DEVELOPING BIODIVERSITY MONITORING INDICATORS FOR UGANDA *(DRAFT)*

SEPTEMBER 2011

CITATION

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ACKNOWLEDGEMENT

The National Environment Management Authority (NEMA) is grateful to stakeholders that provided input during the development of biodiversity monitoring indicators for Uganda. In particular NEMA would like thank Uganda Wildlife Authority (UWA), Makerere University Institute of Environment and Natural Resources (MUIENR) now a unit under the School of Forestry, Environmental and Geographical Studies and Nature Uganda for providing technical officers that worked with NEMA in drafting the development of biodiversity monitoring indicators for Uganda.

The Technical Committee on Biodiversity Conservation played a very important role of reviewing and refining the contents of this document. NEMA appreciates time and commitment the biodiversity committee. NEMA urges the committee to maintain this spirit and also to play an indicative role in building capacity of institutions in the development and use of biodiversity monitoring indicators.

Financial support for the development of biodiversity monitoring indicators for Uganda was from the United Nations Environment Programme through World Conservation and Monitoring Centre (UNEP-WCMC) under the BICSAfrica Project. NEMA, on behalf of Government, would like to thank UNEP-WCMC for the financial support and for training technical officers from UWA, Nature Uganda, MUIENR, Uganda Bureau of Statistics (UBOS) and NEMA on developing biodiversity indicators. The knowledge and skills that was acquired by these officers was used in preparing Biodiversity Monitoring Indicators for Uganda.

Lastly, the preparation of this document required coordinating activities and participation of stakeholders. In this regard, NEMA commends Mr. Francis Ogwal for coordinating the activity and networking with technical officers from UWA, MUIENR and Nature Uganda as well as the Technical Committee on Biodiversity Conservation.

FORWARD

Uganda depends on the exploitation of its natural resources for national development, livelihood improvement and poverty eradication. One of these resources is biological diversity or biodiversity for short. Due to its unique geographical location and favourable climate, Uganda is blessed with diverse ecosystems like forests, wetlands, hilly and mountainous areas, rangelands, rivers and lakes with a rich biodiversity. Biodiversity provides the raw materials and ecosystem services that sustain human wellbeing on earth.

The world's fisheries resources is estimated to employ approximately 200 million people, providing about 16% of the protein consumed worldwide and have a value estimated at US$ 82 billion..The fisheries of Lake Victoria are shared between Kenya, Tanzania and Uganda and provide an immense source of income, employment, food and foreign exchange for East Africa. The lake produces a fish catch estimated at over 800,000 tonnes annually, worth about US $590 million.

Globally, the tourism sector accounts for 10% of the job market. In 2007 it was estimated that the sector generated US$856 billion and this is mainly biodiversity based tourism. On the side on medicine, the pharmaceutical sector turnover of US$650 million annually is estimated to be derived from biodiversity resources. In Africa, the percentage of people who rely on traditional medicine (from plants and animals) is estimated at 80%. In Uganda, the population (especially the rural poor) relies heavily on traditional medicine to supplement primary health care. Biodiversity maintains a diverse pool of genetic resources available for future developments and applications, some of which may not be known now.

Despite the importance of biodiversity for human wellbeing, biodiversity is under threat globally and nationally. Forty (40%) of the bird population in the world are declining. Sixty (60%) of the ecosystem services (the benefits and services that we get from ecosystems like water catchment functions, soil erosion control, flood regulations, nutrient re-cycling, fresh water, wood and fibre, water purification, aesthetic, cultural and spiritual values among others) have been degraded in the last 50 years.

About 50% of the known 52,000 medicinal plants in the world are threatened with extinction. Globally, a minimum of 16,928 larger animal species are threatened with extinction and these includes mammals, birds, reptiles, amphibians and of fish. The abundance of species worldwide has declined by 40% between 1970 and 2000.

In Uganda forests and woodland covered approximately 45% of the total land area in 1890. , and today this has declined to only 20%. Already 30% of Tropical High Forest which provide high value forest products, environmental services and biodiversity is estimated to have been degraded. The forest cover is estimated to be shrinking at 86,000 ha per year. Only about 8 % of the population have access to and use electricity. The rest mainly depend on fuel wood. It is estimated that between16-18 million tonnes of firewood are consumed per year as domestic firewood while another 4 million tonnes of charcoal are consumed per year. The white rhino became extinct in 1970's because of destructive use and Government has had to buy rhinos from other countries and re-introduce them in Uganda.

Biodiversity loss is therefore not only an environmental and social issue, it an economic one too. The cost of biodiversity loss on land alone in the last 10 years (globally) is estimated at US$500 billion. The costs of environmental degradation to the Uganda's economy is estimated at about 17% of the GDP of which 11% is constituted by soil degradation estimated at US $ 625m per annum while loss of biodiversity is estimated at US$ 240 million per year.

The continued loss of biodiversity needs mechanism to be put in place to track the status and trends of biodiversity overtime. What is needed a set of indicators that can be used to monitor the status and trend of biodiversity to inform and pre-empt early action before the situation gets worse.

NEMA in collaboration with UWA, MUIENR, Nature Uganda, UNEP-WCMC and the Technical Committee on Biodiversity Conservation has prepared this document which provides guidance to stakeholders involved in biodiversity conservation on steps involved in the development of indicators for monitoring the status and trends of biodiversity in Uganda.

I call up on Government ministries and agencies to use this document o prepare biodiversity monitoring indicators. This information will not only guide informed decision making but will also contribute to reviewing existing policies and strategies on biodiversity as well as formulation of new policies and strategies to address the emerging issues as provided from the use of biodiversity monitoring indicators.

Dr. Tom O. Okurut
EXECUTIVE DIRECTOR

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LIST OF ACRONYMS

BICSAfrica – Biodiversity Indicators Capacity Strengthening in Africa
CBD – Convention on Biological Diversity
CHM – Clearing House Mechanism
IBA – Important Bird Areas
IUCN – International Union for the Conservation of Nature
KNP – Kibaale National Park
LPI – Living Planet Index
MGNP – Mgahinga Gorilla National Park
MUIENR – Makerere University Institute of Environment and Natural Resources
NBDB – National Biodiversity Data Bank
NBSAP – National Biodiversity Strategy and Action Plan
NEMA – National Environment Management Authority
NFA – National Forestry Authority
NGOs – Non Governmental Organization
PAs – Protected Areas
SPI – Species Population Index
UBOS- Uganda Bureau of Statistics
UNEP-United Nations Environment Programme
UWA – Uganda Wildlife Authority
WCMC – World Conservation Monitoring Centre
WCS – Wildlife Conservation Society
WWF – World Wildlife Fund

EXECUTIVE SUMMARY

Indicator adopted by Uganda is the one used in the 2010 Biodiversity Indicator Partnership (BIP) capacity building workshops which is, "***a measure based on verifiable data that conveys information about more than itself***". The indicators selected are purpose dependent implying that the interpretation or meaning given to the data depends on the purpose or issue of concern. For example status and trends of the components of biodiversity i.e trends in abundance and distribution of selected species, trends in extent of selected ecosystems and habitats and the indicators used are living planet index, water bird indicator and extent of forests and forest type. A successful indicator should be scientifically valid, based on available data, responsive to change in the issue of interest, easily understandable, relevant to user's needs and is easily used.

In Uganda the development of indicators was an iterative process, with progress in one component sometimes requiring revisiting work done for another component. This is has been the case in the identification of possible indicators and was a backwards and forwards process at the stage of gathering and reviewing of data.

Identification and consultation of stakeholders was the first stage of the process and involved consultations with the indicator producers and users to define the indicator's purpose and the most appropriate ways indicators should be communicated and interpreted for to the users / audience. Among the producers and users were government conservation agencies, conservation-focused nongovernmental organizations (NGOs) and relevant departments in universities and research institutions. Government agencies responsible for management of natural resources and land-use planning, agencies with an interest in rural development and indigenous peoples groups were also identified and consulted.

The definition of key questions was conducted as part of the identification and consultations with stakeholders. Nonetheless most stakeholders were not clear what questions they had regarding biodiversity-related policies and management. They also differed widely in their awareness and understanding of the relationships between biodiversity and their own interests.

Presentation of existing information and indicators developed helped to stimulate stakeholders' thinking and awareness of questions and therefore indicators that are important to them for targets monitoring and reporting, decision-making and the science-policy interface.

The biodiversity indicators development framework for Uganda follows steps developed UNEP-WCMC developed and used in regional indicator capacity building under the Biodiversity Indicators Capacity Strengthening in Africa (BICSAfrica) project. This is an ideal framework, having been compiled from many different sources and experiences. The Framework contains key steps for producing successful biodiversity indicators and is explained in Chapter two.

CHAPTER ONE: INTRODUCTION

1.1 Definition and importance of Indicators

The definition of an indicator adopted by Uganda is the one used in the 2010 Biodiversity Indicator Partnership (BIP) capacity building workshops which is, "**a measure based on verifiable data that conveys information about more than itself**". Simple measures such as the population of an important species in a country, or more complex measures such as indices produced by combining several variables or data sets, such as Ecological Footprint.

Representation of measurable indicators has been in a numerical or quantitative form, such as a graph, pie chart or map. Selected indicators were based on verifiable data, so that the source and suitability of the data can be checked by others for credibility.

The indicators selected are purpose dependent implying that the interpretation or meaning given to the data depends on the purpose or issue of concern. For example status and trends of the components of biodiversity i.e. trends in abundance and distribution of selected species, trends in extent of selected ecosystems and habitats and the indicators used are living planet index, water bird indicator and extent of forests and forest type.

A successful indicator should be scientifically valid, based on available data, responsive to change in the issue of interest, easily understandable, relevant to user's needs and is easily used.

1.2 Data management and use in Uganda

1.2.1 Data and information users

The data and information held and produced by the National Biodiversity Data Base (NBDB) have been used both locally and globally in biodiversity information issues. Users include individual researchers and students; government agencies; and local, regional and global organizations

1.2.2 Data sources

Data used in this report come from many different sources and are of varying kinds, namely:

1. From institutions, e.g., the Uganda Wildlife Authority, Wildlife Conservation Society, NatureUganda.
2. From published sources, mainly journals, but also books and reports.
3. From individual researchers, often as part of a broader programme, such as higher degree studies.
4. Data was also obtained from the National Biodiversity Data Bank (NBDB) in the College of Agriculture and Environmental Studies. Examples include data from Bird Population Monitoring programme (collected jointly with NatureUganda), counts of fruit bats in the Kampala area, independent researchers, among others

Where programmes are known to be on-going (such as UWA's counts of large mammals, or censuses of mountain gorillas), the NBDB endeavours maintain contact with the

person(s) responsible, so that the NBDB is kept up-to-date. The philosophy that data should be used in and, consequently, shared – is a good one and should be strongly encouraged, although there will inevitably be some explains, such as locations of threatened species, or sometimes for work in progress.

