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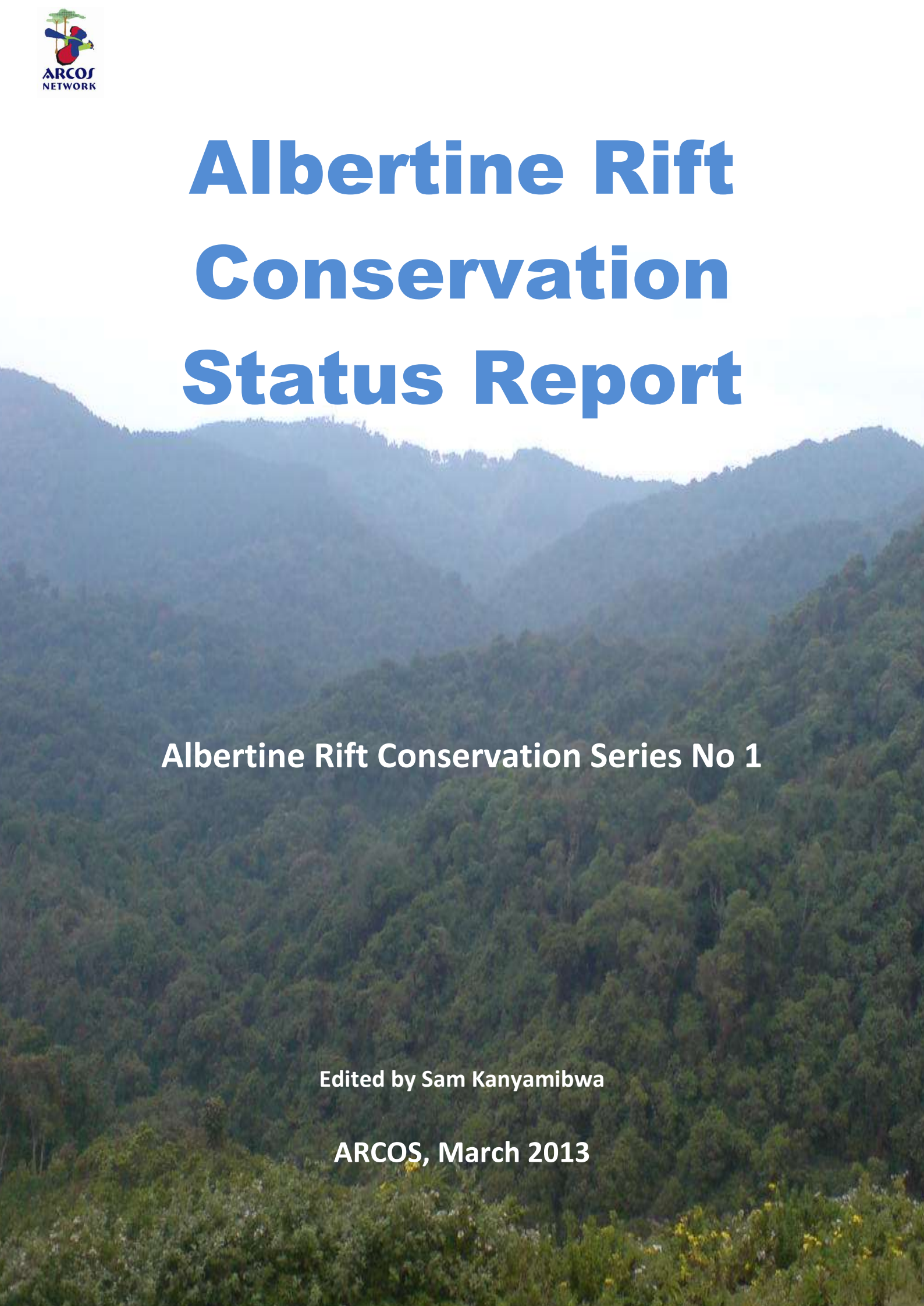

Albertine Rift Conservation Series No 1

Edited by Sam Kanyamibwa

ARCOS, March 2013

Albertine Rift Conservation Society (ARCOS)
Albertine Rift Conservation Status Report
Albertine Rift Conservation Series No 1

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Figure 1. Mountain Gorilla, Volvanoes National Park, Rwanda.- Photo/ARCOS

i. Acknowledgements

The work presented here constitutes a significant landmark of promoting ARCOS'S core value of "Collaborative Action for Nature and People", and a mechanism to implement a regional MOU with National Data Centres in the Albertine Rift that we would like to salute here: Institut National de l'Environment et Conservation de la Nature (INECN) in Burundi, Centre de Recherche en Sciences Naturelles CNR-Lwiro in DRC, Centre for Geographic Information System of National University of Rwanda, Tanzania Wildlife Research Institute in Tanzania and the Makerere University in Uganda.

The completion of this study would not have been possible without the dedicated input of several persons, whom we now feel obliged to acknowledge. First, we salute all the contributing authors for their dedication, hard and quality work they have shown during the whole process leading to the production of this report.

Secondly, we would like to thank all individuals and institutions who have participated in the planning and production meetings for this report, including government institutions, international and local NGOs, for taking their time to share with us their understanding of the subject matter in their respective areas. It is our most sincere hope that the information they shared with us will be reflected in the next pages in a way or another.

Our special gratitude goes to the John D. and Catherine T. MacArthur Foundation for [roviding funding support towards the preparation process and production of this report

Finally, our appreciation goes to ARCOS Staff, Board Members and Associates for their hard work to liaise with authors and contribute in the review of the articles: Claudien Nsabagasani, Laure Rurangwa, Aventino Kasangaki, Faustin Gashakamba and Philbert Nsengiyumva, Paul Buckley. Kathleen Rosewarne, Derek Pomeroy and Beth Kaplin.

Sam Kanyamibwa

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ii. Foreword

The Albertine Rift's unique beautiful landscapes, biodiversity and diversity of its people make it one of the most attractive transboundary ecosystems in East Africa and in the world. The region is home to over 20 million people, and visited by thousands of people every year.

The mountain ecosystems of the Albertine Rift and their natural forests are among the richest in the world. They include the third peak in Africa (Rwenzori Mountains) home to the rarest Great Ape in the world (the Mountain Gorillas) and the second deepest lake in the world (Lake Tanganyika). The services from these ecosystems play an important part in daily life and well-being, and are at the centre of our national economies, such as tourism and energy production.

The Albertine Rift Conservation Status Report is a collaborative effort by experts from East African countries, including from government agencies, under the coordination of the Albertine Rift Conservation Society. The report looks at the status of our environment and biodiversity today and highlights ongoing efforts and improvements that have been made and challenges we face.

The report has identified some improvements in terms of government policies to protect the environment, but has also identified gaps. These challenges present also opportunities to create a sustainable green economy. We are committed to creating a sustainable growth, creating jobs and reducing pollution for the benefits of our people, the environment and our transboundary ecosystems, particularly in face of increasing climate change.

We congratulate ARCOS and the contributors to the Albertine Rift Conservation Status Report and their various partners, particularly those who have provided funding support for this work: The John D. and Catherine T. MacArthur Foundation and JRS Biodiversity Foundation. We look forward to future reports, providing regular updates and monitoring progress against the environmental status presented in this report.

The Treaty for the Establishment of the East African Community in Article 112 enjoins the Partner States to cooperate in all issues of Environment and Natural Resources Management. The Albertine Rift Conservation Status Report makes a clear contribution to EAC's Transboundary Ecosystems Management Bill, 2010, aimed at promoting public participation, and adoption of common environmental standards and exchange of information among others. I am delighter to write this foreword and invite everbody interested in the Albertine Rift's rich biodiversity and its conservation to read this volume.

Amb. Dr. Richard Sezibera
Secretary General,
East African Community

iii. Message from Funding Partners

The Albertine Rift Region is one of the world's hotspot for biodiversity conservation, and the region's ecosystems provide valuable services to local population. However, the threat to biodiversity in the region is alarming and one of the root causes to this problem is the lack of effective mechanisms to share existing information for a wide range of audience including environmental practitioners, government and non-governmental organisations, technical institutions, schools and media, decision-makers.

The John D. and Catherine T. MacArthur Foundation's Conservation and Sustainable Development (CSD) program launched a 10-year grant program in the Great Lakes region of Africa in March 2001. Since 2000, three grants implemented by ARCOS were allocated to support the strategic planning process and building regional information and exchange mechanisms. Between 2001 and 2003, a Regional Strategic Process was undertaken by a core group of conservation organisations operating in the Albertine Rift, under the overall coordination of the Albertine Rift Conservation Society and with funding from the MacArthur Foundation. The most important progress achieved has been the production of the Albertine Rift Strategic Framework 2004-2030. The second grant to ARCOS allowed the continuity of strategic planning from regional to planning units, and Strengthening Information and data management in the region, and a "Regional Biodiversity Monitoring Framework" developed under facilitation of ARCOS in 2007. Finally, the third grant allowed ARCOS to initiate the Albertine Rift Regional Biodiversity Monitoring and Information System (ARBMIS), including the production of the State of Biodiversity and conservation status in the Albertine Rift region.

In 2012, the JRS Biodiversity Foundation provided a grant to the Albertine Rift Conservation Society, to develop a collaborative biodiversity portal for integrated biodiversity information systems in the Albertine Rift region through north-south-south collaboration, capacity building and information dissemination, and provide additional support for the production of the Albertine Rift State of Biodiversity Report. The mission of JRS Biodiversity Foundation is to enhance knowledge and promote the understanding of biological diversity for the benefit and sustainability of life on earth. JRS being to advance initiatives that focus on: (1) collecting data, (2) aggregating, synthesizing, publishing data, and making it more widely available to potential end users, and (3) interpreting and gaining insight from data to inform policy-makers, we are pleased to have provided support to ARCOS for the production of the Albertine Portal and its related product "The Albertine Rift Conservation Status Report".

Elizabeth Chadri
Program Officer, Conservation and Sustainable Development
John D. and Catherine T. MacArthur Foundation

Dr. Don S. Doering
Executive Director
JRS Biodiversity Foundation

iv. Executive Summary

Sam Kanyamibwa, ARCOS

1. Introduction

Between 2001 to 2003, under the facilitation of the Albertine Rift Conservation Society (ARCOS), in collaboration with a core group of international conservation organisations operating in the Albertine Rift and with funding support from the John D. and Catherine T. MacArthur Foundation, stakeholders from government institutions and NGOs involved in biodiversity conservation in the Albertine Rift region engaged a process to develop a Regional Conservation Framework for the Albertine Rift also referred to as the Albertine Rift Regional Conservation Strategic Plan (ARCOS 2004). The Strategy document formulated a regional vision and identified six sub-planning units, where more detailed plans were suggested to be developed involving actors in these respective units, to harmonise their activities.

Since 2007, ARCOS initiated the "Albertine Rift Biodiversity Monitoring and Information System (ARBMIS)", which culminated into the signing of a regional Memorandum of Understanding with National Data Centres in each country of the Albertine Rift, namely: The University of Burundi and National Institute of Nature Conservation in Burundi, Centre de Recherche en Sciences Naturelles inDRC, Centre for Geographic Information System of the National University of Rwanda in Rwanda, Tanzania Wildlife Research Institute in Tanzania) and the Makerere University in Uganda.

2.The process and scope

The process leading to the production of the **Albertine Rift Conservation Status Report (ARCSR)** was coordinated by ARCOS, with funding support from the John D. and Catherine D. MacArthur Foundation and JRS Biodiversity Foundation. It started in 2010 with a regional stakeholders meeting to agree on standards and themes. The meeting also involved training in information management and was followed by interactions with authors from various institutions in the region.

As part of the ARBMIS Framework, the Albertine Rift Conservation Status Report is based on Pressure-State-Response indicators, part of the Drivers-Pressure-Impact-State-Response (D-P-I-S-R) Framework used commonly to evaluate the *pressures* of human activities on environmental *states* and to provide political *responses* in order to come back to a "desirable state".

Figure 2. Amietophrynus kisoloensis Rugezi Marshland, Rwanda- Photo/Behangana

The Report provides an overview of biodiversity status in the Albertine Rift at the level of species, habitats and protected areas, and ecological processes, discusses problems and challenges, disturbance regimes of biodiversity, including climate change and socio-economic pressures, it reviews existing initiatives that contribute to biodiversity conservation from community level and research interventions to national policies and strategies and suggest recommendations for addressing the issues identified in order to reach "desirable state". The report aims to improve understanding and awareness of biodiversity and ecological processes, and emerging environmental issues and support decision-making processes so as to promote sustainable development practices.

3. Key Findings

The summary of the five key priority environmental issues in the ARCSR are discussed below.

a) The meaning, significance and implications of biodiversity

From the results of recent surveys, compared to the 2003 results, this report confirms that the Albertine Rift is the most species rich region of continental Africa for vertebrates and has more endemic and threatened species than any other Ecoregion on the continent. More than 50% of Africa's birds, 39% of mammals, 19% of amphibians and 14% of Africa's plants and reptiles are found here (Plumptre et al. 2003; 2007a). But there are still gaps in areas surveyed, with some areas were much better surveyed than others for some taxa. Recent surveys show an increase in the number of endemic and threatened species for most taxa as new species have been discovered and described as well as with increased numbers of species classified under the IUCN criteria. There is also a difference in taxas, for example with more threatened mammal species and less for plans, while some new species are being identified, particularly in amphibians. Andy Plumptre also provides the species richness and endemism for different landscapes under the regional Strategic Framework with the Greater Virungas ranking high as the most rich landscape, followed by Maiko-Itombwe and Congo-Nile Divide. However, threats to biodiversity remain, linked to human population pressure, leading to more human-wildlife conflicts. Animal hunting, ivory trade and protected area encroachment is also a concern, particularly in eastern DRC. While significant efforts are being undertaken in several landscapes, increased conservation action is needed. The protection of Itombwe massif, and the planning for Marungu-Kabobo, only planning unit without a strategic plan constitute one of the top priorities.

Albertine rift ecosystems are not only rich in biodiversity, but they also provide various services such as f Food, water, climate regulation, erosion control and tourism, and many others to local communities and to national economies. However, the high population pressure in the region is leading to rapid ecosystem degradation with major impact on some of the ecosystem services. For example, most wetlands outside protected areas have been converted to agriculture thus compromising the ecological functions that the wetlands serve. Several ecosystem services were already under stress and include biodiversity loss caused by habitat fragmentation, deforestation, hunting and poaching; food provision affected by soil and land degradation. All this is accelerated by the impact of climate change. As illustrated by pilot initiatives by ARCOS, interventions such as Payment for Ecosystem Services (PES) need to be developed in the various landscapes within the Albertine Rift region.

b) Biodiversity status - trends and indicators

The threats to the Albertine Rift biodiversity are unfortumnately alarming. Of these 41 species are endemic to this region while 25 are considered to be highly threatened for example, and over 14% of the mammal species in the AR area are listed by IUCN in the various levels of threat. For example for Reptiles, In total, 295 species of reptiles are presently known to occur in the Albertine Rift, 14.5% of which are endemic to the region including two species of crocodile that are EN but other species are listed as NE by IUCN. For Amphibians, 45 species sont endemics (25.7%), including 11 vulnerable (VU) and 2 endangered (EN) specie, and 38 reptile endemics

Part of this is due to habitat loss as a result of the increasing human population growth, with the density reaching up to 800 habitants/sq. km in many parts of the region. Most of the threat to the forested areas arose due to the high human population densities and the resultant demand for farmland and firewood for cooking. Hunting for bushmeat, once a subsistence activity, has become heavily commercialized and much of the meat goes to urban residents who can afford to pay premium prices for it.

The situation is expected to worse in the future. Kashambuzi & Mugisha (2003), Louise (2007) and Kityo (in prep) among others, have reviewed issues related to oil, energy and other developments in the AR region. These developments although regulated continue to pile pressure on the ecosystems in the Albertine Rift. Mechanism need to already be put in place to monitor and document the nature of the

cumulative impacts and analyze their impacts on the biodiversity.

It is also important to consider the long-term changes. More serious and longer term impacts will be experienced as result of ongoing developments but also from climate change. it will increasingly become important to harmonize conservation efforts, to monitor these changes, to establish corridors where this is possible to ensure ecosystem connectivity and functions.

c) Conservation issues and challenges

Having one of the poorest and highest population densities in Africa, the Albertine Rift is faced with many challenges as highlighted in several sections above. In this section, key conservation issues are discussed, including climate change, volcanic eruptions, socio-economic development and land use change. Climate change is one of the most pressing issues faced by the world today and the impact of climate change in the Albertine Rift is already significant with ice melting on Rwensozoris Mountains, as well as adverse agricultural responses, changes in seasonal runoff, floods, storms; plant phenology and extreme temperature and rainfall events. BirdLife Interntaional conducted a detailed modelling for 14 Albertine Rift) endemic species to determine future species shifts in the face of climate change. All 14 endemic species studied are projected to be at severe risk from climate change, with some species like the Red throated Mountain-babbler *(Kupeornis rufocinctus)* projected to lose all suitable climate space within the IBAs in the region. Studies of the Mountain gorilla also shows that climate change is likely to result in shifting of range of the species and clustered distributions represent a significant vulnerability of the species to disease. Protection and or restoration of natural habitats outside the protected areas is likely to represent a key adaptive management strategy in an effort to ensure resilience regional biodiversity under climate change. The effects of climate variability on crop production and livelihood options of small scale farmers is discussed, and linked to land use change. Apart from climate change, natural phenomenon such as the volvanic eruption that occurred in 1992 for Nyiragongo volcano has a serious impact on the fauna and flora of the region, as wild species as well as cultivated plants are attacked by volcanic particles and acidic rain waters. This has serious consequences to human health but also has an impact on livelihoods and economies in general.

With the need to accelerate socio-economic development in the Albertine rift region, the governments of the different countries spanning the rift are faced with the dilemma of striking a healthy balance between the quest for rapid socio-economic development and conserving biodiversity. Unless sustainable measures are mainstreamed in economic development activities, particularly emerging economic opportunities such as oil and energy, sustainable agriculture, biodiversity and the livelihoods options of the poor will be affected, which is a big issue as over 80% of people in the region depend on agriculture.

Figure 3.Over 95 % of Lake Tanganyika Cichlids are endemic to the lake

The vulnerability of the agricultural and rural poor in particular, is expected to increase with predicted climate change and associated extremes such as frequent and more severe droughts, abnormally wet periods and higher temperatures. The resilience of the above sectors must be improved in response to current and future climate variability.

d) Responses: Institutions and stakeholders role in developing policy and responses

Caring for our environment and natural resources is a shared responsibility. For transboundary ecosystems such as the Albertine Rift, acting in isolation will never be an answer for sustainable results. Individuals, government institutions, civil society and the private sector, all need to do their bit in addressing the challenges we have by generating information for awareness raising and decision-making, by developing good policies and taking appropriate actions.

4. Key Conclusions and Recommendations

The results of this report confirm that biodiversity in the Albertine Rift is faced with a number of challenges, particularly climate change, high population density in the region, unsustainable practices and the need for policies integrating emerging sissues such as climate change, ecosystem services in development agenda. Oil and other emerging economic development opportunities continue to put pressure on the exiting protected areas, critical habitats and peoples livelihoods, special measures need to be taken. While countries have made good efforts to establish a good network of protected areas, there is still a gap in protection, in terms of key sites of Itombwe and Marungu-Kabobo highlands, as well as establishing critical corridors to ensure viable populations and resilience in face of climate change. Freshwater ecosystems need also special attention, in terms of level of protection, development of national wetlands policies and limitation of destructive activities. Integrating human needs in the management of protected area is also a big need, build on existing efforts to promote benefit sharing in the region.Based on the issues above and other mentioned in this report, the following recommendations are proposed:

Need for a participatory review of the Albertine Strategic Framework and

- It is now 10 years after the production of the Albertine Rift Strategic Conservation Framework 2004-2030 (ARCOS 2004). Given the change in socio-economic, political and environmental conditions over these years and the emergence of new challenges and emerging issues, there is a need to conduct a review of the implementation of the strategy.

Need for Regional approach and transboundary mainstreaming in national strategies and policies

- The mountain and freshwater ecosystems of the Albertine Rift of the different countries share the same type of terrain, biological diversity, and climactic conditions and face the same challenges of global change. There is a need for global and regional institutions stand to benefit from interacting more closely with each other and working together to share, exchange, and develop strategies for comprehensive solutions to the challenges of global change in mountain areas and transboundary ecosystems.
- Taking into consideration the increasing need for regional collaboration to manage global issues such as climate change or transboundary and regional issues such as refugees, river basin management, we urge countries in the region to reflect the use of transboundary water resources, including both surface water and groundwater in national policies and the international community to pay special attention to regional dialogue, regional mechanisms and initiatives.

Need for protection of critical terrestrial and freshwater habitats and processes

- While we recognise the efforts made by governments in the region in the establishment of a good network of protected areas and investing resources for protected area management, we urge governments to consider wider landscape planning and ecosystem based approach and connectivity, particularly in face of increasing climate change and urge particularly an official protection status for Itombwe Mountains in eastern DRC. Government should especially develop policies allowing communities to benefit from ecosystem services.

Need to balance economics needs and sustainability of ecosystem services

- With the increasing depletion of resources in the region, there is a need to increase public and social understanding that there is no sustainable development if the current rapid exploitation models are maintained. There is a need to move from rapid and uncoordinated use of resources to more inclusive models of environmental management. Coordination of multiple uses and social participation.

Need for consistent, comparable, and representative data to monitor resilience to climate change

There is need for consistent, comparable, and representative data to monitor change. This involves climatic, physical, and biological parameters on species and ecosystems, as well as sociocultural and livelihood data. Economic and socioeconomic studies are also needed to assess what factors characterise community resilience to climate change. Capacity building will be needed to carry out specific research in taxonomy, conservation biology, impact assessment, and livelihoods.

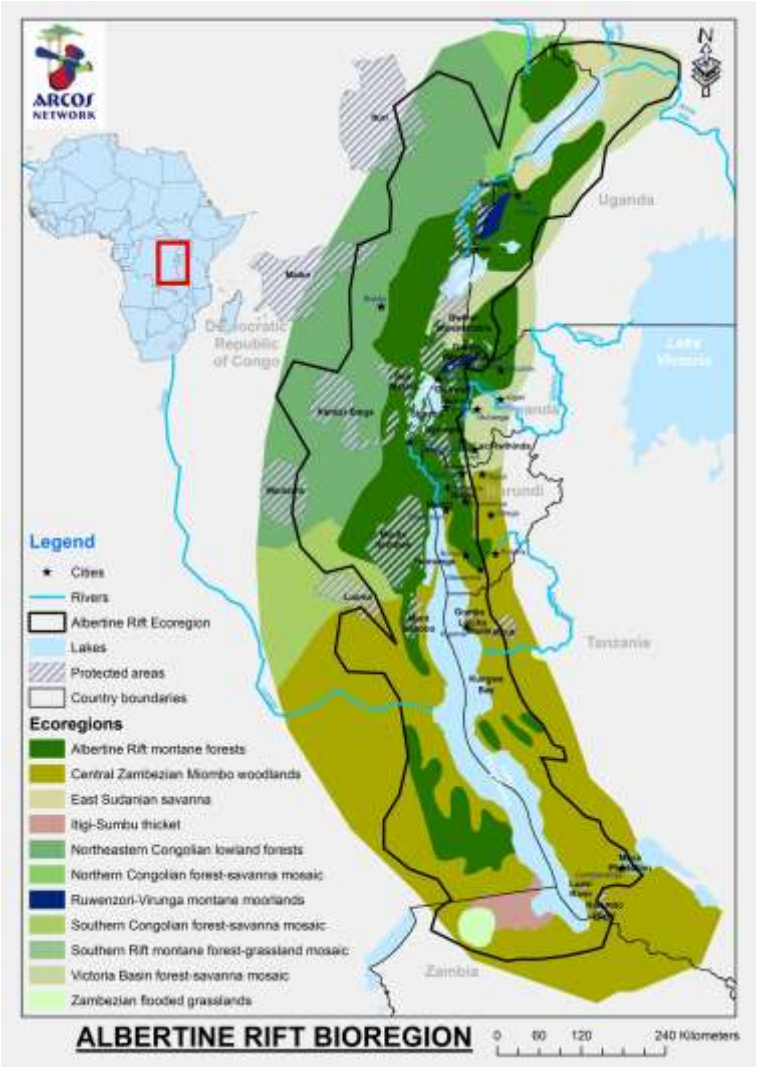
1. Introduction

Sam Kanyamibwa, ARCOS

1.1. Background

The Albertine Rift is the western branch of the African Rift Valley, extending from the northern tip of Lake Albert to the southern tip of Lake Tanganyika, straddling the borders of 6 different countries: eastern part of Democratic Republic of Congo, western part of Uganda, Rwanda, Burundi, Tanzania and northern part of Zambia. The Albertine Rift bioregion as defined by ARCOS (Fig. 4) includes the Albertine Rift Ecoregion and the ecological, physical, political and cultural systems within and around the ecoregion.

The Albertine Rift is of global importance for biodiversity conservation, due to a high proportion of species endemism and evolutionary processes (Stattersfield et al. 1998, Olson et al. 1998; Brooks et al. 2004, Mittermeier et al. 2004). The region harbours mountain massifs of volcanic origin including the active Virungas Volcanoes, biodiversity diverse montane forests, great lakes, river systems and savannah habitats, most of them across international boundaries. The third highest montane in Africa (Ruwenzoris Mountains), the second deepest lake in the world (Lake Tanganyika), the most endangered Great Ape species (The Mountain Gorillas, *Gorilla gorilla beringei*) and many other wonders found in the Albertine Rif.



These ecosystems regulate a stable climate across the region, protect water catchment areas and provide services for community livelihoods and are engine for sustainable development.

However, the pressure on natural resources and the rate of environmental degradation are extremely high. Encroachment, illegal logging, pollution and soil erosion, habitat loss due to mining, disruption of water flows, agriculture and climate change are among the increasing threats to biodiversity, community livelihoods and sustainable development in the Albertine Rift.

The regional and transboundary nature of these ecosystems need regional collaborative efforts. In 1995, the Albertine Rift Conservation Society was established to promote collaborative conservation and sustainable development in the Albertine Rift region through biodiversity monitoring, information exchange, networking, capacity building, conservation action and policy work. In 1999, ARCOS organised the first Albertine Rift Regional Forum and in 2001, the MacArthur Foundation, initiated a regional investment for 10 years. A participatory Strategy for the Albertine Rift was facilitated by ARCOS, in collaboration with government institutions and various organisations involved in the region (ARCOS 2004). During the planning process, stakeholders formulated the vision below and identified six planning units as follows:

– Murchison-Semuliki landscape linking Murchison Falls National Park through Budongo and Bugoma Forest Reserves, Kagombe, Kitechura, Muhangi, Itwara Forest to the Toro-Semuliki Wildlife Reserve at the southern end of Lake Albert.
– The Greater Virunga Landscape: including Virunga National Park in DRC, Rwenzori Mountains National Park and contagious protected areas in western Uganda, and Volcanoes National Park in Rwanda.
– Maiko-Itombwe landscape: the largest landscape extending from Maiko National Park in DRC down through Tayna Community Wildlife Reserve, Kahuzi Biega National Park to Itombwe Massif.
– Congo – Nile Divide: From Gishwati and Mukura Forest Reserves through Nyungwe-Kibira forest block at the Rwanda-Burundi and to Bururi Forest in Burundi
– The Gombe-Mahale Southern Highlands Landscape the Mahale Mountains and Gombe Stream National Parks and extensive forest reserves and unprotected land east of Lake Tanganyika.
– Marungu-Kabobo landscape: encompasses most of the escarpment above the western side of Lake Tanganyika in DRC.

