Geotechnologies and the Environment

Jeffrey O. Durrant · Emanuel H. Martin
Kokel Melubo · Ryan R. Jensen
Leslie A. Hadfield · Perry J. Hardin
Laurie Weisler *Editors*

Protected Areas in Northern Tanzania

Local Communities, Land Use Change, and Management Challenges

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Foreword

Tanzania is home to some of our planet's most beautiful and captivating natural areas. In particular, Northern Tanzania contains majestic Mount Kilimanjaro, the Serengeti National Park, the Ngorongoro Conservation Area, and many other areas with astonishing wildlife and vegetation. These areas are critically important in supporting the country's economy through the tourism industry. For decades, the protected areas in the north have played a significant role in biodiversity conservation and have supported protected areas located in other parts of the country where tourism revenues generated are too minimal to meet the budgets required for operational and administrative costs.

In the face of increasing challenges such as rapid human population growth, poverty, climate change, and human-wildlife conflicts, these areas and the species that inhabit them are becoming increasingly threatened. Population growth is causing changes in land use and land cover, and, consequently, the natural environment is being altered through loss of habitats, destruction of breeding sites and dispersal areas, and blockage of wildlife corridors. Poverty is forcing people to violate laws governing the protected areas in order to survive. Where poverty is prevalent, wildlife crimes such as poaching and encroachment are also common. It is apparent that human-wildlife conflicts are a function of rapid human population growth, poverty, and climate change.

This book presents a significant and important contribution to understanding the protected areas in Northern Tanzania. Key human and physical characteristics in and around these protected areas include historical protective land trends, government policies and governance of protected areas, local people's attitudes towards protected lands, wildlife crime, historical changes in porter work, land cover changes in and around protected lands, conservation of large animals and cavity-nesting birds, wildlife censuses, and student preparation to manage protected lands. These and other relevant topics are elucidated in concise and efficient studies and chapters.

The book is multidisciplinary and encompasses the perspective of numerous people with diverse academic backgrounds and varying experiences. I believe that this book will be a useful conservation tool and will attract attention from a wide

range of researchers, scientists, students, policy-makers, administrators, and local stakeholders wishing to better understand various dynamics regarding protected areas in Northern Tanzania.

Rector Professor Jafari R. Kideghesho
College of African Wildlife Management,
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Chapter 1
Tanzania: A Microcosm of the World's Changing Geography for Protected Areas

Jeffrey O. Durrant and Rebecca Formica

Abstract On October 6, 1889, Yohani Kinyala Lauwo guided Hans Meyer to the summit of Mount Kilimanjaro. "Lauwo," as he is often referred to, was only a teenager when he was chosen by local Chagga leaders to guide the European expedition on the first known ascent to the highest point in Africa. One hundred years after this first ascent of the legendary mountain, Lauwo was able to attend the centennial celebration of the climb, as he lived until May of 1996. The 107 years between the first known ascent of Kilimanjaro and the death of Lauwo brought massive changes to the area around the mountain and the country of Tanzania. And the subsequent decades have only hastened these changes and the broader geography that surrounds protected areas such as Mount Kilimanjaro.

Keywords National parks · Protected areas · Kilimanjaro

On October 6, 1889, Yohani Kinyala Lauwo guided Hans Meyer to the summit of Mount Kilimanjaro. "Lauwo," as he is often referred to, was only a teenager when he was chosen by local Chagga leaders to guide the European expedition on the first known ascent to the highest point in Africa. One hundred years after this first ascent of the legendary mountain, Lauwo was able to attend the centennial celebration of the climb, as he lived until May of 1996. The 107 years between the first known ascent of Kilimanjaro and the death of Lauwo brought massive changes to the area around the mountain and the country of Tanzania. And the subsequent decades have only hastened these changes and the broader geography that surrounds protected areas such as Mount Kilimanjaro.

With its vibrant and youthful population, abundance of natural resources, diverse wildlife, and its tradition of valuing and protecting special places, Tanzania is an accelerated microcosm of how the modern geography of protected areas is changing

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across the world. Three key factors are intersecting rapidly and intensely in Tanzania forcing the country to grapple and experiment with efforts to protect some of the world's most beautiful and threatened resources: (1) the amount of Tanzanian land dedicated to protected areas has grown rapidly over the past century; (2) tourism in Tanzania has expanded; and (3) Tanzania's population is accelerating. Compared with the population in 1889 when the expedition summited Uhuru Peak, Tanzania's population has experienced considerable growth and is projected to more than double its current population by 2050.

On the day Lauwo led the expedition in 1889, the concept of a national park was just emerging (with the designation of Yellowstone National Park as the world's first national park in 1872). Currently, Tanzania is home to 16 national parks, 28 game reserves, 44 game controlled areas, 1 conservation area, and 2 marine parks (UNWTO 2018), as well as 7 world heritage sites (UNESCO 2019). And while Lauwo and the British expedition were the first group known to summit Kilimanjaro, thousands of people each year now make the trek. All of these factors provide the context for the research presented in this book and bring different pressures and challenges for Tanzania's protected areas.

1.1 Tanzania's History of Protecting Special Places

Conservation is an important value for Tanzania. Over 40% of the country is set aside for wildlife conservation or various other forms of protected areas (Kijazi n.d.). Protected areas include national parks, conservation areas, game reserves, grasslands, mountains, archeological sites, and world heritage sites.

While Tanzanian history provides some insight into how the idea of protected areas originated, Tanzania has taken significant actions since independence to define how it will protect its special places. Restrictions established during the colonial period, such as on hunting, were often continued or extended after independence (Kijazi n.d.). But since independence, Tanzania has expanded protected areas and undertaken different efforts to involve or benefit local populations, with differing levels of success. In what has become known as the Arusha manifesto, the first president Julius Nyerere articulated the importance of Tanzania's flora and fauna not only to Tanzania but also to the world:

> The survival of our wildlife is a matter of grave concern to all of us in Africa. These wild creatures amid the wild places they inhabit are not only important as a source of wonder and inspiration but are an integral part of our natural resources and our future livelihood and well-being. In accepting the trusteeship of our wildlife, we solemnly declare that we will do everything in our power to make sure that our children's grandchildren will be able to enjoy this rich and precious inheritance. The conservation of wildlife and wild places calls for specialist knowledge, trained manpower, and money, and we look to other nations to cooperate with us in this important task – the success or failure of which not only affects the continent of Africa but the rest of the world as well. (Kideghesho 2008)

In addition to expanding the number of protected areas, Tanzania has taken other significant steps to facilitate the protection of its resources, such as the establishment of the College of African Wildlife Management, which provides competent

and informed wildlife managers and has become a leader in quality wildlife management training in Africa. The Tanzania Wildlife Research Institute (TAWIRI) also helps coordinate and supervise quality wildlife research throughout the country.

Tanzania has expanded its national park system from 3 parks that existed at independence in 1961 to 15 current national parks. One example of national park development is provided by Mount Kilimanjaro. Mount Kilimanjaro is the tallest mountain in Africa and the tallest freestanding mountain in the world. In 2016, Mount Kilimanjaro was declared Africa's leading tourist attraction by the World Travel Awards Africa at the Indian Ocean Gala Ceremony in Zanzibar. Mount Kilimanjaro was first designated as a game reserve in 1910 and was later recognized as a forest reserve in 1921. It was established as a national park in 1973 but was not opened to the public until 1977. The park was recognized as a world heritage site by UNESCO in 1987 and voted as one of the Seven Natural Wonders of Africa in 2013. Kilimanjaro covers an area of 1668 km^2 and sees approximately 25,000 visitors every year. Tanzania National Parks Authority (TANAPA) has established seven official hiking routes on the mountain with 31 camping sites. Logging, fires, and the conversion of montane first to softwood plantations have dramatically changed the montane forest on the slopes (Fig. 1.1).

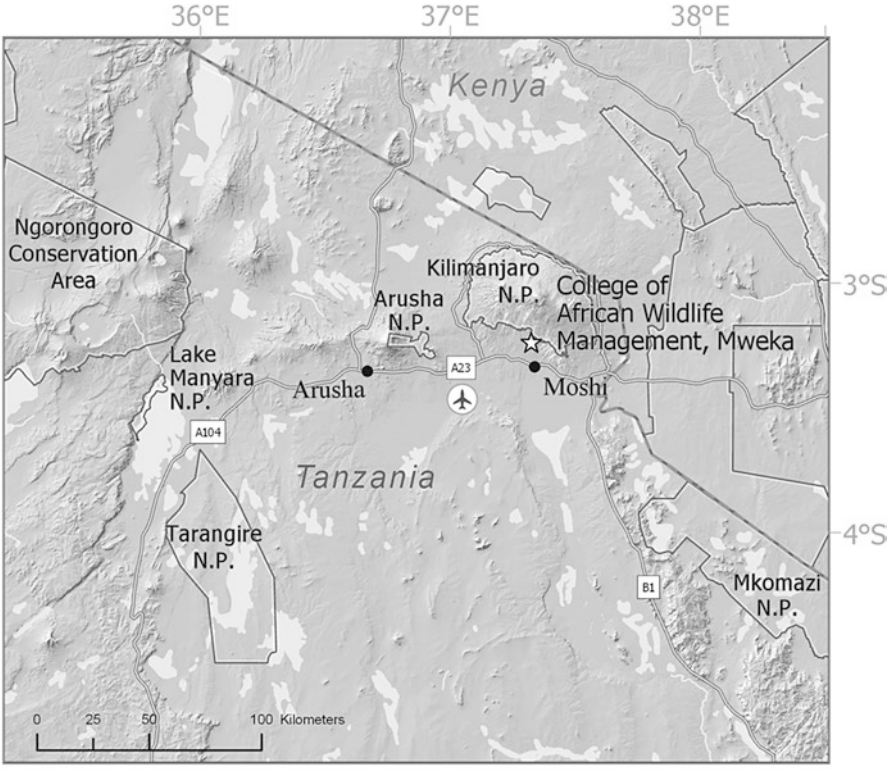

Fig. 1.1 Kilimanjaro area in Northern Tanzania

1.2 Pre-Independence

During the Berlin conference in 1884–1885, Germans were given control over what was then called Tanganyika. The Germans used questionable treaties and imperial charters to assert authority over the land. Germany implemented the first wildlife hunting law in 1891, which severely limited the local populations' ability to hunt by banning the use of indigenous weapons. The licensing fees were expensive, and natives were not allowed to own rifles, effectively barring them from access to the resources and wildlife upon which many depended for life (Kideghesho 2008). Ironically, during Germany's movement to stop "cruel, wasteful and barbarous African hunting" purportedly to prevent depletion of the big game, European hunting in Tanzania was only increasing. The result of the German measures "was to convert … wildlife from a locally used and customarily managed component of the natural resource base, to a resource which Europeans largely possessed exclusive legal access to" (Nelson et al. 2007 p 236).

The German administration also established some protected areas, with 14 by 1913 that covered approximately 3% of the territory's land (Koponen 1994 p 538–540). "As a rule, however, local people continued living in these areas based on their customary rights to occupy land, although there as elsewhere, their rights to use wildlife itself were significantly curtailed" (Nelson et al. 2007 p 236).

After Germany's defeat in World War I, German colonies were divided among the allied nations and Britain gained control over Tanganyika in 1920 (Kideghesho 2008). The British administration, like the Germans, viewed wildlife as a valuable source of economic revenue (Kideghesho 2008), and British colonial conservation policy sought to promote economic interests while also catering to conservation groups' demands to preserve the exotic animals, especially the larger ones. Under British rule, however, there was little to no focus on the well-being of the local people or their connection to preserving areas or protecting the animals. Through the 1950s, British policies increasingly focused on protecting land and wildlife while limiting local access and involvement. The game preserves often imposed high costs on the nearby populations, who lost access to resources such as firewood, food, medicinal plants, grazing areas, and spiritual sites (Kideghesho 2008). For example, when the Serengeti National Park was established in 1959, resident Maasai pastoralists were removed from the park (Neumann 1998). A new National Parks Ordinance "extinguished all customary land rights of communities living in the Serengeti and any future national parks, meaning that local people were henceforth not allowed to live in these areas" (Nelson et al. 2007 p 237).

Under British rule, all wildlife was declared to be property of the Queen of England, and the preserves were often referred as "the Queen's farm" (Kideghesho 2008 p 2). A British organization, the Society for Preservation of Flora and Fauna for the Empire (SPFFE), advocated to increase the protected status of several game reserves to the more restrictive category of National Parks. Major Richard Hingston, a representative of this group, traveled to East and South Africa to investigate such possibilities and returned with the recommendation that humans should be evicted

from these protected areas (Kideghesho 2008). However, there was some British recognition that local populations should benefit from their country's natural resources. Sir Donald Cameron, the governor of Tanganyika in 1926, declared, "The interests of the people must be paramount…the conventional attitude as regards game preservation requires revisions" (Neumann 1998).

1.3 Post-Independence

Tanganyika and Zanzibar gained their independence from Great Britain in 1961 and united to form Tanzania in 1963. Tanzania retained several of the colonial conservation practices, and, according to Kideghesho, the new Tanzanian government was often even more strict in its conservation efforts (Kideghesho 2008). Economic opportunity was a significant motivating factor, but now economics were more closely connected to national interests rather than just protecting exotic animals. Tanzania's first president, Julius Nyerere stated, "I personally am not interested in animals. I do not want to spend my holidays watching crocodiles. Nevertheless, I am entirely in favor of their survival. I believe that after diamonds and sisal, wild animals will provide Tanganyika with its greatest source of income. Thousands of Americans and Europeans have the strange urge to see these animals" (Levine 2002 p 1047).

Nyerere's observation was accurate. Hundreds of thousands of Americans and Europeans now flock to Tanzania each year to see the animals as well as Tanzania's other natural wonders like Mount Kilimanjaro. The country's natural resources provide great economic opportunity.

Tanzania built upon the Tanganyika National Parks Ordinance CAP, which was passed in under British rule in 1959, and established the organization now known as Tanzania National Parks Authority (TANAPA) to govern its national parks. After independence, no radical changes were adopted to address the customary rights to the natural resources the local people lost during the colonial regime (Neumann 1996; Levine 2002). Instead, the wildlife-related benefits were targeted toward the entire nation and encouraging foreign interests, rather than the communities living near the wildlife who bore the heaviest costs associated with its protection and conservation such as threats to crops, livestock, and livelihoods. "Tanzania's rural villagisation programmes of the mid-1970s, where up to 5 million Tanzanians were relocated, with little heed paid to pre-existing land rights or claims, represented an unprecedented effort by the state to shape rural patterns of land use and livelihoods" (Nelson et al. 2007 p 239).

However, since the 1990s, at least in theory and on paper, more focus has been put upon local populations and their involvement in both the management and benefits of protected areas. In 1998, the Wildlife Policy of Tanzania was enacted, which promoted local participation in wildlife management and promoted community-based conservation. Although the state retains ownership of wildlife, the Wildlife Policy states, "It is the aim of this policy to allow rural communities and private land

holders to manage wildlife on their land for their own benefit" (MNRT 1998p 14; Nelson et al. 2007 p 243). However, the results of this policy have not materialized, and some have written that control over wildlife and hunting has become even more centralized than in 1998 when the policy was enacted (Nelson et al. 2007 p 247).