Data are normally given freely to the NBDB on the understanding that they are for use in a broader, national monitoring programme; and that where the data are used for any other purpose, the source is clearly acknowledged.

It is important that all the data within a series are collected in the same way; and, where relevant, in the same season of the year. Some data sets are the work of a single individual which usually ensures a high level of consistency.

1.2.3 Types of data

Biodiversity can be considered at three levels – genetic, species and ecosystems. The structure of the NBDB follows this scheme.

(a) Genetic data. In practice this means the number of species in a particular taxon in Uganda. When any of these species becomes extinct in Uganda (as has happened to several species of large mammals, and many cichlid fish in Lake Victoria), this represents genetic loss to Uganda. New species also arrive, and sometimes become pests or invasive, but they are not included as they are not native. The number of species can also change as a result of taxonomic revisions, but these do not affect the sum of genetic material, and are not considered here. We know of only one species which has arrived in Uganda without human involvement, namely the European House Sparrow, *Passer domesticus*.

(b) Species data form the great bulk of the information in the NBDB and they are of two broad types:

b1 Population data. Counts of animals, especially mammals and birds, are common in conservation studies, and many such sets are available for Uganda (and most other countries). In addition, there are a few counts of trees. The methods available for making such counts are very many and all have advantages and disadvantages. In vetting data before entry into the NBDB, particular attention is given to the appropriateness of the methods and the experience of those providing the data. Where these are in doubt (e.g. some work by young students) the data may be kept as hard copies but not used in analyses.

b2 Species counts. Lists of species are commonly made in biodiversity surveys and lists from the same area in different years invariably show changes. Losses or gains in the numbers of species in particular areas, such as national parks, represent changes in their amounts of biodiversity. This commonly occurs with changes in land use.

(c) Ecosystem data. For Uganda, there are estimates for various years of the extent of wetlands, woodlands and forests. All are becoming smaller in extent, again representing biodiversity loss.

Data can be classified in other ways as well namely:

i. national (such as mountain gorilla censuses) or local (such as fruit bats in Kampala); the former obviously carry more weight;
ii. for individual species or groups of species (e.g. herbivores, primates);
iii. by land use, notably protected areas (National Parks, Wildlife Reserves, Forest Reserves), pastoral lands and agricultural areas. A few data also exist from built-up areas.
iv. by conservation status, mainly using the IUCN Red Lists of threatened, endangered and critically endangered species.

1.2.4 Data analyses

The output from sets of monitoring data is invariably in the form of trends. Trend analysis is complex, especially with data such as those in the NBDB, because –

i. Most data sets are incomplete (missing years)
ii. For grouped data (the majority in the analyses that are presented here), the data from the sets forming the groups are typically from different years from each other.
iii. Data may need to be weighted, e.g. with national sets more heavily weighted than local ones; those with data from more years also being more 'valuable' than those from only two.

The teams responsible for World Wildlife Fund (WWF's) 'Living Planet' global reports have carried out the analyses for Uganda; in exchange for the use of Ugandan data (they mainly use data of category b1 above, population data, and only for vertebrates). Their methods of trend analysis are described by in Loh *et al* (2005). For this report, most trends are in the form of indices, taking the year 1970 as a base line, by when there were already 31 data sets on trees and birds. In common with many other indices, ours were set to 100 in 1970.

CHAPTER TWO: BIODIVERSITY INDICATOR DEVELOPMENT

2.1 Indicator Development Process in Uganda.

In Uganda the development of indicators was an iterative process, with progress in one component sometimes requiring revisiting work done for another component. This is has been the case in the identification of possible indicators and was a backwards and forwards process at the stage of gathering and reviewing of data.

Identification and consultation of stakeholders / audience was the first stage of the process and involved consultations with the indicator producers and users to define the indicator's purpose and the most appropriate ways indicators should be communicated and interpreted for to the users / audience. Among the producers and users were government conservation agencies, conservation-focused nongovernmental organizations (NGOs) and relevant departments in universities and research institutions. Government agencies responsible for management of natural resources and land-use planning, agencies with an interest in rural development and indigenous peoples groups were also identified and consulted.

Uganda like most other countries has management objectives and policies in place that have direct or indirect impacts on biodiversity. However biodiversity-relevant policies and management are scattered through a wide variety of sectors and many do not include clear objectives or targets.

Management policies include national biodiversity strategies and action plans (NBSAP), protected areas systems plans and endangered species action plans and legislation. Relevant policies in natural resource management sectors include wildlife policy, national forest plans, fisheries policies, water policies, land-use plans and environmental impact legislation.

The definition of key questions was conducted as part of the identification and consultations with stakeholders. Nonetheless most stakeholders were not clear what questions they had regarding biodiversity-related policies and management. They also differed widely in their awareness and understanding of the relationships between biodiversity and their own interests.

Presentation of existing information and indicators developed helped to stimulate stakeholders' thinking and awareness of questions and therefore indicators that are important to them for targets monitoring and reporting, decision-making and the science-policy interface.

2.2 Biodiversity Indicator Development Framework

The biodiversity indicators development framework presented in Figure 3 contains the components for production of indicators that UNEP-WCMC developed and used in regional indicator capacity building under the Biodiversity Indicators Capacity Strengthening in Africa (BICSAfrica) project

This is in an ideal framework, having been compiled from many different sources and experiences. The Framework contains key steps for producing successful biodiversity indicators. No single biodiversity indicator has been produced following all of the components of the framework, and it is certainly not a requirement for indicator development to include all of the components.

In Uganda the development of indicators was an iterative process, with progress in one component sometimes requiring revisiting work done for another component. This is has been the case in the identification of possible indicators and was a backwards and forwards process at the stage of gathering and reviewing of data.

Figure3. Biodiversity indicators development framework adopted

The Framework is divided into three themes:

Purpose – actions needed for selecting successful indicators

Production – essential to generate indicators

Permanence – mechanisms for ensuring indicator continuity and sustainability.

2.3 Identify and consult stakeholders / audience

This was the first stage of the process and involved consultations with the indicator producers and users to define the indicator's purpose, how simple or complicated the indicator can be, and the most appropriate ways it should be communicated and interpreted to the users / audience. Among the producers and users were government conservation agencies, conservation-focused nongovernmental organizations (NGOs) and relevant departments in universities and research institutions, are obvious. Others, including government agencies responsible for management of natural resources and land-use planning, agencies with an interest in rural development and indigenous peoples groups, may be less apparent.

At this level, management objectives and targets were identified, and, key questions and indicator use were determined.

2.4 Identify management objectives and targets

Uganda like most other countries has management objectives and policies in place that have direct or indirect impacts on biodiversity. However biodiversity-relevant policies and management are scattered through a wide variety of sectors and many do not include clear objectives or targets.

Management policies include national biodiversity strategies and action plans (NBSAP), protected areas systems plans and endangered species action plans and legislation. Relevant policies in natural resource management sectors include wildlife policy, national forest plans, fisheries policies, water policies, land-use plans and environmental impact legislation.

Reporting /demonstrating progress on achieving the management objectives has played a big role for impacts on biodiversity. Whilst these policies have clearly stated objectives and there have no explicit targets.

2.5 Determine key questions and indicator use

Because selected indicators are purpose dependent purpose of the individual indicators was discussed and stated to determine the key question for which an indicator is needed.

One of the benefits of defining a key question has been enhancing of the selection and communication of the indicators in a form that aids their interpretation.

The definition of key questions was conducted as part of the identification of stakeholders or the audience for the indicator and consultations with them. The output of this stage was the definition of the key questions which the users had regarding the

biodiversity issue of concern. Also a result of the identification of management objectives and targets was a key question

Most stakeholders were in the first instance not clear what questions they had regarding biodiversity-related policies and management. They also differed widely in their awareness and understanding of the relationships between biodiversity and their own interests. Presentation of existing information and potential indicators helped to stimulate stakeholders' thinking and awareness of questions that were important to them. The definition of key questions with stakeholders was an iterative process and a number of questions were identified, and not all of them were of the kind best answered using indicators, such as, 'what are the relationships between poverty and biodiversity?'

2.6 Gather and review data

This stage of biodiversity indicator development was conducted in conjunction with the stage to identify possible indicators.

Lack of suitable data was identified as a major constraint to the production of biodiversity indicators.

2.7 Identify possible indicators and calculating indicators

Available data were used to produce indicators that respond to specific key questions.

The selection or development of a particular indicator considered one or more of the following factors:

i. how well does it help to answer the key question(s)?
ii. how easily will it be understood by the intended users?
iii. what is the demand or need for this indicator?
iv. are the methods of data collection and analysis scientifically valid and defensible (considering the conceptual framework)?
v. is the available data suitable for the intended use?
vi. is the data accessible and likely to be continued to be produced in the future?
vii. is there sufficient institutional technical capacity and resources to produce the indicator now and in the future?
viii. is the indicator also used for international reporting?

An example on how to develop sector indicators based on the above key questions is provided in the example of the fact sheet for Uganda Wildlife Authority (Annex 1). Institutions can use this example to develop their own indicators.

The Technical Committee on Biodiversity Conservation reviewed and refined the proposed framework for developing biodiversity monitoring indicators in Uganda.

CHAPTER THREE: BIODIVERSITY INDICES

3.1 Current National Biodiversity Indicators

The indices in this section were developed in the same way as for the Living Planet Index (LPI) of WWF, which is a global biodiversity, index – more details of this are given below. The term index, as in a cost-of-living index, for example, has much the same meaning as an indicator, although the latter tends to provoke the question 'indicator *of what*?

Since 1999 the National Biodiversity Data Bank (NBDB) in the College of Agriculture and Environmental Studies has been producing reports every two years on the State of Uganda's biodiversity. These have drawn on data from a wide variety of sources and have resulted in a series of indicators (or indices) on the biodiversity itself.