The Albertine Rift Conservation Framework Vision Statement:
"By 2030, the ecological, economic and social values of biodiversity in the Albertine Rift are recognised and acknowledged by local, regional and global stakeholders and this should be reflected by:
- ***The maintenance and integrity of a representative protected area network, and its unique endemism***
- ***The effective connectivity of habitats and landscapes***
- ***The effective regional integration of policy and management by a broad range of actors, and significant contribution to sustainable development and rural livelihoods across the region"***

One of the core areas of the Albertine Rift Conservation Society (ARCOS) has been to promote biodiversity monitoring, data management, sharing and reporting in the Albertine Rift, consolidated in an initiative called *"Albertine Rift Biodiversity Monitoring*

Figure 5. Albertine Rift Planning Units – identified in the Regional Strategic Framework (ARCOS 2004), updated in 2008 by WCS

and Information System, ARBMIS". The overall vision of the programme is "A harmonized, participatory and cost-effective regional biodiversity monitoring framework that generates and provides information that is used by all stakeholders for biodiversity conservation and for promoting sustainable development in the Albertine Rift by 2030".ARBMIS is based on four pillars: 1) Developing participatory regional priority setting and standards, 2) capacity building, 3) data and monitoring activities on priority issues and 4) information sharing and dissemination. The ***Albertine Rift Conservation Status Report*** offers an opportunity to review the progress made in the implementation of the Regional Conservation Framework.

This publication is a result of collaborative efforts, involving scientists and experts from the Albertine Rift region, under the facilitation of ARCOS and funding support from the MacArthur Foundation and the JRS Biodiversity Foundation. As part of promoting regional information sharing and dissemination, ARCOS signed in October 2010 a regional Memorandum of Understanding with National Data Centres in different countries of the Albertine Rift region (Institut National de l'Environment et Conservation de la Nature (INECN) in Burundi, Centre de Recherche en Sciences Naturelles CNR-Lwiro in DRC, Centre for Geographic Information System of National University of Rwanda, Tanzania Wildlife Research Institute in Tanzania and the Makerere University in Uganda.

1.2. Objectives and Scope of the Report

The *Albertine Rift Conservation Status Report* is designed for everyone who wants to know what the state of biodiversity in the Albertine Rift is and what the consequences will be of certain policies, projects or actions. It is a tool to monitor the implementation of the Albertine Rift Regional Strategic Framework (2004-2030). It is designed for governments and other agencies and stakeholders (individuals, communities and organizations) to improve understanding and awareness of biodiversity and ecological processes, and emerging environmental issues and support decision-making so as to promote sustainable development practices. Authors provide a picture of changes and trends of state of biodiversity and environment and challenges, and report on progress or lack of progress of current policies, programmes and initiatives to the environmental issues and trends identified. The report provides access to biodiversity information that has been integrated, analysed and interpreted to enhance and inform decision making and sustainable development planning. It finally identifies and recommends strategic actions that can be adopted to respond to the issues.

Figure 6. Rwenzori Turaco – Photo/Nigel Osmaston

The *Albertine Rift Conservation Status Report* will be published regularly as part of the *Albertine Rift Conservation Series.* The Albertine Rift Conservation Series will strive to maintain a balance between research-oriented studies and conservation experiences from the ground. As such, authors have been encouraged to show relevance, clarity, topicality, singularity and the extent to which the article advances knowledge and conservation and sustainable development in the Albertine Rift. The name of the Report changed from "State of Biodiversity Report" to "Conservation Status Report" to reflect its inclusiveness of not only biodiversity issues but conservation issues in general.

Figure 7. Participants at the Production Meeting posing with Hon Stanislas Kamanzi, Minister of Natural Resources, Republic of Rwanda (5th left)

1.3. Production Process

The process to produce the Albertine Rift Conservation Status Report started was officially launched during a *"Regional stakeholders meeting on Biodiversity Data Management, Sharing and Reporting in the Albertine Rift region"*, held at the National University of Rwanda, Centre for GIS in Butare, Rwanda on 28th-30th April 2010, coinciding with the International Year of Biodiversity and ARCOS 15th Anniversary.

The objectives of the meeting were: - To develop a participatory plan for the Regional State of Biodiversity Report; - To endorse the framework for data sharing protocols in the region, and - To identify needs and mechanisms for strengthening data management capacity and sharing. An Editorial Committee, composed of representatives from different institutions in the regions, was established to work with arcos Secretariat in the coordination of the Report.

The main production meeting was held in Kigali in August 2011 and attended by 26 participants. The meeting provided guidance to authors and was an opportunity for peer-review that authors found particularly very useful. But the production of this first

This Report is based on individual author's research and findings. Guidelines to authors were produced by ARCOS, for harmonisation purpose and consistency in the message. Only eligible papers were selected, based on relevance, clarity, topicality, singularity and the extent to which the article advances knowledge and conservation and development in the Albertine Rift.

Albertine Rift State of Biodiversity Report encountered a number of constraints, linked mainly to slow response from participating authors and limited budget to engage more interactions, though the majority of authors cooperated extremely well and ARCOS commends their efforts. Another issue has been the language barrier for some experts with limited English but ARCOS has fortunately enough capacity to translate the materials when necessary

1.4. Report Structure

The report is presented in five main sections:

- The ***introduction*** indicates the topic and purpose of the document, describe the methodology used and the structure of the report.
- The chapter on the ***meaning, significance and implications of biodiversity*** provides an overall picture of the biodiversity in general and the values and uniqueness of biodiversity and ecosystem services the Albertine Rift;
- The Chapter on ***Biodiversity status and trends*** describes the state and trend of biodiversity at the level of species, habitats, protected areas, and ecological processes.
- The Chapter on ***Biodiversity issues and allenges*** focuses on disturbance regimes, including climate change, land use change and fragmentation of habitats and other socio-economic pressures;
- The chapter on ***Responses*** describes existing institutional arrangements and interventions to improve the State by different actors.
- Finally, the Chapter on ***Conclusions and recommendations*** summarises key issues raised, highlight and open to broader issues and connections to other related problems leading to recommendation to echo important conclusions.

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Figure 8. Water Towers in the Albertine Rift are sources of complex and important rivers systems (Photo/ARCOS

2. Overview of Albertine Rift Biodiversity and its Services

Figure 9: Montane Forests and Freshwater services are important biodiversity area and provide critical resources for communities, national and international development. Photo/ARCOS

2.1. Introduction

Aventino Kasangaki, ARCOS

The Albertine Rift is endowed with a variety of ecosystems ranging from the snow-capped Mt Rwenzori; montane, mid altitude and lowland forests, savannahs and woodlands, several streams and rivers that drain into the numerous wetlands and lakes. Because of the diversity of habitats, the Albertine Rift harbours a variety of plant and animal species some of which are endemic to the region.

A process to develop a strategy for the conservation of the Albertine Rift biodiversity was initiated in 2001 with support from the John D. and Catherine T. MacArthur Foundation. This process brought together protected area authorities from Burundi, Rwanda, Uganda, Democratic Republic of Congo and Tanzania, national and international NGOs and donors interested in the region over a three year period to develop a strategic plan for the conservation of the Albertine Rift (ARCOS 2004). The different priority landscapes for conservation within the Albertine Rift are presented in the chapter on biodiversity.

This section discusses the trends in biodiversity while exploring its significance to human wellbeing. The section also defines biodiversity in broader terms and the different approaches to conserving biodiversity within the landscape. The different ecosystem services provided by biodiversity and their current status are explored. The chapter on ecosystem services also explores examples of interventions aimed at enhancing the flow of benefits to the surrounding communities. Market based mechanisms such as payment for environmental services are discussed as approaches aimed at abating biodiversity loss.

Figure10. Charcoal is one of the major causes of forest degradation and biodiversity loss in the Albertine Rift. Photo/ARCOS

2.2. *Overview of Biodiversity* in the Albertine Rift and its Six Key Landscapes

Andy Plumptre, WCS

Abstract

This paper provides an update on the number of vertebrate and plant species found in the Albertine Rift. Species lists were compiled for all known surveyed sites in 2002-2003 as part of a strategic planning process to conserve sites in the Albertine Rift. This assessment showed that the Albertine Rift region was the most species rich in Africa and also contained more endemic and threatened species than any other region. At the time several sites had been poorly surveyed or not surveyed at all for several taxa and since then the Wildlife Conservation Society together with other scientists have been undertaking surveys to make the data more comparable between sites. Six key landscapes were identified during the strategic planning and the total number of species and number of endemic and threatened species are given here for each landscape as well as the Albertine Rift as a whole. The numbers of endemic and threatened vertebrates have increased since 2003 but the number of endemic plants has decreased with improved distribution data. There is a need to support the development of a comprehensive list of endemic plant species for the Albertine Rift as the current one is not complete.

The results show that the Greater Virunga Landscape and the Maiko-Itombwe Landscape are the two most important landscapes for threatened and endemic species but that all landscapes contain some species of conservation concern not found elsewhere.

The Albertine Rift

The Albertine Rift is an Ecoregion, part of the Eastern Afromontane Biodiversity Hotspot (Brooks *et al*. 2004) and an Endemic Bird Area. Extending from the northern tip of Lake Albert and Murchison Falls National Park to the southern tip of Lake Tanganyika and encompassing the mountains on either flank of the rift valley, the Albertine Rift covers about 313,000 km^2 (Plumptre et al. 2003; 2007a). Ranging from glaciers at 5,100 metres to lowland forest at 600 metres a.s.l. the Rift contains a wide variety of habitat types associated with these elevation changes, including alpine and montane forest, bamboo, savanna woodland and grassland and wetlands. This habitat diversity allows a great diversity of plants and animals to flourish. Six main landscapes were identified in the Strategic Plan (See introduction, Section 1).

Landscape 4 is the only landscape confined to protected areas because all other natural habitat outside has been converted to agricultural production. All other landscapes include areas of unprotected natural habitat that link protected areas and act as corridors for species such as elephants, lions, gorillas and chimpanzees. Only about 49% of these landscapes were contained in any protected area when the strategy was developed (Table 1).

Compiling biodiversity information for the Albertine Rift

As part of the development of the strategic plan, WCS led a process to compile existing biodiversity information for any site where surveys had been

made in the Rift. The species of mammals, birds, reptiles, amphibians and plants for as many of these sites as possible were compiled, taking care to ensure that names were all corrected from synonyms to the current name at the time. The data showed that the Albertine Rift was the most species rich region of continental Africa for vertebrates and has more endemic and threatened species than any other Ecoregion on the continent. More than 50% of Africa's birds, 39% of mammals, 19% of amphibians and 14% of Africa's plants and reptiles are found here (Plumptre et al. 2003; 2007a). However, it was clear that some areas were much better surveyed than others for some taxa.

WCS therefore started a process of making surveys of all of the Albertine Rift sites using standardized methods to allow comparisons to be made between them. The surveys focused on large mammals, birds and plants. In addition, work by Julian Kerbis, Robert Kityo, Prince Kalemie and Mike Hundhorf on small mammals (Kerbis Peterhans and Hutterer, 2009; Kityo *et al.* 2009; Kerbis Peterhans *et al.* 2010) and by Michele Menegon, Mathias Behangana, Eli Greenbaum and Zacherie Chifundera on amphibians and reptiles (Evans *et al.*, 2008; 2011) enabled better lists to be compiled for these taxa also. I present here the updates of species numbers for the Albertine Rift as well as for each of the landscapes.

Table 1 summarises the numbers of endemic species, threatened species (IUCN criteria: CR, EN and VU) and total species numbers that we have currently for the Albertine Rift and compares them with the 2003 estimates.

Landscape	Landscape Area (km^2)	Area Protected (km^2)	Percentage protected
Murchison-Semuliki	10,500	7,350	70.0
Greater Virunga	15,700	13,800	87.9
Maiko-Itombwe	40,300	16,500	40.9
Congo Nile Divide	1,450	1,450	100.0
Greater Mahale Ecosystem	14,700	1,600	10.9
Misotshi-Kabogo-Luama	4,850	2,300	47.4
Total Albertine Rift Area	**87,500**	**43,000**	**49.1**

Table 1. *Total numbers of species, and endemic and threatened species, for the Albertine Rift for four vertebrate taxa and plants. Comparions are made between the numbers identified in 2003 and currently (2011).*

Table 2 provides the same data for the six landscapes as well as for the Albertine Rift as a whole. When compared with the data compiled in 2003 there has been an increase in the number of endemic and threatened species for most taxa because new species have been discovered and described as well as increased numbers of species being classified under the IUCN criteria. In addition the total numbers of species for most taxa have increased as more species have been discovered. The number of endemic plants has decreased, however, because better distribution data are now available which has enabled us to remove them from the list. More endemic species of plant probably do exist but it requires a dedicated effort to compile a full species list from the various herbaria around the world. Mammal species numbers have also declined, partly because of changes in taxonomy of some species, partly because of the mis-identification of shrews and bats which have been corrected, and partly because the 2003 list included some subspecies. The number of threatened reptiles and plants are relatively low because few species in these taxa have been assessed by IUCN specialists.

More species continue to be found and are in the process of being described. At least 5 new amphibians, which will be endemic species for the Albertine Rift, are in the process of being described at the moment (M. Menegon, E.Greenbaum and Z. Chifundera pers. comm.) and these species will likely deserve an IUCN threatened status given their restricted range and likely small populations.

	2003			2011		
Taxon	**Species**	**Endemic**	**Threatened**	**Species**	**Endemic**	**Threatened**
Mammals	402	34	36	385	45	36
Birds	1,061	35	25	1,074	42	25
Reptiles	175	16	2	177	18	2
Amphibians	119	34	16	143	38	15
Plants	5,793	567	40	6,409	341	73

Table 2. *Numbers of species, endemic species and threatened species for each taxa in each landscape.*

Priority landscapes

The Greater Virunga Landscape is the most species rich in the rift with 1409 vertebrate species and 3,755 plant species. It also contains more endemic (100 vertebrate and 111 plant) and threatened (56 vertebrate and 53 plant) species. Maiko-Itombwe is not as rich but contains more endemic birds and amphibians than the Greater Virunga Landscape, with a similar number of endemic species (97 vertebrate, 119 plant) and threatened (49 vertebrate and 28 plant) species. The Congo-Nile Divide is richest for endemic species because of the intensive work on plants by Eberhard Fischer in the Nyungwe National Park (Fischer and Killmann, 2008), and ranks fourth for threatened species. Marungu-Kabobo ranks highly for species numbers and endemic species but low for threatened species. The latter landscape has been the least surveyed, however, and with further effort it is likely more endemic species may be found and that classification of some of the new species will increase the number of threatened species. The Greater Mahale Ecosystem and Gombe, together with the Murchison-Semliki landscape, have the fewest endemic species, Murchison-Semliki ranks third, however, for threatened species, and both landscapes contain species not found elsewhere in the Albertine Rift, with Kungwe Apalis, an endemic bird, in the former and one of the two threatened reptiles (*Trionyx triunguis*) for the Albertine Rift in the latter.

Landscape		Mammals	Birds	Reptiles	Amphibians	Plants
Murchison-Semliki landscape						
	Endemic	3	0	1	2	31
	Threatened	8	4	2	0	35
	Species	200	684	78	41	1,580
Greater Virunga Landscape						
	Endemic	31	35	15	19	141
	Threatened	28	18	1	9	53
	Species	293	890	135	91	3,755
Maiko-Itombwe Landscape						
	Endemic	25	38	13	21	134
	Threatened	19	17	0	13	28
	Species	169	651	86	73	2,226
Congo-Nile Divide						
	Endemic	19	29	11	12	167
	Threatened	14	7	0	6	16
	Species	128	367	43	42	1,344
Greater Mahale Ecosystem & Gombe						
	Endemic	0	2	1	0	22
	Threatened	6	2	0	0	20
	Species	71	473	28	22	1,345
Marungu-Kabobo Landscape						
	Endemic	5	22	2	4	48
	Threatened	6	4	0	2	20
	Species	75	445	11	27	1,047

Threats to these landscapes

The threats to these landscapes and their biodiversity are many and varied. They stem mainly from two underlying factors: a) the high human population pressures due to fertile land which allows high densities of people; and b) poverty resulting from lack of land and high fertility rates. These factors have led to much conflict between local people and protected area authorities, and more broadly to larger conflicts within countries over access to natural resources, including the civil wars in Uganda (1978-1986); Rwanda (1990-1994); Burundi (1990-2006); and DR Congo (1996-2006).

Civil strife has led to large-scale movements of people who have often settled within or near protected areas with subsequent impacts on those protected areas (Plumptre, Masozera and Vedder, 2001; Plumptre, 2003; Shambaugh et al. 2001). People have also moved into areas of natural habitat to escape conflict or to find alternative livelihood options. Artisanal mining for gold, columbo-tantalite and other minerals has been common in natural habitat in eastern DR Congo. Similarly, fishing has increased on the lakes because of a breakdown in the enforcement of fishing regulations. Where livelihood options are scarce or where settlement has occurred within protected areas, people have resorted to hunting of large mammals for meat and ivory (elephants and hippos in savannas, and ungulates, primates and large birds in forests). The construction and rehabilitation of roads, particularly in Eastern DR Congo, is a threat because it opens up the region and allows further settlement and migration of people. Deforestation is greatest in DR Congo along the roads through the forests.

Conservation action

Many institutions and NGOs are working to conserve this globally important region and many of the articles in this book reflect these efforts. Since the strategic framework plan was produced there has been an effort to develop 10-year strategic plans for each of the core landscapes; currently these exist for the Greater Virunga Landscape, the Congo-Nile Divide and the Greater Mahale Ecosystem. Plans are in development for the Maiko-Itombwe and Murchison-Semliki landscapes. Planning has taken longer for the Marungu-Kabobo region because so little was known for this region but efforts are underway to create a national park here together with a surrounding buffer zone which will be connected to the Luama Katanga Hunting Reserve. Once established, a landscape plan will be developed for this region. Implementation of these plans has started and is leading to improved conservation of these landscapes.

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2.3. Status of Ecosystem Services in the Albertine Rift region

Aventino Kasangaki, ARCOS

Introduction

Humans benefit from a variety of resources and processes that are supplied by natural ecosystems. Collectively they are known as ecosystem services or environmental services, and they are defined as the benefits humankind derives from natural ecosystems. The Millennium Ecosystem Assessment (from hereon called MA, 2005) defined four categories of ecosystem services that contribute to human well-being, each underpinned by biodiversity (MA, 2005) and they are:

- Provisioning services – for example wild foods, crops, fresh water and plant-derived medicines;
- Regulating services – for example filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters;
- Cultural services – for example recreation, spiritual and aesthetic values, education;
- Supporting services – for example soil formation, photosynthesis and nutrient cycling.

In addition to supporting life and regulating natural systems, ecosystem services specifically provide health and cultural benefits to people (MA, 2005). The Millennium Assessment predicts that their loss or degradation is a significant barrier to the achievement of the Millennium Development Goals especially goals related to reduction of poverty, hunger and disease. The same report (MA, 2005), identified that 15 of the 23 ecosystem services assessed were being degraded or used unsustainably.

Methods

The paper reviews the state of knowledge on ecosystem services within the Albertine Rift region and how these are being managed for the benefit of the local population. Relevant literature on the subject from within the region has been reviewed. Furthermore, ARCOS's experience and results of implementing ecosystem services' related projects in the region are shared in the article.

Results

In the Albertine Rift countries that are characterised by an ever growing human population, ecosystem degradation has already had an impact on some of the ecosystem services. For example, most wetlands outside protected areas have been converted to agriculture, thus compromising the ecological functions that the wetlands serve. In the Kabale District of South-western Uganda, the Yamuriro wetland has been decimated and only a 50 foot buffer remains along the river in some parts (Kasangaki, pers. observ.). Fig 1. As a result of wetlands degradation, the quality and quantity of water originating from the wetlands has deteriorated, and thus the health of the humans that depend on it is at risk from water related diseases. According to the scoping report by the International Institute for Sustainable Development (ISSD, 2005), in Western Uganda (which lies mostly within the AR), several ecosystem services were already under stress and include biodiversity loss caused by habitat fragmentation, deforestation, hunting and poaching; food provision affected by soil and land degradation and control of pests; water supply, regulation and purification affected by wetland degradation and water pollution, while energy (fuel) was manifested by wood deficit in many districts. An equally alarming trend was reported for Rwanda, where a similar study revealed four critically stressed ecosystem services: maintenance of biodiversity;

food and fibre provision; water supply, purification and regulation; and fuel provision (ISSD, 2005). An integrated landscape assessment carried out by ARCOS around Echuya Forest Reserve (Uganda), Kibira-Rusizi Landscape (Burundi), and Mukura Forest in Rwanda revealed that communities in these landscapes are already stressed for fuel wood and water. Unsustainable landuse practices such as draining of wetlands for cultivation has negatively impacted water quantity and quality around the landscapes. Ecosystem service degradation may lead to poverty traps whereby there is a decline in the ability of locals to earn a living since the ability to produce agricultural cash crops is deteriorating. Due to wetlands degradation, droughts and floods and water pollution, ecosystems are no longer able to regulate water supply and quality, leading to an increased prevalence of diarrhoea and a potential water shortage in certain parts of the Albertine Rift.

Precautions are therefore needed in order to maintain healthy ecosystems and the continued flow of ecosystem services over the long term. Policy makers need to understand more fully the links between ecosystem services and wellbeing. The Economics of Ecosystems and Biodiversity (TEEB) report (2010) contends that there is growing evidence that many ecosystems have been degraded to such an extent that they are nearing critical thresholds or tipping points, beyond which their capacity to provide useful services may be drastically reduced. Yet, the Millennium Assessment (2005) argues that in sub-Saharan Africa especially, improving the condition and management of ecosystem services is an essential component to reducing poverty. If sustainable development is to be achieved in the Albertine Rift, both natural and agricultural ecosystems need to be harnessed so that the flows of services on which humans depend are maintained.

Interventions in the area of ESS within the Albertine Rift: Examples

Currently, in most Albertine Rift countries, the use of ecosystem services as a conservation tool is not yet mainstream in conservation agencies. Sustaining ecosystem flows requires a good understanding of how ecosystems function and provide services, and how they are likely to be affected by various pressures. For example, how is the flow of ecosystem services likely to change under different climate change scenarios? In an attempt to fill this gap, ARCOS has started several initiatives within the region aimed at mainstreaming ecosystem services within the conservation agenda. One such initiative is entitled 'Capturing the benefits of ecosystem services to guide decision-making in the Greater Virunga Landscape of the Albertine Rift Region or GREVIRES in short. The GREVIRES project aimed to conduct a detailed analysis on ecosystem services in the Greater Virungas Landscapes (including the Rwenzori Mountains), and to facilitate better understanding to help stakeholders in the region make informed decisions. Several ecosystem services, such as water yield, carbon

Figure 11. Areas of charcoal production within the Greater Virunga landscape. Note that areas of high charcoal production are mostly outside protected areas

sequestration, non-timber forest products (NTFPS) and sediment retention, were mapped using a GIS-based modelling tool, Integrated Valuation of Ecosystem Services and Tradeoffs (INVEST), developed by the Natural Capital Project. Preliminary findings show an abundance of ecosystem services within protected area systems compared with those outside protected areas. In terms of charcoal production, this is mainly concentrated outside protected areas, mainly in the DR Congo near Butembo and Goma and some parts to the west of Lake Albert. According to Wong, et al (2005), firewood and charcoal and agricultural wastes are the primary sources of energy in Uganda and account for 93 per cent of energy consumption. Rapid deforestation coupled with an increasing population has resulted in over-exploited forest areas. Charcoal is the primary fuel among urban dwellers, and charcoal making accelerates deforestation more than firewood collection. Fig shows the current concentration of charcoal producing areas within the Greater Virunga landscape. If the deforestation rate has to be controlled, energy-efficient interventions have to be promoted in the heavily deforested areas, and urban dwellers should be encouraged use to energy efficient stoves and electricity or gas for cooking.

Water yield was predicted to be high in mountainous regions which include mountains in the DR of Congo, the Volcanoes Mountains on the western side of Lakes Albert and Edward, and the Ruwenzori Mts. The area between Beni and Goma in DR of Congo appears to have the highest water yield. In Uganda, high water yield areas are those around Fort Portal, and the Maramagambo forests on the eastern side of Queen Elizabeth National Park. However, due to unsustainable agricultural practices and deforestation in most parts of the Albertine Rift, water quantity and quality is already under stress. Most rivers flowing through urban and rural areas carry a heavy sediment load and are therefore turbid throughout the year, and become intensely turbid during wet periods (Kasangaki et al, 2008). Examples include the Nyabarongo in Rwanda, the Rusizi in Burundi and the Semliki

Figure 12. Wetland conversion to agriculture in Yamuriro wetland, Uganda. Note the only buffer left along the river channel. Photo/ARCOS

at the DR of Congo–Uganda boarder. Several rivers such as the Ishasha, Ntungwa, and Kyambura that drain into the Lakes George–Edward system also carry sediment to the lakes throughout the year. This has resulted into reduced productivity in these lakes. Sedimentation of the lakes coupled with unsuitable fishing practices has resulted in dwindling fish stocks. As a result, cross-border conflicts over fishing rights are common between Congolese and Ugandan fishermen on Lakes Albert and Edward.

The IPCC (Kundzewicz et al, 2007) predicts an overall net negative impact of climate change on water resources and freshwater ecosystems. Areas in which runoff is projected to decline are likely to face a reduction in the value of the services provided by water resources. The beneficial impacts of increased annual runoff in other areas will be tempered by the negative effects of increased precipitation variability and seasonal runoff shifts on water supply, water quality, and flood risks (Kundzewicz et al, 2007). In Rwanda, Wong et al (2005) predict that the present supply of water will not be sufficient to meet the demands of intensified agriculture and individual water demands. More focus on watershed management will need to be put in place along with better management of wetlands. In addition, policy makers need to understand more fully the links between ecosystem services and human wellbeing.

An on-going project on Enhancing Ecosystem Services Resilience and Sustainable Benefits to Local Communities

(ESLOC) in the Albertine Rift region –is being implemented in three landscapes in Burundi (Kibira–Rusizi landscape), Rwanda (Mukura forest), and in Uganda (Echuya Forest Reserve). Through a consultative process involving stakeholders in the different landscapes, several monitoring indicators have been identified under biodiversity, ecosystem services, and socio-economic themes. The main ecosystem services identified by the stakeholders were water, carbon sequestration, non-timber forest products and ecotourism. If natural ecosystems are to continue providing the services identified, there is an urgent need to put in place sustainable management initiatives such as collaborative forest management and restoration to enable the flow of services in perpetuity. There is also a need to evaluate the ecosystem services in terms of their dollar value if policy makers are to mainstream ecosystem services into the development planning process.

Market-based approaches to conservation such as Payment for Ecosystem Services (PES) need to be developed in the various landscapes within the AR. PES programs are voluntary and mutually beneficial contracts between consumers of ecosystem services and the suppliers of these services. The party supplying the environmental services holds the property rights over an environmental good that provides a flow of benefits to the demanding party in return for compensation (Vonada et al, 2011)

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3. State:

Albertine Rift Biodiversity Status and Trends

Figure 13. Red-and-black Striped Snake. Bothrophthalmus lineatus.
Photo/Z. Chifundera

3.1. Introduction

Claudien Nsabagasani, ARCOS

The Albertine Rift region contains more vertebrate species than anywhere else on the continent. It is important for mammal conservation in general (with 40% of Africa's mammals) and three species of large mammals: Rwenzori Duiker, Golden Monkey and Mountain Gorillas are endemic to this area. The region is home to 175 species of Amphibians and 290 species of Reptiles of which 25.7% and 14.5% respectively are solely occurred in this region. The region has more endemic species of birds than other regions of Africa where more than half of continental Africa's birds, including 41 endemic, are found. The region is also home to 27 primate species among which the endangered Eastern Gorilla, one of the most charismatic flagship species in Africa conferring the region a status of important site for global conservation.