Conservation in Tanzania is still governed by the Wildlife Conservation Act of 1974, although there has been pressure for adoption of community-focused policies similar to the Wildlife Policy [verify]. The Wildlife Conservation Act allows the government to establish protected areas and outlines how these areas are to be organized and managed. National Parks represent the highest level of resource protection under the Act and the core business of TANAPA (TANAPA 6 July 2019).

Another management body, the Tanzania Wildlife Management Authority (TAWA), was established under the Ministry of Natural Resources and Tourism in 2014 (TAWA 6 July 2019). TAWA is responsible for administering the sustainable management of wildlife resources and biodiversity conservation outside the National Parks and the Ngorongoro Conservation Area. This means management of an area that represents 79% of the total protected areas in Tanzania (approximately 169,553 km^2). These areas include game reserves, game controlled areas, and open areas.

1.3.1 Tanzania National Parks and Protected Areas Within a Global Context

Since independence, wildlife management in Tanzania has remained largely centralized, featuring large state-protected areas and strict controls on resource use and access. While there have been several attempts to adopt global management ideals that local communities should be closely involved in and benefit from decentralized wildlife management, the reality on the ground remains highly centralized. Local control is strongly supported by nonprofit environmental groups, large donors, foreign conservation organizations, and official government policies. But despite the good intentions and even official policies, centralized control over wildlife and protected areas continues to be the norm, with local communities a mere afterthought at best.

1.3.1.1 IUCN Categories

The International Union for the Conservation of Nature (IUCN) created global categories of protected areas that range from Category I (a strict nature reserve with little to no human interaction) to Category VI (a protected area where human interaction is a vital part of the protected area). The IUCN categories have moved beyond a simple description to helping decision-makers categorize their priorities for an area and adjust the area's management and policies accordingly. The IUCN defines

a protected area as "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (IUCN and WCPA 2013).

The six categories reflect different priorities and protection goals and have been largely adopted to describe protected areas throughout the world. Below are brief descriptions of these protections.

Categories Ia and Ib: Strict Nature Reserve/Wilderness Areas

Strictly protected areas set aside to protect biodiversity, natural character, and potentially geological/geomorphic features. Human visitation, use, and impacts are strictly limited to preserve the natural character of these places. Such protected areas can serve as indispensable reference areas to measure human impacts through scientific research and monitoring.

Category II: National Parks

Large natural or near-natural areas are set aside to protect large-scale ecological processes and the species and ecosystems. While there are protections against human impacts, National Parks are also meant to provide opportunities for visitors, education, and recreation.

Category III: Natural Monuments or Features

Areas are set aside to protect a specific natural feature such as a landform, seamount, submarine cavern, or a geological feature, such as a cave, or even a living feature, such as an ancient grove. Category III areas are generally smaller and often have high visitor value even without the large-scale ecosystem protection.

Category IV: Habitat/Species Management Area

These areas aim to protect particular species or habitats, and their management reflects this priority. Many Category IV protected areas need regular, active interventions to ensure that the requirements of particular species or habitats are maintained.

Category V: Protected Landscape/Seascape

A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural, and scenic value. In these areas, safeguarding the integrity of these interactions is a key value.

Category VI: Protected Area with Sustainable Use of Natural Resources

These areas attempt to conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with the majority of the area in a natural condition while a portion is used for sustainable natural resource management. Low-level, nonindustrial, and sustainable uses of the natural resources are a key aim of these areas (ICUN 2013).

Table 1.1 National parks in Tanzania

Park	Size	Date
Arusha	552 sq. km (212 sq. miles)	1967
Mkomazi	3245 sq. km (1240 sq. miles)	
Mt. Kilimanjaro	1688 sq. km (651 sq. miles)	1973
Serengeti	14,763 sq. km (5700 sq. miles)	1959
Tarangire	2,850 sq. km (1,100 sq. miles)	1970
Lake Manyara	648 sq. km (250 sq. miles)	1960
Gombe	56 sq. km (21 sq. miles)	1968
Katavi	4417 sq. km (1727 sq. miles)	1974
Mahale	1613 sq. km (623 sq. miles)	1985
Rubondo Island	456 sq. km (176 sq. miles)	1977
Saanane	2.18 sq. km (0.84 sq. miles)	2013
Kitulo	412.9 sq. km (159 sq. miles)	2005
Mikumi	3230 sq. km (1250 sq. miles)	1964
Ruaha	20,226 sq. km (7809 sq. miles)	1974
Udzungwa	1990 sq. km (770 sq. miles)	1992
Saadani	1100 sq. km (424 sq. miles)	2005

Protected areas have proliferated worldwide and now account for nearly 13% of the world's surface area excluding Antarctica (ICUN 2013). Since independence, Tanzania has expanded and developed the protected areas within its boundaries. Table 1.1 outlines the current protected areas that exist in the country (Fig. 1.2).

1.4 Tanzania's Growing Population

While accurate population figures are not available for Tanzania during Lauwo's famous summit in 1889, by using world population figures as a guide, it is likely that the population of Tanzania was somewhere around five million people. As shown in Table 1.2, the population of Tanzania has grown rapidly since then and is now ranked as the 23rd largest country in the world (World Population Review 2019).

Tanzania is projected to exceed 100 million people by 2037. It has the 18th highest population growth rate and birth rate in the world, with no signs of a slowdown (Population Reference Bureau 2018). Tanzania's population tends to congregate in fertile rural areas as well as key urban areas. There are about 53 people per square kilometer in the water-rich mainland highlands, which includes the Kilimanjaro area, and up to 134 people per square kilometer in the most densely populated urban areas such as Zanzibar. About 80% of the population lives in rural areas (Population Reference Bureau 2018).

As seen in Table 1.3, Tanzania is outpacing population growth trends in Africa generally and is going in the opposite direction of Europe whose population is projected to decline over the next several decades.

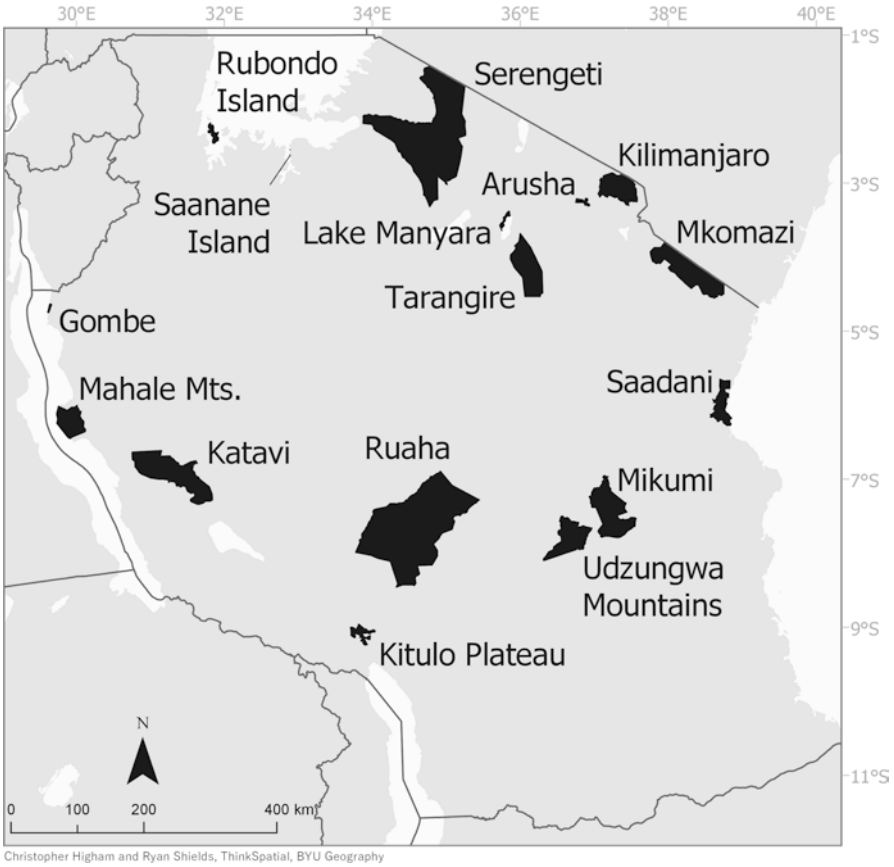

Fig. 1.2 National Parks in Tanzania

Table 1.2 Tanzania's population source: US Census

Tanzania	1961	1990	2019	2050
Total population	10.5 million	24.8 million	56.9 million	118.6 million
Population density (people per square kilometer)	11.9	28.0	64.3	133.9

While Tanzania's total fertility rate is projected to decline over the coming decades—from 4.7% in 2019 to 3.1% in 2050—it is projected to remain slightly above Africa's rate (currently 4.2% and projected at 2.8% in 2050). This contrasts strongly with Europe's rate (projected at 1.7% by 2050) (US Census n.d.). Tanzania's high fertility rate is largely a function of the population's age structure that is younger than Africa's and dramatically younger than the world's and Europe's (Table 1.4).

Table 1.3 Population trends source US Census

	1890	1961	1990	2019	2050
World	1.5–1.7 billion	3.084 billion	5.286 billion	7.582 billion	9.488 billion
Africa		292.5 million	631.7 million	1.294 billion	2.412 billion
Europe				748 million	717 million
Tanzania	Approx. 5 million	10.6 million	24.8 million	57.0 million	118.6 million

Table 1.4 Population characteristics. 2018 World Population Data Sheet

	2018: % Population under 15 years of age	2050: % Population under 15 years of age	2018: % Population over 65 years of age	2050: % Population over 65 years of age
Tanzania	45%	36%	3%	5%
Africa	41%	32%	3%	6%
Europe	16%	15%	9%	16%
Global	26%	21%	18%	28%

Table 1.5 Percentages of people living in rural areas. 2018 World Population Data Spreadsheet

	% Population living in rural areas		% Population living in rural areas
Tanzania	66%	Europe	25%
Africa	57%	China	41%
Global	45%	India	66%
Most developed countries	21%	Least developed countries	67%

These numbers show the age characteristics that will lead to the projected population growth by 2050. Population projections have generally proven to be true over time; while minor adjustments may be made over the decades, large changes are very uncommon. Because of Tanzania's age structure, the people that will produce the population increases projected by 2050 have already been born, even though the most of the women have not yet reached their childbearing years.

While Tanzania's large urban areas are experiencing dramatic growth, the population in Tanzania will remain quite rural for the foreseeable future. With approximately 80% of its population living in rural areas, changing to a majority urban population will take place only slowly. This contrasts with the average global population, which became urban for the first time this decade. Table 1.5 shows how Tanzania compares with Africa and the world as to where its population is distributed.

As the table indicates, there are massive differences between regions and developed and undeveloped countries in terms of rural and urban population distribution. The most developed countries and the least developed countries, including Tanzania, have an almost inverse relationship in where their populations live.

1.4.1 The Tourist Influx into Tanzania

Tourists are drawn to Tanzania from all parts of the world to witness the beauty of its landscapes and wildlife. Tourism is a growing industry throughout Africa and is amplified in Tanzania. The 2018 annual report of the United Nations World Tourism Organization (UNWTO) found that Africa demonstrated the most rapid growth in global travel and tourism (UNWTO 2018). Tanzania is the seventh most visited country in sub-Saharan Africa, and from 2006 to 2014, the number of international tourist arrivals in Tanzania increased from 622,000 to 1.1 million (UNWTO 2018), a 77% increase in just 8 years. In 2006, tourism in Tanzania brought in approximately 862 million US dollars. Tourism for wild game hunting alone brought in $27 million (Baldus and Cauldwell 2004; Barnett and Patterson 2006).

Table 1.6 illustrates the growth of tourism over the past 20 years. The numbers show that Africa has outpaced global growth percentagewise, and as one of the most popular tourist destinations in Africa, not surprisingly, Tanzania has dramatically outpaced African growth percentagewise in tourism.

Tourism is one of the fastest growing economic sectors in the country and contributes around 17.2% of the GDP and 41.7% of foreign exchange earnings (Kijazi n.d.). Tourism also provides significant direct employment opportunities estimated at over 377,000 direct jobs in 2011 (3.7% of total employment). This number is projected to rise to 497,000 jobs (3.9%) by 2021 (Kijazi n.d.). Tourism's real impact on jobs is even more extensive, with estimates of jobs indirectly supported by tourism at more than 1,124,000 jobs (11.2% of total employment) in 2011 and a projection of 1,477,000 indirect jobs (11.7%) by 2021 (Kijazi n.d.). But even with these numbers, according to Euromonitor International (2010), travel and tourism in Tanzania remains relatively untapped.

This book is presented to explore the details of Tanzania's past and ongoing conservation efforts and to present current research that can inform protective efforts across the globe within the context of the changing geography of Tanzania and its protected areas. The eight chapters in this book focus on specific situations that illustrate the geography of protected areas in Tanzania and provide real examples of how the forces of protected area growth, population growth, and tourism are converging and the ways people and areas have reacted to this convergence.

Table 1.6 Growth of tourism Worldbank.org

International tourism arrivals			
Year	World	Africa	Tanzania
1997	584,000,000	14,690,000	347,000
2017	1.341 billion	42,364,000	1,275,000
Total increase over two decades	230%	288%	367%

1.5 Book Chapters

This book is presented to explore details of Tanzania's past and ongoing conservation efforts and to present current research that can inform protective efforts across the globe within the context of the changing geography of Tanzania and its protected areas. The ten additional chapters in the book focus on specific situations that illustrate the geography of protected areas in Tanzania and provide real examples of how the forces of protected area growth, population growth, and tourism are converging and the ways people and areas have reacted to this convergence.

Chapter 2 illustrates some of the real costs of population growth and modern society's move toward mass production of agriculture, such as at coffee plantations. While cavity-nesting birds have done well in protected areas, Dulle et al. found the birds are facing some irreversible forces through population growth and changes in land use outside of protected areas. Dulle et al. found that heavy losses of deadwood near coffee plantations are negatively impacting cavity-nesting birds. Dulle et al. examined the effects of providing artificial nesting boxes and suggest them as one option to address losses of these nesting birds that is seen as irreversible.

Hadfield takes a historic look at how Africa's colonial past is impacting current tourist interaction with the porters and guides on Mount Kilimanjaro (Chap. 3). Hadfield examines how some attitudes from the use of porters in colonial expeditions have evolved to modern-day tourism. Even with current porter organization efforts to prevent colonial-type practices that require constant service to outsiders with little regard for the health and well-being of the local porters and guides, challenges such as heavy loads, poor equipment, and inadequate food and safety remain.

Looking at Arusha National Park, Mahenya et al. (Chap. 4) study how the individualized impacts to those living nearby affected their attitudes toward the Park. Mahenya et al.'s study found that the attitudes of locals were more positive toward Arusha National Park in relation to giraffes, since giraffes present few problems to the residents and are associated with the positive benefits of tourists. However, more negative attitudes resulted from interactions with more destructive animals such as baboons or when people had been fined for domestic livestock grazing in the Park.