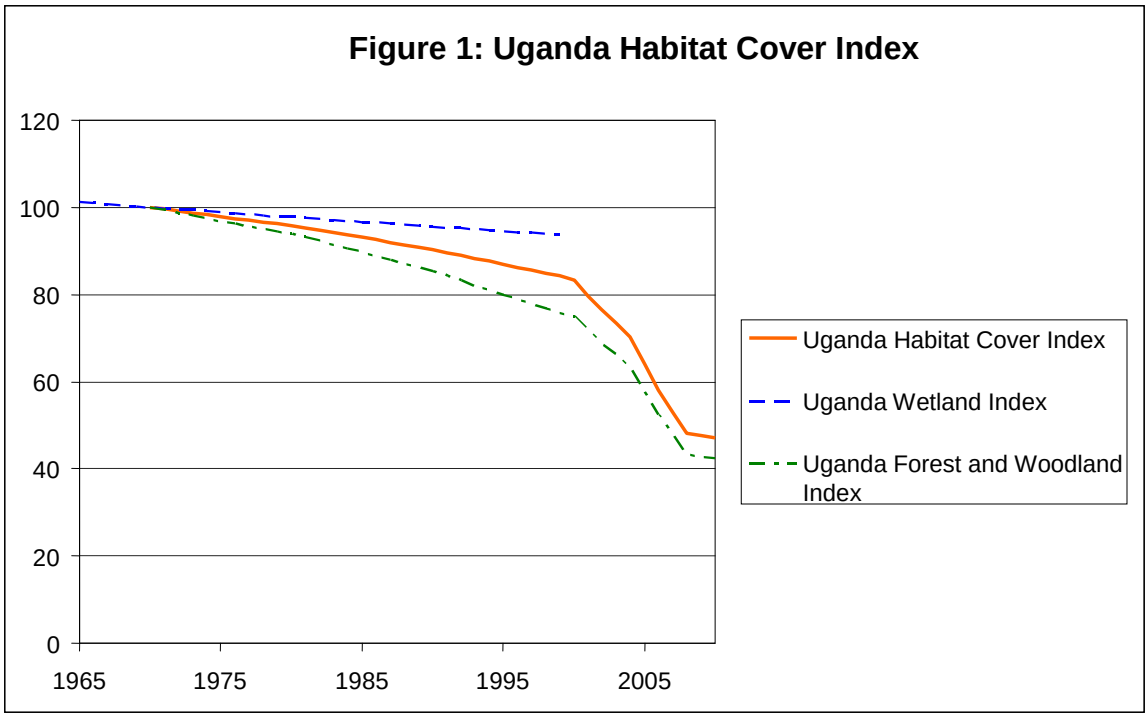
This section draws on this existing body of data, updated to 2010 (and in a few cases, 2011) and presented in the form of indices. As will be seen, these reflect a general loss of biodiversity, but this is more serious for some aspects of biodiversity than others. Taken together, there is some clear evidence of a reduction in the rate of loss, indicating that Uganda may be meeting its target under the Convention on Biological Diversity. Indicators also exist already for the environmental conditions of Important Bird Areas (IBAs), but other types await development.

The indices presented here are in three groups. The first provides the basic background information, the second offers information that is potentially of practical use to managers, and finally we ask how is Uganda doing overall, and what are the policy implications? Here we present the key results: information on how the indices were compiled is given in Annex 2.

3.2 Background trends

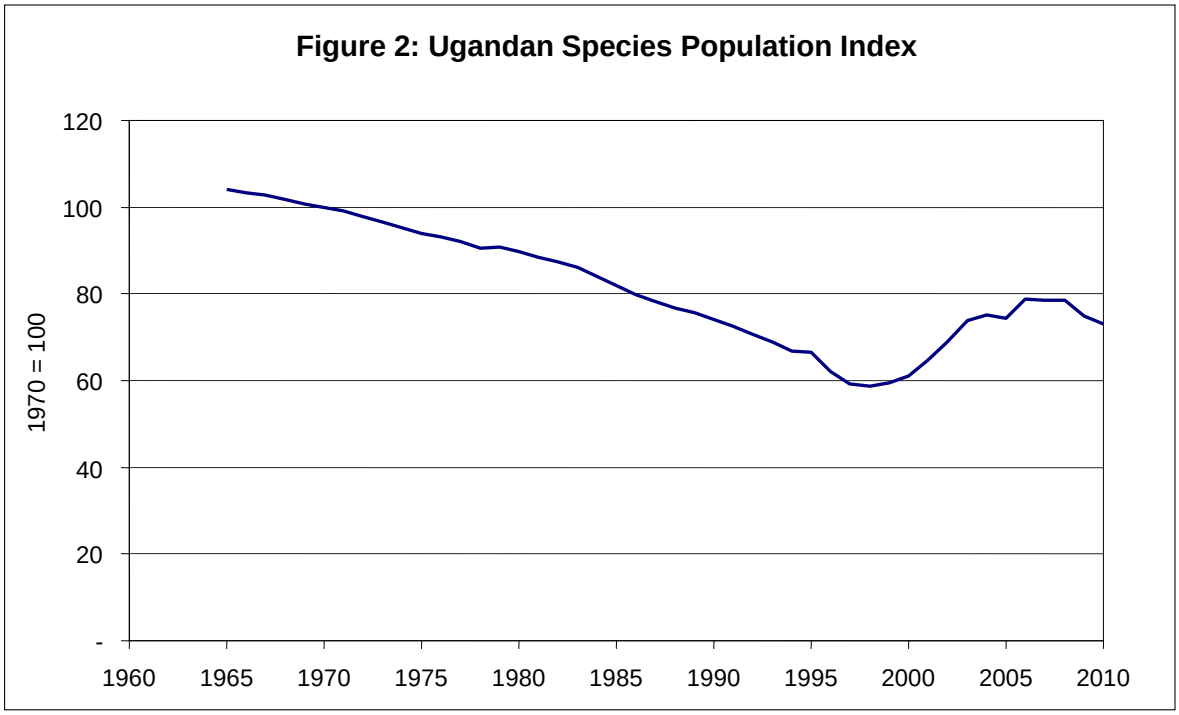
Index 1: Uganda Habitat Cover Index

From 1999 to 2010 it is based on the trend in forest and woodland cover alone. The UHCI shows a 15% decline between 1970 and 2000. Between 2000 and 2008 it dropped steeply to below the 50% mark. The step change in rate of decline after 2000 looks strange, running counter to the up-turn in the species population index over the same period, and suggests there may be some anomalies in the forest time series data. From 2008 to 2010 the Forest and Woodland Index returns to its pre-2000 rate of decline.



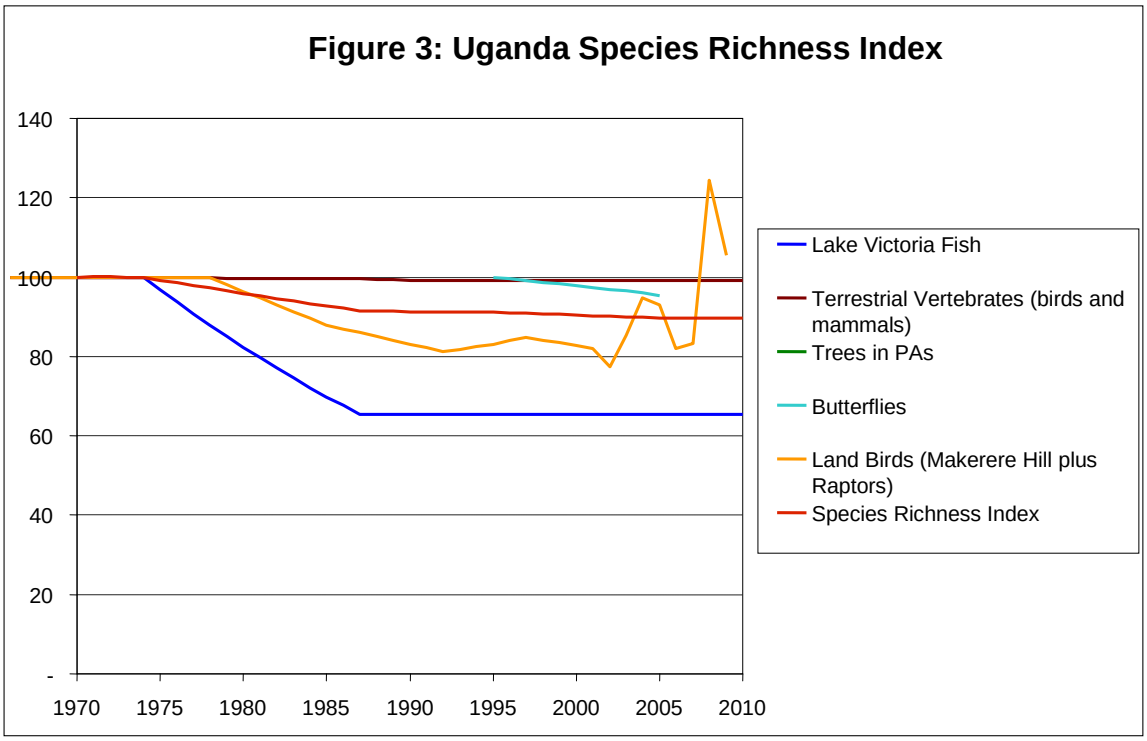
This index is based upon the areas of forest, woodland and wetlands, using a wide variety of data sources: but the most recent wetland data are from 1999. There are clear declines, especially in recent years when deforestation has become widespread. However, all of the terms forest, woodland and wetland are difficult to define precisely, and different sources give different figures of, for example, the current area of forest in Uganda.

Index 2: Uganda species population index.



This index is based upon many individual data sets, in fact all but one of those for which the numbers of trees or birds or mammals were counted. The exception is the fruit bats of Kampala, whose recent sudden drop may be temporary: counts in the next few years will resolve that question. Whilst the general trend is downwards, fluctuations in the most recent years indicate some gains as well as losses. Since 1970, this index has dropped by some 20-30%.

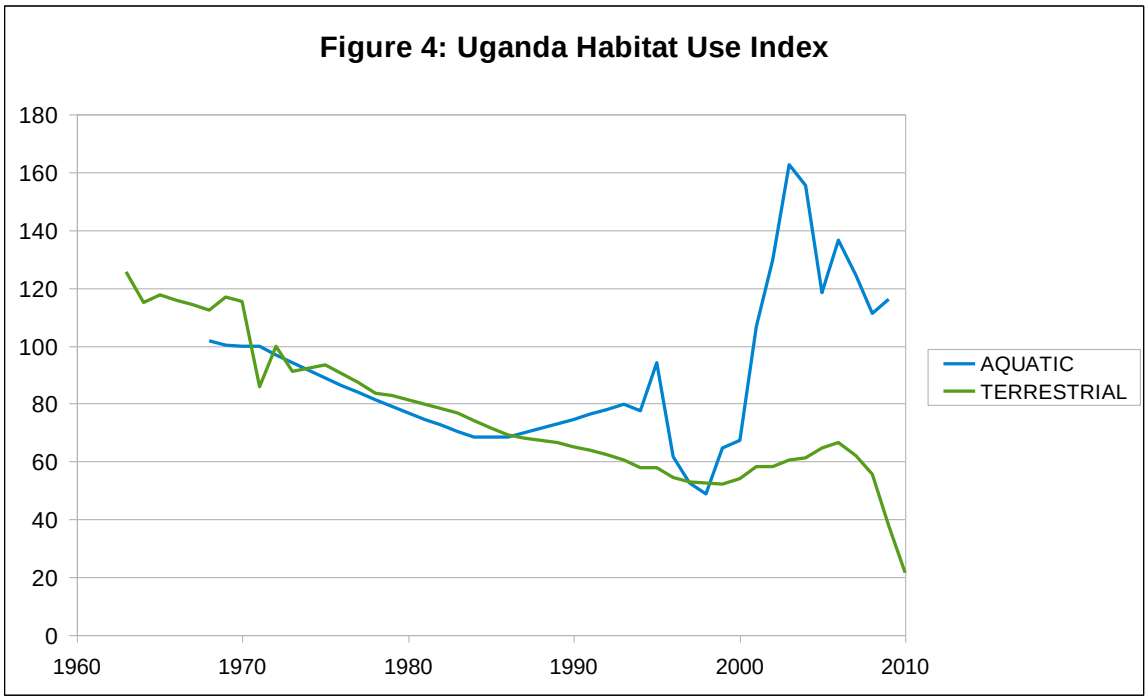
Index 3: Uganda species richness index.