Despite its importance in biodiversity conservation, the Albertine Rift region is threatened by illegitimate activities which have direct and indirect effects on the habitat, success of reproduction, population distribution and food availability. These threats include among others habitat encroachment for farmlands, illegal extraction of oil and gas, uncontrolled mining, poaching and impacts of climate change.

The threatened sites in the region vary from country to country but the most threatened include wetlands and forests out of the protected areas and the unprotected sites such as the Itombwe Massif, Kahuzi Biega National Parks (in DRC), Rugezi marsh and Mukura Forest in Rwanda, Kibira and Rusizi in Burundi and Echuya forest in Uganda. Protected areas are also facing the effects of civila war and the lack of law enforcement and decision-making in natural resources harvesting; case of Virunga National Park in DRC.

Papers presented in this report comprise the results on the status, trends and indicators of 4 taxa namely Mammals, Reptiles, Amphibians and Birds. The report puts also an emphasis on the umbrellas and flagship mammals species, Chimpanzees and Mountain Gorillas. On each taxa, Authors described the current status, discussed the causes of change (positive or negative), policy or practices application, institutional arrangements and information on some case studies and management options were highlighted.

Figure 14. Regal Sunbird, endemic to the Albertine Rift Photo/ARCOS

3.2. Large Mammal Status in the AR and Priorities for Conservation

Kityo Robert, Makerere University

Summary

The Albertine Rift region is an important area for mammal conservation with over 40% of the Africa's Mammals of which 3 are endemic to the region. Over the years, populations of many species have gone through sharp declines with the clearance of sweetable habitats, hunting and animal trade. In more recent times, oil has been discovered in parts of the AR with many confirmed productive sites like Virunga National Park in DRC. This development poses a new and different source of pressure for mammal conservation and is potentially a real challenge for balancing conservation with extractive use of natural resources while mitigating for negative impacts for mammals conservation.

Introduction

The Albertine Rift (AR) region and its fascinating landscape was formed millions of years ago through geologic activities that led to the formation of a wide diversity of habitats characterize the region today including glaciers, alpine grasslands, volcanoes, lowland and montane forests, and various grass and woodland savannas, lakes and wetlands (Stabach *et al.* 2010). It contains a chain of over 40 protected areas in both savannah and forested ecosystems and montane to altitude situations. Brooks *et al*., (2001); Plumptre *et al*., (2003) and Plumptre *et al.* (2007) all pointed to the fact that the Albertine Rift was the most species rich region for vertebrates on the African continent.

This paper is largely based on a review of some of the available literature and data on mammals and highlights the diversity, current status and trends, conservation challenges and opportunitiesin the Albertine Rift. Although several of the examples given in this paper are using data from Uganda, the key concerns are true for the whole of the AR, for which similar pressures on land, natural resources, poaching etc are experienced.

Mammalian diversity

The AR region currently has a known richness of at least 402 species of mammals (Plumptre *et al* 2007) distributed into 13 orders of land mammals and bats (Table 3). Of these only about 30% comprise orders of mammals which for purposes of this paper are described as large mammals, with all the rest (70%, * in Table 1) considered small mammals. Over 14% of the mammal species in the AR are listed by IUCN in the various categories of endangerment (Table 1) which increases the conservation importance of the area.

Figure 15. The towering giraffe in Murchison Falls National Park, Uganda.- Photo/ Kityo

Table 3: Mammalian diversity by orders and IUCN level of threat for the region.

Order	Not assessed	CR†	DD	EN†	LC	NT†	VU†	VU?†	Grand Total
Artiodactyla				1	31	3	1	1	37
Carnivora	1		1	1	28	2	2		35
Chiroptera*	7	1	6	1	69	5	2		91
Hyracoidea					3				3
Insectivora*	9		5	4	32	5	4		59
Lagomorpha*					4				4
Macroscelidea*			1		2	1			4
Perissodactyla		1			1				2
Pholidota					2	2			4
Primates	4	1		5	20	1	3	4	38
Proboscidea							2		2
Rodentia*	20	1	4	2	88	1	6		122
Tubulidentata					1				1
Grand Total	40	4	17	14	281	20	20	5	402

CR – Critical, DD – Data deficient, EN – Endangered, LC- Least concern, NT - Near Threatened, VU- Vulnerable

Endemism and widely occurrence of Mammals in the Albertine Rift

Rwenzori duiker (*Cephalophus rubidus*), Golden monkey (*Cercopithecus kandti*) and Mountain gorilla (*Gorilla gorilla beringei*) represent the species endemic to the AR, while Owl-faced monkey (*Cercopithecus hamlyni),* L'hoest's monkey (*Cercopithecus lhoesti),* Spectacled Galago (*Galago matschiei*), Grauer's Gorilla (*Gorilla beringei graueri*), Giant Forest Genet (*Genetta victoriae*), Aquatic Genet (*Osbornicitis piscivora*) are considered near endemic.

Table 4 Distribution status of IUCN listed large mammals in the AR region

Row Labels	AR	NE	Widely occurring	Grand Total
Artiodactyla (vegetation eating animals)	1		29	30
Carnivora (meat eating mammals)		2	30	32
Hyracoidea (Hyraxes)			2	2
Orycteropodidae (Aardvark)			1	1
Pholidota (Pangolins)			4	4
Primates (Apes and monkeys)	2	4	22	28
Proboscidea (elephants)			1	1
Grand Total	**3**	**6**	**89**	**98**

Acronyms: AR – Albertine Rift endemics, NE – Near endemics

Some recorded trends in mammal populations

Large mammals' species in the AR are experiencing considerable levels of protection, especially in protected areas. However, in several instances, the populations of the different species are on the decline (Table 3). between 1970 to about 1995 mammal populations declined tremendously to in cases of mammals for which data are available way below 20% of the pre-1970 populations. In all cases, the populations are marked by a decline in numbers until the mid 1990s after which recovery, albeit slow is observed (Olupot *et al,* 2010). As other parts of the world, poaching of elephants, rhinoceros for ivory and antelopes for meeta is taking a high shape protected areas of DRC where the civil war are still occurring. The armed groups have become increasingly involved in poaching for ivory and bushmeat and illegal fishing on Lake Edward (http://ens-newswire.com/2012/10/25/eight-dead-in-attack-on-virunga-national-park-rangers/).

Table 5 Global population trends and IUCN status for 6 large mammals whose range extends into the AR

Species /subspecies	Global population	Trends	Threats	Status
African Elephant *Loxodonta africanus*	470,000 - 690,000	Declining	Habitat loss/hunting for ivory	Near Threatened
Mountain Gorilla *Gorilla beringei*	700	Decreasing	Confined habitat	Endangered
Grauer's Gorilla *Gorilla beningei graueri*	<16,000	Decreasing		Endangered
African Lion *Panthera leo*	30,000 - 50,000	Downward	Declining prey base and killing by people	Vulnerable
Africa White Rhinoceros *Ceratotherium simum*	17,000	Increasing	Hunting for ivory	Near-Threatened
Africa Black Rhinoceros *Diceros bicornis*	3,500	Increasing		Endangered

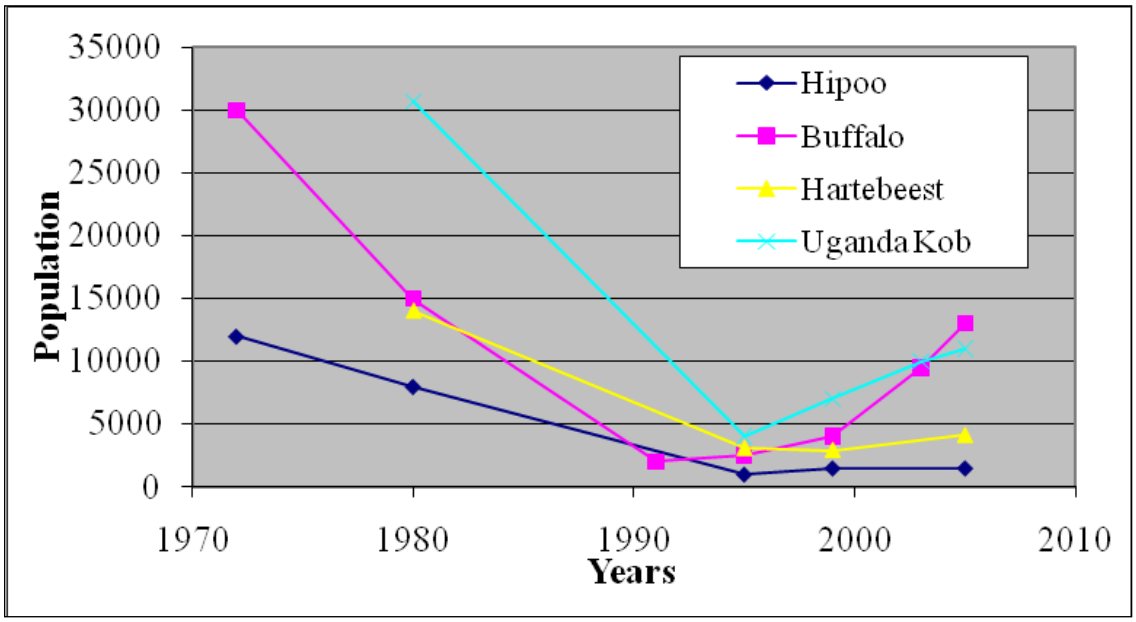

Figure 16. Population trends in four species of mammals in MFCA, 1973-2006 (Data from Rwetsiba & Wanyama 2005)

Challenges for mammal conservation

A good proportion of the AR is contained in a chain of protected areas (PA) with diversity of habitat ranging from savannah to forest reserves, and from low to high altitude PAs. Plumptre *et al* (2003) showed considerable amounts of forest loss in the AR area with forest cover loss ranging from 1.5 to 7.19% (Table 4). Whereas forest loss is easily quantifiable using GIS and satellite imagery, such loss in land cover in savannah systems although not impossible might give less accurate estimates. The same authors also observed that forested areas of the Albertine Rift were the sites of the greatest terrestrial diversity of species and in particular the endemic species. The forested areas however were reported by these authors to be severely threatened in the rift as a result of the increasing human population in this part of Africa and the resultant demand for farmland and firewood for cooking. Many of the natural protected areas are increasingly surviving as Islands separated from each other and genetic flow between subpopulations in increasingly getting blocked.

Table 6 Forest cover and forest loss in the eight zones of the AR (source Plumptre et al 2003)

Zone	Forest cover 1980s (km2)	Percentage of zone forested	Area of forest lost (km2)	Percentage loss
1	3237.8	27.6	507.8	15.7
2	1302	19.6	58	4.5
3	1807.7	16.7	24.9	1.4
4	752.5	6	33.4	4.4
5	351.7	5.6	15.2	4.3
6	7428.6	57	117.6	1.6
7	10377.1	38.8	310.3	3
8	8686.9	41.3	492.9	5.7

Other threats to the Mammals of the Albertine Rift included heavy poaching for bushmeat and habitat destruction due to timber exploitation, mining for minerals, encroachment for agricultural land, introduction invesive species . Some of these had major while others had minor implications for the sites and therefore the wildlife in them.

Conclusion and Recommendations

There is no doubt about the importance of the AR for mammal conservation, while on the other hand, it is evident anthropogenic pressures of different nature will continue to be a challenge for conservation. It will increasingly become important to harmonize conservation efforts with exploitative use of resources in ways that will ensure that the biodiversity value of the area and, its tourism importance are maintained. Mechanism need to already be put in place to monitor and document the nature of the cumulative impacts and analyze their impacts on the mammals.

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Figure 17. Hippo with baby in Murchison Falls National Park

3.3. Gorilla Status in the Albertine Rift Region and Priorities for Conservation

Augustin K, Basabose, IGCP

1. Summary

Currently only two species of gorilla are recognized living in African tropical forest: the western species (Gorilla gorilla) and the eastern species (Gorilla beringei). The eastern species inhabiting the Albertine Rift region comprises two subspecies including the eastern lowland subspecies (G. beringei graueri) and the mountain subspecies (G. beringei beringei). The eastern lowland gorilla is endemic in the eastern forests of the Democratic Republic of Congo (DRC) and has the widest altitudinal range of any of the gorilla subspecies. It ranges in mountain, transitional and lowland forests in eastern DRC. The mountain gorilla occupies higher altitude in transitional and afromontane forests to sub-alpine habitat. Despite the remarkable increase in mountain gorilla populations (G. beringei beringei) and to some extend the noticeable resumption of eastern lowland gorilla population (G. beringei graueri) inhabiting the upland sector of Kahuzi-Biega National park, habitats of both gorilla subspecies are under constant threat, including illegal poaching, habitat encroachment and illegal mineral mining. Conservation efforts should concentrate on addressing these issues to ensure the long term survival of gorilla populations inhabiting the Albertine Rift Region.

2. Introduction

The Albertine Rift Region is one of the most species rich regions in Africa with an extraordinary endemism rate in fauna and flora species making it one of the prominent tourism destinations in the world.

The Albertine Rift Region is home to 27 primate species among which the endangered eastern gorilla, one of the most charismatic flagship species in Africa conferring the region a status of important site for global conservation.

There are currently two recognized species of gorilla, the western species (*Gorilla gorilla*) and the eastern species (*Gorilla beringei*). The two species separated from about 2 millions years and evolved separately in different bloc of forests.

This paper summarizes the conservation status of the eastern gorilla ranging in the Albertine Rift region using existing literatures and analyzing ranger based monitoring data collected in eastern gorilla protected areas.

3. Gorilla Habitat

Gorillas are forest dwelling species. They rely heavily on easily digestible terrestrial herbs with less secondary compounds, and their distribution is limited to areas within the tropical forests where plenty of herbs are available throughout the year. Recent studies on western and eastern lowland gorillas suggest a strong preference for fruits by gorillas in the lowland tropical forests (Rogers et al., 2004; Yamagiwa et al., 1994, 2005; Remis, 1997a; Doran et al., 2002). Scarcity of preferred foods (fruits) may not influence the range size of lowland gorillas, During fruit scarcity, they rely on leaves, piths and various kinds of bark as staple Fall Back Foods allowing them to maintain cohesive groups with similar home range across habitats irrespective of fruit abundance (e.g. Yamagiwa and Basabose, 2009). Mountain gorillas range in high-altitude forests with a dense herb layer and relatively low abundance of fruits (Doran & McNeilage, 1998, 2001). They Mountain have a home range similar in size to that of eastern lowland gorillas (Yamagiwa and Basabose, 2009), and their ranging patterns are influenced by both fruits and vegetative foods (e.g. Ganas and Robbins, 2005).

All eastern forms prefer old clearings, valley bottoms, landslides, etc., where there is a dense herbaceous growth. Particularly, the mountain gorillas live peacefully within the confines of the mountain forests and avoid the open, cultivated fields of the surrounding humans. Occasionally, however,

mountain gorillas have been observed to enter the farmers' gardens for crop raiding and foraging on other resources outside the forests.

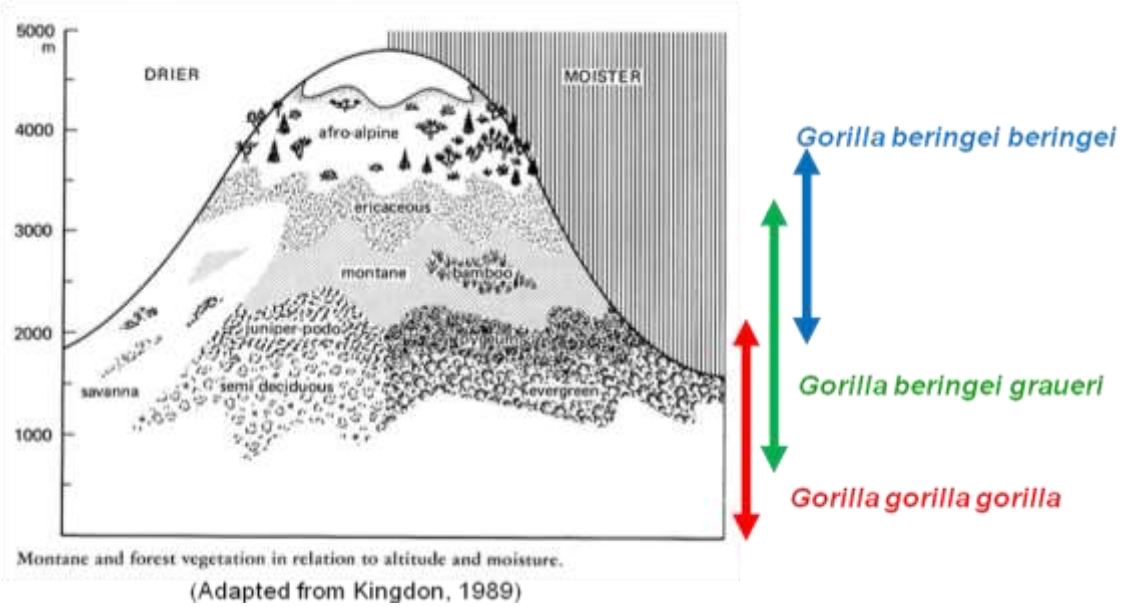

Figure 18. Altitudinal distribution of 3 different gorilla subspecies

3. The eastern gorillas inhabiting the Albertine Rift Region

The eastern species of gorilla inhabiting the Albertine Rift region comprises two subspecies including the eastern lowland subspecies (*G. beringei graueri*) and the mountain subspecies (*G. beringei beringei*). It is estimated that eastern lowland gorilla has been isolated from mountain gorilla about only 400,000 years ago.

3. 1. Status of the Eastern lowland gorillas (Gorilla beringei graueri)

The eastern lowland gorilla is endemic in the eastern forests of the Democratic Republic of Congo (DRC). This subspecies has the widest altitudinal range of any of the gorilla subspecies, ranging in mountain, transitional and lowland forests in eastern DRC (Fig. 19)

In early 1990's it was estimated that about 17,000 eastern lowland gorillas (G.beringei graueri) were living in at least 11 subpopulations in the rain lowland tropical forest of Kahuzi-Biega and Maiko National Park and in Itombwe and adjacent forests and that 86 % of the entire eastern lowland gorilla population was living in Kahuzi-Biega National Park (Hall et al., 1998).

The overall geographic range of this subspecies is today estimated at around 90,000 Km2. Two small isolated gorilla populations are known to range in Masisi and Mount Tshiaberimu and are particularly vulnerable to extensive encroachment.

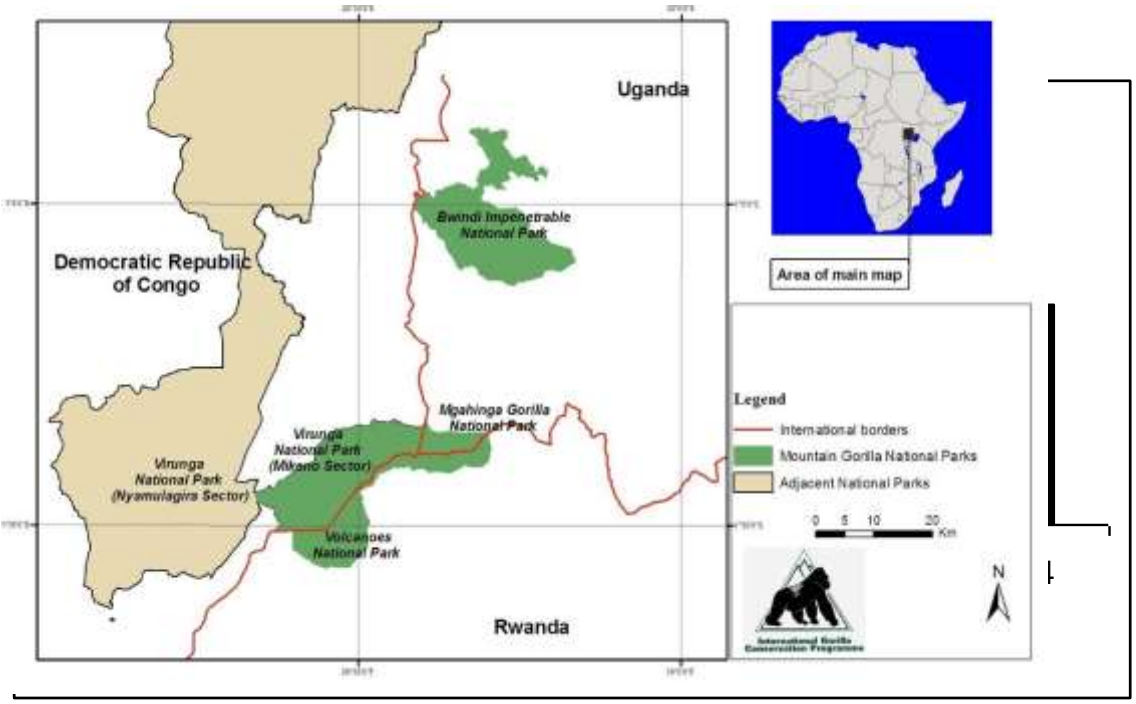

Figure 19. Geographical location of mountain gorilla populations in the Albertine Rift Region

It has been reported that human related habitat loss of the eastern lowland gorillas is the highest of any other gorilla subspecies (Wilkie et al., 2000) remaining with only about 13 % of the former geographic range. These populations are largely threatened by the mass logging and mineral mining. As far as eastern lowland gorilla populations are concerned, conservation efforts should concentrate on the lowland sector of Kahuzi Biega National Park and Kasese forest, where illegal poaching, encroachment and illegal mineral mining are threatening the biodiversity, including the endangered eastern lowland gorillas. Re-establishment and maintenance of a forest corridor connecting the upland to the large lowland sectors of Kahuzi-Biega National Park is essential to maintain high genetic variability in the population and avoid inbreeding issues which may result from long term population isolation. The on-going effort to gazette Itombwe forest as a protected area should continue for the conservation of Eastern Lowland Gorillas.

As shown on the fig.2 above, due to substantial conservation effort late 1980's, eastern lowland gorilla population in the upland sector of Kahuzi-Biega Nationl park was increasing in early 1990's but due to the recurrent unrest situation in mid 1990s following the large and uncontrolled weapon circulations after the infernal cycle of wars which erupted in the Great Lake Region, the gorilla population drastically decreased due to logging for timber exploitation, mass poaching for bush meat trade, hunting for live animals trade and illegal mineral mining. This drastic picture of what happened in the upland sector of KBNP where accurate data are available, may indicates how worse could have been in remote gorilla habitat where wildlife killing was reportage to be very destructive.

3.2. Status of the mountain gorilla species (Gorilla beringei beringei)

The mountain gorilla is the other subspecies of the eastern form spreading in two small isolated populations, one living in the Virunga Massif at the border of the RDC, Rwanda and Uganda and the other ranging in Bwindi Impenetrable National Park in southwest Uganda on the border with DRC (see map bellow).

Bwindi gorillas tend to live in lower elevations, warmer temperatures and are more arboreal than Virunga gorillas (Sarmiento et al., 1996). In the virunga massif, mountain gorilla habitat is mostly consisted of woodland or bamboo forest with a relatively low open canopy and extremely dense herbaceous understory (Watts,

1998). Though the protected areas home to mountain gorillas are relatively small in size, with about 440 Km2 for Virunga massif, and 330 Km2 for Bwindi Impenetrable National Park, gorillas tend to be habitat selective, ranging in only approximately 375 km2 and 215 Km2 in the virunga massif and in Bwindi respectively.

In both ecosystem, the mountain gorilla display a site fidelity ranging patterns, each individual gorilla family ranging in the same area for years, despite the high overlap of neighbor gorilla groups. Both populations of mountain gorillas have been regularly counted over the last thirty years. According to the last sweep census (Gray, 2009), the population of mountain gorillas of the Virunga massif is currently estimated at 380 individuals inhabiting in an habitat shared by Mgahinga Gorilla National Park in Uganda, Volcano National Park in Rwanda, and Virunga National Park in the DRC.

When compared this result to that of the last complete census which took place in 1989 in the same area, and during which an estimated number of 324 gorillas was then counted (Sholley, 1991), there was a population increase of 17% with an annual growth rate of 1.15% despite the instability due to recurrent civil wars that have shaken the Great Lake Region between 1991 and 1999. The mountain gorilla population in Bwindi impenetrable forest is growing as well; the population increasing from 300 individuals as estimated from the 1997 census to 340 individuals counted in 2006 (McNeillage et al., 2006; Robbins et al., 2009).

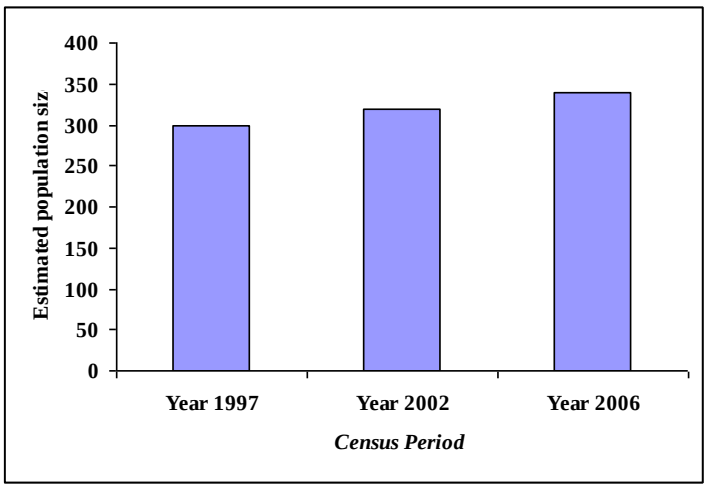

Figure 20. Estimated population trends for Bwindi National Park mountain gorillas

4. Current and Future challenges in gorilla conservation in the Albertine Rift Region: priorities for their conservation

Wherever eastern gorilla populations are ranging they are protected by the range state, but face many types of threats which jeopardized their long term survival in wild habitats. Among the threats which we have to address by putting in place multisectorial adaptation strategies are habitat encroachment, poaching, increasing demand in gorilla tourism, global climate change, emerging diseases, high human density, etc.