Similarly, Melubo et al. (Chap. 5) found that having personal experiences in protected areas contributed to better attitudes and ability to manage protected areas. Melubo et al. studied students at CAWM who had been involved in a wilderness training program that involved at least a short overnight experience in a protected area. Students who participated in these programs were found to be better equipped to operate and manage protected areas in their future careers.

Extending the theme of effective protected area management, Shoo evaluates the impact of having an effective management structure in place on the success of ecotourism (Chap. 6). Shoo found that a sound management plan can help managers avoid obstacles that often prevent successful ecotourism, such as environmental deterioration and inequitable development among the local communities. Shoo studied Lake Natron, which has a high potential for ecotourism development.

However, Shoo found that without a sound general management plan, Lake Natron suffered from inadequate funding at the operational level, lack of mechanisms to secure a fair distribution of ecotourism benefits, and poorly developed tourism infrastructure and facilities that reduced the potential for successful ecotourism at the park.

Rjia and Kideghesho examined nine poacher's strategies used in the Serengeti ecosystem (Chap. 7). They argue that increased enforcement of wildlife crimes has influenced adaptability in poacher's strategies. Field rangers and wildlife managers can use the nine strategies they described to more effectively combat wildlife crimes, and the authors provide three recommendations to help inform field patrols and other mitigation efforts.

In Chap. 8, Kisingo and Kidegheso present findings from previous community governance studies using a V3 model. They found some changes in community governance with regard to conservation, livelihood improvement, and social benefits. They also note some setbacks in community governance that need to be addressed.

Several chapters examine biophysical characteristics of protected areas in northern Tanzania.

Martin et al. (Chap. 9) used temporal remote sensing data to study land use and land cover change near the Kwakuchinja Wildlife Corridor in northern Tanzania. They found that while a paved road provided better connections between two towns, it also impacted animal movement between two national parks by providing a physical obstacles and bringing in more settlement. Satellite remote sensing data showed that over time, the most significant changes were from bare ground to "savanna with some agriculture" and "agriculture with some grassland."

Mseja et al. used transect lines in Mkomazi National Park to count wild animals as ground reference information for the population density (Chap. 10). A total of 22 species were estimated, and African e Buffalo (*Syncerus caffer*) was the most common species, while Gerenuk (*Litocranius walleri*) was the least. Mseja et al. suggest other methods be used to count more elusive species. For example, camera traps could be used to estimate carnivores and dung counts for elephants. The combination of these methods can give a benchmark for future population estimates.

In Chap. 11, Martin et al. used MODIS land cover data and scripts in Google Earth to examine vegetation change within Mkomazi National Park in northeastern Tanzania both before and after it became a national park in 2008. The data showed relatively subtle changes and most likely reflect that only subtle changes in land management policy have occurred since its conversion from two separate game reserves.

Finally, in Chap. 12, Kideghesho et al. review the challenging dynamics between wildlife conservation and human population growth and urbanization. The authors provide recommendations on the best manner to minimize the negative impacts of human population growth on large mammals.

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Chapter 2
Growing Concern for the Conservation of Cavity-Nesting Birds Outside Protected Areas: Can Artificial Nest Boxes Be Effective Conservation Tools?

Hamadi I. Dulle, Saleh S. Seif, Shedrack K. Mungure, and Jafari R. Kideghesho

Abstract The overwhelming demand of deadwoods outside protected areas has not given deadwoods enough time to remain standing for the formation of the tree cavities by birds and other natural agents. Consequently, cavity adopter and large-bodied species face difficulties in finding and establishing acceptable nest sites. The focus of biodiversity conservation has been mainly within protected area systems, and less attention has been given to areas outside protected areas despite the fact that these areas support a bigger proportion of bird community. A high pace of deadwood loss on the entire landscape on the southern slopes of Mount Kilimanjaro is an irreversible situation in which is increasingly becoming a growing concern for the conservation of biodiversity beyond protected areas. Here, we investigate what extent deadwoods have in providing nest sites among cavity-nesting birds. We do this through observations and by placing artificial nest boxes on trees within three different land-use types. We found that deadwood volume and number of natural tree cavities were lower at coffee plantations as compared to mixed farming areas and Kilimanjaro National Park (KINAPA). Likewise, tree cavity positions from the ground were higher at coffee plantations than in other two land-use types. However, application of artificial nest boxes reveals that a good number of larger artificial nest boxes had greater occupancy, as did boxes placed at higher positions on trees from the ground at coffee plantations and mixed farming areas than at KINAPA, suggesting a shortage of natural cavity-nesting sites for larger birds and an avoidance of nest predation or human disturbances, respectively. Therefore, provision of artificial nest boxes could offer nesting opportunities for a range of cavity-nesting birds if designs and constructions take into consideration all possible factors that might hinder their occupation by cavity-nesting birds. In this manner, application of cavity

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nest boxes could be a vital alternative tool for conservation of cavity-nesting birds beyond boundaries of protected areas.

Keywords Cavity-nesting birds · Tree civities · Deadwood · Mount Kilimanjaro National Park · Artificial Nest Boxes as conservation tools · Conservation

2.1 Introduction

There are several limiting factors, other than food, that are known to limit bird species abundance and their geographic distributions. At its simplest level, the effect of a shortage of any resource is not always obvious, especially in more diverse habitats that may take several years before it is reflected in poor recruitment in bird populations. Over the course of history, human's destructive land-use practices have undoubtedly contributed to the transformation of the original birds' habitats into structurally different environments. Accordingly, the negative habitat changes have been increasing more rapidly than ever before (see, e.g., Newmark 1996; Kideghesho et al. 2006; Elmqvist et al. 2016). Such transformations may have caused a shortage of important resources for birds, particularly those with specific requirements (i.e., nesting sites).

The cavity-nesting guild includes a diverse group of birds that all require the use of cavities or crevices as roosting and nesting sites. Deadwoods are among essential resources for many forest birds, but competing human demands have deleteriously affected cavity-nesting birds, albeit in a variety of ways. For instance, the reproductive success of cavity-nesting birds is directly associated with the availability of natural tree cavities (Waters et al. 1990). As is well-known among cavity-nesting birds, deadwoods play a major role in providing roosting and nest sites (Arnett and Sallabanks 1998; Lambrechts et al. 2010; Catry et al. 2013). Therefore, the lack of acceptable nest sites, particularly in highly populated areas, as a result of limited deadwood availability, adversely affects reproduction and distribution of cavity-nesting birds. Consequently, the number of available tree cavities in a given habitat is an important determinant for occurrence and reproduction success of cavity-nesting birds. Some studies have indicated that nest-site quality, not just quantity, influences occurrence and productivity of cavity-nesting birds (Wiebe 2011). However, the overwhelming focus of biodiversity conservation has been mainly within protected area systems, and less attention has been given to areas outside protected areas despite the fact that these areas support a bigger proportion of biological resources. The mechanisms underlying the distribution pattern of secondary cavity-nesting birds subjected to different management systems are poorly known (Robles et al. 2011).

Cavity-nesting birds are an important part of the forest ecosystem (Macdonald 1979). Accordingly, the majority of cavity-nesting birds are insectivorous, and because they make up a large proportion of the forest-dwelling bird population, they

play an important role in the control of forest insect pests (Kirk et al. 2011). Woodpeckers, for example, are important predators of many species of tree-killing bark beetles. Cavity-nesting birds mostly occur in areas characterized by the presence of big trees that provide cavities suitable for nesting and foraging sites. Accordingly, cavity-nesting bird species have been classified in two groups according to their ability to excavate tree holes: primary cavity-nester species (species that are able to dig their own cavities) called excavators and secondary cavity nesters or non-excavators (species nest in pre-existing cavities) known as cavity adopter species (Martin et al. 2004). Furthermore, cavity-nesting bird species have been classified according to their level of dependence on tree cavities, those that can use tree holes, but are not obligate cavity nesters, and birds that use tree holes only (Newton 1998; Brandeis et al. 2002).

In light of these classifications, the excavators (e.g., woodpeckers) have an advantage of being able to excavate their own tree holes; however, outside protected areas, they are limited by the low density of deadwood. Accordingly, the obligate and non-obligate cavity-nesting birds differ in several important life history traits including nesting success, clutch size, nestling period length, and adult survival (Martin et al. 2004). Most obligate cavity nesters are in the orders Passeriformes (songbirds), Piciformes (woodpeckers), Apodiformes (swifts), Coraciiformes (rollers), Strigiformes (owls), Psittaciformes (parrots), and Anseriformes (waterfowl) (Newton 1998). The occurrence and abundance of the obligate species may be dictated by the availability of tree cavities in their habitats (Fig. 2.1). Breeding success is expected to vary with the number of tree cavities that might limit the number of breeding pairs.

Over the years, Mount Kilimanjaro has undergone major land use and cover changes that have led to degradation of the land and loss of biodiversity of both flora and fauna (Misana et al. 2012). Thus, the high pace of deadwood loss on the entire landscape on the southern slopes of Mount Kilimanjaro due to agricultural practices (i.e., shade-free coffee plantations, maize, and banana farms) and deadwood collection for fuel wood may affect a number of cavity-nesting bird species. Removal of

Fig. 2.1 Violate-backed Starling nesting in a pre-existing tree cavity created by *excavator* species (primary cavity nester) at a very short and small deadwood. (Source: Photo by H. Dulle)

Fig. 2.2 Snag harvesting for timber in mixed farming areas contributes to the shortage of deadwood hence low density of natural tree cavities. (Source: Photo by Shedrack K. Mungure)

deadwood and the harvest of snags (Fig. 2.2) may be directly associated with the shortage of tree cavities that in turn limit the occurrence of cavity-nesting birds on the slopes of Mount Kilimanjaro. The first phase of this study explored the occurrence of cavity-nesting birds as a response to the availability of tree nesting cavities in areas with different land uses (Fig. 2.1a). Observations were made on densities of the tree cavities in selected areas outside and inside the park with the assumption that inside the park, there is minimal deadwood harvest. The purpose of this chapter is therefore to provide insights on the effect of deadwood shortage on the landscape, emphasizing the availability of suitable nesting sites for the cavity-nesting bird species.

2.2 Effects of Deadwood Shortage on Cavity-Nesting Bird Community

Deadwoods were once widely spread throughout the landscapes on the southern slopes of Mount Kilimanjaro. However, due to the continuing habitat destruction by human activities, much of the populations of cavity-nesting birds are becoming increasingly restricted to the protected areas. As human population increases, most of the landscapes outside protected areas are becoming more prone to incomparable

Fig. 2.3 Most landscapes on the slopes of Mt. Kilimanjaro outside Kilimanjaro National Park are limited by the availability of big standing deadwood like these that can be used by birds to make tree cavities for roosting and nesting. (Source: Photo by H. Dulle)

rates of deadwood utilization, and the landscapes are becoming limited by the availability of big standing deadwood that can be used by birds to make tree cavities for roosting and nesting (Fig. 2.3).

The ongoing deadwood offtake in many landscapes is associated with the loss of natural tree cavities that may heavily impact the reproduction success of cavity-nesting birds and variably affect opportunistic cavity-nesting birds (Warakai et al. 2013). The lower southern slopes of Mount Kilimanjaro between 1000 m and 1600 m asl are densely populated and primarily used in coffee and banana plantations, while remnants of the natural forest are mostly restricted to deep valleys and gorges (Hemp 2006). Most of these forest patches have little to no deadwoods within them to support cavity-nesting birds. However, the effects of deadwood shortages are especially severe for non-excavator bird species, as they are optimistically depending on already available tree holes (Fig. 2.4).

Fig. 2.4 Cavity-nesting birds in highly disturbed habitats can take advantage of any available deadwood to make their nests; i.e., the use of electric poles indicates a serious shortage of standing deadwood suitable for cavity-nesting birds to make tree cavities. (Source: Photo by H. Dulle)

The findings from this study have empirically demonstrated that the availability of deadwoods outside protected areas is crucial for the conservation of cavity-nesting birds (Fig. 2.5). Other studies have confirmed that cavity-nesting birds primarily use standing dead trees or snags as a source of foraging and nesting sites (Brandeis et al. 2002). Nevertheless, the overwhelming utilization of deadwoods on the southern slopes of Mount Kilimanjaro does not give the deadwoods enough time to remain standing for the formation of the tree holes by birds or natural agents. Consequently, cavity adopter species are suffering a serious shortage of acceptable nest sites. Removal of deadwood in many landscapes has been suggested as creating adverse effects to cavity-nesting bird species, such as woodpeckers (Loose and Anderson 1972). Some studies have demonstrated a strong correlation between the removal of snags and the reduction of bird populations (Scott et al. 2004).

Investigating the relationship between number of natural tree cavities and the deadwood volume in three land-use types, we found that there was a significant difference in number of tree cavities $t = 2.3366$, $df = 179$, p-value = 0.02057, and there was a positive association between the number of tree cavities and deadwood volume $R = 0.1720409$. The decline of tree cavities outside protected areas is becoming insurmountable, and its effects are reflected in poor recruitment in bird populations over time. This decline poses challenges on biodiversity conservation, particularly in continuously changing habitats. It has been observed that the occurrence of primary and secondary cavity-nesting birds in their natural habitats is often directly related to deadwood density (Cockle et al. 2011). Thus, the effect of forested land conversion into non-forest vegetation at lower elevations of Mount Kilimanjaro is primarily felt on by large-bodied and secondary cavity-nesting birds corresponding to a lack of large deadwood and a low density of readily available tree cavities, respectively. In such situations, large-bodied and secondary cavity-nesting birds in particular should be facing more difficulties to find suitable deadwood (Fig. 2.4) and natural tree cavities.

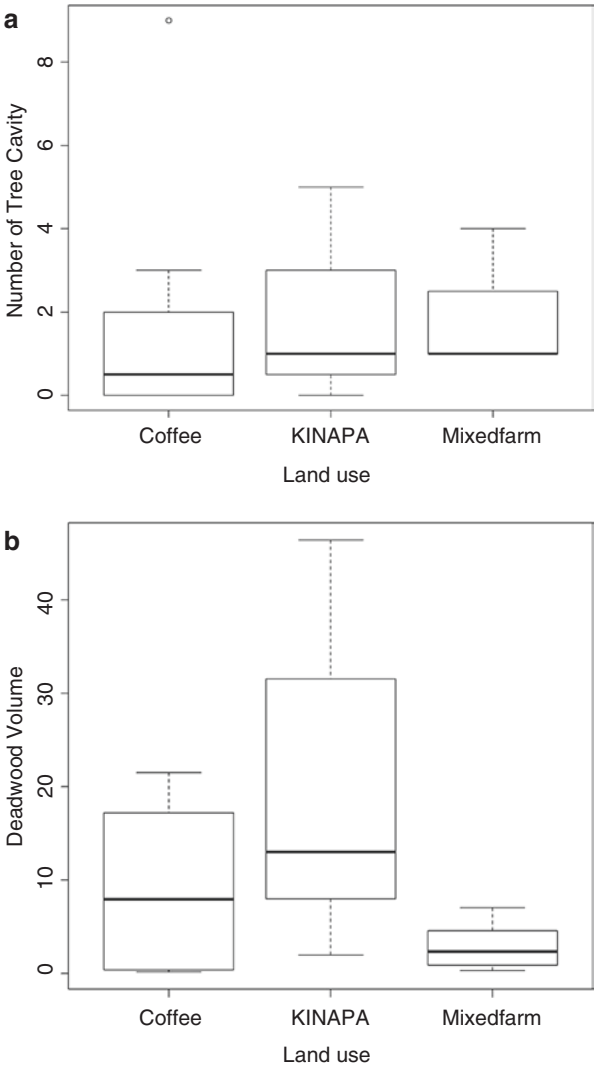

Fig. 2.5 Number of natural tree cavities (**a**) and deadwood volume (**b**) recorded within three land uses: coffee plantations, Kilimanjaro National Park (KINAPA), and mixed farming areas

The findings from our study reveal that cavity-nesting bird responses on shortage of tree cavities vary considerably among the cavity-nesting birds depending on the body size, ability to excavate their own tree holes, and availability of suitable sizes of deadwoods. Using artificial nest boxes outside the park, we realized that larger artificial nest boxes had greater occupancy, as did boxes placed at higher positions on trees from the ground at coffee plantations and mixed farming areas compared to those at KINAPA. These findings suggest a shortage of natural cavity-nesting sites for larger birds and an avoidance of nest predation or human disturbances, respectively. These findings corroborate other experimental studies conducted on the use of artificial nest boxes by cavity-nesting birds (e.g., Tyson et al. 2011; Warakai et al. 2013).

