Acraea zetes	Large Spotted Acraea	W
HESPERIIDAE		
Coeliadinae		
Coeliades forestan	Striped Policeman	W
Tagiades flesus	Clouded Flat	F
Eagris leucetia		f
Eretis lugens		W
Eretis melania		W
Sarangesa astrigera		W
Sarangesa haplopa		W
Spialia ploetzi	Forest Grizzled Skipper	F
Hesperiinae		
Metisella medea		f
Metisella orientalis		f
Ceratrichia flava	Yellow Forest Sylph	F
Chondrolepis niveicornis	Snow Horned Skipper	F
Chondrolepis telisignata		FH
Zenonia zeno	Bellboy	f
Gegenes hottentota	Hottentot Skipper	O
Gegenes niso	Plain Hottentot	W

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

Chapter 7

Large Moths

Compiled by

Peter Howard BSc(Hons), MSc, PhD

7.1 SUMMARY

The moths were sampled with a mercury vapour light trap at four sites for a total of 116 nights, between February and September 1994. Altogether 1156 hawkmoths (Sphingidae) of 51 species, and 228 silkmoths (Saturniidae) of 30 species were captured. These were predominantly species characteristic of closed canopy forest, with both highland and lowland species present. Ten restricted-range species are known from the forest, including the rare Albertine Rift endemic hawkmoth, *Temnora scheveni*, and the silkmoths *Epiphora marginimacula* and *Pselaphelia vandenberghei*.

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

Carcasson (1976) records 12 species of hawkmoth from Bwindi, all except one (*Temnora zantus*) of which have been recorded again under the present inventory programme. A. McCrae (pers. comm.) compiled records of 23 silkmoth species from this area based on museum specimens and personal observation, pre-1970. These records include five species (*Goodia lunata, Goodia smithi, Gynanisa festa, Imbrasia krucki* and *Ludia hansali*) not encountered during the present work.

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

Two separate sampling strategies were employed at Bwindi, the first being the 'standard' procedure of the biological inventory team personnel spending relatively few days at a number of widely scattered sites, and the second being more intensive sampling of two sites, at very different altitudes. The inventory team work covered three sites (Ruhija, Buhoma and Kitahurira) ranging in altitude from 1500 m to 2300 m (Fig. 7.1). Two sampling periods were involved, from 8 to 17 February 1994 (F. Tinkasimiire) and from 27 August to 3 September 1994 (D. Mijumbi, Table 7.1) with a total of 15 nights of trapping carried out. Two independent trapping operations were carried out, one at the Institute of Tropical Forest Conservation (ITFC) site at Ruhija (2300 m), and the other at Kitahurira Forest Station (1600m). The trap at ITFC was operated by postgraduate student Vincent Mwesigye, for a total of 43 nights between 13 March and 14 May 1994, while the one at Kitahurira was run by ranger Vincent Katogye over 58 nights between 15 April and 21 June 1994.

Table 7.1 Personnel, dates and areas sampled in Bwindi

	Bwindi				
Moth-trap locations (UTM)	RJ093838	QJ913907	RJ087847	QJ995906	QJ995906
Altitude	2300	500	2300	1600	1600
Moth-trap operator	F. Tinkasimiire	F. Tinkasimiire	V. Mwesigye	V. Katogye	D. Mijumbi
Co-ordinator	T. Davenport	T. Davenport	P. Howard	P. Howard	M. Baltzer
Dates	8-11/02/94	14-17/02/94	13/03-14/05/94	15/04-21/06/94	27/08-3/09/94
Sampling period (days)	4	4	43	58	7
Vegetation type (Langdale-B)	B1	C3	B1	C3	C3

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 species captured by inventory team personnel is provided in Appendices 7.1 and 7.2 while separate records for the ITFC site are included as Appendices 7.3 and 7.4, and for the Kitahurira site as Appendices 7.5 and 7.6. Overall, 1156 Sphingids of 51 species were captured, together with 228 Saturniids of 30 species. Complete lists of hawkmoths and silkmoths known from Bwindi (including old records) are included as Appendices 7.7 and 7.8 respectively.

7.4.2 Ecological characteristics

Tables 7.2 and 7.3 provide a breakdown of the moth fauna, according to the ecological characteristics of its constituent members. The species recorded at Bwindi include a high proportion of true forest and forest-edge species, including both highland and lowland elements.