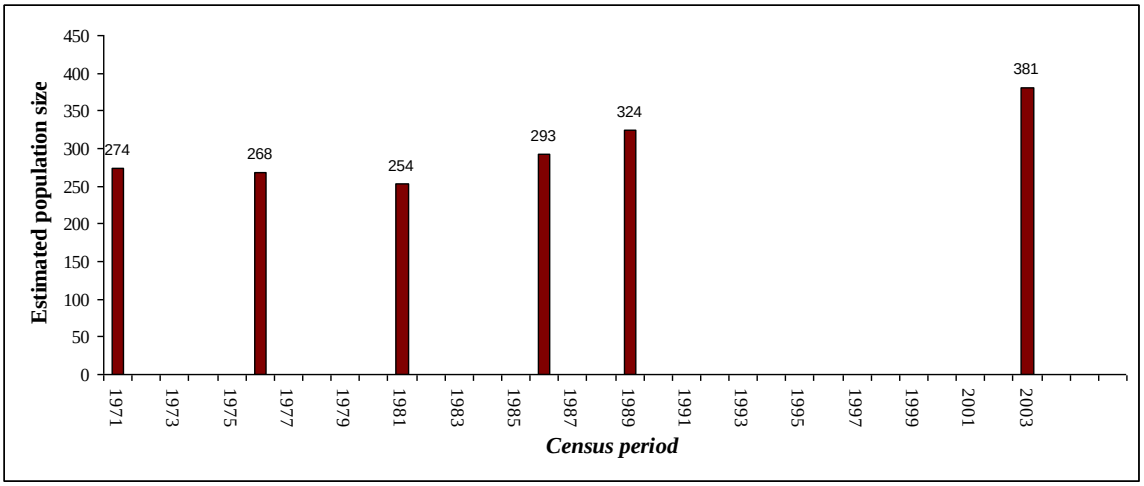

Figure 21. Estimated population trends for Virungas mountain gorillas

Despite the remarkable increase in mountain gorilla populations (*G. beringei beringei*) and to some extend the noticeable resumption of eastern lowland gorilla population (*G. beringei graueri*) inhabiting the upland sector of Kahuzi-Biega National park, habitats to both gorilla subspecies are under constant threat.

Accidental entrapment in wire snares used to trap other wild animals is also a threat to gorillas. The impact of this threat needs to be assessed in eastern lowland gorilla area. In 1998, in the highland sector of KBNP, at least one individual in each of the then habituated gorilla group had lost a hand to snares (Yamagiwa, 2003).

In fact, the eastern gorilla populations inhabiting mountain forests live in close proximity to some of the highest densities of rural human populations in Africa, with up to 1000 inhabitants per km².

The human population growth and the corresponding needs of agriculture land and forest resources is obviously a serious and continuous pressure to mountain gorilla survival.

Mountain gorillas have little hope of survival without family planning and agriculture improvement programs among local people. Here is where international conservation agencies can perhaps provide the most help in the long run, not only to the ecosystems that they are trying to save but also to the people that live around them (Harcourt, et al., 1983). The growth of nearby human settlements is increasing the demand for more resource leading to escalating illegal logging practices, degrading gorilla ecosystems and habitat through illegal forest clearing for agriculture, illegal cattle grazing, firewood collection, small-scale timber extraction, and charcoal making, which are serious and continuous pressure to eastern gorilla species and their natural habitats.

In all the protected areas, conservation laws to protect the gorillas are being enforced including effective anti-poaching approaches put in place and lobbying for stopping and/or persecuting all person judged guilty in disturbing or smuggling the gorillas.

Wherever possible, we should encourage maintaining and/or establish corridors to bridge different isolated gorilla populations to ensure their long term survival in a safe wild environment.

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Figure 22. The Mountain Gorilla, Photo/ARCOS

3.4. Chimpanzee Populations in the Albertine Rift

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1. Introduction

The Albertine Rift region contains more apes than any other African ecoregion including the rare primates like Mountain Gorilla *(Gorilla beringei beringei)* , L'Hoest's Monkey (Cercopithecus l'hoesti) and a sub-species of Hamlyn's Monkey (*Cercopithecus hamlyni)* and the Common Chimpanzee (*Pan troglodytes*). Chimpanzee is one of the charismatic apes in the Albertine Rift Forest. This mankind's closest relatives is a good indicator of the health of conservation of an area but is currently classified as "Endangered" on the IUCN's list due to human activities including poaching, habitat loss and diseases. This paper illustrates the information on the population status, threats and conservation efforts of Chimpanzees in the Albertine Rift Region.

2. Chimpanzee populations in the Albertine Rift

Chimpanzee surveys were conducted in different countries of the Abertine Rift and in total 22 forests were surveyed and an estimated total chimpanzee population of 5000 individuals was obtained (Plumptre, A et al, 2003).

In Uganda, Kibale National had the highest population of 1429 individuals and only four forest reserves (Kibale, Ruwenzori Mountains, Budongo and Bugoma) had more than 500 chimpanzees each.

In Burundi, the big population of chimpanzee is found in Kibira National Park where the population was estimated at 400 individuals (Bumakabuye, 2007). An uncertain populations (very small probably) of Chimpanzees are also available in three other forests Bururi, Rumonga and Vyenda.

In Rwanda, the bulk of Rwanda's chimpanzee population is found in the forests of Congo-Nile divide. The survey of 2007 (Barakabuye, N. et al) estimated 400 chimpanzees in Nyungwe National Park, 13 for Gishwati Forest Reserve and 25 in Cyamudongo.

In Tanzania, The Albertine Rift is the only part of Western Tanzania which has chimpanzees. A Survey by Moyer et. al. (2006) estimated the chimpanzee population of Western Tanzania to be 2700 – 2800 individuals. More recently a survey by Yoshikawa et. al., 2008 estimated a chimpanzee density of between 0.01 and 0.2 chimpanzees per square kilometer and he further suggested that chimpanzee populations may be declining.

The Democratic Republic of Congo (DRC), is the highly forested country in the Albertine Rift and forests of the Eastern part hold the bulk of the Eastern chimpanzee populations. Chimpanzee population estimates are still scarce in the DRC, only the estimates were made in Itombwe Massif (6302 individuals), Kauzi Biega National Park (835), Virunga National Park (578), Mt Murungo and Mt Kabobo.

3. Threats

The biggest threats to the common chimpanzee include among others habitat destruction and fragmentation, which is the major threat to the conservation of the Common Chimpanzee, poaching and disease. Degradation of forests through logging, mining, farming, and other forms of land are the lead to the habitat patches which are often small and unconnected, leaving chimpanzee populations isolate. Cyamudongo forest used to be connected to Nyungwe NP but today the two sites are disconnected, Gishwati forest in Rwanda hosts a

small population of Chimps but these days looks as an Island in a high density of communities.

Poaching for bush meat is a serious problem affecting chimpanzee populations in the DRC where a study showed that offtake was 5 to 7%, surpassing annual population increase. In addition, Chimpanzees, and other apes, are often injured or killed in snares set for other animals. Infant chimpanzees are frequently taken alive and sold in the cities as pets for entertainment and for biomedical research (Plumptre, A. et al, 2003)

Ebola outbreaks have led to serious declines ape populations in the DRC. This disease was reported in Uganda but its effects on the population of Chimpanzees are still unknown. such outbreaks have not been reported in any other countries.

4. Conservation Effort

Actions for Chimpanzees conservation in the Albertine Rift were taken but more efforts are still needed. Mechanisms to conserve natural forest to slowdown the habitat loss and poaching are ongoing. Research on the population, threats and conservation actions to influence decision-making were conducted: WCS has been surveying eastern chimpanzee populations in Uganda (Andrew Plumptre), eastern Democratic Republic of Congo (John Hart, Deo Kujirakwinja), Rwanda (Andrew Plumptre and Michel Masozera) and Tanzania (Andrew Plumptre and Tim Davenport). Jane Goodall Institude and Budongo Forest Project have established snare removal programmes in Budongo forest and Kibale park which have been very successful (Plumptre, A, et all, 2003). However, illegal activities are still occurring in some areas off-limits because of conflicts in non secured part of DRC. The 10-year Chimpanzees Conservation Plan aiming to protect chimps from hunting, habitat loss, disease and other threats was elaborated during the August 2009 workshop held in Kampala (www.livescience.com, March 2013).

5. Conclusion

Chimpanzees are charismatic apes in the mountain forests of the Albertien Rift region with the high population in the forests of DRC. This spies contribute to the countries economy throigh the tourism. However, this humankind closer species was classified to the endangered by IUCN red list due to human activities like forest clearance, poaching, and diseases transmission. Effort by both government, NGO and researcher were initiated to protect the remaining population of this species but initiatves like promoting transboundary collaboration in the Nyungwe-Kibira Landscape for the conservation of chimpanzees and their habitats and raising the communities awareness among the local population and governments would help to protect the remaining population of Chimpanzees.

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3.5. Birds' Status in the AR and Priorities for Conservation

Claudien Nsabagasani, ARCOS

Summary

The Albertine Rift region is known for its importance in biodiversity conservation especially endemic and abundant bird species. According to BirdLife International, the Albertine Rift is an Endemic Bird Area. A total of 1061 bird species have been recorded in this region and this is 52% of all of Africa's birds. Of these 41 species are endemic to this region while 25 are considered to be highly threatened. The richness is attributed to the habitat diversity including low and medium altitude and montane forests, small and big wetlands and savannah areas.

Introduction

The Albertine Rift comprises a number of protected areas, Natural reserves, wetlands and RAMSAR sites. The region has been identified as a region of great importance for conservation of biodiversity; it is an 'eco-region', 'biodiversity hotspot' and an 'endemic bird area'. The region has more endemic species of birds than other regions of Africa where more than half of continental Africa's birds were identified. This richness is linked to the huge variety of habitat including volcanoes, high and low mountains, savannah and wetlands.

Due to various effects including climate change, birds' hunting and human activities like timber and minerals exploitation, birds' habitats are disturbed with the forest loss and reduction of suitable habitat which affect the birds' population and reproduction patterns. Using the information from cases studies, research reports and our own observations, we produced this paper which relates on the richness of birds diversity and population, threats and conservation measures in the Albertine Rift.

Methods

The information in this paper was collected from the desk research. The paper comprises resources from cases studies, research reports, our own observations and information from people from government and NGO involved in biodiversity conservation in the Albertine Rift.

Species diversity and richness

The Albertine Rift is one of Endemic Bird Areas identified by Birdlife International with a total of 1,061 bird species of which 41 species endemic to the Albertine Rift including 6 species from Eastern Zairian Lowland forests.

The species richness varies from site to site, the Virunga National Park in DRC has a recorded list of 706 species and is the richest of the protected areas in the Albertine Rift while the Itombwe Massif has more bird species endemic to the Albertine Rift than any other site (with 34 endemic species) and it has more highly globally threatened species than any other site with 15 species (Plumptre, 2003). Many factors underpin the birds and biodiversity richness in the Albertine Rift region and the main one is that the region is the Pleistocene refugium. There also are numbers of protected areas such as National Parks, RAMSAR sites, Wildlife Reserves, Forest Reserves and different sites identified as Important Bird Areas. Sites like Virunga Massif, Kibira-Nyungwe and Lake Albert, constitute trans-boundary ecosystems and hence

Threats to birds of the Albertine Rift

As other taxa, the bird diversity and abundance in the Albertine Rift are threatened by political instability, civil war and human pressure among others habitat encroachment and fragmentation with forest clearance, farming and un-organised mining and oil exploitation. The forest of the Lendu Plateau in the northern reaches of the Albertine Rift have almost completely disappeared (www.worldwildlife.org, March 2013) while the East of Mahale Mountains Park may also be vulnerable as refugees from the Burundi civil wars move down and settle near the

park (www.panda.org, March 2013) and Mukura Forest Reserve in Rwanda is heavily destroyed by the mining of coltan. The population of birds are also affected by hunting and illegal capture. Chicks and adults of Grey Parrots and Grey Crowned Cranes are collected from the wild and they are destined for the hotels and the elite garden display trade in main cities (Picture).

Climate change and natural hazards affect also

Figure 23. Grey Crowned Crane is highly confiscated at hotels/ Photo/ARCOS

specific and vulnerable habitats. Lakes in Volcanoes National Park in Rwanda are drying up due to natural effects and wetlands are being replaced by montane forest vegetation (Pers. Observation) while changes in the snowfall pattern have been observed in mountain and highland systems, notably ice retreating on Rwenzori Mountain.

Bird Conservation actions

Many sites in the Albertine Rift benefit from protected area status and having the tans-boundary sites in the Albertine Rift region promotes the cooperation for researchers and better management of these sites. Status of birds was a subject in biodiversity surveys undertaken in different sites of Albertine Rift like the survey conducted in Virunga massif (2004), Rugezi Marsh (2012) and different activities by Wildlife Conservation Society (WCS), Birdlife International (and its local partners).

Law enforcement, information sharing, awareness raising and integrated conservation development projects were intensified around the protected areas in the Albertine Rift region to support the lives of people and improve the local communities' attitudes towards habitat and bird conservation.

Conclusion

The Albetine Rift is a hotspot region, very rich in birds and other biodiversity. The two contiguous Endemic Bird Areas, which overlap in altitudinal range: Albertine Rift and Eastern Zairean Lowlands, host over half of all Africa's birds and a particularly high number was recorded in the Virunga National Park. This richness is linked to the habitat factors and climate of the region. However, birds and other biodiversity are stressed by human activities which not only alter the habitats but also disturb the population and reproduction patterns. Conservation activities are being conducted on different sites by various stakeholders including law enforcement, transboundary conservation initiatives, researchers and information sharing, community awareness and livelihood activities to strengthen the conservation actions and ensure that the decision-making is based on scientific information. But, much on birds of the Albertine Rift is still poorly known, especially outside the protected areas, and it is probable that many more species will be discovered if continuous monitoring is conducted in the AR sites.

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3.6. Status of Amphibians and Reptiles in the AR and Priorities for Conservation

Chifundera Kusamba (CRSN-Lwiro, DRC) & Mathias Behangana (Makerere University)

Summary

We report on the current status of amphibians and reptiles in the Albertine Rift and their conservation status. Data from recent ongoing field surveys and the literature are used. As fieldwork and surveys progress, new species are discovered, and DNA analyses identify lineages that can be recognized as new genera. Time-constrained visual observations and opportunistic searching were used as sampling methods. In total, 175 species of amphibians and 290 species of reptiles are presently known to occur in the Albertine Rift, with 45 and 38 reptile respectively endemics to this region. A news species Xenopus itombwensis is added to the list, and papers describing more new species are in press for publication. Various threats to species and habitats are reported, the most important of which are habitat loss and some infection diseases. Activities like researches and information sharing for conservation measures are conducted. However, it is important to develop strong conservation actions by involving local communities.

Introduction

The content in this paper comprises the information on species richness and distributions recorded within and outside of protected areas as well as the results on the preliminary results on the ongoing herpetofaunal surveys of the Albertine Rift initiated in 2007 in Democratic Republic of the Congo (DRC). At the end of the survey project we will be able to produce reasonable checklists for each country of the Albertine Rift. This paper is considered by the authors to be part of an ongoing process to provide more complete lists of all the sites, thus providing a good 'first cut' of the herpetofaunal diversity of the Albertine Rift and the priority sites for conservation.

Methodology

Inductive and deductive methods were used to produce this paper. The information is based on results from an ongoing survey project developed since 2007 in collaboration with different partners institutions in DRC as well as European research institutions. It also includes information from recent studies and reports on amphibian and reptile fauna in the Albertine Rift. In these surveys, different sites were sampled in 4 provinces of Eastern DRC: Katanga, South Kivu, North Kivu, Orientale Provinces. In total 2300 specimens representing the majority of amphibian and reptile species were collected, euthanized, labelled and most of the collections are preserved in 95% ethanol at the University of Texas at El Paso (UTEP, USA). The information in this paper comprises also information from publications, the internet, workshops and museum collections. The very important web sites related to taxonomy and phylogeography of species were visited to update the lists and comply with any change in taxonomy as well as the IUCN status.

Status of amphibian and reptile species in the Albertine Rift

Presently, there are 175 species of amphibians known from the Albertine Rift region with 45 endemics (25.7%) including 11 vulnerable and 2 endangered (Table1). A news species *Xenopus itombwensis* is added to the list (Evans et al., 2008), and other papers describing more new species are in press for publication (Evans et al., submitted).

About 290 species of Reptiles are recognized and 38 species are endemic, representing 13.1% of the total number of species known from the Albertine Rift, but their IUCN status is not yet evaluated (NE). Species

and their status are illustrated in the annexes of this report.

Threats

As other biodiversity, Reptiles and Amphibians are affected by high human population density mainly the conversion of forest to agricultural land and other human effects resulting habitat loss. Most of the African amphibian populations have not been studied in the context of mass declines and populations trend. The most recent threat assessment of montane Albertine Rift frogs was done by Stuart et al. (2008) and IUCN (2009). In addition, high population of amphibian from Kahuzi Biega National Park and the Itombwe Plateau have tested positive for chytrid fungus infections, but no mass die-offs were observed during fieldwork activity (Roelke et al., in press).

Conservation status

Different NGOs are working hard to improve conservation of Amphibians and Reptile in the Albertine Rift. Researches and information communication is one of these activities. However, it is important to develop strong conservation actions by involving local communities. The war in DRC and Burundi was a serious handicap to conservation efforts in the region, but the Governments are striving to establish a peaceful climate and new protected areas are under consideration with the support from international NGOs, such as WWF and WCS, FFI, CLP and RSG.

Conclusion and Recommendations

Inductive and deductive methods combining fieldwork and literature compilation allowed the estimate of the species richness and conservation status and production of this paper. In total, 175 species of amphibians and 290 species of reptiles are presently known to occur in the Albertine Rift, with a higher percentage of endemic species: 25.7% and 13.1% respectively for amphibians and reptiles. Mature rainforest habitats at mid- to high elevations are key habitat for the herpetofaunal communities of the Albertine Rift (Behangana et al., 2009), and therefore, should be of priority for conservation. All stakeholders in conservation are urged to develop appropriate management and conservation measures for protecting the mature forests in local and regional conservation programs by involving local communities through education and development projects and infectious diseases, like Chytridiomycosis, need be monitored carefully to prevent the amphibian population declines in the region.

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Figure 24. Hyperolius kivuensis, Endemic to the Albertine in Rugezi Marsh, Photo/Mathias Behangana

3.7. State of Plant Biodiversity in the Albertine Rift and Priorities for Conservation

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Abstract

In this paper, a review is made of the information available about plants in the Albertine Rift region, their key threats and initiatives to conserve them. The level of species richness, endemism, protected area networks and priorities for conservation action are provided. Information about collection of plants and information about them was reviewed. The region is one of the most important for conservation of plants in Africa, with remarkable levels of plant richness and endemism. Many plant species with restricted range of geographic distribution, including endemics and near-endemics have been identified from the region. However, some of the areas have not been well surveyed and hence limited information is available about them. These still need extensive surveys to document their floral diversity. Others are not effectively protected or face immense challenges owing to new economic adventures in the region, such as oil drilling. Well thought out plans need to be formulated to minimize impact on plants and biodiversity as a whole, and also closely monitor the responses of various elements of biodiversity to the changed conditions in their environment.

1. Introduction

The efforts to document plant species richness and diversity in the Albertine Rift region began way back, from the efforts of European explorers in the various countries of the region. These botanists, biogeographers and other professionals made great strides in this endeavour when they made collections of plant material from the entire region. Speke & Grant (in 1860s through 1870s), Scott Elliot (1890s), Kassner T, Mahoni, Bagshawe AG, Dawe IR, Brown E, Wollaston AFR (all in the 1900s), Fyffe R, Snowden JD, Dummer RA, Grant CHB, Peter A, Burtt, BD (1910-1920s) were among the earliest collectors of plants from the region (Table 2). Many others followed later (The Natural History Museum, London 2005), including the Forest Department surveys of forests in Uganda in then 1990s (Howard & Davenport 1996) which yielded data on trees and shrubs in the Albertine Rift. The Wildlife Conservation Society (WCS) began assembling of data on plants in the region around 2002 but also later conducted their own surveys in the region which led to the Plumptre *et al*. 2003 publication. These efforts have been instrumental in revealing the floral value of the Albertine Rift, but there is still a great need to conduct more surveys in the region as a number of areas are still poorly known.

The human population density in the region is high, leading to tremendous pressure being exerted on the natural resources. The resultant effects of habitat loss and degradation, and their consequent decimation of biodiversity are major challenges. The region needs to be secured against loss of such an important resource base with a large potential to contribute to economic development of the countries in the region. All possible mechanisms and strategies should be explored in order to achieve sustainable utilization of the region's wealth of plant and other resources. This requires involvement of all key players including policy makers and implementers, as well as communities who are directly affected by the policies, among others.

2. About the Albertine Rift flora

a) Biomes and habitats

Much of the Albertine rift lies within the Guineo–Congolian phytochorion with parts of the Afromontane and Zambezian phytochoria of White (1983). Accordingly, many of the sites in the region are montane or submontane and hence do not have a great diversity of tree species. The habitats range from a) low-mid altitude forests (e.g. in Semuliki, Budongo, Kibale, Kasyoha-Kitomi, Kalinzu-Maramagambo and Bwindi); b) high altitude forests (Rwenzori, Echuya, Virunga Volcanoes and Virunga south – Gombe, Mbizi/Ufipa and Virunga north, Mahale Mountains Park; c) medium altitude forests in Nyungwe and Kahuzi Biega; and d) the savanna sites (Queen Elizabeth, Virunga central and all the Virunga National Park).

b) Species richness

At least 6,409 plant species are known to occur in the Albertine Rift (Linder 1998, Plumptre *et al.* 2003), which is about 14% of plant species in mainland Africa and about 23% of the Guineo-Congolian, Afromontane and Zambesian phytochoria that form most of the Albertine Rift (Plumptre *et al*. 2007). Of the 6,409 plant species, 821 are tree species, 499 grass species, 186 species of climbers, 360 species of ferns and the rest are other herbs and shrubs (Plumptre *et al*. 2007). Virunga National Park has registered the highest species richness of all plant life forms followed by Bwindi Impenetrable and Mahale Mountains National Park (Table 1). The richest site for only tree species was Budongo Forest Reserve (449) followed by Kalinzu-Maramagambo forests (442) and Kasyoha-Kitomi Forest Reserve (419). But some sites such as Budongo have been better surveyed than others. Burundi and Zambia are the least known about plants in the region.

c) Endemism

A total of 341 species endemic to the Albertine Rift have been identified to-date. Virunga National Park has the largest number of endemic species (230) of which 124 are found in the Virunga Volcanoes with Kahuzi Biega National Park (145) and Nyungwe Forest (137) in second and third place Virunga National Park, Kahuzi Biega National Park and Mahale Mountains National Park account for 84% of endemic and threatened species

d) Phenology and biodiversity conservation

Phenological processes are highly correlated with climatic signals. The phenology, or timing of life history events, is affected by ambient temperature and precipitation regimes. Changes in plant phenology are said to be the most immediate indicators of climate change. Climate change has already altered range boundaries and phenology elsewhere in the world. Increase in temperature can have dramatic implications for the timing of flowering and fruiting for plants and can also directly affect growth rates and other physiological factors that will cause species to migrate or become extinct. Alteration of phenological patterns of plants can have profound impact on frugivorous communities as it may disrupt food supply. Changes in season length could affect flowering and other aspects of plant phenology, as well as the annual cycles of pollinators, disease-causing insects, and other organisms. Alpine species in the region such as *Dendrosenecio* spp. and *Lobelia* spp. and montane species such as *Erica* spp. and *Rapanea* spp. are particularly vulnerable to impacts of climate change on phenology. Populations of these species are also at the edge of their altitudinal range, insular in distribution, genetically impoverished owing to isolation. Not many phenological studies have been carried out in the region. Tree phenology has been studied in Nyungwe Forest Reserve, Budongo Forest Reserve and Kibale National Park.

Table 6. The plant species richest areas in the Albertin Rift

Protected Area	Number of plant species
Virunga NP	2077
Bwindi INP	1405
Mahale National Park	1174

d) Protected Areas

One of the opportunities existing for conservation of the Albertine Rift flora is that the region contains many protected areas. These have varying levels of protection from the well protected National Parks to less protected Forest and Wildlife Reserves down to Wildlife Sanctuaries. These areas occur naturally connected though may be managed as distinct protected areas, sometimes by different institutions in a given country. The continuity of the connectivity of these landscapes requires that they are managed as one contiguous unit rather than independent sites. Corridors or stepping-stones of suitable habitat may facilitate the migration of species in response to climate change, and are important for maintaining species migrations and gene flow. The Democratic Republic of Congo, in particular, has several sites important for conservation, and these would require legal protection in the future. The largest and most critical of the landscapes includes the Virunga National Park in DRC, the Parc National des Volcans in Rwanda; Semliki, Rwenzori, Queen Elizabeth, and Kibale National Parks, Kasyoha-Kitomi, Kalinzu-Maramagambo Forest Reserves and Kyambura Wildlife Reserve in Uganda. This 'Greater Virunga landscape' covers about 12,860 km^2 and includes a wide variety of habitats and altitudes, ranging from 600-5,100 meters above sea level. It is also incredibly rich in species and endemic and threatened species. Possible landscapes that have been recommended by WCS for a program of transboundary collaborative management as contiguous units include:

a) Nyungwe-Kabira forests contiguous across the Burundi-Rwanda border

b) Murchison Falls National Park - Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve which link Murchison Falls to Semliki Wildlife Reserve through a corridor of forests reserves, grasslands and private forests

c) Kahuzi-Biega National Park - Tayna Community Reserve - Itombwe Massif which are not linked by protected areas but with a considerable amount of natural habitat

d) Mahale Mountains - Ufipa plateau with much wild land still existing to the east of Mahale Mountains National Park and down towards Ufipa Plateau.

3. Conservation significance

The Albertine Rift region is now recognized as one of Africa's most important sites for the conservation of biodiversity in general (Plumptre *et al.* 2007). Its huge diversity of habitats incorporates the ice fields on top of the Rwenzori Mountains at 5,000 meters (16,000 feet), active volcanoes, hot springs, bamboo, alpine vegetation, montane forest, savanna and down to the lowland forests of Semuliki at 600 meters (1,800 feet). This wide range of habitats and altitude has caused a correspondingly high biological diversity in the region. BirdLife International identified the Albertine Rift as an Endemic Bird Area (Stattersfield *et al*. 1998). It is also an Ecoregion by the World Wildlife Fund. Conservation International also later recognized it as one of the world's Biodiversity Hotspots in their second global analysis (Myers *et al*. 2000). The region is very high in species richness, with over 6,400 plant species, of which over 340 are endemic. This important eco-region is however, also among the most threatened regions of the world.

Figure 25. Part of Matiri Forest Reserve opened up for cultivation of crops/Photo Kalema

5. Threats to plants

A total of 73 plant species are threatened and 51 are IUCN-listed in the Albertine Rift (Plumptre *et al*. 2007 and unpublished updated report). Bwindi Impenetrable National Park and Budongo Forest Reserve have the largest number of threatened (CR/EN/VU) species (18 species each) with Kasyoha-Kitomi Forest being the third (17 species). The most threatened sites in the rift occur in DRC and include both the parks and the unprotected sites such as the

Itombwe Massif, Marungu Massif and Mt Kabobo. Forest loss around Bugoma and Budongo is heavy, primarily occurring outside the protected areas on private or government owned land (Plumptre 2002). For protected forests, forest loss tends to be highest between 2 and 4 km from the boundary, for many of the forests (Plumptre 2002). Changing climate and other local principal drivers such as human induced landscape changes pose real threats to plants and all biodiversity.

i) Habitat (especially forest) loss and degradation over the past 10-15 years has varied between sites but has been particularly severe east of Lake Albert in western Uganda (Fig. 26) and eastern Congo around Kahuzi Biega National Park and the Itombwe Massif (Plumptre *et al*. 2003). Illegal harvesting of timber and other plant products, charcoal burning, and encroachment for farmland (Figs 1-3) have been identified as key causes of habitat loss and degradation (Plumptre 2002).