2.3 Application of Artificial Nest Boxes as a Conservation Tool

Increasingly, protected areas are the last places left for much of the planet's biodiversity. Habitats outside the protected areas are distressed in a way that cannot support bird species with specific requirements such as nesting sites. Therefore, the second phase of this study was to examine whether supplementing natural tree cavities with artificial nest boxes could be a useful conservation strategy for many species that are obligate tree hole nesters and non-excavators to successfully halt or even reverse declining populations (Kook et al. 2008). However, some studies have demonstrated that enriching small trees with artificial nest boxes cannot mimic the value of big trees for cavity-nesting birds (Le Roux et al. 2016). In some cases, where natural tree cavities are scarce, application of artificial nest boxes has been proven to contribute significantly in improving the densities of cavity-nesting bird species (Fargallo et al. 2001). Given the important contributions of cavity-nesting birds to ecosystem functioning, and the associated lack of sufficient empirical data, it is crucial to test the use of artificial nest boxes as a conservation tool. Indeed, with the increasing decline of deadwood to provide suitable nesting sites for cavity-nesting birds, we presume that the application of artificial nest boxes will be significant in studying the effects of deadwood decline and space use by cavity-nesting birds. As suggested by Goldingay and Stevens (2009), we placed artificial nest boxes of different sizes, particularly in entrance diameter, ranging from 5 cm to 12 cm on trees with different diameters at breast height, in order to investigate the full potential of artificial nest boxes and strengthen any generalizations (Fig. 2.6).

A variety of approaches have been used to quantify the effects of deadwood shortage on cavity-nesting bird species distributions and abundance trends (e.g., Twedt and Henne-Kerr 2001), including application of artificial nest boxes (Warakai et al. 2013). Recognizing the presence of different sizes of cavity-nesting bird species in our study area, we used artificial nest boxes of three different sizes: (i) large-sized artificial nest boxes to accommodate larger-bodied cavity-breeding birds such as hornbills; (ii) medium-sized artificial nest boxes for cavity-nesting birds like starlings, white-eared barbet, and others; and (iii) small-sized artificial nest boxes for cavity-nesting birds of smaller sizes such as tinkerbirds and others of similar size. In each of the three land uses, we established three study sites of 100 m × 100 m whereby five artificial nest boxes of each size were placed on live trees at each of four heights from the ground (10 m, 15 m, 20 m, and 25 m). For each study site in a given land-use type, we categorized trees into three sizes in terms of diameters at breast height: (i) small tree (25–35 cm), (ii) medium tree (40–50 cm), and (iii) large tree (> 100 cm). We made our artificial nest boxes by using easily available timber and placed them on trees within three study sites along the land-use gradient (Kook et al. 2008). The GPS coordinates of each nest box in each of the study sites were recorded.

Accordingly, by the time we conducted analysis of the available data, the results indicated that the majority of the artificial nest boxes occupied by cavity-nesting

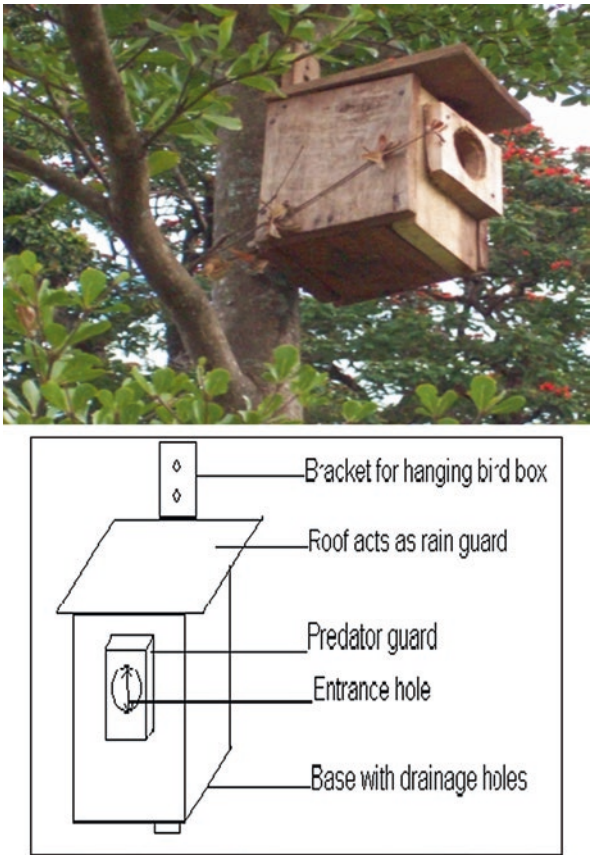

Fig. 2.6 Artificial nest box mounted on a tree designed based on sketch diagram beside the photo. (Source: Photo and drawing by Shedrack K. Mungure)

birds were of 6 cm in entrance hole size. This could be associated with the artificial nest boxes design. Other studies have demonstrated that cavity vertical depth is an important feature in bird's nest-site selection (Tyson et al. 2011). However, this was not considered in the course of designing our nest boxes. The shallow vertical depth from the entry hole could have been a hindrance to some bird species not to occupy our artificial nest boxes. Therefore, it is an important learning point that all possible factors that may hinder occupation of artificial nests by cavity-nesting birds should be taken into consideration at the designing stage.

We found seven cavity-nesting bird species using our artificial nest boxes in different levels at each land-use type (Fig. 2.7). However, a great proportion of large cavity-nesting birds such as hornbills, barbets, and woodpeckers occupied nest boxes at coffee plantations and mixed farming areas, suggesting a shortage of natural tree cavity-nesting sites for larger birds (Fig. 2.7).

Furthermore, we observed that the positions of artificial nesting boxes from the ground occupied by cavity-nesting birds were lower at Kilimanjaro National Park (KINAPA) than those at the other two land uses. The occupation of artificial nest

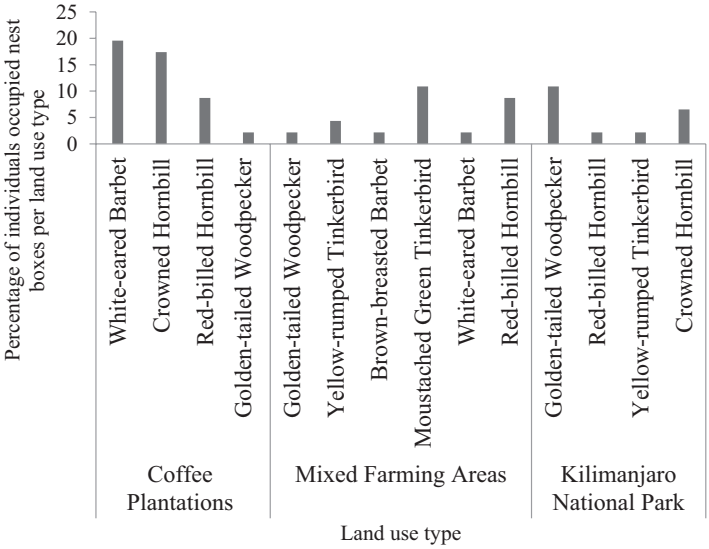

Fig. 2.7 Percentage of individuals of cavity-nesting bird species that were recorded using the artificial nest boxes in three types of land uses (n = 46) on the southern slope of Mt. Kilimanjaro

boxes among three land uses was statistically significant (p-value = 0.0001) using ANOVA. In coffee plantations, the positions of the artificial nesting boxes from the ground were higher than in the other two land uses. The occupation of artificial nest boxes placed at higher positions on trees suggests avoidance of nest predation or human disturbances. These findings corroborate other experimental studies conducted on the use of artificial nest boxes by cavity-nesting birds (e.g., Tyson et al. 2011; Warakai et al. 2013). Other studies have empirically demonstrated that cavity-nesting birds use artificial nest boxes more frequently during colder months (Harper et al. 2005), establishing that the application of nest boxes increases the space use by cavity-nesting birds in disturbed areas of ecosystems. The findings from this study revealed that responses of cavity-nesting bird species to the shortage of natural tree cavities vary considerably depending on the body size, ability to excavate their own tree holes, and availability of suitable sizes of deadwoods. Accordingly, the application of the artificial nest boxes outside the park would be of conservation value if all occupation hindrance factors are taken into consideration at the designing stage.

Astonishingly, our study recorded some non-cavity-nesting bird species using nest boxes (i.e., tambourine dove, red-eyed dove, and speckled mousebird). Such species were observed carrying nest building materials into the artificial nest boxes, suggesting that some bird species can opportunistically use artificial nesting boxes. As part of our research observation, we constructed artificial nest boxes using timbers from different tree species, some of which produced a strong smell that may have influenced the occupation of artificial nest boxes by birds.

There could be several contributing factors hindering the preference for nest boxes that were not recorded as occupied by cavity-nesting birds, including the strong smell of timber from some tree species, the placement and position of nest boxes, and the size of the tree on which the artificial nest boxes were mounted. However, other studies have suggested that the main design elements such as entrance size, hollow volume, hollow vertical depth below entrance, and wall thickness may influence the use of artificial nest boxes by cavity-nesting birds (Goldingay and Stevens 2009; Tyson et al. 2011). A great amount of general literature is available recommending detailed box designs for birds (Lambrechts et al. 2010; Warakai et al. 2013). Therefore, it is worth taking note of the tree species to be used for build nest boxes.

2.4 Conclusion and Recommendations

We observed a substantial number of individuals of some large cavity-nesting birds such as Hornbills, Barbets, and Woodpeckers occupying nest boxes at coffee plantations and mixed farming areas compared to those in Mount Kilimanjaro National Park, indicating a shortage of natural tree cavity-nesting sites for larger birds. This observation suggests that large-bodied and secondary cavity-nesting birds are of those populations of concern because the accessibility of suitable natural tree cavities outside protected areas is very limited. Likewise, by using artificial nest boxes outside the park, we realized that larger artificial nest boxes had greater occupancy, as did boxes placed at higher positions from the ground. It is important to consider all possible factors at the designing stage that may hinder occupation of artificial nests by cavity-nesting birds.

Nevertheless, the occupation of artificial nest boxes by cavity-nesting birds varied greatly among the three land-use types. The probable factors for such variation may include the body size, ability to excavate their own tree holes, and availability of suitable sizes of deadwoods. However, the provision of artificial nest boxes to cavity-nesting birds is a viable alternative tool for conservation of cavity-nesting birds outside protected areas to maintain the functional roles of cavity-nesting bird species across different trophic levels. Some studies on the application of artificial nest boxes have revealed several positive results in increasing the breeding success of cavity-nesting birds and improved survival by protecting individuals from predators (Remm 2006).

We recommend that the appropriate knowledge of artificial nest boxes be disseminated to the local communities on the entire landscape of the southern slopes of Mount Kilimanjaro and beyond so as to increase the chances of conserving cavity-nesting birds. The observational knowledge prior to placement of artificial nest boxes is crucial for studying the effect of deadwood shortages in any given landscape. Moreover, information on all active nest boxes such as positions from the ground might be worth taking into consideration in the design and placement of artificial nest boxes on trees. We noted a sizeable proportion of artificial nest boxes

that were not occupied by cavity-nesting birds; however, observers could have missed them during observations. To capture all events taking place around and inside the nest boxes, we highly recommend studies incorporating infrared camera traps so as to improve data collection on the use of artificial nest boxes by cavity-nesting birds and other opportunistic users.

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Chapter 3
Historical Change in Porter Work on Kilimanjaro

Leslie A. Hadfield

Abstract This chapter charts changes in the nature of porter work on Mount Kilimanjaro from the first Europeans to employ porters on their expeditions to Kilimanjaro in the mid-to-late nineteenth century to the more recent changes in regulations of porter working conditions. It separates the changes over time into three main periods: the period of long-distance trade caravans and colonial expeditions; the rise of the climbing and tourism industry on the mountain when local Chagga guides and porters dominated the mountain crews; and, finally, the era of more responsible tourism and porter organizations around the turn of the twenty-first century. Highlighting this history brings into relief the characteristics of porter work on the mountain and the dynamics of the relationships involved. The chapter argues that as porter work shifted from long-distance trade caravans to high-altitude mountain tourism, colonial customs that disadvantaged porters continued. As the support crew, porters were expected to attend to every need of the visiting climbers with little regard for their own conditions. When some of the people driving the industry (foreign climbers) challenged the system, porter organizations were formed which helped advocate for better working conditions, although some challenges in regard to the loads porters carry, their equipment, clothing, food, and health continue.

Keywords Porters · Kilimanjaro · Mountain Climbing Industry · Colonial · History

3.1 Introduction

The great majority of porters and guides who have long accompanied visitors to Mount Kilimanjaro go unnamed and unrecognized. The oversight of guide and porter work on Kilimanjaro has carried over into scholarly work as well. As Brent

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Lovelock wrote in the literature about mountain guiding operations in general, "there has been more detailed coverage of the conditions for pack animals" than the conditions for porters (Lovelock 2017 p 275). Kokel Melubo has similarly observed that more research has been done on conservation biology and climatology on Mount Kilimanjaro than porters. Yet, as Melubo argued, porters are crucial to the climbing industry on Kilimanjaro, even "the heart and soul of the trekkers on the mountain" (Melubo 2017 p 285). David Peaty has pointed out, "Not a few wealthy foreign trekkers owe their very survival to their poorly-paid, overworked, undernourished trekking staff" (Peaty 2012 p 7).

