EVALUATION OF THE EFFECTIVENESS OF PROTECTED AREAS IN CONSERVING ECOLOGICAL INTEGRITY IN KIBALE AND QUEEN ELIZABETH CONSERVATION AREAS, UGANDA

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A THESIS SUBMITTED TO KYAMBOGO UNIVERSITY DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN BIOLOGICAL SCIENCES OF KYAMBOGO UNIVERSITY

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Declaration by candidate

I, Joseph Katswera, declare that this thesis is my own independent and original work and has not previously been presented either in whole or in part for any academic award at this University or elsewhere.

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Dedication

To my wife and children

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List of Abbreviations

CA	Conservation Area
CBC	Community Based Conservation
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
DRC	Democratic Republic of Congo
ECOTRUST	Environmental Conservation Trust of Uganda
FFI	Fauna and Flora International
GVTC	Greater Virunga Transboundary Collaboration
HWC	Human-Wildlife Conflict
IUCN	International Union for Conservation of Nature
KCA	Kibale Conservation Area
KNP	Kibale National Park
KTWR	Katonga Wildlife Reserve
MWTA	Ministry of Tourism, Wildlife and Antiquities
NDP	National Development Plan

NEMA	National Environment Management Authority
NFA	National Forest Authority
NP	National Park
OAG	Office of Auditor General
PA	Protected Area
QECA	Queen Elizabeth Conservation Area
QENP	Queen Elizabeth National Park
QEPA	Queen Elizabeth Protected Area
RMNP	Rwenzori Mountains National Park
TRA I	Threat reduction assessment index
TSWR	Toro-Semliki Wildlife Reserve
UBOS	Uganda Bureau of Statistics
UWA	Uganda Wildlife Authority
VNP	Virunga National Park
WR	Wildlife Reserve
WWF	World Wide Fund for Nature

ABSTRACT

The effectiveness of wildlife protected areas in conserving ecological integrity in Kibale and Queen Elizabeth Conservation Areas, Uganda was explored. The study was conducted from August 2017 to October 2019 in response to the inadequate data and information that existed on how effective wildlife protected areas conserve ecological integrity with a view to suggest management strategies to enhance the conservation of biological diversity and ecosystem processes. An evaluation of how the long-term wildlife monitoring, wildlife corridors, community-based conservation, and threats affects biodiversity and ecological integrity was conducted through a survey. Document review, semi-structured questionnaires, Key Informant Interviews, Focus Group Discussions, the Nature Conservancy's Conservation Action Planning methodology, Threat Reduction Assessment technique, and Geographical Information System/remote sensing were used to collect data. A sample size of 416 respondents was used during this study. Data was analysed using inferential statistics, and results presented in tables and figures. The study established that Wildlife Monitoring was done primarily in-house by the protected area staff; and rarely through co-operation with other agencies, academic institutions, co-operative projects with NGOs, and contracting out to consultants and/or freelance researchers, (χ^2 (4, N = 81) = 15.523, p = .000, α = .05, V=.526). The long-term wildlife monitoring program used on-the-ground monitoring, and rarely used traditional knowledge and remote sensing which would improve wildlife monitoring. Wildlife monitoring guided the wildlife agency to formulate conservation-related policies (χ^2 (1, N = 81) = 297.1, p = .000, α = .05, V = .342), identify new conservation initiatives (χ^2 (1, N = 81) = 7.247, p = .000, α = .05, V = .370), and propose innovative conservation policy areas (χ^2 (1, N = 81) = 9.351, p = .001, α = .05, V = .416) to conserve biodiversity and protect ecological integrity. The landscape had 20 key wildlife corridors which facilitate the movement of migratory animal species mainly Elephants, Chimpanzees and Lions. However, the corridors experienced changes in vegetation cover, corridor connectivity, migratory animal populations, and stepping stone habitats. Community Based Conservation contributed to overall conservation through participation of local communities (χ^2 (1, N = 268) = 46.013, p = .000, α = .05, V = .588), local authorities (χ^2 (4, N = 268) = 17.021, p = .000, α = .05, V = .261) and private sector (χ^2 (1, N = 268) = 20.822, p = .000, α = .05, V = .326) in conservation programs which improved community-park relations (χ^2 (3, N = 268) = 24.815, p = .000, α = .05, V = .229). Further, the wildlife protected areas were primarily threatened by anthropogenic and natural threats, and administrative constraints which threatened habitat quality, diversity, and continuity. The average threat reduction indices for both Conservation Areas were less than 50% implying that management only mitigates less than 50% of the PAs threats, hence a significant "dissatisfactory" on the overall performance of the conservation areas to protect ecological integrity. In conclusion, long-term wildlife monitoring guides development of conservation-related policies, innovative conservation initiatives, and proposes policy areas to conserve the ecological integrity. The wildlife corridors provide ecological linkages for migratory animal species contributing to the overall conservation of biodiversity. Community-based conservation is fundamental to conservation of biodiversity since it improves community knowledge and collaboration, creates trust, belonging and acceptance, reduces pressure on the park resources, and improves community-park relations. Threats in the conservation areas were reducing. Therefore, wildlife agency should provide incentives to meet community needs, strengthen the benefit sharing scheme, and create and strengthen community conservation institutions to participate in conserving biodiversity. The wildlife agency should formulate more conservation-related policies; integrate ecosystem health in the wildlife monitoring program; and also put more effort to address the threats affecting biodiversity to move from "dissatisfactory" to "satisfactory" level of ecological integrity. Finally, further research should investigate ecosystem health; the magnitude (area) and intensity of habitats affected by invasive and alien plant species; restoration options of the wildlife corridors; and the impact of tourism-related infrastructural development on ecological integrity of the wildlife protected areas.

Key words: *Biodiversity, Conservation, National Parks, Wildlife*

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter provides an overview of the thesis highlighting the background to the study, statement of the problem, objectives of the study, research hypothesis, significance of the study, and scope of the study.

1.1 Background to theStudy

1.1.1 The Origin of Protected Areas

The International Union for Conservation of Nature (IUCN) defines a protected area as "a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008) Protected areas (PAs) are a cultural artifact, and have a long history (Holdgate, 1999). Some areas were specifically set aside for the protection of natural resources over two mellenia ago (Holdgate, 1999). In Europe, some areas were protected as hunting grounds for the rich and powerful nearly 1,000 years ago. Moreover, the idea of protection of special places is universal: it occurs among the traditions of communities in the Pacific ("tapu" areas) and parts of Africa (sacred groves), for example.

While many societies set aside special areas for cultural and resource uses, PAs were first set aside by kings and other national rulers in Europe early in the Rennaissance, typically as royal hunting reserves. Slowly these sites became open for public use, providing the basis for community involvement and tourism. The English poet, William Wordsworth, wrote in 1810 of his vision of the Lake District as “a sort of national property”. And in 1832, the American poet, explorer, and artist George Catlin pointed to the need for “… a nation’s park, containing man and beast, in all the wild and freshness of their nature’s beauty”. Catlin was responding to the destruction of aboriginal peoples and cultures in the rapidly developing eastern part of this expanding country; in contrast, he perceived a harmony between the native peoples and their environment on the Great Plains. In 1864, with the Yosemite Grant, the US Congress gave a small but significant part of the Yosemite National Park to the State of California for “public use, resort and recreation”. The first true national park came in 1872 with the declaration of Yellowstone by United States law “as a public park or pleasuring ground for the benefit and enjoyment of the people”. Interestingly, the creation of Yellowstone did not allow for the sympathetic treatment of native people and their environment as envisaged by Catlin (Eagles et al., 2002). These and other early United States national parks, such as Grand Canyon and Mount Rainier, were created in the west and covered extensive tracts of land with superb natural features. However, the idea of making the great natural areas of the US into national parks was most popular with large sections of the population that lived in the east of the country.

In 1866, the British Colony of New South Wales in Australia reserved 2,000 ha (nearly 5,000 acres) of land, containing the Jenolan Caves west of Sydney, for protection and tourism. Later additions created a park complex now known as the

Blue Mountains National Park. In 1879, Royal National Park was set up, also in New South Wales, in the wilds south of Sydney, so as to provide a natural recreation area for the burgeoning populations of this metropolitan area (Eagles et al., 2002).

In 1885, Canada gave protection to hot springs in the Bow Valley of the Rocky Mountains, an area later named Banff National Park. The legislation passed in 1887 borrowed from the Yellowstone legislative wording: the park was "reserved and set aside as a public park and pleasure ground for the benefit, advantage and enjoyment of the people of Canada". The railway companies, whose lines were under development across the country, saw the creation of a park as an excellent way to stimulate passenger growth through tourism (Marty, 1984). Elsewhere, several forest reserves were set up in South Africa in the last years of the nineteenth century. In 1894, Tongariro National Park was established in New Zealand by agreement with the Maori people, a place that was, and still is, important to them for spiritual reasons. There were common features to these emerging national parks. First, they were created by government action. Second, the areas set aside were generally large and contained relatively natural environments. Third, the parks were made available to all people. Thus, from the very beginning, park visitation and tourism were central pillars of the national parks movement (Eagles et al., 2002). In large, federated countries, such as Australia, Canada, South Africa and the USA, the provincial or state tier of governments also started to create PAs. For example, the Province of Ontario in Canada created Queen Victoria Niagara Falls Park in 1885 and Algonquin

National Park, later named Algonquin Provincial Park, in 1893 (Eagles et al., 2002).

1.1.2 The History of Conservation in Uganda

In Uganda, wildlife conservation dates back to the 18th century. Between the late 1880's and 1902, there were concerted efforts of setting aside major ecosystems and wildlife communities for conservation and sustainable use. This was preceded by an era of self regulation and control of use of all wildlife resources under guidance of culture and traditional way of life. The period 1902-1923 was characterized by introduction of sport hunting, banning use of traditional hunting methods and tools, creating limitations and difficulties to continued use of wildlife resources by local communities. In 1923, the colonial government established a Game Elephant Control Unit that was later transformed into the Game Department in 1925/26 under the Game Ordinance of 1926 to mitigate against potential depletion of large game species including elephants, rhinos, lions and hippos. The colonial government continued with the process of touring and assessing the condition of wildlife resources culminating into identification of areas of great concentration and healthy community condition as wildlife sanctuaries, some of which were later gazzeted as Game Reserves (Lake George, Toro, Lake Edward, Bunyoro and Gulu) under the Game (Preservation and Control) Ordinance of July 1926. (MTWA, 2014a)

The process of identifying areas important for wildlife resources based on population numbers and habitat condition continued, culminating into creation of two National Parks, in a process that combined lake Edward and Lake George Game Reserves to create Queen Elizabeth National Park and combining of Gulu and Bunyoro Game Reserves to create Murchison Falls National Park, under the National Parks Ordinance No. 3 of 1952. The National Parks Ordinance created a new dispensation in wildlife conservation where the management of the new national parks - a highest category of wildlife conservation area, was put under a separate fully autonomous institution called the Uganda National Parks. The process and the new development therefore left the Game Department under the Game Preservation and Control Act to be responsible for management of all wildlife outside National Parks and overall policy development and supervision of the sector. Kibale National Park was established by presidential decree in 1992, and at that time, all land use and settlement within the park was immediately banned, and up to 200,000 people were evicted from the corridor (Hartter & Ryan, 2010). It was formed by combining Kibale Forest Reserve and a game corridor connected to Queen Elizabeth National Park to the south. Kibale National Park is a remnant of a transitional forest between savannah and mid-altitude tropical forest surrounded by a large agricultural population and is home to one of the largest populations of chimpanzees in East Africa and to 12 other primate species (Chapman & Lambert, 2000; Plumptre et al., 2003), making it one of the most diverse primate communities in the world. Semuliki National Park was gazetted as a forest reserve in 1932 by the Uganda Forest Department. In 1992 the Forest Department raised its status to a Forest Park and in 1993 gazetted it as a National Park. Also, Rwenzori Mountains was gazetted as a Forest Reserve by the

Uganda Forest Department in 1941, later as a National Park in 1991, and in 1994 it was designated as a World Heritage Site. (MTWA, 2014a)

From 1959 to 1962, the national programme on wildlife conservation, now under the two institutions, led by the Game Department, embarked on consolidating gains including identification of additional important areas for (a) protection of wildlife and (b) human-wildlife conflict with special reference to problem elephants. As a result, more conservation areas were created including Controlled Hunting Areas (seasonal) and Wildlife Sanctuaries; leading to the National Wildlife Conservation Programme that was adopted by the newly independent Uganda of 1962 under the Game (Preservation and Control) Act of 1962. The subsequent process involved the creation of more protected areas, Game Reserves and in particular the establishment of permanent Controlled Hunting Areas under Uganda National Parks Act of 1964 and Game (Preservation and Control) Act of 1964 respectively. The post-independence governments of the 1960s continued with the same colonial policy of protection. During the 1970s and 1980s, the network of protected forests and wildlife areas which had emerged as the cornerstone for conservation activities suffered from political instability and the breakdown of the public service institutions that were mandated to manage these resources. Therefore, in 1986, Government put in place a number of policies, legal and institutional reforms to ensure that the management of Uganda’s natural resources is in tandem with national development policy objectives and this is consistent with her international obligations and commitments. (MTWA, 2014a) Government undertook major reforms during the 1990s resulting into the incorporation of conservation objectives in the 1995 Uganda Constitution. This Constitution provides for wildlife conservation as well as biodiversity and the natural environment. These provisions create an enabling environment for policy formulation, planning and programme development to protect important natural resources, and also provides for creation and development of parks, reserves, and recreation areas. Then, in 1999, government developed a Research and Ecological Monitoring Policy, which emphasizes wildlife monitoring (MTWA, 2014a).

Therefore, government set aside national parks and wildlife reserves for protection of wildlife heritage and wilderness ecosystems to contribute directly to the country's economic development through tourism and provision of ecosystem services and managed by Uganda Wildlife Authority (UWA) with a legal mandate to conserve and manage wildlife in the country and enforce wildlife laws and regulations. Its mission is "to conserve, economically develop and sustainably manage the wildlife and protected areas of Uganda in partnership with the neighboring communities and other stakeholders for the benefit of the people of Uganda and the global community". To realise this mission, UWA runs six strategic programs and they include: Resource Conservation and Management, Research and Ecological Monitoring, Capacity Development, Community Conservation, Tourism development and financial sustainability, and Governance and Corporate Affairs (UWA, 2013a). However, there have been challenges especially those that tend to erode the natural ecosystems. Critical issues affecting parks in Uganda include the need for r*estoring and maintaining healthy ecosystems* (The Uganda Wildlife Act Cap: 200 of 2000). Among the wildlife management areas in Uganda are Kibale and

Queen Elizabeth Conservation Areas which are centered on wildlife resources conservation and protected area management. (MTWA, 2014a)

In addition, other policies were developed to provide further strengthen conservation of wildlife. The Uganda Wildlife Policy (2014) was developed with a goal to conserve wildlife resources of Uganda in a manner that contributes to the sustainable development of the nation and the well-being of its people. This Policy provides a framework within which all Government institutions, private sector, development partners, civil society and all other stakeholders in the wildlife conservation industry must operate in order to sustainably conserve and develop the wildlife resource base for national social-economic transformation. This Policy further outlines Government commitment to mitigating human wildlife conficts, eliminating illegal wildlife trade and traffcking, ensuring that oil and gas sustainably co exists with conservation, promoting of research and conservation education, enhancing community benefts from conservation and promoting private sector enterprises in wildlife conservation. (MTWA, 2014b)

Also, the Uganda Forestry Policy (2001) under Policy Statement 7: on the conservation of forest biodiversity, states that Uganda's forest biodiversity will be conserved and managed in support of local and national socio-economic development and international obligations (MWLE, 2001). This Policy further asserts that the government is committed to the conservation of Uganda's rich forest biodiversity, to meet the needs and aspirations of present and future generations. The government will promote the conservation and wise use of representative examples of all ecosystems and species in the country. The government's biodiversity conservation strategy will continue to be based on a system of Protected Areas, including Forest Reserves, National Parks and Wildlife Reserves. The government recognises that local communities must enjoy adequate benefits from these Protected Areas, and to achieve this, they must have a meaningful participation in their management. In addition, the government will support efforts to safeguard biodiversity in private forests and to improve agricultural biodiversity through farm forestry initiatives. (MWLE, 2001). Further, the Uganda Wildlife Statute No. 14 of 1996 (Uganda Wildlife Act, Cap 200 of 2000) and Uganda Wildlife Training Institute Statute of 1996 (Uganda Wildlife Training Institute Act, Cap 139 of 2000), Uganda Wildlife Education Centre Trust Deed of 1994, and the Uganda Game (Preservation and Control) Act Cap 198, were developed. These laws provided for rationalization of the wildlife sector to the current set up. (MTWA, 2014a)

In addition, the National Environment Management Policy (NEMP) of 1994 has an overall goal of sustainable social and economic development which maintains or enhances environmental quality and resource productivity on a long term-basis that meets the needs of the present generations without compromising the ability of future generations to meet their own needs. This policy recognizes the need to enhance environmental quality for the present and future generations. (GoU, 1994).

1.1.3 Importance of Protected Areas

The World Conservation Union (IUCN) (1994) specifies that common goals for the management of national parks include protecting ecological integrity, eliminating exploitation or occupation inimical to their purpose, and taking into account the needs of Indigenous people, including subsistence resource use, in a manner that does not adversely affect the other objectives of management. A park can be considered to have ecological integrity if it achieves park management objectives in a manner that sustains biodiversity and ecosystem processes while abating threats (Ervin, 2003). National parks are considered fundamental to efforts to protect biodiversity around the world (Gaston et al., 2006). They are classified under category II of the IUCN categories of protected areas. National Parks are created to protect the ecological integrity of one or more ecosystem for present and future generations; exclude exploitation or occupation detrimental to the purposes of designation of the area; and provide a foundation for spiritual, scientific, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally compatible (Chape et al., 2003).

National Parks comprise the highest percentage (23%) of the total area covered by protected areas worldwide (Chape et al., 2003). For instance, according to estimates by Colchester (2003), Africa has more than 1,812 National Parks covering a total 3,112,027 km^2 of the continent. In Sub-Saharan Africa alone, over 1 million km^2 of land out of 23 million km^2 (constituting approximately 4%) has been set aside as National Parks. In Uganda, Wildlife Protected Areas cover 11% of Uganda’s total area, hold about 50% of the country’s wildlife and they include 10 National Parks, 12 Wildlife Reserves, 5 Community Wildlife Areas, and 13 Wildlife Sanctuaries totaling to 25,960km^2 of land (UWA, 2013a) out of 236,000 km^2 of the country's total area (Langdale-Brown et al., 1964).

Many existing parks are currently experiencing difficulties in achieving their conservation aims, and their long-term sustainability has been questioned (Bruner, 2001). Critics have claimed that national parks cannot be expected to carry the burden of maintaining biodiversity (Eagles, 1993), that they do not necessarily protect biotic integrity within their borders (Terborgh, 2004; Bruner et al., 2001; Salafsky et al., 2002), or that they have been poorly located from the standpoint of biodiversity conservation (Scott et al., 2001; Rodrigues et al., 2004). Also, [critics claim] that in the context of growing human pressures and development needs, parks cannot protect the biological resources within their borders (Ghimire & Pimbert, 1997). The accuracy of these claims is of critical importance to policy and funding decisions. The global network of parks currently is nonetheless a key option for maintaining and enhancing biodiversity conservation; ways need to be found to strengthen those that are failing (Terborgh & Schaik, 2002), and to understand and replicate those that are succeeding. Efforts to improve the sustainability of national parks have often reflected professional and disciplinary lines, with ecologists and conservation biologists emphasizing something different from social scientists and people's rights advocates (Blaustein, 2007; King et al., 2007). National parks in Uganda equally threats (UWA, 2018a).

1.1.4 The Historical Perspective of Ecological Integrity

The notion of ecological integrity is not new. The most famous early allusion to it can be traced to Leopold (1949), who opined, “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise” (p. 224–225). But Leopald never explained what he meant by integrity. Cairns (1977) was more helpful when he defined biological integrity as “the maintenance of the community structure and function characteristic of a particular locale or deemed satisfactory to society”. Obviously, is more difficult to quantify than simpler concepts such as richness, evenness, and diversity; use of these simpler measures presents enormous problems related to scale, sample size, and most importantly lack of consideration of species identity (Noss, 1990b). The maintenance of biological integrity and ecological integrity were enshrined as legal mandates under the US Clean Water Act of 1972 and the Parks Canada Act of 1988, spurring significant academic debate about the meaning and practical application of the concept (Woodley et al., 1993; Pimental et al., 2000). Since the late 1990s, practical and measurable approaches to ecological integrity in the context of resource conservation have been grounded in the scientific foundations of conservation biology and community ecology.

Therefore, ecological integrity is a holistic concept that encompasses other ecological notions, such as ecosystem and environmental health, biodiversity, sustainability, naturalness, wildness, stability, and resilience (Andreasen et al., 2001). Thus, ecological integrity centres on conservation of native biological diversity, using the natural or historic range of variation as a reference point, and promoting resilience, that is, “the capacity to reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks” (Walker et al., 2004; Woodley, 2010; Keenleyside et al., 2012). Ecological integrity emphasizes the importance of ecological processes such as natural disturbance regimes that provide the structures and functions on which the full complement of species in an ecosystem or landscape depend (Angermeier & Karr, 1994; Andreasen et al., 2001). Furthermore, ecological systems that retain their native species and natural processes are hypothesized to be more resistant and resilient to natural and anthropogenic stresses over time (Parrish et al., 2003; Woodley, 2010). Ecological integrity frameworks also typically emphasize the intrinsic value of native biodiversity, beyond its functional role in supporting the renewal and reorganization of ecosystem function and structure over time (Woodley, 2010).

These characteristics of ecological integrity are reflected in a recent and oft-cited definition provided by Parrish et al., (2003) where *ecological integrity* is defined as “the ability of an ecological system to support and maintain a community of organisms that has species composition, diversity, and functional organization comparable to those of natural habitats within a region. An ecological system has integrity when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human disruptions (Parrish et al., 2003, p. 852).

Parks Canada (1998) defines ecological integrity, with respect to a park, as “a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes”. Ecological integrity is the ability of ecological systems to support and maintain a community of organisms that have a species composition, diversity, and functional organization comparable to those of natural habitats within the ecoregion range or area (Toevs et al., 2011). An ecological integrity assessment is a multi-metric index in the form of an ecological scorecard (Faber-Langendoen et al., 2012a, b) that is intended to assess ecosystem structure, composition, function, species composition, diversity, and \functional organization. Therefore ecological integrity ‘‘can be effectively assessed using a suite of rapid assessment metrics, structured around a general ecological model’’ (Faber-Langendoen et al., 2012b, p. 1).

1.1.5 Components and Attributes of Ecological Integrity

Ecological integrity is commonly characterized in terms of the ecological components of composition, structure, and function at multiple levels of hierarchical organization, from species to landscapes (Andreasen et al., 2001, Dale & Beyeler, 2001). Composition may refer to attributes associated with the species within an ecosystem, such as species richness or evenness, and structure may refer to physical features, such as canopy openings or patch size. Function encompasses dynamic biotic interactions, such as herbivory and predation; biological processes, such as primary productivity; and abiotic processes, including hydrological processes and fire regimes (Dale & Beyeler, 2001). Evaluating ecological integrity requires an understanding of the dynamic spatial and temporal relationships, links, and interactions among ecosystem components at multiple levels of the ecological hierarchy.

A rigorous, scientifically based understanding of an ecosystem facilitates the identification of the key attributes of composition, structure, and function that are most crucial for biodiversity conservation and ecological resilience. For example, key attributes of composition (or biodiversity) may be species or functional groups of species (e.g., beavers or riparian vegetation) that provide essential structural or functional roles in the ecosystem. Processes such as fire also may be considered key attributes. In addition to composition, structure, and function, it is often also helpful when building a conceptual model of ecological integrity to characterize the ecological drivers, such as climate regimes or geology that determine or influence the variation in ecological components (Parrish et al., 2003, Tierney et al., 2009). In some applications, dominant disturbance regimes are characterized as drivers in order to more clearly illustrate the role of critical-ecosystem processes and their effects on other attributes (Mitchell et al., 2014). The identification of the key attributes of ecological integrity requires the specification of spatially explicit ecosystems or landscapes for assessment and measurement. The subjective nature of ecological boundaries can make identifying focal ecosystems challenging. Although an ecosystem may be defined on the basis of management goals or compositional elements such as dominant vegetation, it also must take into consideration the spatial and temporal scales of dominant processes and interactions across the wider landscape (Andreassen et al., 2001). A nested, multiple-scale approach for evaluating ecological integrity at both the ecosystem and landscape level may be essential for ecological systems in which cross-scale interactions and processes, such as large-scale disturbances, are particularly relevant for native biodiversity or ecological function.

In order to assess and measure ecological integrity, it is useful to compare the current state and ranges of variation in ecosystem components with desired states and ranges of variation through the use of benchmarks or reference points. This is done to evaluate the influence of anthropogenic or biological stressors on key ecosystem attributes and assess progress toward management goals, such as restoration (Karr & Chu, 1998, Parrish et al., 2003). There are different approaches for determining benchmarks and reference points, each with relative strengths and weaknesses. While one approach relies on the use of historical ecology to identify the natural or historic range of variation, another approach uses reference conditions in pristine or relatively pristine ecosystems to evaluate and compare ecological attributes in more degraded systems. The ecological attributes of stream systems in un-degraded or protected areas have been widely and successfully used to evaluate the effects of human development and use in more managed watersheds or landscapes (Karr & Chu, 1998). By using existing reference conditions, the relative ecological integrity of ecosystems may be evaluated over time, allowing inference into the effects of human use or management actions, even when, given the effects of climate change, returning to historic conditions may not be the goal (Hanberry et al., 2015). However, reference conditions must be chosen carefully.

1.1.6 Measuring and Communicating Ecological Integrity

Measures of ecological integrity must be based on indicators that are useful for conveying information about the composition, structure, and function of selected ecosystems over time and across spatial scales. Ideally, indicators should provide quantitative measures of the status and trend of key ecosystem drivers and attributes, reflect the influence of natural versus anthropogenic stressors, and serve to identify the causes of environmental change at different hierarchical levels of ecological organization (Andreassen et al., 2001, Dale & Beyeler, 2001, Niemi & McDonald, 2004). Monitoring indicators will necessarily be a subset of possible measures. This subset must provide enough information to understand the status of ecological integrity, be feasible to measure and cost effective, and provide results with sufficient statistical power for management and decision making (Noon et al., 2009). Limiting indicators is challenging, but a particularly persistent challenge is selecting indicator species for monitoring ecological integrity, because of the varying responses of species to stressors and their limited ability to represent impacts to associated taxa (Carignan & Villard, 2002). Indicators must also be chosen on the basis of whether they assist managers and stakeholders in understanding and communicating ecosystem status.

1.2 Statement of the Problem

Globally, many parks are experiencing difficulties in achieving their conservation aims, and their long-term sustainability has been questioned (Bruner, 2001). National parks cannot carry the burden of maintaining biodiversity (Eagles, 1993), that they do not necessarily protect biotic integrity (Terborgh, 2004). Past studies in National Parks in Africa do not include community conservation, socioeconomic and cultural factors (Muhumuza & Balkwill, 2013). In Uganda, past studies emphasize research on only disease outbreak management (UWA, 2012a) but could not consider other aspects of ecological integrity which are useful to guide conservation. It’s important to note that Uganda is estimated to have lost about 50% of its biodiversity value between 1975 and 1995 (Pomeroy et al., 2017; Plumptre et al., 2019) due to various threats. The threats experienced in wildlife protected areas of Kibale and Queen Elizabeth Conservation Areas experienced threats like armed poaching, human wildlife conflict, poaching, habitat loss, climate change, invasive species, diseases and parasites (UWA, 2018) that constraint resource conservation. Further, the parks have migratory animals (UWA, 2012b) yet their migratory routes were not known. Despite the importance of national parks in conservation of biodiversity, their ability to maintain nativeness, pristineness, diversity, and resilience or adaptability, and impact of human actions on them was inadequately documented. There was limited information on threat levels, the role of communities in conservation, animal migratory corridors, and wildlife monitoring to guide decision makers and managers on development of appropriate policies and prioritization of management strategies to enhance conservation of biological diversity and protect the integrity of the wildlife conservation areas. The limited information on: threat levels, animal corridors, community basesed conservation, and wildlife monitoring limits decisions on development of policies and prioritization of management strategies. Therefore, this study was meant to establish the effectiveness of wildlife protected areas in conserving ecological integrity of Kibale and Queen Elizabeth Conservation Areas.

1.3 Objectives of the Study

1.3.1 The Study General Objective

The general objective of this study was to establish the effectiveness of wildlife protected areas in conserving ecological integrity in Kibale and Queen Elizabeth Conservation Areas.

1.3.2 The Specific Objectives

The effectiveness of conservation areas in conserving ecological integrity was explored, and specifically, this study set out to accomplish the following objectives:

i. Assess how long-term wildlife monitoring influences policy to conserve the ecological integrity of Kibale and Queen Elizabeth Conservation Areas.

ii. Evaluate the changes in wildlife corridors and how they affect the ecological integrity of Kibale and Queen Elizabeth Conservation Areas.

iii. Investigate how the community-based conservation approach protects ecological integrity of Kibale and Queen Elizabeth Conservation Areas

iv. Analyse the threats to wildlife conservation of Kibale and Queen Elizabeth Conservation Areas and how they are being currently addressed.

1.4 The Research Hypotheses

This study sought to test the following hypotheses:

i. Wildlife monitoring influences development of conservation policies to protect ecological integrity of Queen Elizabeth and Kibale Conservation Areas.

ii. Changes occurring in wildlife corridors affect the ecological integrity of Queen Elizabeth and Kibale Conservation Areas.

iii. Local communities participate in wildlife programmes to conserve biodiversity and protect ecological integrity of Queen Elizabeth and Kibale Conservation Areas.

iv. Threats to wildlife conservation are reducing across Queen Elizabeth and Kibale Conservation Areas.

1.5 Significance of the Study

In Uganda, the Ministry responsible for Tourism, Wildlife and Antiquities seeks that collaborations be established between Protected Areas and relevant research institutions like Centers for Disease Control, Ministry of Agriculture, Animal

Industry and Fisheries, Makerere University and other relevant institutions, to conduct ecological research in the areas of emerging diseases like Marburg, anthrax, and other zoonotic and notifiable diseases, and also for the purpose of building a diagnostic capacity in the PA and enhancing disease management capacity of staff (UWA, 2011). There was inadequate information on maintaining and enhancing the conservation of biological diversity and ecosystem processes. This study, therefore, presents empirical results from an assessment of how effectively the wildlife protected areas in the Kibale and Queen Elizabeth Conservation Areas are protecting ecological integrity; through evaluating the threats and their level of reduction, the long-term wildlife monitoring, the changes in wildlife corridors, and the community-based conservation approaches. This study, therefore, generated scientific information that contributes to scholarly research and literature hence extension of knowledge and other related studies; and also provides guidance to Uganda Wildlife Authority and conservation managers the Worldover to make policy and management decisions to effectively conserve wildlife and biodiversity. This study further recommended strategies how local communities should participate in the conservation of protected areas, and areas for further research.

1.6 Scope of the Study

This study on evaluation of the effectiveness of protected areas to conserve the ecological integrity in Kibale and Queen Elizabeth Conservation Areas was conducted between August 2017 and April 2019. It was conducted along a wide landscape to cover wildlife protected areas in the two conservation areas. Data was collected using literature review (park reports, desk examination of General Park Management Plans, wildlife monitoring reports, ecological monitoring reports); semi-structured questionnaires; key informant interviews; focus group discussions; the Nature Conservancy's Conservation Action Planning (CAP) methodology; Threat Reduction Assessment (TRA), and GIS/remote sensing. The study specifically established how wildlife monitoring influences formulation of conservation-related policies, the threats and level of threat reduction, the status of wildlife corridors and their effect on the different ecosystem attributes on the ecological integrity of the conservation areas.

1.7 Organization of the thesis

This thesis is structured as follows: the foregoing chapter one provides background to the study, statement of the problem, objectives of the study, research hypothesis, significance of the study, and scope of the study. Chapter two presents the literature review which consists of the theoretical review of the long-term wildlife monitoring, wildlife corridors, community-based conservation, and threat reduction. This chapter further presents the existing research gaps, and the conceptual framework of the study. Chapter three presents the materials and used in the study, research design, research philosophy, operationalization and measurement of variables, the target population, sampling design, data collection instruments, data collection procedure, and data analysis and presentation. Chapter four presents study findings and discussion. Chapter five presents summary, conclusion and recommendations.

1.8 Limitations encountered in the course of the study

The absence of baseline data on ecological integrity was a limitation of this study since ecological interity is supposed to have a reference point for comparison.

Some of the respondents were uncooperative and reluctant to provide the needed information

Some of the participants sampled to participate in the study decided to withdraw their participation, which reduced on the number of respondents

There was no census data for Rwenzori Mountains National Park hence incomplete data on animal populations in the two conservation areas studied to have a complete analysis of the migratory animals.

The process of approval of the research proposal application by the Uganda Wildlife Authority (Appendix IX), and Ethical Approval by Research Ethics Committee (Appendix X) were tedius and delayed data collection.

The challenge of COVID-19 pandemic. The continued lock-downs could not allow travels to collect data.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter discusses the theoretical framework of the literature related to the effectiveness of wildlife protected areas in conserving ecological integrity in Kibale and Queen Elizabeth Conservation Areas. The theoretical review was conceptualized under the objectives of the study and focuses mainly on the long-term wildlife monitoring program, wildlife corridors, community-based conservation approach, and threat reduction level and their relationship with the ecological integrity of the conservation areas. This chapter further presents the existing research gaps, and the conceptual framework of the study.

2.1 Theoretical Review

The theoretical framework adopted for this study was derived from the emergy systems theory developed by Odum (1996). Emergy is defined as the available energy of one kind previously used up directly and indirectly to make a service or product, usually quantified in solar energy equivalents (Odum, 1996). From its origins in ecosystem science, emergy analysis has evolved into an environmental assessment tool grounded in the laws of thermodynamics that offers a biophysical alternative to economic analysis (Odum, 1996). The theory predicts the expected states for structural organization of an ecosystem [ecological integrity] (Campbell, 2001). Therefore, the only meaningful way to study the integrity of parks is to appreciate that ecological systems and human social and economic systems are energetic systems, which exhibit characteristic designs that reinforce energy use (Odum 1996, 1998; Odum et al., 2000). It provides a theoretical basis for defining, measuring, and interpreting the concepts of ecological integrity and ecosystem health and emphasizes the hierarchical structure, function and processes of an ecosystem (Odum, 1996) which is in line with the purpose of the study. The emergy systems theory, which operates on the principle of systems science, postulates that you need to model the system that is one size larger than the one you want to understand (Odum, 1994) and that systems should always be modeled (and ecological integrity evaluated) at more than one scale. This window of attention (Odum, 1983) is a useful device for specifying system boundaries within a hierarchy, because it divides the universe into three parts, the system, its subsystems, and the next larger system, which often correspond to different levels of hierarchical organization.

In addition, other theories concur with the emergy systems theory to explain ecological integrity. For instance, Kay put forward a theory of ecosystem development, based on a study of thermodynamics and the development of complex systems (particularly self-organization phenomena) (Kay, 1984; Kay & Regier, 1999; Kay, 2000). Ulanowicz (1986) has put forth a complimentary theory which focuses on the development of mass and energy flow networks in ecological systems (Kay et al., 1989). Kay has used this theory and other elements of complex systems theory to develop an ecosystem approach for evaluating integrity (Kay, 1991; Kay & Regier, 2000). Allen has been working on hierarchy theory, a dialect of general systems theory that unites thermodynamics and network theory. Hierarchy theory takes into account issues of scale and observer decisions as to type and significance of systems (Ahl & Allen, 1996). Luvall and Holbo (1989) have a number of data sets of remotely sensed thermal images of ecosystem. Collectively, undertakings by researchers are to meld theory and field observation through experimentation, to treat vegetation as a complex thermodynamic system. The ultimate goal is to understand the functionality and complexity of ecosystems (natural and human urban ecosystems), so that it can be measured and used to develop management and guide policy.

This study, therefore, was modeled on the postulates of the emergy systems theory because it provides a theoretical basis for defining, measuring, and interpreting the concepts of ecological integrity and ecosystem health (Odum, 1996), and it also emphasizes the hierarchical structure, function and processes of an ecosystem which is in line with the purpose of the study. As adapted in this study, the emergy systems theory holds that characterizing ecological integrity using an energy systems approach is to specify the composition and variability of an appropriate reference emergy signature and that the structural components of a system and all processes operating within this system of components is functioning optimally to produce maximum empower in the network. It therefore recognizes ecosystem characteristics (structure, composition, diversity, habitat quality, and function), ecological processes, interacting components and pathways which include drivers and stressors, park management actions and community-park interactions influence ecological integrity.

2.2 Empirical Review

2.2.1 The long-term wildlife monitoring and ecological integrity

Ecological monitoring is fundamental to management of the environment and conservation of biological diversity. (Cord et al., 2017; Hays et al., 2019) Ecological monitoring involves purposefull collection of information to monitor and understand changes in ecosystem structure, ecological processes, and the ecological services that ecosystems provide (Lindenmayer & Likens 2018). As the need for monitoring species, habitats, and ecosystems increases, the ways scientists and managers use to collect, process, and analyze data also increase. (Allan et al., 2018; Hill et al., 2018) Managing wildlife in a sustainable way is a key challenge around the globe. To balance societal needs and ecological functions, the complex interactions between humans, wildlife, and habitats must be fully understood (Apollonio et al., 2017).

Decision makers currently face the challenge of navigating through a wealth of disparate information. As sustainability is primarily a trans-disciplinary issue, no single metric exists that is able to independently and solely address the full complexity of sustainability (Galli et al., 2012). Nonetheless, quantitatively assessing and monitoring individual sustainability dimensions (e.g., the environmental pillar) is feasible. This requires a systemic approach, capable of analyzing wildlife data through a consistent lens to inform decisions. In addition, monitoring that is not otherwise driven by a specific hypothesis can help researchers understand impacts of unplanned events such as weather (short term) and climatic patterns (long term) on wildlife populations (Beever & Woodward, 2011; Fancy & Bennetts, 2012; Johnson, 2012). However, formal processes necessary to implement a monitoring program may seem daunting. A monitoring program includes identifying an appropriate species or taxa (Carignan & Villand, 2002), selecting metrics that are sensitive to changing conditions (Williams et al., 2002) and sampling methods that best maximize efficiency (Garton et al., 2005). It also includes using an experimental design to isolate the hypothesis of interest with the most efficient probabilistic sampling (Garton et al., 2005; Morrison et al., 2008). Monitoring program also includes employing sufficient effort (sample size) to achieve the desired level of power for detecting biologically meaningful changes (Williams et al., 2002; Field et al., 2007).

However, biodiversity monitoring is claimed to be ineffective at integrating information into decision-making and insufficiently relevant to the needs of land and resource managers (Danida, 2000; Sheil, 2001). The accuracy of these claims is of critical importance to policy and funding decisions. Failure to give these decisions proper attention often leads to misallocated resources, resulting in suboptimal information for decisions and planning objectives (Yuccoz et al., 2001). Therefore, the ability to contextualize scientific information for park decision-makers by scaling up among multiple parks and with surrounding landscapes is a particularly important aspect of long-term monitoring and research in protected-area networks (Rodhouse, 2016).

Past assessments of monitoring initiatives have focused on their ability to detect trends (Yoccoz et al. 2001). “There is a particular need for monitoring designs that anticipate future needs (and social conflicts), and quantify current ecological changes in a manner which enables the forecasting of ecosystem change to improve risk management and sustainable economic and social development” (Lindenmayer et al., 2015).

In Uganda, inadequate information exists on how results of wildlife monitoring influences policy formulation to protect the ecological integrity. Uganda Wildlife Authority, the agency responsible for management of wildlife and protected areas in Uganda, has the mandate to collect, analyze and provide data and information on the available types of species, their populations and trends, types and trends of wildlife (NEMA, 2008). The agency established the department of ecological monitoring in 1999, according to the UWA’s Monitoring and Research Policy (1999), which requires that surveys be carried out in the forested parks (for instance Kibale NP, Rwenzori Mountains NP and Semuliki NP) and in the savannah parks (for instance Queen Elizabeth NP) after every 5 years and every 2 years, respectively. Despite this provision in the monitoring and research policy, UWA has inadequate data to adequately monitor the status of wildlife and other resources and develop plans that will adequately ensure sustainable wildlife management (OAG, 2011). UWA’s Research and Monitoring Unit is not carrying out surveys consistently for biodiversity management; as a result, the promotion, collection and provision of relevant, accurate and timely information for conservation and good management of Uganda's wildlife resources and its biodiversity is not being fully achieved (OAG, 2011).

2.2.2 The Wildlife Corridors and biodiversity conservation

Corridors are cornerstones of modern conservation. "An ecological corridor or linkage is a swath of natural land, or stepping stones of natural land, that is conserved to enhance the ability of plants and wildlife to move among larger habitat patches" (Bennett, 2004; Resasco, 2019). Understanding the changes experienced in wildlife corridors and the causes of these changes is fundamental to wildlife conservation managers and policy makers to guide decision making. The long-term viability of populations often depends on regional habitat connectivity (Heller & Zavaleta, 2009; UNEP, 2019). While connectivity areas for one species could not be used by others, estimates of connectivity might be sensitive to this choice of species (Cushman, Landguth, & Flather, 2013; LaPoint et al., 2013) and conservation strategies need to be optimized for each of these species (Cushman, Lewis, & Landguth, 2013). However, as many species are affected by fragmentation, connectivity areas/corridors could secure regional biodiversity if they are established to support the movement of multiple species simultaneously rather than the movement of a single species (Brodie et al., 2015; Liu et al., 2018).

2.2.3 Community-based conservation and biodiversity conservation

Community-based conservation is "any voluntary initiative of natural resources or biodiversity protection conducted by, for, and with the local community" (Western & Wright, 1994). Community-based conservation can thus encompass a myriad of initiatives with different aims, governance systems, and levels of local decision-making power, ranging from self-regulated to co-managed conservation strategies (Dudley, 2008). In self-regulated initiatives (i.e., community-managed forests, sacred forests, agropastoral systems, and small-scale fisheries), management authority and responsibility rest with rural communities and/or indigenous peoples (Dudley, 2008) whose informal rules and social bonds can facilitate institutional flexibility to deal with rapid change (Folke et al., 2005). In co-managed initiatives (i.e., co-management of protected areas), international and national agencies with the support of nongovernmental organizations (NGOs) promote community-based conservation by involving local people in decision making around natural resource management. These initiatives are sometimes developed to respond to the failure of top-down conservation models (Berkes, 2004) or as a strategy to reinforce conservation initiatives led by self-governing communities (Armitage, 2005). In both contexts, complex institutional mechanisms are designed to allocate management authority and responsibility among a plurality of actors (Dudley, 2008), which can in turn draw upon both traditional ecological knowledge and scientific knowledge to define specific conservation strategies (Mehring et al., 2011).

Some of the initiatives involved in the community-based conservation approach include signing of resource use agreements which allow local people who neighbour National Parks to have access to specific resources from the park for subsistence use (Tumusiime et al., 2011). In other cases, local people are given money for infrastructural development, such as in Integrated Conservation and Development Initiative in Korup National Park in Cameroon (Malleson, 2000). And in other National Parks such as Pendjari National Park in Benin, local people are given a percentage of revenue generated from tourism activities in the park (Vodouhˆe, 2010). Community-based conservation promotes transfer of management of resources and user rights to local communities, hence a tool for conservation of natural resources (Western & Wright (Eds)., 1994; Borgerhoff & Coppolillo, 2005).

Community-based conservation aims "to enhance wildlife/biodiversity conservation and to provide incentives, normally economic, for local people" (Campbell & Vainio-Mattila, 2003, p. 421). Community-based conservation initiatives aim at protecting biodiversity while promoting local development (Gómez-Baggethun & Muradian, 2015) with main strategies of (i) integrating conservation and livelihood goals, (ii) providing economic and development benefits in return for conservation, and iii) providing communities control over their natural resources (Nilsson et al., 2016). Community-based conservation is promoted as a means to re-aggregate the common resource, provide biodiversity conservation, and enhance human livelihoods under increasing pressures from population growth, land use changes, and other forces (Reid et al., 2014). Local land users are thought to be ideally central to crafting and implementing conservation and development initiatives in a Community-based conservation model (Agrawal, 2003; Armitage, 2005; Black & Cobbinah, 2017). Appropriate approaches to balance the public need for sustaining biodiversity and natural heritage and private need for basic livelihood and culture maintenance are always under discussion and practice around the world (Lele et al., 2010; Brooks et al., 2013). While there is no fixed set of governance institutions that are appropriate to effectively govern resources (Ostrom, 2007; Andersson & Ostrom, 2008), CBC institutions are often exemplified by nongovernmental organizations (NGOs), private individuals, and layers of government that represent, facilitate, or at least support local communities in conservation governance and resource management (Baival & Fernández-Giménez, 2012). Community-based conservation institutions offer incentives to sustainably manage natural resources and have some measure of devolution of resource management responsibilities (Berkes, 2007; Plummer & Armitage, 2007; Suich, 2010; Morton et al., 2016).

Global experience both in developing and developed countries has confirmed that community participation in protected area management can be adapted to different social-ecological conditions with different conservation targets (Brooks et al., 2013; Li, 2014; Selfa & Endter-Wada, 2008). Research has also revealed that many factors can impact the success of community participation, such as formulation and implementation of laws and regulation, acceptance of local knowledge and development demand, provision of social welfare, etc. (Calfukura, 2018).

2.2.4 Threat reduction and biodiversity conservation

"Biodiversity is the wealth of all life forms found on earth and encompasses all species of plants, animals, microorganisms, the ecosystems and ecological processes. Moral justification and value to human existence are two major reasons for conserving biodiversity" (Christ et al., 2003). However, renewable natural resources are being utilized by humans at a rate exceeding their natural abilities to renew themselves (Christ et al., 2003). Human encroachment into natural ecosystems is increasing drastically throughout the world. Forests are being exploited and cleared, farmlands have increased in extent, demand for grazing areas is on the rise and unregulated harvesting of the wild resources is becoming uncontrollable. As human activities exert pressure on the global environment, biological diversity declines, habitats are transformed and the population of some species dwindles to the point of extinction (Whitmore & Sayer, 1992). Since man is constantly at variance with nature, the ever increasing human population coupled with technological development place stress on the environment and the world's natural resources hence the unprecedented rate of biodiversity disappearance.