7.4.3 Species accumulation rates

Figs. 7.2 and 7.3 show the cumulative total number of species of the two families recorded by inventory team personnel over the 15 nights of sampling they carried out. Figs 7.4 and 7.5 show equivalent species accumulation curves for the ITFC site, and Figs. 7.6 and 7.7 for the Kitahurira site.

7.4.4 Restricted-range species

Table 7.4 details the ten restricted-range species recorded, of which three are hawkmoths and seven silkmoths. Three of these are rare Albertine Rift endemics, namely the hawkmoth *Temnora scheveni* and the silkmoths *Epiphora marginimacula*, and *Pselaphelia vandenberghei*; and one (*Imbrasia krucki*) is known only from Kenya and Uganda. Of the remainder, *Temnora albilinea, Imbrasia rubra, Lobobunaea angasana, Lobobunaea ansorgei* and *Orthogonioptilum vestigiatum* are all noteworthy as uncommon forest specialists known from very few sites.

7.5 DISCUSSION

For such an important site, the moth fauna remains rather inadequately sampled, and relatively unknown. From the shape of the species accumulation curves (still rising quite steeply at the end of the sampling periods), it is clear that further sampling is likely to yield a significant number of additional records. It would be particularly valuable to conduct further sampling at the lower altitudes, such as Buhoma, Rushaga or the Ishasha gorge, since several lowland forest specialists (*Nephele bipartita, Polyptychus carteri* and *Orthogonioptilum vestigiatum*) have already been recorded, and some West African rainforest specialists on the eastern limits of their ranges should be anticipated.

Nevertheless, despite the rather limited sampling, the results obtained support the conclusions drawn from studies of other taxa, that this is a very important site for biological conservation, on account of the relatively large number of Albertine Rift endemics which occur here. These tend to be montane forest specialists, and the higher-lying parts of the forest are clearly most important for their conservation.

7.6 REFERENCES

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7.7 TABLES

Table 7.2 The ecological characteristics of hawkmoth species recorded from Bwindi. 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		Bwindi		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	38	33	17	33	45
FH	5	4	5	10	100
FL	6	5	1	2	17
FM	1	1	1	2	100
f	24	21	8	15	33
fH	0	0	0	0	0
fL	3	3	1	2	33
G	13	11	0	0	0
W	16	14	11	21	69
WM	9	8	8	15	89
TOTAL	**115**	**100**	**52**	**100**	**45**

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				

Table 7.3 The ecological characteristics of silkmoth species recorded from Bwindi. 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		Bwindi		
Ecological Type	**No. of Spp.**	**% of Tot.**	**No. of Spp.**	**% of site Tot.**	**% of Ug. Tot.**
F	35	36	15	43	43
FH	6	6	3	9	50
FL	2	2	0	0	0
FM	0	0	0	0	0
f	43	45	17	49	40
fH	1	1	0	0	0
fL	0	0	0	0	0
G	8	8	0	3	0
W	1	1	0	0	0
WM	0	0	0	0	0
TOTAL	**96**	**100**	**35**	**100**	**36**

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				

Table 7.4 Restricted-range moths recorded from Bwindi

Species	Ecol. Type.	Other forests where species has been recorded	Previous records in EA	Status and Distribution in Africa	Conservation Significance
Hawkmoths					
Macroglossum trochilus	W	Kibale, Bugoma, Echuya	20	Very common in most habitats throughout southern and eastern Africa (day-flying species, not attracted to light)	4
Temnora albilinea	F	Kalinzu-Maramagambo, Sango Bay, Zika	6	Forests throughout central and eastern Africa, from Cameroon to Tanzania, Kenya	2
Temnora scheveni	FH	Rwenzori, Kalinzu - Maramagambo, Kasyoha-Kitomi	1	Highland forests of the Albertine Rift	1
Silkmoths					
Epiphora marginimacula	FH	Echuya, Mafuga	-	Highland forests of the Albertine Rift	1
Imbrasia krucki	F	Mt. Elgon, Nyangea-Napore, Bwindi, Sango Bay, Morungole	-	Known only from Kenya and Uganda	1/2
Imbrasia rubra	f.	Mt. Elgon, Echuya	-	Zambia, Zaire, Tanzania and Uganda only	2
Lobobunaea angasana	f.	Kalinzu-Maramagambo, Moroto, Kadam	-	Widespread throughout southern, eastern and central Africa, from Zimbabwe to Kenya, Cameroon	2
Lobobunaea ansorgei	F	Rwenzori, Kibale, Sango Bay, Echuya	-	Eastern Africa and Cameroon	2
Orthogonioptilum vestigiatum	F	Budongo, Bugoma, Sango Bay, Zika	-	Forests from Ghana to Angola, Uganda	3
Pselaphelia vandenberghei	FH	none	-	Highland forests of the Albertine Rift	1