This chapter seeks to bring the history of porters who have worked on Kilimanjaro to light, starting with the first to accompany European explorers, to those who worked as the mountain tourism industry grew from the mid-twentieth century, to more recent times when porters have gained more recognition and policies to ensure better working conditions. Porters here are defined as people employed to carry loads, set up and take down camp, and sometimes prepare food as part of trekking or travel groups (Melubo 2017 p 286). The chapter demonstrates how the work of porters and their relation to tourists on Mount Kilimanjaro are tied to the history of labor in long-distance travel and trade in pre-colonial Africa, colonial labor and social relationships, and more recent dynamics of the commercial tourism industry. It demonstrates that as the type of porter work and people who engaged in it changed over the years, colonial and mountain tourism approaches to porters persisted until some of those driving the industry raised awareness of the unequal aspects of the work. This history is important to understand the nature of this aspect of mountain adventure tourism on Kilimanjaro along with the related moral questions involved. It can also help to understand how the industry might break from or build on aspects of the past.

3.2 Long-Distance Trade Caravans to Colonial Expeditions

Various aspects of porter work in East Africa have their roots in the long-distance trade caravans that dominated the region's interior in the nineteenth century as well as in the colonial relationships that developed in the latter part of the century. A few historians have examined pre-colonial porterage in different parts of the African continent, including the use of slaves to traverse long distances (Lovejoy and Coquery-Vidrovitch 1985; Rockel 2006, 2000). By the early nineteenth century, a free wage labor market for porters had developed in the East African region between the coastal hubs such as Bagamoyo, Saadani, and Mombasa, and inland areas leading to Lake Tanganyika or passing through the Kilimanjaro region to Lake Victoria. Since pack animals were too susceptible to trypanosomiasis spread by the tsetse fly in these regions, caravans relied almost solely on human labor (Rockel 2006 p 4). (Trypanosomiasis, or sleeping sickness, caused by a microscopic parasite, did affect humans in some conditions, but tended to kill more animals.) A porter culture developed in caravans that included internal porter organization and established customs

of work and caravan life. In this partly monetized economy, porter labor became commercialized with specialization and the rise of recruitment agents. European explorers and missionaries moved into this established caravan system in the mid-to-late nineteenth century, bringing with them their colonial sense of racial and cultural superiority. Scientific and geographic expeditions led by Europeans added an element of specialization to certain porter roles. In long-distance trade at the time, people from particular ethnic groups along the coast in the central regions worked as porters, while the Chagga living on Mount Kilimanjaro served mainly as temporary guides when requested.

Stephen Rockel's work on Nyamwezi porters (Rockel 2000, 2006) and the writings of European explorers who led expeditions to Kilimanjaro such as the British Harry Hamilton Johnston (Johnston 1886) and Hans Meyer (Meyer 1890, 1891) give a sense of the conditions of porter work and the culture of caravans in the region in the mid-to-late nineteenth century. Long-distance porter work had long been established by the time Europeans came to travel to Mount Kilimanjaro, when slaves and ivory were the major trading items sent to the coast in exchange for cloth, beads, guns, and other imported goods. Porter work became dominated by particular groups, such as the Swahili on the coast and the Nyamwezi in the region between the coast and Lake Tanganyika. At this time, different groups of people collectively called the Chagga lived on the lower regions of Kilimanjaro. The mountain's two most prominent volcanic peaks rise high above, with the highest point on the top of Kibo peak (5895 m), opposite Mawenzi (5149 m). The Chagga people had often traversed the mountain highland areas and had camped soldiers there in times of conflict (Bender 2013). Living in the verdant region of the mountain, the Chagga were linked to the long-distance trading routes; yet, they engaged with long-distance trading caravans more so by welcoming them as visitors who stayed to trade and refresh than by working as porters (Munson 2005). Some Chagga sold slaves to these caravans who may have used the slaves as porters before selling them when they reached the coast. Chagga groups lived in clans and chiefdoms on different ridges on the lower regions, with the Moshi, Kibosho, and Marangu groups having the most contact with Europeans in the late nineteenth century.

The size and nature of caravans varied from small groups of a dozen people to huge caravans of hundreds of porters; from cooperative groups banding together to caravans run by commercial bosses; and from occasional to full-time porters. Porters were hired at various points along the trading routes, but largely at either end of the long-distance routes. Recruitment agencies and agents arose in coastal towns as more Europeans arrived there and created a bigger demand for porters in the late 1800s. Porters could register with agents or market their labor individually. They were paid a large percentage upfront (in goods or money) and then compensated for the rest of their work at the end of the trip. Rockel demonstrates that Nyamwezi men often engaged in this porter work to invest back into their homes and families. The structure of their society and agricultural and economic activities meant that they had access to labor in their homes which allowed more men to leave to work as porters (Rockel 2000). The seasons and agricultural conditions also determined

when some were willing to work in trading caravans. Others may have engaged in porter work because of agricultural hardship or because the more urban coastal regions they originated from also facilitated this form of long-distance trade work.

In larger caravans, a culture of hierarchy, internal organization, and standard practices developed, influenced heavily by Nyamwezi along with coastal groups (Rockel 2006). Once the caravan labor was organized (either through announcements in villages and towns, individuals searching for work, or recruitment agents), the loads were distributed and a division of labor established. Europeans described dividing provisions and goods into parcels weighing 50–70 British pounds each, although certainly the loads varied in weight depending on the objects carried. Porters had to carry their assigned load along with some of their own equipment and even protection, such as a firearm or spear, if traveling through dangerous regions. Other porters carried food, which consisted of staples, such as beans, rice, or millet, easy to transport and prepare. Caravan officers and leaders managed large numbers of porters, with officers handling the recruitment, organization, and provisions for porters and guides or march leaders setting the pace and marking the path. Rockel also highlights the role of *mganga* or diviners in protecting Nyamwezi-led caravans (Rockel 2000 p 184). As the caravan reached its destination each day, managers and officers directed the setting up of camp and designated cooks prepared food. After a morning or day's march, porters would have time to make any necessary repairs, attend to injuries, eat and rest, or entertain themselves before sleeping. As free agents, porters at times negotiated better working conditions, but at other times fell victim to hunger, thirst, and fatigue that came with this physically taxing work.

European missionaries and explorers started hiring porters for their journeys to Kilimanjaro in the mid-to-late 1800s. Missionary Johannes Rebmann is credited with the first European citing of Kilimanjaro on his 1848 journey for which he recruited a team of men (Lenoble-Bart and Constantin 2006 p 6). Rebmann was followed by other German missionaries and British geographers and explorers in the ensuing decades, with Hans Meyer and Ludwig Purtscheller being the first Europeans to reach the highest peak in 1889. Accounts of their expeditions, written often by the lead Europeans, reveal the colonial and scientific aspects of their caravans that shaped the character of these early European-led journeys. They were colonial in purpose, seeking to know, claim, and conquer African land, but also with the sense of racial and cultural superiority that Europeans brought to their relationship with their crews. The exploratory and scientific purposes of these expeditions also changed the nature of the caravan work, increasing the time of the journey, changing the destination, and altering the type of work porters engaged in.

Johnston and Meyer described processes and organization of porter work in their expeditions similar to other trade caravans of the time. They wrote about the effort that went into securing a team of porters through local contacts on the coast or individual porters they already knew. Johnston wrote that his caravan consisted of 120 men who carried 50 pounds each. 30 of these men were hired for 1 month to take them to the base of the mountain (see Johnston 1886 p 48). Meyer gathered men from various places for a total of around one hundred (hiring 60 Swahili porters at Zanzibar) (Meyer 1891 p 37) who carried about 60 pounds each. They employed a

hierarchy of managers and headmen among the crew and paid them according to the customs of the time. However, unlike trade caravans, they also sought people with particular skills and encamped in places for some time to conduct their studies or expeditions. Johnston, Meyer, and other European expeditions set up camps on Kilimanjaro among the Chagga for months. Johnston spent 6 months and Meyer just over 1 (16 of those days in the upper camp just below Kibo and Mawenzi). Groups of porters were left for periods of time at lower camps as the Europeans ascended. Johnston took nine of his own men on his first ascent and three on his second, and Meyer and Purtscheller left two head men, nine porters, and three Somali managers at a central camp, while supposedly taking Mwini Amani with them to their upper camp. The smaller number of porters who stayed with the explorers shifted from carrying loads to building and managing camps. Those who accompanied these explorers to higher elevations met different difficult weather conditions with extreme cold temperatures and the physical risks of high altitudes. Both expeditions also hired guides with valuable local knowledge of the mountain from different Chagga chiefs—Johnston taking six from Moshi and then two from Marangu, and Meyer writing about taking two (unnamed) from Marangu.

The colonial mindset was evident in the way that these explorers wrote about and treated their porters. They commented on the simple wants and aptitudes of the porters or their complaints about the work as evidence of their racial weakness. For example, Johnston described the variety of food he took for himself, then contrasted that with the beans and maize they packed for the porters, exclaiming, "How easily fed these Swahili porters are! What other race would be content to trudge twenty miles a day with a burden of sixty pounds, and be regaled on nothing but maize and beans?" (Johnston 1886 p 46). Both Johnston and Meyer deliberated on the best way to inspire discipline in the porters, with Johnston recounting an incident at the beginning of his trek where he physically punished a porter in a way that Johnston claimed established his authority (Johnston 1886 p 57). Other local or Arab caravan commissioners and managers certainly also meted out punishments, especially if the porters were slaves. Yet, Rockel indicates that African caravan leaders took a more non-violent approach (Rockel 2000 p 182). Porters Johnston and Meyer could trust were described as exceptions. Certain ethnic groups were praised over others. Johnston complained of the problematic Rabai porters he hired on the coast near Mombasa. Meyer's "rather crude" descriptions of Africans led Boris Michel to argue that Meyer "was constantly concerned with the self-fashioning of his own whiteness and with German civilization" (Michel 2018 p 7). Meyer hired a small number of Somali porters on his way to Zanzibar because he held a racial philosophy that they had "superior characteristics" for working with Europeans and believed that having foreign managers reduced the chance of insubordination among porters (Meyer 1891 p 30–31). Describing one of the head Zanzibari porters he obtained through his recruiting agent, Meyer wrote, "Ugly, lazy, insolent, cowardly, weak, dishonest, untruthful, he is a typical Zanzibari. Nevertheless I tolerate him, for he is personally responsible to Siwa Haji for the behavior of the rest of the caravan." Meyer also spoke of the "easy-going, contented Wanyamwezi" in contrast to others who were "constantly in need of the whip to bring them to their senses." On

Fig. 3.1 Hans Meyer's 1889 caravan on its way to Kilimanjaro (Meyer 1891; public domain)

the same page, he praised the porters' "physical performances" which "would do credit to any respectable beast of burden"—to which he added, "in many respects, they bear a striking resemblance" (Meyer 1891 p 48) (Fig. 3.1).

Missionaries and explorers often opened the way for colonial conquest in Africa. Those who attempted to climb Kilimanjaro preceded the establishment of scientific stations, colonial governments, and European farms that followed. German armies subjugated the Chagga and established headquarters in Old Moshi in 1890. The German government took over control of the region from the German East African company in 1895, after which they began to implement "rational development" in the form of colonial government, infrastructure, and new forestry and agriculture on Kilimanjaro complete with scientific stations (Munson 2013, 2005). The construction of railways across the East African interior, reaching the modern-day town of Moshi in 1911, instigated a decline in long-distance caravans and porter work (Fabian 2007). At the same time, the demand for porters and guides for European exploration of Kilimanjaro arose and Europeans shifted to rely almost exclusively on Chagga porters and guides for mountain expeditions. The American trek of Peter MacQueen and Peter Dutkewich in 1908, for example, employed the guide Souho and 16 men provided by the Moshi Chief Sulim (Salkeld 2002 p 137). Under German colonial rule, mainly Germans focused on mapping and studying the mountain. In 1909, the surveyor M. Lange made the second successful ascent of Kibo with his assistant Weigele, Germans Fritz Klute and Edward Oehler made the first ascent of Mawenzi in 1912, and a handful of other Germans subsequently climbed the mountain before World War I (Burns 2006; Mushi 2011). In addition to Yohani Kinyala Lauwo, the Kilimanjaro National Park names other Chagga guides as some

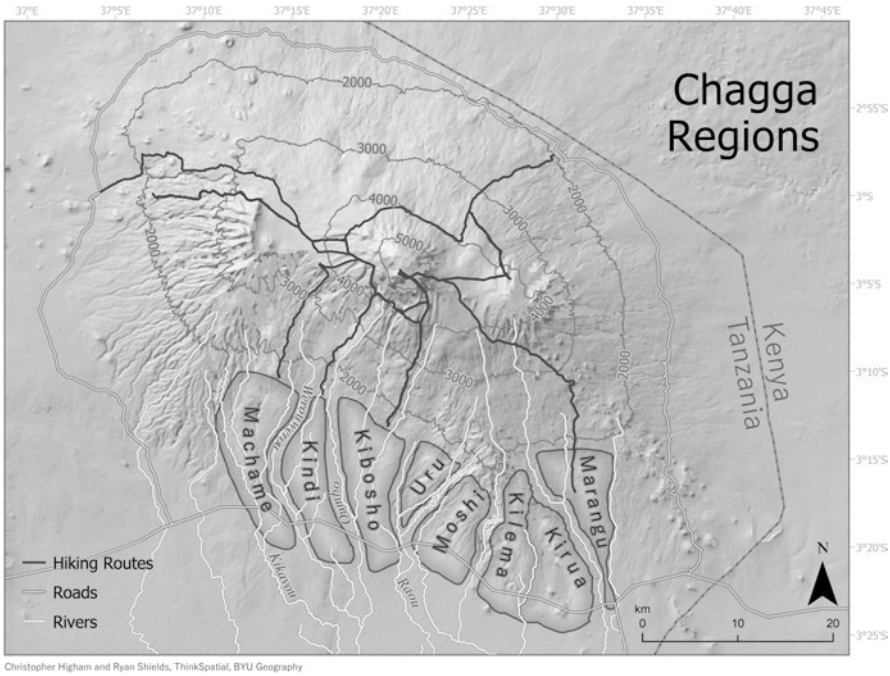

Fig. 3.2 Historical distribution of Chagga groups

of the first to accompany Europeans during this time: Oforo and Jonathan Mtui, as well as those who had likely served as porters: Elia Minja, Tom Mosha, Makalio Lyimo, and Mamba Kowera (Salkeld 2002 p 233). It would be after the British took control of Tanganyika in 1916 and the end of World War I that more British climbers began to tackle the mountain and tourism activity would begin on the mountain. This new form of porter work involved almost exclusively local Chagga but drew on customs of the earlier periods (Fig. 3.2).

3.3 The Rise of the Climbing Industry and Chagga Porters

Guided mountaineering or mountain tourism is not necessarily colonial in and of itself. It utilizes the knowledge and skill that guides have to offer and is part of risk management in adventure tourism (Thompson-Carr 2017). Yet, as mountain tourism—people making mountains of various types a destination for nonwork or leisure activities (Beedie 2017)—developed on Kilimanjaro, it did so within a colonial context. As Paul Beedie wrote, the European pattern of a "rich and educated relatively elite group buying local guiding services in the pursuit of personal glory," spread to other parts of the world in the twentieth century with the "expansionist agenda," of "'opening up' wild and remote mountain areas, often in relatively

poorer countries" (Beedie 2017 p 48). As the industry matured, it continued colonial practices of serving the foreign visitor's agenda with little regard to local interests, particularly in regard to porter work. Vestiges of these colonial characteristics and customs persisted even into the era of Tanzanian independence. While guides gained more prestige and higher economic status through their work, porters continued to perform the difficult labor of carrying loads for trekking groups for a lesser reward, reflected in the local terms for porters, *wagumu* (the tougher) or *wapiganaji* (the fighters) (Melubo 2017). The increase in tourism in the late twentieth century exacerbated the risks of porter work as more people competed for jobs on the mountain. Because of their local knowledge, proximity, and the economic opportunities it brought, Chagga peoples living on the mountain dominated guiding and porter work into the 1990s.