Data for this index come from two main sources. Firstly the numbers of species of both birds and large mammals are relatively well-known in Uganda, and the loss of one bird species and several species of large mammals (such as the Oryx and both species of rhinoceros) is well-documented. It is also known that large numbers of fish species, mostly cichlids, have become extinct in Lake Victoria following the introduction of the Nile perch.

Secondly, there are several groups of species of trees, butterflies and birds at a wide variety of places where the numbers of species have been counted in two or more years. In one case – the numbers of bird species – there has been an increase in recent years but the overall trend of this indicator suggests a 10% loss from 1970 to 2010.

Index 4: Uganda Habitat Use Index

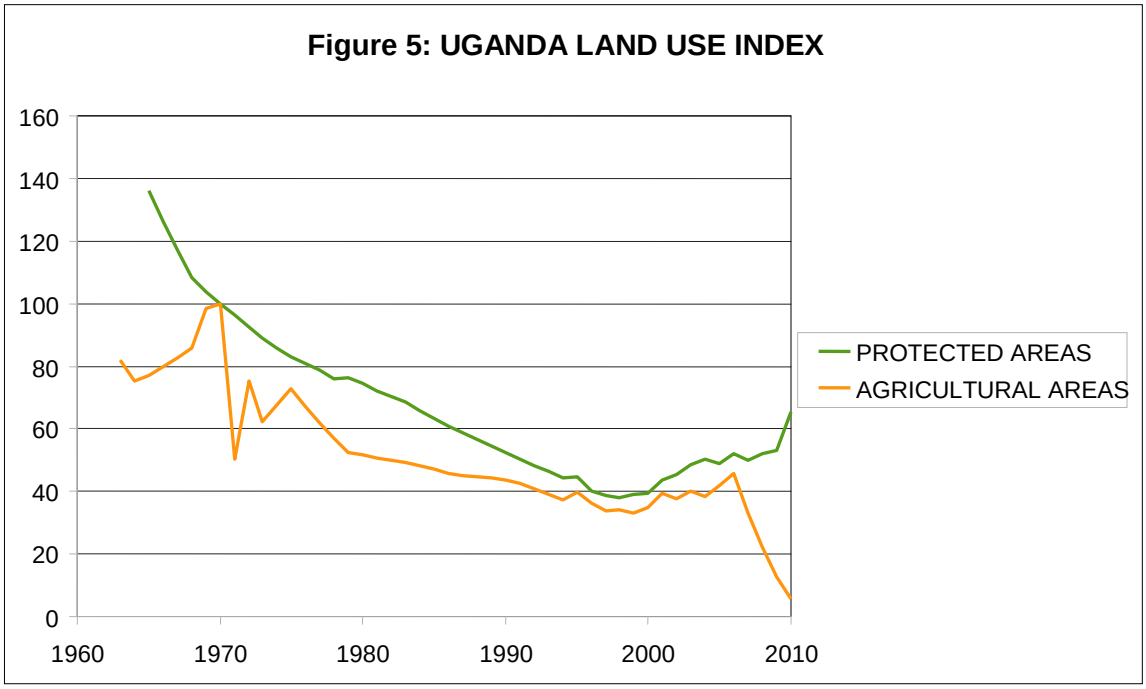


Counts in both aquatic and terrestrial habitats are combined in Figure 4. The general downward trend of terrestrial life is not unexpected, partly due to the decline over the past 50 years of the populations of large mammals. The graph for aquatic species is quite different and to some extent at least shows the problems of analyzing these data. For the past 15 years, this indicator has ranged from below 50 to above 160, all relative to a value of 100 in 1970. This is partly because of small sample sizes, but is also positive in the sense that it is counter-intuitive given the general picture of loss, including that of wetlands.

3.3 Information for managers

Data sets can be combined in various ways, as here is Figure 5, whilst Figure 6, 7 and 8 are examples of how successful or otherwise conservation policies have been.

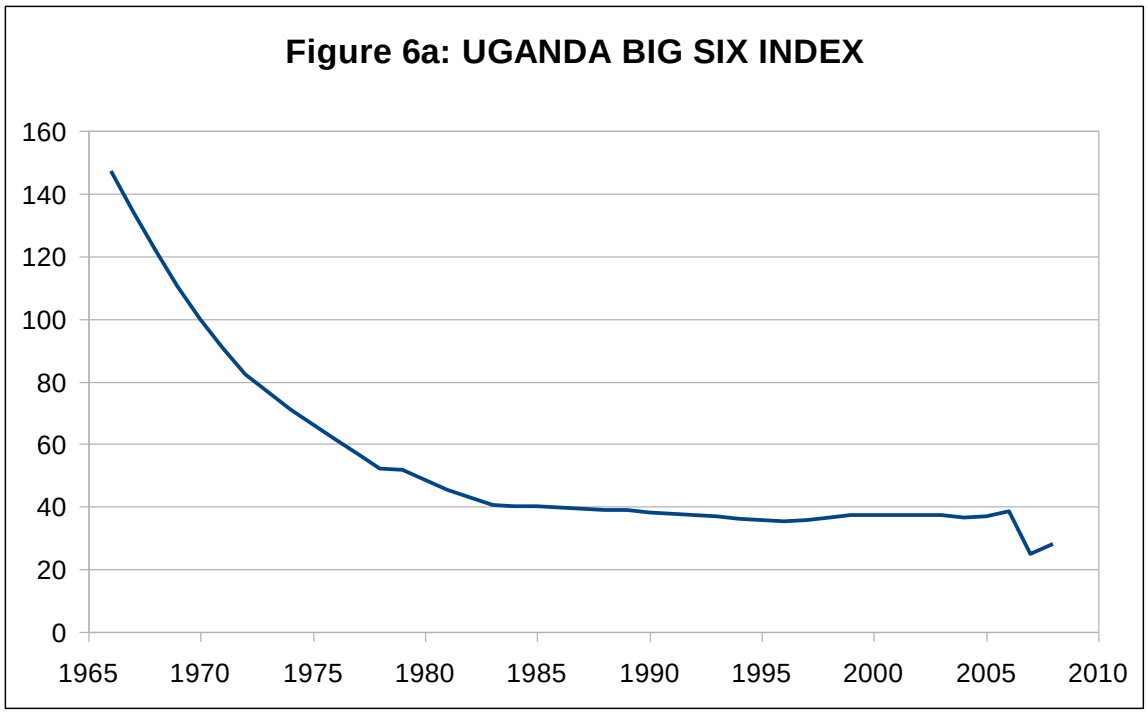
Index 5: Uganda land use index



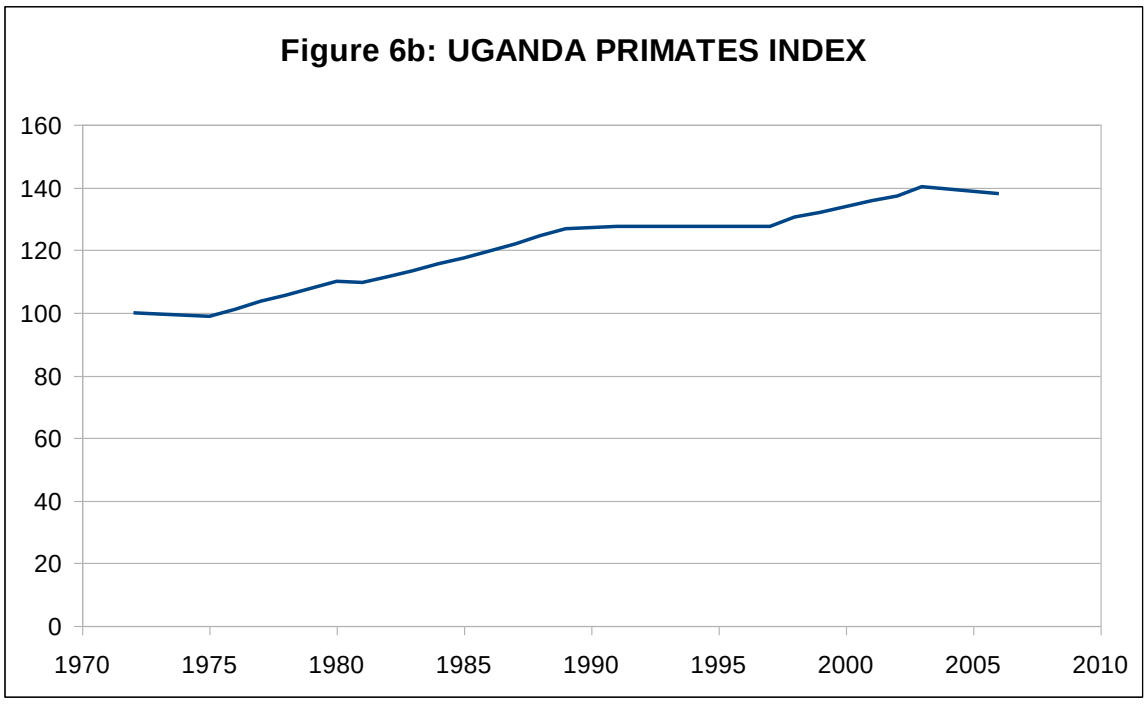
Here we compare a whole range of data from Protected Areas (mainly National Parks, but some Forest and Wildlife Reserves) with some from agricultural areas. The latter are relatively few and hence show greater fluctuations whilst the PA index declines steadily from the 1970s to the 1990s, corresponding of course to a long period of political instability. More recently however, and especially in the 2000s, the index has climbed from around 40 to about 60. From this we can argue that the PAs are indeed effective – but also that considerable biodiversity does remain in agricultural areas, although generally that is of less conservation concern as most threatened species are largely confined to PAs.