Protected areas (PAs) are a cornerstone of biodiversity conservation efforts, as they provide various species with safe havens (Radeloff et al., 2010). Protected areas now cover more than 14.7% of the terrestrial land surface (UNEP-WCMC, IUCN, 2016). Recent syntheses suggest that PAs are performing better than the broader landscape (Barnes et al., 2016; Gray et al., 2016), although numerous studies suggest that biodiversity continues to decline within many PAs (Craigie et al., 2010; Geldmann et al., 2013; Laurance et al., 2012). A principal objective of PAs is to conserve nature by eliminating, minimizing, or reducing human pressures and threats operating within their boundaries. In addition to preserving biodiversity, PAs should maintain natural processes and promote survival of species by excluding threats (Margules & Pressey, 2000). To achieve these goals, we must understand what the main threats are, where the potential threats occur, and where high-risk areas are distributed. Identifying these threats is therefore crucial for conservation managers to take effective measures to mitigate some of the proximate threats to PAs (Wilson et al., 2005).

2.3 Summary of Literature and Research Gaps

The management of wildlife protected areas in Uganda is guided by the Wildlife Policy and Wildlife Act, in addition to international laws and conventions to which Uganda is a signatory. The Wildlife Agency has further developed guidelines and plans to assist in the implementation of existing laws and policies. However, there are a number of weaknesses and gaps within the existing policy and legal framework to effectively address the challenges facing conservation efforts, and in order to address them, the agency developed a strategy to initiate the formulation of wildlife regulations, and also develop new and review existing organizational plans (UWA, 2013a). This strategy needed to be guided by consolidation and analysis of the wildlife monitoring reports to generate policy recommendations to strengthen conservation of biological diversity. Therefore, the wildlife agency had inadequate data that would otherwise generate significant analysis of wildlife monitoring information to guide policy formulation processes. This study, therefore, in its first objective evaluated how information generated from the wildlife monitoring reports influence policy to protect the ecological integrity [of protected areas], and recommend policy areas for effective management of the conservation areas.

In addition, Ryan and Hartter (2012) in their study suggested that “while the Kibale-Queen corridor demonstrates some of the ecological measures of success from a tropical forest restoration and connectivity perspective, it is difficult to ascertain if the major conservation connectivity goals for fauna and forest connectivity are being met”. They added that “further research on faunal passage as a means to look at goals of the corridor and guidance for future monitoring research is required. In addition, they recommended that the biodiversity conservation goals of faunal and forest connectivity need to be monitored”. The question still remained: what changes exist and what effect do they have on protecting the ecological integrity of the wildlife protected areas? Therefore, studying wildlife corridors attracts a lot of interest in conservation the world over and Uganda is not exceptional. Thus, inadequate data exists on wildlife corridors. Therefore, the study tested the hypothesis that: changes in wildlife corridors in the PAs had no relationship with protection of ecological integrity. Therefore, this study specifically answered the question through evaluating the wildlife corridors, the threats affecting their functionality, and their role in biodiversity conservation, and recommend management strategies to guide both policy makers and practitioners on wildlife corridor preservation.

Moreso, limited data existed on community based conservation of conservation areas. The assumption that community based conservation protects biodiversity needed to be continuously investigated. Jagger (2008) only looked at collaborative management agreements and agreements on sharing benefits from the park that had contributed to increase in household incomes. Mugisha (2002) concluded, that CBC has marginally performed better, as an approach to PA management than the traditional top-down approach, and recommended that more pragmatic approaches that go beyond the PA boundaries to address human welfare issues and conserve PAs into the future. This conclusion and recommendations did not explicitly reveal to what extent CBC protects ecological integrity which this study addressed. Therefore, the third objective of this study was to evaluate how community-based conservation protects ecological integrity, and recommend management strategies for conservation.

Finally, knowledge of the occurrence and severity of threats to PAs has largely been informed by remote sensing data (Geldmann et al., 2014), modeling (Hole et al., 2009), as well as questionnaire surveys with an emphasis on tropical regions (Bruner et al., 2001; Laurance et al., 2012; Leverington et al., 2010). Freely available satellite data offer global and standardized metrics form measuring those threats to PAs that can be observed remotely, such as deforestation (Joppa & Pfaff, 2011) and fires (Nelson & Chomitz, 2011). However, many other threats, including some of the most frequently reported threats to species, according to the International Union for Conservation of Nature (IUCN) Red List (e.g., overexploitation of species, invasive alien species, pollution, climate change), cannot be measured from space (Joppa et al., 2016) and require field-collected data (Mwangi et al., 2010). Therefore, past studies did not assess the level of threats and threat reduction, and how to mitigate threats to biodiversity, hence inadequate information existed on. Hence, the fourth objective of this study was to evaluate the threats and their level of reduction in the conservation areas as a measure of conservation success, and also generate management strategies to enhance conservation of biological diversity.

2.4 Conceptual Framework

In application of the emergy systems theory (Odum, 1994) to this study, the variables were identified and a conceptual framework developed (Fig. 2.1).

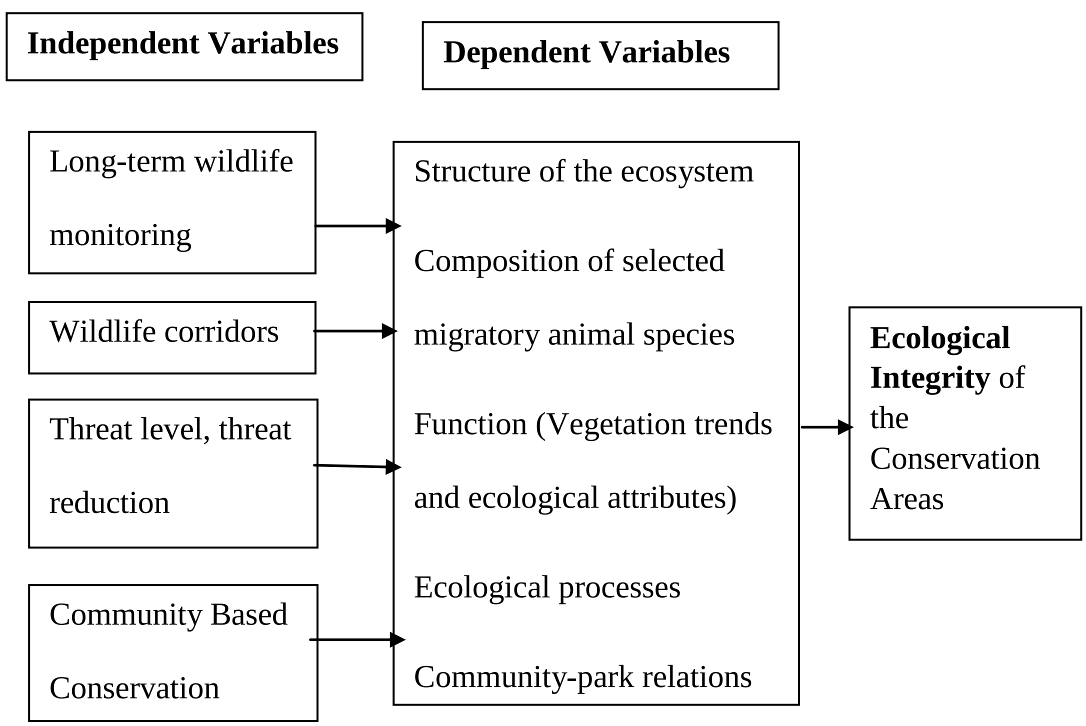

Fig. 2.1 The Conceptual Framework for Evaluating Ecological Integrity of Kibale and Queen Conservation Areas

It was hypothesized that the independent variables directly influence the dependent variables, but the results may be confounded by the effect of the extraneous variable (gender) which was controlled by using a large sample size. This conceptual model describes the linkage between key independent and dependent variables and was used for identifying and interpreting metrics with high ecological and management relevance. The independent variables included: long-term wildlife monitoring, community based conservation, wildlife corridors, and threats, while the dependent variables were the ecosystem characteristics and community-park relations. This conceptual model identified key ecological variables that influence the ecological components: structure, composition, function and ecological processes which were primary variables in evaluating ecological integrity of the two conservation areas. The primary threats impacting on these ecological components were identified and incorporated into the conceptual model which then described the relationships between ecological components and their threats. Finally, the conceptual model established how Community Based Conservation influences community-park relations to conserve biodiversity.

This conceptual framework also hypothesized that i) the decisions and actions from the wildlife monitoring information did not influence policy to protect ecological integrity of Kibale and Queen Elizabeth Conservation Areas, ii) changes in wildlife corridors along the landscape had no relationship with protection of the ecological integrity of Kibale and Queen Elizabeth Conservation Areas, iii) the threats in Kibale and Queen Elizabeth Conservation Areas had not reduced and the management strategies had not contributed to threat reduction, and iv) the Community Based Conservation approach had no relationship with conserving the ecological integrity of Kibale and Queen Elizabeth Conservation Areas. Therefore, these indicators were used to assess the performance of biodiversity and ecological integrity with a view to generate policy and management recommendations to manage change.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents a detailed description of the materials and methods used in the study, research design, research philosophy, operationalization and measurement of variables, the target population, sampling design, data collection instruments, data collection procedure, and data analysis and presentation.

3.1 Research design

This study was conducted through a survey research design to investigate a population by selecting samples to analyse and discover occurences, and also provide numeric description of events. The survey involved eight wildlife protected areas of Kibale and Queen Elizabeth Conservation Areas (Fig. 3.1). Here, the study investigated the population by selecting national parks and wildlife reserves to analyse and discover occurrences. The survey enabled generation of information, analysis and explanation of the effect of long-term wildlife monitoring; changes in wildlife corridors; threats and threat reduction; and community-based conservation approach on protecting ecological integrity. Recent work by Hasan and Csanyi (2023) on Attitude Index of Local Communities toward Wildlife and their Management Methods in Malaysia adopted use of survey research design to collect data. Work by Merkebu and Yazezew (2021) used a survey to collect data on Assessment of Human-Wildlife

Conflict and the Attitude of Local Communities to Wild Animal Conservation around Borena Sayint National Park, Ethiopia.

3.2 Research Philosophy

A research philosophy is a framework that guides how research should be conducted based on ideas about reality and the nature of knowledge (Collis & Hussey, 2014, p.43). The two main research philosophies are positivism and interpretivism. These philosophies represent two fundamentally different ways that we as humans make sense of the world around us: in positivism, reality is independent of us and researchers can therefore observe reality objectively, and in interpretivism, reality is seen as highly subjective because it is shaped by our perceptions (Collis & Hussey, 2014, p.45). This research study was underpinned by the positivism research philosophy. It focused on scientific testing of hypothesis and finding logical or mathematical proof that derives from statistical analysis (Collis & Hussey, 2014, p.44). This study therefore used large sample size to produce precise, objective and quantitative data (Collis & Hussey, 2014, p.50).

3.3 Operationalization and Measurement of Variables

Under the objective of long-term wildlife monitoring, the indicators assessed included ecosystem drivers (for instance human pressures), ecosystem integrity (e.g. selected 'key' animal species), natural ecological processes (e.g fires, habitat change), and threats (e.g. impacts of alien biota). These indicators were evaluated through document review (for instance, state of the park reports) to obtain secondary data; and also site visits to the eight wildlife protected areas to generate primary data. The changes in the wildlife corridors along the landscape were studied using various indicators which included: landscape characteristics (connectivity, vegetation change), their conservation targets; key ecological attributes; or ecological interactions (e.g. dominant animal species). These were captured using GIS/remote sensing, document review, and The Nature Conservancy's Conservation Action Planning (CAP) methodology. Community Based Conservation (CBC) approach was measured through evaluation of the community participation, community perceptions and attitudes towards wildlife protected areas. These variables were evaluated from the existing documents, questionnaires, and focus group discussions. Finally, threats and threat reduction in the study area were evaluated basing on three indicators mainly area, urgency, and severity of the threat to generate the threat reduction indices for each wildlife protected area. The threats and their occurrence were evaluated using the Threat Reduction Assessment (TRA) approach.

3.4 Study Area

This study was carried out in Kibale and Queen Elizabeth Conservation Areas because of their historical, cultural, and biological characteristics; the wildlife monitoring program; communities inside and outside the wildlife protected areas, existence of wildlife corridors, and existence of threats. The area studied was bounded by altitudes 0° 34' South and 1° 09' North and longitudes 29° 28' West and 30° 56' East in the Albertine Graben, Uganda. In each conservation area, 4 wildlife protected areas were studied. Specifically, they were Kibale National

Park (795 km^2), Semuliki National Park (220 km^2), Toro-Semliki Wildlife Reserve (542 km^2) and Katonga Wildlife Reserve (207 km^2) in Kibale Conservation Area; and Queen Elizabeth National Park (1978 km^2), Rwenzori Mountains National Park (995 km^2), Kyambura Wildlife Reserve (157 km^2) and Kigezi Wildlife Reserve (330 km^2) in Queen Elizabeth Conservation Area (Fig. 3.1).

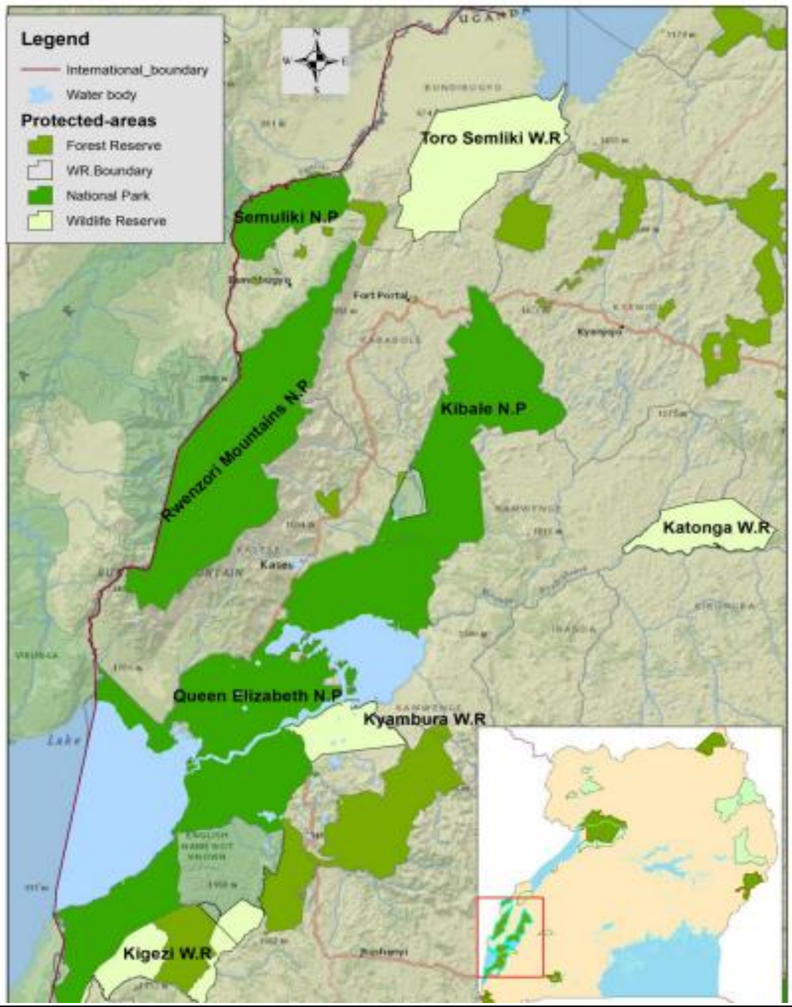

Fig 3.1: Map showing Wildlife Protected Areas in Kibale and Queen Elizabeth Conservation Areas (N.P-National Park, W.R-Wildlife Reserve) (Map generated using GIS/Remote sensing)

The landscape experiences a bimodal rainfall pattern occurring during March-May, and August- November. Annual rainfall ranges from 800 mm to 1600 mm, and is greatly influenced by altitude. The landscape lies astride the equator. It experiences small annual variation in air temperature; and the climate is generally hot and humid, with an average monthly temperatures varying between 27°C and 31°C, with maximums consistently above 30°C and sometimes reaching 38°C Average minimum temperatures are relatively consistent and vary between 16°C and 18°C. The average monthly humidity is between 60 and 80%. The high air temperatures result in high evaporation rates causing some parts to have a negative hydrological balance. The drainage consists of three main lakes—Albert, Edward, and George, and there are a number of rivers and streams. A wide variety of vegetation ecosystems and species are known to exist in this landscape; on the mountain and escarpment slopes and in the valleys and flats. The main vegetation ecosystems include montane forests, tropical forests (including riverine and swamp forests), savannah woodlands and grassland mosaics, papyrus and grassland swamps (NEMA, 2009).

3.5 Sampling Design and Sample Size

The study population comprised of a sample size of 416 respondents disaggregated as 268 from local residents, 81 from park staff, and 67 from local authorities, private sector and opinion leaders involved in conservation programmes adjacent the wildlife protected areas. This sample size was determined using proportion of people from a known population (Conroy, 2018). Conroy (2018) provides a table of calculating the sample size (Appendix VIII).

The sample was then determined using systematic sampling (Cochran, 1963) and purposive sampling techniques (Babbie & Benaquisto, 2002). Systematic sampling was used since it ensures that at the same time, each unit has an equal probability of inclusion in the sample. Here, the sample was obtained by selecting every k^{th} element of the population, where ***k*** is an integer >1. This techniques involved selecting **n** units from a known population of **N** units, and therefore a skip pattern was run through a list of the **N** units to select the sample. Purposive sampling (Babbie & Benaquisto, 2002) was used to select the eight wildlife protected areas in the two conservation areas; and also to collect focused information from different categories of respondents on ecological issues that were not identified by other methods. Stratified sampling technique was used to select respondents from the identified sub groups in the communities neighboring the PAs. The target population was not uniform since different PAs had varying structure, composition and function that do not necessarily have similar characteristics, and therefore, the target and accessible populations could not be regarded as homogenous. The sample size of respondents (in percentage) for each wildlife protected area was dependent on its size (in sq. km) (Fig. 3.2).

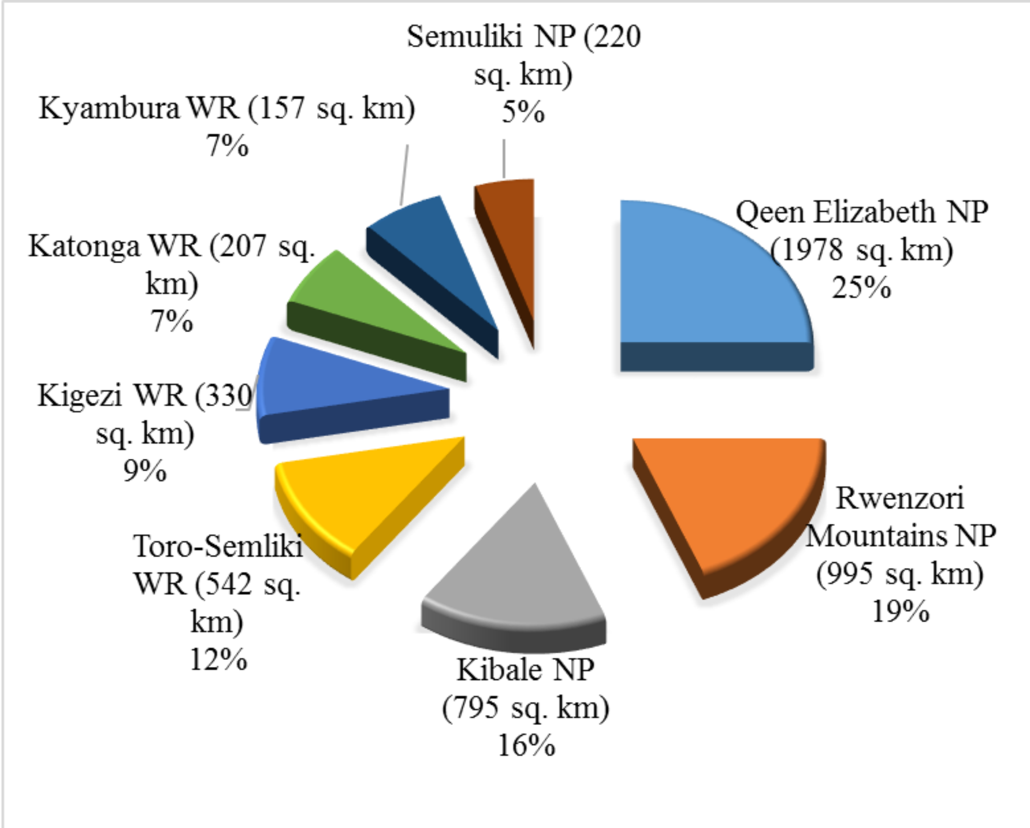

Fig. 3.2: Relationship between Sample Size and Size of Wildlife Protected Area

3.6 Data Collection Instruments and Procedure

This study used the following instruments and tools to generate information:

3.6.1 Structured and semi-structured questionnaire

This tool was used to collect information on: wildlife monitoring (objective one), wildlife corridors (objective two), community-based conservation (objective three), and threats (objective four). The validity of the questionnaire was established through, first, an exhaustive document review, second through re-assessing the contents of the questionnaire to determine whether or not the questionnaire was specifically tailored for the objectives of the study, and third, through a follow-up assessment by a subject matter expert, who eliminated questions or items that were not significant. Next, a pre-test survey was conducted to ensure that the questions are clearly articulated and that the response options are relevant, comprehensive, and mutually exclusive –not just in their own estimation, but from the point of view of the respondents as well. The findings from pre-testing prompted rephrasing of some questions in the questionnaire to avoid distortion when translated into the local languages. The questionnaires consisted of open and closed-ended questions (Appendices III to VII) which were communicated to respondents in their preferred language. Then, the actual survey was conducted using three assistants (with atleast secondary education) who were were recruited, and trained for two days. The respondents were from house holds ≤ 10km from the park boundary since they much interact with the park (Gandiwa et al., 2014). On entering a village, the first household was marked and every third household (sampled using systematic sampling) was interviewed to give a good coverage of the community. To assure representation of the perspectives of different residents, the sampling scheme included age, sex, education level and length of residence in the area. A questionnaire was administered to the household head or in the absence of the household head, to an adult household member. The research team first obtained consent from all individuals who were interviewed. Each questionnaire took approximately 30 to 45 minutes to complete. In addition, the reliability of the questionnaire was done thorugh pre-testing on a small sample in Lake Mburo Conservation area. All the questions in the questionnaire were administered and analysed to ascertain if they would produce reliable results the full-scale study. The findings from pre-testing guided the contents of the questionnaire before conducting the study. To determine the scale's internal consistency, the scales were tested for reliability using the Cronbach's alpha coefficient (α). In some questions, the respondents were asked to indicate the extent they agreed with the given statements concerning their perceptions of the protected area, the threats or other issues identified on a five-point Likert scale (Likert, 1932). The five-point Likert scale was used to prevent respondents from being too neutral in their responses (Colman et al., 1997). Other questions that required the respondents to indicate level of interest in conservation of the park and its attributes, were measured in nominal scale and rated using 5=very interested, 4=interested, 3=neutral, 2=not interested and 1= not very interested. During this study, GPS points were captured using Garmin eTrex GPS for every household sampled.

3.6.2 Document review

A detailed review of relevant documents was carried out to gain an understanding of: wildlife monitoring (objective one), wildlife corridors (objective two), community-based conservation (objective three), and threats (objective four) at the eight wildlife protected areas in the two conservation areas. The documents reviewed included the park general management plans, annual reports, wildlife monitoring reports, annual operation plan, routine reports, revenue sharing program reports, resource use agreements, park reports, and academic journal articles published after the year 2000.

3.6.3 Interviews

Semi-structured interviews were used to collect information on wildlife corridors (objective two) concerning large mammal presence and the locations of wildlife corridors in communities surrounding Queen Elizabeth and Kibale Conservation Areas. The study was introducted to the participants, and a consent was obtained before the start of the interview. The interview questions based on a similar survey conducted on wildlife corridors in the Greater Wami-Mbiki Ecosystem in Tanzania (Van de Perre, 2014; Riggio & Caro, 2017). The interview questions included "Do you think there is a path (corridor) that wild animals use to move from the park?", "Where is this path located (show on map)?", "Where do the animals go?", "Which species use this path?", "What time of year do animals use this path?", "Do the animals move across cultivated land?", "How do you know about this path?", and "Do you think this path will disappear? And why?" If the response to the first question was no, then other questions including, "Was there a path used by animals?", "Is there something blocking the path of animal movement?", and "When did the path become blocked?" "This can be an accurate and cost-effective method in places where people live or work. Interviews with people living within or adjacent to wildlife corridors can provide accurate information on wildlife movements that can be obtained fairly easily. These data can then be used to validate connectivity models." (Riggio & Caro, 2017).

3.6.4 Focus Group Discussions

Focus Group Discussions (FGDs) was used to generated information on: wildlife monitoring (objective one), wildlife corridors (objective two), community-based conservation (objective three), and threats (objective four). The key informants included:park staff, community members, resource access groups, leaders from local authorities, CSO members, and private sector members involved in conservation activities. They considered threats affecting the habitat integrity, quality, and functioning of the ecosystem. There were 5 to 9 participants in each FGD and they ranked the threats based on relative importance and experiences using the Likert scale. Next, the respondents answered how worrisome they estimated each threat using the same Likert scale to their respective protected area based on the risks they thought affected the protected area, and what preventive measures were required.

Field visits were then conducted to ground-truth the threats. Additionally, the FGDs were held to explore local contribution to conservation of the wildlife, about conservation policies and incentives related to the community based conservation. This allowed interviewees to construct their own accounts of experiences to counter the limited explanatory power of structured questions.

3.6.5 The Nature Conservancy's Conservation Action Planning approach

This approach is used as a way of assessing, managing and monitoring the status of an ecosystem or conservation area (TNC, 2007). This approach focuses on most important biodiversity and ecological characteristics and was therefore chosen to identify the status of wildlife corridors (objective two) in the study area. This approach involved various key steps:

a) The people to be involved in the study were identified. These people were selected using stratified random sampling and they included park staff, local authorities, private sector, and local communities. The local communities were represented by some of the participants that had been interviewed, to validate their submissions on corridors.

b) The identified people defined the targets for conservation. These targets were the key biodiversity components of a conservation area that were considered to represent their unique biodiversity, the multiple spatial scales and levels of biological organization, and the scale at which threats and management occur.

c) They then assessed the viability of the identified focal conservation targets. This step looked at each of the focal targets carefully to determine how to measure its "health" over time. And then identified how the target was doing and what a "healthy state" might look like. This step identified which conservation target(s) were most in need of immediate attention (conservation). This represented the key biodiversity components of the wildlife corridors, and their importance in supporting the integrity of the protected area.

d) For each conservation target, key ecological attributes were identified which were key for sustaining the target for conservation and would be degraded by human threats. The threats affecting the conservation target(s) and which threats were more of a problem were identified. Identification of the critical threats was done by identifying and rating of stresses affecting each conservation target, identifying and rating sources of stress for each identified target, and determining the critical threats. The threats were ranked according to the level of damage (severity) and the geographic extent of impact on the conservation target at the site (scope). The root causes of the critical threats, degraded targets and opportunities for successful action.

e) The participants developed conservation strategies by conducting a critical analysis of the threats and the degraded key ecological attributes of the corridors.

f) Then, measures to effectively manage the conservation targets were identified. This involved measuring how the strategy effectiveness—conservation actions to achieve the desired conservation results; and status of the conservation targets.

g) Finally, strategic actions and measures were developed and responsibilities assigned to guide conservation of the the resource.

Further, a list of threats to the wildlife corridors and biodiversity generated from the CAP approach was printed. The list contained eleven carefully designed statements concerning the threats to guide rating of the participants' responses. The participants were asked to answer two questions to enable them comprehend the threats further drawing from their perceptions and experiences. First, the participants were asked them to respond by indicating their level of agreement or disagreement with the threats on a 5-point Likert scale starting from ‘1 = strongly disagree’ to ‘5 = strongly agree’, and second, the participants were asked to answer how worrisome they estimated each threat using the same 5-point Likert scale. The questions help prevent neutral responses from respondents (Colman et al., 1997).

3.6.6 Threat Reduction Assessment (TRA) technique

This technique was used to assess the main types of threats (objective four) affecting the PAs, their impact, and their occurrence. The study adopted the Threat Reduction Assessment (TRA) approach by Margoluis and Salafsky (1998). Salafsky et al. (2008) defined threats as any human activity or processes that caused destruction, degradation, and/or impairment of biodiversity targets. This TRA technique based on three key assumptions: a) all biodiversity destructions are human-induced; b) all threats to biodiversity at a given site can be identified and c) changes in all threats can be measured or estimated (Margoluis & Salafsky, 1998). The TRA method identifies threats, ranks them based on the criteria and assesses the progress in reducing them (Rome, 1999). The TRA technique followed the procedural approach developed by IUCN (1998), Margoluis and Salafsky (1999) that this involved six steps:

a) The wildlife protected area was defined, and all direct threats affecting the protected area were listed;

b) The listed threats were ranked based on three criteria: area, intensity and urgency (area refers to the percentage of the habitats in the site; intensity refers to the impact or severity of destruction caused by the threat; and urgency refers to the immediacy of the threat). Out of the total threats, the highest ranked threat for each criterion received the highest score, and lowest ranked score received the lowest score;

c) Then the total rank of each threat was obtained by adding up the scores of the 3 creteria

d) Then, the degree to which each threat had been met was determined;

e) The raw score for each identified threat was calculated by multiplying the total ranking by the percentage calculated;

f) Finally, the final threat reduction index score was calculated by adding up the raw scores for all threats, dividing by the sum of the total rankings, and multiplying by 100 to get the TRA index as a percentage.

To integrate science and social values into the selection of indicators used in this study, two techniques were employed: the use of conceptual framework that present interactions between key ecological components at different scales and the potential indicators that can be measured to assess them; and collaborative workshops and expert opinion. This process incorporated views of experts, and was vital in the identification of key attributes and indicators of ecological integrity.

3.7 Data Analysis and Presentation

The GPS points collected in form of latitudes and longitude were downloaded, entered in Ms-excel, converted to decimal degrees and exported to Geographical Information System (GIS) software ArcView version 10.31 for map production. The household survey data was entered in MS-Excel, summarized, cleaned, and collated using Statistical Package for Social Sciences (SPSS version 22). Data were analysed using descriptive statistics, measures of variability, and inferential statistics. Socio-demographic data were analyzed by age, sex, education level and location. The data generated by objective one (long term wildlife monitoring) was obtained from document review and park staff. This data included information on the population of selected animal species and which was compared and analysed to show population trends over the past four decades. The responses from park staff on the influence of long term wildlife monitoring on policy development to conserve wildlife and biodiversity of the protected areas were analysed using the Pearson Chi-square test. The data generated by objective two (wildlife corridors) were analysed using the 5-point Likert scale and Kruskals-Wallis Analysis of Variance (ANOVA). The data generated by objective three (community-based conservation) was analysed using Kruskal-Wallis Analysis of Variance, Pearson Chi square test and Spearman's rho correlation coefficient (rho). The data generated by objective four (threats and threat redcution) was analysed using the threat reduction assessment tool, Spearman's rho correlation coefficient, and one-way Analysis of Variance. The Internal consistency and reliability of responses on all the objectives were determined using Cronbach's alpha coefficient (α).

Specifically, Kruskal-Wallis Analysis of Variance (ANOVA) was used to test whether there were significant differences in responses on changes in wildlife corridors and community participation in conservation of biodiversity in the different wildlife protected areas. The Pearson Chi square (χ^2) test was used to compare statistical differences in responses among respondents. The Spearman's rho (ρ) correlation coefficient was used to establish socio-demographic factors that influence community perception of wildlife conservation**.** Other factors analysed included length of residence of the respondents in the area neighboring the park, the approximate distance of the household to boundary of the park, and the land holding. The reliability of the questionnaire was determined using the Cronbach's alpha coefficient (α) and the scales' reliability ranged from 0.58 to 0.82 in all the communities. These reliability results were all acceptable as the recommended value for α was 0.76 for all the measures, which fitted well with the results. Also, the Analysis of Covariance (ANCOVA) was carried out to control the variation attributed to extraneous variables through statistical analysis and the results showed $F(1) = 0.811$, $p = .0369$, $\alpha = 0.05$. Thus less than 0.811% was due to chance (sex of participant as a confounding variable). Finally, the results were presented in tables, and graphs. The data on distribution of selected animal species obtained from document review were also compared and analysed to show the animal population distribution.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents analysis of findings from both primary and secondary sources, and discussion. To assess and measure ecological integrity at each objective, it was useful to compare the results (current state of ecosystem components) with desired states through the use of benchmarks or reference points. Objective one (long term wildlife monitoring) was assessed by comparing the legal and policy regimes on wildlife management before 1999 (the reference year when ecological monitoring policy was developed and implementation started on) with the current state (2019), that is over a period of 20 years of implementation, and assess their contribution towards influencing policy development to conserve biodiversity and ecological integrity. Objective two (changes in wildlife corridors) was evaluated by comparing the intactness of vegetation (Langdale-Brown et al., 1964) in wildlife protected areas and stepping stone habitats in the 1960s as a reference period with the trends in vegetation change up to 2015. Then, objective three (community-based conservation) was assessed with reference to the conclusion by Mugisa (2002) that “CBC was implemented for more than ten years in Uganda … but the results indicate that CBC as an approach to PAs’ management has not performed as expected”. Mugisa added that “the poor performance was due to the prevailing social and economic conditions … and the shifts of attitudes and behavior among people can take a relatively long time, and the time span of 10 years, could still be too early to detect widespread changes in the population". Finally, objective four (threats and threat reduction) was analysed by taking stock of threats in the wildlife protected areas during the 1980s and comparing them with the present threats and threat reduction level, and relating them with population of selected migratory animal species.

4.1 Analysis of Response Rate and Descriptive Statistics

A total of 482 questionnaires were issued to the respondents mainly park staff and households in communities adjacent the case study protected areas (Fig. 4.1), and 416 usable questionnaires were returned, indicating 86.3% response rate.

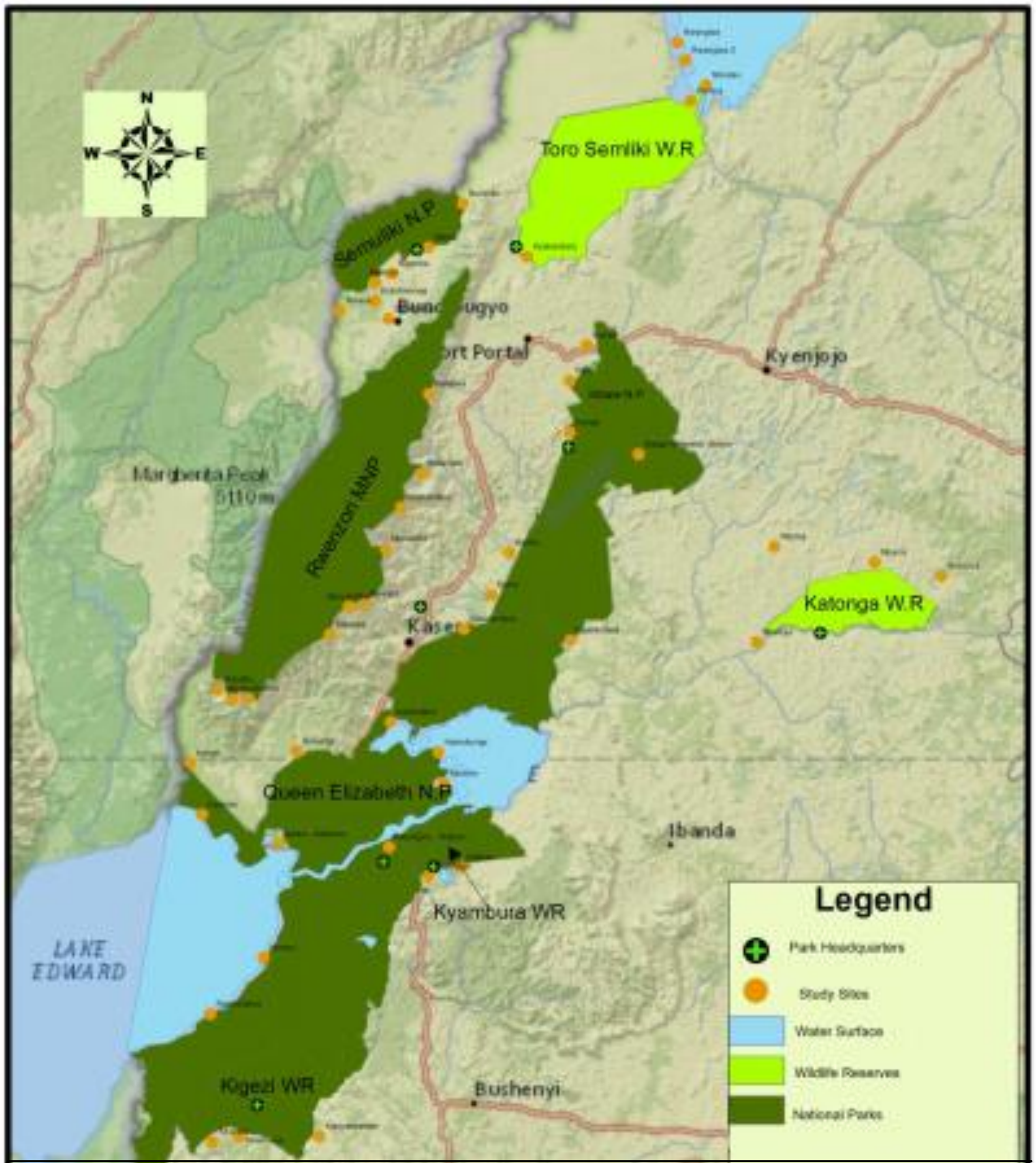

Fig 4.1: Map of Kibale and Queen Elizabeth Conservation Areas showing Location of Respondents

4.2 Inferential Analysis

4.2.1 Long-term wildlife monitoring and policy development

The study under objective one investigated how the long-term wildlife monitoring influences policy to conserve the ecological integrity of PAs in the conservation areas using document review and FGDs. The following findings were obtained:

4.2.1.1 Indicators for monitoring

The study revealed that the wildlife protected areas had an ecological monitoring and research program guided by the conservation values, management purpose, management zone and management programs. Wildlife monitoring was done primarily in-house by the protected area staff (Fig 4.2), and rarely through co-operation with other agencies, academic institutions, co-operative projects with NGOs, and contracting out to consultants and/or freelance researchers (χ^2 (4, N = 81) = 15.523, p = .000, α = .05, α = .05, V=.526) where V is Cramer's value.

The ecological monitoring and research in the wildlife PAs use on-the-ground monitoring which is a feasible approach, and rarely uses remote sensing (such as through satellite data) which is a cornerstone for wildlife monitoring and traditional knowledge. A combination of both approaches is needed to verify data, and to monitor ecosystem conditions where either approach cannot be used alone to capture other aspects such as water quality, which would improve wildlife monitoring. Also, park management in both conservation areas did not involve communities in wildlife monitoring yet this would present an opportunity for indigenous knowledge which would contribute not only attitudinal change of communities towards wildlife PAs but also to sustainable management and conservation of wildlife.

Fig 4.2: Monitoring for wildlife (Field photo, 2019)

Monitoring wildlife was based on two categories of indicators: 1) the ecosystem category indicators which measure changes occurring directly within the habitats; and 2) the human category indicators which measure changes directly linked to human presence in the ecosystem. (Table 4.1) These indicators mainly targeted animal species (their health, population density and distribution, and behavior), exotic and invasive alien species (identification and minimally pilot restoration in degraded areas), fires, poaching and illegal wildlife trafficking, and illegal activities (un-authorized resource off-take, grazing, and fishing). The Long-term Wildlife Monitoring is based on ecosystem category, and human category indicators which measure changes occurring directly within the habitats, and changes directly linked to human presence in the ecosystem respectively.

Table 4.1: Monitoring Indicators

Threat	Monitoring parameter	Indicator	Method(s)	Frequency
Poaching	Frequency of poaching incidences; large mammal population size; extent of poaching; origin of poachers	Number of poachers arrested; number of prosecutions; population sizes of key species; density of key species; number of snares and carcasses per km; number of armed exchanges with poachers; number of reports of poaching activities; mammal density	Ground truth monitoring; remote sensing monitoring	Periodically
Fire	Incidences of fire; extent of fire; vegetation change; vegetation	Number of fires; area burnt and its location; habitat area on satellite/aerial images increased; number per	Ground truth monitoring; remote sensing monitoring	Periodically

	regeneration	unit area of trees, poles, saplings		
Human Wildlife conflict	Community attitudes and behavior towards the PA and control measures; sites where raiding/ injuries occur	Number of animals or people injured or killed; number of park-related projects that people have volunteered to participate in	Ground truth monitoring	Periodically
Resource harvesting	Quantities harvested; incidences of illegal activity in multiple use zone	Number of bundles (or whatever unit is appropriate) per harvest day per licensed person; number of illegal activities encountered per km walked	Ground truth monitoring; remote sensing monitoring	Periodically
Road kills	Incidences of road kills; incidences of illegal fishing	Number of animals killed; number of people arrested	Ground truth monitoring	Periodically

Climate change	Impacts of climate change; vegetation changes; weather data; glacier and snow recession; water quality and quantity of rivers	Habitat size, density, distribution & diversity including gap distribution, tree density, species diversity, gap size; area in Kms	Ground truth monitoring; remote sensing monitoring	Periodically

(Adopted from UWA, 1999)

However, this study identified more indicators which include: baseline information on natural ecosystem processes (such as hydrology), abiotic components (non-living chemical and physical factors in the environment, geology, and soils), other biotic components such as vegetation, birds, etc. Stressors such as climate change (except in Kibale National Park, and Rwenzori Mountains National Park) that pose a threat to the ecological integrity of the protected areas needed to be included as well. Socio economic data should be captured. The human component indicators of landscape spatial organization (infrastructure density, fragmentation and periphery land use), park boundary status, and infrastructure (paths) were sparingly captured in the monitoring plans. Other indicators not captured were: non-indigenous plant propagation, environmental disturbance, and restoration of degraded sites. In addition, other water quality parameters including benthic faunal quality, bacterial and physical-chemical stream water quality, acidity level and trophic level were not considered. The wildlife agency only puts emphasis on mammal population monitoring, through appropriate protocols, such as point-counts or line transect surveys, and very little on habitat monitoring where key attributes of habitat, such as vernal pools in different ecosystems. No inventory of plant resources and their distribution within the park, and vegetation change exists. Therefore, gaps still remain in baseline data on park ecosystems and processes. The program was still inadequate in capturing data on ecosystem health including the components, ecological processes or functions to be able to determine the condition and effectiveness of the wildlife protected areas.

The wildlife monitoring indicators provide up-to-date information for planning, decision-making and evaluation in biodiversity conservation and sustainable management of wildlife resources. This wildlife monitoring supports the wildlife agency to pursue its mission by providing broadly based, scientifically sound information on the state of the protected area system and the impact of management (UWA, 2018). Uganda Wildlife Authority carries out periodical surveys of medium - large mammals using both aerial and ground count methods to establish species' population trends and distribution patterns in the country (UWA, 2018), which information guides decision making. The indicators for wildlife monitoring identified in this study are similar to those monitored by other researchers in some parts of the World (Sadaula et. al., 2019; Fancy et. al., 2009). In Nepal, population monitoring is being done for few wildlife species only although monitoring of other species is also important for making proper conservation plan and such studies provide strong recommendations to community persons, leaders, conservation NGO/INGO, and government bodies to prepare the future action plan strategies about the conservation and monitoring of flagship endangered wild animal species at protected areas (Sadaula et. al., 2019). In the United States, the National Park Service indicated that a long-term ecological monitoring program provides information on the status and trends of selected park resources as a basis for making decisions and working with other agencies and the public for the long-term protection of park ecosystems (Fancy et. al., 2009).

4.2.1.2 Key conservation policies and laws developed to protect the integrity of protected areas

The responses of park staff on the question "Does the long-term wildlife monitoring program influence formulation of policies to protect ecological integrity of the protected areas" revealed statistically significant Pearson Chi-square result, χ^2 (1, N = 81) = 297.1, p = .000, α = .05, V = .342 (Appendix I) and the high value (V) shows a strong influence that the long-term wildlife monitoring program has on formulating policies to protect ecological integrity. In addition, responses from the park staff on the question of "What influence does the long-term wildlife monitoring program have on policies to conserve biological diversity and ecological integrity of the protected areas", 57% of the respondents indicated improved planning, management decision making and improvement in conservation of ecological integrity, 29% indicated that it mainstreams the wildlife PA operations and provide information to the national agency, 12% indicated that the information generated informs the conservation agency of its appropriateness/relevance and need to adapt wildlife management approaches (N = 81) (Fig. 4.3).

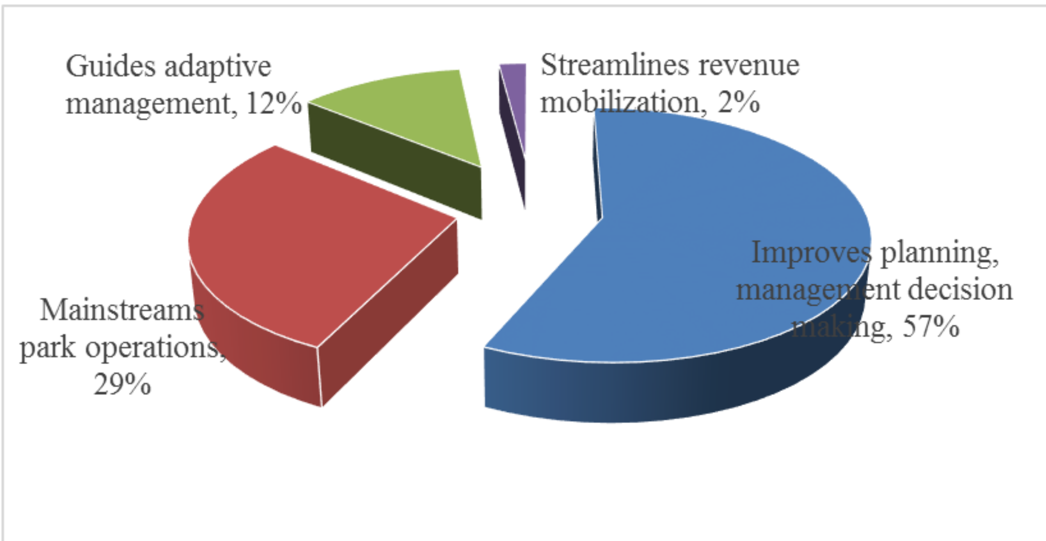

Fig. 4.3: Effect of wildlife monitoring information on policy development to protect ecological integrity

Long-term Wildlife Monitoring contributes to biodiversity conservation through improved planning and management decision making; mainstreaming wildlife PA operations and provision of intelligence information to the national agency, informing the conservation agency of its appropriateness/relevance and need to adapt wildlife management approaches; and streamlining revenue mobilization to finance management and conservation of wildlife.