After World War I, more people began to desire to climb Kilimanjaro, beginning with mountaineers in the 1920s. Experienced technical climbers mostly of British descent tackled various parts of Kibo and Mawenzi, taking local guides and porters with them. This led to the beginnings of commercial tourist activity on the mountain in the 1930s. The East African Mountain Club was founded at Moshi in 1929 and offered its services to those seeking to climb Kilimanjaro (and became the Kilimanjaro Mountain Club in 1960). It sought "generally to encourage climbers and visitors to the district" and arranged for "capable guides and porters" ("The East African Mountain Club" 1931). The club also maintained huts on the mountain for visitors for a number of years to come (Busk 1955; Hall Jr 1936).[1] The Marangu Hotel, established by Martin Lany (a Lutheran missionary seeking other profit-making ventures as world coffee prices fell), began offering guided tours for people around the same time ("Marangu Hotel—Our Story," www.maranguhotel.com). Joined by the Kibo Hotel, these hotels outfitted groups of tourists, offering equipment, provisions, and arranging for local guides and porters. Post-World War II global tourism also influenced the growth in the interest in Kilimanjaro, along with a receding snow line and the opening up of less-technical routes to the top of Kibo. Although the high altitudes and extreme temperatures restricted who would attempt the climb (Musa et al. 2017), the mountain became more open to people not trained in mountaineering. By 1955, *Alpine Journal* writer and mountaineer DL Busk wrote that the "vast majority" of the "numerous parties attempting the climb are tourists and not mountaineers" (Busk 1955 p 99). The *Alpine Journal* later reported that more than 700 people attempted to summit the highest peak in 1959 (only about half reached the top) and that climbing Kilimanjaro had become a "popular business" by the 1960s (Brooke 1963; Burns 2006 p 20).

Local guides specializing in catering for tourists began to make a career out of this work and jobs for porters also continued to grow. The hotels organized these teams of guides and porters and insisted that people could not use the huts without a local guide (Busk 1955 p 102). In the 1920s and 1930s, the number of climbers or

[1] The Kibo Hut, situated as the last camp before summiting, was apparently built in 1932 (Burns 2006). The Club provided books to certify guides (Busk 1955 p 101)

hikers was not as steady, making it difficult for guiding and porterage to become a constant form of work. The work was also seasonal, with visitors coming to the mountain when they would find the best weather conditions and when it was holiday season in Europe and America. Nevertheless, porters engaged in this work for similar reasons as porters in the past—to invest in their homes and families, supplement other economic activities, or sustain themselves through hard times. The rise in the mountain tourism industry in the mid-twentieth century coincided with an increase in pressure on the land in the lower regions of the mountain inhabited by the Chagga. Porter work opened opportunities for Chagga men to earn a wage in a more monetized economy when their access to land declined as the population grew and forest reserves and European agriculture limited expansion (Bender 2013; Håkansson et al. 2008). Guiding and porter work offered temporary employment, while others established careers in the industry. The varying pay levels and the dynamics of this work developed over the late twentieth century into the conditions described in more detail below. Along with having porters carry their loads, European visitors also continued to enjoy personal service of porters and cooks, many of whom go unnamed in published accounts and kept separate quarters, similar to domestic servants. Busk's (1955) comments about the breakfast on the morning of his summit provide a poignant example: "A shout aroused my 'cook-porter' and tea was served to me in my sleeping bag from the petrol primus, a luxury I have never enjoyed in a hut before. I then deigned to rise for porridge and bacon and eggs, served on a table cloth with a napkin placed neatly beside my plate" (Busk 1955 p 100) (Fig. 3.3).

With Tanzanian independence, Kilimanjaro became a national symbol and a source for more tourism promising to bolster the newly independent state's economy (especially after the 1967 Arusha Declaration affirming the country's commitment to self-reliance). Upon independence from British rule in December 1961, the new country of Tanganyika (combined with Zanzibar to create Tanzania in 1964) significantly renamed the highest point on Kibo from Kaiser Wilhelm's Peak to Uhuru Peak (Uhuru meaning liberty in the Swahili language). Lt. Alexander Nyirenda of Tanganyika African Rifles raised the Tanganyikan flag on the peak (Salkeld 2002). In subsequent decades, Tanzania built up its national parks system and sought to harness certain areas for greater tourism revenue. In 1973, the state-run Tanzanian Tourist Corporation created the Kilimanjaro National Park Authority (KINAPA) to manage the mountain as a national park open to the public. Also in the 1970s, the state built the Kilimanjaro airport and passed regulations to force tourist agencies taking visitors up the mountain to return to Tanzania instead of taking business to Kenya (Lenoble-Bart and Constantin 2006). Situated between Arusha and Moshi, the Kilimanjaro airport was conveniently located for tourists coming to hike Kilimanjaro and visit other parks in the region. KINAPA began to require that a registered tour company with trained guides accompany each group into the park and guide training and licensing became standardized. Strong Chagga men maintained a monopoly in porter work until the mid-1990s. Living on the mountain for centuries, dominating the mountain tourism support crews, and working as KINAPA officials, many Chagga felt a sense of ownership of the mountain.

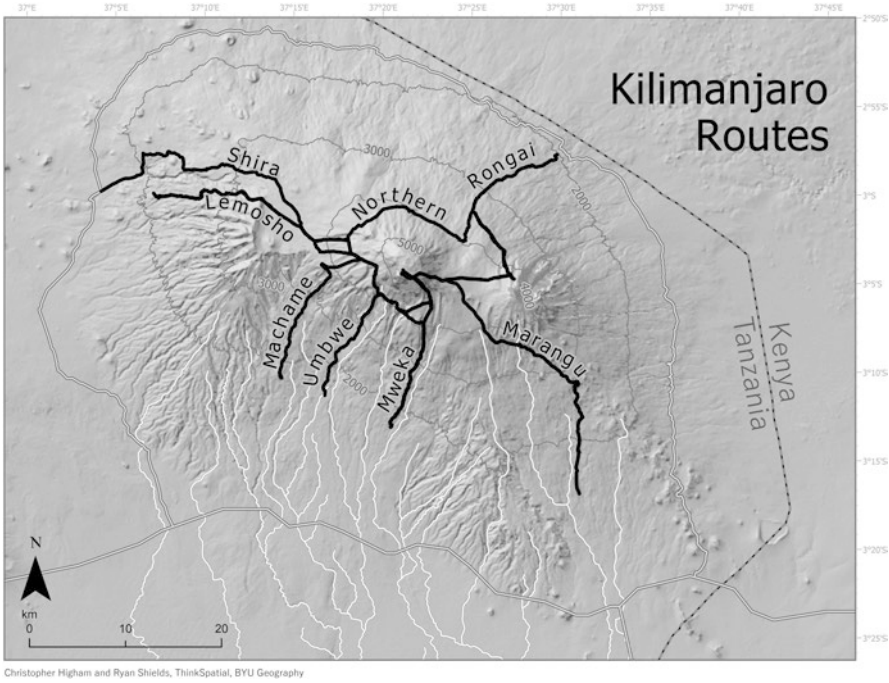

Fig. 3.3 Routes to Kilimanjaro summit

Even as mountain tourism on Kilimanjaro became more professional and regulated, unequal relationships continued with porters performing much of the heavy work of carrying provisions for tourists under difficult conditions. As François Constantin wrote, "wealthy Europeans were ready to exploit local porters and guides," paying them very little for their work (even though it was still at a wage higher than the "local standard of living") (Lenoble-Bart and Constantin 2006 p 18). The rise of tourism companies that hired guides and porters added another layer in insulating tourists from the porters, as tourists paid companies instead of the porters directly (Lovelock 2017 p. 275). Melubo's work on porters in the early twenty-first century reveals the customs and conditions that developed in the late twentieth century that disadvantaged porters in terms of the loads they carried, their equipment and clothing, food, and health (Melubo 2017).

Carrying heavy loads, hiking quickly to the next camp to set up before tourists arrive, porters had physically demanding jobs (Fig. 3.4). Before weight regulations, porters may have carried over 60 pounds. This work at high altitudes, combined with inadequate nutrition, clothing, and equipment, made them even more susceptible to sickness or injury. The food many porters ate in some ways reflected the descriptions of porters' meals by Johnston and Meyer. It became common practice on Kilimanjaro for porters to eat *ugali* (a stiffened maize porridge), tea, chapatti (bread), or popcorn, with some able to make or buy other food to refuel on the way.

Fig. 3.4 Porters on the first day of the Northern Circuit, May 2018 (photo by author)

With the demands on the porters' time and efforts to save money, many ended up having only one or two substantial meals per day. The development of more sophisticated clothing and gear facilitated more people engaging in mountain tourism on Kilimanjaro; at the same time, porters—the ones who needed the gear more than the tourists who carried a small day pack—did not have it. Many struggled to afford this kind of gear, given their relatively low pay, or struggled to fit the gear in the small amount of weight allowed for their own provisions. Porters also suffered from the elements because they often slept outside in caves or huddled around fires (Joshua Mwakalinga interview May 8, 2018). Even if tourists slept in huts or cabins, there may not have been room for porters in the structures, especially during peak seasons. Porters and guides were expected to stay separate from the tourists at camps, with separate toilets for visitors and porters still marked at certain campsites to this day. It was estimated in 2008 that 20 porters died each year on the mountain from altitude sickness, hypothermia, and pneumonia because of these conditions (Christie et al. 2013; Melubo 2017 p 230). Porters engaged in this work to earn extra cash or as their main form of livelihood, even though it was seasonal work. They could

make anywhere from $2 to later $5–$10 a day, more than other work opportunities at the time. However, the risks were high. These aspects gained more attention at the turn of the century when there was a shift in the way tourists viewed their relationship to porters and the type of people who engaged in the work expanded.

3.4 Twenty-First-Century Responsible Tourism and Porter Organizations

Mountain tourism on Kilimanjaro grew to a huge industry with 30,000–40,000 people visiting the mountain every year in the early years of the twenty-first century and an estimated 10,000 porters, 500 cooks, and 400 guides working on the mountain in 2009 (Christie et al. 2013 p 230; Melubo 2017 p 285). In fact, porters constituted the majority of people on Mount Kilimanjaro, with at least three porters, a cook, as well as a guide per tourist. The years surrounding the turn of the century brought some significant changes in porter work on Kilimanjaro with more ethnic groups and women working on the mountain and greater recognition of the need to improve porter working conditions beginning in the late 1990s. The trend to more responsible tourism at this time had to be balanced with more people attempting to climb Kilimanjaro on a lower budget (Lenoble-Bart and Constantin 2006; Lew and Han 2017 p 25; Lovelock 2017 p 18; Peaty 2012). Organizations and activists started to whittle away at some of the unequal aspects of a system rooted in past customs while competing with economic forces influencing tourist decisions and cost-saving practices of companies, guides, and porters. A more competitive job market for porters exacerbated some of these aspects. International and local groups have established a basis of regulations and advocacy networks; however, not all of these regulations are followed, especially for temporary or occasional porters.

Kilimanjaro has not attracted much local tourism. Yet, as more people from other parts of Tanzania moved to the region looking for economic opportunities, the ethnicity of people working on the mountain began to change. As Chagga may have put it, many *kyasaka* (outsiders or foreigners) now work on Kilimanjaro. When Joshua Mwakalinga moved to the area from Mbeya in southern Tanzania in the early 1990s, he was drawn to the mountain, a wonder he had only seen before in schoolbooks. As he searched for a new way to make a living while staying in the town of Himo, he decided he wanted to summit Kibo. As an outsider, the only way he could obtain a position as a porter was through a connection with someone who worked at the gate and came from his own ethnic group in the south. He summited on his first trip up the mountain. Soon after, he qualified as a guide and the first time he took his own crew with people who did not live on the base of the mountain, it took him an hour to convince the park rangers to admit them (Joshua Mwakalinga interview May 21, 2018). Batchi Vitalis Donat, a Rombo Chagga guide (not a group who traditionally worked on the mountain), credited Mwakalinga with opening up work on the mountain to other ethnic groups. According to Batchi, almost every ethnic group in

Tanzania is now represented among those who work on the mountain, KINAPA officials come from various parts of the country, and crews are encouraged to speak Swahili to be more inclusive (Batchi Vitalis Donat interview May 22, 2018).

There has also been an increase in women working on the mountain. Most local Chagga women have traditionally stayed home to work on the farm, perform domestic work, and go to the markets (Melubo 2017 p 286). Female porters also face the challenges of working with majority male teams that do not cater to separate genders. Yet, the number of women working on the mountain has grown, proving their physical ability to perform the work. Some women have also become guides. Batchi remembered seeing a group on the mountain in 2017 led by female guides and with almost 80% female porters (Batchi Vitalis Donat interview May 22, 2018). As the number of women who work on the mountain grows, this is likely to become more common.

At about the same time that Mwakalinga began working on Kilimanjaro, various groups of people were making a more concerted effort to improve the working conditions of porters. This led to the institution of new regulations and the establishment of international and local organizations. Two international organizations formed in places where most tourists originated: the International Mountain Explorers Connection (IMEC) based in Colorado in the United States, founded in 1996, and the United Kingdom-based International Porter Protection Group (IPPG), founded in 1997 in part by a British doctor and mountaineer. A number of local organizations and porter unions also working on ensuring porters work under better conditions were subsequently organized. The IMEC supports the Kilimanjaro's Porter's Assistance Project (KPAP) which was established in 2003. Another major organization, the Mount Kilimanjaro Porters Society (MKPS), was formed in 2005. Peaty and Melubo also list the Kilimanjaro Porters' Association, Mount Meru and Arusha Associations, the Kilimanjaro Guides and Porters Union, Kilimanjaro Porters Assistance, and, finally, the Tanzania Porters Organization (f. 2013) (Melubo 2017; Peaty 2012). All porters are required to belong to a recognized porters' association (Peaty 2012 p 6). These organizations register porters and endorse teams and companies that follow their recommended guidelines (which should entice tourists seeking to engage in responsible tourism) (Lovelock 2017). Local organizations also provide free educational programs and training for porters, and some, such as the MKPS, even offer some financial assistance and engage in environmental activities ("Mount Kilimanjaro Porters Society—About Us" www.kilimanjaro-porters.org).