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				

Conservation significance:

1 Regional endemic (Albertine rift or northeastern Africa)

2 Apparently uncommon, but widely distributed; of possible concern

3 Status outside EA unknown (possibly common); reaches few sites in Uganda at extreme limits of range, and not known elsewhere in EA region; regionally important, but perhaps of little global concern

4 Common and widespread; of little immediate concern

Notes:

1) Other forests where species has been recorded includes all (old and new) records

2) Previous records in EA refers to number of localities mentioned in Carcasson (1976) for hawkmoths (no equivalent data available for silkmoths).

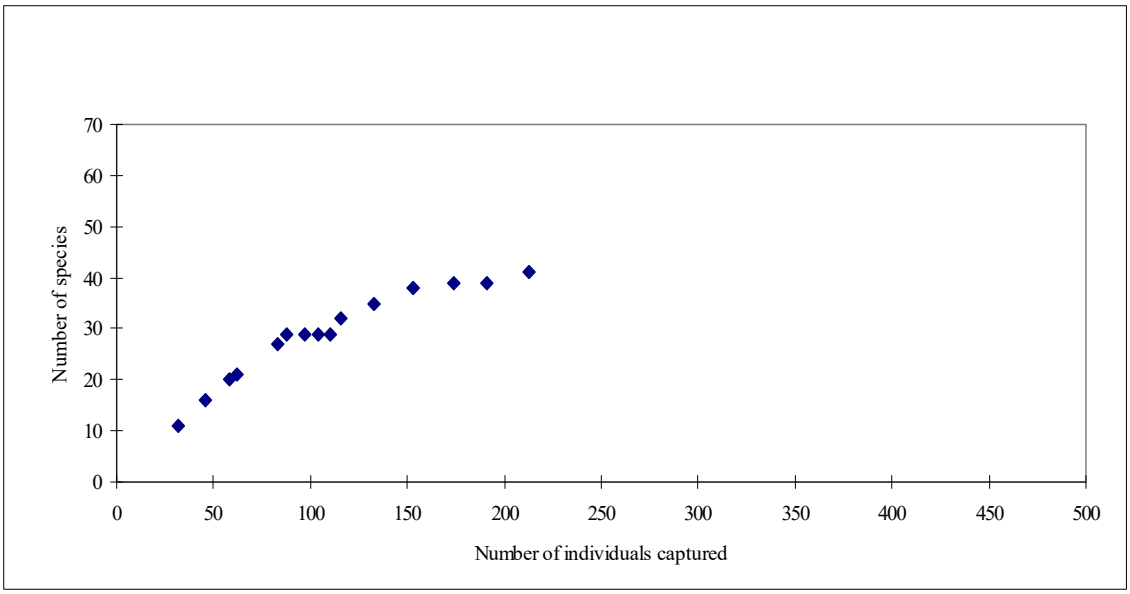

Fig. 7.2 Species accumulation rates for hawkmoths from inventory team personnel at Bwindi