From document review, FGDs and interviews with PA employees, the following policies, were formulated with guidance of reports of the wildlife monitoring program:

The merger of Uganda National Parks and the Game Department. Uganda National Parks and the Game Department were merged into Uganda Wildlife Authority (UWA) in 1996 by an Act of Parliament. This merger was due to duplication of roles by both government agencies (Uganda National Parks and the Game Department) in the management of wildlife, and also the Game Department had failed to manage wildlife outside national parks. This was informed, in addition, by reports of wildlife monitoring generated by Uganda National Parks. The merger was done to ensure sustainable management of wildlife and coordinate, monitor and supervise activities related to wildlife management and provide guidance for the management of Community Wildlife Areas and Wildlife Sanctuaries. The merger also brought in and recognized management of wildlife outside the protected areas and participation of park adjacent communities in conservation activities.

The shift in the national institutional arrangements to integrate local interests in the wildlife legislation. The Uganda Wildlife Authority (UWA) is charged with the responsibility of, inter alia, ensuring the sustainable management of wildlife. Significantly, the Wildlife Policy (1994) (later revised in 2014) laid the basis for the wildlife law in Uganda with a mission of “conserve in perpetuity the resources within the National Parks and other wildlife areas to enable the people and the global community to derive ecological, economic, and aesthetic and education benefits from wildlife”. Further, the Uganda Wildlife Act cap 200 of the Laws of Uganda 2000 (later reviewed in 2019) provides for integrating local interests in the implementation of the wildlife legislation where local authorities are empowered to form wildlife committees to advise on wildlife management and utilization within the local jurisdiction.

The shift from protectionism to conservation as enshrined in the Wildlife Policy 2014. This policy change involved a shift from the traditional state-centric approach of wildlife management to a modern approach involving the people living with wildlife or affected by wildlife legislation. This policy change resulted into stakeholder involvement in the conservation of biodiversity through the community based conservation approach which provides adjacent communities with access and rights over use of selected in-park resources. While people had been illegally exploiting the wildlife resources in the past, the policy gave an opportunity to park adjacent communities to access in-park resources including medicinal plants, firewood, mushrooms building poles, walking stakes; and also participate in wildlife conservation programmes. The policy also enhances benefit sharing through wildlife use rights and promoting public participation in wildlife management. It vests the ownership of wildlife in the government *in trust* for the people, and allows the use of wildlife for cultural purposes by any community. The policy contributes towards promoting the conservation and sustainable utilization of wildlife for the benefit of the people of Uganda; enhancing benefit sharing through wildlife use rights, and promoting public participation in wildlife management.

Formulation of the Revenue Sharing Policy and Guidelines. The Uganda Wildlife Policy (2014) provides for revenue sharing where 20% of the park entry fees collected from a wildlife PA is given to the local government(s) of the areas surrounding such PAs. This policy was formulated with input from the long-term wildlife monitoring program. The goal of revenue sharing is to ensure strong partnership between protected areas management, local communities and local governments leading to sustainable management of resources in and around the wildlife protected areas by enabling people living adjacent to wildlife protected areas obtain financial benefits derived from the existence of these areas that contribute to improvements in their welfare and help gain their support and acceptance for protected areas conservation. The shared revenue is managed by the respective District Local Governments and is used to fund problem animal management, conservation, livelihood and public goods projects decided upon by the beneficiary park adjacent communities.

Formulation of the Community Conservation Policy. Originally, the agency responsible for wildlife management used to protect wildlife in isolation of other parties. With the birth of the Community Conservation policy in 2004, whose goal is to strengthen conservation of wildlife resources through sustainable and equitable distribution of conservation benefits and/or costs among all stakeholders, there was a paradigm shift in conservation. This policy provides for collaborative management arrangements and partnerships, benefit sharing and community-based tourism management with local communities, local governments, private sector and others for wildlife resource sustainable management. In addition, collaboration with other agencies including the security agencies—army and tourism police—in the conservation of the biodiversity has supported the law enforcement department to combat armed poaching in wildlife protected areas. This policy, whose formulation was guided by the periodic wildlife monitoring reports, has strengthened collaboration of park management with other players including local communities.

Formulation of the Research and Ecological Monitoring Policy. The Research and Ecological Monitoring Policy of 1999, a new policy reform, mandates UWA to carry out ecological monitoring and research in the wildlife PAs. This policy emphasizes research and ecological monitoring as a key strategic program to support decision making, and was formulated with input from the periodic wildlife monitoring reports to strengthen ecological monitoring in the protected areas.

Elevation of conservation status of wildlife protected areas. The elevation of wildlife protected areas to higher status of conservation, was guided by the periodic wildlife monitoring reports. During this study it was revealed by park staff that processes were underway to elevate Toro-Semliki Wildlife Reserve to a National Park status as guided by the periodical wildlife monitoring reports, among others.

Review of the Wildlife Act cap 200 of 2000. The reduction in elephant population as revealed by the wildlife monitoring reports, and the increasing cases of armed poachers, among other factors, caused revision of provisions in the Wildlife Act to include formulating stringent and deterrent measures to control illegalities, hence influencing policy. In addition, introduction of a section into the wildlife law on compensation of loss occasioned by wild animals escaping from wildlife protected areas was another development premised, among others, on the emerging issues including human wildlife conflict, and revelations by the wildlife monitoring reports. The compensation issue was critically examined with a view i) to provide for compensation of the loss occasioned by wild animals escaping from wildlife protected areas and this would be premised on mitigation for loss of property to wildlife, ii) to provide for clarification of the extent of liability of UWA in regard to wildlife induced damage and conservation area land ownership, and iii) to strengthen an effective mechanism for management of wildlife outside protected areas by providing for broader structures particularly community structures for management of wildlife outside PAs.

These policies and laws developed show that long-term wildlife monitoring information influences development of policies and laws to conserve biodiversity. Generally, the policies and laws contribute towards promoting the conservation and management of wildlife for the benefit of not only the people of Uganda but also the world over. Specifically, these polices and laws have strengthened benefit sharing through promoting wildlife use rights and public participation in wildlife management, and also provided guidance for the creation and management of

Community Wildlife Areas. In addition, they have contributed towards livelihood and public goods projects decided upon by the park adjacent communities through implementing the revenue sharing scheme. As a result of implementation of these policy and institutional changes, PA staff intimated that there was reduction in overall illegal activities.

These findings support the first hypothesis that long-term wildlife monitoring program influences development of conservation policies to conserve biodiversity and protect ecological integrity of PAs. This agrees with MTWA (2014b) that policies guide conservation and management of the environment, strengthening benefit sharing and promoting local participation in wildlife management. Further, the policies have guided creation and management of Community Wildlife Areas, deciding livelihood and public goods projects through implementing the revenue sharing scheme, and reduction in overall illegal activities. These findings agree with related studies on ecological monitoring in Tanzania where Robinson et al. (2018) asserts that effective monitoring is essential to inform appriate management and enable better conservation outcomes for the most vulnerable species and ecological communities. Studies in Central Africa by Starkey et al. (2014) indicate that ecological monitoring is an essential part of adaptive management, and is necessary for evaluating the outcomes of conservation action. In other regions of the World, data from monitoring have substantial value for detecting relationships between management actions and animal populations (Pollock et al., 2002) and should provide direction regarding future management decisions (Nichols & Williams, 2006; Kendall & Moore, 2012). Achieng et al. (2023) underscore the importance of establishing monitoring programs focusing on biodiversity-ecosystem linkages in order to inform evidence-based decisions in ecosystem conservation and restoration in Africa.

4.2.1.3 Long-term wildlife monitoring and new conservation initiatives

Over the past two decades, conservation of wildlife resources in Uganda had seen a number of new conservation initiatives. This was revealed by the responses of park staff on the question "Over the last one or two decades, have you participated in developing and implementing any new conservation initiative(s) to protect ecological integrity in Uganda?" The responses indicated statistically significant Pearson Chi-square result, χ^2 (1, N = 81) = 7.247, p = .000, α = .05, V = .370. (Appendix I) The initiatives developed include:

Adoption of Spatial Monitoring and Reporting Tool (SMART) in conservation. The use of SMART approach started in 2014 in the PAs and covers three areas: software, capacity building and site-based protection standards. This tool uses icons to represent animals and threats in a SMART configured data model. SMART is a site-based approach to monitor, evaluate and improve the effectiveness of conservation management through monitoring wildlife, mapping poaching and trafficking hotspots and other threats, and helping in reporting by ranger teams. The adoption and use of SMART in data collection in the wildlife PAs guides identification of areas for adaptive management, wildlife distribution, documenting trends of illegal activities and prosecuting of offenders in Courts of

Law (as the tool provides evidence of where the wildlife offence was committed), and park management planning and decision-making.

Adoption of the SMART Tool in conservation plays a major role in adaptive management including data collection by rangers, data entry, analysis and report, debriefing and strategic planning. Rangers use this tool to capture data on threats in close to real time, and transmit the information to the head office. This allows the head office to deploy rangers in response to the information hence mitigating the threat. The tool strengthens planning, management decision making and operations, and also ensures clear flow of information to the wildlife agency which all contribute to improved biodiversity conservation. This tool helps ascertain the state of wildlife resources in the wildlife protected areas, provide scientific and management oriented information for planning, better understanding of the ecological and social economic dynamics, and also enable development of management strategies for sustainable wildlife management. SMART has been widely adopted to monitor law enforcement efforts and allow adaptive management in the conservation of wildlife resources (Kuiper et al., 2020; Lynam et al., 2016). While data from SMART informs law enforcement locally, it has also been relevant to the global conservation of several endangered species (Gray et al., 2018; Hoette et al., 2016). Analysis and use of SMART data collected strengthens planning, management decision making and operations, and also ensures clear flow of information to the wildlife agency which all contribute to improved conservation of ecological integrity.

Ascertain the state of wildlife resources. The documents reviewed, and FGDs with park staff from both conservation areas, revealed that census of wildlife resources had not been carried out in all the wildlife protected areas in the landscape. Inadequate data exist on the population of wildlife resources in the Rwenzori Mountains National Park and Semuliki National Park. Therefore, the state of wildlife resources was incomplete. The state of wildlife resources in the wildlife conservation areas provide scientific and management oriented information for planning, better understanding of the ecological and social economic dynamics, and also enable development of management strategies for sustainable wildlife management. The state of wildlife resources establishes the state of ecosystems, wildlife habitat health, species diversity, and abundance and distribution patterns within protected areas (UWA, 2018a).

Basis for adaptive management. On what measures park management employs to conserve biodiversity, the park staff indicated i) adoption of sympathetic/modified management practices around/adjacent to protected areas to reduce/mitigate external stresses (74%); and ii) use of monitoring and adaptive management in the wildlife protected areas (26%). The habitats under adaptive management through restoration activities were recorded in Kibale National Park, Queen Elizabeth Protected Area and Rwenzori Mountains National Park. The restoration initiatives include tree growing with indigenous trees namely *Spathodea campanulata, Erythrina abyssinica, Bridelia micrantha* and *Prunus africana* which was evident inside Kibale National Park and along the boundaries of Rwenzori Mountains National Park; and eliminating through uprooting of hyper-abundant species such as *Dichrostachys cinerea,* and *Lantana camara* that threaten biodiversity conservation, and ecological integrity of the park ecosystems. Wildlife monitoring helps identify sites within the park and along the park boundary that need restoration. This agrees with Roux and Foxcroft (2011) that monitoring aims at generating scientific and management oriented information and is the basis for adaptive management and better management, and UWA (2013) adds that monitoring information is necessary to be able to adapt to the changes and modify conservation strategies. Schoenefeld and Jordan (2017) also report that monitoring results used to inform decisions about environmental management in order to fulfil the adaptive management cycle.

Opening and demarcation of park boundaries. Park management engages in securing park boundaries through planting concrete pillars and live marks. In 2002, park management jointly with the local communities opened boundaries of PAs, and in 2005 concrete pillars were planted—an effort to address the park boundary conflict—and this development was informed by the periodic monitoring of wildlife and park boundaries. Opening park boundaries helps minimize boundary contentions between park management and the park adjacent communities.

Restocking wildlife protected areas. Restocking wildlife protected areas is done through translocation of wild fauna from one wildlife protected area to another as guided by the periodical wildlife monitoring and animal census reports. For instance, in 2013, a total of 90 Impalas and 6 zebras were successfully translocated to Katonga Wildlife Reserve (UWA, 2013b). Such decisions on translocation of animals help to control numbers where populations are high and to boost numbers where they are low, and also improve tourism.

Mitigate wildlife crime and trafficking. New units that address wildlife crime and trafficking have been established. The use of the canine unit (one of the new units) was introduced in Uganda in 2016 to mitigate wildlife crime and trafficking. The canine unit uses sniffer dogs as a tool to sniff out wildlife contraband and provide evidence that the product is an actual specimen wildlife contraband (some of which include ivory, pangolin scales, hippo teeth and rhino horns), and such evidence is used to facilitate effective prosecution of wildlife cases. Other new technologies for curbing illegal activities and managing park resources are use of drones, forest alerts; and employing e-governance—use of emails, telephones, twitter, skype, etc. This conservation initiative builds and strengthens capacity of the wildlife agency to detect and investigate poaching, wildlife trafficking and related crimes. Adoption of appropriate technological surveillance tools to monitor animal populations, combat poaching and wildlife trafficking is a key effort that supports conservation.

Other conservation initiatives. The FGDs held with park staff revealed that the wildlife agency developed other conservation initiatives mainly landscape approach to management of wildlife including transboundary management of wildlife resources, community involvement and stakeholder participation in conservation work, adoption of the community conservation education and awareness strategy, and developing a monitoring and evaluation tool and standard report writing tool for the organization. The initiatives developed strengthen conservation efforts in the country.

4.2.1.4 Innovative conservation policy areas for consideration into future policies and strategies to further enhance biodiversity conservation

The study identified innovative conservation policy areas which needed to be captured to develop future policies and strategies that could further enhance biodiversity conservation, (χ^2 (1, N = 81) = 9.351, p = .001, α = .05, V = .416). (Appendix I) The identified innovative conservation policy areas that would further enhance biodiversity conservation include:

Integration of ecosystem health into wildlife monitoring. The findings of this study indicated that the wildlife monitoring program only considered ecosystem drivers (for instance human pressures such as poaching, disturbances e.g fires), threats (for instance illegal resource harvesting), animal populations (trends, distribution, and health e.g presence/absence of zoonotic diseases), and miniature on extent of spread of exotic and invasive species. Wildlife monitoring remains inadequate without inclusion of ecosystem health into the monitoring program. This policy area would capture information on natural ecosystem processes, abiotic components, climate change aspects, human component indicators of landscape spatial organization, and socio economic data. Monitoring program should consider ecosystem or landscape-scale paradigms which emphasize ecological processes (e.g. nutrient cycling) and habitats rather than individual species (Franklin, 1993), and biological diversity is best preserved by maintaining healthy ecosystems (Bourgeron & Jensen, 1993). Studying ecosystem health will contribute to scientific knowledge and make significant progress towards the preservation of existing biodiversity. This would assess the condition of the protected area (condition monitoring), and the success of ecosystem maintenance and restoration initiatives (effectiveness monitoring). Wildlife monitoring should look at detecting ecosystem health in terms of trends in the components, processes or functions and to provide early warning of situations that require interventions (Noss, 1990a); and that long-term wildlife monitoring program is used to track the overall condition or "health" of park natural resources (Davis, 2005).

Community involvement in wildlife monitoring. From the FGDs with park staff, park management does not involve local communities in wildlife monitoring across the wildlife PAs in both conservation areas. Involvement of local communities in wildlife monitoring would present an opportunity for indigenous knowledge into wildlife monitoring which would not only create attitudinal change of communities towards the PAs but also contribute towards sustainable management and conservation of wildlife. According to Springer (2005), participation in wildlife monitoring provides concrete opportunities for indigenous people to be heard by the park authorities and for the authorities to benefit from indigenous knowledge, and the indigenous community members report immediately and directly to the protected area head and rangers on matters such as violations of resource use regulations by outsiders.

Management (including monitoring) of wildlife outside protected areas. Uganda's wildlife resources occur in and outside PAs. From existing literature and focus group discussions, the status of biodiversity outside the PAs is not known for most species as they are not monitored. Therefore, this biodiversity constantly suffers negative impacts as communities exploit them for livelihoods. The management of forest reserves, wetlands and forests on private land focuses more on flora, ecological and socio-economic functions with limited regard to wildlife/fauna conservation. The policy and legal mechanisms for wildlife conservation outside the protected areas remain weak. Therefore, management of wildlife outside protected areas—a policy area—would enable the country protect wildlife resources outside PAs. It is estimated that over 50% of Uganda's wildlife resources still remain outside designated protected areas, mostly on privately owned land; and is of most urgent concern for protection and development (UWA, 2014). These wildlife resources depend on the individual owners of land since the existing land tenure systems (freehold, customary and lease) do not provide for maintenance of habitats and conservation of biodiversity and this leaves them vulnerable to various threats including hunting and other unsustainable harvesting methods and practices (UWA, 2014). Routine monitoring on ecological and socio-economic dynamics on wildlife outside wildlife protected areas to generate information for decision making has been prioritized (UWA, 2020).

Establishment and management of biological corridors. Establishment and management of biological corridors between wildlife protected areas had not been captured as revealed from the key informant interviews. This is a key policy area that would enable establishment and management of biological corridors to create connectivity between protected areas for effective protected area system as well as facilitate animal migrations across the landscape.

Payment for Ecosystem Services. From the key informant interviews conducted, the Payment for Ecosystem Services (PES)—a strategic initiative to finance conservation—was not captured in the existing policy and legal framework. The PES scheme has both short term and long term benefits. The short term benefits include: a) capacity building of local communities to get engaged in park management through the taungya system, setting up apiaries along the park boundaries to reduce on human wildlife conflicts, and b) through sustainable land management interventions, enhance crop yield and fertility creating income generating opportunities and benefits for the local communities, reducing soil erosion (which improves the water quality within the ecosystem—an ecosystem service). In the long term, water quality, quantity and reliability would be assured as vegetation cover increases; and flora and fauna population would also increase. The PES scheme should be considered a key policy areas for inclusion into the legal and policy framework to further enhance conservation of biodiversity and ecological integrity.

Regulating development of tourism infrastructure inside the PAs. Specifically, on the question of whether "increasing development of tourism infrastructure inside wildlife PAs conflict with conservation of biodiversity", the results revealed statistically significant responses from park staff, (χ^2 (1, N = 81) = 35.314, p = .000, α = .05, V = .858, (Appendix I), and this value (V) shows a very strong effect. For instance, trails constructed in the parks interrupt the wildness and pristineness of the wildlife protected areas. Increase in tourism volumes and associated development of tourism infrastructure inside the wildlife protected areas affect conservation of biodiversity and ecological integrity as they pose serious negative impacts on wildlife preservation and conservation. The increase in tourism infrastructure development inside the wildlife protected areas interferes with the wildness, naturalness and pristineness of the wildlife PAs through littering—which generates wastes in the pristine environment raising a social concern—, and also interrupt the animal migratory routes. Therefore, fomenting tourism in wildlife protected areas increases vulnerability to social and ecological degradation. The growth of interest in sustainable tourism and ecotourism reflects a rising tide of social concern about the quality of the natural environment and the effects of tourism (Tourism Canada, 1995). This policy area would ensure that tourism infrastructural development is regulated, without interfering with the pristineness and naturalness of park environment, and interrupting animal movements.

4.2.1.5 Challenges affecting the success of the long-term wildlife monitoring

From the FGDs, the approach to wildlife monitoring was the same across all national parks and wildlife reserves in both conservation areas. This approach faces a number of administrative constraints that include: inadequate gadgets for monitoring, inadequate financial resources, inadequate staff, and inadequate skills in GIS/remote sensing. In addition, challenges of weather, remoteness and large geographic areas of the wildlife PAs also constraint developing a functioning ecological monitoring system.

These findings under objective one support the first hypothesis that long-term wildlife monitoring program influences development of conservation policies to protect ecological integrity of protected areas in Kibale and Queen Elizabeth Conservation Areas as evidenced by policies formulated with input from park monitoring reports.

4.2.2 The wildlife corridors and ecological integrity

The second objective assessed the changes in wildlife corridors, and their effects on the ecological integrity of the PAs. The study, through the Nature Conservancy's Conservation Action Planning (CAP) methodology, the wildlife corridors (Fig. 4.3), their key conservation targets, their key ecological attributes, critical threats were identified, and then conservation strategies developed.

4.2.2.1 Changes in wildlife corridors and their functionality

4.2.2.1.1 Wildlife corridors and their ecological attributes

This study revealed a total of 20 wildlife corridors in the Kibale and Queen Elizabeth Conservation Areas (Fig 4.4) which provide connectivity that enables animal migrations. Most of the corridors cross land that has been or are likely to be converted.

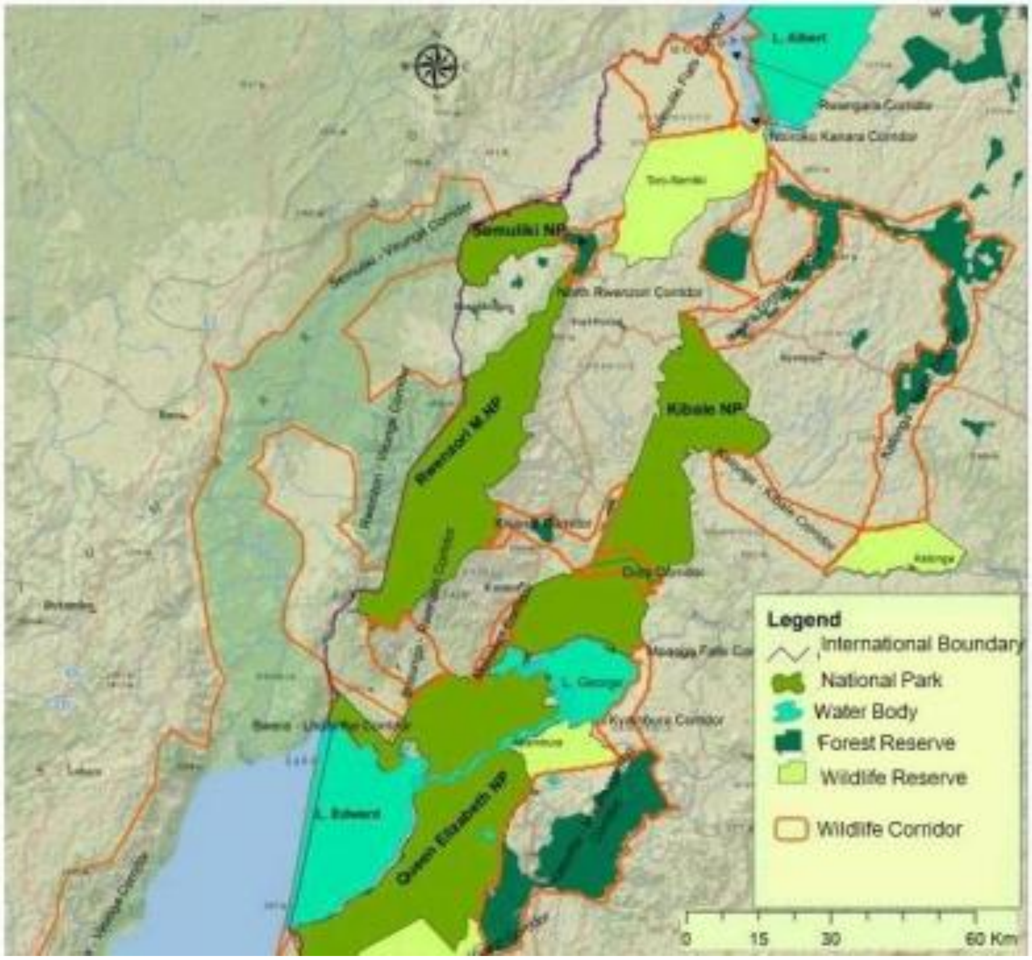

Fig. 4.4: Map showing Location of Wildlife Corridors in Kibale and Queen Elizabeth Conservation Areas (NP-National Park, WR-Wildlife Reserve)

The corridors are priorities areas for conservation of migratory mammal species. The key ecological attributes (Table 4.2) of the wildlife corridors to the migratory animal populations are that the corridors offer migration routes, safe havens for security, seasonal food and water sources, habitats for mammal population size and reproduction rate, and genetic variability.

Table 4.2: Wildlife Corridors and their Ecological Attributes

Name of corridor	**Protected areas they connect**	**Wildlife that use them**	**Ecological attributes**
Kalinzu-Kigezi corridor	Kalinzu Forest Reserve, Kigezi Wildlife Reserve and the southern part of Queen Elizabeth National Park	Chimpanzees and Elephants	The forest reserve, wildlife reserve and the park were linked. Migratory route.
Kasyoha-Kitomi/ Kalinzu-Maramagambo (Kasyoha-Maramagambo) corridor	Queen Elizabeth Protected Area, Kasyoha-Kitomi Forest Reserve and Kalinzu-Maramagambo Forest Reserve	Chimpanzees, Elephants, Wild Pigs, Duikers, Striped Jackal, Serval Cats, and Jennets	Existence of grassland. The forest reserve, wildlife reserve and the park were linked. Migratory route
Kyambura-Kasyoha-Kitomi	Queen Elizabeth	Elephants, Chimpanzees	The forest reserve, wildlife reserve and the park were

corridor	National Park, Kyambura Wildlife Reserve, Kasyoha-Kitomi Forest Reserve	and Birds	linked. Migratory route
Kyambura Gorge-Kasyoha-Kitomi corridor	Queen Elizabeth National Park	Chimpanzees, Lions and Bird Life	Savanna vegetation. Dense riverine forest and a fast flowing Kyambura River which pours into the Kazinga Channel amidst a papyrus swamp. The gorge is a home to chimpanzees, lions and bird life. Migratory route Kasyoha-Kitomi Forest reserve and Kyambura Wildlife Reserve were linked. Availability of food and water sources to the diverse fauna. Existence of safe havens for security of the wild fauna

Mpanga Falls corridor	Kibale	Cycads (*Encepholartos whitelockii)*	Critical site for conservation of Cycads
Kibale-Queen corridor	Queen Elizabeth Protected Area and Kibale National Park	Elephants	It's part of the Lake George Ramsar site. Varied habitats mainly grassland, swamp forest, woodland and bushland. Migratory route. Safe havens for security. Genetic variability. Provides food and water sources for wild fauna.
Kisangi corridor	Kibale National Park and Rwenzori Mountains National Park	Elephants and hippos	Links the western part of Kibale National Park with the south-eastern part of Rwenzori Mountains National Park through Kisangi forest reserve. Migratory route
Katonga-Kibale corridor	KNP, Katonga Wildlife Reserve, Lake Mburo National Park	Sitatunga waterbucks, hippos, primates and birds	Links KNP with Lake Mburo National Park. Migratory route for elephants. Distinct vegetation types - the open grasslands, riverine grasslands, wooded grasslands, woodlands,

			riverine woodlands and wetland, which enhances the faunal diversity.
Katonga-Matiri corridor	Katonga Wildlife Reserve and Toro-Semliki Wildlife Reserve	Elephants	Links Katonga and Toro-Semliki wildlife reserves through Matiri, Ibambaro, Kitechura, Kagombe and Muhangi forest reserves. Key migratory route
Itwara Forest corridor	KNP to Toro-Semliki Wildlife Reserve	Elephants	Links the northern part of KNP to Toro-Semliki Wildlife Reserve through River Muzizi and Itwara forest reserve. Links the northern part of KNP through a series of degraded small forest reserves of Oruha, Kyehara, Kikumiro, Kibego, Kagona and Muhangi. Migratory route for elephants
Ntoroko-Kanara corridor	Ntoroko-Kanara Wildlife Sanctuary, Rwangara	Elephants, Shoebill Stock	Habitat to the endangered shoebill stork population that breeds in this wetland. Links reserve to DR Congo. Conserves

	Community Wildlife Area TSWR		a fragile and degraded strip of land along Lake Albert. Migratory route for elephants.
Rwangara corridor	Toro-Semliki Wildlife Reserve	Shoebill Stock, Elephants, Buffaloes, Uganda Kob	Link between TSWR and DR Congo. Varied habitats for animal species. Migratory route of wildlife. Wetlands and forests which are breeding grounds for some fauna, watering points for animals, and congregation areas for the game.
Semliki Flats corridor	Toro-Semliki Wildlife Reserve	Kobs and Buffalos	Controlled Hunting Area
North Rwenzori corridor	RMNP, Semuliki National Park and TSWR	Primates mainly Chimpanzees, Black and White Colobus Monkeys, Red Tailed Monkeys, Blue Tailed Monkeys, Baboons and	The forest fragments that link TSWR with Northern part of RMNP and eventually SNP. An extensive network of *Celtis-Chrysophylum,* riverine forest. Habitat to a variety of primates

		Vervet Monkeys	
Semuliki-Virunga corridor (Semuliki-Ituri forest-Virunga corridor)	SNP and Virunga National Park	Elephants, Buffalos, Chimpanzees, Antelopes and Sitatunga	Links the SNP and North Virunga National Park (VNP) through the Ituri forest. A transitional zone between the Congo basin and the East African region forming part of the Guinea-Congo biome. Existence of Ituri forest Link with VNP. Migratory route
Virunga – Rwenzori	RMNP and Virunga National Park	Elephants	Links the western part of the RMNP with the VNP
Ishasha-Virunga	Southern sector of QENP and Virunga National Park	Elephants, topi, the tree-climbing lions and hippos.	Riverine woodland and woody grassland. Link between QEPA and VNP. Provides refuge for animals from DR Congo.
Bwera/Virunga Lhubiriha	QENP and Virunga National Park	Elephants	Mixed wetland, grassland and woodland habitat that support few resident wildlife species. Link between QENP and VNP. Serves as the only protected migratory route for wildlife

			between the two parks. Has food and water sources for the wild fauna. Safe havens for security. Population size of grazing/ browsing species and their reproduction rate. Genetic variability. Species composition and re-generation
Muhokya	QENP and KNP	Elephant, Uganda kob, Waterbuck and Buffalo	Linkage between Dura and Kasenyi. Migratory route for elephants. Key food and water source for the fauna. Safe havens for security. Population size of grazing/ browsing species and reproduction rate. Genetic variability. Species composition and re-generation
Busunga-Rwenzori	QENP and RMNP	Elephants	Link between QENP and RMNP through River Nyamugasani. Migratory route for elephants

(Source: Survey data, 2019)

Generally, the wildlife corridors offer key ecological attributes that enable movement of migratory animal populations within the broader landscape.

Ecological connectivity provides the capacity for the movements of organisms, for gene flow, and for range shifts (Beier et al., 2011; Keeley et al., 2018), and thereby is a key factor in the long-term viability of populations, particularly for animal species (Cushman et al., 2009).

4.2.2.1.2 Wildlife corridors and migratory conservation targets

The key migratory animals in the wildlife corridors, selected for this study, were elephants (*Loxodonta africana*), lions (*Panthera leo*), chimpanzees (*Pan troglodytes*).

The elephants. The corridors of QECA and KCA are priorities for conservation of elephants (*Loxodonta africana*) on account of their status as globally endangered species, their own specific threats from ivory poaching, their role in driving ecological processes within the ecosystem, and the fact that they are charismatic animals that can attract tourism revenue necessary to support conservation activities. The corridors facilitate movement of elephants within the landscape, with primarily a high distribution and abundance around water sources and then access to seasonal food to sustain population size and genetic variability. The elephants heavily use the savanna corridors (which is their principal habitat), and the savanna woodland. They utilise the corridors as important food and water sources and safe havens from poaching. The transboundary Ishasha-Virunga and Bwera/Virunga Lhubiriha corridors played a critical role in enabling elephant populations to escape localised insecurity in both Uganda (in the 1970s) and neighbouring DRC (since the 1990s) and to withstand poaching pressures (UWA, 2008). The key ecological attributes of the wildlife corridors to the elephant population is that the corridors offer migration routes, safe havens for security, seasonal food and water sources; offer habitats for elephant population size and reproduction rate; and genetic variability (Table 4.2).

The lions. The lions (*Panthera leo*) live in the Ishasha/Virunga corridor (within Queen Elizabeth Protected Area). The key ecological attributes of the Ishasha/Virunga corridors in habiting lions include sufficient prey species to the lion population, habitat for the lion population and its reproduction, predator "cover" when hunting their prey through the savanna woodlands and grassland vegetation, enabling their movement into DRC over the Ishasha River which is important for maintaining a healthy population size and range, and source of food for the lions due to the abundance of prey species, such as topi. (Table 4.2)

The Chimpanzees. From the existing literature, chimpanzees (*Pan troglodytes*) live in the forest corridors of Kyambura, Kasyoha-Kitomi / Kalinzu-Maramagambo, Kalinzu-Kigezi, and Kibale-Katonga (UWA, 2008). The key ecological attributes of the corridors to the chimpanzees are that corridors provide a movement route between the forests and Kyambura Wildlife Reserve over the Kyambura River in order to access the fruits in season, to access "fallback" fruiting trees when there is a food shortage; and also ensure genetic variability in the populations. Similarly, the corridors offer habitats for chimpanzees population size and reproduction rate; and genetic variability. The key ecological attribute of the primate populations is conservation of forest bird species.

The wildlife corridors in the landscape present key ecological attributes mainly providing linkage amongst each other, migration routes, safe havens for security, food, water, habitats, animal population size and reproduction rate, and genetic variability that enable migration of animal populations within the broader landscape. Ecological connectivity provides the capacity for the movements of organisms, for gene flow, and for range shifts (Beier et al., 2011, Keeley et al., 2018), and thereby is a key factor in the long-term viability of populations, particularly for animal species (Cushman et al., 2009).

4.2.2.1.3 Changes in the wildlife corridors and Wildlife Populations

Changes in vegetation. The vegetation in the landscape of Kibale and Queen Elizabeth Conservation Areas has remained fairly intact from 1964 to 2015 (Fig. 4.5). The intactness of the vegetation in the wildlife conservation areas was because of sustained management by park management. There are also other factors responsible for this intactness. Specifically, in the Kibale-Katonga corridor with the removal of cattle from Katonga wildlife reserve, the grazing pressure on the vegetation reduced (UWA, 2018b).

However, there is an observed remarkable difference in vegetation outside the wildlife conservation areas with reducing vegetation cover in the central forest reserves and private land over years as manifested in the disappearing greenness. Specifically, the landscape has become less green as seen in the vegetation maps of 1990 and 2015 when compared especially in the forest reserves and private land (Fig. 4.5).

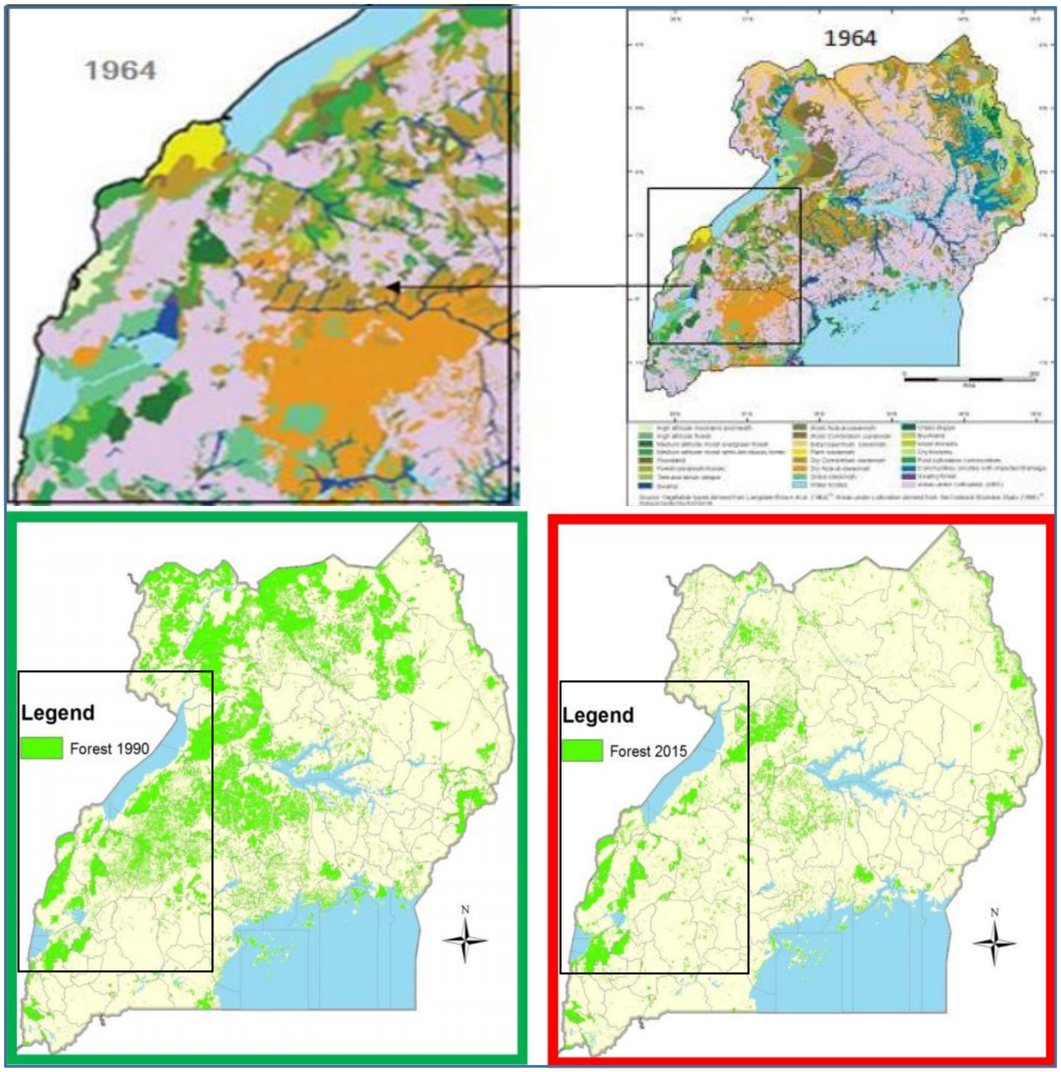

Fig. 4.5: Map showing Vegetation Change in Kibale-Queen Elizabeth Landscape (Adopted from NFA, 2015)

The forest estate has continued to shrink from close to 4.9 million hectares in 1990 to close to 1.9 million hectares in 2015 which is 30% reduction (Table 4.3) —a loss of over half of the forests in a span of 25 years! (MWE, 2016), and the built up land area increased by more than ten-fold in the same period (UBOS, 2014).

Table 4.3: Forest Cover Change in Uganda

Natural Forest (Ha)	1990	2000	2005	2010	2015
Total	4,880,483	4,018,466	3,573,591	2,292,838	1,829,778
On private land	3,319,090	2,546,778	2,177,331	1,046,306	660,986
In protected areas	1,531,394	1,449,688	1,364,260	1,189,532	1,067,793
%age (natural forests on private land)	68%	64%	61%	46%	38%
%age (natural forest in protected areas)	32%	36%	39%	54%	62%

(Adopted from NFA, 2015)

The reduction in vegetation outside the wildlife conservation areas in the central forest reserves and private land over the years was due to human population influx into the forest reserves as a result of non-deterrent laws, institutional weaknesses, greed and corruption, and this vegetation change could affect survival and movement of animal species that are sensitive to habitat change and degradation. Specifically, the Semliki Flats corridor, a Controlled Hunting Area, was heavily settled by communities with large herds of cattle which have led to overgrazing of the area. There were growing populations in the settlement areas of Makondo, Rwebisengo, Nyakasenyi, Kamuga, Katanga, Rwangara, Katolingo, Masaka, Kacwankumu and Budiba leading to loss of vegetation cover (UWA, 2007).

The reduction in vegetation cover could also be due to the negative impacts of climate change. Past studies indicate that the change in vegetation is due to degradation and deforestation as a result of agricultural activities, high demand for forest products, weak law enforcement and policy implementation (Obua et al., 2010); and weak governance in the forestry sector, illegal and unregulated trade of forest products, and the unsecured forest tenure rights (MWE, 2016).

The reduction in vegetation disrupts the continuity and linkage of the animal migratory routes. “Reduced connectivity between habitats exacerbates these threats by increasing the isolation of breeding populations, the likelihood of movement through inhospitable matrix, and the proportion of edge habitat, reducing successful dispersal between suitable habitat patches” (Fahrig, 2002; Bowne & Bowers, 2004); and therefore, an effective habitat corridor provides a continuous, or near continuous, link of suitable habitat through an inhospitable environment (Noss, 1993).

*Changes in migratory animal population*s. The population of elephants has generally increased across the landscape since 2000, an indication that they have remained a cornerstone of conservation of biological diversity. The population of lions has declined over years (Fig. 4.6) as a result of poisoning (Fig. 4.7) and accidental shocks from the electric fence (Fig. 4.8); while that of chimpanzees has not grown. (Fig. 4.6)

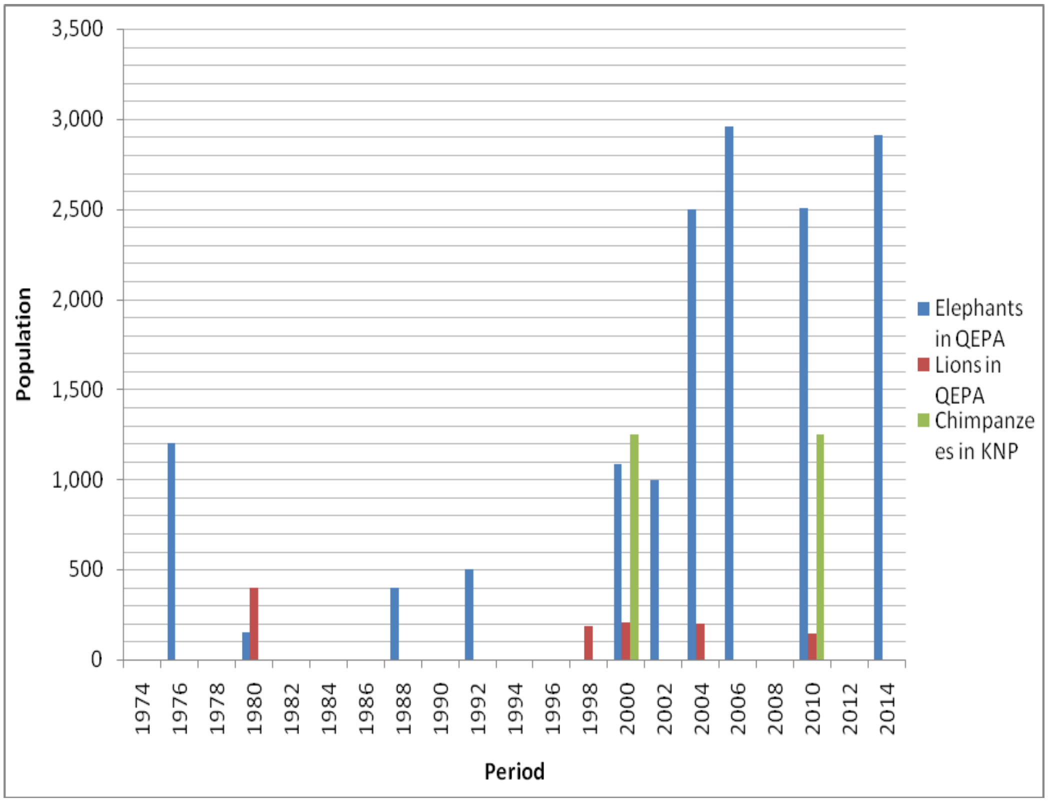

Fig. 4.6: Population Trends of Migratory Animal Populations (Raw data adopted from UWA, 2016a)

The increase in elephant population could be attributed to the existence of wildlife corridors that provide linkage of PAs, migration routes, safety, food, water, and habitats for their sustenance. In addition, development and implementation of the National Ivory Action Plan, recruitment of the wildlife protection force, enhanced patrols by rangers, and increased vigilance and monitoring through deployment of security team at strategic entry and exit points are other factors. However, the decline in lion population could be attributed to habitat loss/degradation, poaching, diseases such as tuberculosis (UWA, 2018a), poisoning (retaliation by pastoralists), and accidents from the electric fence.

Fig. 4.7: Lions poisoned in the Ishasha corridor (Field photo)

Fig. 4.8: Lions killed accidentally by electric fence, Rubirizi in QENP (Field photo)

The population of the Chimpanzees has not grown over the years mainly due to armed poaching, uncontrolled fires, invasive species (especially *Lantana camara)*, and agricultural encroachment which lead to loss of corridor connectivity (UWA, 2018a).

Degradation in corridors leading to reduced corridor width. From the CAP results, most of the wildlife corridors across the landscape were degraded resulting into tremendous reduction in width over the past years. For instance, according to the Community Conservation Ranger at Kyondo Ranger Post, 400 acres of land were curved out of the Kibale-Queen corridor, and as a result, this Ranger Post which was formally inside the corridor now sits on community land. Other corridors whose sizes have reduced include Ishasha/Virunga corridor, Kyambura/Kasyoha-Kitomi corridor, Kibale-Queen corridor and Muhokya corridor. (UWA, 2008). The degradation in corridors was probably due to anthropogenic factors mainly agricultural encroachment, settlement, unclear boundaries, and infrastructure development. Increasing human population puts pressure on the corridors through agricultural encroachment and settlements (Plumptre et al., 2007). This degradation affected especially the larger fauna since they tend to have larger habitat needs—larger ranges for foraging and hunting. The reduction of connectivity from habitat loss and fragmentation can restrict movement of organisms between sub-populations, which can result in decreased gene flow, local extinctions, and loss of biodiversity (Hilty et al., 2006; Haddad et al., 2015).

Loss of connectivity and/ or migratory routes. Some of the wildlife corridors have lost connectivity, for instance, the Busunga-Rwenzori corridor, Muhokya-Rwenzori corridor and the Kisangi corridor (Fig. 4.3) through human activity mainly cultivation. From existing literature, the Katonga-Kibale corridor which used to provide a continuous link from Kibale National Park through Katonga Wildlife Reserve and Lake Mburo National Park to Tanzania has also lost its connectivity (UWA, 2018b). The loss of connectivity could be due to anthropogenic factors mainly severe encroachment through settlements, agriculture and infrastructure development (UWA, 2018b); and natural factors which contribute to reduction in vegetation cover hence affecting the migration of mammals across the corridors. Further, severe encroachment through settlements, agriculture and infrastructure development is a common phenomenon across protected areas (UWA, 2018b). This loss of connectivity affects animal migrations.

Degraded stepping stone habitats. The landscape presents degraded stepping stone habitats [a special type of habitat linkage that facilitate dispersal along a patchwork of isolated habitat patches within a matrix of unsuitable or inhospitable habitat (Runge et al., 2015)] which include forest reserves, and wetlands that connect wildlife corridors. For instance, the central forest reserves of Matiri, Ibambaro, Kitechura, Kagombe which form the Itwara corridor that links Kibale National Park with Toro-Semliki wildlife reserve; and those of Oruha, Kyehara, Kikumiro, Kibego, Kagona, and Muhangi which form the Katonga-Matiri corridor that links Katonga wildlife reserve and Toro-Semliki wildlife reserve have been degraded through cultivation hence disrupting connectivity to the wildlife PAs (Fig. 4.4).