Figure 26. Ugandan endemic Encephalartos whitelockii in panga River gorge threatened by dam construction /Photo Kalema

ii) Timber exploitation is not that big a threat in most sites in the region but has the potential to become a major threat in DRC when the civil war ends and access to the forests improved.

iii) Mining for oil is only just beginning in many parts of the region, but is a huge potential threat even to plants in protected areas in the northern end of the Albertine Rift. Mining for minerals has led to invasion of protected areas in DRC and hunting wildlife around the mining sites, degrading habitats for flora and other biodiversity; in Queen Elizabeth National Park, mining has already led to chemical pollution of the soils and water, directly affecting vegetation (Oryem-Origa *et al*. 2007)

iv) Introduction of alien plants is a problem in some parts of the Albertine Rift. In Budongo Forest Reserve, *Broussonetia papyrifera* was introduced for the paper industry, and has since spread to cover vast areas owing to its invasiveness. *Senna siamea* was introduced in Semuliki National Park as a boundary marker but invaded many parts of the park, into its interior and adjacent community land. These invasions have had devastating impact on indigenous flora elsewhere in the world, reducing plant diversity and hence conservation value of affected sites. *Mimosa pigra* is a notorious shrub invading many wetland ecosystems in the entire region. It takes over large areas rapidly, suppressing the indigenous flora. Disturbances, such as grazing and vegetation cutting, accentuate its growth and spread. *Lantana camara* is also a common invasive alien in drier areas of the region which has covered sizeable areas, leaving very little of the indigenous flora.

v) Virunga and Kahuzi Biega National Parks are severely threatened by encroachment for land, settlement in fishing villages and heavy poaching for bushmeat. Encroachment leads to removal of natural vegetation cover or decimation of its coverage.

vi) Nyungwe faces a variety of threats, but recently, the greatest has been fires that have occurred in *El Nino* years and have destroyed large areas of the forest

vii) Since the early 1990s, devastating civil strife (Stabach *et al*. 2010**)** in this biodiversity hot spot has led to heavy influx of refugees, compounding the problem of forest degradation, fragmentation, and loss - particularly in protected areas and decimation of wild flora and fauna and loss of protected area integrity

viii) The region is one of the most populous in Africa, with up to 700 people per square kilometer in some locations placing a heavy demand on land for cultivation and other resources (Fig. 27).

Figure 27. Charcoal burning is one of the major threats to plant diversity in Kabwoya Wildlife Reserve, Uganda (Note the charcoal kilns) /Photo Kalema

4. Recommendations for conservation priorities

i) It is important to prioritize at the ecosystem type, site conditions and species level. For sites, particularly important are size, integrated landscapes and biological and evolutionary processes (such as the influence of isolation on speciation). Alpine areas are particularly important owing to their susceptibility.

ii) Sites with higher species richness, endemism, and level of threat are critical for biodiversity conservation and ecological integrity. Basing on species richness, Plumptre *et al*. (2007) ranked the sites as 1.Virunga 2.Bwindi 3.Mahale Mts 4.Kahuzi Biega and 5.Nyungwe National Parks, in that order. These are already protected but it is important to emphasize this continued high level of protection owing to their significance in plant conservation

iii) Basing on endemism, Plumptre *et al*. (2007) ranked the areas as: 1.Virunga, 2.Kahuzi Biega 3.Nyungwe 4.Bwindi, and 5.Rwenzori Mountains National Parks. iv)Basing on number of IUCN threatened (CR, EN, and VU) species, Plumptre *et al*. (2007) ranked them thus: 1.Budongo Forest Reserve, 2.Bwindi Impenetrable National Park, 3.Kasyoha-Kitomi Forest Reserve, 4.Semuliki National Park, and 5. both Kibale National Park & Bugoma Forest Reserve in 5th position. These are very critical for protection of the globally threatened plants they contain.

v) Large areas of contiguous habitat require landscape management approaches for the long-term conservation of species; The Virunga Landscape which encompasses the Virunga National Park and contiguous protected areas is particularly rich in total species, endemic and threatened species and thus a high priority in the region. The proposed landscape approach to conservation needs emphasis.

vi) Virunga, Kahuzi Biega, Semuliki, Kibale and Bwindi Impenetrable National Parks, Nyungwe Forest Reserve, Itombwe Massif, and Lake Tanganyika are 'High' priority sites for 'species richness' and 'endemic and threatened' species across five taxonomic groups: Plants, Amphibians, Reptiles, Birds and Mammals. Their protection and conservation would probably provide proxy conservation of other biodiversity elements in the region.

vi) Identification of gaps where further research is required. Sites that need further survey work and hence top priority for gap bridging are those at the southern end of the Rift, including the Marungu Massif, Mt Kabobo, Itombwe Massif, Mahale Mountains and east and south of Mahale in Tanzania.

viii) Involvement of local communities in the management of the natural habitats in the region. It is also necessary to sensitize and involve them in law enforcement and decision-making, e.g. in exploring alternatives to forest resources.

5. Recommendations for monitoring

i) The impact of climate change needs to be monitored as alpine and montane species of plants are sensitive to such change. Their abundance and distribution need to be monitored in the wake of changing climatic patterns

ii) Ecosystem health (through species composition and structure, invasions especially of aliens, ecosystem size) needs to be monitored through regular surveying to ensure ecosystem integrity and maintenance of life support systems. Results of restoration programmes need monitoring in order to evaluate their effectiveness.

iii) Many of the endemic and threatened plant and other species were found in areas where flagship

species such as gorilla numbers were low. There is thus a need to ensure monitoring of abundance and distribution is done throughout the region rather than using a few as surrogates

iv) Plants are one of the most needed resources especially in forested areas in the region. Any efforts made to allow controlled access to plant resources in the protected areas through multiple use schemes need to be monitored to allow the sustainable resource use

v) Pollution and fire effects on plant growth and survival are vital to structural properties of the habitat. The impact of drilling oil and mining of other minerals and wild fires require close monitoring before, during and after the operations in order to avert deterioration of habitat quality

vi) Strategic planning efforts (2001-2003) for the region recognized planning units at landscape level. The connectivity for these needs to be maintained and monitored for migration of species and long distance dispersal of plant propagules

viii) Different policies in the region may contradict and counteract effective resource management. These policies, guidelines and agreements may need to be harmonized programmes for monitoring implementation and compliance developed

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4. Pressures: Conservation Issues and Challenges

Figure 28. Sand mining in river, western Rwanda. Photo/ARCOS

4.1. Introduction

Faustin Gashakamba, ARCOS

The Albertine rift is one of the most geologically unstable regions of the continent. Coinciding with the western branch of the East African Rift and the most geologically active branch in terms of seismicity and volcanicity, the biodiversity and sometimes entire ecosystems are affected after a major earthquakes or eruption happens.

Seismic waves cause a lot of damage most specifically to aquatic ecosystems where the disturbance of lakes' bottom gases can cause eutrophication in the lake's waters and kill fishes and other creatures therein.

Most catastrophically, the highly stratified structure of Lake Kivu concerns scientists and the general public indeed because a big shake of its bottom could trigger the lake overturn (so-called limnic eruption) which can be deadly not only to the lake's biodiversity but also to thousands of people living in its surroundings.

Volcanic eruptions also frequent in the region are not without harm to biodiversity and the environment. In fact, scientists have observed that the frequent eruptions of one of the most active volcanoes in the region (Volcano Nyiragongo) release huge quantities of Nitrous and sulphurous gases that are at the orgin of the subsequent acid rains causing ravaging damage to crops and the natural vegetation in the area. This goes without saying the already bad enough effect of the eruptions themselves since the lava flow destroy big expenses of lands forcing life to restart all over again.

Apart from these classic purely natural disasters, other partly or entirely human-induced disasters can also have a significant impact on the environment in this region. One of these is climate change whose impacts are only yet to be grasped fully abreast.

Studies have shown how climate change will affect for instance the Albertine Rift endemic bird species whereby the most IBAs in the region will experience substantial turnover in the future if the today's climate change trends are maintained. Moreover, climate change and even in its narrower form, climate variability, can have big adverse impact on people's livelihoods by desynchronizing rain and crop planting seasons thereby bring the rain-fed agriculture machine to a halt.

With decreasing productivity, farmer communities try to remedy the problem by extending arable lands at the expense of natural forests and other preserved ecosystems which only exacerbates the habitat degradation and increases the biodiversity loss rate.

Finally, economic growth and its associated infrastructure development is threatening leave long-lasting effects on the environment, an impact which will be felt even long after the benefits from this development will have vanished. In fact, the recent enthusiasm about oil discoveries in many parts of the region, the pressing needs to tap into the huge mineral resources available in the rift, the need to harness every watt of hydropower potential at any river system, the strong drive to exploit at any cost any bits of land and many more large, medium or small-scale economic activities that are going on in the countries of the region can be best described as short-sighted in most cases. The fact is, sometimes the legal and policy frameworks are in place that provide for environmental safeguards but transparency or governance in general in this part of the world is making the implementation pointing in the other direction. Cases abound where results of EIAs are purposefully distorted, or where activists are taxed as downright opposing social and economic development and therefore casted out of the game.

This chapter looks at some of these pressures in depth, leaning on the results of some studies that were made in some sites and draws some recommendations on how we can bring a solution to these concerns and make the much-needed economic development respectful to nature and sustainable.

4.2. Climate Change Impact on Birds in the Albertine Rift

Ken Mwathe, BirdLife International

Summary

Climate change is one of the many environmental pressures facing the Albertine Rift region. Increasing impacts on the region ecosystems also arise from humans (rapid human population growth, diseases, low literacy, poverty and political instability). Human impacts add pressures on ecosystem services, such as land cover change, desertification, alien species invasion, unsustainable resource use, soil erosion and pollution (Millennium Ecosystem Assessment 2003).

Predictions presented in the current assessment of the Intergovernmental Panel on Climate Change (IPCC) regarding how the climate in East Africa will change indicate that it is still difficult to tell whether the Albertine Rift region as a whole is going to get wetter or drier, although it is almost certain that the temperature will increase, current models of climate change for Africa have not yet been performed at a sufficient level of resolution to determine such localized predictions (WCS 2008).

One of the evidences usually presented for the changing climate in the region is the receding glaciers of the Ruwenzori Mountains. Pictures of Ruwenzori in 1906 show the mountain nearly fully covered by ice, but photos of 2008 shows a few ice bars. "*Ice in the Rwenzori is disappearing so swiftly that much critical information may have already been lost. There is a lot of concern about whether there is even a viable ice core*," said Richard Taylor, a hydrologist at University College in London.

Studies on the impacts of climate change in the Albertine Rift are still in the formative stages and most of the initiatives focus on understanding past and current climate and modelling the impacts of climatic changes on various social, ecological and economic aspects. Notable on climate assessment are Seimon and Philips (2010) and Picton et al (2010). However, there seems to be consensus on the key areas that will require everyone's focus in the future. These are: changes in rainfall and temperature, changes in phenology, changes in habitats, changes in animal distributions and changes in where people currently live.

Chapman et al (1999) has shown that rainfall has increased around Kibale National Park since 1900. Related to this, the phenology of certain trees has changed and some trees such as Mimusops bagshawei rarely fruit now. This is because fruiting is correlated with minimum temperature in previous cry season.

One of the charismatic species in the Albertine Rift is the Mountain Gorilla that may require active management. Studies of the Mountain gorilla shows that climate change is likely to result in shifting of range of the species. It has also been shown that clustered distributions represent a significant vulnerability of the species to disease. Community isolation would seem to be the strongest safeguard to preserve the species against invasive pathogens introduced into its range by climate change. This might therefore require assisted migration as an adaptive measure to establish one or more communities in comparable montane habitat well outside of their present range (AWF 2010).

Climate change is also expected to affect people, land use and the ecosystem services upon which they depend for survival. The Albertine Rift has one of the highest human populations in Africa – reaching 500-700 persons per sq km densities - and as favourable agricultural land shifts with a changing climate, it is expected that people will also shift as an adaptation measure.

One of the lingering questions as far as climate change in the Albertine Rift is concerned is what needs to be done to plan and adapt people, ecosystems and key species to the impacts of climate change. In order to address this, a number of organizations are carrying out scientific and action oriented work to find solutions to this question. Among these organizations are the Albertine Rift Conservation Network (ARCOS), Wildlife Conservation Society (WCS), BirdLife International,

African Wildlife Foundation and International Gorilla Conservation Programme. The respective governments in the five Albertine Rift countries are also undertaking various initiatives with a view to addressing the challenges of climate change. This is especially within the National Adaptation Programmes of Action.

The rest of this paper provides a more detailed synopsis of BirdLife International's work on climate change in Africa and more specifically in the Albertine Rift.

Impacts of Climate Change on birds in the Albertine Rift – BirdLife Models

BirdLife International has been implementing a climate change models across Africa to assess the impact of climate change on Important Bird Areas and priority species therein. With support from the MacArthur Foundation, BirdLife in collaboration with Durham University did modelling work to look at current and future distributions based on temperature and precipitation. Maps, depicting modelled present-day and modelled projections of future species ranges approximating to four discrete time periods: present-day (based on the mean climate between 1970–2000), 2025 (a mean of climate projections for the period 2010–2039), 2055 (mean for 2040–2069) and 2085 (mean for 2070–2099), were produced. These maps are available here: http://www.africa-climate-exchange.org/maps/ and published in Hole et al 2009 and Hole et al 2010.

Summary of fine scale modelling for the Albertine Rift

BirdLife in collaboration with Durham University and the Wildlife Conservation Society (WCS) did detailed modelling of 14 Albertine Rift (Table 1) endemic species using point locality data provided by WCS - to determine future species shifts in the face of climate change. Models were generated using Maxent, a relatively new species distribution modelling package that under rigorous testing has proven to be one of the most effective modelling tools currently available.

Table 1: List of 14 Albertine Rift endemics

Scientific name	Common name
Alethe poliophrys	Red-throated Alethe
Apalis personata	Black-faced Apalis
Apalis ruwenzorii	Ruwenzori Apalis
Batis diops	Ruwenzori Batis
Bradypterus graueri	Grauer's Swamp-Warbler
Francolinus nobilis	Handsome Francolin
Hemitesia neumanni	Neumann's Warbler
Kupeornis rufocinctus	Red-throated Mountain-Babbler
Nectarinia alinae	Blue-headed Sunbird
Nectarinia purpureiventris	Purple-breasted Sunbird
Nectarinia regia	Regal Sunbird
Parus fasciiventer	Stripe-breasted Tit
Prionops alberti	Yellow-crested Helmetshrike
Zoothera tanganjicae	Kivu Ground-Thrush

Variables that can be interpreted in terms of a species' ecology were used. All proved optimal in previous modelling of African birds and mammal. These variables are:

a) Mean temperature of the coldest month;
b) Mean temperature of the warmest month
c) The ratio of actual to potential evapotranspiration
d) Wet season 'intensity'
e) Dry season 'intensity'
f) Slope
g) Aspect.

The above variables (a-e) are climatic parameters and were estimated for future time periods through interpolation of temperature and precipitation anomalies from the HadGEM general circulation model (A1b emissions scenario), included in the IPCC Fourth Assessment Report (2007). Interpolated anomalies were applied to the Worldclim; present-day climate dataset.

Three time periods were modelled – the present-day, and 30-year averages centred on 2025 and 2085.

Variables (f) and (g) represent potentially important physical descriptors of the environment, whose relationship with climate is unlikely to change as climate change proceeds. It is therefore appropriate to retain them when projecting onto future climates. Landcover was not included as an additional variable in the modelling, since adequate projections of future changes in landcover at the resolution used were unavailable. As such, these models are likely to provide an optimistic scenario of current and potential future ranges under climate change, since suitable climate for many or all of the species considered is likely to occur in areas where suitable habitat is unavailable now, or will be unavailable in the future.

The Fig 1 shows projected species richness of the 14 AR endemics across time periods, in a three-dimensional view. This view better reveals the general upward (and northward) shift prevailing across the 14 species. As a composite figure, it provides with confidence that these overall trends are likely to be robust.

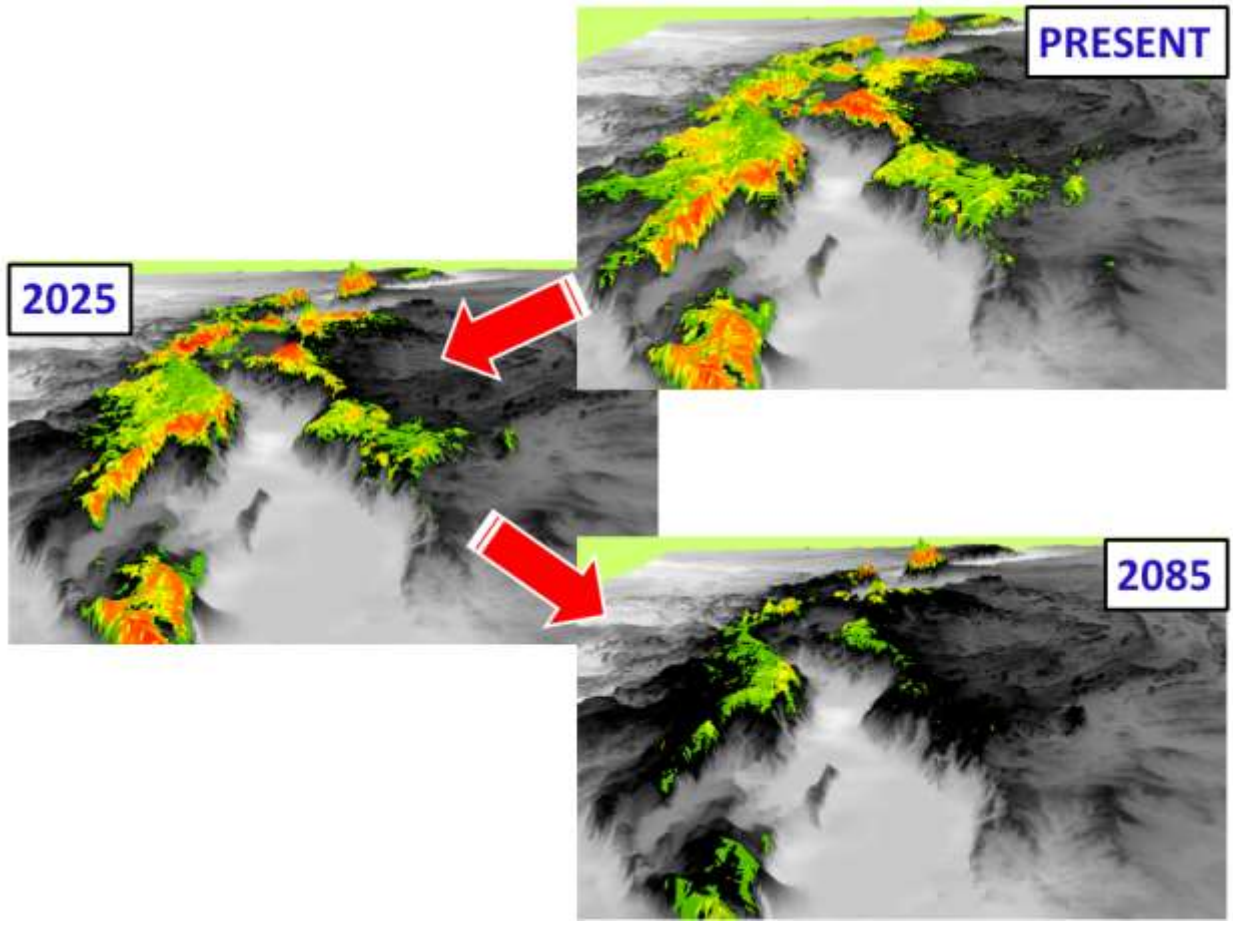

Figure 29. Projected species' richness of 14 AR endemic birds across time. Warmer colours indicate higher richness. Grey-scale is a 30 arc-second digital elevation model, with dark colours representing higher elevation. Graphic is looking due north 'up' the rift.

The modelling results

All species show dramatic declines in both measures across time, with the Red throated Mountain-babbler (*Kupeornis rufocinctus*) projected to lose all suitable climate space within the IBAs in the region. Clearly therefore, all 14 endemic species are projected to be at severe risk from climate change. However, those species that are likely to be at greatest risk are those projected to experience only a small overlap between their present and future ranges (<5%), those that will remain with only a small future range (10% of current range), or both. Top amongst these are Handsome Francolin, Grauer's Swamp Warbler and Neumann's Warbler.

Secondly, all 14 species are projected to shift upwards in their distributions (a trend both modelled and observed to occur in a range of species and taxa in mountainous regions across the globe) by, on average, 350m by 2085.

Finally, two regions outside the current IBA network but that are projected to be crucial in providing suitable environmental conditions for many of the 14 species by 2085, were identified. Protection and or restoration (as appropriate) of the forests in certain regions outside the IBA network is likely to represent a key adaptive management strategy in an effort to ensure resilience of the Albertine Rift's IBA network under climate change.

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Figure 30. Floods are reportedly more and more frequent and intense in the Albertine Rift (Photo © REMA 2012)

4.3. Climate Variability and Crop Production in the Albertine Rift Region

Katcho Karume (OVG, DRC), Kazi S Majaliwa Mwanga (CRSN-Lwiro, DRC) and Asasira Josephine (Makerere University)

1.Summary

Climate change is a global phenomenon, but its negative effects are more felt by populations living in poor countries (DFID, CE, PNUD and World Bank, 2002). They are particularly vulnerable due to their strong dependence to natural resources and their limited capacity to face climate variability and extreme meteorological phenomena (Dilley et al., 1997; Downing and Patwardhan, 2003).

Agriculture in the Albertine Rift Region is practiced on subsistence basis using traditional methods (low input technologies) on small land holdings (Barhalengehwa J., 2008). Already the region is reported to be experiencing warming, floods and droughts (Karume et al., 2008). Generally land management practices are poor, and decline in food production has been observed across the region (Majaliwa et al., 2008). On the other hand the region's population is exponentially increasing (with population growth rates averaging 2.5 %, creating a per capita food consumption gap (Barhalengehwa J., 2008). This has subsequently affected food security, income generation, nutrition and its related diseases, and the rate of school drop, ultimately causing poverty and reducing the quality of life of the peasant populations who depend on the land resources for a living.

The result of this has been an intensive use of land which does not adequately take into consideration conservation measures as land is not protected and productivity is not enhanced. Continued mismanagement of land resources will also lead to increased climatic problems.

2. Introduction

Spatial and temporal variations in climate within a region are important in land suitability, crop production, management of natural resources, land-use planning, watershed management and territorial ordering.

The study described here tested the hypothesis that climate change is one of main factors influencing crop production and livelihood in the Region. Also the hypothesis that land use change is the main factor influencing climate variability in the Albertine Rift Region is tested.

This study characterizes climate variability in seven Albertine Rift Region locations (Bukavu, Lwiro, Goma, Kibuye, Shabunda, Fizi and Uvira) using rainfall and temperature data, and links this variability to land use change. It analyzes the potential effects of climate change on crop production and livelihood options of small scale farmers.

Results showed very slight (almost no) change in monthly mean temperature in areas covered by forest while in urban areas the monthly mean temperatures increased for about 0.6^{o}C in 20 years. Redistribution of rainfall and temperature has been observed in these urban areas of the region. This has induced decreasing of crop production and suggests that forest and open water around some areas of the region somehow kept the climate while the heavy urbanization of the other sites has been responsible of climate variability.

3. Methods

This study was conducted in seven Albertine Rift Region sites. Climatic data covering a period of about 25 years (1966-1986 and 2003-2007) were collected from meteorological stations.

The datasets included Minimum and Maximum temperatures and rainfall. Data were entered and analyzed in Excel software on monthly basis. The mean values were computed and trend line made out of them using regression techniques. Mean values were later on compared for different months of different years to isolate the increase or decrease of climatic parameters considered in different sites.

Livelihood change was characterized using semi-structured questionnaire and group discussion. Only local chiefs and 55 years old and above heads of households were consulted during the interviews. A total of 399 respondents were interviewed (individually and in groups). Focus groups discussions were done to cross-check individual interviews answers. Questions focused on past and current livelihoods indicators such as land-use, soil productivity/fertility, fish production, socio-economic conditions and constraints to improved livelihoods. In addition, 10% of the interviewed households were subjected to household analysis. All the socio economic data were coded and entered in and analyzed using Statistical Package for Social Scientists version 12.

Spatial data analysis was done in ILWIS 3.2 software system and ArcView 3.1 software. The system generates area, length perimeter and general relationships of one feature to another.

Land use maps were drawn up through an unsupervised classification interpretation work. It was based on 7 predominant land use types: tropical high forest, open water, farm lands, woodland (scrubs and fallow), grasslands, wetlands and built-up areas.

In this study, biomass classes identified from remotely sensed data were verified initially with the use of secondary data sources such as natural resource reports and maps (FAO Map, National Biomass Study map). Field verification of key areas was undertaken to check ground interpretations. This fieldwork was undertaken in the region in April 2005 and confirmed for the study area in July 2005.

4. Results and Discussion

It is important to notice that the Albertine Rift Region has experienced variations in monthly rainfall, despite the fact that rainfall amount did not change significantly with time in the region. Data analysis shows that rainfall amount for the entire region observed a decline in January and February for the last two decades compared to the 1960's; and an increase in April and October. There is a decrease of 14 mm (R2=0.72), 6 mm (R2=0.60) every 5 years. The increment is of 17 mm (R2=0.90) in April and 30 mm (R2=0.83) for every 5 years since 1966, these results were also noticed by Karume et al. (2008). Perhaps long term climatic data is needed for a more accurate trend. However, the number of extreme events is on increase, many small streams are now becoming seasonal, and the frequency of floods has increased in the area. The occurrence of floods was reported to be 20 to 25 years in 1950, it passed to 10 years between the 1950 and 1980, and now it is occurring almost every 5 years.

Temperature data analysis has shown over time an increase in temperature of the order of 0.4 in Kibuye and Lwiro stations, while in Bukavu and Goma an increase of the order of 0.8 has been noticed. This can be attributed to the regulation role played by the Kivu Lake as far as temperature is concerned in Lwiro and Kibuye. The presence of Kahuzi Biega Park (Forest) has played a big role in rainfall and temperature regulation in Lwiro.

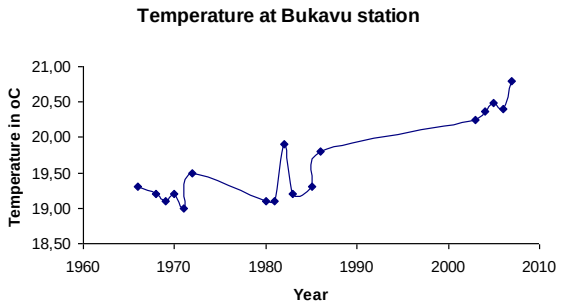

Figure 31. Average temperature at Bukavu Station, eastern DRC

The major sources of income in the region are agriculture (65%), small businesses (20%), Livestock (10%) and fisheries (5%). Agriculture is basically practiced in the villages, and for subsistence. The major crops grown in the study area are sorghum, beans, potatoes, sweet potatoes, maize, rice, cassava, and banana. For more than two decades the seasonal calendar has been changing. The wet season used to cover between 8 and 9 months, but currently covers 5 to 6 months depending on years, and starting date for the season being generally uncertain. This has considerable impact on agricultural production of all households in the region.

All the interviewed reported that the area was covered by dense forest with a high fauna and flora diversity up to 1940's. Fuel wood is the major source of energy for 95% of the households. This was noticed by Karume et al., 2006. Up to recently, charcoal and firewood used in cities was emanating from the study area. Today, there are only few pockets of planted woodlots were hunting is almost

impossible because of animal scarcity. The region is now covered by rangelands. This has induced generalized scarcity of fuel wood in the region.

Seventy percent of the farmers declared that soil fertility has declined and household crop production is not sufficient to satisfy the household needs and growing population in the villages and cities. Sixty nine percent of the households said they don't have sufficient food to cover a full year and ninety percent of them have seen their income reduce considerably (by 50% in a decade).