Regulations and changes in porter working conditions have related to the weight porters carry, equipment and clothing, accommodation, food, the health and safety of the porters, and wages. Members of one guiding team who also worked as porters in the early 2000s witnessed the changes in these regulations and testified that porters have gained better sleeping arrangements, guarantees for more meals, and greater enforcement by park authorities of weight limits (Enock Mwakalinga and Hudson Mwakalinga interview May 9, 2018; Joshua Mwakalinga and Matthew Laurent interview May 21, 2018; Batchi Vitalis Donat interview May 22, 2018). In Batchi's view, more respect has developed between the guides and porters than when he started working on the mountain. Melubo has provided the most

comprehensive outline of porter conditions on Kilimanjaro, including both improvements and continuing challenges (Melubo 2017). One of the main issues porters' organizations have addressed is the weight of the loads porters carry. Regulations now stipulate that porters may carry up to 25 kg/55 lb (20 kg for the tourist and 5 kg for the porter's own necessities). Park officials enforce this by weighing loads at park gates and other points along the way (particularly the first camp). This has improved some conditions; however, Melubo wrote that evidence confirms that corruption at park gates and guides trying to save money may mean that porters are still often given overweight loads. Porters desperate for jobs may not resist this, but resign themselves to carrying loads that are too heavy.

Porters' organizations have also worked to ensure porters obtain clothing, receive adequate nutrition, and have access to greater health care or insurance. In order to address the lack of adequate clothing and gear, the IMEC and KPAP established a clothing and gear bank where porters can borrow clothing for free. Porters' organizations also lobbied to ensure that porters have tents to sleep in. Porters' organizations advocate for three meals a day, a practice of their affiliated companies or teams. They also advocate for health insurance or access to health care and first aid training for porters. Most tourists come with health care and extra provisions for emergency care, whereas the porters have not had such. Some end up pushing themselves to work while sick or injured because of the possibility of losing wages if they descend early, while others are sent down alone without care if they are unable to continue (Melubo 2017 p 298). Securing health insurance has been more of a challenge although a few have gained this and provide first aid training to their members (Peaty 2012).

Finally, there have been efforts to increase the wages of porters with some success, but there are continued challenges, especially for temporary workers. Similar to porter work in previous times, there are still varying types of porters who may work temporarily, as standby porters, or on permanent contract. In 2010, the Tanzanian National Parks Authority (TANAPA) set the minimum daily wage for porters at $10 per day (roughly 20,000 Tanzania shilling), with some receiving a portion of wages before the job. Tanzania is one of the world's poorest countries (Peaty 2012 p 2). Porters do not receive lucrative pay; however, in comparison with farmers and teachers, they are seen as having profitable jobs (Melubo 2017 p 286; Salkeld 2002 p 48). In 2010, a World Bank publication reported that guides received an average annual income of $1830 USD, porters $842, and cooks $771 (Christie et al. 2013 p 230), while Peaty reported that the average annual income for Tanzanians was $300 per person (Peaty 2012 p 3). Thus, some porters who manage their money well can make a secure living, even putting their children through school. Many also benefit from their connections with tourists who may pay for further study or offer other types of sponsorships. This prospect attracts some temporary or standby porters; however, they are more easily exploited. Standby or temporary porters who wait at park entrances for jobs may not receive the same amount. They may even only receive half the amount and be given inferior gear because of their disadvantaged position (Melubo 2017 p 289). The pay is also seasonable and arguably still not commensurate with the risk of this difficult work.

3.5 Conclusion

From the time European missionaries and explorers tapped into the porter labor market in East Africa to the end of the twentieth century, porter work saw both continuities and major changes in the nature of the work and the relationships involved in that work. Europeans paid porters mainly from the coast and inland porter populations to take them along routes that these porters had likely traversed before. However, these expeditions had a different purpose. Once they arrived at Kilimanjaro, Europeans hired local Chagga guides and porters, and the long-distance caravan work shifted to high-altitude mountain conditions. With the railroad and the rise of mountain tourism in the colonial context, the Chagga provided the majority of guides and porters for a new industry that drew on practices of the past. Chagga and foreign visitors engaged in these activities for similar reasons as those in the past. Customs that disadvantaged porters continued and evolved into the late twentieth century when conditions began to be challenged. Yet these challenges have not changed the whole system. Competition for jobs and financial concerns, even corruption, perpetuates some of the poor working conditions. Hopefully, a better understanding of the history of porter work may contribute to more positive changes.

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Chapter 4
Attitudes of the Local Community Toward Giraffe in Arusha National Park, Tanzania

Obeid Mahenya and Naomi Chacha

Abstract This study examines the attitudes of the local community toward giraffe in Arusha National Park, Tanzania. This study was carried out between January and May 2018. Data were collected through questionnaires and key informants, to investigate views and attitudes of people toward giraffe. Our results revealed that local community had positive attitudes toward giraffe. Important variables that explained the positive attitudes of local people toward giraffe were sociodemographic variables (age, education, occupation, and duration of stay), calmness, and peacefulness of giraffe. Other important factors that influenced positive attitudes of local people toward giraffe were economic significance accrued from the presence of giraffe through tourism revenues and employment opportunities offered by the Park authority. We recommend the Park and other stakeholders to raise awareness among the local community through education to stop and discourage the notion of seeing giraffe through their primitive norms, taboos, and beliefs that its bone marrow cures HIV/AIDS.

Keywords Arusha National Park · Conservation · Girrafe · Local community

4.1 Introduction

Attitudes of local people toward carnivores and mammals including wolves (*Canis lupus*), African lions (*Panthera leo*), African elephants (*Loxodonta africana*), African buffaloes (*Syncerus caffer*), and yellow baboons (*Papio cynocephalus*) have been widely negatively reported (Hill 1998; Hoare 2000; Kideghesho et al. 2007; Romanach et al. 2007; Røskaft et al. 2007; Tilahun et al. 2017). However, attitudes

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of local people toward giraffe have not been documented. Attitude is a psychological concept, a mental and emotional entity that is inherent in or characterizes a person. Attitudes are complex and a state acquired through experiences (Browne-Nuñez and Jonker 2008).

Currently, the number of giraffe is reported to be declining due to several factors including poaching for meat, habitat loss, and local beliefs that giraffe bone marrow is a cure for HIV/AIDS (Tessema et al. 2010; Strauss et al. 2015). In Africa, giraffe populations have declined by around 40% in the past 15 years (Strauss et al. 2015). In Tanzania, the giraffe population is reported to be declining as well (Strauss et al. 2015).

Studies have shown that perceptions of people influence their actions, and such actions make up people's attitudes which in turn determine people's behaviors (Kideghesho et al. 2007; Tessema et al. 2010). This suggests that positive attitudes may promote conservation, while negative attitudes are associated with behaviors or actions that are detrimental to wildlife (Tessema et al. 2010). Therefore, understanding relationships between local people and wildlife is a critical step in designing and sustaining effective conservation strategies. Such relationships have relevance to the management of protected areas (PAs) where longstanding tensions over land tenure, local use of natural resources, and human wildlife conflicts might limit local acceptance of conservation goals (Lilieholm and Romney 2000; Whitesell et al. 2002; Balint 2006).

Several factors have been considered to influence the local community's attitudes toward large mammals such as giraffe. These factors are age, education level, occupation, duration of stay, and the animal's characteristics.

Some studies have reported that knowledge accumulates with age (Jianying Xu et al. 2006). Aged people are considered to be more aware with animals around them to either accept or reject animals based on their long interactions with animals. Also, studies have shown that younger ages are likely to support wildlife conservation (Kideghesho et al. 2007). Hence, age might influence local people's attitudes toward giraffe.

Education is an important element in influencing people's attitudes negatively or positively. A study conducted in western Serengeti reported that people with high level of education supported the conservation efforts (Kideghesho et al. 2007). Education enables people to understand the rules of the game in wildlife. It influences one's behavior and his or her perceptions of value of wildlife resources around as well as lifestyle.

Occupation of an individual has great influence on the perception of the value of the wildlife. For instance, farmers in Niger were reported to perceive giraffe negatively, as during the critical periods of food shortages, giraffe fed on cowpeas and mangoes in the farmers' fields (Leroy et al. 2009).

The longer an individual stays in a village or area, the more he/she will know the geography of the surroundings and wildlife resources present in the area. Experience and knowledge on issues pertaining to attitudes toward wildlife resources in an area are enhanced as a person stays for a long time in the area.

According to Browne-Nuñez and Jonker (2008), giraffe are widely considered to be polite, intuitive, and vigilant animals. Therefore, our overall objective of this study was to assess the attitude of the local community toward giraffe in Arusha National Park, specifically understanding factors influencing peoples' perception toward giraffe.

4.2 Materials and Methods

4.2.1 Study Species Giraffe

The giraffe (*Giraffa camelopardalis*) is a genus of African even-toed ungulate mammals, and they are the tallest living terrestrial wild animals and the largest living ruminants in the world (Dagg 2014). The giraffe's chief distinguishing characteristics are its extremely long neck and legs, its hornlike ossicones, and its distinctive coat patterns. It is classified under the family *Giraffidae*, along with its closest extant relative, the Okapi (Dagg 2014). The genus currently consists of one species, *Giraffa camelopardalis,* while seven other species are reported to be extinct (Chardonnet et al. 2016), and the International Union for Conservation of Nature (IUCN) currently recognizes only one species with nine subspecies (Dagg 2014; Fennessy 2004).

Giraffe are distributed from Chad in the north to South Africa in the south and from Niger in the west to Somalia in the east. Giraffe are restricted to the African continent as their only geographical range (Fennessy 2004). Giraffe usually inhabit savannahs and woodlands. They live in small family groups that consist of one male, some females, and cubs; they live in herds of related females and their offspring, or bachelor herds of unrelated adult males, but are gregarious and may gather in large aggregations. Males establish social hierarchies through "necking," which are combat bouts where the neck is used as a weapon. Dominant males gain mating access to females, and the females bear the sole responsibility for raising the young. Giraffe do not protect their territories, but every group inhabits an area of about 50 km^2. Giraffe foods include leaves, and fruits and flowers of woody plants of mostly the acacia species, and they browse at higher heights where most other herbivores cannot reach. Giraffe may be preyed on by lions, leopards, spotted hyenas, and African wild dogs.

Giraffe are classified by the ICUN as vulnerable to extinction and have been extirpated from many parts of its former range (Sticking and Their 2011). Giraffe are still found in numerous national parks and game reserves, but estimations as of 2016 indicate that there are approximately 97,500 members of giraffe in the wild, with around 1144 in captivity.

4.2.2 The Study Area

The study was conducted in three villages close to Arusha National Park (ANAPA) in Arumeru District, Tanzania. The park is relatively small, covering 552 square kilometers (ANAPA GMP 2003). It is located in the northern part of Tanzania, and it is approximately 20 kilometers north of Arusha town. The park's altitude ranges from 1400 m above sea level in the Momella lakes and Ngongongare section, to almost 4565 m at the summit of the second highest mountain in Tanzania, Mount Meru (ANAPA GMP 2003).

Although the park is small, it is endowed with an abundant diversity of natural resources. Common animals found in the park include giraffe, Cape buffalo, zebra, warthog, the black-and-white colobus monkey, the blue monkey, flamingo, and elephant. Leopard populations are present, but it is very difficult to spot them (Mahenya et al. 2016). The Park borders with five wards namely, Engare Nanyuki, Maji ya Chai, Embaseny, Leguruki, and King'ori in the Arumeru District. According to the 2012 population census, the district had a total population of 590,726 (NBS 2013). Of these, 285,565 were males and 305,161 were females.

4.2.3 Data Collection

Three techniques were involved in data collection: questionnaire, key informants, and personal observation. The questionnaire survey involved respondents randomly selected from 108 households drawn from updated village registers. The sample size was calculated following Boyd and Stach (1988) formula; n/N. Where "n" is the size of the sampled households, and "N" is the total population of households in the village. In this study, we defined household as a group of one or more persons living together under the same roof or several roofs within the same dwelling and eating from the same pot or making common provision for food and other living arrangements (Kideghesho et al. 2007).

Three villages under study were Uwiro (n = 36) in Engare Nanyuki ward, Ngurdoto (n = 36) in Maji ya Chai ward, and Ngongongare (n = 36) in Embaseny ward. Household heads were chosen as respondents, and if absent, their wives were interviewed; if both were absent, a permanent member above 18 years was interviewed. About 75% interviewed were males and 25% were females. Information sought included respondent's characteristics (age, education level, duration of stay, and occupation) and attitudes toward giraffe questions – "How do you rank the value of giraffe in terms of sociocultural significance, economic or tourism significance, national symbol (national game) significance, and ecological significance of giraffe?" "What is your relationship with giraffe: good, fair, or bad?" – and whether or not the local community was ready to support the conservation effort as prompted by Tanzania National Parks (TANAPA).

The key informants' interview involved presentation of oral-verbal stimuli and replies in terms of oral-verbal responses (Kothari 2009). There were two categories of key informants: key informants from three villages (leaders and elders), park authority (rangers), and park officials (park ecologist, park warden) and informants in charge of community outreach program. These were the people considered to have influence on the success of conservation efforts. We also observed the way local people behaved when giraffe interacted with local people in terms of giraffe welfare, security, and other environmental resources found both within and outside the park.

4.2.4 Data Analysis

The statistical package for social sciences (SPSS) software was used to analyze quantitative data collected. Frequencies and percentages were calculated to determine the attitudes of local community toward giraffe. Qualitative data were also analyzed by using content analysis, whereby meaningful information was broken down into themes.

4.3 Results

4.3.1 Variables Influencing People's Perception of Giraffe

The major variables influencing people's perception of giraffe are associated with socioeconomic demographic characteristics on the value and conservation of wildlife resources. The main socioeconomic demographic characteristics examined under this study were age, education level, occupation, and duration of stay.

Majority of respondents who were between 46 and 60 years had positive attitudes toward giraffe (64.8%), followed by respondents aged between 30 and 45 years (18.5%) who had low attitudes (Table 4.1). Most respondents with secondary school education had high positive attitudes (74.1%), followed by respondents with primary education who had low attitudes (13.8%), and then those with no formal education who had the lowest attitudes toward giraffe (12%) (Table 4.1). Those respondents who had crop farming only as their main occupation had high positive attitudes toward giraffe (78.7%) compared to those practicing both crop farming and livestock keeping (16.7%) (Table 4.1).

Duration of stay was considered as one of the factors influencing people's attitudes toward giraffe. The results revealed that a group of people who stayed for 10–30 years had positive attitudes (79.6%) toward giraffe compared to those with less than 10 years of stay (Table 4.1).

Table 4.1 Sociodemographic variables vs attitudes toward giraffe (n = 108)

Variable	Alternatives	Frequency	Percentage (%)
Age	Below 30 years	10	9.3
	Between 30 and 45 years	20	18.5
	Between 46 and 60 years	70	64.8
	Over 60 years	8	7.4
Education	No formal education	13	12
	Primary education	15	13.8
	Secondary school education	80	74.1
Main occupation	Crop farming only	85	78.7
	Crop farming and livestock keeping only	18	16.7
	Trading	5	4.6
Residence duration	<10 years of residence	13	12
	10–30 years of residence	86	79.6
	≥30 years of residence	9	8.3

Table 4.2 Ranking the value of giraffe

Variable	Rank
Sociocultural significance of giraffe	2
Economic significance of giraffe	1
Ecological significance of giraffe	4
National symbol (National game) significance	3

4.3.2 Bona Fide Local Community Toward Giraffe

The study showed that the local communities recognized the benefits obtained from the wildlife resources. Majority of respondents ranked economic significance of giraffe as number one (1) of importance to local community followed by sociocultural significance (Table 4.2), while national symbol (national game) significance was ranked third (3), and ecological significance of giraffe was the least ranked (4) (Table 4.2).