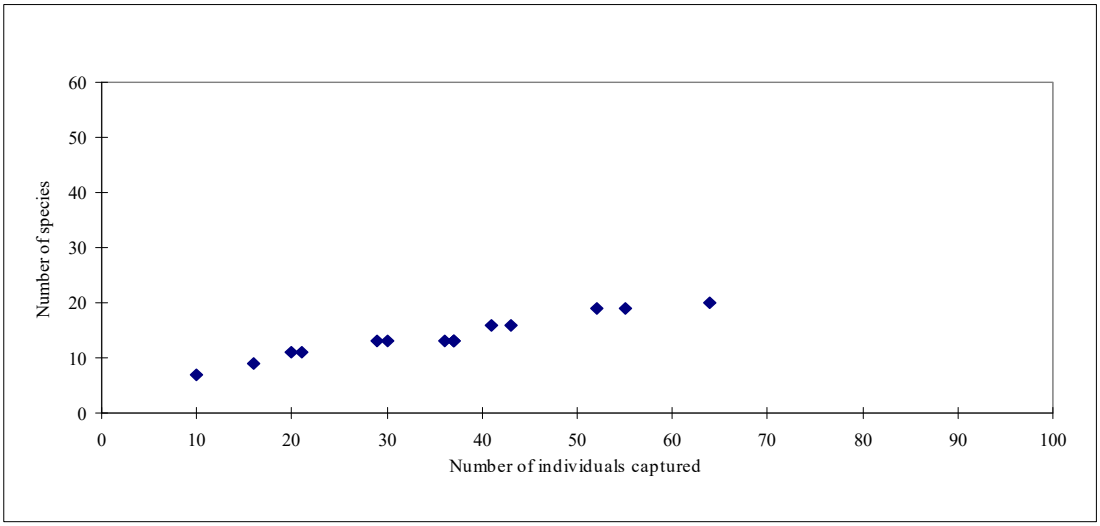

Fig. 7.3 Species accumulation rates for silkmoths from inventory team personnel at Bwindi

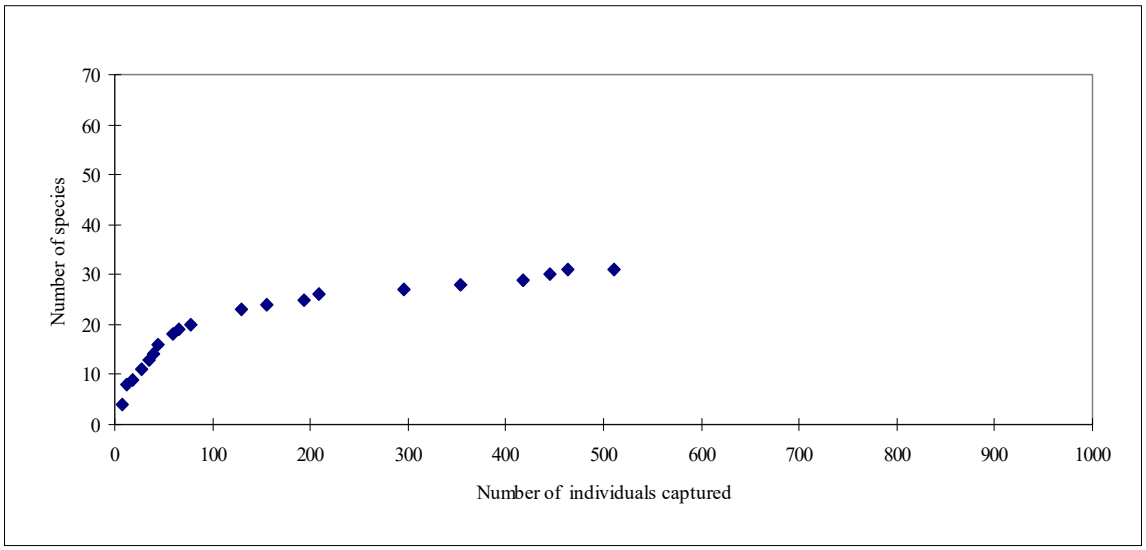

Fig. 7.4 Species accumulation rates for hawkmoths from the ITFC site, Ruhija, Bwindi