Most of the heads of households believe that fishermen are now few and fish has disappeared in the Tanganyika and Kivu Lakes.

The introduction of new drought resistant varieties and improved varieties can explain the general yield increase observed in 1990 and 2000 and was subsequent to the lowest yield observed before due to mainly crop diseases outbreak and heavy rains which destroyed crops. The major problem in the study area is the relative lack of resources, institutions, and infrastructure to promote such adaptations.

Decline in maize yields under climate variability in the study area could be mitigated if climate change was accompanied by increases in irrigation, fertilizer use and the use of drought resistant varieties.

The tropical crops considered in this study are closer to their high temperature optima and experience high temperature stress, insects and diseases, already much more prevalent in warmer and more humid regions have become even more widespread in this region.

Insects have extended their ranges and their survival and increased their number of generations per season; this has been also observed by Stinner, et al., 1989. Pests and diseases from low latitude regions (Uvira) have been introduced at higher latitudes (Lwiro, Fizi and Kabare). As a consequence of the resulting pest increase, there has been a substantial rise in the use of agricultural chemicals.

Lwiro, Fizi, and Shabunda have suffered the smallest decline in the total value of crop production; these areas are covered by heavy tropical rain forests which have kept the climate (temperature and rainfall) steady.

It has been estimated that the region has been more vulnerable to climate change because of economic and social constraints. In addition, greater economic and individual dependence on agriculture, widespread poverty, inadequate technologies, and lack of political power have exacerbated the impacts of climate change in this region.

The higher decrease in crop production observed in 2005 is attributed to the fact that the starting date for the season is being generally uncertain. This has considerable impact on agricultural production of all households in the region.

5. Conclusion

Agriculture is the main sources of income in the region followed by small businesses, and livestock.

Farmers perceive that:

- Agricultural activities have been affected by the fluctuating seasonal calendar
- Fishery activities have decreased because of fish biodiversity and abundance decline.

Adaptations to climate change to be considered include changes in planting and harvest dates, tillage and rotation practices, substitution of crop varieties or species more appropriate to the changing climate regime, increased fertilizer or pesticide applications, and improved irrigation and drainage systems.

One of the most important effects of an increase in temperature, particularly in regions where agricultural production is currently limited by temperature, would be to extend the growing season available for plants and reduce the growing period required by crops for maturation. But the opportunities for introducing new crops or crop varieties that tolerate warmer climate would increase the region's overall potential for agricultural production as suggested by Williams et al., 1988.

Agricultural crops and cropping systems have to be developed for, and adapted to, these varied regimes of climate, soil, diseases and pests as suggested also by Haws et al., 1983.

Rainfed and irrigated agriculture are essential human activities that have long been vulnerable to seasonal climatic variability and shocks. The vulnerability of the agricultural and rural poor in particular, is expected to increase with predicted climate change and associated extremes such as frequent and more severe droughts, abnormally wet periods and higher temperatures. The resilience of the above sectors must be improved in response to current and future climate variability. Means must be sought to ensure the transition from coping with shocks towards more adaptive resilient systems that can confront future

climate extremes as suggested by Sanginga P. et al., 2006.

Changes in land use and land cover are important contributors to climate change and variability. The IPCC also appropriately identifies land cover change as one of the forces for climate change.

Climate variability can induce a biodiversity loss due to a very long dry season and heavy rains occurring in some days of the year.

6. Recommendations

- Allow communities to participate in assessments and to share their knowledge in order to collect first-class information on climate hazard management at local level.
- Collect and generate climate data for seasons forecasting and making vulnerability maps to climate change and variability.
- Give access to quality information on climate change effects. Poverty reduction strategies efficiency depends on it. Early warning systems and information spreading mechanisms allow catastrophes anticipation and/or prevention.
- Increase subsistence means, coping strategies should sustain and rely on local subsistence means, taking into account autochthon response knowledge and strategies. Traditional mechanisms of risks share could be completed by micro assurance plans.
- Exploiting renewable energies, enhancing sinks and preparing for adaptation to adverse effects of climate change.

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4.4. Impact of Volcanism on the Environment and Development in the Albertine Rift

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1. Summary

The last eruption of Volcano Nyiragongo on January 17th, 2002 has been accompanied 4 months later by the reactivation of a crater lava lake. Through this lava lake, a plume of gases oriented preferentially toward the west following the dominant winds direction in the region can be noticed. Some of these gases such as sulfur dioxide (SO2) and the nitrogen dioxide (NO2) are at the origin of acidic rains that destroy vegetation around this volcano. The chemical analysis of rainwater, spring and river samples reveals the excessive presence of fluorine, nitrate, chlorine and sulphate in waters consumed by the population. The acid rainwater has been responsible of habitat destruction around Nyiragongo and Nyamulagira volcanoes. The carbon dioxide (CO2) found along some fissures and in front of lava flows have been killing birds and reptiles at sites of high gas concentration.

2. Introduction

The Western branch of the East African Rift experiences intense seismicity and moderate volcanism. The Western Rift is formed by the succession of 40-70 kilometer-wide basins characterized by grabens and half-grabens in 100 kilometer-long segments (Ebinger 1989; Ebinger et al., 1991). It is here that the deep and anoxic African Great Lakes are nested. Successive basins are linked by accommodation zones characterized by oblique-slip transfer faults and volcanic provinces such as the Virunga (Ebinger et al., 1989b).

Figure 32. Nyiragongo Volcano: gas plume above Goma city – May 2003 (Photo © JDurieux-OVG)

The activity of Nyiragongo and Nyamulagira is believed to be directly related to the opening of the Western Rift Valley (Kasahara et al., 1992). The 2002 eruption of Nyiragongo, for example, occurred during a regional rifting event between the volcano and Lake Kivu (Komorowski et al., 2002/2003). In addition, the 1977 eruption of Nyiragongo occurred four days after a Mw 5.3 event struck the Bukavu area (Hamaguchi et al., 1992). Despite the temporal link between several large earthquakes and volcanic activity, it should be noted that light to moderate earthquakes occur frequently in this region, and many of these are not linked to eruptions.

Since June 2001, there is formation of a new lava lake manifested by fountains. This frees in the atmosphere an enormous loaded gas plume of various strong volcanic products such as slag, Pele hairs of Peeled and dusts (Fig. 32 and 33).

Among the free gases in the plume, can be mentioned, among others, the dioxide of carbon (CO2), the dioxide of Sulfur (SO2), fluorine (F), methane (CH4), the dichloride (Cl2) and oxides of nitrogen (NO3, NO2), etc. Most of these gases in this plume are chemically very unsteady and have tendency to react directly with the atmospheric water to form acids that are hygroscopic compounds. These acids are mainly: the sulfuric acid (H2SO4), the nitric acid (HNO3), carbonic acid (H2CO3), the fluoride acidic (HF) and the hydrochloric acid (HCl).

These compounds absorb water and are soluble in water. They generate acidic rains that encourage the strong particle dissolution in the atmosphere and affect dangerously the chemical composition of the surface waters and soil that become harmful to plants and animals and this, provokes the

deterioration of the environment (Faure, G., 1998). The acidic rains are recorded in various places around the crater and in the neighboring villages of the Nyiragongo volcano

3. Method

The seismological network of Goma Volcano Observatory (GVO) provided seismograms. The observation network consists of 8 seismic stations equipped with short-period Kinemetrics vertical SS-1 ranger pick up (T0=1s) connected to PS-2 portable seismic recorder instruments.

The method of transect was used in this study to assess damages caused by the volcanic particles on vegetation in each of the considered sites. A delimited area of 200 m of large and 500 m of long using a tape, in which plants damaged by the volcanic particles were counted and determined.

Specimens of plants inventoried were packed and sent for complete identification to the herbarium of Centre de Recherche en Sciences Naturelles de Lwiro.

In different prospected sites, farmer's interviews were conducted to have their opinions on the agricultural damage level since the beginning of ash fall. Surface waters were also sampled (spring water, harvested rainwater stocked in reservoirs) for the chemical analyses in laboratory to search for signs of pollution by volcanic particles.

Water samples were collected in polyethylene bottles of 150 mls. Their pH was determined directly by a digital pH-meter at Goma Volcano Observatory. The samples were later on sent to University of Florence in Italy for deeper analyses of Fluorine, Chlorine, Nitrate and the Sulfate.

4. Results and Discussion

It was noticed by using the differential optical absorption spectrometer (DOAS), that the daily amount of SO_2 ejected in the atmosphere by Nyiragongo volcano is varying between 3000 and 52000 tons. The lava lake of Nyiragongo volcano is generating volcanic cloud containing several gases, such as: SO_2, NO_2, Cl_2 and F.

Results have shown that the cultivated plants are more vulnerable than the wild plants. This has consequences on food security since crop cultivation is the main source of livelihoods in the area. However, wild plants are affected as well and this disturbs the habitat for the wild fauna and threatens tourism in the region.

Species affected are mainly: Arundinaria alpine, Rumex usambarensis, Guizotia scabra, Pentas zanzibarika, Crotalaria intermedia, C. Dewildemania, Microglossa densiflora, Ficus sycomorus, Pluchea ovalis, Maesopsis eminii, Vernonia ruenzoriensis, Acanthus pubenses, Dombea goetzenii, Erica arborea, Helichrysum stulmanii, Lobelia wollstonii, Senecio manii, Peuncedamum linderi, Umbilicaria sp. and cultivated plants are: Alium cepa, Colocasia sp., Ipomoae batata, Solanum tuberosum, Sorgum bicolor, Musa sp, Manihot sp., Phaseolus vulgarus, Zea mays.

The geochemistry measurements done on the ground along some fissures, land depression points and front of old lava flows in Nyiragongo volcano field had shown the concentration of carbon dioxide (CO2). These gases have an impact on biodiversity in the VNP and the surrounding region.

Figure 33. Vegetation destruction by lava flows from Volcano Nyamuragira eruption in November

Figure 34. Beans plants attacked by volcanic particles and acidic rain

5. Conclusions

Volcano Nyamulagira is among the most active volcanoes in the world as indicated, since 1901, by a sequence of 30 flank eruptions (Pouclet, 1975; Smett et al, 2009).

This study has shown how much the current activity of Nyiragongo volcano has a serious impact on the flora of the region. Wild species as well as cultivated plants are attacked by volcanic particles and acidic rain waters (Fig. 4).

If the volcanoes maintain their current activity, important consequences would be to fear in years to come. As shown by the study, the eruptions not only pose a health risk but also have an impact on livelihoods and economies in general.

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Figure 35. Small scale mining can indeed lead to large scale disasters. Most AR forests are affected regardless of their protection status

Socio-economic Development in the AR and its Impact on the Environment

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1. Abstract

Society has to constantly make decisions over the allocation of resources to balance the short-run and long-run costs and benefits of forest and biodiversity conservation. With the need to accelerate socio-economic development in the Albertine rift region, the governments of the different countries spanning the rift are faced with the dilemma of striking a healthy balance between the quest for rapid socio-economic development and conserving biodiversity. Doing this at the local, national and international level is quite complex and dynamic. To accelerate development and to combat problems of poverty and food insecurity in the region, human activities are increasing and consequently posing various degrees of threats to biodiversity. In the past, the main threats consisted of conversion of the natural habitat to tea, coffee and pyrethrum plantations and to both large and small scale farms. In recent years, the main threats are coming from the consequences of a rapidly expanding human population paralleled with growing demand for land, pasture (grazing) and water. This pressure means that in many places, land has been transformed right up to the boundaries of the protected areas. This analysis gives a synopsis of numerous human activities in the Albertine rift that have implications for biodiversity conservation.

Figure 36. Human population pressure at the edge of the Volcanoes national park, Rwanda (Source: CGIS-NUR.

2. Introduction

Studies have examined the impacts of human activities on biodiversity which often translate into habitat modification e.g. impacts of farming, forest fragmentation, timber extraction, fuelwood collection, tourism, overgrazing and infrastructure development (see Tole 1998, Chapman and Chapman 2003, Plumptre et al. 2003, Fawcett et al. 2004, Totland et al. 2005, Ewers and Laurance 2006, Robbins et al. 2006, Savilaakso Sini 2009, Olupot 2009, Olupot et al. (2009a, 2009b).

To accelerate development and to combat problems of poverty and food insecurity in the region, human activities are increasing and consequently posing various degrees of threats to biodiversity. Rapid urbanization and the great demand for cropping, grazing land are some of the drivers of natural resource exploitation leading to biodiversity loss in the region (see Plumptre et al. 2003).

The occurrence and intensity of these numerous threats vary by region and country. Sites within the rift that are mostly threatened by human activities are those with no protected status such as Itombwe Massif, Mt Kabobo, Marungu Massif and the Lendu plateau.

With an average regional annual population growth of about 2.6 % in the Albertine rift region, the need for natural resources will continue to increase. More than 50% of the people live in extreme poverty (that is, less than 1 USD per day)[1] and lacking sufficient land to meet their basic needs (Lanjouw et al. 2001).

As population increases, land and other important resources become scarce, causing an increase in people's dependence on natural resources. The implication is that in many protected areas in the rift, land has been converted to other uses right up to the boundaries (WWF et al. 2008). An example is the volcanoes national park in Rwanda where human population pressure is severe (see Figure 36).

[1] Note the poverty threshold has now been revised to $ 1.25 by 2005 PPP

Consequently, much of the natural forest on private lands occurring just outside the protected areas have already disappeared due to conversion of forests to agricultural and pasture land (Dirichi et al. 2002 cited in Bush 2009, Olupot et al. 2009a). Socio-economic development and biodiversity protection are better viewed as not separable. It is a proven fact that on the long-run, the end result of the other way round would be against both the development and environment.

With a population density of between 600-700 people per km2 in the central part of the rift, it has one of the highest population densities in Africa (Plumptre et al. 2003). Intense human population pressure has been identified as one of the major causes of biodiversity loss in the world (Wilson 2006, Hanson et al. 2009).

Adding to this, infrastructure development such as dam and road building reduces natural habitats for biodiversity. Hydropower generation is a highly favoured option for meeting energy demand where riverine natural resources are available. New roads being constructed are opening up these habitats, thus giving access to additional areas, which results in further biodiversity losses. Twenty-one percent of Important Bird Areas (IBAs) in Africa are affected by habitat destruction as a result of ongoing or planned infrastructure development (BI 2004). The next sub-section examines hydropower generation at the Rugezi wetland (Rwanda).

3. Hydro-electricity power generation

The Rugezi-Bulera-Ruhondo wetland complex has been recognized as being of international importance under the Ramsar Convention in 2005. Apart from the unique biodiversity the Rugezi wetland hosts, its watershed supports the most bulk of Rwanda's electricity supply. However, the Mukungwa and Ntaruka stations on wetland's outlet currently operate at only 30-50% efficiency for various reasons (CITT-KIST 2006, REMA 2006, Uwizeye and Hammill 2007).

Although the effect of climate change on the degradation of the swamp cannot be totally denied, Hategekimana and Twarabamenye (2007) posited that the activities carried out within the catchment indicated that the impact of anthropogenic factors was severe. A major cause of the degradation of the Rugezi wetland is the demographic pressure in the catchment which led to its development. Between 1978 and 2000, the population in the catchment increased from 29,5021 to 51,7715 inhabitants with approximately 75.5 % increase over a period of 24 years. The population density grew from 337 to 577 persons per km^2 while family farm size shrunk from 1.4 to 0.6 hectares. Being in a completely rural area, with the population depending only on agriculture, the pressure for land was great.

This case illustrates clearly the fact that economic growth in general and infrastructure development in particular needs to have an environment bearing if it is to be sustainable.

4. Mining and mineral exploration,

The Albertine rift region is not only a biodiversity hotspot; it is also endowed with many mineral resources as well. Mineral exploration and exploitation is a major threat to biodiversity where biodiversity richness coincides with mineral availability.

Evaluating habitat characteristics of the East Usambara wetland forests, Senzota and Mbago (2010) found that the disturbance from small-scale quarrying significantly reduced woody cover and changed species composition in the herbaceous layer. In fact, trees in the surrounding area are cut down and the logs used for heating and weakening the stones for easy crushing (Nyeko 2009) resulting in a cascade of adverse effects from the combined mining & quarrying, deforestation, pollution, etc.

5. Oil and Gas exploration and exploitation

Oil exploration has been taking place around Lake Albert over the past 10 years and exploratory drilling is now taking place. Several of the protected areas, including Queen Elizabeth, Semliki, Murchison Falls and Virunga National Parks and Budongo, Bugoma and Itwara Forest Reserves all fall within concessions for oil exploration. If significant amounts of oil are discovered under these protected areas great pressure will be put on them to either allow drilling or de-gazette them all together (Plumptre et al. 2007).

Elsewhere, the government of Rwanda and DRC have now started extraction projects of methane gas from

Lake Kivu. Although the process is believed to reduce the risk of a limnic eruption, concerns are very high over the level at which the ecosystem function and biodiversity will be affected when the activities are stepped up at large scale.

6. Intensification of agriculture

The drive for agricultural development to achieve food security in the rift is intense. Agriculture remains the main contributor to the GDP, contributing 43% - Tanzania, 34% - Kenya, 30% - Uganda, 34% - Rwanda, 35% - Burundi, 42.5% - DRC (World Bank 2008, http://www.state.gov/r/pa/ei/bgn/2823.htm, Salami et al. 2010).

Examples of large scale agriculture includes crop farming, livestock ranching and perennial cropping such as coffee and oil palm (BI 2004) while small scale agriculture is more subsistent in nature.

The fact that subsistence farming accounts for about 75% of agricultural production and over 75% of employment among the population in the region shows the magnitude (Salami et al. 2010) at which the high pressure for agricultural land represents to conservation in the region (Kayitare 2005). The intensification of agriculture and husbandry affects the natural habitats of species. The farming system in the north and eastern parts of Uganda is environmentally destructive. All the cash and food crops grown in these regions are very susceptible to heavy tree shades. It is estimated that for every hectare of land under cultivation, there is a similar amount under deforestation (Nyeko 2009).

5.Energy for cooking

The exploitation of forest resources to meet energy demand, especially for cooking is expressed as the need for fuel wood and burning of forest trees for charcoal (see Figure 5). Charcoal places a heavy strain on local wood resources. Charcoal production harms the environment in two ways: deforestation and CO2 gases. In order to produce charcoal, trees must be removed from the forest, and the wood must be burned in kilns, slowly, for long periods of time. During this process, CO2 is released into the air. Because it burned hotter and cleaner, charcoal was considered superior to wood and preferred by urban dwellers. http://www1.american.edu/ted/charcoal.htm#end.

To meet domestic energy needs in the different countries, the percentage accounted for by burning wood and charcoal are as follows: over 90% - Burundi, 90% - Rwanda, 91% - Tanzania 90% - Uganda (UNDP 2007, http://www.africa.upenn.edu/NEH/kenergy.htm)

6.Conclusion

This article discusses numerous types of human activities and examines the impact on biodiverty in various sites in the Albertine rift region. Threats to biodiversity as a result of increasing human activities vary between the sites in the region. Of particular concern is the Virunga N.ational Park. Which, as a result of prolonged civil unrest, is severely threatened by encroachment for land, settlement, in fishing villages and heavy poaching for bushmeat. The challenge of striking the right balance between the need to develop the region socio-economically and conserving biodiversity, especially endemics is better described as a jig-saw puzzle. Some countries have adopted the use of protected area management strategies for forest and biodiversity conservation such as integrated conservation and development, ecotourism. Bush (2009) looked at the contribution that forest conservation in protected areas can make to poverty alleviation and economic development (see also Lamprey 2003). To conserve biodiversity, particularly large mammals, there is need to improve anti-poaching efforts and re-establishing control in the gazetted areas (Blom and Bowie 2001). Giving an economic value to environmental benefits helps to mainstream environmental considerations in the economic decision making frameworks of policy makers (Hanley & Shogren 2002). (Campbell & Luckert 2002) state that valuing non market goods and services from natural resources is of critical importance to Less Developed Countries' (LDC) economies due to the dependence of the rural livelihoods on natural resources in general, and trees and forests in particular. This means that a great deal of goods and services from natural resources are effectively 'un-priced'. Poor price information means that policy makers have little information available to make economic decisions about resource allocation which is critical in setting development priorities in

an economic framework. Conservation areas are invariably major natural resources in LDC economies, enabling governments to make informed decisions about economically optimal strategies towards their conservation and management is a critical aspect of successful planning for their long-term preservation.

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Figure 37.ARCOS Training field visit discussing pollution affecting Freshwater ecosystems – Lake Tanganyika/ Photo/ARCOS

5. Responses: Conservation Acction, Research and Policies

Fiure. 38. Rugezi Wetland, northern Rwanda, an example of wetland recovery in the Albertine Rift region Photo/ARCOS

5.1. Introduction

Philbert Nsengiymva, ARCOS

The success or failure of any response to biodiversity conservation depends on the ecological and institutional setting in which it is applied (Millennium Ecosystem Assessment, 2005).

The Albertine Rift, being highly important for biodiversity conservation, but also highly stressed by various threats, more effort is needed to provide effective responses for the sustainability of the region.

Involving different stakeholders, the conservation of the Albertine Rift region is one of the responsibilities of the countries, given their objective to protect the environment for the good of the general public. To do so, governments try to establish an appropriate set of organizations and put in place specific programmes, aiming in fact at achieving national and regional objectives not only for conservation purposes but also for the sustainable development of countries.

National Biodiversity policy, strategies and Action Plans are the key instruments developed to address threats to biodiversity at the national level. Even if there is a continued increase stress on the Albertine Rift region's biodiversity and natural ecosystems, most species still exist and could recover if necessary and Effective conservation policies, strategies and plans are developed and implemented in a transparent, participatory and sustainable way.

Figure 39. ARCOS Team conducting field research, Kibira National Park, Burindi. Photo/ARCOS

The biodiversity research and monitoring and availing needed information for the conservation is crucial (). It helps understand the breadth and impact of ecological change, and regional and global drivers for the change and therefore allows responding more proactively to threats and opportunities for conservation of biodiversity in the region.

Papers in this chapter highlight some case studies of existing institutional arrangements in the Albertine Rift region from community level, with some community conservation approaches tried, and also to the country and regional level with transboundary conservation approaches initiated. It will look at the existing efforts and investment to support biodiversity monitoring and research activities in the region. And finally it will note the current situation and the trend aspects of the policies, strategies and plans with a view to proposing some recommendations.

5.2. A Review of Benefit Sharing and Community Conservation Approaches in the Albertine Rift Region

Aventino Kasangaki (ARCOS) and Robert Bitariho (ITFC)

1. Summary

The creation of protected area systems within the Albertine Rift region deprived local communities of their sources of livelihood and as such caused resentment and conflict towards the gazetted areas. Several initiatives by protected area authorities and conservation NGOs have been started around the protected areas to try and resolve the conflicts and increase the benefits the communities derive from protected areas. The initiatives include revenue sharing schemes, resource access programs, income generating activities, problem animal control techniques and collaborative resource management. Revenue sharing schemes have been successful in Rwanda and Uganda, but no such initiative exists in the protected areas of Burundi and Democratic Republic of Congo. Collaborative forest management approaches seem to be functional only in the protected forest reserves in Uganda and as such there is need for sharing the successful initiatives in other regions of the Albertine Rift. Regulated resource access programs, mostly of Non Timber Forest Products (NTFPs), are being implemented in several protected areas in Uganda. It is suggested that policies need to be formulated to adopt the successful community conservation approaches in countries where these are not being practiced.

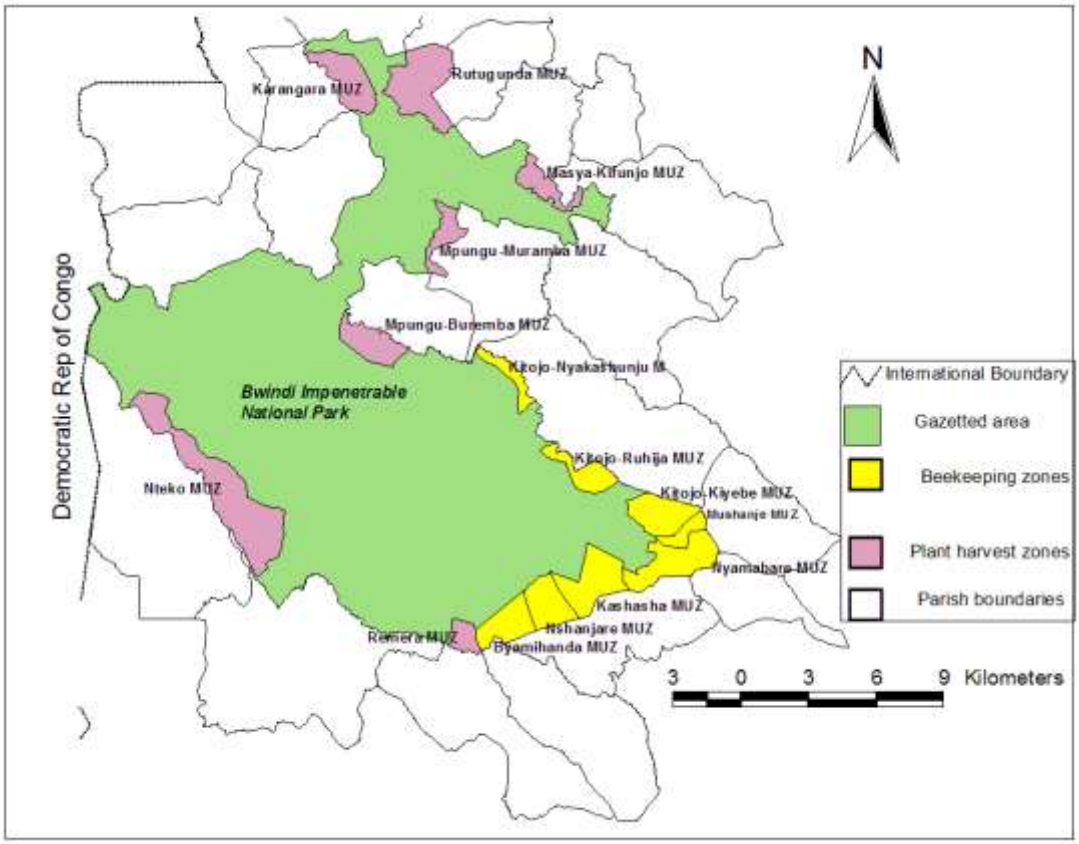
2. Introduction

Community conservation approaches in most tropical country shave an origin from a need to resolve conflicts between protected areas (PAs) and local people adjacent. These conflicts usually originate over a need by PA managers to protect PA resources that are a source of livelihood to the local people neighbouring the PA. Following the establishment of National Parks and Forest Reserves in the Albertine Rift region, conflicts and resentment by the local people developed against the gazetted protected areas as they were no longer allowed unregulated access to resources that they accessed in the past. In order to resolve the conflicts and resentment, PA authorities in the Albertine Rift introduced the community conservation approaches in the management of the PAs. These approaches were deemed important after the Convention on Biological Diversity (CBD), in Rio de Janeiro1992. The CBD highlights under Article1 the importance of sustainable use of biodiversity and its components and equitable sharing of benefits arising out of the utilization of biodiversity resources by allowing among others; appropriate access to genetic resources. The Rio conference further advocated for the inclusion of local communities in the management of protected areas.

Communities living near protected areas often experience problems from animals coming out of protected areas that destroy their crops and sometimes leading to loss of lives. There are no governments' policies regarding compensation for loss of crops and human life caused by animals coming out of the PAs in all Albertine Rift countries.