Index 6: Biodiversity and tourists

Tourists come to Uganda for many reasons, but seeing 'the big six' is certainly one of them. Here we combine data from UWA and elsewhere on the populations of the mountain gorilla, chimpanzee, Uganda kob, Rothschild's giraffe, elephant and lion. As a group, they show a similar decline in the 1970s and 1980s to that seen in Figure 5 for PAs. Since then, the numbers have been very steady, although at only 40% of the 1970 value.

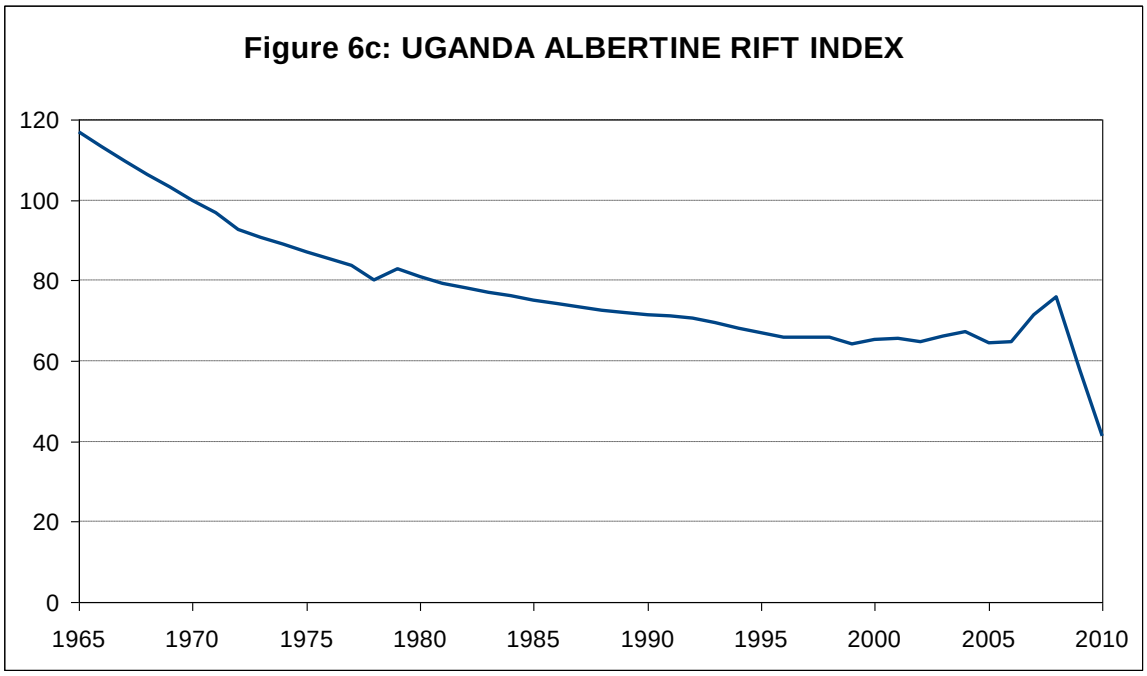


Looking more specifically at primates – not just gorillas and chimpanzees – the recent trend is encouragingly positive (Figure 6b). Clearly primates hold considerable potential for tourism opportunities.



By far the most important part of Uganda for tourism is the west, from the Virungas to Murchison Falls and beyond. Much of this is within the Albertine Rift area of endemism

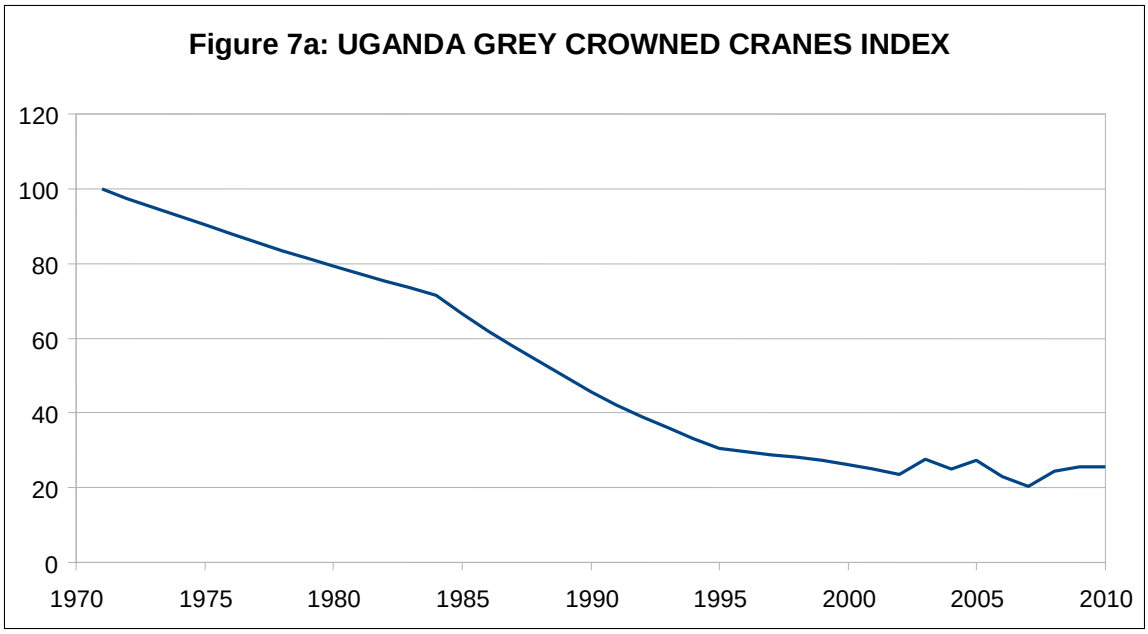
where the overall rate of biodiversity loss has been lower than in Uganda as a whole (Figure 6c), implying that its tourism potential remains good.

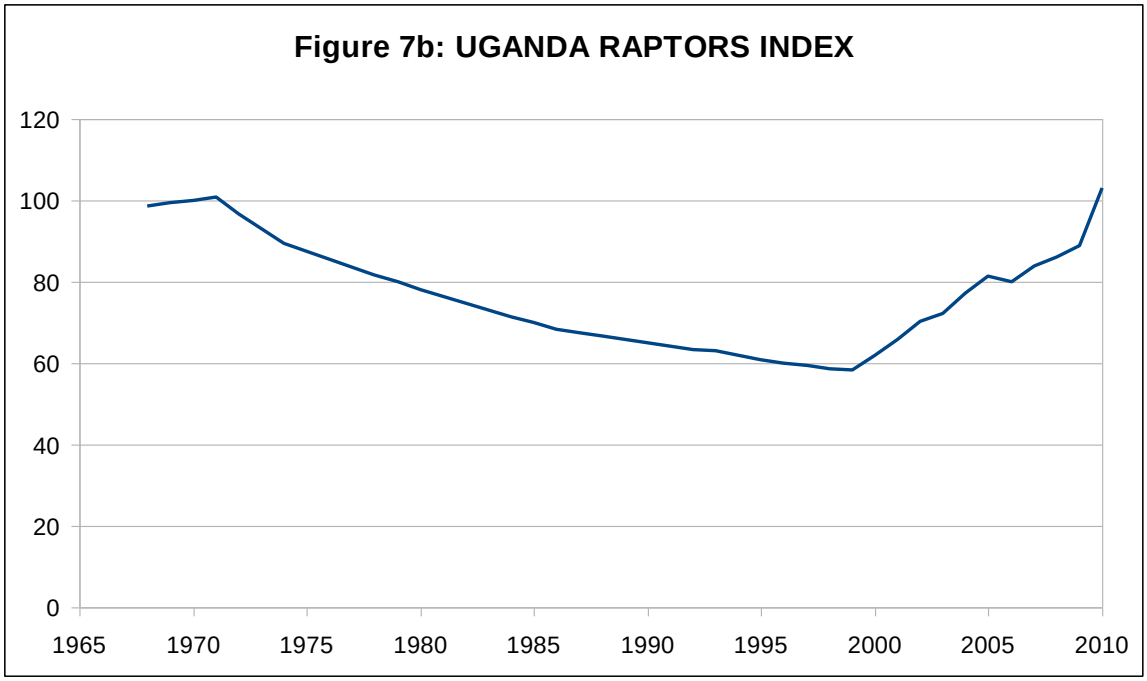


3.4 Overview with policy implications

Some of the indicators in previous sections have clear relevance to policy: for example, the generally good performance of indices of relevance to tourism (section 3.2). Here we give two rather different examples and then look at Uganda's overall trends, to see to what extent current information shows Uganda's policy commitments to the CBD are being successful.

The National Bird of Uganda is the Grey Crowned Crane and its survival depends heavily upon having suitable wetlands with minimal disturbance for the 2-3 months each year when it is nesting. But, as Figure 7a shows, the policy of conserving wetlands has not succeeded in preventing the loss of three-quarters of Uganda's cranes. The downward trend has been lower since about 1995, by which time the loss was already about 70%, but it is now fluctuating between 75 and 80%. The species' future does not look very secure.