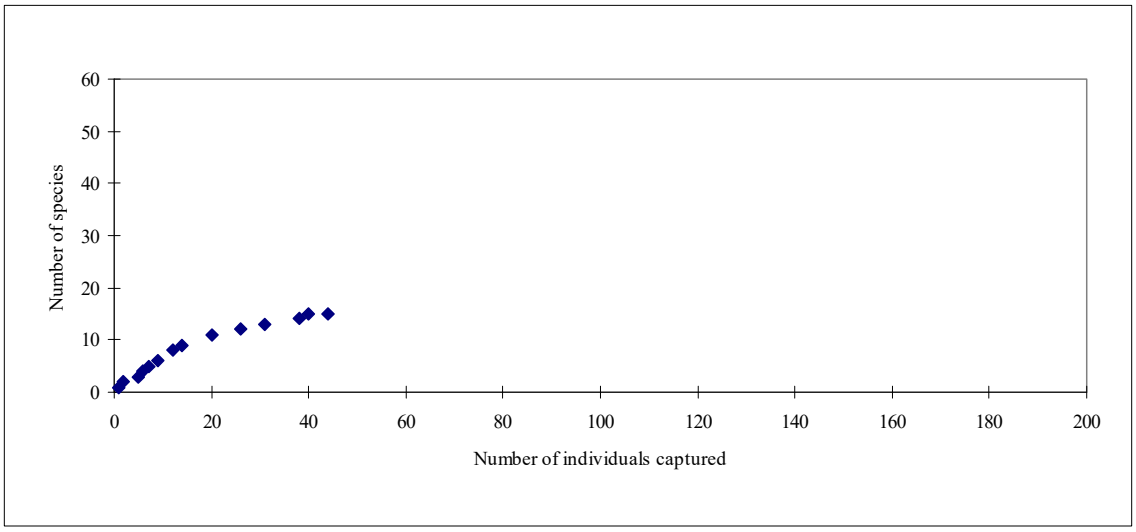

Fig. 7.5 Species accumulation rates for silkmoths from the ITFC site, Ruhija, Bwindi

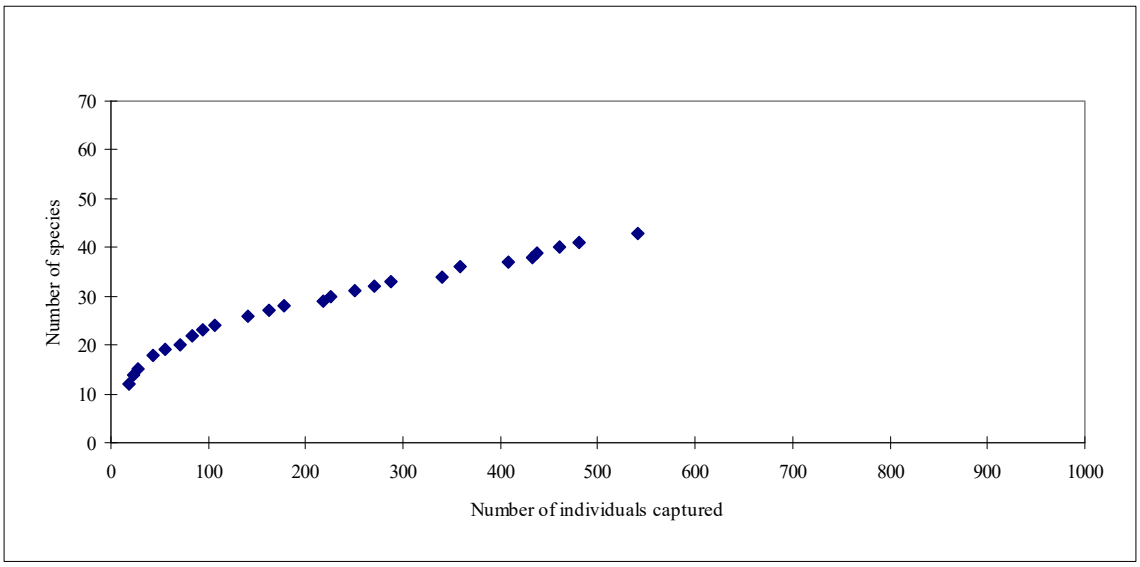

Fig. 7.6 Species accumulation rates for hawkmoths from Kitahurira Forest Station, Bwindi