Degradation of the stepping stone habitats disrupts connectivity to the wildlife PAs hence interrupting the animal migratory movements. Degradation of the stepping stone habitats was due to anthropogenic factors mainly agricultural encroachment and settlement. Other studies in other countries indicate that stepping stone habitats are particularly important for migratory species that rest and refuel at stop-over sites between the end-points of their migratory route (Runge et al., 2015).

Community level effects / human population effects. The human population surrounding the Kibale-Queen Elizabeth landscape (Fig. 4.9) which is part of the Greater Virunga Landscape is growing at almost 3% per year. The population density of communities living within a radius of 5 kilometers from the park boundary range between 100 – 500 person/km^2, with higher population densities in the southern section ranging from 500 to over 1000 person/km^2 (GVTC, 2017). This growth has created pressure on the corridors through need for agricultural land, resource off-take, illegal fishing and destruction of fish breeding zones, setting of fires, and poaching which have ultimately degraded the wildlife habitats, and growth in infrastructure development that may result into fragmentation of the landscape (GVTC, 2017).

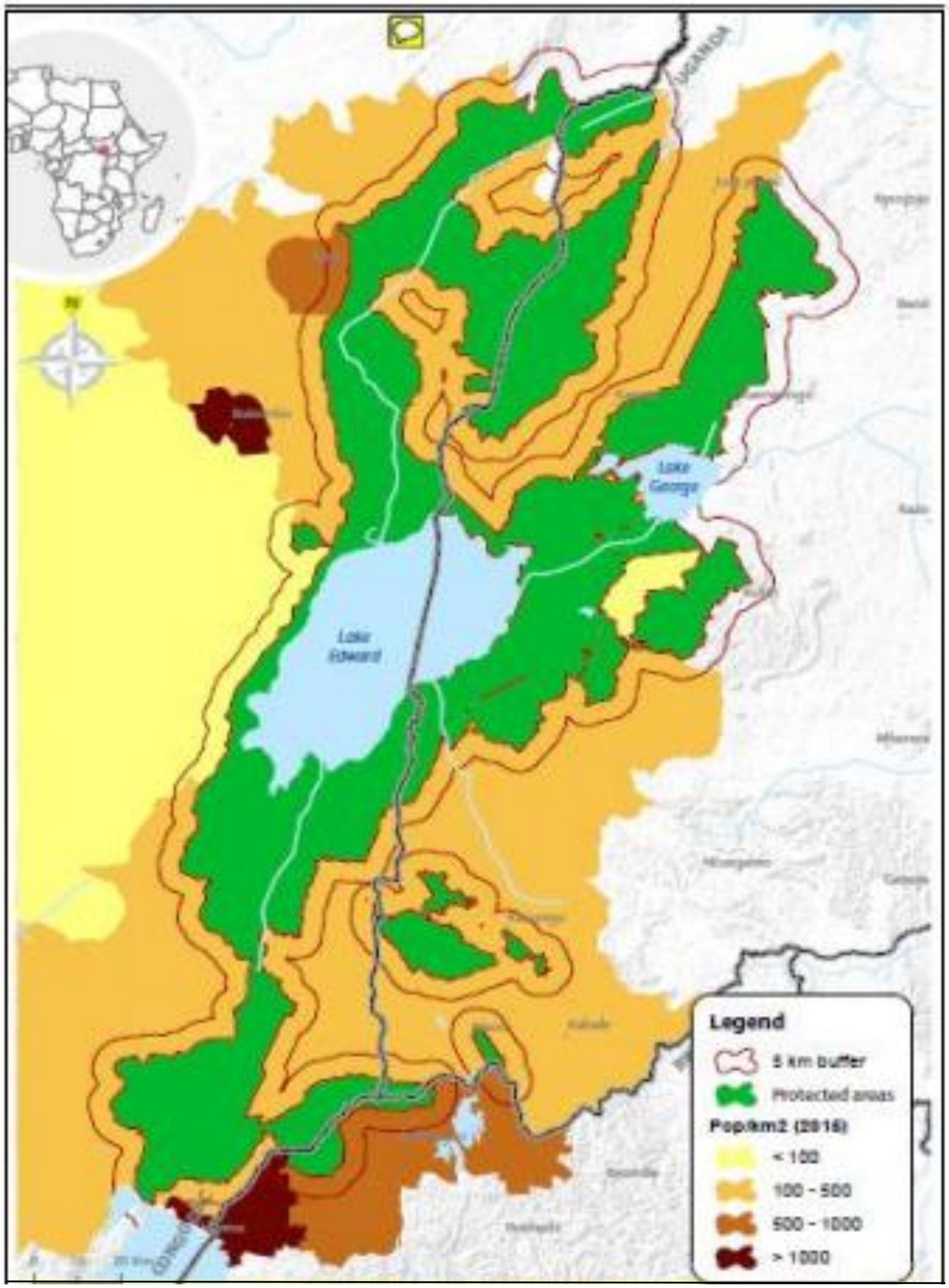

Fig. 4.9: Human Population Density Estimates 2015 within the Greater Virunga Transboundary Collaboration (Adopted from GVTC, 2017)

Proliferation and spread of invasive alien species. Proliferation and spread of invasive alien species is common in most wildlife corridors in the landscape, displacing or killing native flora and fauna. The main invasive species are *L. camara* (Fig 4.10) across most corridors*; D. cinerea* in the Rwangara corridor, and *E. candelabrum* in the Ishasha/Virunga corridor. Other invasive species that affect the corridors in Queen Elizabeth National Park are *Parthenium hysterophorus*, *Imperata cylindrica*, *Leucaena leucocephala, Broussonetia papyrifera, Cymbopogon nardus, Senna spectabilis, Mimosa pigra*, *Acacia hockii* and *Vossia cuspidate.* The invasive species threaten biodiversity and integrity of the protected areas. The proliferation and spread of invasive species is worrying and has affected most of the suitable habitats for grazers in the parks (UWA, 2018a).

Fig. 4.10: Invasive species in QENP (Field photo, 2019)

4.2.2.2 Threats affecting wildlife corridors and their impacts

Statistically significant threats with $p<0.05$, using Kruskal-Wallis ANOVA, included illegal activities (mainly pit sawying, illegal fishing, grazing, illegal harvest of resources) ($p = .002$), poaching and illegal wildlife tracking ($p = .000$), increasing human population ($p = .000$), habitat change/habitat loss due to high proliferation of invasive alien species ($p = .006$), wild fires ($p = .003$), trans-boundary threats ($p = .020$), degradation in wildlife corridors ($p = .012$), unsustainable natural resource use ($p = .001$),), development of infrastructure network inside corridors ($p = .019$), and climate change impacts ($p = .000$). However, statistically not significant threats were human wildlife conflicts (p =

.082), and pollution in the wildlife corridors ($p = .239$). The stakeholders' response on how worried they felt about the threats yielded significant results on illegal activities ($p= .001$), poaching and illegal wildlife tracking ($p= .000$), increasing human population ($p= .002$), habitat change/habitat loss ($p = .016$), human-wildlife conflicts ($p = .004$), and trans-boundary threats ($p = .001$). However, degradation of wildlife corridors ($p = .204$), unsustainable natural resource in the corridors ($p = .719$), development of infrastructure ($p = .768$), and pollution ($p = .810$) were statistically non-significant (Table 4.4).

Table 4.4: Responses on the threats affecting wildlife corridors

Threats to wildlife conservation	Kruskals-Wallis ANOVA test (n = 252, d.f = 4, α = .05)				
	Sum of Squares	**Mean Square**	**Mean Likert Score**	**Kruskal -Wallis**	**P value**
a) Responses on the level of agreement of respondents on the threat					
Illegal activities	8.912	2.971	4	1.377	.002
Poaching and illegal wildlife tracking	8.704	2.901	5	12.320	.000
Increasing human population	11.487	3.829	5	5.338	.000
Habitat change/habitat loss	4.621	2.103	5	1.967	.006
Human-wildlife conflicts	3.908	1.303	2	1.961	.082
Wild fires	13.271	4.424	4	3.639	.003
Trans-boundary threats	9.469	3.156	4	2.688	.020
Degradation of wildlife corridors	21.440	7.147	4	2.953	.012
Unsustainable natural resource use in the corridors	10.930	3.643	5	4.440	.001
Pollution	17.935	5.978	2	2.864	.239
Development of infrastructure network inside corridors	12.527	4.176	4	2.726	.019
Climate change impacts in the corridors	16.938	5.646	4	6.901	.000

b) How worrisome the respondents estimated the threat					
Illegal activities inside the wildlife corridor	16.877	5.626	4	4.371	.001
Poaching and illegal wildlife tracking	5.244	1.748	5	5.075	.000
Increasing human population	20.157	6.719	4	3.948	.002
Habitat change/habitat loss	8.263	2.718	4	3.046	.016
Human-wildlife conflicts	27.127	9.042	4	3.582	.004
Wild fires	18.273	6.091	4	13.489	.000
Trans-boundary threats to biodiversity conservation	0.183	0.183	4	0.799	.001
Degradation of wildlife corridors	0.392	0.392	2	1.659	.204
Unsustainable natural resource in the corridors	0.194	0.194	2	0.131	.719
Pollution	0.094	0.094	2	0.058	.810
Development of infrastructure network	0.152	0.152	1	0.088	.768
Climate change impacts in the corridors	0.392	0.392	4	1.659	.004

(Source: Survey, 2019)

Poaching and illegal wildlife tracking (p = .000). Poaching and illegal wildlife tracking is a key threat to biodiversity conservation and is especially high in savanna corridors of Ishasha/Virunga, Kibale-Queen and Muhokya grasslands and acacia savanna woodlands because they are easily accessible, and the wild animals are more visible and open to attack and more likely to stray into adjacent community land. The wild animals most commonly poached in these corridors include hippos and buffaloes; and those less poached include the Uganda Kob, Topi, Reedbuck, waterbuck, warthog and giant forest hog and to some extent the elephants and primates. Poaching and illegal wildlife tracking includes illegal killing of wildlife for bush-meat trade, trophy hunting and the killing of problem animals that have destroyed community crops, livestock or property, and to a limited extent for home consumption. The threat is largely attributed to the demand for products from wild animals (for food, cash, medicine and game trophies), inadequate manpower, limited number of ranger outposts and inadequate patrols due to long distance from the park headquarters and ranger outposts. A substantial loss of lions has been observed at the Ishasha/Virunga corridor, which was mainly attributed to poaching (snaring) thought to be in retaliation for lion attacks on livestock (Owiunji & Plumptre, 2007). Poaching and illegal wildlife tracking has caused a significant decline in wild population and in some cases resulted to localized species extinction.

Human population pressure ($p = .000$). The corridors are threatened by socio-economic and anthropogenic factors mainly from a growing human population neighboring the corridors with its associated agricultural activities. These corridors are not maintained at all, leaving a lot to be desired! Yet, the long-term survival of species depends on maintaining viable habitats and connecting corridors which ensures variation in gene pool, and avoids risks associated with habitat fragmentation and isolation of species. Nearly all the corridors are threatened by anthropogenic factors including the Mpanga falls corridor where loss of woody cover was due to charcoal burning, agricultural land expansion, livestock grazing in the park, over-fishing and destruction of fish breeding zones, fires, poaching of hippos in the river, sedimentation from poor agricultural practices, and harvesting of the endemic cycad plants *Encepholartos whitelockii*. The Kibale-Katonga corridor has been severely encroached through settlements, agriculture and infrastructure development leading to loss of connectivity between Katonga Wildlife Reserve and Kibale National Park. In addition, the corridors of Rwangara wetland, Ntoroko-Kanara, the Semliki Flats and the forested corridors linking TSWR with North Rwenzori Forest Reserve and eventually with Semuliki National Park have settled in which has interfered with the movement of wildlife especially the shoebill stock, elephants, buffaloes, Uganda Kob, etc. Further, to ensure viable habitats and gene flow it is essential to maintain connectivity of the landscape through corridors.

Wild fires ($p = .003$). Wild fires are common in the corridors especially during the dry seasons. The fires originate from various sources: crop farmers as they prepare their gardens for planting, poaching activity as the poachers use them as a means of hunting, and smokers littering the park with un-extinguished cigarette butts. The fires are frequent mainly in the vast grasslands of the Ishasha/Virunga corridor, Kyambura Gorge/ Kasyoha-Kitomi corridor, Kibale-Queen corridor, Muhokya corridor, Kibale-Katonga wetland corridor (UWA, 2008). Wild fires destroy the visual appeal of the park after a fresh burn, deprive animals of pasture, kill slow moving animals, and destroy nests and eggs of breeding birds. These fires create lust green grass to attract animals to particular areas and consequently hunted reducing the animal population in the corridors. Wild fires are exacerbated by the presence of elephants that promote the establishment of trees that are fire-resistant and damage young trees, inhibiting regeneration and leading to lower vegetation diversity, especially of herbaceous plants.

Trans-boundary threats (p = .020). Trans-boundary threats to biodiversity conservation are mainly poaching across borders, trafficking of wildlife and forest products, seasonal incursions of pastoralists for water and grazing resources, fishing, charcoal burning, and timber harvesting. The wildlife corridors in the conservation areas have high biodiversity ecosystems and link across international borders which are largely porous. People from neighboring countries enter and engage in illegal activities and resource off-take for subsistence and commercial use. Trans-boundary threats were due to the porous and trans-boundary nature of corridors. These trans-boundary issues threaten the type and preference of habitats by the animals, and are probably due to recurrent civil wars in the DR Congo which result into influx of wild animals into the Queen Elizabeth Protected Area for safety (UWA, 2008).

Degradation in wildlife corridors (p = .012). The change in corridor width is vivid in Ishasha/Virunga corridor, Kyambura/Kasyoha-Kitomi corridor, Kibale-Queen corridor, Muhokya corridor and this affects migration of large mammals especially the elephants, buffalos, primates. Larger fauna tend to have larger habitat needs—quite literally, they have larger ranges for foraging and hunting. If one is to protect and maintain those large home ranges and allow for movement between parks, corridors are necessarily required to be large (Newmark, 1993). The reduction in corridor width affects migration of large mammals especially the elephants, buffalos, primates they tend to require larger habitat needs. This reduction is attributed to anthropogenic factors mainly agricultural encroachment, settlement, unclear boundaries, and infrastructure development.

Habitat transition/changes/habitat loss ($p = .006$). Habitat change/habitat loss is due to high proliferation of invasive alien species as a result of rampant wild fires, overgrazing, and climate change (UWA, 2008). Additionally, agriculture, livestock grazing, expansion of human settlements, and uncontrolled fires which have led to the loss of vegetation diversity in forest corridors leading to proliferation of less nutritious or palatable vegetation for wildlife. In some savanna corridors, biological diversity is being eroded as a result of invasive alien species through their proliferation and spread, displacing or killing native flora and fauna and affecting ecosystem services as evident in Muhokya corridor with *L. camara;* Rwangara corridor with *D. cinerea* which is colonising at a fast rate; Ishasha/Virunga corridor with *L. camara* and *E. candelabrum* (UWA, 2008). In addition, there is disappearance of migration routes of wild animals as a result of agricultural encroachment and illegal cutting of forest/park products. These factors have eroded quality of wildlife corridors resulting into disturbed migration routes across protected areas in addition to an increase in cases of problem animal incursions in search for forage. Habitat loss, degradation, and fragmentation are among the largest threats to biodiversity worldwide and they predominantly lead to the decline of local populations through the loss of available resources (Baguette et al., 2013). Any further habitat loss or degradation to these corridors will reduce their ability to protect the identified habitat and the conservation targets and, over time, the corridors will increasingly be avoided by migrating and resident wildlife (UWA, 2008).

Unsustainable natural resource use ($p = .001$). The natural resources unsustainably extracted from the forest corridors include timber, building poles and stakes for farming, whilst at the savanna corridors, firewood collection was rampant and this is most damaging and unsustainably done. At the Kyambura Gorge/ Kasyoha-Kitomi corridor and the Kyambura/ Kasyoha-Kitomi corridors, river water has been extracted and diverted for local agriculture. These human activities had resulted into habitat degradation, gapping in the forest, and interfering with the animal migratory route.

Climate change. Climate change impacts affect wildlife populations ($p = .000$). The populations fluctuate seasonally and from year to year based on seasonal weather patterns. Climatic factors regulate wildlife populations through changes in rainfall amounts, temperatures and levels of irradiation. These factors influence the quality and availability of food for wild animals resulting into high levels of inter and intra competition for food thereby affecting reproduction and survival rates and species shifts. Climate change may be experienced in form of extreme weather events such as prolonged droughts and floods, disease outbreaks and proliferation of invasive species which lead to wildlife mortality (UWA, 2018a).

Illegal activities (p = .002). Illegal activities exist in all corridors in the landscape and they include pit sawying, illegal fishing, grazing and illegal harvest of resources. The underlying causes to increase in illegal activities are increasing human population (leading to increasing demand for park resources), change in land use patterns (UWA, 2013). Other causes are weak governance (e.g. limited institutional capacity, especially for patrolling the PAs; limited enforcement of illegal hunting and timber harvesting), limited alternative sources of livelihoods, high poverty levels in the park adjacent communities, poor perception of the value of natural ecosystems, and climate change effects (UWA, 2013). These illegal activities affect habitat quality, diversity and continuity.

Infrastructural development. Development of infrastructure network (p = .019) has led to reduction in corridor values. The growing road network and power line, cutting through the Kyambura gorge corridor and its escarpment banks that links Kyambura and Kasyoha-Kitomi, make deep intrusions into the underground riparian forest belt inhabited by an isolated small groups of endangered chimpanzees and other primates like the red tailed, black and white, vervet monkeys and olive baboons and a wide range of birds. Large mammals including elephants, hippos, buffaloes, and lions roam the gorge. The road network that cuts across corridors expose the migratory animals (Fig. 4.11) to road kills. The discontinuity of these corridors has resulted into wildlife casualties through road kills, and discontinuous migratory routes for inhabitant animal population (UWA, 2008).

Fig. 4.11: Infrastructural development and migratory animals in Virunga-Lhubiriha corridor (Field photo, 2019)

Human-wildlife conflicts. Human-wildlife conflicts was not statistically significant (p = .082) across the wildlife corridors. However, across the corridors human-wildlife conflicts take the form of damage to crops and livestock, injury to humans and livestock, and death of humans and livestock. The problem animals causing these conflicts were mainly elephants, lions, buffalos, hippos, chimpanzees and crocodiles. In addition, some of the wildlife dispersal areas and migration corridors have been settled and cultivated. For instance, the Rwangara corridor that provides for wildlife crossing between the TSWR and DRC has been settled in by cattle keepers from DRC as refugees which has interfered with the movement of the shoebill stock, elephants, buffaloes and Uganda Kob. As a result, wildlife competes for resources with livestock thereby causing conflicts.

Human-wildlife conflicts could be attributed to habitat degradation as a result of proliferation of invasive species, increasing animal population in a shrinking habitat, proximity to community land, changing land use patterns, increasing human population without land increase which has resulted into people settling and cultivating in wildlife dispersal areas. Crop raiding is one of the major causes of conflicts between farmers and wildlife in Uganda (Osborn et al., 2011).

Pollution. Pollution was not statistically significant across the wildlife corridors ($p = .239$). However, pollution poses a potential threat to biodiversity through habitat modification or loss (NEMA, 2016) in the Kibale-Queen and Muhokya corridors, where the lake/ wetland system is polluted from past and present mining operations (including heavy metal contamination from the former Kilembe Mines operation). Mining of limestone from Dura quarry has opened part of the Kibale-Queen corridor to pollution and proliferation of *Lantana camara* and *Senna spectabilis* which affects the habitat and the migratory route of animals through the corridor. In addition, the oil and gas activities within the Albertine Rift pose a threat to movement of migratory animals and ecosystem integrity.

Encroachment leading to loss of connectivity. The wildlife corridors have been severely encroached. For instance, Kibale-Katonga-Lake Mburo corridor has been severely encroached through settlements, agriculture and infrastructure development leading to loss of connectivity (UWA, 2018b). Bush burning, cultivation and grazing have maintained the Kasyoha-Kitomi / Kalinzu-Maramagambo corridor as grassland. These forms of enchroachment limit movement of migratory species especially the elephants, chimpanzees, lions, wild pigs and duikers.

4.2.2.3 Management measures for corridor conservation

A critical analysis of the changes and threats in the wildlife corridors, and discussions with park staff, local authorities and private sector players, identified the following key management measures for corridor conservation which should be integrated into the existing legal and policy framework:

Develop landscape plans, policies and future perspectives for corridor conservation. The findings of this study provide information and literature on wildlife corridors which should contribute towards strengthening connectivity as well as develop landscape plans, policies and future perspectives for connectivity/corridor conservation. They should help to guide planning, decision-making, management, and policy development for connectivity/corridor conservation. Development of plans, policies and future perspectives should follow the IUCN 'Guidelines for Conserving Connectivity through Ecological Networks and Corridors' (Hilty et al., 2020).

Understanding the functional and structural connectivity nature of corridors. Understanding the functional and structural connectivity nature of the corridors is fundamental to corridor conservation. Analysis of the threats affecting the corridors shows various and related aspects of functional and structural connectivity nature which should guide park management to address them. Majority of parks are linked to each other through stepping stone habitats—

mainly forest reserves, and wetlands—which are degraded, and therefore need restoration to facilitate connectivity. Complementary aspects of the functional and structural connectivity results deliver a picture to serve in preserving and mitigating threats to connectivity or improve and restore it (Churko et al., 2020).

Development of strategic plan for preservation. The corridors are migratory routes for mammals and hence developing a strategic plan to guide corridor preservation is paramount. The plan should address strategic issues that affect animal migration across landscapes including collaboration amongst local authorities, Ministries, Departments and Agencies responsible for management and conservation of forestry, wetlands and wildlife resources. Abrahms et al. (2016) asserted that "the success of corridor efforts also relies on an accurate understanding of how animals move through their environment, and given limited conservation resources and rapidly changing environments, efficient and accurate corridor identification, establishment and management is a critical need in conservation planning".

4.2.2.4 The role of wildlife corridors in conservation

Conservation of migratory animal species. The wildlife corridors conserve key migratory animal species mainly elephants, lions and chimpanzees. The savanna corridors of Ishasha/Virunga, Bwera/Virunga Lhubiriha, Muhokya and Kibale-Queen; forest corridors of Kyambura-Kasyoha Kitomi and Kasyoha-Kitomi/ Kalinzu-Maramagambo; and the wetland corridor of Rwangara (that links TSWR with the DRC protected area system) are all important corridors for the elephants.

The corridors enable elephant migration within the broader landscape, which is important for accessing seasonal food and water, and for sustaining population size and genetic variability. The elephants' heavy use of the savanna corridors could be attributed to the savanna woodland—their principal habitat—, existing food and water sources, and safe havens from poaching. The trans-boundary Ishasha/Virunga and Bwera/Virunga Lhubiriha corridors provided escape routes for elephants during the 1970s when both Uganda and DRC were insecure and poaching was severe. The connectivity between the Kyambura / Kasyoha-Kitomi corridor and Kyambura Wildlife Reserve provide a large size to maintain a viable elephant population (UWA, 2016a).

Maintaining biological connectivity. The conservation goals of corridors in biodiversity hotspots such are often directed at maintaining biological connectivity (Taylor et al., 1993), ensuring persistence and sufficient habitat to maintain existing fauna and flora (UWA, 2016a). The specific metrics of connectivity goals are dictated by larger conservation goals, such as species-specific needs, or perceived needs. Particularly in the Albertine Rift, the role of charismatic mega-fauna in both the perceived and actual needs of habitat connectivity is considerable (Nampindo & Plumptre, 2005; Plumptre et al., 2007). Chimpanzees (*Pan troglodytes*), elephants (*Loxodonta africana*), lions (*Panthera leo*), Gorillas (*Gorilla gorilla berengei*), and many smaller endemic primates, and enormous endemic avifaunal richness are of high conservation and tourism value. Larger fauna tend to have larger habitat needs—quite literally, they have larger ranges for foraging and hunting. If one is to protect and maintain those large home ranges and allow for movement between parks, corridors are necessarily required to be large (Newmark, 1993). In addition, the type of ecological habitat needed—undisturbed old growth forests, connected canopies, sufficient feeding resources—may be a specific requirement of the corridor (Jason & Taylor, 1998), and many considerations may contribute to design or planning goals (Dobson et al., 1999; Tewksbury et al., 2002). Faunal connectivity remains a high priority from a conservation perspective in the Kibale-Queen Elizabeth landscape and will likely continue to be the primary driver in management of this landscape (UWA, 2016a).

Maintain perpetuity of populations/ minimum viable populations. From existing literature, in order to embark on this discussion, it is important to first understand 'source' and 'sink' populations. 'Source' populations are those localized populations where the birth rate exceeds the death rate, and are a source of perpetuity of the species/sub-species. 'Sinks' are populations where deaths exceed births, and depend on an influx of individuals for their sustenance (Pulliam, 1988). These terms are usually used in the context of single-species conservation in spatially fragmented habitats. Typically, sink populations occur in areas adjoining human habitats and are usually marginalized as a result of this. Linkages such as corridors, then, must logically play a crucial role in sustenance of sink populations. It has, in fact, been theoretically proven that active dispersal from source populations can maintain 'evolutionarily stable sink populations' (Charlesworth et al., 2007). Fragmented sub-populations of single species, known as 'regional populations', interact through linkages (such as corridors) to supplement the ‘meta population’ gene pool (Ministry of Environment and Forests, 2012). The success of this mechanism is premised on the inviolate nature of the source populations, and therefore the protection of source habitats is a *sine qua non* for the efficacy of corridors in ecological conservation. There is, therefore, a cyclical causative nexus between the scientific management of protected areas and the positive effects of corridors in promoting biodiversity and sustenance of meta-populations. Add to this the omnipresent variable of human–wildlife conflict and it becomes apparent how delicate and complex the exercise of corridor delineation and management actually is.

Maintain minimum viable habitats and conservation strategies. According to UWA (2016a), the wildlife corridors enable wildlife to escape from poaching and insecurity and provide a refuge or “safe haven” for wildlife. For instance, the elephants have used the trans-boundary Ishasha/Virunga and Bwera/Virunga Lhubiriha corridors to escape the insecurity and armed conflicts in Uganda during the 1970s and in DRC since the 1990s which caused their decline and from the mid 1990s the elephant population has seen an increase (UWA, 2016a). In addition, the physical movement, which is crucial to the long-term viability of animal population: feeding/foraging, seasonal migrations as well as permanent movements in case of habitats being rendered unfit (due to climate change or other anthropogenic factors) are facilitated by, and occur through, corridors. This agrees well with the concept that a ‘minimum viable habitat’ area is necessary for the survival of a species. As a rule for most species, a minimum contiguous area is desirable for their long-term viability. It is also intuitive knowledge that owing to increased anthropogenic pressures on existing regional populations, source populations now occur largely in core zones of protected areas (Beninde et al., 2015). Therefore logically follows that corridors would be at their most effective when linking protected areas and increasing the continuity of source population habitats. Habitat conservation and management strategies should be characterized by advocacy and more study in the area of land-use planning around protected areas (especially in identified wildlife corridors) (UWA, 2016a).

These findings under objective two support the second hypothesis that threats to wildlife conservation were reducing across Queen Elizabeth and Kibale Conservation Areas.

4.2.3 Community-based conservation and ecological integrity

The third objective investigated the extent to which community based conservation protects ecological integrity. The extent of community participation, and their perceptions and attitudes towards wildlife conservation were evaluated. Data was generated using the structured and semi structured questionnaires.

4.2.3.1 Socio-demographic characteristics of community respondents

The respondents were a representative of the various stake holder categories in the landscape. Majority of the respondents were segregated as 32-45 years age group (56.7%). Further, 42.3% had attained primary education; and 7.7% had a college degree. On gender of respondents, 66.8% were males and 33.2% were females. On duration of residence, the majority of respondents (84.2%) had stayed adjacent the parks for over 10 years, and 15.8% for less than 10 years; and 75% of the respondents lived in a distance of <5 km from the park boundary. Land holding varied from <5 hectares (78.8%) to >6 hectares (21.2%) across the landscape (Table 4.5).

Table 4.5: Socio-demographic Characteristics of Respondents

Socio-demographic characteristic	**Category**	**Frequency**	**%**
Sex (N=268)	Male	179	66.8
	Female	89	33.2
Age (N=268)	18-31 years	76	28.4
	32-45 years	152	56.7
	46-60 years	19	7.2
	61+ years	21	7.7
Education level (N=268)	Primary	113	42.3
	Secondary	80	29.8
	Certificate	28	10.6
	Diploma	27	9.6
	Degree	20	7.7
Acreage (if owns land) (N=268)	<1 hectare	14	5.3

	1-5 hectares	197	73.5
	>6 hectares	57	21.2
Length of residence (N=268)	1-3 years	11	4.3
	4-6 years	18	6.8
	7-9 years	13	4.7
	10 years and above	226	84.2
Occupation of respondents (N=268)	Formal employment	27	10.1
	Business	43	15.9
	Peasant farmers	157	58.6
	Fisherfolk	41	15.4
Distance from park (N=268)	<5km	201	75
	5 -10km	49	18.3
	>10km	18	6.7

(Source: Survey, 2019)

In addition, 58.6% were peasants, 15.9% were business people, 15.4% were fisherfolk, and 10.1% were formal employees (Table 4.5). The farmers were both crop and livestock farmers. The study also reveals that the majority of respondents (74%) are small to medium scale farmers (peasants and fisherfolk) and this has implications on conservation in the sense that it increases the likelihood of human-wildlife conflicts (HWC), particularly due to crop raiding and collection of firewood from the protected areas for smoking fish.

4.2.3.2 The extent of community participation in the protection of ecological integrity

4.2.3.2.1 Community participation in conservation education and awareness programme

Local communities adjacent the parks participate in conservation education and awareness programmes as revealed by the statistically significant test results with χ^2 (1, N = 268) = 46.013, p = .000, α = .05, V = .588 (Appendix II). The high Value (V) of .588 shows a very strong effect of community conservation education and awareness programmes towards conserving biodiversity and protecting ecological integrity. The conservation education and awareness programmes in the communities include outreach programmes (Fig. 4.12), in-park visits, talk shows, and drama in the communities; and awareness meetings, in-park visits, debates, contests, and distribution of educational materials in schools (Fig. 4.13).

Fig. 4.12: Community sensitization and awareness in Bikone Nyakalengija, adjacent Rwenzori Mountains National Park (Source: Survey, 2019)

Fig. 4.13: Education and awareness sensitization on conservation of the park at Good Samaritan Primary School in Kisinga Sub County, adjacent Rwenzori Mountains National Park (Source: Survey, 2019)

On the question of ownership of parkland, the responses from the park adjacent communities indicated state ownership (75.9%) and indigenous ownership (24.1%); and this was an indication that communities are aware of the ownership issues (χ^2 (1, N = 268) = 20.064, p = .000, α = .05, V =.387 (Appendix II) and the high value (V) shows a high level of awareness on ownership of the park land.

Communities participate in conservation education and awareness which is critical in community based conservation and hence an essential tool for achieving conservation sustainability in wildlife conservation areas. Local people's participation is key for the conservation activities at grassroots level; and awareness programme with well collaboration with local people is always a necessity for making them conscious about biodiversity conservation and its importance (Lamichhane, 2020). This also agrees well with the Community Conservation Policy which states that "the ultimate goal of conservation education and communication is to promote positive attitudes, knowledge and change of behavior of the neighbouring communities and the general public towards wildlife conservation" (UWA, 2003). Sustainable conservation of the national park requires empowering the local communities so as to reduce their interference in the implementation of the park management programme (Ezebilo & Mattsson, 2010).

4.2.3.2.2 Community participation in wildlife management decision making areas

Local communities participate in the development of general park management plans and other community development programmes that support conservation of biodiversity (χ^2 (1, N = 268) = 35.16, p = .026, α = .05, V = .270). However, communities do not participate in resolving human wildlife conflicts (χ^2 (1, N = 268) = 20.538, p = .303, α = .05, V = .216) in all the wildlife protected areas of both conservation areas (Appendix II). These conflicts were mainly handled by the local authorities and park management without involvement of local communities. Community respondents intimated that "We are not given opportunities to participate in handling human wildlife conflicts". Further, local communities had no established institutions that would participate in resolving human wildlife conflicts—which conflicts arise from resource access, park boundary contentions, crop damage, livestock loss, and human injuries and loss from attacks by wild animals.

Communities participate in management decision making in the development of general management plans, and implementation of community development programmes. However, they do not participate in resolving human-wildlife conflicts and sharing conservation-related responsibility. Indigenous peoples and local communities need to have a voice in decision-making, as partners with others or on their own, …and equitable sharing of powers, costs, and benefits of conservation must be ensured, which will enhance public support; and local citizens must hold or share authority in management (Kothari et al., 2013).

Creating partnerships with local communities, and including local communities in PA-management decision making are essential to help protect PAs (Andrade & Rhodes, 2012; Liberati et al., 2016).

4.2.3.2.3 Community participation in management of wildlife sanctuaries

Queen Elizabeth National Park was designated as a UNESCO Man and Biosphere (MAB) Reserve in 1979 in recognition of the role it plays in providing an opportunity to explore and demonstrate approaches to sustainable resource utilization. This MAB reserve has 11 fishing enclaves which include Hamukungu, Kahendero, Kasenyi, Kashaka, Katunguru in Rubirizi, Kayanja, Kisenyi, Katwe-Kabatoro, Rwenshama, Kazinga which are gazetted, and Katunguru in Kasese which has not been gazetted. From the FGDs with local communities neighboring the park and park staff, the Biosphere has varied wildlife habitats mainly savanna grassland, forests, water and wetlands. The discussions further revealed that the local communities do not participate in the management of these wildlife sanctuaries, but instead presents threats such as illegal resource uptake from the parks, and grazing inside the park.

The Biosphere reserve supports a wide range of Uganda's natural habitats and diverse landforms, including grassy plains, distinctive savanna woodlands, tropical forest, wetlands, rivers, swamps, lakes and volcanic craters; and a biodiversity hotspot within the framework of ecosystem approach for sustainable development" (UWA, 2012). The reserve has a greater biodiversity, and is a model for conservation education, research and monitoring of biodiversity trends.

The vast savannah and forest animal species and the scenic landforms attract an increasing number of tourists to the reserve hence contributing greatly to the country's tourism industry. The Biosphere reserve is a home to an increasing large mammal population mainly hippopotamus, elephant, buffalo, Uganda Kob, waterbuck, topi, lion, and leopard; (UWA, 2018a) which is threatened by both anthropogenic and natural factors.

4.2.3.2.4 Community participation in the benefit sharing scheme

Communities participate in the different schemes under benefit sharing and these include conservation awareness and education, collaborative resource management, resource access, revenue sharing, community tourism, wildlife use rights, and wildlife enterprises/business opportunities (Appendix II).

Collaborative resource management. Through collaborative resource management (where protected area management shares benefits, decision-making, authority and responsibility in the management of protected areas or their resources with the local people), communities enjoy a multiple of benefits from the wildlife protected areas in both conservation areas and these benefits contribute towards reduction of poverty reduction in the communities (χ^2 (1, N = 268) = 38.479, p = .001, α = .05, V= .283. (Appendix II) The high value (V) shows that collaborative resource management plays a vital role in conservation. Community responses (N = 268) on benefits that accrue from the conservation areas indicated: resource access and use, employment, environmental services, community tourism enterprises, appreciating wildlife and beauty, revenue sharing, culture related benefits, scholarships, and wildlife use rights (Fig. 4.14).

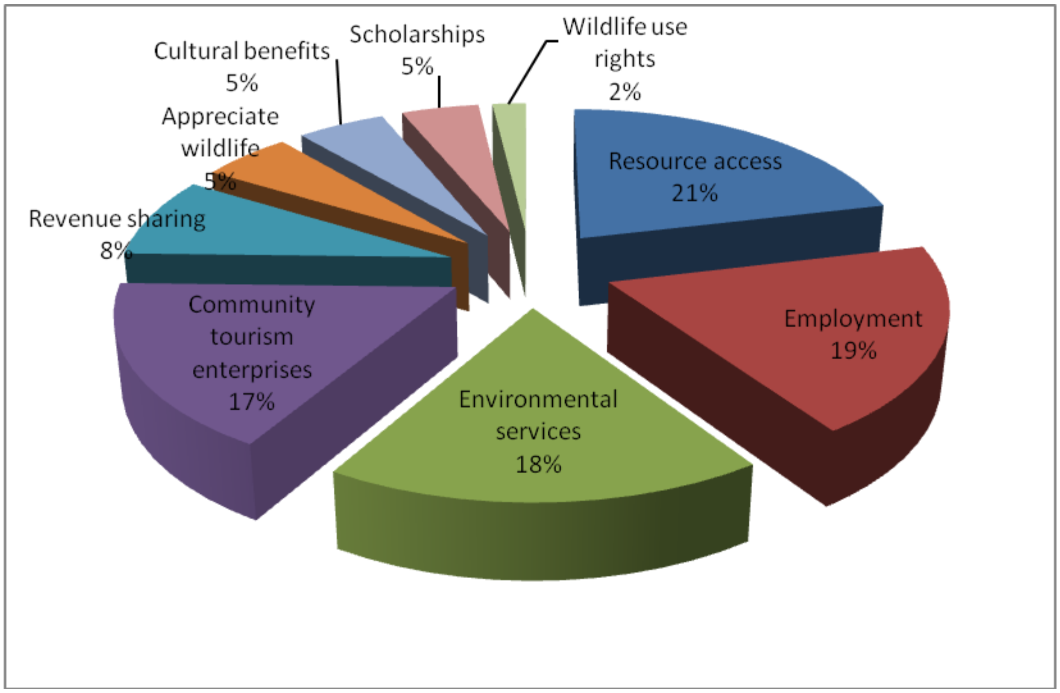

Fig. 4.14: Community Benefits from the Protected Areas

Resource access and use. Analysis of responses on the question, "does your household/community access or use resources within the national park?", using the Pearson Chi square test revealed significantly statistical result (χ^2 (1, N = 268) = 10.055, p = .000, α = .05, V=.247) (Appendix II). Local communities access in-park resources through use of permits (χ^2 (1, N = 268) = 3.469, p = .000, α = .05, V = .325), and resource use agreements (χ^2 (1, N = 268) = 1.972, p = .000, V = .576) (Appendix II). The resources accessed include snail shells, elephant dung, fish, honey bamboo, medicinal plants, mushrooms, firewood, building poles and grass for construction.

Revenue sharing programme. Responses to the question "does your community receive funds from the park under revenue sharing scheme?", a statistically significant was obtained (χ^2 (1, N = 268) = 1.310, p = .000, α = .05, V = .084) (Appendix II). Responses to the question "do the funds under revenue sharing program motivate you to participate in conservation activities", the analysis showed statistically significant results that the respondents adjacent to the PAs were motivated to participate in conservation activities by revenue sharing funds (χ^2 (1, N = 268) = 17.609, p =.001, α = .05, V = .340) (Appendix II). Further, on the issue of management of revenue sharing funds, the communities, who are the focal beneficiaries, were aware of the channel of disbursement of revenue sharing funds. (χ^2 (1, N = 268) =.463, p = .001, α = .05, V = .792) However, they criticized the channel of disbursement of funds (χ^2 (1, N = 268) =.939, p = .001, α = .05, V = .816) (Appendix II).

The expression of dissatisfaction on the channel of disbursement of funds under the revenue sharing programme was due to lack of a clear institutional framework to manage the fund. The revenue sharing policy and guidelines only consider frontline villages to the parks and yet there are other communities beyond these (frontline villages) which do not necessarily touch the parks, and yet they are adversely affected by wild animals including problem animals. Communities in such areas do not benefit from the revenue sharing programme even when damage to crops and livestock has been inflicted by the wild animals in such areas. This is a fundamental weakness in the policy and guidelines.

The role of park adjacent community in implementation of the revenue sharing scheme was obscure. Only 46% of the responses indicated community involvement at project identification, 34% during implementation, 15% during monitoring and evaluation, and none during reporting and accountability. Four percent (4%) expressed no role at all throughout the project cycle. Therefore, less than 50% of the park adjacent communities participate in the implementation of the revenue sharing scheme across the wildlife protected areas. Further, the FGDs showed that the revenue sharing programme was guided by the Revenue Sharing guidelines issued by Uganda Wildlife Authority. These guidelines provide for Project Management Committees at community level for the identified revenue sharing projects. These committees are adhoc. During their existence, communities would be vibrant in conservation work to show appreciation of the park resources, and the community-park relations would improve. Shortly after completion of the community projects, the institutions disintegrate. Therefore, there are no formal institutions for implementation of revenue sharing scheme at community level.

Further, the respondents indicated that the funds finance conservation and problem animal management interventions The interventions include: construction of some trenches and tourist campsites, uprooting *Lantana camara*, maintaining the park boundary, setting up apiaries and growing Mauritius thorn (*Caesalpinia decapetala*) hedge along the trenches in the elephant crossing hotspots, which all support protection of ecological integrity. These projects build appreciation of park resources by the communities, strengthen collaboration between the communities and park, and also ensure community involvement in biodiversity conservation.

Local communities adjacent the wildlife protected areas receive funds under the revenue sharing scheme to support community conservation programmes, problem animal interventions, and livelihood improvement projects. These revenue sharing funds motivate communities to participate in conservation programmes and related activities. This is similar to the revenue sharing programme enjoyed by local communities living adjacent Bwindi Impenetrable National Park (BINP) (Mugyenyi, Amumpiire & Namujuzi, 2014). Here, an additional component of revenue sharing is received from the gorilla permits where a share of U$5.00 per gorilla permit fee is given to communities adjacent the park to improve their welfare. This revenue sharing programme in Bwindi has enhanced contribution towards sustainable park management and poverty alleviation (Mugyenyi, Amumpiire & Namujuzi, 2014). The incentive scheme of revenue sharing with park adjacent communities was considered critical and remains important in wining community support and compliance with conservation requirements (Mugyenyi, Amumpiire & Namujuzi, 2014). The Conservation Areas should introduce a levy on Chimpanzee tracking as an additional fund to the share from revenue sharing. UWA (2012) asserts that the overall goal of revenue sharing is to ensure strong partnership between protected areas management, local communities and local governments leading to sustainable management of resources in and around protected areas by enabling people living adjacent to protected areas obtain financial benefits derived from the existence of these areas that contribute to improvements in their welfare and help gain their support for protected areas conservation. And specifically, its objectives include: i) to provide an enabling environment for establishing good relations between the protected areas and their neighboring local communities, ii) to demonstrate the economic value of protected areas and conservation in general to communities neighboring protected areas, and iii) to strengthen the support and acceptance for protected areas and conservation activities from communities living adjacent to these areas (UWA, 2012). The benefit sharing scheme creates visibility of the park in the communities, and strengthens community park relations, which contribute towards community conservation.

Community Based Tourism. From interviews and focus group discussions, local communities participate in CBC through forming community based tourism groups across the wildlife PAs in both conservation areas. These groups consist mainly of women and youth from the park adjacent communities. On the question, “do you generate conservation-based income as a community?”, analysis showed statistically significant results that the local communities generate income from community based tourism (χ^2 (1, N = 268) = 6.926, p = .074, α = .05, V = .219) (Appendix II). The income sources were mainly nature ecotourism, cultural homesteads, fishing, and operating tourist lodges, bandas and campsites (Fig. 4.15) which contribute towards poverty reduction within the local communities.

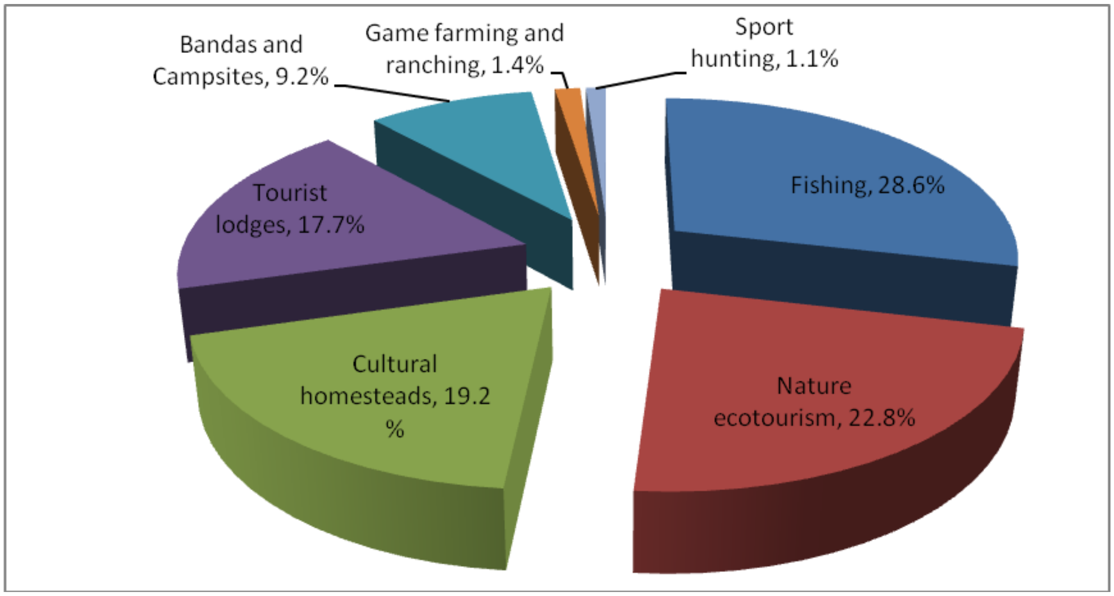

Fig. 4.15: Conservation-based Income Opportunities

The community based tourism groups and private sector offer a number of tourism programs, products and services to their visitors. These include: mountain climbing, nature trails/walks, tracking of lions, birding, scenery (photo and filming), tracking of large mammals especially lions, birding, different cultures, art products, crafts, performance arts, conservation education, boat riding, and music, dance and drama. Other products are village walks, home stays, rural experiences, crafts (Fig. 4.16) and local cuisine; and coffee safari/experience (Fig. 4.17). Further, the private sector participate in community based tourism through (i) mobilizing local communities to form CBT groups and acquire legal recognition (31%), (ii) building capacity of CBT groups to acquire benefits from the various cultures and nature (29%), iii) strengthening the capacity of local communities and CBT groups to develop a variety of products and services to attract tourists who come for safaris in the country (27%), and (iv) marketing, selling, and delivering on wildlife tourism experiences (13%) (χ^2 (3, N = 268) =

9.143, p = .000, α = .05, V = .621) (Appendix II). The high value (V) shows that private sector plays a significant role in promoting community-based tourism.