3. Methods

This paper reviews some of the case studies in the region and proposes some recommendations in terms of good policies that can be scaled up in areas where these do not exist. We review policies in the different countries such as Rwanda, Uganda, Tanzania and Democratic Republic of Congo that are relevant to benefit sharing, community conservation approaches, human wildlife conflicts, and collaborative natural resource management approaches. In addition, we have reviewed different published articles on the subject from within the region and accessed information from various internet sources. Face to face and email/Skype interviews with conservationists familiar with community conservation approaches in the region



such as Wardens and policy makers in the relevant government departments in the region were carried out. The documents reviewed include the Rwanda Development Board Policy on benefit sharing (2005), the Uganda Wildlife Act, 2000, and the Uganda Forestry and Tree Planting Act.

Figure 40. Map of the multiple use zones in Bwindi Impenetrable National Park (source: Bitariho in prep)

4. Community conservation approaches in the Albertine Rift

To mitigate the effects of crop raiding and to reduce existing conflicts between park authorities and local people, The Uganda Wildlife Authority introduced a revenue sharing program in Bwindi Impenetrable National Park (BINP) on a pilot basis in 1994. The revenue sharing programme involves local people being given 20% of annual total gate collections from national parks. The funds are then invested in development projects such as schools, dispensaries and roads (Government of Uganda 1996). Because of its success, the revenue sharing programme started in BINP was later expanded to other national parks of Uganda. Despite the success however, there is also some contention that 20% of the gate collection fees is too low compared to costs the communities incur by being neighbours to the protected areas. The revenue sharing program, community conservation programs, increased visibility of park staff, and cooperation with community groups have all helped to improve relations between the park and communities around PAs (Blomley*etal,* 2010).

Another community conservation approach introduced in BINP was the multiple use programme (MUP). The MUP involves local people around the park entering into agreements with National Park authorities in order to harvest park resources such as medicinal plants, handicraft materials and beekeeping. For beekeeping, local people are allowed to place beehives inside the forest at the park periphery. So far fourteen parishes are benefiting from the programme (Figure 40). Like the revenue sharing programme, the MUP has been on-going for the past 17 years. After the success of the multiple use programme in Bwindi, PA resource access programs have also been introduced in other

national parks in Uganda such as Queen Elizabeth , Rwenzori Mountains, Semliki and Kibale National Parks in mid-western Uganda and in Echuya and Budongo Forest Reserves (Bitariho in prep).

However, the MUP has been criticised because most of the PA resources the local people around BINP consider important for their livelihoods were not considered for harvest by the PA managers (Bitariho in prep). These resources include poles, hoe handles, walking sticks and wild honey and the BINP park management does not allow their harvest. It has actually been pointed out by Bitariho in prep that BINP's MUP is not collaborative since park authorities have not relinquished some powers of park management to the local people.

In Rwanda, the Revenue Sharing policy and implementation guidelines are guided by Rwanda Development Board's mission, which is: "To conserve Rwanda's rich biodiversity for sustainable development of the country and as global heritage through the application of sound ecological principles and the cultivation of strategic partnerships with local communities and other stakeholders"(ORTPN, 2005).The overall goal of the Revenue Sharing Programme is: To ensure sustainable conservation of the National Parks with the participation of the neighbouring communities by contributing to the improvement of their living conditions (ORTPN, 2005).The revenue sharing program is being implemented in communities around the three National Parks in the country, i.e Nyungwe, Volcanoes, and Akagera National Parks. In Rwanda, the policy is quite different from that in Uganda in that in Rwanda, 5% of all income for the protected area is invested in community projects compared to 20% of gate collections in Uganda. For example around Nyungwe forest, communities have been trained in modern beekeeping technologies and honey generated from this intervention has been certified by the relevant agency in Rwanda and can now be accessed and accepted in hotels and supermarkets across the country (Louis, Pers. com. Warden Nyungwe NP). The revenue sharing program has improved park-community relations with communities volunteering information about illegal activities taking place in the park and it is reported that communities now willingly help report and put out fire outbreaks in the park. Other activities that have been supported include community tourism development through provision of finances and capacity building to the communities. Since the inception of the revenue sharing program in 2005, a total of $640,903 has been disbursed to fund local community projects around the Virunga Volcanoes national Park up to end of financial year 2000/10 and $392,000 has been distributed in communities around Nyungwe National Park (Plumptre et al 2011, Chao *et al* 2011).Despite the investment in community projects, no critical evaluation has been done on the effectiveness of revenue sharing programs and how they impact conservation. The communities around Nyungwe Forest continue to exhibit high levels of poverty and continue to bear the costs of conservation as they see no tangible benefits from the national park (Chao et al, 2011). There is therefore a need for implementing effective policies in the communities around the Park to improve benefits derived from the Park to local communities, through supporting communities to increase their agricultural income and generate alternative livelihoods and employment opportunities to reduce their reliance on the forest resources. Providing employment opportunities in tourism and research to communities around the parkas has been done around Kibale and Bwindi National parks in Uganda could be one way of winning over the communities to support conservation.

No specific case studies or examples could be got from other Albertine Rift countries such as Burundi, and Zambia and as such, the conservation approaches from the two countries have not been presented in this paper. In Tanzania, Tanzania National Parks (TANAPA) has a well-developed program to share benefits with communities surrounding national parks. Under the Community Conservation Service (CCS), an outreach program of TANAPA, over US$ 3 million was invested in development and environmental education programs around national parks in the country. The objectives of the CCS are: to improve relations between National Parks and local communities; to ensure that the interests of TANAPA with regard to natural resources conservation and community welfare are expressed at all levels; to facilitate benefit sharing; to assist communities to gain access to information on resources and services that promote sustainable

development; to strengthen local institutional capacity, including Community Based Organizations (CBOs) in addressing conservation issues; to develop professional and collaborative linkages with all community conservation stakeholders and to conduct community conservation education programs. However, no specific examples were available from Mahale and Gombe Stream National Parks within the Albertine Rift.

In the Democratic Republic of Congo, several community conservation initiatives have been initiated around Kahuzi-Biega National Park and these have been mainly with support of local NGOs as there was a breakdown of law and order following the civil strife since the 1990s. For example the Pole Pole Foundation (POPOF) has been implementing programs aimed at mitigating the conflicts between the national park and local people. They have initiated community development projects such as tree planting, handicraft making, and environmental education that aim to simultaneously benefit conservation inside the park and promote economic development of the local people (Yamigawa et al 2011). All initiatives in DRC seem not to be backed by policies from government. According to the Pole Pole Foundation website (http://www.polepolefoundation.org/kbnp.php), a lot of people still practice bushmeat hunting and also harvest fruits, wild vegetables, mushrooms and honey from the park. There is therefore need for strategies aimed at integrating the local communities into the conservation effort while improving their economic and living conditions.

5. Integrated conservation and development projects

In order to diffuse the tension that existed between local communities and protected area managers, several integrated conservation and development programs were initiated around Bwindi Impenetrable National Park, south western Uganda. Development activities, such as health centres, schools and road construction and income generating activities are often supported. The Bwindi Mgahinga Conservation Trust (BMCT) was established with a Global Environment Facility Grant (GEF) in 1994.The Trusts' mission is 'to foster conservation of the biodiversity of Mgahinga Gorilla National Park (MGNP) and BINP through investments in community development projects, grants for research and ecological monitoring, funding park management and protection and programmes that create greater conservation awareness' (BMCT website, accessed 28 September, 2011). Some of the projects funded by BMCT include construction of schools and health facilities around the protected areas and income generating activities such as vegetable growing and beekeeping for community groups.

There is evidence that these interventions have been effective at improving relations between the local population and park authorities, as the local communities now see the park as their own, as evidenced from the economic benefits they gain mainly from tourism-related activities. For example, surveys showed improved community attitudes towards participation in putting out fires started accidentally within the forest (Kasangaki *et al.* 2011).

6. Collaborative Natural Resources Management approaches in the Albertine Rift

The traditional protectionist approach of policing natural resources especially forest reserves has not been successful in many Albertine Rift countries. As a result more pro people approaches are being initiated around protected areas within the Albertine Rift region. Examples include Collaborative Forest Management in some Central Forest Reserves located in the Albertine Rift region in Uganda. Collaborative Forest Management (CFM) is loosely defined as a working partnership between the key stakeholders in the management of a given forest—key stakeholders being local forest users and state forest departments, as well as parties such as local governments, civic groups and nongovernmental organisations, and the private sector (Carter and Gronow 2005). In Uganda collaborative forest management is a process approach based on learning by doing– communities as well as forest resource managers learn from one another. It is based on the principles outlined below: Meaningful participation and shared analysis –communities getting deeply involved.

Negotiation and consensus building – exchange of opinion, the buy-and-take approach. Appropriate representation and responsibilities –with due consideration of women, the elderly and the disadvantage groups. A supporting legal and policy framework– CFM guidelines. Building capacity for change – tolerating one another. Long term perspective – starting small and thinking big, forestry enterprises are long term. Transparent communication to attract marginalized stakeholders (EMPAFORM 2006).

Around Echuya Central Forest Reserve in south western Uganda, four collaborative forest management agreements have been signed between four community-based organisations and the National Forestry Authority (NFA) aimed at achieving sustainable forest management. Under the agreements, the community groups have the following roles; participate in protection against illegalities, participate in fighting wild fires, provide information about illegal activities, implement the plan, promote alternative forestry and other income generating activities outside the forest reserve. NFA roles in the agreements include; Provide technical advice and guide on the implementation of forest management activities issue licenses for resource use in accordance with the National Forestry and Tree Planting Act, and the relevant regulations & guidelines, supervise resource use extraction participate in forest protection activities ensure effective communication with other partners, and link the community to other development partners among others (Echuya CFM agreements, 2007).

Conclusion and recommendations

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5.3. Evolution and development of Transboundary Collaboration in the Greater Virunga Landscape: Lessons and Future Prospects

Tom Sengalama (GVTC)

1. Introduction

Transboundary Natural Resource Management (TBNRM) may be defined as any process of collaboration across boundaries that increases the effectiveness of attaining natural resource management or biodiversity goal (Harry van der Linde *et al,* 2001)

The realisation that natural resources management problems were becoming more politically, legally and ecologically complex was the major driver for the increased necessity of governments and other stakeholders to take a broader look at their natural resource base and consider the full range of ecosystem processes that provide and sustain those resources (Harris *et al*, 2001). This more holistic, expanded view of ecosystem management often requires more coordination between different agencies, stakeholders or governments who must work across jurisdictional boundaries. Transboundary Natural Resource Management (TBNRM) is thus seen as an important tool in advancing broader landscape approaches to sustainable natural resource management and biodiversity conservation. It is seen as a way to promote regional economic development, reunite divided communities and act as a peace initiative in areas and regions with history of conflicts over natural resource access and use. It is also viewed as a means to fulfil many other opportunities such as large investments at landscape scale.

This paper presents the why and how transboundary collaboration was initiated in the Greater Virunga landscape. The paper first highlights the history and then looks at the key opportunities and drivers to collaboration, and assesses the main barriers and how they are being overcome. It further highlights some of the major lessons that can be drawn from the Greater Virunga process. The paper concludes with some highlights on the way forward stressing future prospects for Transboundary collaboration.

2. How Transboundary collaboration was conceived in the Greater Virunga Landscape

Transboundary Collaboration Process around the Virunga-Bwindi landscape started in 1991 as informal collaboration between protected area field staff in Rwanda, the Democratic Republic of Congo and Uganda. The aim was mainly to coordinate the protection of the endangered mountain gorillas. This process was then formalised in 2004 with the signing of a Trilateral Memorandum of Understanding (MOU) between the Protected Areas Authorities in the three countries namely, Institut Congolais pour la Conservation de la Nature (ICCN: Democratic Republic of Congo), Office Rwandais du Tourisme et des Parcs Nationaux (ORTPN: Rwanda) and the Uganda Wildlife Authority (UWA: Uganda). The process was also officially backed in November 2005 by the Governments of the three countries through the "Tripartite Declaration of Goma on the Transboundary Natural Resources Management of the Transfrontier Protected Area Network of the Central Albertine Rift". The 2004 MOU established a transboundary core secretariat composed of the Directors of ICCN, ORTPN and UWA with the mandate to develop a Transboundary Strategic Plan and to coordinate transboundary collaborative activities. In 2007, the three PAAs through IGCP secured a 4-year financial support from the Kingdom of Netherlands to implement part of the 10-year transboundary strategic plan with focus on strengthening transboundary processes and

supplementing revenue sharing and conservation enterprises in the Virunga-Bwindi landscape. In July 2008, the three governments signed the Rubavu ministerial declaration for the Greater Virunga transboundary collaboration which reaffirmed the earlier commitments by the three countries to strengthen transboundary collaboration in conserving the Greater Virunga landscape and promote socio-economic development within and around the landscape.

While the initiation of the transboundary process was based on the practical needs on the ground and the process followed a bottom-up approach, the collaboration requires a legal personality to enable full functionality of its organs. The greater Virunga transboundary collaboration has an institutional structure composed of the council of ministers as the policy making organ, the board which takes management decisions and the executive secretariat that executes the decisions of the board. In addition, the collaboration has four technical committees, a forum of chief wardens and a transboundary stakeholder's forum. All these organs meet regularly to discuss and take decisions. For the decisions to take effect however, the collaboration needs to be legally constituted. The secretariat is thus pursuing the legal institutionalization of this collaboration as the cornerstone for its success.

The process to institutionalize the Greater Virunga Transboundary Collaboration started with the setting up of the permanent secretariat to coordinate negotiation processes and to develop the necessary legal instruments required to have the secretariat constituted as a legal entity. The secretariat has since employed different approaches to mobilize both political and other stakeholder support to quicken the institutionalisation process. Presently, a draft treaty is being discussed by the respective governments in preparation for its signature. It is the Treaty that will give the secretariat the required mandate to coordinate transboundary processes.

The experience of the Greater Virunga Landscape is extremely unique as it is probably the only transboundary process in Africa that started from the field and progressively secured buy-in from the senior government decision makers. In most transboundary collaboration mechanisms, the process starts with the signing of a treaty on the collaboration then implementation mechanisms are developed later. This was the case with Commission des Forets d'Afrique Centrale (COMIFAC) that was initiated by the presidential declaration of Yaounde and the Great Limpopo transfrontier parks.

It is thus important to appreciate that transboundary processes may start from the recognized transboundary needs of communities, field level stakeholders or state governments. But for sustainable transboundary collaboration to be achieved, states must own the process since international cooperation is a function of states.

3 Some of the Barriers to the success of TBNRM and how they are being overcome

While transboundary natural resource management is a very good mechanism for the management of natural resources and ecosystems that straddle international boundaries, its success depends how the different types of barriers to effective transboundary collaboration are overcome. In this paper, four main types of barriers are discussed. These include:

· Legal and governmental differences that complicate coordination and implementation;

· Barriers to communication, movement, and information;

· Social and cultural differences including language differences that inhibit the development of trust and a common sense of community; and

· Economic disparities that constrain certain stakeholders' willingness or ability to participate in the process

3.1 Legal and Governmental Differences

Sovereign states have their legal frameworks and mechanisms for their implementation. Agreement on harmonized approaches to ecosystems management across international borders therefore may require adjustment of some national laws and guidelines. This is normally a challenge as it requires negotiations that tends to take long. It the legal differences between sovereign states that

strengthens the need for framework agreements to enable effective transboundary collaboration.

3.2 Overcoming Communication Barriers

In most transboundary protected area management arrangements, communities and leaders across the boundaries do not understand each other in terms of culture, language and approaches. These present communication barriers and can delay the process of forging agreements. Such barriers are addressed through structured meetings, information sharing. Informal networks are normally important in developing and sustaining communication channels. In the case of the greater Virunga landscape, organizing regular regional meetings, joint capacity building and cross-exchanges have been instrumental in bridging communication gaps. In all the transboundary meetings, the facilitation process ensures that everybody is an active participant and understands all the decisions being taken. This is done through translation and provision of sufficient background information. Informal discussions are also encouraged to strengthen confidence building.

3.3 Overcoming Social and Cultural Barriers

In facilitating a transboundary mechanism, understanding social and cultural sensitivities is very critical. One of the strategies that has been used to bridge social and cultural barriers has been promotion of cross-exchanges between communities, promoting joint activities and organizing social functions during transboundary meetings. In order to strengthen collaboration at community level, the secretariat organizes cross exchanges and study tours across the international borders. In addition, resource persons are drawn from either side of the border to encourage social and culture acceptance.

3.4 Overcoming Economic Barriers

Because of economic disparities between communities, harmonizing priorities across boundaries is normally a challenge. This is where differentiating activities suitable for implementation at national level from those that are transboundary in character becomes critical. By addressing the pressing priorities within the country, strategic buy-in for the transboundary activities is facilitated. This approach also helps to reconcile conflicting economic connections to transboundary resources. Furthermore, facilitating participation, of governments and stakeholders who do not have the economic means to participate can empower them to become long-term partners in a transboundary effort.

3.5 Maintaining an Effective Transboundary Process

In order to sustain effective transboundary processes, it is important to have a more structured mechanism facilitating representation and participation and providing a forum for addressing more difficult issues. Attracting financial resources to the landscape facilitates buy-in and building of legitimacy to transboundary effort since economic incentives are powerful tools of negotiation. In the case of greater Virunga landscape, the collaboration has structured levels of representation starting from the council of ministers, the board, the executive secretariat, regional technical committees and the regional forum. All these structures facilitate transboundary discussions and agreements. It is however important to recognize that transboundary collaboration can be extremely slow, and it can take many years to achieve procedural outcomes, let alone ecological ones, so it important that participants remain patient and committed. For instance the greater Virunga transboundary collaboration has taken three years negotiating a treaty even when there are many documents and joint activities supporting the process. The delay in securing a legal personality means that some aspects of collaboration may not be effectively undertaken.

4 Conclusions

This write up has mainly talked about transboundary collaboration in the context of its processes, opportunities, and barriers. It is however important to recognise the invaluable contributions that effective transboundary collaboration can bring.

The fact that this mechanism brings state institutions together, it is a powerful framework for inter-governmental dialogue on the joint and coordinated management of transboundary natural resources. It therefore provides opportunities for joint fundraising, establishment of regional enterprises, development of regional infrastructure and improved information sharing. In addition, it is easy to coordinate transboundary illegal activities, enhance monitoring of ecosystems and wildlife health, reduce transboundary conflicts over natural resource use and may lead to increased focus on landscape/transboundary approaches to conservation.

Based on the importance of transboundary natural resource management, one can conclude that this approach has very high chances of becoming the main approach to transboundary natural resource management. It is also understood to be a good approach to the establishment of peace parks due to its ability to link communities and landscapes. It can thus act as a strong driver in enhancing regional cooperation.

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Figure 41. The Volcanoes Region Rwanda/Uganda/DRC. Photo/ARCOS.

5.4. Satus of Research, Knowledge and Future Priorities

Andy Plumptre (WCS) and Cecily Kabagumya (ARCOS)

1.1. Background

As a result of the great altitudinal variation and resulting diversity of habitats, Africa's Western Rift Valley or Albertine Rift is the most bio-diverse region of Africa for vertebrate conservation, with 1,762 vertebrate species known from this region and more species being discovered regularly. It is also known to support over 5,700 plant species (Table 1.1). Endemic species (species found in this region and nowhere else in the World) number at least 1,181, and threatened species number at least 118 species). These numbers are likely to increase with further research in the region particularly the numbers of amphibians, fish and plants (Plumptre et al. 2003; 2007).

Due to this diversity, the Albertine Rift region is not only recognized as a biodiversty hotspot (Brookes et al. 2004) but also an endemic bird area (Stattersfield et al. 1998) and an ecoregion (Olson and Dinerstein, 1998). It contains four World Heritage Sites, two Biosphere Reserves and four Ramsar Sites (wetlands of international importance).Important sites for conservation have been identified within the Albertine rift region (Plumptre, 2004; Plumptre et al. 2007; Plumptre, Kujirakwinja and Nampindo, 2009) and they highlight the importance of conserving the larger landscapes around protected areas. Six core landscapes have been identified as part of a strategic planning process, which brought together Protected Area Authorities and Conservation NGOs to develop a strategic framework plan for the Albertine Rift (http://www.arcosnetwork.org/publications/ reports_reviews/ARSP_03WS.pdf). Only 50% of the total area of these six landscapes is currently protected (Plumptre, Kujirakwinja and Nampindo, 2009) although the percentage varies greatly between individual landscapes. Some of the most important sites for conservation such as the Itombwe Massif and Misotshi-Kabogo (or Kabobo) in DRC are currently lacking any protection.

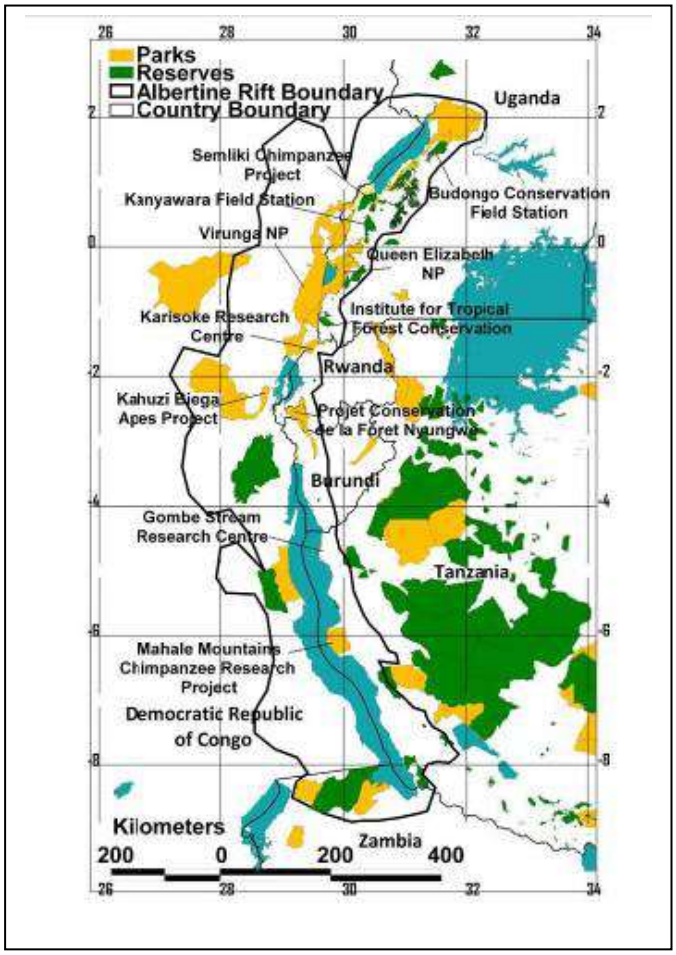

Figure 43= The location of the eleven research stations in the Albertine Rift.

History of ecological research in the Albertine Rift

The Albertine Rift has many of Africa's longest running research institutions, some of which have been operating for 40-50 years. Famous names in the Great Apes world such as Jane Goodall, Dian Fossey, George Shaller, Toshisada Nishida, and Richard Wrangham have launched their careers from this region. We here summarise the history of each of the research stations (fig 1.1).

1. **Budongo Forest Conservation Project:** Established in 1990 by Professor Vernon Reynolds of the Institute of Biological Anthropology at Oxford University, this field station built upon research on the ecology of chimpanzees in 1960 (Reynolds and Reynolds, 1965) and of the ecology of the forest (Eggeling, 1947)). The main focus of the research has been on the ecology and behaviour of a community of Chimpanzees, the Sonso Community, but quite a bit of ecological work has also been undertaken on the impacts of long term selective timber extraction on the forest and its wildlife (Plumptre, 1996).

2. **Semliki Chimpanzee Project**: Established in 1996 by Kevin Hunt, this station has been studying a community of chimpanzees in the Toro-Semliki Wildlife Reserve in Western Uganda. Despite several periods of insecurity the research has been able to continue to the present day and is collecting data on chimpanzees at the forest-savanna ecotone.

3. **Kanyawara Research Station**: Established by Tom Struhsaker in 1968 in the Kibale National park in western Uganda (Struhsaker 1997). Research initially focused on primate ecology and abundance but it has broadened to investigate many aspects of forest ecology. Now the Makerere University Biological Field Station, this research station attracts many scientists from around the World.

4. **Queen Elizabeth Park (QENP):** The savannas of Queen Elizabeth National Park in western Uganda have been studied since the 1950s. The Nuffield Unit of Tropical Animal Ecology was established at Mweya Peninsula in QENP in 1961 and later became the Uganda Institute of Ecology and continued operating until early 1990s. Individual researchers, however, have continued undertaking research to the present day.

5. **Virunga Park**: Virunga National Park in eastern DRC was created in 1925, and it was the first African National Park. Research projects on species identification and ecology were carried out in1930s-1980s. In 1972 a research laboratory was established in Lulimbi in theEestern region of the park on the border of Uganda. Since insecurities in 1996 there has been limited researches taking place at this station.

6. **Institute of Tropical Forest Ecology**: This research station was established by Tom Butynski in Bwindi Impenetrable National Park in south western Uganda in 1988 to undertake research on the ecology of the forest and in particular of the Mountain.

7. **Karisoke Research Centre**: Building on research by George Shaller in 1959-1960 this research station was established by Dian Fossey in 1967 to undertake research on Mountain Gorillas. Situated for many years in the Volcanoes National park in North west Rwanda it has relocated outside the park since the 1994 genocide. Most of the research has focused on the ecology and behaviour of mountain gorillas but broadened in the late 1980s to include the general ecology of the park (Plumptre, 1991; Plumptre and Williamson, 2001).

8. **Projet Conservation de la Foret Nyungwe**: Located in the Nyungwe National Park in south west Rwanda, research started in 1986 and has continued to the current time with only a brief halt during the genocide in 1994. The research has focused on the ecology of the forest, monitoring the changes in animal and bird numbers and the ecology of the primates and birds.

9. **Kahuzi Biega Apes Project**: Established by Juichi Yamagiwa in the early 1990s, research on Grauer's gorillas and chimpanzees have been carried out in the highland sector of the Kahuzi Biega National Park in eastern DRC.

10. **Gombe Stream Research Station**: Established by Jane Goodall in 1960, this is the longest running chimpanzee research station in the World. The focus of much of the research has been on the ecology and behaviour of the chimpanzees in the Gombe Stream National Park in Western Tanzania but there have also been studies made on other primates and changes in the habitat.

11. **Mahale Mountains Chimpanzee Research Project**: Established in 1965 in the Mahale Mountains National Park in Western Tanzania by Toshisada Nishida, the research has focused on the ecology and behaviour of chimpanzees. However, other studies have collected data on the more general ecology of the park and its surroundings.

Long term changes in the Albertine Rift

The Albertine Rift is also one of the most highly populated regions in Africa with human population density reaching 700 people per kilometer square (Cordeiro et al. 2007), and this can be attributed to the fertile volcanic soils. Increase in human population has taken place very recently in geological history, peaking over the past 50-100 years. Combined with the global climate change taking place, population pressure is a threat to natural ecosystems of such a globally important hotspot. The relatively long history of each of the above mentioned research stations allows us to assess the ecological changes that have been taking place in the Albertine Rift over the past 50-100 years.