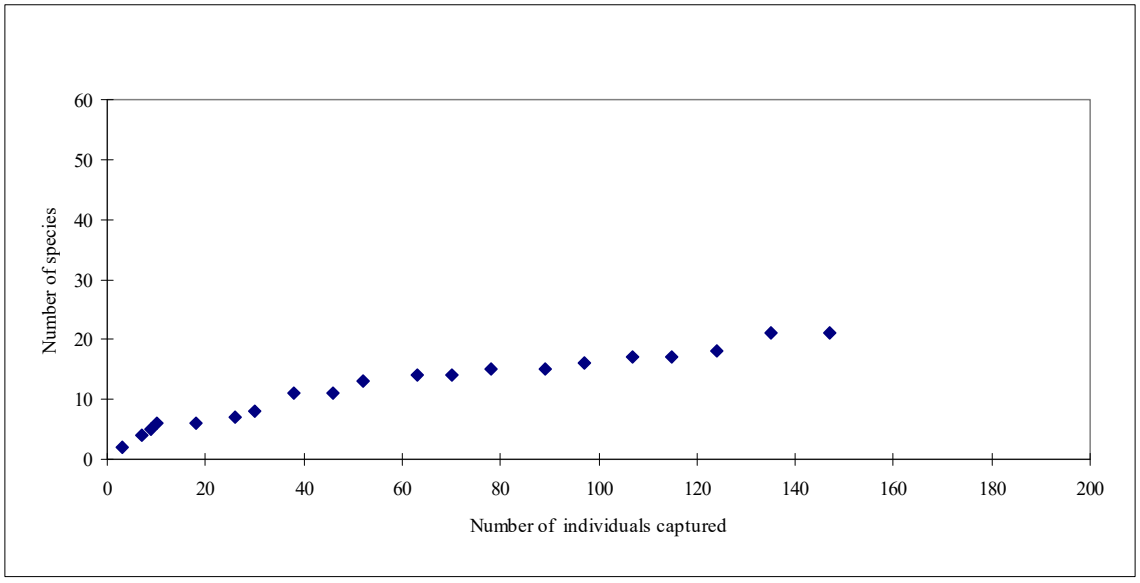

Fig. 7.7 Species accumulation rates for silkmoths from Kitahurira Forest Station, Bwindi

7.9 APPENDICES

Appendix 7.1 Daily record of hawkmoths (number of individuals) captured by inventory team personnel at Bwindi

	Site		RJ093838				QJ913907				QJ995906							
	Vegetation type (Langdale-B.)		B1				C3				C3							
	Month (1994)		2	2	2	2	2	2	2	2	8	8	8	8	8	9	9	
	Date		8	9	10	11	14	15	16	17	27	28	29	30	31	1	3	Total
Code	**Species**	**Ecol. Type**																
201	*Acherontia atropos*	WM		1						1		1					1	**4**
202	*Andriasa contraria*	W	1		1	1											1	**4**
212	*Centroctena rutherfordi*	F															1	**1**
215	*Chaerocina dohertyi*	FH			1													**1**
217	*Coelonia mauritii*	W		1			2	1	5	2	1	1	2	2	4	1	3	**24**
218	*Deilephila nerii*	WM		1	1													**2**
219	*Dovania poecila*	F	2	1									1	1				**5**
220	*Euchloron megaera*	WM		1	1		1									1	1	**5**
221	*Falcatula cymatodes*	F					1											**1**
222	*Falcatula falcata*	W													1			**1**
223	*Herse convolvuli*	WM	4	2			1											**7**
226	*Hippotion celerio*	WM	3	2														**5**
227	*Hippotion eson*	WM	5				4		1	2					1	2		**15**
228	*Hippotion irregularis*	F					3										2	**5**
229	*Hippotion osiris*	WM	1		1													**2**
239	*Macroglossum trochilus*	W				1												**1**
243	*Nephele accentifera*	W					1										1	**2**
244	*Nephele aequivaens*	f											1		1			**2**
246	*Nephele comma*	W	8	1		1	2			1								**13**
248	*Nephele funebris*	W						2	1	1					1		2	**7**
249	*Nephele monostigma*	FH						1						1	1	3		**6**
253	*Nephele rosae*	f					1							1	1		1	**4**
256	*Platisphynx constrigilis*	F												1	1			**2**
260	*Polyptychus affinis*	F											1					**1**
261	*Polyptychus andosus*	F												3	2	2	2	**9**
262	*Polyptychus carteri*	F									1		3	2	1		1	**8**
269	*Pseudoclanis postica*	W	1										2			2		**5**
276	*Temnora crenulata*	F					1											**1**
279	*Temnora elisabethae*	F		2	1													**3**
280	*Temnora eranga*	F									2		4	1		1		**8**
282	*Temnora funebris*	F	3		1		1		1			1	1	1	1	1	1	**12**
285	*Temnora iapygoides*													2		1	2	**5**
286	*Temnora livida*												1				1	**2**
288	*Temnora pseudopylas*	W	3													1		**4**
289	*Temnora pylades*	FH			1													**1**
292	*Temnora scheveni*	FH			1			1	1			1	1	4		2		**11**
293	*Temnora scitula*	F	1	2	2	1	1				1	2		1	6		1	**18**
297	*Theretra jugurtha*	f									1							**1**
298	*Theretra orpheus*	f					2											**2**
306	*Macropoliana ferax*	FH			1													**1**
307	*Nephele maculosa*	F															1	**1**
	Total individuals		**32**	**14**	**12**	**4**	**21**	**5**	**9**	**7**	**6**	**6**	**17**	**20**	**21**	**17**	**22**	**213**
	Cumulative individuals		**32**	**46**	**58**	**62**	**83**	**88**	**97**	**104**	**110**	**116**	**133**	**153**	**174**	**191**	**213**	
	Total species		**11**	**10**	**11**	**4**	**13**	**4**	**5**	**5**	**5**	**5**	**10**	**12**	**12**	**11**	**16**	
	New species		**11**	**5**	**4**	**1**	**6**	**2**	**0**	**0**	**3**	**0**	**3**	**3**	**1**	**0**	**2**	**41**
	Cumulative species		**11**	**16**	**20**	**21**	**27**	**29**	**29**	**29**	**32**	**32**	**35**	**38**	**39**	**39**	**41**	