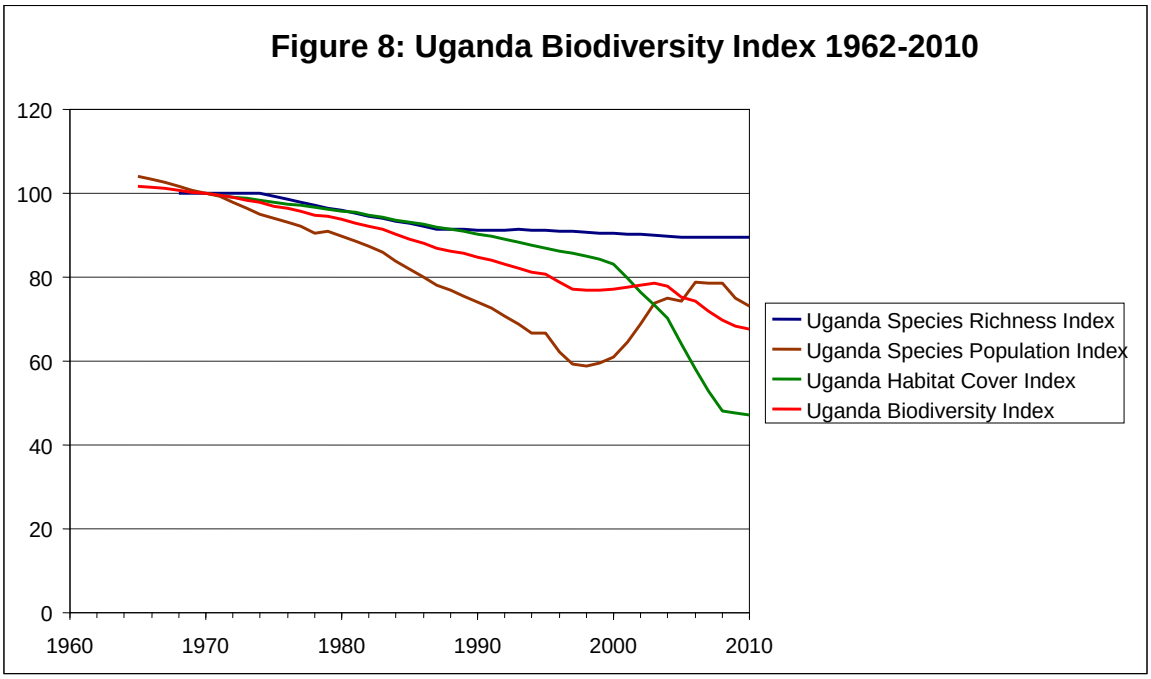


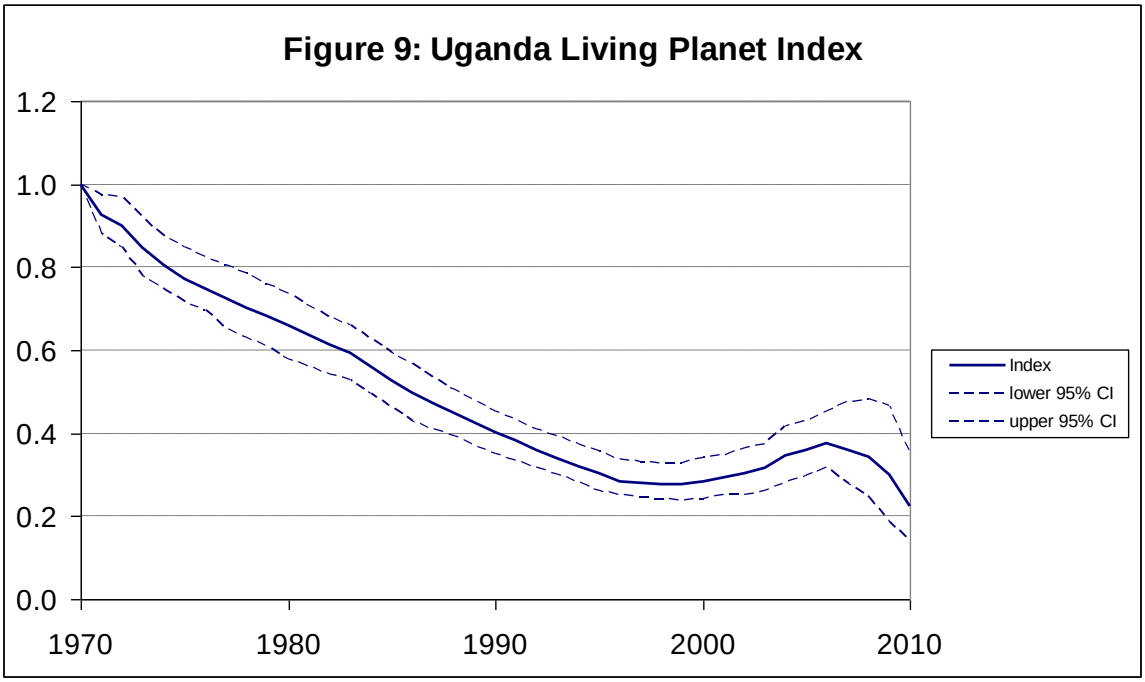


Birds of prey, or raptors, include many charismatic species such as the Fish Eagle and Long-crested Eagle, the latter having been the emblem of NatureUganda for over a hundred years. Worldwide, these birds have been declining through poisoning, habitat loss, trade and other causes. Many raptors require extensive open areas in which to hunt their prey, such as pastoral areas and savanna parks. The positive trend in these species' numbers in the past decade is one indicator of environmentally-friendly land-use policies.

In section 3.1 we considered three background indices – habitat cover, species populations and species richness. These are combined in Figure 8 to give an index

spanning nearly 50 years. The overall Uganda biodiversity index has declined from 100 in 1970 to around 70 now, and appears still to be dropping. However, the general picture in the past 20 years or so suggests that Uganda is quite close to meeting its CBD obligations. We suggest that this index may be the best overall indicator of the success of environmental policies in Uganda as they relate to biodiversity.





The best global comparison that can be made is with WWF's Living Planet Index (LPI) for the tropics as a whole (Figure 9). The LPI only uses populations of vertebrates and that is the main reason why Uganda seems here to be doing badly. The extensive slaughter of game animals in the 1970s and 1980s produced the rapid declines in that period. More recent declines could be due to chance and although potentially worrying, may be reversed to some extent in the next few years.

CHAPTER FOUR: IMPLEMENTATION ARRANGEMENT

4.1 Coordination

The development and use of biodiversity monitoring indicators involves different stakeholders. Whereas the development of sectoral biodiversity monitoring indicators will be done by the respective Government ministry, department or agency, NEMA will provide overall coordination through the Technical Committee on Biodiversity Conservation.

4.2 Government agencies

Government ministries, agencies or departments involved in management of biodiversity will develop biodiversity monitoring indicators using the steps outline in Chapter Two. NEMA shall constitute a technical team to provide technical backstopping.

4.3 Reporting

Indicators that have been developed by stakeholders have to be used for preparing reports on status and trends of biodiversity. Thus the indicators developed should be measurable, achievable and realistic. In addition, mechanisms for continuous data collection should be in place or instituted and implemented to ensure that the indicator(s) developed in useful. Stakeholders will prepare and submit **periodic reports** on the status and trends of biodiversity (based on the indicators developed) to NEMA.

4.4 Use of reports

The reports produced by stakeholders shall be used for preparing reports on the status and trends of biodiversity in Uganda. These reports shall inform stakeholders on the progress being made to halt biodiversity loss as well as the progress towards the achievement of the 2011-2020 biodiversity targets adopted by Parties to the Convention on Biological Diversity at its tenth meeting which was held in Nagoya, Japan in October 2010.

4.5 Sharing of reports

NEMA is setting up a Clearing House Mechanism (CHM) which will enhance information sharing among stakeholders when it becomes operational. Reports provided by stakeholders on the status and trends of biodiversity (from use of identified indicators) shall be made available through the CHM. NEMA shall provide the website for the CHM once it is operational.

4.6 Resource mobilization

Each stakeholder shall plan and allocate resources for collecting data to report on the indicators that have been developed. NEMA shall explore opportunities for mobilizing financial resources from development partners. However this should not be the basis for stakeholders not to mobilize resources on their own.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The capacity building on indicator development has created understanding on the importance of indicators. It has provided framework for developing sector indicators. Indicators contribute to enhancing quality of reports on biodiversity.

5.2 Recommendations

1. The indicators should be used during the preparation of national biodiversity reports and report on progress toward the achievement of the 2011-2020 Aichi (Biodiversity) Targets.

2. Focused training on indicators with emphasis on identification and use of selected indicators for targeted technical staff from key Government agencies and academia.

3. Printing and dissemination of this document for use by stakeholders.

4. There is need for development of national biodiversity indicators to inform managers, policy and decision makers on biodiversity trends and its social, economic and environmental implications.

REFERENCES *(to be completed)*

Aryamanya-Mugisha, H (2007): The Nexus between Poverty, Environment and Development

CBB (2010): Global Biodiversity Outlook 3. Secretariat of the Convention on Biological Diversity, Montreal, Canada

CBD (2010): Forest Biodiversity: Earth's Living Treasure. Secretariat of the Convention on Biological Diversity, Montreal, Canada

NEMA (2010): Environmental Sensitivity Atlas for the Albertine Graben, NEMA, Kampala

NEMA (2002): National Biodiversity Strategy and Action Plan (NBSAP), NEMA, Kampala

Annex 1 Indicator Fact Sheet

Indicator Fact Sheet developed by UWA

Indicator Name: Status and trends of key mammalian species in protected areas of Uganda.

Lead Agency: Uganda Wildlife Authority, in the Ministry of Tourism, Wildlife and Heritage, is the Lead Agency with its Monitoring and Research Unit being responsible for calculating and communicating the indicator

Key Question:

The indicator helps to answer the key question "What is the status and trends of key mammalian species in protected areas of Uganda" with regards to numbers and distribution.

Rationale for selecting the indicator:

Wildlife is the mainstay for tourism development which is one of Uganda's leading foreign exchange earners. Available statistics indicate a favourable growth outlook for the tourism industry at 5.1 % annual growth in real terms from 2007 to 2016. The wildlife sector also provides development opportunities to the rural communities neighbouring the protected areas. Over 600,000 Ugandans living in parishes surrounding national parks have enjoyed a number of benefits including sharing of revenue accruing from tourism. The Uganda Wildlife Act provides for 20% of all Park entry fee collections to flow directly to the relevant communities So far, US$ 1.2 has been disbursed to communities neighboring protected areas[1]. The Uganda Wildlife Act also provides for granting of wildlife use rights among which is sport hunting which also provides reasonable income. Proximity to protected areas has also enabled some communities to start their own community eco-tourism initiatives.

Uganda's wildlife PAs were severely encroached and wildlife populations drastically reduced by poaching and habitat destruction during the 1980s and 1990s. Wildlife has also been put under increasing pressure from encroachment and poaching as a result of the growing human population in the country, estimated at approximately 3.0 % per annum. Because of these threats, the status of some of Uganda's mammalian species is precarious. Though for some of the species the numbers have been increasing, there have been some drastic declines for others. As these mammalian populations form the mainstay of Uganda's tourism industry, there numbers and distribution need to be carefully monitored to enable ration decisions to be made regarding their management, and for setting compliance targets as well as for reporting locally, nationally and internationally.

[1] State of Environment Report for Uganda, 2008, page 117

Users of the indicator:

Users of this indicator include central and local Government sectors/departments involved in natural resource management, policy making, planning and decision making and specifically NEMA, NFA, MUIENR, UWA, UBOS, NGOs, private sector and local communities.

Scale of appropriate use:

This indicator can be used to generate data at national scale for decision making at all levels, for monitoring species trends and developing strategies to conserve species under pressure, to update existing wildlife related policies, to develop appropriate and supportive policies e.g. Environmental Impact Assessments and to report on globally important species. The indicator could also be developed at local level to address specific issues.