Fig. 4.16: Tourists buying art and craft products from a local community-based tourism group in Kasenyi on Lake George (Source: Survey, 2019)

Fig. 4.17: Community-based tourism group in Kasenyi making art and craft products (left) and tourists enjoy a cup of coffee at the group's canteen (right) (Source: Survey, 2019)

Communities adjacent both conservation areas participate in community based tourism by offering various tourism programs, products and services from which they generate income which motivates them to participate in conservation work. Communities play various roles in the conservation and management of biodiversity namely (1) conserving nature through promoting tourism products which are enjoyed by local, national and international tourists; (2) providing tourism services like tour guiding; (3) awareness creation on biodiversity conservation and community tourism through information sharing and education to their visitors; (4) ensuring safety of wild fauna around their tourism facilities; (5) mobilizing revenue to the parks through bookings of tourists; (6) helping expose the park and its activities to the world; (7) working with communities to guide stray problem animals return to the park; and (8) reporting illegal activities to park management. Community participation in tourism could be associated with the financial benefits from the tourism industry, and this supports the findings of other researchers that tourism is a dominant mechanism to reduce poverty and provide employment near PAs (Ferraro & Hanauer, 2014; Naidoo et al., 2016).

Wildlife use rights. On the issue of whether communities are aware of wildlife use rights, a benefit sharing from wildlife protected areas, analysis revealed a statistically non-significant results (χ^2 (1, N = 268) = 31.359, p = .091, α = .05, V = .388) (Appendix II). Further, the FGDs revealed that wildlife use rights scheme did not exist in both conservation areas except in Katonga wildlife reserve, and yet the scheme would be an incentive to generate conservation-based income, finance livelihood alternatives, promote the conservation of wildlife outside protected areas and improve people-park relations.

Wildlife enterprises/business opportunities. On the level of awareness of communities on wildlife enterprises/business opportunities, also a form of benefit sharing from wildlife protected areas, analysis revealed a statistically significant result (χ^2 (1, N = 268) = 24.734, p =.000, α = .05, V =.345) (Appendix II). This meant that communities adjacent both conservation areas had knowledge on wildlife enterprises/business opportunities offered by the PAs.

Generally, park management supports park adjacent communities in both conservation areas to participate in the benefit sharing schemes and the schemes mainly conservation awareness and education, collaborative resource management, resource access and use, revenue-sharing, community tourism, and wildlife enterprises/business opportunities (Appendix II). Through this collaboration, park management recognizes local communities neighboring the wildlife protected areas as key stakeholders in ensuring the protection of wildlife both inside and outside the protected areas. This support and recognition results into great non-financial benefits, namely, (1) increased appreciation of wildlife, (2) garnering support for the protection of the wildlife protected areas, (3) community involvement in decision-making, (4) linking planning for conservation with planning for development, and (5) provide mechanism for communication, where views, concerns and opinions on management of the protected area can be shared between park management and communities. The access of resources enables the communities to appreciate the contribution of the conservation areas to their livelihoods, and hence improves community park relations and their participation in wildlife conservation programmes. Strengthening the benefit sharing scheme could result into ownership and acceptance of wildlife and protected areas. National parks, and other protected areas must strive to involve indigenous people in protected area management, and protect their access rights if these areas are to be considered equitable (Blaustein, 2007). However, the wildlife agency does not relinquish some of its powers to the local people to get more involved in conservation activities including conflict resolution. For CBC to be effective, governments and wildlife institutions should relinquish some or even most of its powers to the local people (Songorwa et al., 2000). This would empower the local communities to make their decisions and enable governments to play a facilitation, coordination and educational role.

4.2.3.2.5 Indigenous people's property

Community responses on whether the park animals had strayed on people's farm, dwelling, and destroyed property (including damage to crops, injury to livestock), analysis indicated a statistically significant result (χ^2 (1, N = 268) = 4.203, p =.000, α = .05, V = .240), and the affected communities did not receive compensation for the damage caused, (χ^2 (1, N = 268) =2.949, p = .400, α = .05, V = .201). Failure by PA management to compensate for loss of indigenous peoples' property accounts for the 'dissatisfactory' scores on handling indigenous peoples' property as indicated by 91.5% of the respondents who reported that wild animals had strayed onto their farms and family dwelling, and caused damage to their property with no compensation or even consideration. Hence the local communities intimated that the park was not an asset but liability (χ^2 (1, N = 268) = 2.899, p = .821, α = .05, V = .134) (Appendix II) due to the loss problem animals cause to property in the communities. Park management was still challenged in protecting indigenous peoples' property from problem animal invasion. However, community scouts and volunteers join hands with park rangers to protect indigenous peoples' property from problem animals through community volunteers who *scare* them back into the protected areas as they guard crops from damage. In this way, the community scouts and volunteers save them from human attach. The scouts and volunteers use drums, torches, vuvuzelas, and other traditional means. National parks, and other protected areas must strive to involve indigenous people in protected area management, protect property, and access rights if these areas are to be considered equitable from an Indigenous perspective (Blaustein, 2007). As a new development, until July 2019, because of pressure building on government from the park adjacent communities and the general public, compensation for injury and loss inflicted by wild fauna from the protected areas was considered in the law (Uganda Wildlife Act, 2019).

4.2.3.2.6 Human-wildlife conflict management

From the FGDs with the local communities, human-wildlife conflicts arise from crop raids, loss of livestock, human injuries and death as a result of problem animals; and boundary contentions, which constrain community-park relations. These conflicts affect community livelihoods. Analysis of whether communities participate in resolving human-wildlife conflicts in the community revealed non-statistically significant results (χ^2 (1, N = 268) = 20.538, p = .303, α = .05, V =

.216) (Appendix II). Joint discussions with park management and park adjacent communities revealed a number of interventions in place to manage human-wildlife conflicts and these were: provision of funds under revenue sharing programme; construction of a solar powered electric fence in selected hot spots around Queen Elizabeth National Park and Kyambura wildlife reserve; construction of trenches along the park boundaries; setting up apiaries along the park boundaries; growing of non-palatable buffer crops such as chilli-pepper, onions and garlic (green pepper, onion and garlic double as cash crop that generates household income); planting of Mauritius thorn to deter problem animals especially elephants; and active management by scaring the wild animals back into the wild, providing 'consideration funds' to damage affected families, providing education and awareness packages, and to limited extent supporting income generating activities in the park adjacent communities. These interventions contribute to addressing human-wildlife conflicts, improving community-park relations as well as management and conservation of biodiversity.

4.2.3.2.7 Participation of local authorities

When asked about the contribution of the local authorities in conservation of the wildlife resources, 36% indicated mobilizing and sensitizing park adjacent communities towards conservation of the protected area(s), 29% indicated increasing economic benefits, 20% indicated reconciling the goals of conservation and development in the communities, 12% indicated participating in resolving human wildlife conflicts, and only 3% indicated participation in the formulation of park general management plans (Fig. 4.18) and χ^2 (4, N = 268) = 17.021, p = .000, α = .05, V = .261 (Appendix II). The high value (V) shows that local authorities play an important role in conservation.

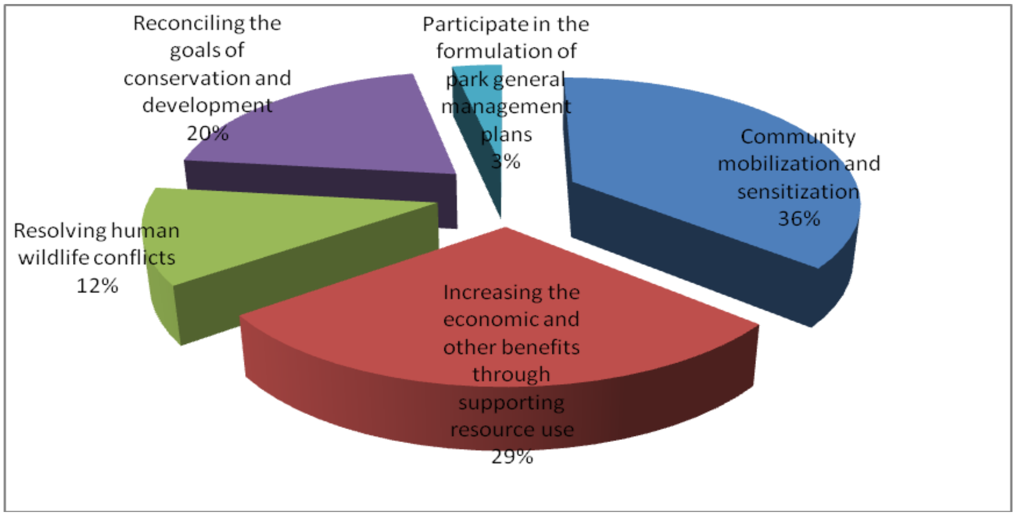

Fig. 4.18: Level of Participation of Local Authorities in Conservation Programmes

Local authorities participate in the conservation and management of the conservation areas through (1) community mobilization and sensitization towards conservation of the PAs, (2) increasing the economic and other benefits through supporting resource use, (3) reconciling the goals of conservation and development, (4) participating in resolving human wildlife conflicts to a limited extent, and (5) participating in formulation of park general management plans. (Fig. 4.18) Dudley (2008) agrees that “community-based conservation can encompass initiatives with different aims, governance systems, and levels of local decision-making power, ranging from self-regulated to co-managed conservation strategies". These initiatives contribute to conserving the wildlife, promoting tourism, and also help to better connect people to nature.

4.2.3.2.8 Private sector participation and ecological integrity

Private sector partners, both local and national, participate in conservation of biodiversity, χ^2 (1, N = 268) = 20.822, p = .000, α = .05, V = .326 (Appendix II). The high value (V) shows that private sector contributes towards conservation. The major partners included the Kibale Chimpanzee Conservation Project/Kibale Forest Schools Program, Semliki Chimpanzee Project, New Nature Foundation, African Cultural Tourism Centre, Rwenzori Mountaineering Services, Ruboni Community, Katebwa community chimpanzee habituation association, Bakingwe for Economic Advancement and Cultural Heritage, UNITE for Environment, among others (Table 4.6).

Table 4.6: Areas of Private Sector Participation in Biodiversity Conservation

Partner	Area of collaboration	Protected area	Conservation area
Worldwide Fund for Nature (WWF)	Capacity building, community benefit sharing, impact monitoring, in park resource use and monitoring	RMNP	QECA
MacArthur Foundation	Infrastructure	RMNP	QECA

	development, climate change research and impact monitoring, staff social facilities		
Fauna and Flora International	Conservation of cultural values	RMNP QENP	QECA
L'Umana Dimora & EV-K2-CNR	Monitoring weather parameters. climate change indicators	RMNP	QECA
Obudhingya Bwa Bwamba (OBB) Obukama Bwa Toro (OBT) Obusinga Bwa Rwenzururu (OBR)	Access to cultural sites, community tourism	RMNP SNP	KCA QECA
ECOTRUST	Visitor facility development	RMNP	QECA
Kibale Forest Schools Program UNITE for Environment	Conservation education and awareness the mobile clinic program.	KNP	KCA
Makerere University Fish and Monkey Project	Coordinating the mobile clinic program	KNP	KCA
Game Trails in	Translocation of	Katonga	KCA

conservation of Katonga wildlife reserve	selected game (Impala, Topi, and Zebras) from the ranches	WR	
Face The Future in the Netherlands.	Restoration of degraded forest ecosystem to offset CO_2 emissions from the atmosphere.	KNP	KCA
Uganda Carnivore Program	Research monitoring, and conservation of Uganda's carnivore Offer compensation to victims of large carnivores	QENP	QECA
Tooro Botanical Gardens	Problem animal management	RMNP	QECA
Kibale Eco health Project	Human-wildlife disease transfer	KNP	KCA
Kabarole NGO CBO Forum (KANCA)	Environmental education and social issues	RMNP	QECA
Makerere University Biological Field Station	Research on biodiversity	KNNP	QECA

	conservation		
Rwenzori Mountaineering Services, Ruboni Community and Turaco Tourism Community Group, Bakingwe for Economic Advancement and Cultural Heritage	Tourism development	RMNP, QENP	QECA
Eco lodges and camp sites	Provision of accommodation to tourists	All NPs and WRs	KCA QECA
District Local Governments	Community mobilization and sensitization	All NPs and WRs	KCA QECA

(Source: Survey, 2019)

The private sector institutions participate in the conservation and management of the conservation areas broadly through: (1) increasing the economic and other benefits to the local communities involved in resource protection and conservation, 2) reconciling the goals of conservation and development in the communities, and 3) research and monitoring, and fostering working relationships with local communities. For instance, the Uganda Carnivore Program has dedicated resources to save Uganda's lions and other carnivores such as leopards and hyenas in Queen Elizabeth Protected Area through research and monitoring, and fostering working relationships with local communities by compensating victims of carnivore attacks. Specifically, they participate in conservation-related initiatives mainly: i) removal of snares from the PAs, ii) conservation education, iii) carrying out research on wildlife, iv) operating science centres, v) promote use of improved cook stoves to reduce on demand for firewood from the park, vi) promote community tourism and cultural values, vii) conduct nature walks, viii) maintain tourism trails in collaboration with UWA, ix) chimpanzee habituation, x) monitor access and use of in-park resources, xi) translocation of selected game from the ranches, xii) human-wildlife conflict resolution, and xiii) maintaining access roads to tourism sites. These initiatives generally contribute to conserving the wildlife through empowering community participation and resource management, enterprise-based conservation, and handling conflicts between the park and community. The initiatives have also contributed to an increase in eco-lodges and campsites over the last decade in both conservation areas, an indication of growth in CBC in collaboration with the park. The initiatives further contribute towards socio-economic transformation, and also build a lasting impression in the communities. These initiatives ultimately contribute towards conserving the wildlife, promoting tourism, conservation of biodiversity, and also help to better connect people to nature with, and within the PAs. Strong institutional arrangements with favorable policy, well coordination between government agencies and conservation partners including local communities is key to success (Lamichhane, 2020). This reinforces the assertion that multiple conservation stakeholders should embrace socio-ecological management practices to ensure biodiversity protection (Campos-Silva et al., 2021).

However, in participating in biodiversity conservation, the private sector experiences a number of challenges: prohibited access to in-park resources for instance building materials for eco-lodges, high research fees, competing services offered by both private sector and park management (for instance, boat cruise, nature walks), limited capacity of the communities to engage in conservation activities, limited capacity to identify tourism opportunities, and limited support from the park authorities to empower communities in conservation-related skills. The private sector handles these challenges through engagement and or advocacy with the PA management.

4.2.3.2.9 Infrastructure development

From the FGDs in both conservation areas, PA management through the revenue sharing scheme supports infrastructure development in the park adjacent communities. This was revealed by the significant results from the Pearson Chi-Square, χ^2 (1, N = 268) = 26.251, p = .000, α = .05, V = .296 (Appendix II). The infrastructure developed were construction of school classrooms, gravity flow water scheme, shallow wells, road maintenance, eco lodges, trench excavation, and road maintenance, among others. The support to infrastructure development in the communities with funding from the conservation areas strengthens community park relations and community based conservation.

4.2.3.2.10 Community participation and park relations

The responses on the relationship between communities and park authorities were varied. The respondents indicated that the relationship was friendly (44%), depends on situation (33%), unfriendly (18%), and rest were undecided. Further analysis showed that community-park relations influences community participation (χ^2 (3, N = 268) = 24.815, p = .000, α = .05, V = .229) and the high value (V) shows a large effect (Appendix II). As a result of this influence, 74.8% of the respondents recommended co-existence with the wildlife protected areas, 8.6% recommended closure and degazettement, and the rest were undecided (χ^2 (2, *N* = 268) = 21.699, p = .001, α = .05, V =.282 (Appendix II**)**. Also, on whether this community-park relationship contributes to protection of ecological integrity, 67.1% of the respondents had a view that it does, and the rest to the contrary (χ^2 (1, *N* = 268) = 25.990, p = .000, α = .05, V = .452) and the high value (V) shows a large effect (Appendix II). This was collaborated by 49.4% of the respondents who valued both wildlife resources and their conservation, and community activities (e.g cultivation, livestock farming) compared to 24% of the respondents who valued wildlife resources and their conservation only, and 26.5% who valued community activities only (χ^2 (2, *N* = 268) = 19.422, p = .000, α = .05, V = .329) (Appendix II).

Communities participate in the conservation and management of wildlife resources which in turn improves community-park relations. They participate in removing snares set by poachers; and providing intelligence information through reporting illegalities; etc, are all indications of community participation in biodiversity conservation. This community participation creates a friendly relationship between the communities and park authorities which strengthen community participation in conservation of wildlife resources. This was evident in both conservation areas, and the reasons for this participation were majorly the benefit sharing programme, and the education and awareness programme to which the communities are beneficiaries. However, there still remained pockets of unfriendly relations between park management and local communities which threaten community based conservation. The unfriendly relations between park management and the local communities was due to (1) park boundary contentions, (2) problem animal-related conflicts, and (3) harshness of some park staff while dealing with community issues and handling of illegalities inside the wildlife protected areas.

Involving community actors in conservation programmes yields great results, namely, (1) increased sense of 'ownership', (2) support for the protection of the wildlife PAs, (3) involvement in decision-making, (4) links planning for conservation with planning for development, and (5) provides a mechanism for communication, where views, concerns and opinions on management of the protected area can be shared between the managers and community stakeholders. Further, the recommendation that local communities should coexist with wildlife protected areas is a clear assertion that communities value wildlife and its conservation. The reasons advanced for this coexistence were provision of ecosystem services, preservation of nature, cultural attachment, contribution to community welfare through access to in-park resources, and support of community development projects.

4.2.3.2.11 Motivation of local communities to participate in conservation programmes

In both conservation areas, communities participate in conservation programmes willingly, out of concern for wildlife, and continual availability of the in-park resources (Fig. 4.19) like water, medicinal plants, mushrooms, firewood, handicraft materials. Communities were motivated to participate in wildlife conservation programmes (χ^2 (2, N = 268) = 46.013, p = .000, α = .05, V = .588) (Appendix II).

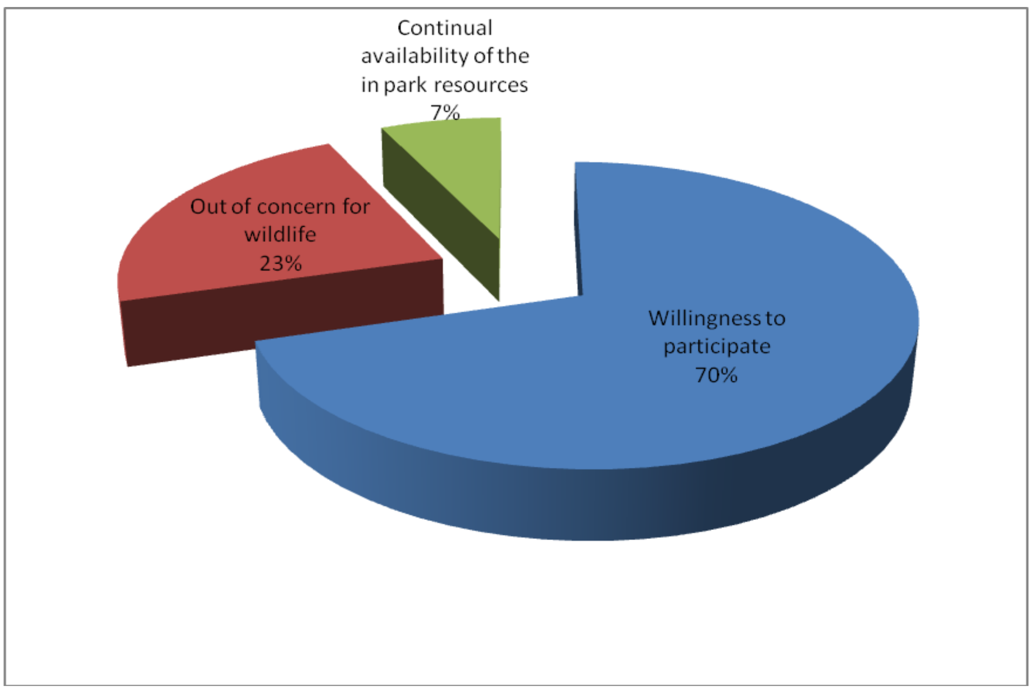

Fig. 4.19: Community Participation in Wildlife Conservation Programmes

Further, the communities were committed to wildlife conservation and related programmes, and the key motivating factors were incentives, cultural attachment, and collaboration with other stakeholders, among others (Fig. 4.20).

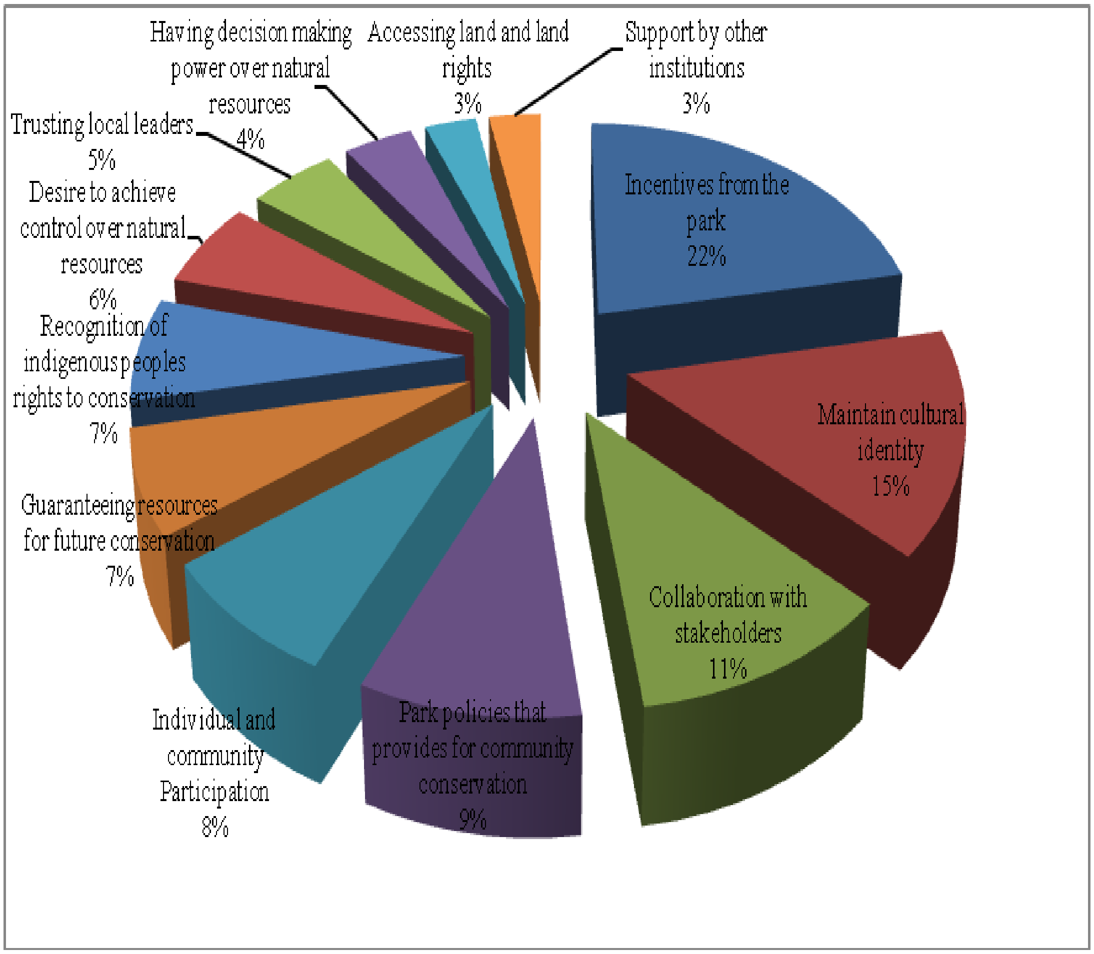

Fig. 4.20: Motivation of Communities to Commit to Conservation Programmes

Local community participation in wildlife conservation programmes is motivated by various factors which are basically self-centered, and these are mainly (1) incentives provided by the conservation areas, (2) cultural attachment, (3) stakeholder collaboration, (4) existing park policies, (5) involvement in park activities, (6) recognition of indigenous rights to conservation, (7) guaranteeing resources for future conservation, (8) dominance over natural resources, (9) trusting local leaders, (10) involvement in decision making, and (11) access to in-park resources (Fig. 4.16). Conservation efforts incorporate the interests and views of local people (Western & Wright (Eds)., 1994).

Generally, Community Based Conservation creates increased community knowledge and collaboration on conservation and management of biodiversity which builds appreciation and capacity of local communities for the wise use of biodiversity and other natural resources since they now have a stake in resource conservation and management. Democratic, equitable governance must be core principles in conservation policy and practice, and communities need to own the process of self organisation and utilisation of natural resources (Kothari et al., 2013). Therefore, CBC to be effective, governments and wildlife institutions should relinquish some or even most of its powers to the local people to empower them make their decisions (Songorwa et al., 2000).

4.2.3.3 Community Perceptions and Attitudes

4.2.3.3.1 Community Perceptions

Socio-demographic factors. Socio-demographic factors had a significant positive association with community perceptions and attitudes of wildlife conservation (Table 4.6). The Spearman's rho (ρ) correlation coefficient revealed a significant positive association between age and community perceptions and attitudes of the importance of the park to protect plants and trees, ($r_s(268) = .708$, $p < .01$), wild animal species, ($r_s(268) = .712$, $p < .01$), and park land, ($r_s(268) = .531$, $p < .05$). There was a significant positive association between level of education and community perceptions and attitudes of the importance of the park to protect plants and trees, ($r_s(268) = .763$, $p < .01$), and wild animal species, ($r_s(268) = .733$, $p < .05$). However, there was negligible correlation between gender, and community perceptions and attitudes of the importance of the park to protect plants and trees in the park, ($r_s(268) = .009$, $p < .01$); and animal species, ($r_s(268) = .049$, $p < .05$); and between distance of household from the park boundary and community perceptions and attitudes of punishing people who poach, ($r_s(268) = .024$, $p < .05$) (Table 4.7).

Table 4.7: Relationship between Socio-demographic Factors and Community Perceptions and Attitudes towards Conservation of Wildlife

Socio-demographic factors	**Conservation perception (Values are Spearman's rho (ρ) correlation coefficient at α=0.01 and α=0.05)**					
	It is important to protect plants and trees in the park	It is important to protect wild animal species in the park	People who poach should be punished	It is good park land is protected	I think the park was created for the betterment of the community	I am happy that my village borders or is in the park
Gender (N = 268)	$r_s = .009$, $p < .01$	$r_s = .049$, $p < .05$	$r_s = .992$, $p > .01$	$r_s = .147$, $p > .01$	$r_s = .978$ $p > .01$	$r_s = .591$ $p > .01$
Age (N = 268)	$r_s = .708$, $p < .01$	$r_s = .712$ $p < .01$	$r_s = .093$ $p > .01$	$r_s = .531$ $p < .05$	$r_s = .034$ $p < .05$	$r_s = .005$ $p < .01$
Level of education (N = 268)	$r_s = .763$, $p < .01$	$r_s = .733$, $p < .05$	$r_s = .318$, $p > .01$	$r_s = .309$, $p > .01$	$r_s = .878$, $p > .01$	$r_s = .284$, $p > .01$
Distance of	$r_s = .533$,	$r_s = .751$,	$r_s =$	$r_s = .533$,	$r_s = .518$, p	$r_s =$

household from PA (N = 268)	p > .01	p < .01	.024, p < .05	p > .01	> .01	.982, p > .01
Length of residence (N = 268)	r_s = .822, p > .01	r_s = .946, p > .01	r_s = .479, p > .01	r_s = .349, p > .01	r_s = .609, p > .01	r_s = .031, p > .01
Household size (N = 268)	r_s =.916 p > .01	r_s = .202, p > .01	r_s = .560, p > .01	r_s = .451 p > .01	r_s = .735, p > .01	r_s = .569, p > .01
Acreage (if owns land) (N = 268)	r_s = .371, p > .01	r_s = .649, p > .01	r_s = .774, p > .01	r_s = .042, p < .05	r_s = .196, p > .01	r_s = .600, p > .01

(Source: Survey, 2019)

Socio-demographic factors mainly gender, age, education level, and distance of household from the park boundary influence community perceptions and attitudes of wildlife conservation. These findings are supported by other past studies (Byer, 1996; Snyman, 2012; Gandiwa et. al, 2013). Community perceptions are affected by different socio-demographic factors (Snyman, 2012). Age has a significant positive correlation with conservation perceptions (Tessema et al., 2007; Snyman, 2012). There is a strong relationship between socio-demographic variables and perceptions and attitudes of local communities towards parks and wildlife. Other studies (Kideghesho et al., 2007; Manyama et al., 2014; Masud & Kari, 2015; Mutanga et al., 2015) also reported a correlation between the level of education and conservation attitudes. Better-educated people may be better able to understand the role of protected areas in conservation, as well as the environmental services they provide (Tessema et al., 2010; Allendorf et al., 2012). Further, the distance of the respondent from the park boundary has significant effect on the attitudes held by individuals. Those from villages bordering protected areas were more negative towards the protected areas than the other group from villages located further from protected areas (Mariki, 2013; Kirumira et al., 2019). The negative attitude towards the protected areas is probably due to the costs incurred by local communities from problem animals and vermin through destruction of crops and livestock, and loss of human life in communities adjacent the PAs. Close proximity to park boundaries increases the likelihood of crop raiding and livestock predation (Salerno et al., 2016).

4.2.3.3.1.1 Local Community Perceptions of the Park

Purpose of the park. Regarding the purpose of the parks, analysis of the community responses indicated statistically significant difference in responses ($F_{(3, 265)}$ = 1.239, p = .001, α = .05). Eighty two percent (82%) of the respondents indicated conservation of wildlife, 16% tourism development, and the rest indicated fulfillment of local social needs and conservation of bio-cultural diversity.

Visit to the parks. Twenty two percent (22%) of the respondents had visited the park (χ^2 (1, N = 268) = 6.523, p = .039, α = .05, V = .204), and their reasons for visitation varied: with resource uptake scoring 97%, tourism (2%), and 1% for study purposes. Those who did not visit the park (78%) cited various reasons: high park entry fees (56%), viewed the park as a liability to them due to human-wildlife conflicts (12%), and the rest “had no reason to visit”.

Community benefits. Communities derive benefits from the parks through the collaborative resource management programme (where protected area management shares benefits, decision-making, authority and responsibility in the management of protected areas or their resources with the local people). The benefits include resource access and use (21%), employment (19%), environmental services (18%), community tourism enterprises (17%), appreciating wildlife and beauty (8%), revenue sharing (5%), culture related benefits (5%), scholarships (5%), and wildlife use rights trailed with (2%) an that these benefits contribute to poverty reduction, as revealed by the statistically significant result of χ^2 (8, N = 268) = 38.479, p = .001, α = .05, V = .283.

Generally, communities have a positive perception towards conservation of parks and wildlife. Their perception is influenced by the benefits they derive from the parks mainly resource access and use, revenue sharing grants, community tourism enterprises/opportunities, employment opportunities, environmental services, appreciating wildlife and beauty, culture related benefits, scholarships, and to a limited extent wildlife use rights. These benefits create a positive perception of the local communities towards wildlife conservation. The benefits boost positive attitudes and perceptions towards conservation (Byer, 1996).

4.2.3.3.1.2 Local community perceptions of the park's attributes

Park boundaries. Local communities were aware of the park boundaries, as revealed by the statistically significant results from the one way ANOVA ($F_{(3, 265)}$ = 4.717, p = .001, α = .001), and they participation in their management was statistically non-significant ($F_{(3, 265)}$ = 17.23, p = 0.060, α = .001). There were still human-wildlife conflicts (situation that arises when wildlife's requirements overlap with those of human population creating costs to the affected people and wildlife) along the park boundary arising from crop raiding, loss of livestock to predators, human injuries and death resulting from attacks by wild animals, and boundary contentons as a result of shifting of park boundaries by local communities and park authorities.

Management of the park and park resources. Analysis using the Pearson Chi-Square revealed statistically significant results on who manages the park and park resources (χ^2 (2, N =268) = 13.288, p = 0.000, α = .05, V = .289) (Appenddix III). Specifically, 95% of the respondents indicated that the wildlife agency (Uganda Wildlife Authority) manages the parks, while the rest didn't know.

Community conservation/involvement of local communities in park management activities. The FGDs with the communities and park staff indicated that park authorities involve the local communities in the benefit sharing schemes mainly conservation awareness and education, collaborative resource management, resource access, revenue sharing, community tourism, and wildlife enterprises/business opportunities. However, the communities were not aware of the wildlife user rights policy.

Institutional arrangements. The focus group discussions with the communities and park staff, revealed that there were no established community conservation institutions which would participate in managing the wildlife in-situ and ex-situ.

Legal and illegal activities. Some residents in the communities were involved in illegal activities mainly armed poaching for game meat, illegal entry into the park, and resource uptake (trees for timber and building poles, charcoal burning, domestic animal grazing, medicinal plants, fish, wild honey, ivory from elephants, and harvesting of *Prunus africana* bark especially in KNP and RMNP). As a result, the victims when arrested were punished. Communities had knowledge of victims punished for participating in illegal activities in the park, and 54% of the respondents viewed the punishments as too harsh and stringent, 36% -not stringent enough, and 9% - fair, and the rest were not decided (χ^2 (3, N = 268) = 1.702, p = .001, α = .05, V = .636). The punishments included imprisonment, fines, and community service.

Wildlife population. With regards to the response to the question "In your own view, has the park contributed to increase in wildlife numbers?," the results were not statistically significant ($F_{(3, 265)}$ = 1.132, p = .338, α = .001).

Research and monitoring. From the FGDs, local communities were not involved in wildlife research and monitoring across the wildlife PAs which involvement would not only present an opportunity for indigenous knowledge, but also create attitudinal change of communities towards the parks and wildlife.

Tourism development. From the FGDs, the local communities indicated that they were aware that the parks are areas of both foreign and domestic tourism. They present an opportunity for local communities to participate in community-based tourism.

Generally, local communities acknowledged the existence of the park, its attributes and resources. This positive community perception could be influenced by the knowledge and awareness of the park and its park's attributes mainly park management, participation in park boundary management, community involvement in park management activities, community-based tourism, and knowledge of legal and illegal activities with associated punishments. The community perception is a testimony to appreciation of conservation of wildlife resources (Muboko et al., 2014).

4.2.3.3.1.3 Local community perceptions of conservation of the park and park resources

Knowledge and awareness of the importance of the park and park resources. Regarding the level of knowledge and awareness of the importance of the park and park resources, 61.5% of the local communities expressed that they were aware (χ^2 (1, N = 268) = 43.511, p = .000, α = .05, V = .468).

Conservation of the park and park resources. All the views of the community on conservation of the park and park resources were positive. The communities had the same mode and range for the last two scale items, that is, 5 and 4 respectively, which indicated positive perceptions towards the protection of plants, trees and wild animals, and the Kruskal-Wallis One Way ANOVA test results indicated statistically significant differences in the perceptions. (Table 4.8)

Table 4.8: Community Perceptions of Conservation of the Park and Park Resources

Conservation perception	Rating of protected areas using Likert scale (Values are the mode, and range in parenthesis)								Kruskal-Wallis One Way ANOVA (α = .05) (N=268)					
	Kibale NP	Semuliki NP	Toro-Semliki WR	Katonga WR	Queen Elizabeth NP	Rwenzori Mountains NP	Kigezi WR	Kyambura WR	N	Sum of Squares	df	Mean Square	F value	P value
It is important to protect plants and trees in the park	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	268	20.822	3	6.941	3.676	.000
It is important to protect wild animal species in the park	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	268	27.847	3	9.282	5.756	.001
People who poach should be punished	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	4(4)	268	21.481	3	7.16	0.609	.610
It is good park land is protected	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	5(4)	268	48.659	3	16.22	7.457	.000
I think the park was created for the betterment of the community	2(4)	2(4)	5(4)	5(4)	1(4)	2(4)	2(4)	2(4)	268	35.482	3	11.827	3.339	.021
I am happy that my village borders or is in the park	2(4)	5(4)	5(4)	5(4)	5(4)	5(4)	1(4)	2(4)	268	135.019	3	45.006	2.298	.080

(Source: Survey, 2019)

Local communities had mixed perceptions of park and park resources. Some communities perceived the parks as areas majorly for conservation of wildlife, and tourism development; and that they do not support community livelihood improvement initiatives. This perception is likely due to the awareness and knowledge about the park and park resources. However, other communities perceive the parks as non-contributing towards betterment of the community, and this perception could be due to the costs local communities incur as a result of the problem animals and vermin from the parks. This finding corroborates with that of a similar study conducted in Southeastern Zimbabwe (Gandiwa et al., 2013) where communities had mixed perceptions of wildlife conservation. This perception may indicate that the communities generally understand the importance of wildlife conservation (Gandiwa et al., 2013; Matema & Andersson, 2015).

Challenges from the park and its resources. Local communities face a number of challenges which affect perceptions about wildlife PAs.These challenges were generated by asking people why they liked or disliked neighboring the park Fifty nine percent (59%) of the respondents (N = 268) indicated that they disliked living adjacent the PAs because of the challenges they pose to them. The key challenges identified by this percentage (59%) of the respondents were crop raids (51.3%), injury or death to humans (13.9%), zoonotic diseases attacking livestock (12.2%), unfriendly park policies 11.3%, and beating by the park patrol team when illegally found in the park (11.3%). The remaining 51% of the respondents (N = 268) indicated that they liked living adjacent the wildlife PAs.

4.2.3.3.2 Local community attitudes

4.2.3.3.2.1 Local community attitudes towards the park and wildlife resources

Community-park relations. Regarding the attitudes of the local communities towards the park authorities, 44% of the respondents indicated a friendly attitude, 33% indicated that it depends on situation, 18% reported unfriendly attitude, and 5% were non committal. The attitudes of park authorities towards communities has an effect on community participation in the conservation and management of the park and wildlife resources (χ^2 (3, N = 268) = 24.815, p = .000, α = .05, V = .229) and the high value (V) shows a very strong effect. Further analysis using Kruskal-Wallis One Way ANOVA revealed a statistically significant difference in community responses on community-park relations with $F_{(3,\ 265)} = 4.526$, p = .001, $\alpha = .05$. And this interaction contributes towards conservation of wildlife ($F_{(3, 265)} = 10.549$, p = .000, $\alpha = .05$).

The local communities expressed mixed attitudes towards the park and park resources. The friendly attitude expressed by the majority of the community members was probably due to the conservation education and awareness, quick response by park rangers to scare away stray wild animals back into the wild, and the benefit sharing programme─especially resource access. And because of this gesture, the communities reciprocate by reporting illegalities inside the park to park management. These interactions between local people and protected area management not only improve the attitudes towards protected areas but also towards conservation issues generally (Moreto et al., 2016). However, the negative attitude was probably due to restrictions on resource access and use, poor handling of victims of illegal entry into the parks and wildlife reserves, and the costs incurred by communities─loss of crops and livestock and injury or even death to humans─as a result of problem animals and vermin from the parks. Communities did not appreciate the fact that their villages bordered the PAs due to the costs they incurred from living closer to PAs, e.g., loss of crops and livestock due to wildlife depredation (Gandiwa et. al, 2013).

Community interest in knowing about conservation of the park and park resources. The responses of the park adjacent communities on the level of community interest in knowing about conservation of the park and park resources revealed that 41.3% of the respondents were "interested" and 39.1% were "very interested." When combined, the overall community interest in knowing about conservation of the park and park resources totals to 80.4% (Fig. 4.21). Further analysis using Kruskal-Wallis One Way ANOVA revealed a statistically significant difference in community responses on level of community interest in knowing about conservation of the park and park resources with $F_{(3, 265)} = 5.231$, $p = .001$, $\alpha = .05$.

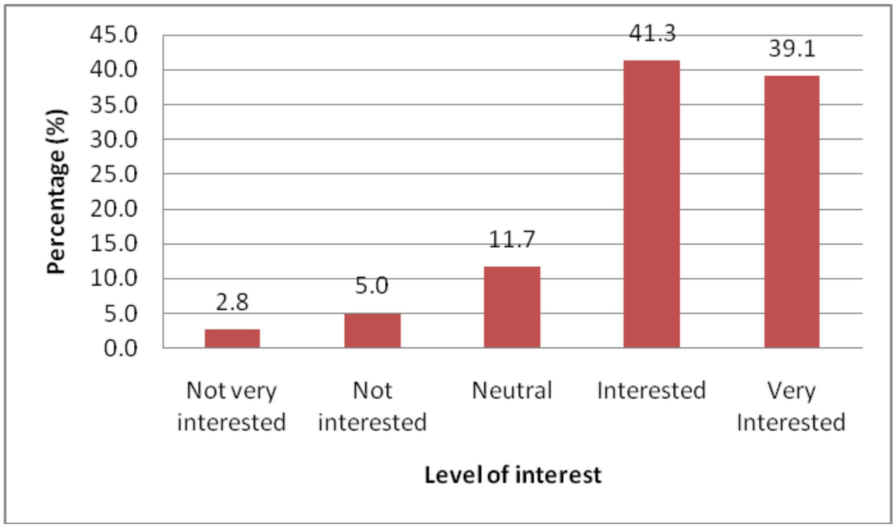

Fig. 4.21: Local Community Interest in Knowing about Conservation of the Park and Park Resources

Level of awareness of communities about the objectives of conservation of the park and park resources. With regard to the level of awareness of communities about the objectives of conservation of the park and park resources, analysis indicated that 83% of the respondents showed interest (Fig. 4.22). Further analysis using Kruskal-Wallis One Way ANOVA revealed a statistically significant difference in community responses with $F_{(3, 265)} = 4.661$, $p = 0.004$, $\alpha = .05$.

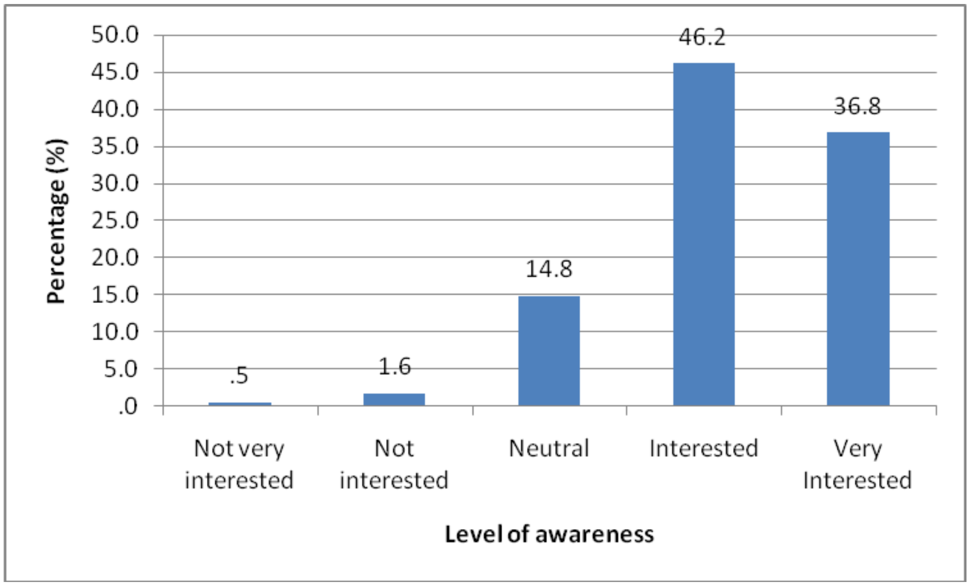

Fig. 4.22: Level of Awareness about the Objectives of Conservation of the Park and Park Resources

Level of interest in involvement in the conservation of the park and the park resources. The level of community interest in involvement in conservation of the park and park resources revealed that 41.2% of the respondents in the park adjacent communities were "interested" and over 40.7% were "very interested." When combined, the overall community interest in involvement in conservation of the park and park resources totals to 81.9% (Fig. 4.23). Further analysis using Kruskal-Wallis One Way ANOVA revealed a statistically significant difference in community responses with $F_{(3, 265)} = 4.053$, $p = .008$, $\alpha = .05$.

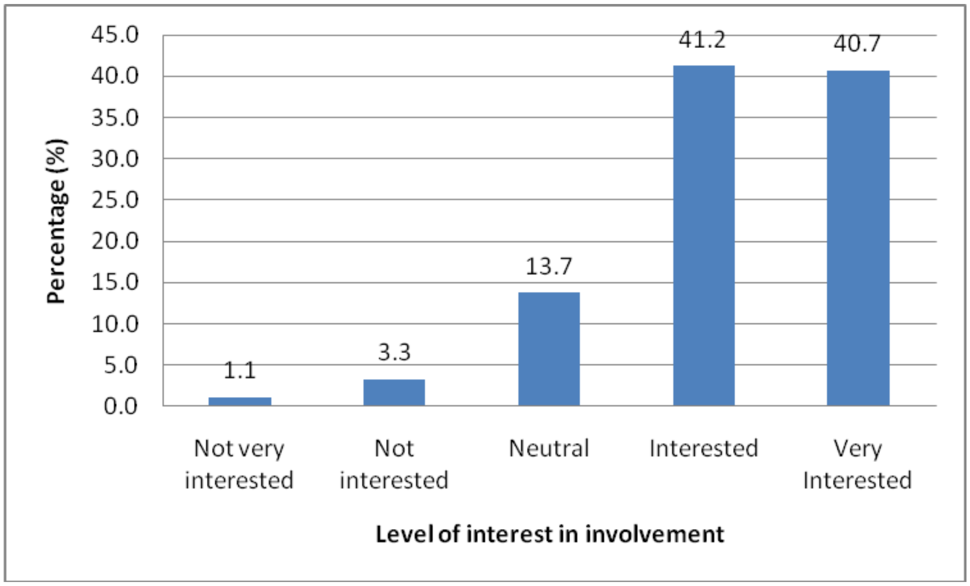

Fig. 4.23: Level of Interest in Involvement in the Conservation of the Park and the Park Resources

Level of community involvement in park programmes. Local community involvement in park programmes varied. Analysis of whether communities participate in park programmes, Kruskal-Wallis One Way ANOVA test revealed statistically significant results for participation in decision making processes ($F_{(3, 265)} = 6.053$, $p = .001$, $\alpha = .05$) and benefit sharing programme ($F_{(3, 265)} = 2.505$, $p = .041$, $\alpha = .05$), and no statistically significant results in resolution of human-wildlife conflicts ($F_{(3, 265)} = 3.777$, $p = .062$, $\alpha = .05$).

Impact of wildlife on people's life and livelihoods. The wildlife protected areas and resources therein impact on the local communities affecting their people's life and livelihoods through loss of crops without compensation (38%), loss of livestock through injury and transmission of zoonotic diseases (27%), loss to human life (18%), depriving the community of access to land for production activities (11%), and law enforcement operations disturb community (6%). (χ^2 (4, N = 268) = 9.031, p = .000, α = .05, V = .374). On responses to the question "as a community adjacent to the park, what do you value most", 26.5% indicated wildlife resources and their conservation, 24.1% indicated that they valued community activities (e.g cultivation, livestock farming, etc), and 49.4% indicated that a combination of both conservation and community activities was more valuable. (χ^2 (2, N = 268) = 15.031, p = .020, α = .05, V = .233)

Generally, the local communities expressed high interest in knowing about conservation of the park and park resources (Fig.4.21), objectives of conservation of the park and park resources (Fig.4.22), and interest in involvement in conservation programmes (Fig. 4.23). The high expression of interest in knowing about conservation of the park and park resources, objectives of conservation of the park and park resources, and interest in involvement in conservation programmes could be due to the conservation awareness and education programme, and value the communities attach to the park, park resources, and their conservation.