Appendix 7.2 Daily record of silkmoths (number of individuals) captured by inventory team personnel at Bwindi

	Site		RJ093838				QJ913907				QJ995906							
	Vegetation type (Langdale-B.)		B1				C3				C3							
	Month (1993)		2	2	2	2	2	2	2	2	8	8	8	8	8	9	9	
	Date		8	9	10	11	14	15	16	17	27	28	29	30	31	1	3	Total
Code	**Species**	**Ecol. Type**																
102	*Athletes nyanzae*	f													1			**1**
105	*Aurivillius triramis*	f	1											1	1		1	**4**
118	*Epiphora albida*	F											1		1			**2**
122	*Epiphora rectifascia*	F	1															**1**
123	*Epiphora vacuna*	f	1	1					1									**3**
132	*Holocerina angulata*	f			1		1							1	3	1	2	**9**
134	*Imbrasia alopia*	F											1				1	**2**
138	*Imbrasia conradsi*	F		1														**1**
139	*Imbrasia eblis*	F															1	**1**
141	*Imbrasia epimethea*	F	1															**1**
148	*Imbrasia petiveri/dione*	f	4	2	2				2									**10**
149	*Imbrasia rectilineata*	f	1															**1**
151	*Imbrasia rubra*	f		2		1												**3**
156	*Lobobunaea acetes*	F													1			**1**
158	*Lobobunaea ansorgei*	F	1															**1**
161	*Lobobunaea phaedusa*	f					1									2	3	**6**
164	*Ludia orinoptena*	f					6	1	3	1			1				1	**13**
168	*Orthogonioptilum adiegatum*	F											1					**1**
172	*Orthogonioptilum vestigiatum*	F													1			**1**
176	*Pseudobunaea cleopatra*	F			1										1			**2**
	Total individuals		**10**	**6**	**4**	**1**	**8**	**1**	**6**	**1**	**0**	**0**	**4**	**2**	**9**	**3**	**9**	**64**
	Cumulative individuals		**10**	**16**	**20**	**21**	**29**	**30**	**36**	**37**	**37**	**37**	**41**	**43**	**52**	**55**	**64**	
	Total species		**7**	**4**	**3**	**1**	**3**	**1**	**3**	**1**	**0**	**0**	**4**	**2**	**7**	**2**	**6**	
	New species		**7**	**2**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**	**1**	**20**
	Cumulative species		**7**	**9**	**11**	**11**	**13**	**13**	**13**	**13**	**13**	**13**	**16**	**16**	**19**	**19**	**20**	

Appendix 7.7 Complete list of hawkmoth species known from Bwindi and their ecological characteristics