Table 7. *The total number of species, number of endemic species, and threatened species for five taxa in the Albertine Rift.Data on endemic fish species for each of the large lakes in the Rift and a list of butterfly endemics were also compiled*

	Species richness	**Percentage for mainland Africa**	**Endemic species**	**Threatened species**
Mammals	406	39.3	38	35
Birds	1,061	52.3	41	25
Reptiles	175	13.6	16	2
Amphibians	112	19.2	36	16
Butterflies			117	
Fish			366	
Plants	5,793	14.5	567	40

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5.5. Biodiversity Policies, Strategies and Action Plans in the Albertine Graben-Transformative Aspects for Upscaling

Telly Eugene Muramira (NEMA, Uganda)

.1. Introduction

The role of policy is not only to provide direction and guide decisions and actions in a particular area but also to avoid certain negative effects and to seek positive results in that sector (Smith 2002).

Some countries in the Albertine Rift region have already biodiversity policies in place and others have at least national biodiversity strategy and action plans. The Albertine Rift region has been one of the challenging area in terms of decision making, because of its high richness in biodiversity, but with High population pressure; people looking for agricultural or settlement land, infrastructures, mining and recently Oil exploration. As far as sustainable development is concerned, policies should be looking at different aspects, taking into consideration not only the economic development but also the environment preservation, without which, there would not be any sustainable development.

This paper presents key biodiversity policies, strategies and plans in the Albertine Rift, covering Uganda, Rwanda, Burundi, Tanzania and Zambia and assesses their impacts. The paper notes the key transformative aspects of the policies, strategies and plans and proposes some recommendations

2. National Biodiversity Policies, Strategies and Plans

Natinal Biodiversity Strategies and Action Plans (NBSAPs) are the key instruments developed to address the myriad threats to biodiversity at the national level. NBSAPs were recommended by the UNCED in Rio de Janeiro in 1992 and are specified as important tools for biodiversity conservation in Article 6 of the Convention on Biological Diversity (CBD).

Article 6 states that 'each contracting party' shall in accordance with its particular conditions and capabilities develop national strategies, plans or programs for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programs which shall reflect, *inter alia,* the measures set out in the Convention and to integrate as far as possible and as appropriate, the conservation and sustainable use of biodiversity into relevant sectoral or cross-sectoral plans, programs and policies.

The article is mandatory and creates an obligation for national biodiversity planning. All Albertine Rift Valley countries have therefore prepared and adopted NBSAPs. This review also indicated that most of the said countries also regularly report to the CBD the various measures their governments have taken to implement the various articles of the Convention and especially through implementation of

This review noted that NBSAPs are not the only avenues countries have used to implement the CBD. Countries have variously integrated the objectives of the CBD in their other national policies, plans and programs particularly for the policies, plans and programs on environment management, fisheries,

Figure 44. Discussions during thel Great Lakes Regional Forum on Freshwater Ecosystems facilitated by ARCOS.

energy, tourism, biotechnology and biosafety, wetlands, wildlife, forests and land management.

3. Policy Performance and Conservation Benefits

Several positive biodiversity policy outputs and outcomes may be mentioned and elaborated in this paper. The main outputs are clustered into five categories including:

- improved conservation of ecosystems
- Focused attention on the conservation of genetic diversity;
- Biodiversity planning and sustainable use and consumption of biological resources;
- Fair and equitable sharing of the benefits arising out of the use of biological resources ;
- Better institutional, human and technological capacity to manage biodiversity at both national and local levels.

There is also considerable policy attention and concern towards invasive alien species. This review noted specific efforts to control key invasive species across the region including estimation of the economic cost invasive species impose on respective national economies. The issues of climate change and pollution have also attracted increased attention and biodiversity planning features as an important aspect of national social and economic development planning.

4. Transformative Aspects of the Policies

The key transformative aspects of biodiversity policies, plans and programs in the Albertine Rift countries may therefore include the following five major output clusters. These include:

- Improved conservation of protected areas and wetlands;
- Sustainable use of biodiversity including ecosystems and their agro-ecosystems counterparts;
- Development and strengthening of policy, institutional, legal and human resource frameworks;
- Rational and safe use of biotechnology and genetic engineering;
- Equitable sharing of all the benefits derived from the use of biological resources.

Each of the five transformative policy outputs is associated with specific objectives, strategies, activities and expected outcomes. These details however, cannot be elaborated in this short paper. Overall, however, the underlying mechanisms for delivering transformation in the sector include:

- The use of agreed indicators to monitor the status and trends of biodiversity;
- Active participation in the development of both national development plans and sector specific policies, laws, orders, administrative measures and regulations;
- Further capacity development of both central and local governments to stem both proximate and underlying causes of biodiversity loss;
- International cooperation and knowledge/technology transfer.

5. Policy Gaps and Practical Challenges

The key challenges to improving biodiversity management in the Albertine Rift may be clustered as follows; National Biodiversity Strategies and Action Plans and other policies remain sectoral, non-holistic and do not benefit from inter-sectoral coordination, synergies and inter-linkages. There is limited or no networking between government departments and between local and central government authorities. Hence deforestation, wild fires, illegal hunting and over-fishing continue to threaten sustainable use and management of biodiversity in the Albertine Rift. Encroachment of protected areas is also a major problem. Yet in the short to medium term, no legal and institutional re-engineering appears in sight to change the situation. Recently also, commercial quantities of Oil and Gas were discovered in the Ugandan section of the Albertine Rift. As part of the on-going effort to develop the Oil and Gas resource, the Ugandan Government plans to construct big infrastructural projects to extract, process and evacuate oil and gas to the market. Similar prospects are possible across the Albertine rift valley. The projects have a potential to negatively affect the rich biodiversity in the area unless precautionary measures are instituted and strictly followed up.

6. Conclusion and policy suggestions

The Albertine Rift has some of the most regionally and globally important biodiversity hotspots in the world. The area has a high incidence of highly endangered, rare and endemic species of both plants

and animals. The area also faces some of the most challenging threats to biodiversity conservation. There is a combination of security, development and natural pressures that impose a heavy toll on biodiversity in the area.

Whereas all Albertine rift countries have signed and ratified and also implemented most of the provisions of the Convention on Biological Diversity (CBD), the key challenges to biodiversity conservation remain significant. This review noted that lack of policy co-ordination; coherence and flexibility are some of the avoidable causes of biodiversity loss.

The review noted that whereas policies should not be fixed, most biodiversity related policies such as wetland policy, in the Albertine Rift have remained un-reviewed and lacking in modern and novel approaches to biodiversity conservation. This review proposes that policies be reviewed and tailored to new and emerging contexts in view of changing and escalating circumstances.

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6. Conclusions and Recommendations

Sam Kanyamibwa, ARCOS

Figure 45. Local Government Official, Mrs Florence Nkuranga, Kisoro District, giving remarks during a stakeholders meeting.

6.1. Key Conclusions

The results from this report show a number of issues that need special attention.

- The protected area network has not changed significantly during the last 10 years. However, several sites such as the Virunga Natonal Park in DRC are in danger and several sites and related corridors needs special protection. One of such sites is Itombwe Mountains Forest containing more endemic species than any other site in the Albertine Rift region.
- The protected areas are very much under the full control of governments and the benefit sharing arrangements are very few in the region. The only good examples on tourism revenue sharing are in Uganda and Rwanda, under the Greater Virungas Transboundary Collaboration.
- Due to human population density, all protected areas are becoming islands of humanity. There is a need for economic based adaptation measures and landscape planning.
- The political instability in the region hunting of large mammals and illegal logging and trade continue to be a major issue for various species n the region. There is a significant decrease of large mammals in the region (Plumptre 2012)
- Oil and other emerging economic development opportunities continue to put pressure on the exiting network of protected areas and critical habitats and peoples livelihoods, special measures need to be taken.
- The protected area n the region is growing. Corporate social and environmental responsibility, government regulations, environmental impact assessment need to be
- Freshwater ecosystems need special attention, in terms of increasing level of protection, development of national wetlands policy and limitation of destructive activities.

Figure 46. Fishing boats in Lake Tanganyika, Photo/ARCOS

6.2. Recommendations

Need for a participatory review of the Albertine Strategic Framework and

- It is now 10 years after the production of the Albertine Rift Strategic Conservation Framework 2004-2030 (ARCOS 2004). The 6 Planning Units identified under the strategy have developed individual strategic plans. There have been significant efforts to update knowledge on species distributions, protected areas, and habitat cover. However, the socio-economic, political and environmental conditions have changed. Currently, almost all the countries in the Rift are part of the East African Community and DRC and South Sudan have observer status. The Lake Tanganyika Authority has been established. New challenges and emerging issues also need to be considered within the region, in particular the highly topical aspects of ecosystem service provision and the impacts of climate change. Due to all these factors, ARCOS believes that there is a need to conduct a review of the implementation of the strategy, by taking into considerations emerging issues such as climate change and ecosystem services and regional integration. The review process would engage more stakeholders, governments, civil society and the private sector to enhance ownership.

Need for Regional approach and transboundary mainstreaming in national strategies and policies

- The mountain and freshwater ecosystems of the Albertine Rift of the different countries share the same type of terrain, biological diversity, and climactic conditions and face the same challenges of global change. Over the last 10years, the Albertine Rift region has been a centre of international attention and development community. However, the response of global agencies has often been bilateral and, consequently, fragmented. The response from development agencies has been more bilateral and therefore fragmented. There is a need for global and regional institutions stand to benefit from interacting more closely with each other and working together to share, exchange, and develop strategies for comprehensive solutions to the challenges of global change in mountain areas and transboundary ecosystems.
- Taking into consideration the increasing need for regional collaboration to manage global issues such as climate change or transboundary and regional issues such as refugies, river basin management, we urge countries in the region to reflect the use of transboundary water resources, including both surface water and groundwater in national policies and the international community to pay special attention to regional dialogue, regional mechanisms and initiatives.

Need for protection of critical terrestrial and freshwater habitats and processes

- While we recognise the efforts made by governments in the region in the establishment of a good network of protected areas and investing resources for protected area management, we urge governments to consider wider landscape planning and ecosystem based approach and connectivity, particularly in face of increasing climate change and urge particularly an official protection status for Itombwe Mountains in eastern DRC.
- While we believe that the management of protected areas should be the responsibility of national governments in the Albertine Rift reion, we call for the international community to support these efforts to ensure integrity of protected area netwok in the Albertine Rift.
- Noting the unique richness of freshwater ecosystems in the Albertine Rift and their services to local communities and economy in te region, we call for increased management in integrated water resources, and the protection of freshwater biodiversity.
- We urge special policy and development activities to respect critical terrestrial and freshwater ecosystems. Environmental Impact assessment and precautionary principle should guide investment decisions when critical habitats and ecosystems in the Albertine Rift region.

Need to balance economics needs and sustainability of ecosystem services

- With the increasing depletion of resources in the region, there is a need to increase public and social understanding that there is no sustainable development if the current rapid exploitation models are maintained. This contributes to further competition and depletion of resources in the region, unsustainable use, contaminated sources, and ecosystems suffering as a result of human interventions. There is a need to move from rapid and uncoordinated use of resources to more

inclusive models of environmental management. Coordination of multiple uses and social participation.

- Government policies and investment strategies are variable from one country to another, but there is a lack of civil society involvement. Given the fragility of ecosystems in the Albertin Rift and increasing opportunities for development such as discovery of oil reserves in the region and other forms of energy, there is a need t promote sustainable investment solutions in h region with transparent and inclusive EIA and SIA.

Figure 47. Bamboo harversting in Echuya Forest, Uganda, an important resource for communities but threatened by unsustainable use and open trade up to to Kampala market. Photo/ARCOS

Need for consistent, comparable, and representative data to monitor resilience to climate change

- Adaptive management will make a significant contribution to the Albertine Rift's environment and long term sustainability. This requires further investment in improving the capture of successful examples of its application and environmental monitoring and data availability. There is need for consistent, comparable, and representative data to monitor change. This involves climatic, physical, and biological parameters on species and ecosystems, as well as sociocultural and livelihood data. The movement of alien, invasive species; critical landscape and land-use linkages to flagship species; adaptability of entities of biodiversity; and documentation of indigenous knowledge and practices for adaptation to climate change and understanding of ecological resilience are also needed. There is also a need for taxonomic studies on specific taxa, to genetic studies to determine evolutionary relationships, ecological studies focused on pollination syndromes, population dynamics, and particularly the effects of climate change on species and communities, biomes and adaptive responses. Economic and socioeconomic studies are also needed to assess what factors characterise community resilience to climate change. Capacity building will be needed to carry out specific research in taxonomy, conservation biology, impact assessment, and livelihoods.

Annexes

Annex I: Acronyms and Abbreviations

ARCOS	ALBERTINE RIFT CONSERVATION SOCIETY
AR	ALBERTINE RIFT
CBD	CONVENTION ON BIOLOGICAL DIVERSITY
CGIS/NUR	CENTRE FOR GIS TRANING/NATIONAL UNIVERSITY OF RWAND
CRSN	CENTRE DE RECHERCHE EN SCIENCES NATIRELLES – LWIRO (DRC)
DFGFI	DIAN FOSSEY GORILLA FUND INTERNATIONAL
DRC	DEMOCRATIC REPUBLIC OF CONGO
EAC	EAST AFRICAN COMMUNIY
GBIF	GLOBAL BIODIVERSITY FACILITY
GIS	GEOGRAPHIC INFORMATION SYSTEM
GVTC	GREATER VIRUNGA TRANSBOUNDARY CONSERVATION
ICCN	INSTITUT CONGOLAIS DE CONSERVATION DE LA NATURE
IGCP	INTERNATIONAL GORILLA CONSERVATION PROGRAMME
INECN	INSTITUT NATIONAL POUR L'ENVIRONNEMENT ET LA CONSERVATION DE LA NATURE (BURUNDI)
ITFC	INSTITUTE FOR TROPICAL FOREST CONSERVATION
IUCN	INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE
KRC	KARISOKE RESEARCH CENTER
MDG	MILLENIUM DEVELOPMENT GOALS
MoU	MEMORANDUM OF UNDEDRSTANDING
NBDB	NATIONAL BIODIVERSITY DATA BANK
NEMA	NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (UGANDA)
NGOs	NON GOVERNMENT ORGANISATIONS
OVG	OBSERVATOIRE VOLCANOLOGIQUE DE GOMA
PA(S)	PROTECTED AREAS
QENP	QUEEN ELIZABETH NATIONAL PARK
REMA	RWANDA ENVIRONMENT MANAGEMENT AUTHORIRY
RBM	RANGER BASED MONITORING
RNRA	RWANDA NATURAL RESOURCES AUTHROTIY
TANAPA	TANZANIA NATIONAL PARKS
TAWIRI	TANZANIA WILDLIFE RESEARCH INSTITUTE
UWA	UGANDA WILDLIFE AUTHORITY
WCS	WILDLIFE CONSERVATION SOCIETY
WWF	WORLD WIDE FUND FOR NATURE

Annex II: Albertine Rift Endemic Species

Table 1: List of Albertine Rift Endemic and Threatened Bird Species per Country

Family	Species	Common name	IUCN	Ende-mism	AR Countries				
					UG	RW	BU	DRC	T
Phasianidae	*Francolinus nobilis*	Handsome Francolin		AR	✓	✓		✓	
Musophagidae	*Tauraco johnstoni*	Rwenzori Turaco		AR	✓	✓	✓	✓	
Strigidae	*Glaucidium albertinum*	Albertine Owlet	VU	AR		✓		✓	
Tytonidae	*Phodilus prigoginei*	Congo Bay Owl	EN	AR		✓	✓	✓	
Caprimulgidae	*Caprimulgus prigoginei*	Itombwe Nightjar	EN	AR				✓	
Caprimulgidae	*Caprimulgus ruwenzorii*	Rwenzori Nightjar		AR	✓	✓	✓	✓	✓
Indicatoridae	*Indicator pumilio*	Dwarf Honeyguide	NT	AR	✓	✓		✓	
Eurylaimidae	*Pseudocalyptomena graueri*	African Green Broadbill	VU	AR	✓			✓	
Paridae	*Parus fasciiventer*	Stripe-breasted Tit		AR	✓	✓	✓	✓	
Timaliidae	*Kupeornis rufocinctus*	Red-collared Mountain Babbler	NT	AR		✓	✓	✓	
Timaliidae	*Kupeornis chapini*	Chapin's Mountain Babbler	NT	AR				✓	
Campephagidae	*Coracina graueri*	Grauer's Cuckoo Shrike	NT	AR				✓	
Pycnonotidae	*Chlorocichla prigoginei*	Prigogine's greenbul	EN	AR				✓	
Turdidae	*Alethe poliophrys*	Red-throated Alethe		AR	✓	✓	✓	✓	
Turdidae	*Cossypha archeri*	Archer's Ground Robin		AR	✓	✓	✓	✓	
Turdidae	*Zoothera tanganjicae*	Kivu Ground Thrush	NT	AR		✓			
Sylviidae	*Apalis argentea*	Kungwe Apalis	EN	AR		✓			
Sylviidae	*Apalis kaboboensis*	Kabobo Apalis	DD	AR					
Sylviidae	*Apalis personata*	Montane Masked Apalis		AR	✓	✓	✓	✓	
Sylviidae	*Apalis ruwenzori*	Collared Apalis		AR	✓	✓	✓	✓	
Sylviidae	*Bradypterus graueri*	Grauer's Rush Warbler	EN	AR	✓	✓	✓	✓	
Sylviidae	*Graueria vittata*	Grauer's Warbler		AR	✓	✓		✓	
Sylviidae	*Hemitesia neumanni*	Short-tailed/Neumann's Warbler		AR	✓	✓	✓	✓	
Sylviidae	*Phylloscopus laetus*	Red-faced Woodland Warbler		AR	✓	✓	✓	✓	
Muscicapidae	*Melaenornis ardesiacus*	Yellow-eyed Black Flycatcher		AR	✓	✓	✓	✓	
Platysteiridae	*Batis diops*	Rwenzori Batis		AR	✓	✓	✓	✓	
Prionopidae	*Prionops alberti*	Yellow-crested Helmet Shrike	VU	AR				✓	
Nectariniidae	*Cyanomitra alinae*	Blue-headed Sunbird		AR	✓	✓	✓	✓	
Nectariniidae	*Nectarinia purpureiventris*	Purple-breasted Sunbird		AR	✓	✓	✓	✓	
Nectariniidae	*Cinnyris regia*	Regal Sunbird		AR	✓	✓	✓	✓	✓
Nectariniidae	*Cinnyris rockefelleri*	Rockefeller's Sunbird	VU	AR		✓	✓	✓	
Nectariniidae	*Cinnyris stuhlmanni*	Rwenzori Double-collared Sunbird		AR	✓	✓	✓	✓	
Ploceidae	*Ploceus alienus*	Strange Weaver		AR	✓	✓	✓	✓	
Estrildidae	*Cryptospiza jacksoni*	Dusky Crimson-wing		AR		✓			
Estrildidae	*Cryptospiza shelleyi*	Shelley's Crimson-wing	VU	AR	✓	✓	✓	✓	
Apodidae	*Schoutedenapus schoutedeni*	Schouteden's swift	VU	EZL				✓	
Pycnonotidae	*Phyllastrephus lorenzi*	Sassi's Olive Greenbul	NT	EZL	✓			✓	
Turdidae	*Zoothera oberlaenderi*	Oberlander's/Forest Ground Thrush	NT	EZL	✓			✓	
Monarchidae	*Terpsiphone bedfordi*	Bedford's Flycatcher	NT	EZL				✓	
Ploceidae	*Ploceus aureonucha*	Golden-naped weaver	EN	EZL	✓			✓	
Ploceidae	*Ploceus flavipes*	Yellow-legged weaver	VU	EZL				✓	

AR= ALBERTINE RIFT
EZL= EASTERN ZAIRIAN LOWLANDS
U= UGANDA
R= RWANDA
B= BURUNDI
D= DRC
T= TANZANIA

EN= ENDANGERED
VU= VULNERABLE
T = THREATENED
NT= NEAR THREATENED
DD= DATA DEFICIENT

Table 2. List of amphibian endemics and their conservation status

Species	Family	Conservation Status	Endemism
Amietia desaegeri	Pyxicephalidae	DD	AR
Amietia ruwenzorica	Pyxicephalidae	NE	AR
Afrixalus orophilus	Hyperoliidae	VU	AR
Boulengerula fischeri	Caecilidae	DD	AR
Callixalus pictus	Hyperoliidae	VU	AR
Cardioglossa cyaneopsila	Arthroleptidae	NE	AR
Chrysobatrachus cupreonitens	Hyperoliidae	DD	AR
Hyperolius atrigularis	Hyperoliidae	DD	AR
Hyperolius castaneus	Hyperoliidae	VU	AR
Hyperolius chrysogaster	Hyperoliidae	VU	AR
Hyperolius diaphanus	Hyperoliidae	DD	AR
Hyperolius discodactylus	Hyperoliidae	VU	AR
Hyperolius ferrugineus	Hyperoliidae	DD	AR
Hyperolius frontalis	Hyperoliidae	VU	AR
Hyperolius langi	Hyperoliidae	LC	AR
Hyperolius leleupi	Hyperoliidae	EN	AR
Hyperolius leucotaenius	Hyperoliidae	EN	AR
Hyperolius kibarae	Hyperoliidae	DD	AR
Hyperolius polystictus	Hyperoliidae	VU	AR
Hyperolius pustulifer	Hyperoliidae	NE	AR
Hyperolius xenorhinus	Hyperoliidae	DD	AR
Laurentophryne parkeri	Bufonidae	DD	AR
Leptopelis fenestratus	Arthroleptidae	DD	AR
Leptopelis fiziensis	Arthroleptidae	DD	AR
Leptopelis karissimbensis	Arthroleptidae	NT	AR
Leptopelis kivuensis	Arthroleptidae	NT	AR
Phrynobatrachus acutirostris	Phrynobatrachidae	VU	AR
Phrynobatrachus asper	Phrynobatrachidae	DD	AR
Phrynobatrachus bequaerti	Phrynobatrachidae	VU	AR
Phrynobatrachus dalcqi	Phrynobatrachidae	DD	AR
Phrynobatrachus petropedetoides	Phrynobatrachidae	LC	AR
Phrynobatrachus rouxi	Phrynobatrachidae	DD	AR
Phrynobatrachus sulfureogularis	Phrynobatrachidae	DD	AR
Phrynobatrachus versicolor	Phrynobatrachidae	VU	AR
Arthroleptis discodactylus	Arthroleptidae	DD	AR
Arthroleptis hematogaster	Arthroleptidae	DD	AR
Arthroleptis loveridgei	Arthroleptidae	DD	AR
Arthroleptis mossoensis	Arthroleptidae	DD	AR
Arthroleptis pyrrhoscelis	Arthroleptidae	VU	AR

Arthroleptis spinalis	Arthroleptidae	DD	AR
Arthroleptis vercammeni	Arthroleptidae	DD	AR
Xenopus itombwensis	Pipidae	NE	AR
Xenopus ruwenzoriensis	Pipidae	DD	AR
Xenopus vestitus	Pipidae	LC	AR
Xenopus wittei	Pipidae	LC	AR

Table 3. List of reptile endemics and their conservation status

Species	Family	Conservation Status	Endemism
Adolfus vauereselli	Lacertidae	NE	AR
Amblyodipsas katangensis	Atractaspididae	NE	AR
Amblyodipsas rodhaini	Colubridae	NE	AR
Apparallactus moruensis	Colubridae	NE	AR
Atheris katangensis	Viperidae	NE	AR
Chamaelo ituriensis	Chamaeleonidae	NE	AR
Chamaeleo johnstoni	Chamaeleonidae	NE	AR
Chamaeleo rudis	Chamaeleonidae	NE	AR
Chamaeleo schoutedeni	Chamaeleonidae	NE	AR
Chamaelycus christyi	Colubridae	NE	AR
Cnemaspis quattuorseriata	Gekkonidae	NE	AR
Dalophia luluae	Amphisbaenidae	NE	AR
Hypoptophis wilsoni	Colubridae	NE	AR
Ichnotropis chapini	Lacertidae	NE	AR
Ichnotropis tanganicana	Lacertidae	NE	AR
Kinyongia adolfifriederici	Chamaeleonidae	NE	AR
Kinyongia carpenteri	Chamaeleonidae	NE	AR
Kinyongia xenorhina	Chamaeleonidae	NE	AR
Leptosiaphos blochmanni	Scincidae	NE	AR
Leptosiaphos luberoensis	Scincidae	NE	AR
Leptosiaphos graueri	Scincidae	NE	AR
Leptosiaphos hackarsi	Scincidae	NE	AR
Leptosiaphos meleagris	Scincidae	NE	AR
Leptosiaphos quattuordigittata	Scincidae	NE	AR
Leptosiaphos rhodurus	Scincidae	NE	AR
Leptotyphlops latirostris	Leptotyphlopidae	NE	AR
Lepidothyris hinkeli	Scincidae	NE	AR
Letheobia sudanensis	Scincidae	NE	AR
Letheobia kibarae	Typhlopidae	NE	AR
Lycodonomorphis bicolour	Colubridae	NE	AR
Monopeltis adercae	Amphisbaenidae	NE	AR
Monopeltis remaclei	Amphisbaenidae	NE	AR
Monopeltis scalper	Amphisbaenidae	NE	AR
Panaspis burgeoni	Scincidae	NE	AR
Panaspis helleri	Scincidae	NE	AR
Philothamnus ruandae	Colubridae	NE	AR
Polemon leopoldi	Atractaspididae	NE	AR
Xenocalamus micheli	Colubridae	NE	AR

Annex III: List of Authros and Contributors

No.	ARTICLE	Author/s
III	Executive Summary	Sam Kanyamibwa
1	Introduction	Sam Kanyamibwa
2	Section Introduction: Meaning and Significance of Biodiversity	Aventino Kasangaki
2.1.	Overview of Biodiversity in the Albertine Rift and its six key landscapes	Andy Plumptre
2.2.	Ecosystem Services in AR	Aventino Kasangaki
3.1.	Section Introduction: State of Biodiversity Status and Trends	Claudien Nsabagasani
3.2.	Large mammals status in the AR and priorities for conservation	Kityo Robert
3.3.	Gorilla status in the Albertine Rift Region and priorities for conservation	Augustin Basabose
3.4.	Chimpanzee status in the AR and priorities for conservation	Gilbert Basuta
3.5.	Bird status in the AR and priorities for conservation	Claudien Sabagasani
3.6.	Status of Amphibians and Reptiles in the Albertine Rift and Priorities for Conservation	Chifundera Kusamba Mathias Behangana
3.7.	Plants and Phenology in the Albertine Rift and priorities for conservation	James Kalema
4.1.	Section Introduction: Biodiversity Conservation Issues and Challenges	Faustin Gashakamba
4.2.	Climate change impact on birds in the Albertine Rift	Ken Mwathe
4.3.	Climate Variability And Crop Production In The Albertine Rift Region	Karume Katcho Kazi S Majaliwa Mwanga Asasira Josephine
4.4.	Impact of volcanism on the environment and development in the Albertine Rift Region	Wafula M.D.
4.5.	Socio-economic development and its impacts on biodiversity in the Albertine Rift	Akinyemi Felicia O.
4.6.	Challenge of land use change and habitat loss on biodiversity conservation in the Albertine Rift Region	Nyandwi Elias Akinyemi, Katcho
5.1.	Section Introduction: Responses	SamK/Editorial Committee
5.2.	Community Development	Aventino Kasangaki and Robert Btariho
5.3.	Transboundary Collaboration in the Greater Virunga Landscape:	Andy Plumptre and Cecily Kabagumya
5.4.	Satus of research, knowledge and future priorities	
5.5.	Biodiversity Policies, Strategies and Action Plans	Telly Muramira
6.	Conclusions and Recommendations	Sam Kanyamibwa