Potential for aggregation

Aggregating data and information regarding numbers and distribution of key mammalian species will help decision makers to determine the conservation status of the key species in time and space and therefore assess the necessity for developing management plans to conserve the species. Species populations can also be aggregated to calculate the species population index (SPI) to give a bigger picture of mammalian population trends for broader decision making. Examples of trends in species index for mammals can be found in the State of Uganda's Biodiversity (2006).

Meaning of upward or downward trends ("good or bad")

Theoretically, an upward trend in species populations and distribution could imply improved biodiversity richness while downward trends might lead to a reduction in the conservation status of a number of species for example in terms of "endangered" or "threatened with extinction".

Possible reasons for upward trend

- Low levels of poaching
- Reduced level of encroachment
- Adequate diet available
- Healthy habitat conditions
- Satisfactory PA governance
- Supportive government policies
- Political stability

Possible reasons for upward trend

- High levels of poaching
- Increased level of encroachment
- Inadequate feeds available
- Reduced or degraded habitats
- Poor PA governance
- Conflicting government policies
- Political instability

Implications for biodiversity management of change in the indicator

In order to promote and maintain viable and representative wildlife populations for species richness and diversity, the indicator of the status and trends of key mammalian species helps the government to identify and maintain critical wildlife species, habitats and ecosystems for sustainable biodiversity conservation. Uganda remains the home of a large number of critically important plant and animal species, including the highly endangered mountain gorilla. Thus this indicator provides information for a framework from which programmes can be developed that contribute to the survival of all wildlife species, and the protection of those that are threatened or endangered including restoration of populations of those species that are at dangerously low levels, or extinct. Rare species, such as the mountain gorilla, are managed for both their conservation value and as a national resource.

Units in which it is expressed:

Number of individuals per unit area, species population in selected or all the PAs, % change in species population over time.

Species distribution in terms of locations or sites where the species is found represented by maps.

Description of source data: (origins, dates, units, sample size and extent, custodians)

Apart from other research institutions in the country, the following have extensive data and information relevant to the indicator:

Uganda Wildlife Authority (UWA) has data on the indicator dating a far back as 1960s. More data continues to be generated through periodic ground and aerial surveys from all the National Parks.

Makerere Institute of Environment and Natural Resources (MUIENR) is a custodian of data and information on many mammalian species in its National Biodiversity Data Bank which are acquired through surveys and inventories. Some of the information is published in internationally recognized journals.

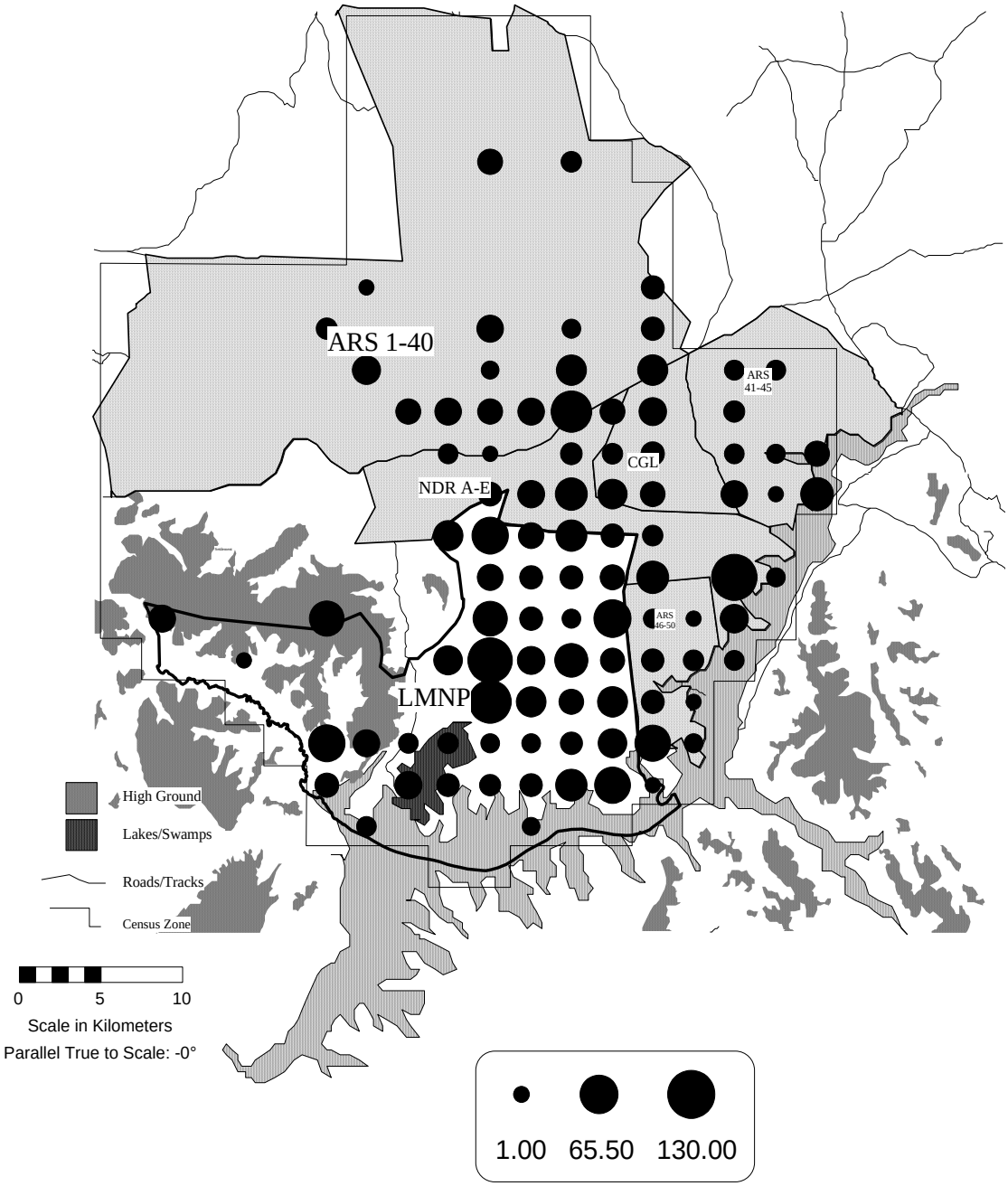
Wildlife Conservation Society, an international NGO, has reasonable amount of data and information on key mammalian species especially from the internationally recognized Albertine Rift region of Uganda.

Calculation procedures

Sample Aerial Counts

Stratification and sampling follow established principles of the census design for transect sampling techniques widely used in terrestrial ecosystems (Norton-Griffiths 1978). A Front Seat Observer seats next to the pilot who continually record radar altimeter readings every half a minute to enable calculation of the strip width of each Rear Seat Observer (RSO). The two RSOs, one in each of the rear seats, continually scan the transect area demarcated by the rods attached to the wing struts on either side of the aircraft and tape-record the count for each species observed in the transect area. The flight transects are systematically spaced to provide a systematic coverage of the area, and thus indicate the distribution of species seen. Transects are spaced at an interval of 2.5 km – 5 km depending on the size of the area and animal densities. The sample strip width used is calibrated by flying back and forth over a straight stretch on which white

markers are placed at an interval of 25 meters on the ground (Norton-Griffiths, 1978).



LMCA All Wildlife June 2004

Ground counts

Distance method is used for estimating population density directly, from which total populations are calculated. This method is employed to forested and woodland areas where aerial surveys can not give good results. Data is collected on aspects such as time, animal species, perpendicular distance from the observor to the animal(s) sighted, group size, GPS coordinates and related information were collected. The transect number, transect lenght, start and end time are also recorded.

Data analysis

Data are dowloaded from from GPS units and corresponding attributes as well as related field observations entered into an excel sheet. Data handling, manupulation and final analysis is done using a computer-based programmes including Garmin/ArcGis, excel and distance.

Presentation of Results

LMCA ground counts population estimate and density (km^2)

Species	Park Density	Ranch Density	Park Estimate	Ranch Estimate	Total Estimate	SE
Impala	4.24	2.25	1611	1508	3119	1804
Zebra	7.82	2.47	2893	1655	4548	1637
Buffalo**	1.36	-	503	-	503	370
Eland	0.46	0.19	170	127	297	181
Topi	0.83	-	307	-	307	133
Warthog	1.12	0.98	414	656	1070	629
Waterbuck	1.96	0.37	725	248	973	506
Bushbuck	0.07	0.09	27	60	87	23

Most effective forms of presentation

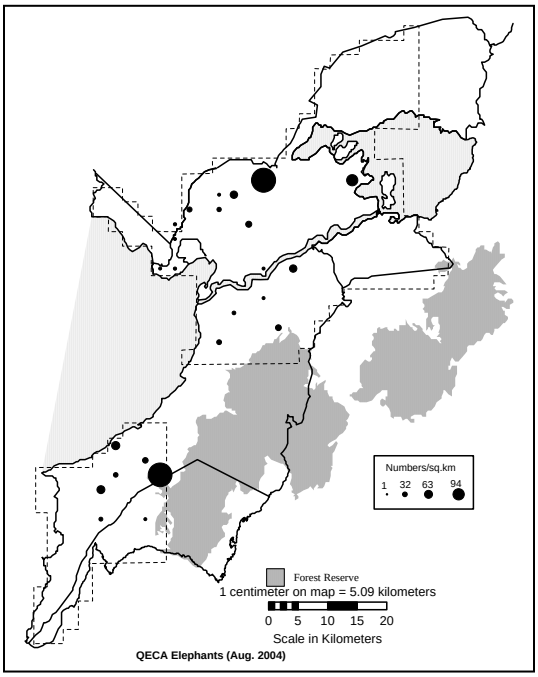
Species population trends can best be presented in the form of graphs or Tables.