Code	Species	Ecological Type	Record
200	*Acanthosphinx guessfeldti*	F	2
201	*Acherontia atropos*	WM	2
202	*Andriasa contraria*	W	3
207	*Atemnora westermanni*	f	1
208	*Basiothia aureata*	f	2
210	*Basiothia medea*	WM	2
212	*Centroctena rutherfordi*	F	3
215	*Chaerocina dohertyi*	FH	3
217	*Coelonia mauritii*	W	2
218	*Deilephila nerii*	WM	2
219	*Dovania poecila*	F	3
220	*Euchloron megaera*	WM	2
221	*Falcatula cymatodes*	F	2
222	*Falcatula falcata*	W	2
223	*Herse convolvuli*	WM	2
224	*Hippotion aporodes*	FM	2
225	*Hippotion balsaminae*	W	2
226	*Hippotion celerio*	WM	2
227	*Hippotion eson*	WM	2
228	*Hippotion irregularis*	F	2
229	*Hippotion osiris*	WM	2
239	*Macroglossum trochilus*	W	2
240	*Macropoliana natalensis*	f	2
243	*Nephele accentifera*	W	2
244	*Nephele aequivalens*	f	2
245	*Nephele bipartita*	fL	2
246	*Nephele comma*	W	2
248	*Nephele funebris*	W	2
249	*Nephele monostigma*	FH	3
253	*Nephele rosae*	f	2
256	*Platysphinx constrigilis*	F	2
260	*Polyptychus affinis*	F	3
261	*Polyptychus andosus*	F	2
262	*Polyptychus carteri*	FL	2
269	*Pseudoclanis postica*	W	2
274	*Temnora albilinea*	F	2
276	*Temnora crenulata*	F	2
279	*Temnora elisabethae*	F	2
280	*Temnora eranga*	F	2
281	*Temnora fumosa*	W	2
282	*Temnora funebris*	F	3
285	*Temnora iapygoides*	F	3
286	*Temnora livida*	F	2
288	*Temnora pseudopylas*	W	3
289	*Temnora pylades*	FH	2
292	*Temnora scheveni*	FH	2
293	*Temnora scitula*	F	3
295	*Temnora zantus*	f	1
297	*Theretra jugurtha*	f	2
298	*Theretra orpheus*	f	2
300	*Xanthopan morgani*	f	2
306	*Macropoliana ferax*	FH	2
307	*Nephele maculosa*	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 7.8 Complete list of silkmoth species known from Bwindi and their ecological characteristics

Code	Species	Ecological Type	Record
102	*Athletes nyanzae*	f	2
105	*Aurivillius triramis*	f	3
118	*Epiphora albida*	F	3
119	*Epiphora antinorii*	FH	2
121	*Epiphora marginimacula*	FH	3
122	*Epiphora rectifascia*	F	3
123	*Epiphora vacuna*	f	3
126	*Goodia lunata*	F	1
128	*Goodia smithi*	f	1
129	*Gynanisa festa*	f	1
132	*Holocerina angulata*	f	3
134	*Imbrasia alopia*	F	2
136	*Imbrasia anthina*	F	3
138	*Imbrasia conradsi*	F	3
139	*Imbrasia eblis*	F	2
141	*Imbrasia epimethea*	F	2
145	*Imbrasia krucki*	F	1
148	*Imbrasia petiveri/dione*	f	3
149	*Imbrasia rectilineata*	f	2
151	*Imbrasia rubra*	f	3
155	*Imbrasia wahlbergina*	F	3
156	*Lobobunaea acetes*	F	2
157	*Lobobunaea angasana*	f	2
158	*Lobobunaea ansorgei*	F	3
160	*Lobobunaea goodii*	f	3
161	*Lobobunaea phaedusa*	f	2
163	*Ludia hansali*	f	1
164	*Ludia orinoptena*	f	3
168	*Orthogonioptilum adiegatum*	F	2
172	*Orthogonioptilum vestigiatum*	F	2
174	*Pselaphelia vandenberghei*	FH	2
176	*Pseudobunaea cleopatra*	F	2
177	*Pseudobunaea epithyrena*	f	2
178	*Pseudobunaea tyrrhena*	f	3
180	*Tagaropsis flavinata*	f	3

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