4.2.3.3.2.2 Good practices to improve on community attitudes

The local communities proposed good practices to park management to improve on community attitudes towards the wildlife PAs, and these were: supporting community livelihood/economic options (45%), empowering the local communities (37%), increasing conservation education and awareness (12%), and strengthening park regulations, policies and laws (6%) (χ^2 (3, N = 268) = 41.531, p = .000, α = .05, V = .493).

4.2.3.4 Role of PA management in supporting Community Conservation

Support infrastructure development outside protected areas. From the FGDs, PA management through the revenue sharing scheme, supports to some extent infrastructure development in the community. On whether infrastructure developed in communities using revenue sharing scheme strengthens community park relations and community based conservation in both conservation areas, result from the Pearson Chi-Square was statistically significant, $\chi^2(1, N = 268) = 26.251$, $p = .000$, $\alpha = .05$, $V = .296$ and the high value V shows a very strong effect that infrastructure development has on the community. (Appendix II) The infrastructure supported adjacent QECA were school classrooms, boreholes, eco lodges, trench excavation, and road maintenance, among others (Fig. 4.24).

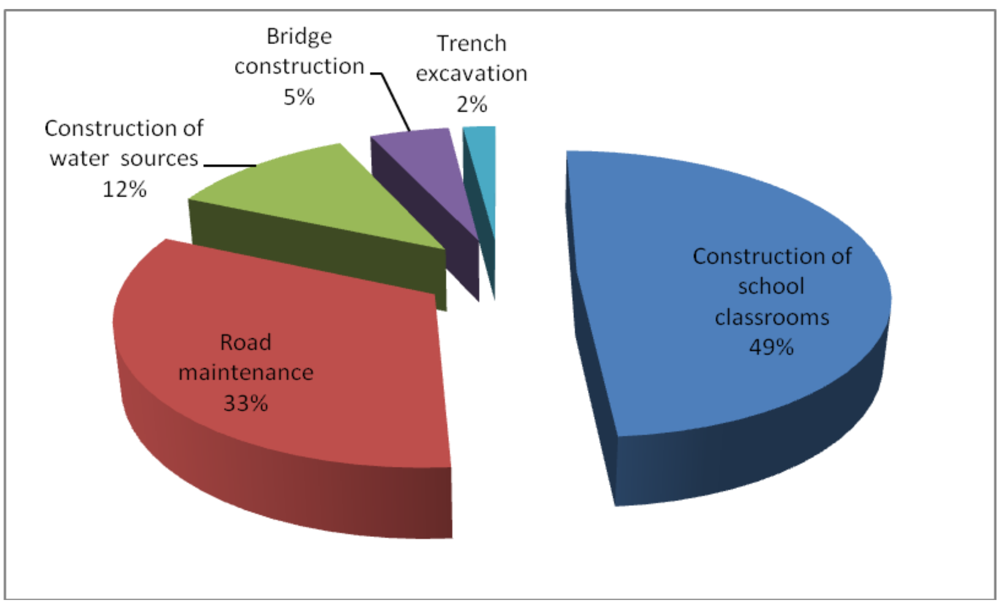

Fig. 4.24: Support of Protected Areas on Community Infrastructure Development

Support community livelihood projects. Park management supports community livelihood projects such as ecotourism ventures, setting up of apiaries, rice growing, capacity building, among others. The FGDs with park staff in the community conservation department revealed that a section of former poachers denounced poaching activities during the period of study in RMNP alone during the study period. They received financial support to finance livelihood projects, and in return they participate in boundary maintenance, report illegalities in the park, and sensitize communities against poaching, interventions that promote that conservation of biodiversity.

In addition, the communities suggested a number of alternative sources of livelihood that the PA management should support to relieve pressure on the park from the local communities, and they included provision of seed and seedlings that are non-palatable to wild fauna, compensation in case of damage to crops and livestock or injury, support to community SACCOs, and capacity building in business and entrepreneurial skills.

Promote Community Based Tourism. During the FGDs, it was evident that the Park Authority continued to engage, promote and involve the local community in conservation and tourism activities. Some of the key community based institutions include: Rwenzori mountaineering services, Ruboni community, Katebwa community chimpanzee habituation association, Nyamugasani community tourism association, Rwenzori Guides and escorting association and Turaco Tourism community group, among others. The PA support these community based tourism institutions through capacity building in well packaged wildlife information to tourists, tour guiding, marketing of tourism products, safety issues, waste management; carry out inspection and compliance checks of CB tourism facilities; allow them access resources from the park to make tourist products; provide incentives to them like space to display their products (e.g handicrafts); provide them with skilled tour guides and drivers to guide their clients in the park; and specifically for Kyambura CB tourism group which operates a tourism site, UWA has employed a manager and guides from the local community to manage the site whom they pay. However, to a limited extent, this opportunity is abused by the groups through engaging in illegal activities like poaching when collecting craft materials from the PA; snatch visitors destined to the park; and impersonate park guides, guide the tourists into the park without security who (tourists) later complain to the park authorities for the poor quality service.

Promote benefit sharing. Through the wildlife use rights scheme, the wildlife agency permits regulated and sustainable utilization of wildlife resources. This has further enhanced the benefits to communities and private sector through wildlife-based enterprise development such as wildlife trade, sport hunting, wildlife farming and ranching. For instance, communities adjacent Katonga Wildlife Reserve receive 50% of park revenue generated from the concessionaire on sport hunting which they use to construct valley dams to address the problem of water scarcity for livestock. During the FGDs, the community expressed satisfaction with the intervention (the 50% of revenue from sport hunting) and intimated that they were fully supportive of conservation of biodiversity in the wildlife reserve. One of the pastoralists in the PA adjacent community asserted that “in the past, when there would be drought, we would seek for permits to collect water inside the wildlife reserve, but this has since stopped with the intervention of the valley dams”. PA management confirmed the assertion and added that water stress would increase pressure for grazing inside the park, which had since greatly reduced.

Contributions from ecosystem services. From existing literature, conservation areas play a critical role in Uganda’s economy through provision of ecosystem services. Although this is an indirect contribution that is not yet quantified in economic terms for the wildlife protected areas, mountainous ecosystems like Rwenzori, are water catchment areas providing water to very large human populations downstream. About 1.5 million people in the districts of Kabarole, Bundibugyo, Kasese and Kamwenge depend on water from Rwenzori Mountains National Park (UBOS, 2011). In addition, several hydropower generating stations have been constructed on the rivers emanating from Rwenzori Mountains National Park. The parks also provide ecosystem services like flood control, control of landslides, and carbon sequestration, among others.

Provision of employment opportunities. The Uganda National Development Plan III (NDPIII) highlights improved employment levels as one of the indicators of socio-economic transformation. UWA contributes to realization of this indicator by offering employment opportunities to the local population. On the question of whether UWA provides employment to members of the park adjacent communities, only indicated 1.2% direct employment, 3.8% indirect employment through employment in lodges, tour companies, community based tourism groups, and other private concessions; and 95% were not aware of any form of employment (χ^2 (2, N = 268) = 316.185, p = .000, α = .05, V = .298) (Appendix II). The communities indicated that employing people from the local communities had contributed towards improving community-park relations hence strengthening the notion of CBC. This was evident when there were occurrences of crop raids and injury or death inflicted by elephants, the communities and associated crowds listened more to natives employed by UWA during such incidents than the non-natives.

Transboundary collaboration. From the FGDs, transboundary PAs which are QENP, RMNP and SNP and their management participate in the trans-boundary collaboration initiatives supported by Wildlife Conservation Society (WCS) and Parc National des Virunga (PNVi). This trans-boundary collaboration involves joint patrols along the park borders, joint boundary meetings to share field reports and experiences, PA security, and planning which interventions contribute to conservation and protection of ecological integrity. However, the main challenges encountered in the trans-boundary collaboration initiative are communication barrier, movement restrictions at the borders, failure to harmonize and interpret the respective wildlife laws. This collaboration needs to be strengthened, and initiate cross border tourism.

Future role of wildlife protected areas. On what should be the priority role of protected areas in future, the respondents (N = 268) rated conservation and development highest with 23%, followed by sustainable use of natural resources and ecosystem services with 19%, promoting local employment 13%, fulfillment of local needs 12%, and provision of experiences of contact with nature trailing with 5% (Fig. 4.25).

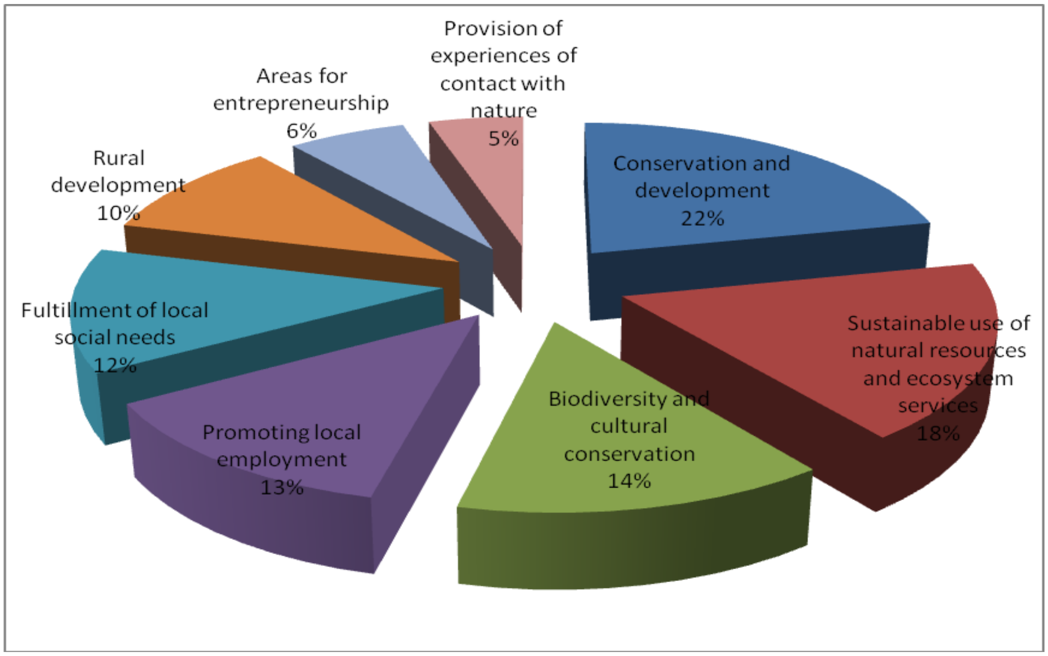

Fig. 4.25: Community Responses on the Future Role of Proceted Areas

The appreciation by local communities of the importance of parks in conservation and development is a testimony of community participation in wildlife conservation and biodiversity.

4.2.3.5 The usefulness of CBC on protection of ecological integrity

Increased conservation education and awareness. Increased conservation education and awareness ($F_{(3, 265)} = 22.574$, $p = .000$, $\alpha = .05$) on conservation and management of biodiversity is a testimony of some level of success of Community Based Conservation. This level of success is due to collaboration that exists amongst various players: local communities, private sector, governments, and wildlife institutions.

Maintenance of park boundaries. Park adjacent communities in both conservation areas were aware of the boundaries of the protected areas as revealed by the ANOVA test results ($F_{(3, 265)} = 4.717$, $p = .001$, $\alpha = .05$); and they participate in their maintenance ($F_{(3, 265)} = 1.723$, $p = .000$, $\alpha = .05$).

Contribution to increase in wildlife numbers. Eighty four percent (88.4%) of the respondents believed that the wildlife conservation areas have contributed to increase in wildlife population and only 16% with a contrary view ($F_{(3, 265)} = 1.132$, $p < .05$, $\alpha = .05$).

Improving collaboration between local communities and protected area management. The FGDs with park management, local communities and local authorities revealed that activities by the communities touch the park boundaries, and park management works with local authorities, to a limited extent, to conserve biodiversity. The private sector players collaborate more often with the community in supporting community conservation work through capacity building, and providing finances to fund short term projects. This collaboration supports conservation efforts ($F_{(3,265)} = 10.103$, $p = .000$, $\alpha = .05$).

Financial and non-financial benefits. The FGDs with park management, local communities and local authorities also revealed that through collaborative resource management, communities access in-park resources which include fish, honey, mushrooms, bamboo, medicinal plants, timber, building poles, grass for construction, stakes for farming, firewood, snail shells, and elephant dung for paper making. These resources attract both financial and non-financial benefits.

Increase in scope of community-based tourism programs, products and services. From the FGDs, there was noted diversity in community-based tourism programs, products and services. These include: nature trails, mountain climbing, tracking of lions, birding, different cultures, art products, crafts, performance arts, conservation education, boat riding, music, dance and drama.

Growth in eco-lodges and campsites. The FGDs with park management and private sector revealed that eco-lodges and campsites inside and outside the national parks have since grown over the last decade, an indication of growth in CBC. This growth has been achieved through collaboration of local communities, CBOs/NGOs, tour industry, and the park.

Infrastructure development outside protected areas. From the FGDs, PA management through the revenue sharing scheme supports infrastructure development. Park management contributes to infrastructure development in communities adjacent PAs, (χ^2 (1, N = 268) = 26.251, p = .000, α = .05, V = .296) (Appendix II), the high value (V) shows a great contribution of infrastructural development.

Access to financial and non-financial benefits to meet needs of local communities including access to in-park resources and incentives to support community projects and enterprises, growth in eco-lodges and campsites, and conservation education and awareness improves community welfare, collaboration between local communities and protected area management, and hence useful in protecting ecological integrity. The local communities need access to in-park resources, and incentives to support community projects and enterprises that improve their welfare. These benefits create meaningful impact in the local communities adjacent the wildlife protected areas. Inadequacy of benefits to the communities creates resentment towards conservation of wildlife resources. There is often contestation between local communities and protected areas premised on inadequate benefits and limited involvement to address their livelihood needs yet such communities bear conservation costs (Twinamatsiko, 2000).

4.2.3.6 Challenges facing Community Based Conservation

Governance challenge. From the focus group discussions with the local communities, issues of governance have a strong influence on the conservation of natural resources. The local authorities, which are the institutions mandated to manage and account for financial resources from UWA, have become the source of conflict. There is little engagement of the local communities in identification of projects to be financed under the revenue sharing scheme. This is due to lack of an institutional framework to govern funds unds under this scheme and other community based conservation initiatives. The private sector players interact more often with the community for the purpose of supporting community conservation work. They support community based conservation initiatives through capacity building, provision of finances and formation of structures. This approach creates community conservation initiatives that are largely focused on the projects themselves -which usually have a short time frame- rather than on community conservation programmes which would be long term-that can continue even after the private sector pulls out.

Limited community involvement in decision making. From the FGDs, representation in the decision making processes by local communities and local authorities was minimal. They only participate in developing park management plans and implementation of community development programmes. They do not participate in resolving human-wildlife conflicts and sharing conservation-related responsibility which are key decision making areas. Therefore, the interests and needs of affected communities are not captured during conflict resolution.

Community involvement in illegal activities. From the focus group discussions, park adjacent communities sign resource use agreements with park management to access in-park resources in both conservation areas. There is a tendency for communities to abuse this collaborative resource management arrangement by engaging in illegal activities especially poaching and harvest of other un-permitted in-park resources, as reported by park rangers and acknowledged by park adjacent communities.

Managing unrealistic expectations. From the FGDs, there was noted an emerging debate by the park adjacent communities about looking at community conservation as a component of livelihood security, as opposed to simply another form of biodiversity conservation. Park adjacent communities had a feeling that periodically they should be allowed to hunt inside the park for income generation and consequently livelihood improvement.

Despite the mixed perceptions and attitudes of local communities towards wildlife protected areas, community participation remains integral to conservation of biodiversity and protection of ecological integrity. This is in support of the third hypothesis that local communities participate in wildlife programmes to conserve biodiversity and protect ecological integrity of Queen Elizabeth and Kibale Conservation Areas

4.2.4 Threat reduction and protection of ecological integrity

This study, under fourth fourth objective, aimed at analyzing threats to wildlife conservation in the study area, and how they were being addressed.

4.2.4.1 Socio-demographic characteristics of the park staff respondents

The park staff were representative of all the study sites, and their representation was according to the size of the protected area (Fig. 4.26).

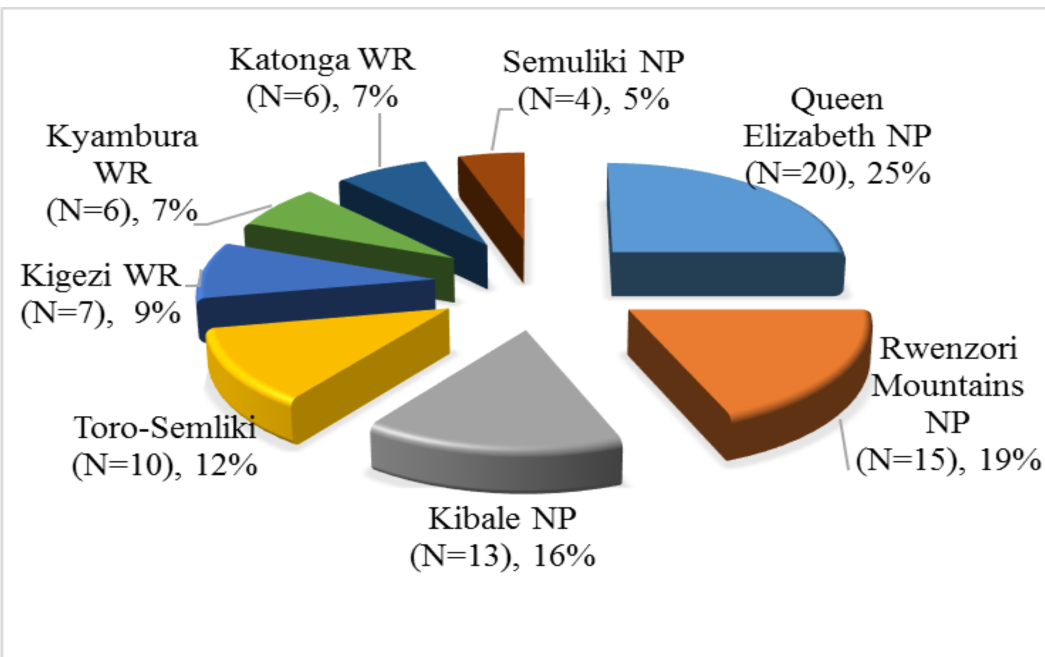

Fig. 4.26: Distribution of Respondents (park staff) across the Protected Areas (N=respondents)

The study established that park management recognizes socio-demographic factors of park staff mainly gender, age, education level and length of work experience in wildlife conservation (Table 4.8). Recognition of gender roles in biodiversity management is an important step in the achievement of conservation and sustainable use of biological resources (Kabir, 2013). The park staff had skills in biological science and other related discipline. They were experienced in wildlife management and biodiversity conservation (Table 4.9). Their long experience (11+ years in service with protected areas) in conservation meant that they understood the threats affecting conservation. Protected area management considers education as a key factor in empowering their staff with knowledge, skills and enhancing capacity and competence to conserve biodiversity. The park employees had the required skills in wildlife management and biodiversity conservation. In addition, length of work experience influences the level of understanding and implementing the mandate of PAs. This implies that these workers are knowledgeable and could provide the needed information on threats to biodiversity conservation in the Park, over the years. The presence of professionals corroborates the suggestion of Green (1999) that some industries required specially trained personnel to actualize set goals, and biodiversity conservation is a peculiar example.

Table 4.9: Socio-demographic Characteristics of Park Staff (N=81)

Variable	Category	Frequency	Percent (%)
Gender	Male	65	79.2
	Female	16	20.8
Age	18-31 years	19	23.7
	32-45 years	41	51.3
	46-60 years	17	21.3
	61+ years	4	3.7
Educational attainment	Certificate	1	1.9
	Secondary	15	18.9
	Diploma	36	43.4
	Degree	29	35.8
Years in service with PAs	<5 years	12	15.1
	6-10 years	20	24.5
	11-15 years	25	30.2
	16-20 years	15	18.9
	21+ years	9	11.3

(Source: Survey, 2019)

4.2.4.2 Overview of park management plans

From existing literature, only the wildlife protected areas studied had approved or draft park management plans. A quick scan through these plans indicated that they contained key sections including management purpose, objectives and strategies; conservation values; zoning; and management programs mainly resource conservation and management, monitoring and research, community conservation, tourism development and park operations which all contribute towards maintenance or restoration of ecological integrity. In addition, these management plans have only identified and documented the threats affecting the wildlife PAs without providing an analysis of the area (of habitat) affected, intensity and urgency of the threat. (UWA, 2011, 2013a; 2015)

4.2.4.3 Threats to biodiversity conservation

4.2.4.3.1 Spatial patterns of threats

From the threat reduction assessment index technique, it was found out that all the wildlife protected areas experience nearly similar threats which affect conservation of biological diversity therein. Out of a total of 14 threats identified, 7 were primary and common threats to all the protected areas studied and these were: i) increasing human population leading to illegal activities/resource off-take, ii) poaching and illegal wildlife trade/trafficking in wild meat and of recent in Ivory, iii) habitat transition/changes due to invasive alien species, iv) human-wildlife conflicts arising from wildlife attacks to humans and livestock, and destroying crops, v) wild fires, vi) unsustainable natural resource use, and vii) boundary encroachment through agricultural development (small-holder farming, and small-holder plantations), urbanization and village settlement (Table 4.10). The other threats were zoonotic and vector-borne diseases, road kill, trans-boundary issues, and infrastructure developments. On the whole, Kibale National Park, Queen Elizabeth National Park and Semuliki National Park were under greatest number of the threats, while Rwenzori Mountains National Park and all the four Wildlife Reserves (Katonga, Kigezi, Kyambura and Toro-Semliki) were under fewer threats. (Table 4.10)

Table 4.10: Spatial patterns of threats

		Conservation Area							
		Kibale				Queen Elizabeth			
	Threats	Kibale	Semuliki	Toro-Semliki	Katonga	Queen Elizabeth	Rwenzori Mountains	Kyambura	Kigezi
1	Human population pressure leading to illegal activities	1	1	1	1	1	1	1	1
2	Poaching and illegal wildlife trade	1	1	1	1	1	1	1	1
3	Habitat transition/changes	1	1	1	1	1	1	1	1
4	Human-wildlife conflicts	1	1	1	1	1	1	1	1
5	Wild fires	1	1	1	1	1	1	1	1
6	Boundary encroachment	1	1	1	1	1	1	1	1
7	Unsustainable natural resource use	1	1	1	0	1	0	1	1
8	Zoonotic and vector-borne diseases	1	1	0	1	1	0	1	1
9	Infrastructure development	1	1	0	0	1	0	0	0
10	Road kills	1	1	0	0	1	0	0	0
11	Trans-boundary issues	0	1	0	0	1	0	0	1
12	Pollution and poor waste management	1	0	0	0	0	1	0	0
13	Variation in water quality and quantity	0	0	0	0	1	1	0	0
14	Negative impacts of climate change	0	1	0	0	0	1	0	0

1=present; 0=absent; (Source: Survey, 2019)

Increasing human population. The existing literature showed that the human population surrounding Kibale and Queen Elizabeth Conservation Areas was growing at almost 3% per annum. The population density of communities living within a radius of 5 kilometers from the park boundary range between 100 – 500 persons per square kilometer, with higher population densities in the southern section ranging from 500 to over 1000 persons per square kilometer (GVTC, 2017). The increasing human population has brought about grazing and wildlife poisoning, reduced wildlife range, degradation of wildlife corridors, etc. There is increasing ecosystem degradation due to rapidly increasing human populations (UBOS, 2017).

Poaching and illegal wildlife trafficking. From the threat reduction assessment method and FGDs conducted, poaching and illegal wildlife trafficking was noted a serious threat in all the case study wildlife protected areas. The animals most commonly poached include hippos, and buffaloes and those less poached include the Uganda Kob, Topi, Reedbuck, Waterbuck, Warthog and Giant Forest Hog in QEPA. The animals are poached for meat, wildlife products, and some species are also captured for trade. Poaching for international trade in trophies such as ivory, hippopotamus teeth, pangolin scales as well as live trade in these products also constitute serious threats. The hunting methods are diverse and include the use of firearms (including automatic weapons such as the AK47), wire snares, nets, traps and use of set fires to lure animals to areas of new growth. Animal poaching for various reasons is the most serious threat to wildlife population growth and sustainability in Uganda (UWA, 2018).

Habitat transition/changes due to invasive alien species. From existing literature and direct observation, the invasive alien species were predominantly *Dichrostachys cinerea, Lantana camara, Opuntia vulgaris, Pathenium hysterophorus* (Congress weed), *Imperata cylindrica, Maerwa documbens, Opuntia vulgari and Clomelaena ordorata* in Queen Elizabeth Protected Area (UWA, 2011); *Eucalyptus spp, Senna spectabilis,* and *L. camara* in Kibale National Park (UWA, 2015); *Terminalia spp, Cedrella spp, L. camara* in SNP (UWA, 2005); *D. cinerea, and L. Camara* in Katonga wildlife reserve (UWA, 2018b); and *D. cinerea, L. Camara* in Toro-Semliki Wildlife Reserve (UWA, 2007). Habitat loss continues to be one of the leading threats to wildlife conservation often in form of degradation, fragmentation or outright loss. Wildlife habitats are therefore, critical components of ecological integrity and long-term survival of the ecosystem, and therefore, their destruction or loss reduces their potential utility (UWA, 2018).

Human-wildlife conflicts. The cases of human wildlife conflicts had a general increase over the years in both conservation areas (Fig. 4.27). However, from 2009 to 2014, KCA had more HWCs compared to QECA; and from 2015 the situation reversed (Fig. 4.27). The conflicts were mainly from crop destruction, livestock predation and human attacks by elephants, crocodiles, lions, leopards, chimpanzees, gorillas, baboons and monkeys. For instance in retaliation, local people killed 11 lions in Hamukungu—a fishing enclave in QENP in March 2018. Poaching has also led to loss of human life where rangers and other conservation cadres have been killed or injured when on duty. Also fatal cases of chimpanzee-human attacks have been occurring mainly targeting children and women around KNP. Also crocodile-human attacks have occurred and reported in the lake communities of Lake Edward and George.

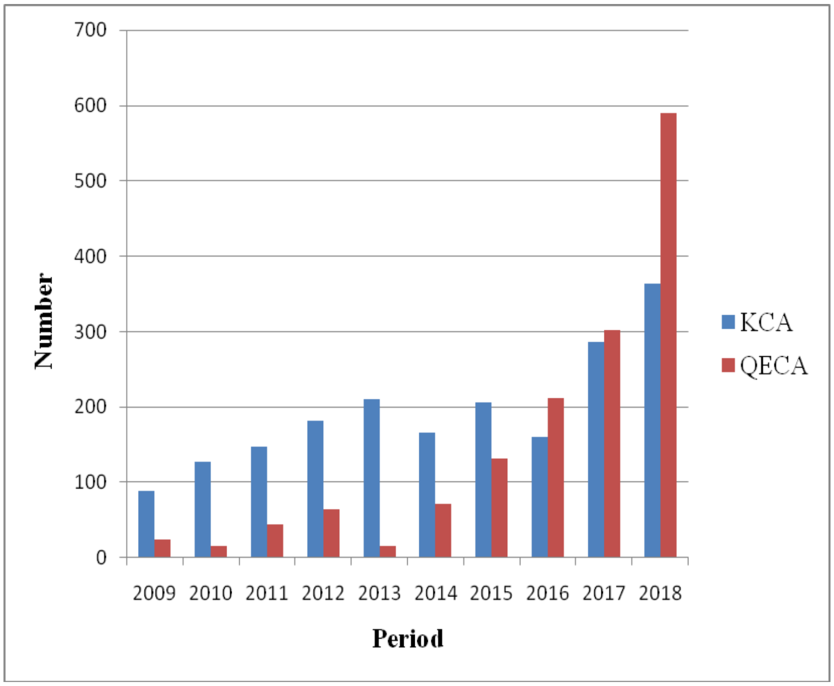

Fig 4.27 Trend in human wildlife conflicts in Kibale and Queen Elizabeth Conservation Areas (Raw data adopted from UWA, 2019)

The human wildlife pose a serious threat to conservation of biodiversity in the wildlife protected areas. Human-wildlife conflicts occur worldwide, and human injuries are the most severe manifestations of these human-wildlife conflicts (Packer et al., 2005; Kabuusu et al., 2018). But the killing of livestock and the crop raiding by wildlife are by far the most widespread source of such conflicts (Allendorf et al., 2012; Andrade & Rhodes, 2012; Kabuusu et al., 2018). For instance, in Canada wolves are reported to have killed close to 3,000 domestic animals in 14 years, whilst elephants in India and China led to a reduction of approximately 14% and 48%, respectively of annual crop production (Madhusudan, 2003; Zang and Wang, 2003). In Tanzania, 86% of the persons living in wildlife buffer zones reported crop damage, while 10% reported the killing of livestock and poultry (Kabuusu, 2018), and baboons have always caused significant crop destruction in Uganda. The incidence of wildlife-associated human injuries increased in QENP between 2006 and 2010, and was mostly caused by hippos (Kabuusu et al., 2018).

Wild fires. Fires are rampant across all the wildlife protected areas during the dry seasons annually. These fires are started by poachers, smokers, and even farmers as they prepare their gardens for planting. These fires spread to the wild threatening the various biodiversity in the wildlife protected areas, including slow-moving animals.

Boundary encroachment. Encroachment is prevalent in all the wildlife PAs. Encroachment results from human settlements, cultivation and with their associated activities. Local communities have removed concrete pillars to disguise and distort the park boundary especially around Kibale and Queen Elizabeth National Parks. Live markers along the park boundary have been illegally harvested, others being debarked to kill them in order to distort the park boundary. Other areas with contentious boundary included Kanyabwanga near river Rushaya in Kiyanga, Katunguru and Katwe-Kabatoro in Kasese District, In SNP the boundary was not opened and marked. It was only in RMNP that the boundary was clear, respected and properly managed under community boundary management committees. Some sections in the wildlife reserves were equally contested especially in Katonga wetlands in Katonga Wildlife Reserve, and sections of Kyabandara and the chimpanzee ranging area at Itojo in TSWR.

Unsustainable natural resource use. The natural resources extracted from the PAs include timber, building poles, grass for construction, stakes for farming, bamboo, firewood, medicinal plants, fish, honey, mushrooms, snail shells, and elephant dung for paper making. These resources attract both financial and non-financial benefits. However, most of these resources are acquired illegally.

Zoonotic diseases and vector-borne diseases. Nearly all the case study PAs are surrounded by livestock agriculture and dense human communities. Wild animals exit PAs to forage in agricultural fields, and people live in or enter national parks for grazing, and collection of in-park resources for their livelihoods; this movement results in interaction and conflict among wildlife, livestock, and people.

Infrastructure developments. Infrastructure developments in and around the parks were majorly hydropower development, road construction, staff accommodation and setting up of tourist lodges. These development projects carry with them associated impacts, including land take, waste generation, disturbance of migration routes, and poor waste management.

Road kills. PA managers stated that existing and proposed road construction (highways) interferes with animal movements and cause animal kills from speeding vehicles. In addition, roads also fragment habitats. Many of the proposed developments inside PAs are likely to be highly disruptive to wildlife (mining and energy development, and their ancillary infrastructure, including roads), and mitigation may not adequately minimize impacts.

Transboundary threats. Park management reported that transboundary threats to biodiversity conservation and forest management were mainly poaching across borders, trafficking of wildlife and forest products, seasonal incursions of pastoralists for water and grazing resources, fishing, charcoal burning, and timber harvesting. The affected PAs were QEPA, RMNP and SNP.

Climate change impacts. From existing literature, evidence has shown direct impacts of climate change on ecosystems within PAs in Uganda, but more systematic monitoring as well as vulnerability assessments is required to better understand the impacts and interactions at landscape scale. According to MWE (2015), the shrinking glacier coverage on the ice caps of the Rwenzori Mountains over the last 100 years is attributed to changes in temperature. The percentage of ice loss is highest on Mount Baker (96 percent), followed by Mount Speke (91 percent), and Mount Stanley (68 percent). Analysis of records on Uganda's glaciers has shown that the ice cap on Rwenzori has shrunk significantly in the last 100 years (IGAD, 2010)

This is affecting vegetation zonation and faunal distribution, including aquatic biodiversity, as the melting snowcaps reduce water reservoirs and may affect stream flow on the mountain (MWE, 2015). Satellite and photographic images show that in the early 1990s, the total glaciated area on Mount Rwenzori, was about 5 km^2 while a century ago it covered nearly 6.5 km^2 (MWE, 2015).

Climate change is also a major driver of species composition, diversity and ecosystem functioning (Galabuzi, 2015). Wildlife populations fluctuate seasonally and from year to year based on seasonal weather patterns. Climatic factors also regulate wildlife populations through changes in rainfall amounts, temperatures and levels of irradiation. These influence the quality and availability of food for wild animals resulting into high levels of inter and intra competition for food thereby affecting reproduction and survival rates and species shifts. Furthermore, climate change may be experienced in form of extreme weather events such as prolonged droughts and floods, disease outbreaks and proliferation of invasive species which lead to wildlife mortality (UWA, 2018a).

Administrative constraints to biodiversity conservation. The findings indicated that administrative costraints: inadequate funding ($F_{(2, 79)} = 5.095$, $p = .000$, $\alpha = .05$), insufficient incentives ($F_{(2, 79)} = 0.35$, $p = .000$, $\alpha = .05$) and inadequate patrol equipment ($F_{(2, 79)} = 0.328$, $p = .001$, $\alpha = .05$) were statistically significant hence threaten conservation of biodiversity. However, poor staff housing ($F_{(2, 79)} = 0.35$, $p = .926$, $\alpha = .05$), and weak support from neighboring communities ($F_{(2, 79)} = 0.35$, $p = .937$, $\alpha = .05$) were not statistically significant (Table 4.11).

Table 4.11: Administrative Constraints to Biodiversity Conservation

Administrative Constraint	Kruskals-Wallis One way ANOVA (α = .05)							
		Sum of Squares	df	Mean Square	Standard Deviation	Standard error	F	Sig.
Inadequate funding	Between Groups	5.105	2	0.729	0.9522	0.1058	5.095	.000
	Within Groups	6.442	79	0.143				
Inadequate patrol equipment	Between Groups	0.363	2	0.052	0.2715	0.0301	0.328	.001
	Within Groups	7.109	79	0.158				
Weak support from neighbouring communities	Between Groups	0.351	2	0.050	0.4653	0.0517	0.350	.937
	Within Groups	6.442	79	0.143				
Insufficient incentives	Between Groups	3.321	2	0.474	0.7047	0.0783	10.674	.000
	Within Groups	2.000	79	0.044				
Poor staff housing	Between Groups	0.351	2	0.050	0.3047	0.0338	0.350	.926
	Within Groups	6.442	79	0.143				

4.2.4.3.2 Analysis of threats

A total of 14 threats were analysed using one-way Kruskals-Wallis ANOVA at α = .05 to determine whether there is statistical evidence that they are significantly different or not. The findings indicated that the threats: increasing human population ($F_{(2, 79)}$ = 3.198, p = .000, α = .05), poaching and wildlife trafficking ($F_{(2, 79)}$ = 3.198, p = .000, α = .05), human wildlife conflicts ($F_{(2, 79)}$

= 3.406, p = .000, α = .05), wild fires ($F_{(2, 79)}$ = 3.917, p = .000, α = .05), boundary contentions ($F_{(2, 79)}$ = 3.198, p = .001, α = .05), habitat change ($F_{(2, 79)}$ = 2.958, p = .000, α = .05), infrastructure developments ($F_{(2, 79)}$ = 10.201, p = .001, α = .05), zoonotic diseases ($F_{(2, 79)}$ = 21.708, p = .001, α = .05), transboundary issues ($F_{(2, 79)}$ = .677, p = .001), unsustainable natural resource use ($F_{(2, 79)}$ = .833, p = .000, α = .05), and climate change impacts ($F_{(2, 79)}$ = 0.362, p = .001, α = .05) were statistically significant (Table 4.12). However, road kills ($F_{(2, 79)}$ = 2.722, p = .075, α = .05), and poor waste management ($F_{(2, 79)}$ = 1.802, p = .175, α = .05) showed non-significant results (Table 4.12). The wildlife protected areas experience various threats which were probably due to anthropogenic (agricultural encroachment, settlement, and infrastructure development) and natural causes (landslides, wild fires). The threats to conservation are growing in Eastern and Southern Africa region (IUCN-ESARO, 2020) and are directly related to population growth and completion for land (IPBES, 2018).

Table 4.12: Analysis of Threats

Threat	Kruskals-Wallis One way ANOVA test (N = 81 α = .05)							
		Sum of Squares	df	Mean Square	Standard deviation	Standard error	F	Sig.
Poaching & wildlife trafficking	Between Groups	3.184	2	1.592	3.184	.07935	3.198	.000
	Within Groups	7.268	79	0.092	7.268			
Habitat change	Between Groups	5.366	2	5.366	.35226	.03914	2.958	.000
	Within Groups	17.064	79	17.064				
Wild fires	Between Groups	0.248	2	0.248	.02565	.00285	3.917	.000
	Within Groups	7.663	79	7.663				
Human wildlife conflicts	Between Groups	5.366	2	5.366	1.02078	.11342	3.406	.000
	Within Groups	9.243	79	9.243				
Increasing human population leading to illegal activities	Between Groups	0.248	2	0.248	.08433	.00937	3.198	.000
	Within Groups	11.534	79	11.534				
Boundary contentions	Between Groups	3.942	2	1.971	.91422	0.10158	3.198	.000
	Within Groups	6.162	79	0.078	6.162			
Infrastructural developments	Between Groups	3.198	2	1.599	.76347	.08483	10.201	.001
	Within Groups	14.457	79	0.183				
Climate change impacts	Between Groups	3.77	2	1.885	.83394	.09266	10.362	.001
	Within Groups	14.378	79	0.182				

Unsustainable resource use	Between Groups	3.202	2	1.601	.28635	.03181	0.833	.000
	Within Groups	14.378	79	0.182				
Transboundary issues	Between Groups	0.14	2	0.07	.77211	.08579	0.677	.001
	Within Groups	8.216	79	0.104				
Zoonotic diseases	Between Groups	5.138	2	2.569	.67833	0.07537	21.708	.001
	Within Groups	17.064	79	0.216	17.064	17.064		
Road kills	Between Groups	0.856	2	0.428	1.23597	.13733	2.722	.075
	Within Groups	12.403	79	0.157				
Poor waste management	Between Groups	0.888	2	0.444	.96075	.10675	1.802	.175
	Within Groups	12.319	79	0.246				
Unsustainable natural resource use	Between Groups	3.202	2	1.601	.28635	.03181	0.833	.000
	Within Groups	14.378	79	0.182				

4.2.4.3.3 Threat Reduction and Threat Reduction Assessment

Data indicators and dataless indicators were considered in this study. The data indicators were analysed and various scores were assigned basing on the TRA Index (Table 4.13). Each indicator of ecological integrity was assigned a color score: dark green (TRA index 81-100%) for “acceptable” ecological integrity, light green (TRA index 51-80%) for moderate ecological integrity, yellow (TRA index 21-50%) indicating a “concern,” and red (TRA index 0-20%) indicating “impaired” condition requiring immediate management action. The dataless indicators mainly connectivity of the protected areas and change in vegetation were considered.

Table 4.13: Rating Scale for Determining Ecological Integrity Score

Rating	% of optimum	Colour	Ecological integrity description
3	81-100	Dark green	Acceptable ecological integrity (Very satisfactory)
2	51-80	Light green	Moderate ecological integrity (Satisfactory)
1	21-50	Yellow	Concern (Dissatisfactory)
0	0-20	Red	Impaired (Very dissatisfactory)

Source: Vickerman & Kagan (2014)

The reduction in threats in both conservation areas varied, as revealed by the threat reduction assessment index results. It was found out that all the wildlife protected areas in Kibale Conservation Area with exception of SNP had their threat reduction greater than 50% compared to all wildlife protected areas in Queen Elizabeth Conservation Area with less than than 50% except Kyambura WR (Table 4.14). According to the ecological integrity score card by Vickerman and Kagan (2014), this means that all the wildlife protected areas in Kibale Conservation Area (with exception of SNP) had a satisfactory level of ecological integrity compared to all wildlife protected areas in Queen Elizabeth Conservation Area (except Kyambura WR) with a dissatisfactory level of ecological integrity. (Table 4.14) This means that the wildlife protected areas that lie entirely within Uganda had a satisfactory level of ecological integrity compared to those that are shared with Democratic Republic of Congo with a dissatisfactory level of ecological integrity (Table 4.14). The satisfactory level of ecological integrity was probably due to creation and implementation of both institutional and legal framework leading to a reduction in threats. Improvement in park management and peace and stability in the region have enabled threat reduction (UWA, 2018a). Also, the dissatisfactory level of ecological integrity in the wildlife protected areas shared with Democratic Republic of Congo is probably due to their transboundary nature, which presents with it varied management challenges (GVTC, 2017).

Table 4.14: Threat Reduction in the Wildlife Protected Areas

Conservation Area	**Protected Area**	**Percentage Threat reduction (%TR)**						
		Habitat transition /changes	Wild fires	Human Wildlife Conflict	Poaching and wildlife trafficking	Population pressure /illegal activities	Boundary encroachment	**Average**
Kibale	KNP	50	80	70	77.5	70	70	69.58
	SNP	5	40	60	50	50	90	49.20
	TSWR	5	50	50	65	80	90	56.67
	Katonga	5	50	60	50	70	95	55.00
	Average in KCA	*16.25*	*55*	*60*	*60.6*	*67.5*	*86.25*	*57.60*
Queen Elizabeth	QE	5	70	30	50	90	50	49.17
	RMNP	0	40	80	40	40	80	46.67
	Kigezi	0	10	40	30	40	70	31.67
	Kyambura	0	90	55	75	85	90	65.00
	Average in QECA	*1.25*	*52.5*	*51.25*	*48.75*	*63.75*	*72.5*	*48.33*

Further, from the threat reduction assessment index analysis, the average TRAI value for Kibale Conservation Area was 45.1% and that for Queen Elizabeth Conservation Area was 49.46% (Fig. 28). Both indices were less than 50% hence falling within the dissatisfactory level of ecological integrity as determined by the ecological integrity score card developed by Vickerman & Kagan (2014).

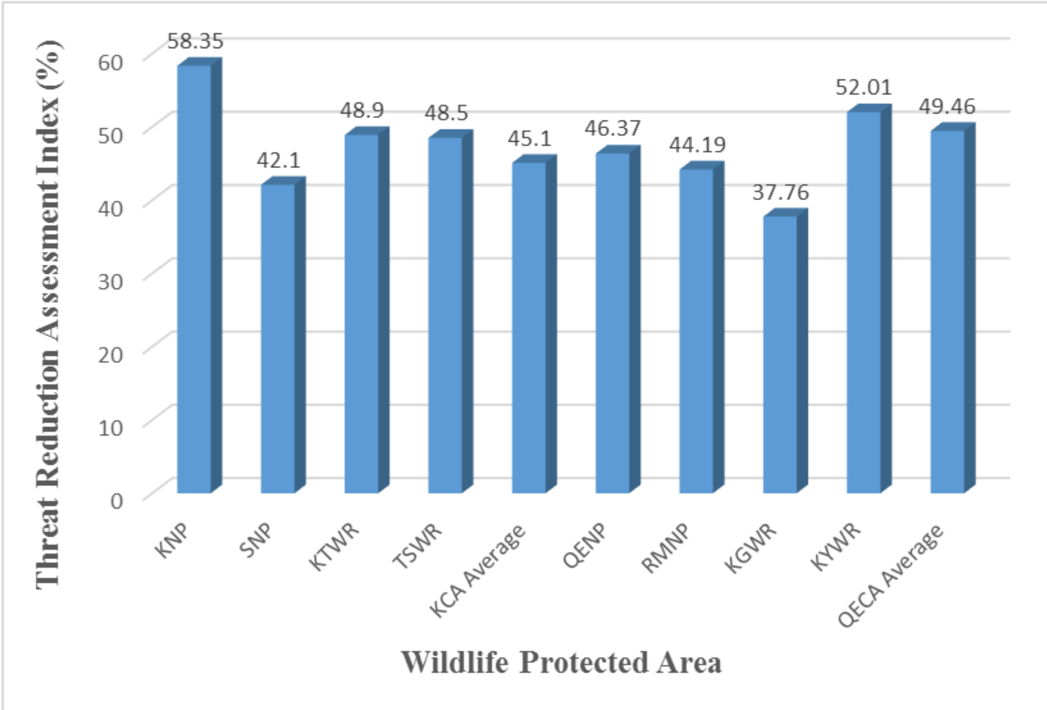

Fig. 4.28: Threat Reduction Assessment Indices of the wildlife protected areas

In addition, there was no significant relationship between the size of the wildlife PAs and the threat reduction assessment indices. (Fig 4.29)

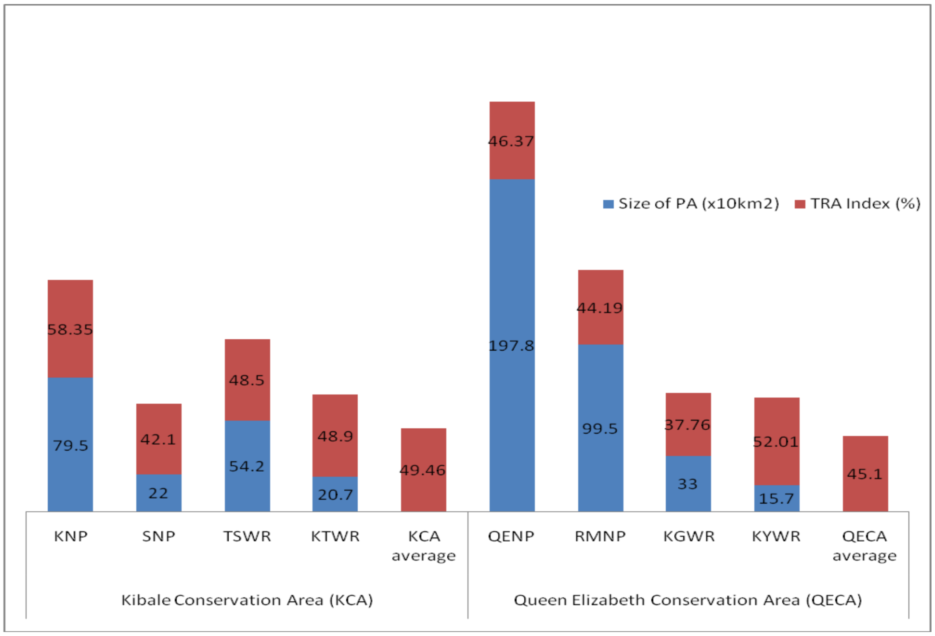

Fig. 4.29: Threat Reduction Assessment Indices and size of wildlife PAs

In addition, the FGDs and field observations identified trails (Fig. 4.30), tourist lodges (Fig. 4.31), road construction, staff accommodation, waste and climate change impacts inside the wildlife PAs which threaten the different wildlife ecosystems.