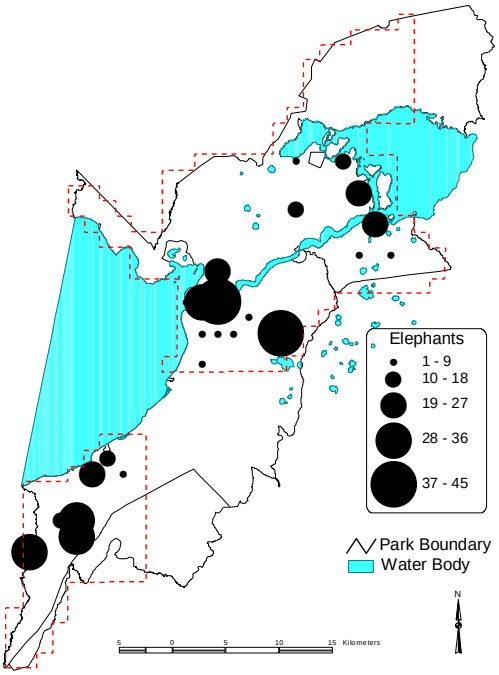
Population estimates of QEPA since 1988

SPECIES	1988/89[A]	1992[B]	1995[C]	1999[D]	2000[E]	2002[F]	2004[G]	2006[H]	% Augmentation since 2004
Buffalo	5,000		17,000	7,000	10,000	6,807	6,777	14,858	119.2%
Elephant	400	500	1,100	1,300	1,100	998	2,497	2,959	18.5%
Hippo	2,200		2,800	2,900	3,400		2,632	5,024	90.9%
Topi	400		500	325	94	157	440	1,521	245.7%
Uganda kob	18,000		31,000	21,000	32,000		17,440	20,971	20.2%
Warthog	1,600		1,200	1,900	2,400		1,880	1,388	-26.2%
Waterbuck	1,500		1,800	2,200	4,500		3,382	3,548	4.9%

[A]Olivier *et al* (1989); [B]Olivier (1992); [C]Lamprey and Michelmore (1996); [D]Lamprey (1999); [E]Lamprey (2000); [F]Rwetsiba *et al* (2002); [G]Rwetsiba et al (2004); [H]Wanyama (2006)

Population distribution density of Elephants





QECA Elephant density distribution 2006

Limits to usefulness and accuracy: **(e.g. slow change in response to pressures, poor quality data, limited scope for updating)**

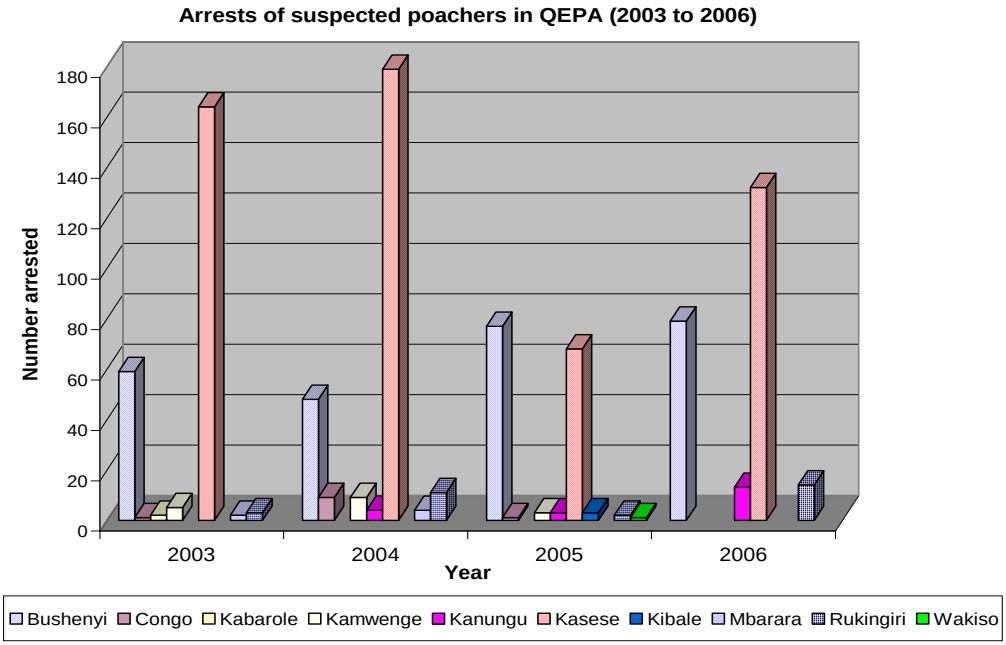
The data and information collected during routine monitoring by rangers are accurate although very often there are not representative since the rangers lack the statistical capacity to design appropriate sampling techniques. During deliberate periodic surveys, the data and information gathered are also accurate. However, these surveys are not done on a regular basis due to lack of equipment and inadequate funds

Updating the indicator:

The indicator could be updated once every 2 years provided funds and the necessary equipment are available. This is because routine monitoring is done everyday when ranges are on patrol while aerial surveys are intended to be undertaken once every two years and ground surveys once every five years.

Closely related indicators:

A closely related indicator for which information can also be easily generated is “Status and trends of threats to key mammalian species in Uganda”. This indicator would have distinct relationships with the population and distribution of a number of mammalian species.



Data analysis

Jolly II Method is used for analysing the aerial sample count data (Jolly 1969). Each transect is treated as a sample of the population.

Presentation of Results

Table 1. Population estimate and standard error (SE) for aerial surveys.

Species	Population Estimate	SE
Huts	6,957	520
Cattle	60,226	3,798
Sheep/goats	14814	1,555
Kraals	300	45
Impala	3,300	952
Zebra	4,280	1,316
Eland	606	335
Warthog	162	82
Topi	162	82

Buffalo	946	425
Hippo	213	131
Waterbuck	548	207
Bushbuck	76	20
Baboon	1,093	496
Crested Crane	59	13
Fish Eagle	112	15

Annex 2 Methods Used to obtain indices

Methods used to obtain indices

Index 7a is the only one in this report that depends on a single data set, that for the Grey Crowned Crane (although that too has several components). All others are made up of several components, as explained in this Appendix.

Index 1: This index is based on the wetland area, the two forest area and the woodland area time series. (We know of no data set for savannas in general). The two forests and the woodland time series are combined with equal weighting to produce a forest and woodland index. From 1970 to 1999 the index is the average of the wetland and the forest and woodland trends, equally weighted (see Table 1).

Table 1	Weight	Contribution
Wetland C2	3	50.00%
Forests C3a	1	16.67%
Forests C3b	1	16.67%
Woodlands C4	1	16.67%
TOTAL	6	100.00%

Note C2, 3 and 4 refer to lines in the overall data set**.**

Index 2: Uganda species population index. WWF have calculated the indices in a slightly different way to the Uganda LPI, to take into account

a) species groups, such as hornbills and monkeys
b) tree data
c) the weightings assigned to each series.

To distinguish this methodology from the LPI methodology we have called this the Uganda Species Population Index, USPI, and set the 1970 value equal to 100 (rather than 1.00 for the LPI).

The USPI is the average of 18 trends derived from the groups into which we have divided the data. Each group is given a weighting. Each group's weighting is calculated as the average of the individual weightings attached to each time series. The contribution each group makes to the USPI is its group weighting divided by the sum of all group weights (Table 2). The USPI (Index 2) fell from 100 to 55 between 1970 and 1996, subsequently recovered and climbed to nearly 70 by 2006, but then fell sharply back.

Table 2	Weight	Contribution
FOREST TREES IN PAs	2.00	3.8%
GREY CROWNED CRANES	2.00	3.8%
WEAVER BIRDS IN KAMPALA	3.00	5.7%
NIGHTJARS	3.00	5.7%
BREEDING COLONY COUNTS	3.00	5.7%
WATERBIRDS	3.67	7.0%
VULTURES IN NPs	3.00	5.7%
LAND BIRDS	3.00	5.7%
OTHER LAND BIRDS	3.00	5.7%
SCAVENGING BIRDS IN KAMPALA	2.50	4.8%
ROAD COUNTS OF RAPTORS	3.00	5.7%
FRUIT BATS IN KAMPALA	3.00	5.7%
FOREST PRIMATES	3.00	5.7%
GREAT APES	3.50	6.7%
ANTELOPES	3.00	5.7%
OTHER HERBIVORES	3.71	7.1%
CARNIVORES in QENP	3.00	5.7%
CROCODILES	2.00	3.8%
TOTAL	52.38	100.0%

WWF have kept the changes they made to the groupings for the previous report. Rothschild's giraffe and warthog swapped groups. Giraffe is included with antelopes and warthog with other herbivores. This seems a better way to group the large herbivores based on phylogeny. Large savanna herbivores now contribute about 13% to the USPI, compared with about 43% of the LPI. Banded mongoose from QENP is again grouped together with QENP lions as it would be wrong to give as much weight to one species of mongoose in one national park as 13 species of antelope from several different parts of the country. The new data sets on land birds, nightjars and raptor road counts have been included as separate groups in their own right and each given a weighting score of 3. It would be quite simple to change the groupings and weightings in order to give a better representation of Ugandan biodiversity.

Index 3: Uganda species richness index. The method here is parallel to that used for the Uganda Species Population Index (Index 2). We have used the weightings attached to each series in calculating the overall index. The land birds were given zero weighting in order to avoid counting them twice, as all bird species are already included in the terrestrial vertebrates; see Table 3. The bird species counts for Makerere Hill differed from the 2008 data, but as these are zero-weighted anyway it does not matter.

Table 3	Weight	Contribution
LAKE VICTORIA FISH	2	19%
TERRESTRIAL VERTEBRATES SPECIES	4	38%
FOREST TREES IN PAs	2.5	24%
BUTTERFLIES	2	19%
LAND BIRDS	0	0%
TOTAL	10.5	100%

Index 4 and 5: Uganda habitat use and land use indices. The main differences between these indices arise in the earliest (1965-70) and most recent (2006-2010) parts of the series. For agricultural areas these parts of the index are dominated by Kampala fruit bats, which are the only species for which data are available during those years. The earliest and most recent parts of the index therefore are not necessarily indicative of trends in agricultural areas throughout the country.

Index 6a: Uganda big six index combine the data from counts of mountain gorillas, chimpanzees, Uganda kob, Rothschild's giraffe, elephant and lion, from the areas where they occur. Data are mainly from UWA and the WCS.

Index 6b: Uganda primates index. Data here included are again gorillas and chimpanzees, but also golden monkeys in MGNP, and various species in KNP.

Index 7a: Uganda Grey Crowned Cranes index. Data mainly provided by NatureUganda from seven different areas, mainly in the south-west.

Index 7b: Uganda raptors index. Nearly 20 data sets of four groups (e.g. road counts, vulture parties at carcasses) are included here, giving a wide coverage and including about 40 species.

Index 8: Uganda biodiversity index 1962-2020. The USRI (Index 3), USPI (Index 2) and UHCI (Index 1) indicate trends in Uganda's biodiversity at the genetic, species and ecosystem levels. The Uganda Biodiversity Index combines these three indices into one overall biodiversity index for the country. Each of the three is given equal weight. The index declined by more than 30% between 1970 and 2010.

Index 9: Uganda Living Planet Index 2010. The LPI Uganda is calculated in the same way as the global LPI. That is to say that each species contributes equally to the index, and, where there is more than one population time series for a single species, each time series contributes equal weight to that species. Plants are not included. Nor are groups of species such as hornbills or forest monkeys. As before, the overall results are dominated by the steep declines in large mammals through the 1970s and 1980s. The index is based on trends in 106 populations of 48 species of mammal, bird and reptile.