Fig. 4.30: Bukurungu Trail in RMNP (Source: Survey, 2019)

Fig. 4.31: Tourism development inside the Kibale National Park at Kanyanc (Source: Survey, 2019)

Infrastructure development inside the wildlife protected areas not only facilitates tourism but also disrupts the scenic view of the PAs and the animal migratory routes. Wildlife tourism can cause significant disturbances to animals in their natural habitats through a boom in infrastructure and construction projects, scare away animals, disrupt their breeding and feeding patterns, or acclimate them to the presence of people, disrupt parent-offspring bonds and increase vulnerability to predators and competitors (Korir et al., 2013).

4.2.4.3.4 Mammal populations in Kibale and Queen Elizabeth Conservation Areas

From existing literature, Kibale Conservation Area shows a general population increase over the past two decades. Specifically, in Kibale National Park, the population of the Black and White colobus monkeys increased from 7,346 in 2005 to 10,459 in 2010; the Baboon population increased from 11,603 in 2005 to 12,191 individuals in 2010. However, other primate populations have had a slight increase. The Chimpanzee population has remained stable over the years (Fig.4.32).

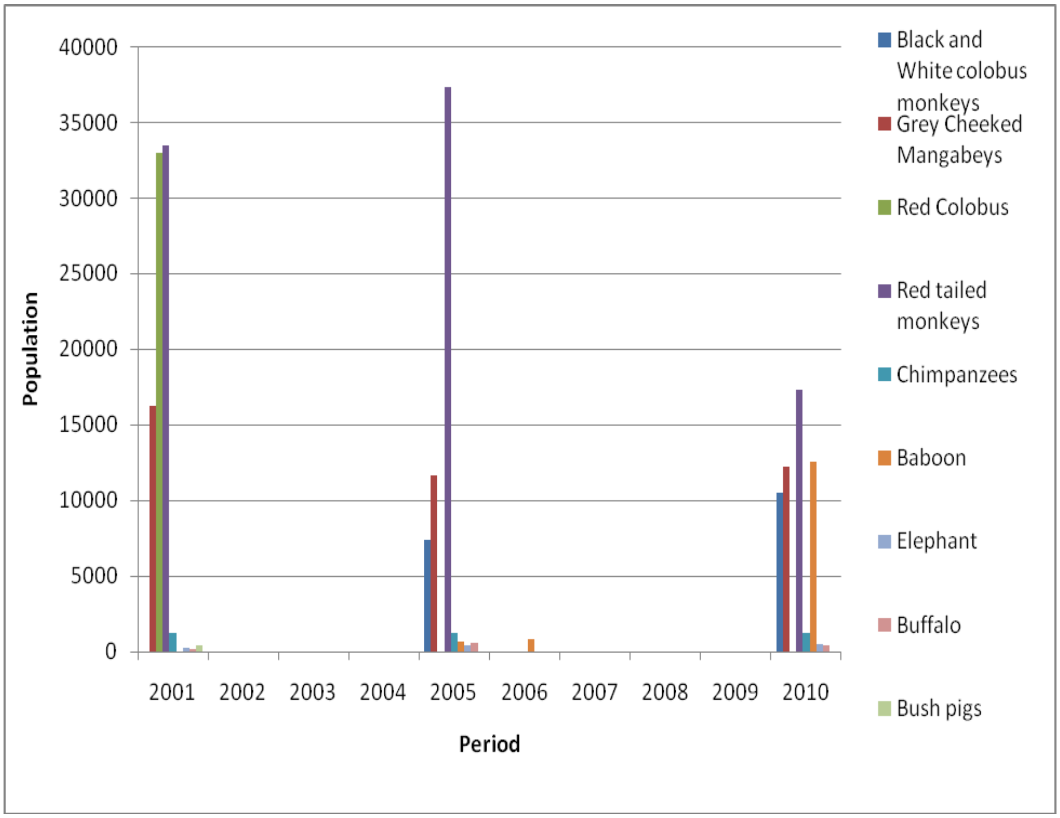

Fig. 4.32: Population Estimate for Primates in KNP. (Raw data adopted from UWA, 2018a)

In addition, the Elephant and Buffalo populations have had an exponential increase. The Elephant population has increased from 262 individuals in 2001 to 487 individuals in 2010; the buffalos from 124 individuals in 2001, to 402 individuals in 2010; and the Bush pigs were only estimated at 400 individuals in 2001 (Fig. 4.32). This general increase collaborates well with highest TRA Index of 58.35% recorded in KNP (Fig. 4.33).

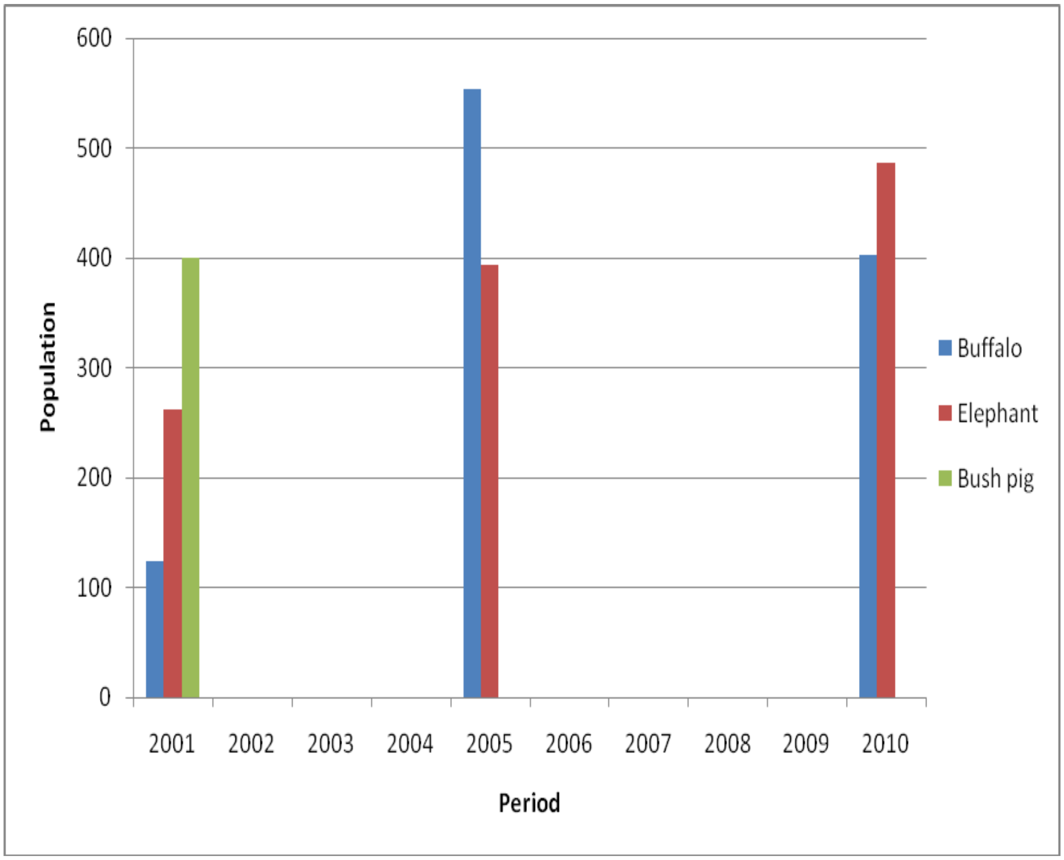

Fig. 4.33: Population Estimate for other Large Mammals in KNP. (Raw data adopted from UWA, 2018a)

In Katonga Wildlife Reserve, there was a steady increase in wildlife population from 2004 to 2013 (Fig. 4.34). The population of the Black and White colobus monkey increased from 1,342 in 2004 to 3,335 in 2013. Duiker population rose from 295 in 2004 to 1,169 in 2008. The Reedbuck and Waterbuck had a more or less stable growth in population over the years (Fig. 4.34).

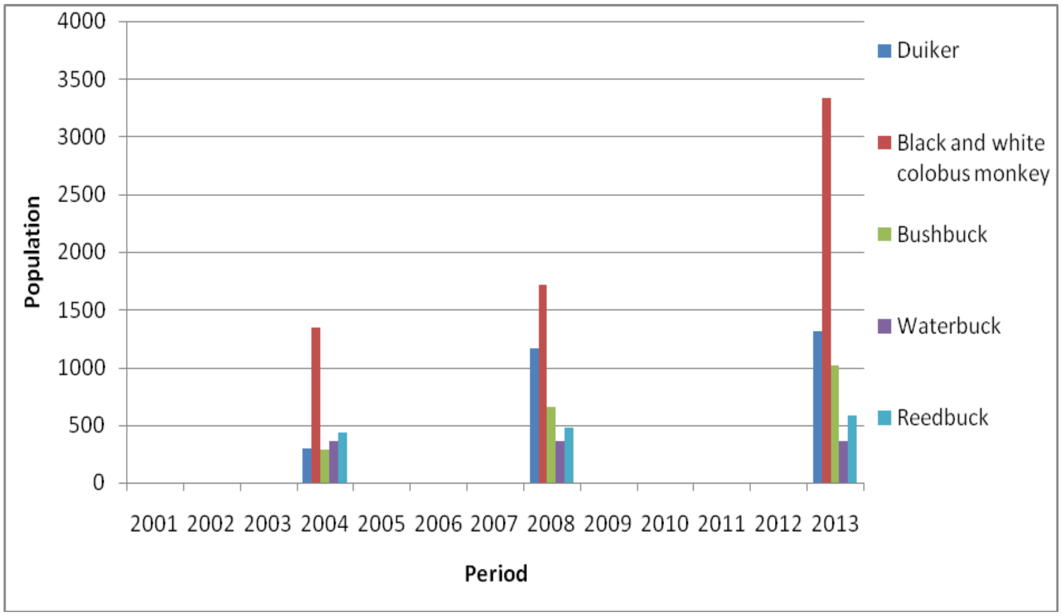

Fig. 4.34: Wildlife Population Trends of Selected Species in Katonga Wildlife Reserve (Raw data adopted from UWA, 2018a)

Similarly, the mammal population in Toro–Semliki Wildlife Reserve had a general increase. Specifically, the Uganda Kob population increased from 3,460 individuals in 1982 to 3,935 by 2015, the waterbuck population increased from 33 individuals in 1982 to through 58 individuals in 2002 to 112 by 2015, and the Buffalo population increased from 219 individuals in 2002 to 449 in 2015 (Fig. 4.35).

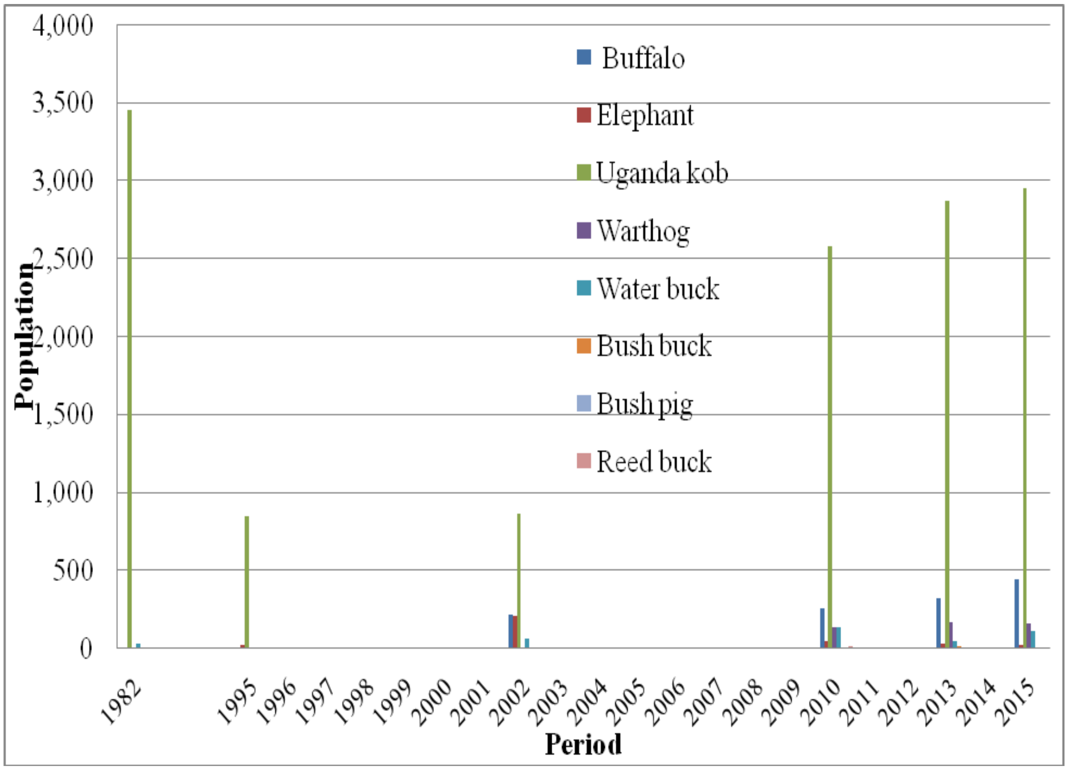

Fig.4.35: Population Estimates for Some Species in Toro-Semliki Wildlife Reserve (Raw data adopted from UWA, 2018a

In Queen Elizabeth Conservation Area, animal population data existed for Queen Elizabeth Protected Area (QENP, KyamburaWR and Kigezi WR), while census data existed for RMNP. In Queen Elizabeth Protected Area, the elephant population reduced from 4,139 in 1969 to about 150 by 1980. It then started recovering until it reached 3018 individuals in 2012. Other wild animal populations have increased (Fig. 4.36).

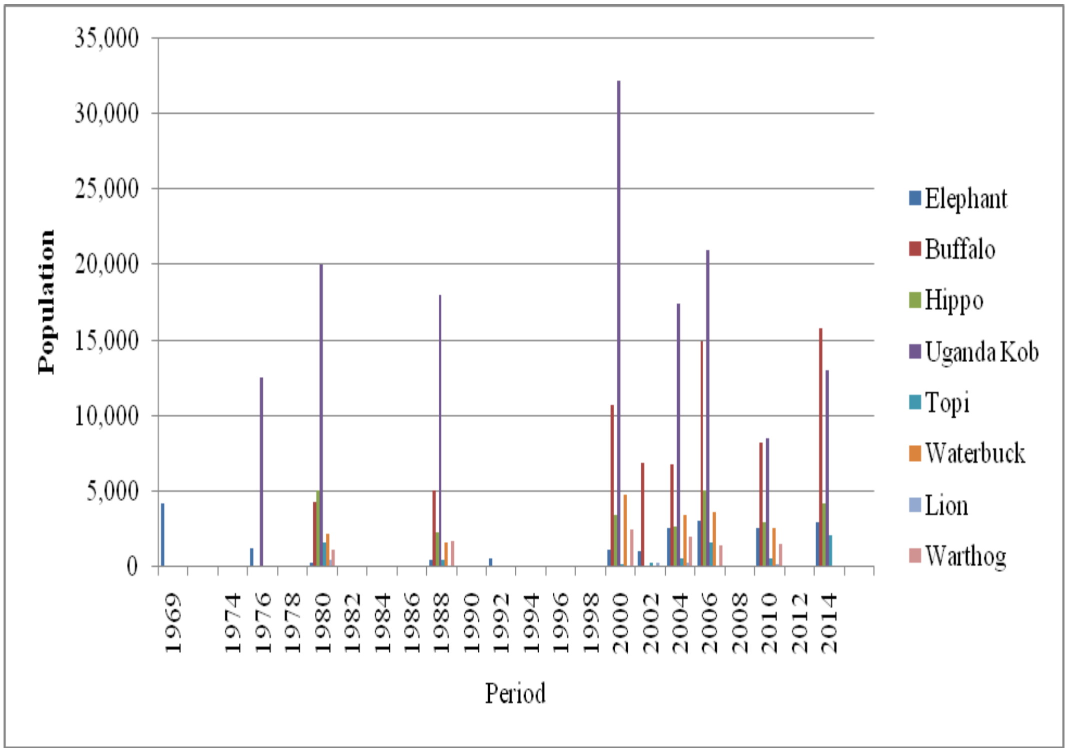

Fig 4.36: Medium to Large Mammal Population in Queen Elizabeth Protected Area (Raw data adopted from UWA, 2018a)

Despite the prevailing threats, the population of elephants and few other large mammals in both conservation areas has generally increased over the past decades. This collaborates well with the TRA indices for each national park and wildlife reserve in each conservation area. The increase in mammal population is probably due to creation of both institutional and legal framework, and strengthened implementation of existing policies, laws and regulations. Specifically, the recovering mammal population in Queen Elizabeth Protected Area could be attributed to better security within Uganda, immigrations and successful breeding. This agrees well with UWA (2018a) that improved PA management, increased vigilance through intelligence and patrols, and most importantly the peace, security and stability in the country and the region as a whole, and increased community conservation programs which have contributed to threat reduction. However, the low threat reduction performance of wildlife protected areas shared with Democratic Republic of Congo (Table 4.12) is probably due to their transboundary nature, which presents with it varied management challenges. (GVTC, 2017)

4.2.4.3.5 Staffing and Threat Reduction Assessment Indices

From the threat reduction assessment index technique, analysis of the comparison of staffing (staff per PA) and threat reduction assessment index (per PA) revealed that staffing and TRA Index scores were moderately and positively correlated (r = 0.590, p = .001, $\alpha = .05$) and t_{80} = 1.412, p = .001, $\alpha = .05$. On average, Staffing scores were 44.2275 points higher than TRA Index scores (95% CI [-29.83, 118.29]). From the box plot, the TRA Index values positively correlated with the staffing level in the PAs. Both variables appear to be symmetrically distributed (Fig 4.37). Staffing level in the PAs has a strong relationship with threat reduction, and therefore, plays a critical role in addressing threats to biodiversity conservation.

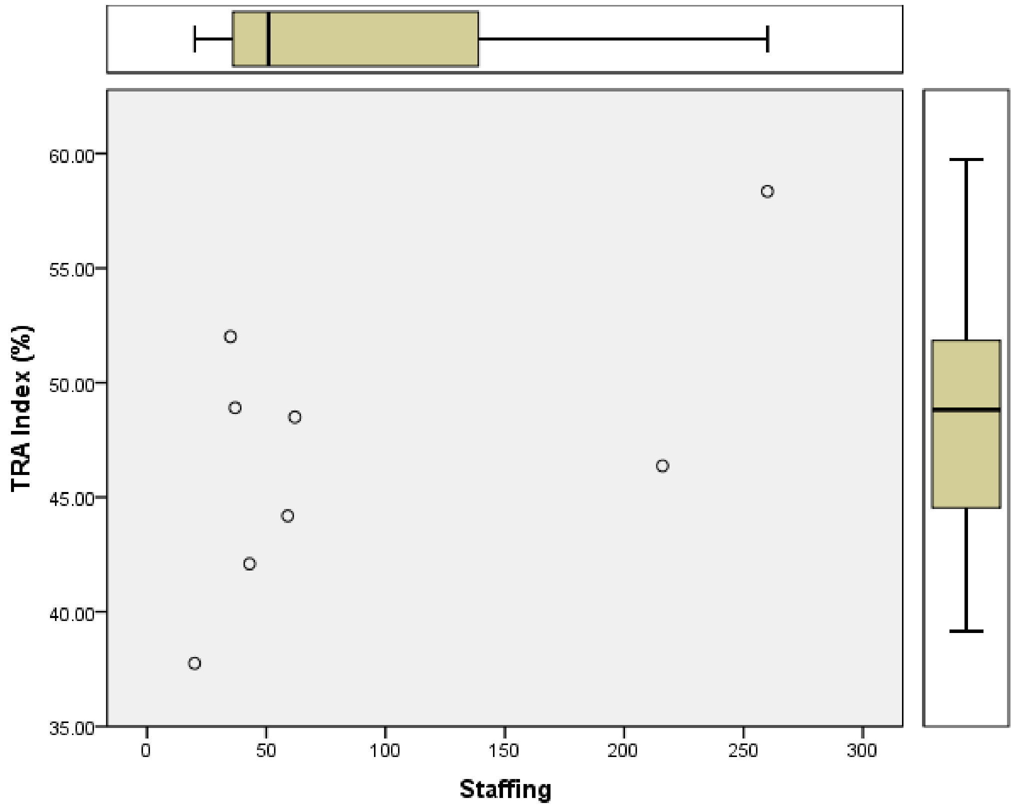

Fig. 4.37: Relationship between Staffing and Threat Reduction Assessment Index

4.2.4.3.6 Ecological Integrity Rating

Ecological Integrity score card. Ecological integrity is evaluated against a scorecard that describes the condition of several integrity indicators along a gradient from excellent condition to poor condition (Vickerman & Kagan, 2014). Using data indicators, each wildlife PA had a score and each threat also had a score to show the level of threat reduction (Table 4.15).

Table 4.15: Ecological Integrity Score Card using Primary Data Indicators

Protected Area (PA)	Performance of Ecological Integrity using data indicators in the PAs									
	Large mammal population increase	Frequency of poaching incidences	Human wildlife conflict	Wild fires	Boundary encroachment	Resource harvesting	Zoonotic diseases	Habitat change	Road kills	Average rating per PA
Kibale Conservation Area										*Yellow*
KNP	Exponential	Light Green	Light Green	Dark Green	Light Green	Light Green	Dark Green	Light Green	Light Green	Light Green
SNP	N/A	Light Green	Light Green	Yellow	Red	Light Green	Dark Green	Yellow	Yellow	Yellow
TSWR	General increase	Light Green	Light Green	Light Green	Dark Green	Dark Green	N/A	Red	Red	Yellow
Katonga WR	Exponential	Light Green	Light Green	Light Green	Dark Green	Light Green	Light Green	Red	N/A	Yellow
Queen Elizabeth Conservation Area										*Yellow*
QENP	General increase	Light Green	Dark Green	Light Green	Dark Green	Dark Green	Dark Green	Red	Light Green	Yellow
RMNP	N/A	Yellow	Dark Green	Yellow	Dark Green	Yellow	N/A	Dark Green	N/A	Yellow
Kigezi WR	General increase	Yellow	Yellow	Red	Light Green	Yellow	Dark Green	Red	N/A	Yellow
Kyambura WR	General increase	Light Green	Light Green	Dark Green	Dark Green	Dark Green	N/A	Red	N/A	Light Green
Average rating per indicator	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Dark Green	Red	Light Green	Yellow

Considering all threats, KNP and Kyambura WR had a "light green" score indicating moderate ecological integrity and hence satisfactory, while the rest of the PAs had each an average score of "yellow" indicating significant "concern" and therefore dissatisfactory. This collaborates with results of analysis of scores by ecological experts, park employees, district local governments, Uganda Wildlife Authority, Wildlife Conservation Society-Uganda, and Ministry of Tourism, Wildlife and Antiquities which indicated the overall performance of the national parks and wildlife reserves as dissatisfactory ($t(80) = 14.148$, $p = .000$, $\alpha = .05$). This finding was based on this category of respondents who were asked to score on how they rated the wildlife protected areas in conserving biodiversity and protecting ecological integrity using a scale of 1 to 4 (where 1- very dissatisfactory, 2- dissatisfactory, 3- satisfactory, and 4- very satisfactory). The rating of the overall performance of the wildlife protcected areas (national parks and wildlife reserves) in both conservation areas as "dissatisfactory" was a testimony that there was great "concern" to conserve wildlife resources. This level of performance could be attributed to the more emphasis the Wildlife Agency puts on animal health issues and diminutive on ecosystem health.

4.2.4.3.7 Existing management strategies to address threats to protect ecological integrity

In appreciation of the threats affecting conservation in the Wildlife Conservation Areas, discussions with park management identified management measures that PA management had instituted to enhance management and improve efficiency in addressing threats to wildlife conservation of Kibale and Queen Elizabeth Conservation Areas. The management strategies contribute to attainment of Sustainable Development Goal 15

(SDG 15) “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”. Therefore, conservation of wildlife directly fulfils SDG 15 in the protection and prevention of biodiversity loss. The management strategies include:

a) Undertaking wildlife related disease surveillance in and around the wildlife PAs and conduct community sensitization programmes on wildlife related diseases

b) Monitoring wildlife and domestic animal movements in and out of the conservation areas

c) Carrying out massive sensitization and educational programmes to the communities adjacent the wildlife protected areas.

d) Strengthening community conservation through resource use agreements, benefit and revenue sharing scheme, problem animal management, conservation education and awareness, community involvement in boundary management (using the taungya approach where community members are allowed to plant crops along a given strip of the boundary while tending to boundary trees under a formal arrangement, also use of concrete pillars and live marking along the park boundary, development of and implementation of fire management plans, etc).

e) Gathering, analysing and acting on intelligence information on illegal activities inside the wildlife PAs

f) Conducting cross border and or coordinated monitoring, control and surveillance patrols inside the wildlife PAs. This also involves cross border joint planning meetings, security operations.

The findings under objective four support the fourth hypothesis that threats to wildlife conservation were reducing across Queen Elizabeth and Kibale Conservation Areas except habitat change which showed description impaired. And park management had instituted various management strategies to reduce on the threats affecting the wildlife PAs in the conservation areas.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents summary, conclusion and recommendations of the study on the effectiveness of wildlife protected areas in conserving ecological integrity in Kibale and Queen Elizabeth Conservation Areas.

5.1 Summary

The study investigated the effectiveness of protected areas in conserving ecological integrity in Kibale and Queen Elizabeth Conservation Areas, Uganda. This investigation was in relation to little information documented on the ability of wildlife protected areas to maintain nativeness, pristineness, diversity, and resilience or adaptability; and as a result there was limited information on maintenance and enhancement of the conservation of biological diversity and ecosystem processes in the protected areas. The study specifically sought to evaluate how long-term wildlife monitoring, changes in wildlife corridors in the the landscape, Community Based Conservation, and threats and threat reduction in wildlife protected areas influence ecological integrity. These objectives were investigated using document review, semi-structured questionnaires, key informant interviews, focus group discussions, the nature conservancy's conservation action planning methodology, and the threat reduction assessment technique.

The long-term wildlife monitoring contributed to development of conservation-related policies. The policies formulated include the merger of Uganda National Parks and the

Game Department, integration of interests of local community in the wildlife legislation, shift from protectionism to conservation, and elevation of conservation status of protected areas. Through the policies developed, the long-term wildlife monitoring guided the PA management to enhance the welfare of wild animals (though with little attention to their habitats and the ecosystem), and also provide scientific information to assist management in decision-making. However, the wildlife monitoring program did not comprehensively capture issues of condition and effectiveness of the wildlife protected areas which constitute ecosystem health. Long-term wildlife monitoring guided development and adoption of conservation initiatives mainly adaptive management, park boundary demarcation and management, and adoption of SMART tool, restocking of wildlife protected areas, and adoption of landscape approach to management of wildlife resources. Creation of new units to mitigate wildlife crime and trafficking, and monitoring, evaluation and reporting tool which have guided the wildlife agency to move with the current trends in the global conservation, and landscape approach to management of wildlife resources have also been adopted. The technological advancement has also greatly improved wildlife monitoring, for instance use of the SMART data tool in all protected areas, a policy initiative, which has helped in data collection. This technology enables daily collection of data on ecological change caused by both humans and nature. In addition, the study established innovative conservation-related policy areas namely ecosystem health, community involvement in wildlife monitoring, management of wildlife outside protected areas, management of wildlife corridors, and Payment for Ecosystem Services which should be integrated into future policies and strategies to further enhance biodiversity conservation of the wildlife protected areas.

Further, wildlife corridors were affected by changes and threats which affect the ecological integrity of Conservation Areas. The study identified a total of 20 key wildlife corridors in the landscape with key ecological attributes that augment regional biodiversity conservation. The key ecological attributes of the wildlife corridors to the migratory animal populations are that the corridors offer migration routes, safe havens for security, seasonal food and water sources, habitats for mammal population size and reproduction rate, and genetic variability. The primary conservation targets utilizing these corridors for migration in the landscape are elephants, lions, and chimpanzees. The corridors experienced key changes: reducing vegetation cover, degradation, loss of connectivity and/or migratory routes, and degraded stepping stone habitats. They (corridors) are threatened by illegal activities, poaching and illegal wildlife tracking, unsustainable natural resource use, human population pressure, habitat transition/changes, human wildlife conflicts, wild fires, trans-boundary threats, infrastructure development, and climate change which affect habitat quality, diversity, and continuity. Despite the existing changes and threats affecting corridor conservation, the wildlife corridors play an important role in conserving biological diversity. The roles include conservation of animal species, maintaining biological connectivity, maintaining perpetuity of animal populations, maintaining minimum viable habitats and conservation strategies, and serving as animal migratory routes. These research findings indicate that wildlife corridors facilitate long-term survival of mammal populations across the landscape, enable movements of animal populations, including migratory species; and also withstand poaching pressures due to their connectivity and trans-boundary nature which factors provide escape routes. The wildlife corridors are a cornerstone of conservation of biological diversity as indicated by the general increase in large mammal populations in the conservation areas and the reduced threat reduction assessment indices. The wildlife corridors protect ecological integrity of the conservation areas through maintaining their nativeness, pristineness, diversity, and resilience or adaptability consequently conserving the biodiversity therein.

In addition, local communities participated in conservation education and awareness, benefit sharing, and boundary management programmes which contribute to biodiversity conservation and ecological integrity. Community awareness and knowledge of key park attributes contributed to realization of the need to participate in conservation of biodiversity and desist from involvement in illegalities in the park. Provision of incentives to the park adjacent communities, and recognition of community support by park management triggers community participation in the conservation of biodiversity. The incentives included the revenue sharing policy (an incentive-based conservation policy which stimulate people's economic interests and mobilize individuals), and access to in-park resources that strengthen participation in the conservation of biodiversity. Strengthening community conservation could contribute towards improving rural livelihoods. Community-based conservation which encompasses contributions of community-park initiatives in the management of park boundaries, and local engagement using private sector players (community-based organizations, community guards, and ecotourism promoters) is a key strategy in conservation and management of ecological integrity of the wildlife PAs. Community-based conservation results into increased community knowledge and collaboration, community-based tourism, private sector involvement; growth in eco-lodges and campsites, and collaboration between local communities and park management. Community based conservation also promotes community participation in management decision making especially in the areas of development of general management plans, and community development programmes. Local community participation creates trust, belonging, acceptance, and reduces pressure on the park resources hence contributing to a fair relationship between the local communities and park authorities. Also, recognition of indigenous people's property; knowledge of Key Park attributes; and participation of local authorities and private sector improves people-park relations, and creates acceptance of wildlife. Therefore, local community participation is a strong pillar in community based conservation. However, there still existed pockets of unfriendly relations and these were caused mainly by park boundary contentions, problem animal-related conflicts, loss of indigenous peoples' property without compensation or even consideration, and harshness of some park staff while dealing with community issues and handling of illegalities inside the wildlife protected areas. Park managers had not played a substantial role to manage the impact of wild animals on indigenous people's property and are therefore not considered equitable from an Indigenous perspective. Lack of compensation for loss of indigenous people's property undermines people's livelihoods, and this damages community-park relations, and consequently creates a negative attitude towards the conservation areas and overall acceptance of wildlife hence threatening biodiversity conservation. Additionally, communities adjacent both conservation areas, had no established community institutions to provide a framework of community participation in conservation, and also provide a link to the conservation areas.

In both conservation areas, local authorities participated in the conservation and management of the conservation areas through (1) community mobilization and sensitization towards conservation of the PAs, (2) increasing the economic and other benefits through supporting resource use, (3) reconciling the goals of conservation and development, (4) participating in resolving human wildlife conflicts to a limited extent, and (5) participating in formulation of park general management plans. However, they did not participate in resolving human wildlife conflicts, a decision making area. Similarly, private sector institutions participated in the conservation and management of the conservation areas broadly through: (1) increasing the economic and other benefits to the local communities involved in resource protection and conservation, 2) reconciling the goals of conservation and development in the communities, and 3) research and monitoring, and fostering working relationships with local communities. Through these roles, the private sector contributes towards conserving the wildlife and biodiversity, promoting tourism, and also support connect people to nature.

CBC registered some degree of success and proved useful in the conservation and management of biodiversity as evidenced by (1) increased community knowledge and collaboration on conservation and management of biodiversity, (2) increased community participation in park boundary management, (3) communities enjoying financial and no-financial benefits from the benefit sharing scheme (4) increase in scope of community-based tourism programs and products, (5) engagement of community volunteers and scouts who rustle with problem animals forcing them back into the parks, bipartite partnership between park management and in-park resource user groups (6) increasing number of tourist lodges and campsites on lands adjacent national parks, and (7) infrastructure development in the park adjacent communities supported.

Community participation in community based conservation programmes was influenced by community perceptions and attitudes towards conservation and management of wildlife and ecological integrity. The local community perceptions and attitudes were also influenced by socio-demographic factors mainly gender, age, education level, and distance of household from the park boundary. Community knowledge and awareness on the existence of the park, its attributes and resources; community benefits, and costs incurred by the community as a result of invasion by wild animals and vermin are other factors. This Community-based conservation approach was, however, challenged by limited community involvement in conservation-related decision making, poor governance of funds and other issues in conservation, community involvement in illegal activities, and managing unrealistic community expectations.

Finally, the conservation areas were threatened primarily by habitat transition/changes, wild fires, human-wildlife conflicts, armed poaching and illegal wildlife trade/trafficking in wild meat and wild products, increasing human population pressure, boundary encroachment through agricultural development (small-holder farming, and small-holder plantations) and urbanization and village settlement, zoonotic and vector-borne diseases, transboundary issues, negative impacts of climate change, and infrastructure developments within the PAs which constrain conservation efforts. Administrative constraints mainly inadequate financial resources, gadgets for monitoring, staff and skills in GIS/remote sensing also hindered sustainable management and conservation of biodiversity. Despite these threats, there was a general increase in large mammal population over the past decades, which collaborates well with the threat reduction assessment indices. The increase in large mammal population, and reduction in threats in the conservation areas is a testimony that protected areas are a cornerstone for conservation of biodiversity and protection of ecological integrity. Therefore, Kibale and Queen Elizabeth Conservation Areas were effective at protecting ecological integrity.

5.2 Novelty of the study

The study identified key migratory routes in the Kibale and Queen Elizabeth Conservation Areas landscape which provide guidance to park management to plan for their restoration and conservation. Integration of ecosystem health in the long-term wildlife monitoring to establish the different habitat conditions and trends, a strategy to guide park management to effectively conserve biodiversity as well as protect ecological integrity. New wildlife monitoring indicators to monitor and assess the performance of the wildlife protected areas in the two conservation areas—natural ecosystem processes (e.g. hydrology); biotic components (e.g. birds); and human component indicators (e.g. landscape spatial organisation such as periphery landuse) have been developed.

5.3 Conclusion

Long-term Wildlife Monitoring influenced formulation of policies to conserve ecological integrity of Kibale and Queen Elizabeth Conservation Areas. The policies brought the wildlife managers closer to the local communities, enhanced management of natural resources in the parks, and helped park management to carry out conservation with consideration of human rights/face. The policies also contributed significantly to the development of good practices/measures that enhance the ecological integrity of the protected areas such as development of park general management plans, developing species/ecosystem management strategies and strategies for elevation of wildlife reserves to national parks, assessing threats, etc. Long-term Wildlife Monitoring further influenced development and adoption of new conservation initiatives, and recommends innovative conservation policy areas that ought to be considered to effectively enhance biodiversity conservation and ecological integrity of wildlife protected areas.

Wildlife corridors experience various changes mainly reducing vegetation cover, loss of migratory routes, degradation, and invasive species due to anthropogenic and natural factors which threaten the effectiveness of the wildlife protected areas in protecting the ecological integrity in Kibale and Queen Elizabeth Conservation Areas. The wildlife corridors represent the wildest or most natural lands that provide ecological linkages between protected areas that ensure survival of migratory mammals and, therefore, maintaining or enhancing their naturalness and reducing anthropogenic impacts along them (corridors) is a strategic direction to ensure habitat quality, diversity and continuity in the landscape. This continuity is vital in conserving ecosystems and biodiversity amidst increasing human population and changing climate. This means that the changes in wildlife corridors affect the ecological integrity of the conservation areas in terms of maintaining the essential components mainly nativeness, pristineness, diversity, and resilience or adaptability consequently conserving the biodiversity therein.

Community-based conservation improves community knowledge and collaboration, peoples' welfare, people-park relations, and creates acceptance of wildlife, hence effectively protecting biodiversity conservation and protection of ecological integrity of Kibale and Queen Elizabeth Conservation Areas.

Kibale and Queen Elizabeth Conservation Areas were majorly threatened by habitat change, wild fires, human-wildlife conflicts, armed poaching and illegal wildlife trafficking, increasing human population, and boundary encroachment which constrain protection of ecological integrity. The general increase in large mammal population, and reduction in threats in the conservation areas were a testimony that protected areas are a cornerstone for conservation of biodiversity and protection of ecological integrity.

5.4 Recommendations

The Ministry of Tourism, Wildlife and Antiquities should develop plans, policies or strategies to sustainably manage and conserve migratory animal biodiversity. The innovative conservation-related policy areas namely ecosystem health, community involvement in wildlife monitoring, management of wildlife outside protected areas, management of wildlife corridors, and Payment for Ecosystem Services which should be integrated into in future policies and strategies to further enhance biodiversity conservation of wildlife protected areas.

The Ministry of Tourism, Wildlife and Antiquities, and Uganda Wildlife Authority should strengthen adaptive management to restore all degraded areas inside the wildlife PAs. This should involve development and implementation of restoration plans.

Uganda Wildlife Authority and research institutions should integrate ecosystem health into the ecological monitoring and research agenda. Monitoring and research should look at ecosystem health in terms of trends in the components, ecological processes or functions to be able to determine the condition and effectiveness of the wildlife protected areas.

The Ministry of Tourism, Wildlife and Antiquities, Uganda Wildlife Authority and local authorities should establish buffer zones around/adjacent to protected areas (where land is available), initiate conservancies on private land neighboring conservation areas, strengthening existing linkages and corridors to connect protected areas, and influencing land use practices in communities adjacent the protected areas. The conservancies would contribute to income generation in the local communities, strengthen collaboration with the park, improve on community-park relations, and ultimately improve conservation and management of biodiversity.

The Ministry of Tourism, Wildlife and Antiquities and Uganda Wildlife Authority should develop policy on management of wildlife outside protected areas, management of wildlife corridors to sustain connectivity, and Payment for Ecosystem Services as an initiative to finance conservation. This should involve formulation of a policy or strategy or management plan for the conservation of wildlife corridors. The National Forestry and Tree Planting Act, 2003 which only provides for the conservation, sustainable management and development of forests, and the promotion of tree planting for the benefit of people of Uganda and the International community should be reviewed to capture issues of conservation and management of wildlife resources in the forest reserves.

The Ministryof Water and Environment jointly with the Ministry of Tourism, Wildlife and Antiquities (through Uganda Wildlife Authority) should consider take over of management of forest reserves by UWA to combat deforestation and forest degradation therein. This requires change in policy and legal framework.

The Ministry of Tourism, Wildlife and Antiquities, Uganda Wildlife Authority and local authorities should strengthen provision of incentives to meet community needs, formulate community conservation and livelihood policy, and also create and strengthen community conservation institutions. Further, the revenue sharing policy and guidelines should be revised to widen the scope to benefit the entire frontline parishes and not limiting to villages. Such incentives would create community appreciation of the value of the biological resources, reduce pressure on such resources, strengthen community-park relations, support the conservation agenda and also contribute towards poverty reduction.

The Ministry of Tourism, Wildlife and Antiquities, and Uganda Wildlife Authority should ensure increased involvement and collaboration of the park adjacent communities, local authorities, private sector, environmental decision makers, educators and education institutions in conserving biodiversity through use of information, education and communication materials and other strategies to disseminate important wildlife conservation information.

The Ministry of Tourism, Wildlife and Antiquities, and Uganda Wildlife Authority, the Ministry responsible for Education, and the National Curriculum Development Centre should integrate environment and wildlife conservation education in the national education curricula starting with primary education. This would help the community and other stakeholders appreciate the value of wildlife conservation and environmental management.

The local authorities and private sector should also provide incentives to the park adjacent communities to provide cash-flows in the local economy and stimulate innovations for enterprise development, which will contribute towards reduction in illegal activities as people (communities) earn incomes outside protected areas.

The Ministry of Tourism, Wildlife and Antiquities, and Uganda Wildlife Authority in collaboration with local authorities and private sector should create and strengthen community conservation institutions to participate in conserving biodiversity *In-situ* and *Ex-situ*. These should include community wildlife scouts committees which should participate in aspects such as wildlife conservation outside protected areas, human-wildlife conflict mitigation, community engagement, wildlife data collection, conservation awareness, community-based tourism, enterprise identification and development, intelligence gathering on wildlife crimes and law enforcement.

The Ministry of Tourism, Wildlife and Antiquities should gazette Katunguru Kasese fishing enclave as a wildlife sanctuary. This would give legal mandate to the community to live in the enclave and also allow participation in activities of conservation of biological diversity.

To improve on community perceptions and attitudes towards the wildlife PAs, Uganda Wildlife Authority should emphasize community empowerment, livelihood improvement, strengthening conservation education and awareness, and integration of community perceptions and attitudes in the park management plans.

The Ministry of Tourism, Wildlife and Antiquities, and Uganda Wildlife Authority should put in more effort and strengthen management strategies to address the threats and demonstrate measurable improvement to move ecological integrity of the wildlife PAs from “concern” to “moderate” level or even the most desirable level of “acceptable” ecological integrity.

5.5 Suggestions for Further Research

Further research should (i) establish connectivity of wildlife corridors across the landscape and come up with corridor restoration options; (ii) establish the health of selected ecosystems in the wildlife protected areas to assess the condition and effectiveness in protecting ecological integrity; (iii) establish the status of biodiversity outside the wildlife protected areas; and (iv) explore site-level assessment of governance and equity of protected areas.

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APPENDICES

Appendix I: Policy aspects of wildlife monitoring

Variable	Variable description	Pearson Chi-Square Test Statistic (N=81, α = .05)			
		χ^2 Value	df	p value	Cramer's Value (V)
Monitoring modality	Circle how monitoring is carried within your protected area(s) a) Primarily in-house within the protected area. b) Through co-operation with other agencies c) Through co-operation with academic institutions d) Through co-operative projects with NGOs e) Contracted out to consultants and/or freelance researchers	15.523	4	.000	.526
Policy formulation	Do findings from monitoring wildlife guide formulation of policies to conserve	297.1	1	.000	.342

	biodiversity and protect ecological integrity?				
Conservation initiatives	Over the last decade, have you participated in developing and implementing new conservation initiatives?	7.247	1	.000	.370
Park aspects	Are there aspects of Park management and operation, that conflict with protection of ecological integrity?	35.314	1	.000	.858
Conservation policy areas	Are there any innovative conservation policy areas guided by the findings from wildlife monitoring that could enhance conservation?	9.351	1	.001	.416
Community participation	Do you (park staff) involve local communities in monitoring wildlife?	16.750	1	.001	.562

Appendix II: Community participation in wildlife conservation

S	Issue	Pearson Chi-Square Test Statistic (N=268, α = .05)			
		χ^2 Value	df	p value	Cramer's Value (V)
1	Do receive or participate in conservation education awareness programmes to manage wildlife resources?	46.013	1	.000	.588
2	Who owns/owned the land that the park is established on: a) State ownership b) indigenous ownership	20.064	1	.000	.387
3	Do you influence park decision making in the park?	35.16	1	.000	.260
4	If yes to (3) do you participate in the following?				
	a) resolving human wildlife conflicts	20.538	1	.303	.216
	b) developing general management plan	35.160	1	.026	.270
	c) community development programmes	35.16	1	.000	.358

5	Does the park and its programmes contribute to poverty reduction in your community?	38.479	1	.001	.283
6	Does your household/community use or access resources within the national park?	10.055	1	.000	.247
7	Do you need a resource use agreement to access the in-park resources?	1.972	1	.000	.576
8	Do you need a permit to access the in-park resources?	3.469	1	.000	.325
9	Does your community receive funds from the park under revenue sharing scheme?	1.310	1	.000	.084
10	Are you aware of what channels you receive the funds?	0.463	1	.001	.792
11	Are you satisfied by the channel through which receive revenue sharing funds?	0.939	1	.001	.816
12	Do the revenue sharing funds motivate you to participate inconservation of the park resources?	17.609	1	.001	.340
13	Do you generate conservation-based income as a community?	6.926	1	.014	.219

14	Does private sector participate in promoting community based tourism?	9.143	1	.000	.621
15	Do you participate in wildlife use rights programme the PA provides?	31.359	1	.091	.388
16	Are you aware of wildlife enterprises/business opportunities the PA provides?	24.734	1	.000	.345
17	Have any park animals strayed onto your farm/family dwelling?	4.203	1	.000	.240
18	Is the park or wildlife reserve is more of a liability to you?	2.949	1	.400	.201
19	Did your family receive some form of compensation for the damage caused?	2.949	1	.400	.201
20	Do local authorities play a role in the conservation of the park and its resources?	17.021	1	.000	.261
21	Does private sector play a role in the conservation of the park and its resources?	20.822	1	.000	.326
22	Does the infrastructure developed in your community using the revenue sharing scheme strengthen community-park relations?	26.251	1	.000	.296

23	How do you rate the relationship between the community and the park authorities? (a) Friendly (b) Depends on situation (c) Unfriendly (d) No comment/reaction	24.815	3	.000	.229
24	As a community adjacent to the park, what do you value most? a) wildlife resources and their conservation, b) community activities (e.g cultivation, livestock farming,) c) both	19.422	2	.000	.329
25	Does the collaboration between park management and the community contribute to protection of ecological integrity?	25.99	1	.000	.452
26	Given the challenges you face from the park, what would you recommend about the park? a) coexistence with the park b) degazettement of the park c) un decided	21.699	2	.001	.282

27	Why do you participate in wildlife conservation programmes of the park? (a) willingly, (b) out of concern for wildlife, and (c) continual availability of the in-park resources	46.013	2	.000	.588
28	Level of awareness of employment opportunities offered by UWA. a) direct employment, b) indirect employment c) not awre at all	316.185	2	.000	.298

RESEARCH INSTRUMENTS

Appendix III: Questionnaire for communities living adjacent the wildlife protected area

Please take some time and answer the following questions to the best of your knowledge about the community-protected area interaction.

Tick here if you are willing to take the survey. ☐

a) Demographic characteristics

Name of Respondent	
Sex	☐ Male ☐ Female
Age	☐ 18-31 ☐ 32-45 ☐ 46-60 ☐ 61+
Marital status	☐ Married ☐ Not married
Household size	
Telephone	
District	
Sub county	
Village	
Ethnic group	
Occupation (specify e.g apiary)	
Level of education	☐ Primary ☐ Secondary ☐ Certificate ☐ Diploma ☐ Degree ☐
Monthly income	
Livestock (type and number)	
Circle approximate distance of the household from the park boundary (km)	1:<5km 2: 5-10km 3:>10km

Number of years stayed in this area	
Land holding (Circle)	1- Landless 2- Owns land:acreage 3- <1 hectare 4- 1-3 hectares 5. 3-5 hectares 6. 5-10 hectares 7. >10 hectares

a) Sensitization and training on management of wildlife resources

1. Do you receive any sensitization or training on management of wildlife resources within the park?
   a) Yes
   b) No

b) Community participation in wildlife conservation programmes

2. Do you participate in wildlife conservation programmes of the park?
   a) Yes
   b) No
3. If yes to (2) above, why do you participate?
   a) Willingness to participate
   b) Concern for wildlife
   c) Continual availability of the in-park resources
   d) Forced to participate
4. Do you influence decision-making in managing the park and its resources?
   a) Yes
   b) No

5. If yes, tick your decision-making role in the management of the park and park resources.
    a) Conflict resolution
    b) Participate in developing general management plan
    c) Participate in community development programmes.
    d) Others (specify)
6. Are you satisfied with your involvement in the management of the park?
    a) Yes
    b) No
7. What motivates you to commit to conservation activities in your area? Tick any issue(s) that apply.
    a) Incentives from the park (in-park resources)
    b) Park policies that provides for community conservation
    c) Recognition of indigenous peoples' rights to conservation
    d) Individual and community participation in the day-to-day running of park activities
    e) Collaboration and the personal desire to maintain cultural traditions
    f) Guaranteeing resources for future conservation
    g) Trusting local leaders
    h) Social cohesiveness
    i) Desire to achieve control over and access to natural resources,
    j) Having decision-making power over natural resources
    k) Developing cultural identity
    l) Accessing land and land rights

m) Isolation from other neighboring villages

n) Maintain cultural identity

o) Support by other institutions (specify______________________________________)

8. As a community adjacent to the park, what do you value most?

a) wildlife resources and their conservation,

b) community activities (e.g cultivation, livestock farming, …) or

c) both

d) Access to in-park resources and livelihood opportunities

9. Does your household/community use or access resources within the national park?

a) Yes

b) No

10. If yes to question (9) above, state the in-park resources accessed

11. Do you need a resource use agreement to access the in-park resources?

a) Yes

b) No

e) Community benefits

12. List the benefits the park provides to you.

f) Benefit sharing

13. Do you participate in the wildlife use rights programme the PA provides?

a) Yes

b) No

14. Are you aware of wildlife enterprises/business opportunities the PA provides?

a) Yes

b) No

15. Does your community receive funds from the park under revenue sharing scheme?

a) Yes

b) No

16. If yes to question (15) above, do these revenue sharing funds motivate you to conserve the park resources?

a) Yes

b) No

17. Through what channels do you receive the funds in question (16) above

a) Local government channel

b) Directly from the park

18. Are you satisfied with the channel of disbursement of the funds?

a) Yes

b) No

19. In your opinion, is the revenue sharing programme a success?

a) Yes

b) No

20. The revenue sharing programme by the park has contributed to solving the human wildlife conflicts in the community. Tick the response.

1=strongly disagree	2=disagree	3=somewhat disagree	4=neither disagree nor agree	5=somewhat agree	6=agree	7=strongly agree

21. Do you generate conservation-based income as a community?

    a) Yes

    b) No

22. If yes to question (21) above, tick the sources

    a) Sport hunting

    b) Game farming and ranching

    c) Nature ecotourism

    d) Cultural homesteads

    e) Tourist lodges

    f) Bandas and campsites

    g) Fishing

    h) Other, specify____

f) Impact on indigenous people's property

23. Have any park animals strayed on to your farm/family dwelling?

    a) Yes

    b) No

24. If yes to question (23) above, with what impact?

a) Damage to crops

b) Loss of lives

c) Damage to other property (list them)

d) Other (specify)

25. In case of damage or injury or loss of life, do you receive some form of compensation or consideration for the damage caused?

a) Yes

b) No

26. The park and its programmes have contributed to poverty reduction in your community. Tick your response.

1=strongly disagree	2=disagree	3=somewhat disagree	4=neither disagree nor agree	5=somewhat agree	6=agree	7=strongly agree

g) Infrastructure outside protected areas

27. Does park management support infrastructure development in your community using the revenue sharing funds or other sources?

a) Yes

b) No

28. If yes to question (27), list the infrastructure

29. If no to question (28) above what infrastructure do you suggest to park management to work on?

h) Changes in the park resources

30. What specific changes do you perceive in the park over the last 10-20 years?

a) Increased frequency of fires
b) Increased invasive species
c) Fewer animal species
d) More animal species
e) Grassland is increasing
f) Forest is increasing
g) Other (specify)____
h) No change

31. List the challenges you face because you neighbor the park

32. Given the challenges you face from the park, what would you recommend?

a) We (people) should co-exist with the park

b) The park should be closed and degazette into farmland

c) I have no answer

33. In your own opinion, what should be the role of protected areas in the near future?

a) biodiversity conservation

b) conservation and development

c) sustainable use of natural resources and ecosystem services

d) fulfillment of local social needs

e) conservation of bio-cultural diversity

f) rural development

g) promoting local employment

h) areas for entrepreneurship

i) provision of experiences of contact with nature

j) others (specify)

i) Other park attributes

34. Are you aware of the park boundaries?

a) Yes

b) No

35. Are there any conflicts as a result of the park boundary?

a) Yes

b) No

36. If yes to (35) above, do you participate in handling the conflicts?

a) Yes

b) No

37. Do you participate in opening/maintaining the boundaries?

a) Yes

b) No

Attitude towards the park authorities

1. How do you rate the attitude between the community and the park authorities?

a) Friendly

b) Depends on situation

c) Unfriendly

d) No comment/reaction

2. Give reason for your answer in (2) above.

3. In your own view, has the park contributed to increase in wildlife numbers?

a) Yes b) No

If no, explain why.

4. What best practices should the park use to achieve successful conservation of the wildlife? Tick **only two.**

a) Empowering the local communities

b) Improved surveillance and patrols

c) Strengthening park regulations

d) Supporting livelihood/economic opportunities.

5. Please rate the following by ticking the most appropriate alternative in the way you perceive conservation of the park and park resources

Conservation perception	**1=strongly disagree**	**2=disagree**	**3=somewhat disagree**	**4=neither disagree nor agree**	**5=somewhat agree**	**6=agree**	**7=strongly agree**
It is important to protect plants and trees in the park							
It is important to protect wild animal species in the park							
People who poach should be punished							
It is good this land (land on which the park is established) is protected							
I think the park was created for the betterment of the community							
I am happy that my village borders or is in the park							

6. Please rate the following by **ticking** the most appropriate alternative in the level of interest you have in knowing about conservation of the park and park resources

Not very interested	Not interested	Neutral	Interested	Very interested

7. Please rate the following by **ticking** the most appropriate alternative in your level of awareness about the objectives of conservation of the park and park resources

Not very interested	Not interested	Neutral	Interested	Very interested

8. Please rate the following by **ticking** the most appropriate alternative in the level of interest you have in involvement in the conservation of the park and park resources

Not very interested	Not interested	Neutral	Interested	Very interested

Perceptions towards the park's basic features

1. Do you visit the park (not for in-park resources but e.g tourism)? Tick the appropriate.

a) Yes b) No

If yes, explain why.

If no, explain why.

2. Are you aware of individuals being punished for participating in illegal activities in the park?

a) Yes b) No

If yes, name the illegal activities.

3. List the types of punishments given to the individual offenders

4. In you view, how do you categorize the punishments listed in (3) above? They are:

a) Fair

b) Too harsh

c) Not stringent enough

5. What is the effect of your answer in (4) above on the individual offenders?

6. What is the effect of your answer in (4) above on the general community?

7. List the effect of the illegal activities named in (2) above on the park resources.

8. List the benefits this PA provide to the local community?

Appendix IV: Questionnaire for district and sub county leaders

Please take some time and answer the following questions to the best of your knowledge about the community-protected area interaction

Demographic Information

Name:____

Position:____

Sex ☐ Male ☐ Female

Age ☐ 18-31 ☐ 32-45 ☐ 46-60 ☐ 61+

Marital status ☐ Married ☐ Not married

District____________________ Sub County)______________________________

Educational qualifications: Please tick as appropriate:

PhD/Masters/Bachelors/Diploma/Certificate

1. Which wildlife protected area(s) (national parks, wildlife reserves, etc) does your district/sub county neighbor or is close to?
2. What role does your district/sub county play in the conservation of the wildlife protected area(s) named in (1) above? (Circle as appropriate)

   a) mobilizing communities towards conservation of the protected area

   b) increasing the economic and other benefits that local people get from becoming involved in resource protection.

   c) reconciling the goals of conservation and development in the communities

   d) others (specify)
3. List **five key** challenges you face from the national park
4. Suggest how the challenges listed in (3) above could be mitigated.

5. In your own opinion, is the protected area serving the conservation purpose for which it was established?
    a) Yes
    b) No
6. Give reasons for your response in (5) above
7. Suggest key policy areas you would propose to the wildlife agency (UWA) to include in the current park laws to enhance conservation.

Appendix V: Questionnaire for Private Sector

Please take some time and answer the following questions to the best of your knowledge about the community-protected area interaction

Demographic Information

Name:____

Position:____

Institution:____

1. Which wildlife protected area (national park, wildlife reserve, etc) does your organization neighbor or is close to you?
2. What role does your organization play in the conservation of protected area named in question (1) above?
   a) Increasing the economic and other benefits that local people get from becoming involved in resource protection.
   b) reconciling the goals of conservation and development in the communities
   c) others (specify)
3. List the conservation-related initiatives that your organization provides which promote conservation of wildlife in the protected area(s)
4. How do the initiatives listed in question (3) above contribute to conserving the wildlife? (tick as appropriate)
   a) Empowers community participation and resource management (specify)
   b) Some initiatives represent "enterprise-based conservation" (specify)
   c) handling conflicts between the park and community (specify)
   d) other (specify)

5. Do you have any partnership with the management of the protected area named in (1) above?
   a) Yes
   b) No

If yes, what role do you play in this partnership?

6. List any 4 key challenges you face from the park
7. How do you address the challenges in (6) above

Appendix VI: Questionnaire for UWA staff

Please take some time and answer the following questions to the best of your knowledge about the community-protected area interaction

Demographic information

Name (optional): ____

Gender:____

Title(s):____

Ministry/Department/Program/Park/Protected area:_________________________

Address/Location:____

Phone/Email: (optional) ____

Educational qualifications ____

Key responsibilities/duties

1. General information: Interpreting the mandate

1.1 How long have you worked with protected areas?

1.2 Are there aspects of park management and operation, in general, that conflict with protecting ecological integrity? (e.g other initiatives, mandates, external realities...)

- ☐ Yes
- ☐ No

If yes to 1.2 above, list them

1.3 What measures does your institution take to enhance the ecological integrity of the protected area(s)? Circle any that apply.

a) Establish buffer zones around/adjacent to protected areas

b) Expand existing protected areas

c) Adopt sympathetic/modified management practices around/adjacent to protected areas to reduce/mitigate external stresses

d) Establish linkages and *corridors* to connect protected areas

e) Use monitoring and adaptive management in and around protected areas

f) Others (specify)

2. The Conservation and Protection of Biodiversity in Protected areas

In order to assess the conservation and protection of the biodiversity in protected areas, the following questions are hereby asked:

2.1 Circle four most important administrative constraints to biodiversity conservation in the protected area you manage?

a) Inadequate funding

b) Inadequate patrol equipment

c) Weak support from neighbouring communities

d) Insufficient incentives

e) Poor staff motivation eg salaries

f) Poor housing for staff

g) Others (specify)

2.2 What is the status of the protected area and its resources that you manage? Circle any that apply.

a) Fully protected from any exploitation

b) Controllably used by the local people under collaborative management arrangement.

c) Suffers from commercial poaching of wild animals and trees

d) Suffers from uncontrolled use by neighboring communities (specify: ____).

e) Irreparably damaged by settlement

f) Irreparably damaged by incompatible land use or other (specify____________________).

g) Other-specify____

2.3 Are there any illegal activities taking place in the park?

a) Yes

b) No

If yes, please list them and where possible, rank them

2.4 How are the illegal activities listed in (2.3 above) handled?

a) Reported, recorded and followed up

b) Reported, not recorded but followed up

c) Reported, not recorded no follow up

d) Not reported, not recorded no follow up

f) Other-(specify)____

2.5 Are the park boundaries well demarcated? Circle appropriately.

a) Fully and carefully demarcated involving neighboring communities and are not contested.

b) Fully and carefully demarcated without involving neighboring communities and are not contested.

c) Well demarcated but are being contested

d) Known, not demarcated, and there are no conflict

e) Not known, not demarcated but it is feared that there is encroachment

2.6 If demarcated, circle type of demarcation,

a) Live making

b) Concrete pillars

c) Others, specify ______________________

3 Disturbance

3.1 Does park management identify disturbances to biodiversity?

a) Yes

b) No

3.2 List the disturbances that affect the PA.

3.3 Which of the disturbances named in question (3.2) above does the PA management address?

3.4 Are there any policies that address any of the disturbances named in (3.3) above?

a) Yes

b) No

4 Other park ecosystem processes

4.1 Tick the information the park collects on natural ecosystems processes

a) fire (extent, frequency, causes, _______________[tick as appropriate]

b) hydrology [name the parameters__________________________________

c) biodiversity (plant and animal populations),

d) climate information (name the parameters _______________________),

e) geology, and soils

f) stressors (such as climate change, disease…)

g) visitor activities,

h) Others (specify)____

6 Management of Protected Areas

To assess whether the line Ministry and Authority have supported and followed up on the target-setting and performance of the national parks so that in the long term they can strengthen and develop the nature, the following questions are hereby asked:

6.1 What purpose does the protected area serve? Tick (√) any that applies.

a) Biodiversity conservation

b) Terrestrial ecosystem management

c) Aquatic ecosystem management

d) Fauna conservation

e) Scientific research

f) Environmental monitoring

g) Education and heritage appreciation

h) Outdoor recreation

i) Tourism destinations

6.2 What are the issues facing the protected area? Tick and rank the issues that apply with 1 as the highest; 2, 3, …….

a) Road kills

b) Pollution

c) Invasive species (list one or two species of concern)__________________

d) Armed poaching and illegal wildlife trafficking

e) Increasing human population

f) Increasing tourism volumes

g) Habitat change/fragmentation/loss

h) Wildfires

i) Climate change impacts

j) Infrastructure development within the park

k) Transboundary threats

l) Poor waste management

m) Others (specify):____

6.3 Which of the following activities/functions are integral/vital to your institution's program for protected areas? Tick (√) any that apply.

a) Conservation

b) Formulation of policy

c) System planning

d) Management planning

e) Conducting research

f) Monitoring

g) Reporting on activities

h) Other (specify):____

6.4 Is your institution in the process of developing new policy and legislation for protected areas?

a) Yes

b) No

6.5 Do you have an approved general management plan?

a) Yes

b) No

If yes, please provide a copy

6.6 Do you have an approved fire management plan?

a) Yes

b) No

If yes, please provide a copy

7 Long-term Wildlife Monitoring

Long-term wildlife monitoring includes detecting ecosystem health in terms of trends in the components, processes or functions and to provide early warning of situations that require interventions. It includes ecosystem basic indicators, and focal animal and plant resources of parks.

7.1 Does your institution carry out wildlife monitoring?

a) Yes (go to question 7.2)

b) No (skip to question 7.3)

7.2 How often do you produce wildlife monitoring reports?

a) Monthly

b) Biannually

c) Yearly

d) Every two years

e) Every five years

f) Other (specify)

7.3 List five key indicators you monitor in the protected area.

7.4 Is there additional ecological information and data that you feel is NOT being captured in the current monitoring reports and yet is important?

a) Yes

b) No

7.5 In general, how is monitoring carried within your protected area(s)? Circle any that apply (ies).

a) Primarily in-house within the protected area.

b) Through co-operation with other agencies (indicate any major ones)

c) Through co-operation with university research (list universities)

d) Through co-operative projects with non-governmental organizations (indicate major ones)

e) Contracted out to consultants and/or freelance researchers e.g

Other (specify) ____

7.6 Why do you carry out wildlife monitoring?

To gain a better understanding of

a) natural ecological processes,

b) biodiversity,

c) the state of ecosystem health

Others (specify) ____

7.7 Do you (park staff) involve local communities in monitoring wildlife?

a) Yes

b) No

7.8 What is the basis for wildlife monitoring?

a) development of ecological indicators

b) research

c) field observations

d) management decision

e) others (specify) ______________________________________

7.9 Does basic ecological information exist? If yes, circle any that apply (ies).

a) Inventory of mammals

b) Inventory of birds

c) Vegetation maps

d) Geological and soils maps

e) Wildlife population trends

f) Aerial photos

g) Socio-economic data

h) Other specify____

7.10 State any problems with, or obstacles to the collection and use of ecological information in the park?

7.11 How does your institution use the results of monitoring efforts in protected areas?

Circle any that apply.

a) Preparation/update of protected area management plans

b) Develop species/ecosystem management strategies

c) Amend policies for protected area design

d) Assess/mitigate external/adjacent stresses

e) Baseline comparison for managed ecosystems

f) Public education and understanding

g) Management of the protected area

h) Tourism development

7.12 Suggest how use of ecological monitoring information can be improved.

7.13 Circle the key elements included in your monitoring guidelines.

a) condition monitoring—the assessment of the condition of the protected area,

b) effectiveness monitoring—the assessment of the success of ecosystem maintenance and restoration projects.

c) Others (Specify) ____

7.14 Does the protected area management have developed guidelines for monitoring ecological integrity?

a) Yes

b) No

If yes, please provide a copy

7.15 Do you have a wildlife monitoring plan /program?

a) Yes

b) No

If yes, please circle the elements in this plan.

a) species abundance

b) species distribution

c) rates of growth of species

d) existing and emerging threats to park ecosystems

e) Other (Specify) ____

Prosecution of Offenders

7.16 Does UWA identify, train and gazette court prosecutors in the protected area?

a) Yes

b) No

7.17 Does the park have an intelligence gathering unit to support law enforcement and prosecution of offenders?

a) Yes

b) No

7.18 In your own view, how do you rate the laws on enforcement and prosecution?

a) weak

b) strong

c) deterrent

d) non-deterrent

8 Adaptive management

8.1 List the sites that are under adaptive management in your/the protected area

8.2 List and briefly explain the adaptive management approach(es) being implemented in each of the sites listed in question (8.1) above.

8.3 List the challenges you encounter in implementing the approaches in (8.2) above

8.4 List the remedies for the challenges mentioned in (8.3) above

Re-introduction and introduction of extinct species

8.5 Are there any species that have been introduced in the protected area?

a) Yes

b) No

If yes, please list them

9 Perceptions of park management towards adjacent communities to the park

9.1 Does the park involve local people in park management activities?

a) Yes

b) No

If yes, state the areas communities are involved in…………………

9.2 List the benefits the PA provides to the local communities

9.3 As a protected area worker, what do you value most?

a) wildlife resources,

b) Community activities around the park or

c) both?

Give reason(s) for your answer.

9.4 List the techniques you use to manage the problem animals

9.5 List enterprises the community should promote to manage human-wildlife conflicts around the park.

9.6 List the challenge you face that affect the protected area from the adjacent communities.

9.7 What do you recommend to adjacent communities to do in order to live in harmony with the protected area?

9.8 Do you train communities in protected area management issues?

a) Yes

b) No

If yes, list key areas/skills you train them on.

9.9 Do you promote any traditional knowledge and practices in the management of human-wildlife conflict when working within and among communities?

a) Yes

b) No

If yes, list them

9.10 Are there other institutions neighboring the PA that help in conservation of biodiversity outside the p.a?

a) Yes

b) No

If yes, list the institutions and what they do.

9.11 Do the institutions in (9.10) above pose any challenges to the PA?

a) Yes

b) No

If yes, list the challenges.

Appendix VII: UWA questionnaire for Chief Park Wardens and Wardens Community Conservation

Please take some time and answer the following questions to the best of your knowledge about the community conservation

Name of protected area: …………

Demographic characteristics

Age: .. Sex: …….. Length in service in years: .. Highest Level of Education: ….

1. When community did based conservation (CBC) programme start in this protected area? ….
2. Is CBC a top priority of the park? Yes or No? ….
3. If no to (2) above, briefly explain why.
4. What partnerships exist between communities adjacent the park and other partners (other than UWA) involved in conservation? List the partners.
5. List the roles the partners listed in (4) above play in conservation of wildlife?
6. What linkages exist between the partners named in (4) above?
7. Are there any private sector institutions (including civil society organizations) involved in conservation? List them and what they do.

8. Over the last 5 or 10 years, is the number of institutions listed in (4) above increasing or decreasing? Explain the reasons for the trend.

9. Tourist lodges, and camps or campsites inside the protected area. Do they exist? If yes, list them and state what they do that supports conservation.

10. Are there any conservancies around the pa? Yes or No? ….

11. If yes in (10) above list them (conservancies) and what they do?

12. Comment on the engagement of private and community initiatives in conservation.

13. Are there any community scouts or guards participating in conservation eg guarding crops against wildlife or otherwise. Yes or No? ….

    If yes, explain.

14. Tick the main activities you implement under community conservation programme. (explain where possible) Tick your response

    a) revenue sharing

    b) collaborative management and resource access

    c) wildlife use rights program

    d) problem animal management

    e) conservation education and awareness

    f) community based tourism

15. Tick the services and support functions partners offer to communities adjacent PAs in contributing towards successful conservation. Tick your response

    a) Fundraising for community conservation
    b) Institutional building
    c) Business networking
    d) Innovation and knowledge transfer
    e) Technical training
    f) Research
    g) Legal support
    h) Infrastructure
    i) Community health and social services

16. Specifically, explain the role communities adjacent the park play to conserve biodiversity.

17. Explain the programs (conservation and none conservation related) you run with communities, schools, etc

18. Do communities contribute towards developing the park strategic action plan, and the general management plan? Explain.

19. How do you collaborate with other stakeholders (name them) involved in conservation and development activities (communities around the park, private sector, NGO etc).

20. Explain benefit sharing, (what is it, how is it done, what programmes are implemented, challenges, strategies to address them, and any other information)

Policy Issues

21. What influence does the long-term wildlife monitoring program have on policies to protect ecological integrity of the conservation area?
22. Why did Uganda National Parks incorporate the game department to form the Uganda Wildlife Authority? What informed this change?
23. The Wildlife policy of 1996 is under review, what has prompted the review of the policy? Tick your response

    a) Re-alignment with other laws and developments which came into force after the enactment of the Uganda Wildlife Act in 1996.

    b) To provide for compensation of the loss occasioned by wild animals escaping from wildlife protected areas

    c) To provide for clarification of the extent of liability of UWA in regard to wildlife induced damage and conservation area land ownership.

    d) To provide for protection of wildlife species important for conservation and national development.

e) To provide for an effective mechanism for management of wildlife outside protected areas.

24. What were the sources of the information that informed the proposed policy change?
25. What issues do you think have been deliberatively left out in the current draft policy that would have had a significant contribution to the future of wildlife in Uganda?
26. Other than the NEW provisions in the draft policy, what recommendations do you suggest to ensure effective management of wildlife in Uganda?

27. How do you generate data/information for influencing policy change? Is it the stakeholder dialogue that generates information or the monitoring information that causes policy change? Do the monitoring reports lead to action / policy change? Explain.

28. State policy changes or new initiatives, if any, you have observed or participated in since you started working in or with protected areas.

29. How have the policy changes listed in (28) above influenced management of protected areas? Explain.

30. Explain the relevance of the policy changes listed in (28) above to conservation

31. List any other policy changes you would propose to include in the current park laws that have not been included that you think would enhance conservation. (State key policy areas)

Are there aspects of park management and operation, in general, that conflict with protecting ecological integrity? (e.g other initiatives, mandates, external realities...). Yes or No… .; If yes, please briefly explain

Appendix VIII: Determination of Sample Size

Table 1.1 Sample sizes for prevalence studies

Acceptable margin of error	Size of population					
	Large	**5000**	**2500**	**1000**	**500**	**200**
±20%	24	24	24	23	23	22
±15%	43	42	42	41	39	35
±10%	96	94	93	88	81	65
±7.5%	171	165	160	146	127	92
±5%	384	357	333	278	217	132
±3%	1067	880	748	516	341	169

Example 1: Sample size for a study of the prevalence of burnout in students at a large university

A researcher is interested in carrying out a prevalence study using simple random sampling from a population of over 11,000 university students. She would like to estimate the prevalence to within 5% of its true value.

Since the population is large (more than 5,000) she should use the first column in the table. A sample size of 384 students will allow the study to determine the prevalence of anxiety disorders with a confidence interval of ±5%. Note that if she wants increase precision so that her margin of error is just ±3%, she will have to sample over 1,000 participants. Sample sizes increase rapidly when very high precision is needed.

Appendix IX: Research Application Approval by UWA

UWA
Conserving for Generations

UGANDA WILDLIFE AUTHORITY

OFFICE OF THE EXECUTIVE DIRECTOR
PLOT 7 KIRA ROAD KAMWOKYA
P. O. Box 3530, Kampala, Uganda

Our Ref: UWA/COD/96/05 — 24th July 2018

Joseph Katswera
Kyambogo University
P.O Box 1
KAMPALA

RESEARCH APPLICATION APPROVAL

I am in receipt of your research application dated July 20, 2018 seeking permission to undertake a research study in Kibale and Queen Elizabeth National Parks titled; ***"Protected Areas and Ecological Integrity".***

I wish to inform you that your research application has been approved with effect from 1st August 2018 to 30th August 2019. You will be expected to submit to UWA a progress report by June 2019 and a final report of your findings by end of August 2021. In case you are unable to work within these dates, please notify us in writing.

You will be required to pay to UWA an application fee of **UGX 20,000 (twenty thousand shillings),** a monthly research fee of **UGX 50,000 (Fifty thousand shuillings)** and a Refundable Report/ Security deposit fee of **UGX100,000 (One hundred thousand shillings).**

You are required by law to seek clearance from the Uganda National Council for Science and Technology (UNCST). By copy of this letter, UNCST is duly informed that your research has been approved by UWA.

Conserving for Generations
Yours sincerely,

EXECUTIVE DIRECTOR
UGANDA WILDLIFE AUTHORITY

Stephen Masaba
For: EXECUTIVE DIRECTOR

CC: Executive Secretary, UNCST
CC: Chief Warden, QECA, KCA
CC: Warden EM& Research, QECA, KCA

Tel: +256-41-4355000, +256-31-2355000 Fax: +256-41-4346291, E-Mail: info@ugandawildlife.org, Website: www.ugandawildlife.org

Appendix X: Ethical Approval by Research Ethics Committee

MENGO HOSPITAL

FOUNDED ON 22 FEBRUARY 1897

Our Ref: Your Ref:

MH/REC/77/03-2022

RESEARCH ETHICS COMMITTEE

16th September, 2022

Joseph Katswera
Principal investigator
Kyambogo University

Dear Sir,

RE: **EVALUATION OF THE EFFECTIVENESS OF PROTECTED AREAS IN CONSERVING ECOLOGICAL INTEGRITY IN KIBALE AND QUEEN ELIZABETH CONSERVATION AREAS, UGANDA**

This is to inform you that the Mengo Hospital Research Ethics Committee (MHREC) has approved the above research study subject to final approval from UNCST. The approval period is from 16th **September, 2022** to **15th September, 2023**. Your study number is 77/03-2022. Please be sure to reference this number in any correspondence with the MHREC.

Continued approval is conditional upon your compliance with the following requirements:

1) A copy of the **Informed Consent Document** approved as of **16th September, 2022** is enclosed. No other consent form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each member must be given a copy of the signed consent form.
2) All protocol amendments and changes to approved research must be submitted to the MHREC and not be implemented until approved by the MHREC except where necessary to eliminate apparent immediate hazards to the study subjects.
3) Significant changes to the study site and significant deviations from the research protocol and all unanticipated problems that may involve risks or affect the safety or welfare of subjects or others, or that may affect the integrity of the research must be promptly reported to the MHREC.
4) Please be informed that MHREC has a right and mandate to monitor your research to ensure compliance to UNCST regulations. This monitoring may be by making a visit to your site. The choice of the site to be visited is entirely under the prerogative of MHREC and may be done any time without prior notice.

"Christian Medical Witness"

1

5) All studies need Human Subject Protection (HSP) training and Good Clinical Practice (GCP) training for clinical studies. MHREC will not approve study protocols whose Principal Investigators have not presented the referred to certificate/certificates.

6) All deaths, life threatening problems or serious or unexpected adverse events, *whether related to the study article or not*, must be reported to the MHREC in a timely manner as specified in the National Guidelines for Research Involving Humans as Research Participants.

7) Please complete and submit reports to the MHREC as follows:

   a) Renewal of the study-complete and return the Continuing Review Report- Renewal Request (Form 404A) at least 8 weeks prior to the expiration of the approval period. The study cannot continue after **15th September, 2023 until** re-approved by the MHREC.

   b) Completion, termination, or if renewing the projects –send the report upon completion of the study.

8) You are required to disseminate a copy of your research findings to the community/ organisation where your research was conducted.

9) Before commencing with study activities and data collection, you will be required to register it with the Uganda National Council for Science and Technology.

Please call the chairman if you have any questions about the terms of this approval. Enclosed are the approved informed consent documents, waiver of informed consent and COVID-19Risk Management Plan (RMP) dated 16th **September, 2022.**

NB: Final approval is to be granted by the Uganda National Council for Science and Technology

Yours sincerely,

Prof. Kawooya G Michael
<u>Chairman (MHREC)</u>

Appendix XI: Published Journal Articles

Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.13, No.10, 2022

The Influence of Long-Term Wildlife Monitoring on Policy Development to Conserve Biodiversity in Uganda

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Abstract
The influence of Long-term Wildlife Monitoring on policy to conserve biodiversity in Uganda was explored. The study particularly sought to evaluate the indicators monitored, policies formulated, new conservation initiatives developed, and also suggest innovative conservation policy areas with guidance of the long-term wildlife monitoring program. The study was conducted through a survey from May to October 2019 using document review, Key Informant Interviews, semi-structured questionnaires, and Geographical Information System/remote sensing. The study established that Long-term Wildlife Monitoring contributes to development of conservation policies. The policies developed include the merger of Uganda National Parks and the Game Department, integration of interests of local communities in the wildlife legislation, shift from protectionism to conservation, and elevation of conservation status of protected areas. The program guides adoption of conservation initiatives mainly adaptive management, park boundary demarcation and management, restocking of wildlife protected areas, and landscape approach to management of wildlife resources. The study identified innovative conservation policy areas namely ecosystem health, community involvement in wildlife monitoring, management of wildlife outside protected areas, management of wildlife corridors, and Payment for Ecosystem Services that should be integrated into the wildlife policy and legal framework. The study concludes that wildlife monitoring program guides development of conservation policies, conservation initiatives, and innovative conservation policy areas to conserve biodiversity. Further research should investigate ecosystem health to assess the condition of the wildlife protected areas.
Keywords: Conservation, indicators, policies, protected areas, wildlife monitoring
DOI: 10.7176/JNSR/13-10-04
Publication date: May 31st 2022

1. Introduction

Ecological monitoring is integral to environmental management and biological conservation (Cord et al., 2017; Hays et al., 2019). Ecological monitoring is the process of purposefully collecting information to track and understand changes in ecosystem structure, ecological processes, and the ecological services that ecosystems provide (Lindenmayer & Likens, 2018). As the need for monitoring species, habitats, and ecosystems increases, so too do the ways in which scientists and managers involve personnel and technology to collect, process, and analyze both samples and data (Allan et al., 2018; Hill et al., 2018). Managing wildlife (i.e. the processes of dealing with or controlling wildlife for different purposes) in a sustainable way is a key challenge around the globe. To balance societal needs and ecological functions, the complex interactions between humans, wildlife, and habitats must be fully understood (Apollonio et al., 2017).

Data from monitoring have substantial value for detecting relationships between management actions and animal populations (Pollock et al., 2002) and should provide direction regarding future management decisions (Nichols & Williams, 2006; Kendall & Moore, 2012). In addition, monitoring that is not otherwise driven by a specific hypothesis can help researchers understand impacts of unplanned events such as weather (short term) and climatic patterns (long term) on wildlife populations (Beever & Woodward, 2011; Fancy & Bennetts, 2012; Johnson, 2012). Proper planning and implementing of a monitoring program includes identifying an appropriate species or taxa (Carignan & Villand, 2002), selecting metrics that are sensitive to changing conditions (Williams et al., 2002), selecting sampling methods that best maximize efficiency (Garton et al., 2005), using an experimental design to isolate the hypothesis of interest (e.g., change detection) with the most efficient probabilistic sampling (Garton et al., 2005; Morrison et al., 2008), and employing sufficient effort (sample size) to achieve the desired level of power for detecting biologically meaningful changes (Williams et al., 2002; Field et al., 2007). Failure to give these decisions proper attention often leads to misallocated resources, resulting in suboptimal information for decisions and planning objectives (Legg & Nagy, 2006). Therefore, the ability to contextualize scientific information for park decision-makers by scaling up among multiple parks and with surrounding landscapes is a particularly important aspect of long-term monitoring and research in protected-area networks (Rodhouse, 2016). Studies by Lindenmayer et al. (2015) revealed that there is a particular need for

Wildlife Corridors and Regional Biodiversity Conservation around Selected Wildlife Protected Areas in Uganda

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Abstract
Wildlife corridors play a vital role in regional biodiversity conservation. Ecological attributes, changes in corridors and wildlife populations, threats to wildlife corridor functionality were evaluated using a case study of the eight wildlife protected areas in Uganda. A survey was conducted from September 2017 to May 2019, using document review, interviews, the Nature Conservancy's Conservation Action Planning methodology, and Geographical Information System/remote sensing. The findings revealed a total of 20 key wildlife corridors in the landscape with key ecological attributes that augment regional biodiversity conservation. These corridors experience reducing vegetation cover, degradation, loss of connectivity, and degraded stepping stone habitats. They (corridors) are threatened by illegal activities, poaching and illegal wildlife tracking, unsustainable natural resource use, human population pressure, habitat transition/changes, wild fires, trans-boundary threats, infrastructure development, and climate change which affect habitat quality, diversity, and continuity. Despite the existing changes and threats, the elephant population, a migratory animal population increased. The wildlife corridors are important in conservation of regional biological diversity through maintaining the nativeness, pristineness, diversity, and resilience or adaptability of the ecosystems. The policy makers, wildlife managers, local authorities and other conservation bodies and practitioners should develop plans, policies or strategies to sustainably manage and conserve migratory animal biodiversity. Further research should be conducted to establish the functional connectivity of wildlife corridors including trends in their width across the landscape and come up with corridor restoration options.
Keywords: Biodiversity, Connectivity, Landscape, Protected areas, Threats, Wildlife
DOI: 10.7176/JRDM/87-05
Publication date: September 30th 2022

1. INTRODUCTION

Globally, land conversion and habitat degradation have resulted in many local wildlife extirpations and, as a consequence, populations are increasingly restricted to reserves isolated by agriculture and urbanization (Wegmann, 2014). Populations that lack connectivity to other protected areas can suffer from an inability to disperse between protected areas, compromised genetic variability within isolated populations due to lack of immigration, an inability of dwindling populations to be rescued from extirpation, and reduced opportunities for range shifts in response to global climate change (Rudnick et al., 2012; Gregory & Beier, 2014). Indeed some argue that the long-term viability of wildlife species relies on maintaining connectivity between protected areas (Rudnick et al., 2012). While connectivity areas for one species could not be used by others, estimates of connectivity might be sensitive to this choice of species (Cushman, Landguth, & Flather, 2013; LaPoint et al., 2013) and conservation strategies need to be optimized for each of these species (Cushman, Lewis, & Landguth, 2013). Many species are affected by fragmentation (Brodie et al., 2015; Liu et al., 2018) and the long-term viability of populations often depends on regional habitat connectivity (Heller & Zavaleta, 2009; Costanza & Terando, 2019; Littlefeld et al., 2019; UNEP, 2019).

The reduction of connectivity from habitat loss and fragmentation can restrict movement of organisms between sub-populations, which can result in decreased gene flow, local extinctions, and loss of biodiversity (Haddad et al., 2015). In the Albertine Graben, limited research had been done on the linkages wildlife corridors provide in the protected areas and conservation of floral and faunal biodiversity. Yet, the wildlife corridors are fundamental in facilitating migratory animals particularly chimpanzees, elephants and lions; and protection of key habitats in the Greater Virunga Landscape (WCS, 2008). Further, Ryan and Hartter (2012) revealed that in the Kibale-Queen corridor, it was uncertain if the goals of conserving flora and fauna connectivity were realised; and they recommended that this needed to be monitored. Past studies could not answers key questions: (1) how have corridors and wildlife populations changed over time; (2) what threats affect wildlife, their migration and conservation efforts, and (3) how the corridors contribute to the performance of regional wildlife? Past studies provided inadequate answers to these key questions. The findings of this study would therefore benefit wildlife managers, policy makers, local authorities, and researchers appreciate the changes and threats affecting wildlife corridors, and then guide decision making, development of policies and strategies to preserve wildlife corridors

Community-Based Conservation and Ecological Integrity: An Assessment of Kibale and Queen Elizabeth Conservation Areas in Uganda

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Abstract
Community-based conservation in four national parks and four wildlife reserves in Kibale and Queen Elizabeth Conservation Areas, Uganda is explored. This study investigated how community-based conservation protects ecological integrity through evaluation of the extent to which communities participate in conservation, its usefulness, and the challenges they face, using a survey. Data was collected May 2018 to April 2019 using literature review, focused group discussions, Key Informant Interviews, and semi-structured questionnaires from 259 respondents selected from the local authorities and households adjacent Kibale and Queen Elizabeth Conservation Areas. This study analysed data using Cronbach's alpha coefficient, Kruskal-Wallis Analysis of Variance, Pearson Chi square test, and Univariate Analysis of Variance; and presented the results in tables and figures. The study established that local communities participate in conservation education and awareness, benefit sharing, and boundary management programmes which contribute to biodiversity conservation and ecological integrity. Recognition of indigenous people's property; knowledge of Key Park attributes; and participation of local authorities and private sector improves people-park relations, and creates acceptance of wildlife. Community-based conservation results into increased community knowledge and collaboration, community-based tourism, private sector involvement; growth in eco-lodges and campsites, and collaboration between local communities and park management. Local community participation creates trust, belonging, acceptance, and reduces pressure on the park resources. The study concludes that Community-based Conservation is integral to conservation of biodiversity and protection of ecological integrity. However, it's challenged by poor governance, limited community involvement in conservation-related decision making, community involvement in illegal activities, and unrealistic community expectations. The wildlife agency should provide incentives to meet community needs, strengthen the benefit sharing scheme, formulate community conservation related policies, and also create and strengthen community conservation institutions to participate in conserving biodiversity and ecological integrity. Future research should explore local community perceptions and attitudes towards wildlife conservation.
Keywords: biodiversity conservation, local community participation, wildlife protected areas
DOI: 10.7176/JEES/12-4-02
Publication date: April 30th 2022

1. Introduction

Community-based conservation (CBC) is any voluntary initiative of "natural resources or biodiversity protection conducted by, for, and with the local community" (Western & Wright, 1994, p. 7). It aims "to enhance wildlife/biodiversity conservation and to provide incentives, normally economic, for local people" (Campbell & Vainio-Mattila, 2003, p. 421). CBC initiatives aim at protecting biodiversity while promoting local development (Gómez-Baggethun & Muradian, 2015) with main strategies of (i) integrating conservation and livelihood goals, (ii) providing economic and development benefits in return for conservation, and (iii) providing communities control over their natural resources (Nilsson et al., 2016). Community-based conservation is promoted as a means to re-aggregate the common resource, provide biodiversity conservation, and enhance human livelihoods under increasing pressures from population growth, land use changes, and other forces (e.g., Galvin, 2009; Reid et al., 2014). Local land users are thought to be ideally central to crafting and implementing conservation and development initiatives in a CBC model (Agrawal, 2003; Armitage, 2005; Black & Cobbinah, 2017). Appropriate approaches to balance the public need for sustaining biodiversity and natural heritage and private need for basic livelihood and culture maintenance are always under discussion and practice around the world (Lele et al., 2010; Brooks et al., 2013). While there is no fixed set of governance institutions that are appropriate to effectively govern resources (Ostrom, 2007; Andersson & Ostrom, 2008), CBC institutions are often exemplified by nongovernmental organizations (NGOs), private individuals, and layers of government that represent, facilitate, or at least support local communities in conservation governance and resource management (Baival & Fernández-Giménez, 2012). Community-based conservation institutions offer incentives to sustainably manage natural

Community-Based Tourism and Biodiversity Conservation in Kibale and Queen Elizabeth Conservation Areas in Uganda

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Abstract

Community-based tourism promotes biodiversity protection and local community welfare. The Queen Elizabeth and Kibale Conservation Areas in Uganda were investigated. To find out more about the importance of local communities and community-based tourist groups in biodiversity conservation, as well as the issues facing community-based tourism, a household survey was conducted from January to April 2019. This study used semi-structured surveys, focus group discussions, key informant interviews, and remote sensing to obtain primary data. A total of 242 people were surveyed. Data was analysed using various statistical tests, and presented results in tables and figures. Participation of communities in community-based tourism development was motivated by financial and non-financial benefits which encouraged them to participate in conserving biodiversity. They participated through collaborative resource management, and offering tourism programs, products and services to their visitors. Community-based tourism contributed to the overall biodiversity conservation, cultural heritage management, and improvement of people's welfare. In strengthening community-based tourism, park management provided skills, benefit sharing schemes, ensure compliance of the community-based tourism facilities, and increased conservation education and awareness which further promoted conservation of biodiversity. In conclusion, community-based tourism plays a positive role in promoting wildlife and biodiversity conservation. However, it's challenged by competition from private tour operators and privately owned hoteliers, inadequate product development and diversification, inadequate access and infrastructure, meeting customer expectations, inadequate knowledge and skills, COVID-19, and security related challenges, among others. Finally, there is need to enhance skills of local communities in community-based tourism development. To market and promote community-based tourism, private sector should strengthen "market intelligence" and also develop a destination branding and marketing strategy.

Keywords: Biodiversity Conservation, Community-Based Tourism, Local Communities, Parks

INTRODUCTION

Tourism continues to flourish and spread. The World Tourism Organization (UNWTO) has seen enormous growth in the last six decades despite global economic shocks (UNWTO, 2015). Protected areas improve tourism sustainability by conserving wildlife. National parks can help boost the economy, which can help cover the expenses of conservation and assist local communities (Eagles, 2014). Community-based tourism (CBT) as a tool for promoting women's and minorities' economic empowerment (Singh, 2008).

According to Hiwasaki (2006), CBT has four goals: (1) Resource conservation: preserving the environment and enhancing the area's natural and cultural resources so, tourism adds

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Scientific Report

Community Perceptions and Attitudes towards Conservation of Wildlife in Uganda

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Abstract

Community perceptions and attitudes towards the parks and wildlife in Kibale and Queen Elizabeth Conservation Areas, Uganda are explored. We determined local community perceptions and attitudes through a household survey from May 2018 to April 2019 using literature review, focused group discussions, Geographical Information System/remote sensing, and semi-structured interviews from 208 respondents randomly selected from local communities living adjacent to the wildlife protected areas. Socio-demographic factors mainly gender, age, education level, and distance of household from the park boundary influence (at α=0.05 and 0.001) local community perceptions and attitudes towards wildlife conservation. Local community perceptions of the park and wildlife were influenced (at α=0.05 and 0.001) by community knowledge and awareness of the existence and importance of the park, its attributes, wildlife resources, and benefits. Local community attitudes were influenced (at α=0.05 and 0.001) by the level of conservation education and awareness, resource access and use, handling of victims of illegal entry into the parks, and the costs incurred from invasion by wild animals. We conclude that socio-demographic factors, community knowledge and awareness of the existence of the park, its attributes and resources, community benefits, and costs incurred by the community as a result of invasion by wild animals and vermin, influence community perceptions and attitudes towards conservation of parks and wildlife. The wildlife agency should integrate local community perceptions and attitudes into the park management plans, intensify wildlife conservation education and awareness programs, and provide incentives to local communities to improve community perceptions and attitudes towards the park and wildlife.

Keywords: Biodiversity conservation, local communities, protected areas, socio-demographic variables

East Afr. J. Biophys. Comput. Sci. (2020), Vol. 1, Issue 1, 1 - 22

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Biodiversity conservation and threat reduction in Kibale and Queen Elizabeth conservation areas, Uganda

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KEYWORDS:

Biodiversity;

Conservation;

Protected area;

Threats;

Wildlife

ABSTRACT

This paper examines threats affecting the wildlife conservation areas, threat reduction and adaptive management strategies that enhance biodiversity conservation. The research was conducted through a survey, and data was collected from August 2018 to April 2019 in Kibale and Queen Elizabeth Conservation Areas using literature review, threat reduction assessment technique, Key Informant Interviews and Focused Group Discussions and semi-structured questionnaires. The data was analysed using Geographical Information System software ESRI ArcGIS version 10.31, threat reduction assessment tool, Pearson Chi square test, Spearman's rho correlation coefficient, Paired Samples t-Test, and one-way Analysis of Variables. The study established that staff education level and experience in conservation work influences biodiversity conservation. The conservation areas are threatened by habitat transition/changes, wild fires, human-wildlife conflicts, armed poaching and illegal wildlife trade/trafficking in game meat and game products, increasing human population pressure, and boundary encroachment. Despite these threats, there was a general increase in large mammal population over the past decades, which collaborates well with the threat reduction assessment indices. Both conservation areas had an ecological integrity rating average score of "yellow" indicating significant "concern" and therefore "dissatisfactory". The two conservation areas are majorly threatened by anthropogenic threats, natural threats, and administrative constraints. The wildlife agency should integrate ecosystem health into the conservation agenda. The agency should also strengthen adaptive management, law enforcement, and collaboration with local communities and other stakeholders to reduce on the threats. Finally, further research should focus on ecosystem health, and also the impact of tourism infrastructural development on biodiversity conservation.

INTRODUCTION

Protected areas harbour a particularly rich and unique biodiversity (Gibson et al.,2011; Tranquilli et al., 2014). However, their existence is challenged by many interrelated anthropogenic activities that have intensified over recent decades (Laurance, 1999; Sodhi et al., 2007; Wittemyer et al., 2008; Tranquilli et al., 2014). Increased human population growth

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