4.3.3 Local Community Relationship with Giraffe

The relationship between people and giraffe was seen also as a factor which influences local communities to perceive giraffe positively. Wildlife must coexist with local communities to ensure their survival. The findings showed that respondents' relationships with giraffe were good (82.4%); hence, it is causative to positive attitudes toward giraffe (Table 4.3); few respondents had fair (13.9%) relationships, and only 3.7% of respondents had bad relationships (Table 4.3).

Table 4.3 Local community relationship with giraffe (n = 108)

Attribute	Frequency	Percentage (%)
Good	89	82.4
Fair	15	13.9
Bad	4	3.7

Table 4.4 Local community support to the conservation efforts of giraffe (n = 108)

Attributes	Frequency	Percentage (%)
Reporting poaching incidences	15	13.9
Participating in community conservation-based projects	50	46.3
Visitation to the park	5	4.6
Attending joint meetings between the village and the Park (ANAPA)	38	35.2

4.3.4 Engagement of Local Communities to Support Conservation Programs

Positive relationship between people and wildlife resources is another factor that is a vehicle for positive engagement toward supporting wildlife programs. The study findings revealed that engaging local communities to support conservation programs is an important step for the survival of giraffe and other species in the Park. Majority of respondents, 46.3%, participated in the community conservation projects followed by attending joint meeting between the village and the Park (35.2%), who reported to have positive attitudes toward giraffe compared to few respondents, 13.9%, who reported poaching incidences, and only 4.6% of respondents who reported to have visited the park (Table 4.4).

4.4 Discussion

4.4.1 Sociodemographic Variables Influencing Peoples' Perception of Giraffe

4.4.1.1 Age of the Respondents

Investigating the age of respondents was crucial due to the diversity of implications each age group has on formation and internalization of attitudes toward giraffe. Our results showed that majority of respondents who were in the groups between 46 and 60 years (64.8%) had positive attitudes toward giraffe. This implies that the older people have rich experience with giraffe and view giraffe as important animals. The reason might be that older people have accrued benefits from tourism revenues to

meet their family's basic needs compared to younger people who have less responsibilities. However, young men at the age of 10–30 years have been associated with poaching activities as they are ready to take risks and they do not have dependents.

4.4.1.2 Education Level of Respondents

Education is considered to be a tool for liberation from poverty. It is also perceived as one of the factors that influence an individual's perception of intervention before such a decision is made. Our results indicated that most respondents with secondary education had positive attitudes toward giraffe (74.1%). People with education have a higher understanding of the importance of wildlife. Our findings concur with those reported by other studies that educated people have a more positive attitude toward conservation of wildlife resources than less educated people (McClanahan et al. 2005; Kideghesho et al. 2007; Ganås 2014). It is suggested that people with education could be easily employed as tour guides and tour operators and also be employed by government and private sectors; thus, they could directly benefit from the presence of giraffe in the park, hence having positive attitudes toward giraffe and other resources in the Park. During the key informant interview, the Chief park warden reported that there were several villagers who were working as tour guides, guiding visitors in the park. Although secondary school education seemed to be an important factor for positive attitudes toward giraffe in Arusha National Park, other studies have reported that educated people play a leading role in the hunting business which could be interpreted as negative attitude toward an animal.

4.4.1.3 Occupation of Respondents

The respondents whose main occupation was crop farming only had high positive attitudes toward giraffe (78.7%) compared to those practicing both crop farming and livestock keeping (16.7%). The possible reason for crop farmers having positive attitudes toward giraffe could be due to the fact that farmers had not experienced any conflict with giraffe by not feeding on their crops or crop damage; it is a peaceful animal (Browne-Nuñez and Jonker 2008). These findings are contrary to those reported by Leroy et al. (2009) that in Niger giraffe fed on mangoes and cowpeas during the critical period of food shortages; hence, farmers had negative attitudes toward giraffe. Unfortunately, in Arusha National Park and its surroundings, mangoes and cowpeas are not common in these areas.

4.4.1.4 Duration of Stay of Respondents

The duration of stay of people in an area has an influence on the attitude toward wildlife resources. The results revealed that a group of people who stayed for 10–30 years had positive attitudes (79.6%) toward giraffe compared to those with

less than 10 years of stay (Table 4.1). The more one stays in an area, the more experience and knowledge they have about the area and wildlife values (Mariki 2018). This also implies that those people who stayed for a longer time had benefited from the presence of giraffe in the park through tourism revenues and employment. During an interview with the key informants, the key informants were asked if giraffe caused any human-wildlife conflicts. Their responses were "no," which meant that giraffe had no bad record with the local community, hence having positive attitudes toward them.

4.4.1.5 Perceptions of Local Community Toward Giraffe

In order to assess whether the local community benefited from the presence of giraffe in the park, respondents were asked to rank the giraffe benefits in the order of 1, 2, 3, and 4. Results revealed that economic significance was the highest factor contributing to positive attitudes to giraffe (Table 4.2). The probable reason for the local community having positive attitudes toward giraffe in terms of economic significance was the benefits that the local community got from the tourism revenues (Tessema et al. 2010). During key informants' interview, village leaders expressed their views on benefits that they receive from the park as regards the presence of giraffe were tourism revenues, school construction, and road maintenance. Giraffe is one of the iconic animals in the Park; thus, visitors visiting the park enjoy seeing giraffe in their natural environment (ANAPA GMP 2003). We observed tourists pass through nearby villages and purchase several items in the curio shops and mini-supermarkets.

Sociocultural significance was ranked second in influencing positive attitudes toward giraffe by the local community in Arusha National Park. The probable reason might be due to the belief by local community that giraffe bone marrow cures HIV/AIDS (Strauss et al. 2015). This belief influences local community perception by valuing giraffe positively. However, such local community belief to some extent is responsible for the declining number of giraffe in most parts of Africa. The notion of wild animals being associated with medicinal values is not only for giraffe. It exists in other parts of Africa exist as well. For instance, in Burkina Faso and Mali, elephant sperm is used to cure sterility or impotence, and in Northern Cameroon elephant bone marrow is used for back pain and rheumatism (Chardonnet et al. 2002). During key informants' interview, village leaders revealed that in the past, elders and chiefs used to kill animals such as lion, crocodiles, and buffaloes as a way of gaining respect from the community and attracting wives, while giraffe skin and tail were used as ornaments. Killing giraffe and other wild animals for the purpose of attracting wives and gaining respect in the society is no longer being practiced these days in many parts of Africa (Tessema et al. 2010). During key informants' interview with village leaders, they were asked if they knew that giraffe is a national animal and thus is sacred. The majority responded "Yes," but they did not know the meaning of being a national animal and how it should be respected.

4.4.1.6 Local Community Relationship with Giraffe

The relationship between local communities and wild animals such as giraffe is of vital importance to biodiversity conservation. We asked how the local community interacted with giraffe and if such interactions had any negative or positive impact to people's livelihoods.

Our results revealed that majority of the respondents had a good relationship with giraffe (82.4%), thus causing the local community to have positive attitudes (Table 4.3). The probable reason for the local community having positive attitudes toward giraffe was historically giraffe lived with people peacefully as compared to other wild animals such as elephants and buffaloes, which often damaged farmers' crops and even killed humans (Lee et al. 2016). Therefore, giraffe have more positive relationships with people, and local communities are more comfortable when the giraffe do not cause damage to the area.

4.4.1.7 Engagement of Local Communities to Support Conservation Programs

In principle, the local community can support giraffe conservation efforts if the wild animal brings the benefits to the local community or the costs of conserving the animal does not outweigh the benefits. Our results indicated that majority of respondents, 46.3%, participated in the community conservation projects. This suggests that people benefit from the presence of giraffe in the park. Similar studies done by de Pinho et al. (2014) reported that if local communities realize the benefit from the presence of animals, they are likely to support the conservation. Another study from central and southern Kenya (Mara 2009) reported that people had positive attitudes toward giraffe. The key informant of the Park asserted that the park's community outreach programs were noticeable in improving local attitudes. The park supports community development projects including building of schools and health centers, boring water holes for domestic animals to drink water, and providing veterinary services in the park's adjacent villages. From our observations, ANAPA, unlike other protected areas, has public roads that transect deep inside the park. These are used by Meru slopes communities in the park neighborhood to access lower areas where major towns such as Arusha, Usa-river, and Tengeru are located. It is from these urban centers that communities get their basic needs.

It was evident that for whatever reasons, the park intends to improve the state of local attitudes toward conservation of its resources, including giraffe. It has been hard to register the desired success of the program, although it can be counted as a reason for improved positive attitudes toward giraffe in Arusha National Park. Just as it was argued by Kideghesho et al. (2007), benefits to the park's adjacent local communities are many, and one of them is associated with the participation of the park in supporting community-based development projects (Mariki 2018). Such benefits were seen to have positively influenced attitudes toward giraffe.

4.5 Conclusions and Recommendations

The overall findings revealed that local community showed positive attitudes toward giraffe. Important variables that explained the positive attitudes of local people toward giraffe were sociodemographic variables (age, education, occupation, and duration of stay) and calmness and peacefulness of giraffe. Other important factors that influenced positive attitudes of local people toward giraffe were sociocultural belief significance and benefits accrued from the presence of giraffe through tourism revenues and employment opportunities offered by the Park authority.

4.5.1 Recommendations

Although it is known by the local community that giraffe is a national symbol, still much efforts should be directed to raising awareness on the value and importance of respecting giraffe and also to propagate awareness education for stopping and discouraging the notion of seeing giraffe through their primitive norms, taboos, and beliefs that its bone marrow cures HIV/AIDS. The responsible institutions such as Ministry of Natural Resources and Tourism (MNRT), Tanzania Wildlife Authority (TAWA) and Tanzania National Parks (TANAPA) should raise awareness among local community through outreach programs, school clubs, social media including radio and televisions.

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Chapter 5
Preparing Students for Protected Areas Through Solo and Plain Expedition on the Roof of Africa

Kokel Melubo, Elizabeth Kamili, and Rehema A. Shoo

Abstract With particular reference to the College of African Wildlife Management, Mweka, this chapter provides an overview of activities involved in preparing students for careers in protected areas through fieldwork. A sample of 87 students in the diploma program consented to participate and complete a survey at the return of their solo and plain expeditions to Mount Kilimanjaro. The study results reveal that through fieldwork activities during their expedition, students acquire hands-on experience in aspects of nature conservation. In addition, wilderness training promotes the students' appreciation and understanding of the wilderness area systems while instilling confidence in leadership capacity development. This study at Mweka College reveals that necessary resources can be harnessed to provide these supportive experiences for students.

Keywords Students · Wilderness skills · Protected area · Tanzania

5.1 Introduction

Training outside a classroom setting, also called field-based training, is widely recognized as an essential form of effective teaching (Boyle et al. 2007; Dando and Wiedel 1971; Fuller 2006). Fieldwork is an essential element of field-based training that stimulates effective approaches to a valuable and enjoyable learning experience (Fuller 2006; Kent et al. 1997). Salter (2001) notes that fieldwork is a powerful tool for boosting student confidence and, through it, students experience job realities. It improves employment prospects as students gain technical and transferable skills, as well as providing a more relaxed natural space to interact socially with their peers

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and lecturers. Such experiences may open up prospects for future academic and career endeavors (Fuller et al. 2006; Durrant et al. 2004). Others (e.g., Anderson and Sanga 2019) note that fieldwork helps to narrow the too theoretically based skills supplied by training institutions to match with the expectations and quality of practical skills required by the industry. In Tanzania, skill deficits are noted in a number of technical fields including outdoors and tourism hospitality-related technology; tactical and anti-poaching operations skills; innovation and creativity skills; leadership and managerial skills; marketing and sales skills; and business concept design (Anderson and Sanga 2019). In the minds of the industry, fieldwork is a platform to produce committed employable individuals who need little or no retraining (Busby 2003).

Others (e.g., Lock 1998; Fuller 2012) note that outdoor fieldwork can enhance attitudes toward a love of nature, natural resources, and conservation. Under the guidance of a skilled practitioner, fieldwork inspires and builds the interest of students to be actively involved in research for conservation, habitat, and ecology and community development. Fieldwork is an integral educational component for students studying environmental related fields such as geography, ecology, geology, biology, and conservation (Teixeira and Baum 2001; Scott et al. 2006). When students visit unfamiliar areas, such contact fosters cultural awareness and understanding, breaks down cultural barriers, creates partnerships, and develops a sense of awareness (Abbott 2006).

Despite the recognition of its significance, not all higher learning institutions are in a position to offer field-based training sessions. Some of the reasons for limited utilization of fieldwork as a teaching approach include the perception that fieldwork is too expensive (it requires ample time and financial resources) (Scott et al. 2006); technological disciplines such as GIS and remote sensing can be done (using virtual reality) solely in the classroom (Kent et al. 1997); the unwillingness of government and donor agencies to pay for fieldwork; the staff time requirement to engage in research and community services; and the possibility that fieldwork gives less attention to physically challenged people (Boyle et al. 2007; Kent et al. 1997). Lock (2002) adds that, contrary to curriculum requirements, some instructors may be reluctant to provide the experience or may lack the necessary competence, experience, and enthusiasm. Durrant et al. (2004) further highlight that involving students in fieldwork increases logistical needs and students' social adjustments to uncomfortable settings and situations.

Despite such challenges, many higher learning institutions in both developed and developing countries continue to embrace fieldwork as a backbone of their teaching and learning modality. This is even more so for institutions that offer training that focuses on nature-based competence requiring outdoor skills. The College of African Wildlife Management (CAWM), Mweka, in Tanzania is a case in point. Fieldwork is a vital component of the College training programs. The College emphasizes provision of practical field-based training with the aim of exposing students to the real-world working environment (i.e., protected areas and beyond) and circumstances that mimic the future working environment of game wardens and outdoor officers. Approximately 40% of the instruction time is dedicated to

field-based teaching and learning. Each academic semester, the College organizes 2- to 3-week-long trips to protected areas for diploma and undergraduate classes. The College recognizes the role of creating resourceful, versatile, and practically trained staff for the success of protected areas, especially in preventing and controlling natural resources crimes (CAWM 2018; Kopylova and Danilina 2011). The purpose of this chapter is twofold: first, to provide the context in which wilderness training program is conducted and, second, to gauge the perspectives of students on the conduct of wilderness training program. The results of this study indicate that fieldwork reinforces students' understanding of wilderness areas and allows them to respond to the potential challenges of working in protected areas.

5.2 The Study Context: The College of African Wildlife Management (CAWM) Mweka

The College of African Wildlife Management at Mweka, Tanzania, has had extensive experience in offering a learning-by-doing approach since its establishment in 1963. The College was established following the Arusha Manifesto signed by President Nyerere in 1961. The Manifesto highlighted, among other conservation commitments, the need to produce knowledgeable, trained manpower to protect and manage Africa's natural heritage (Schauer 2018). A need to have medium-grade conservation areas personnel in postcolonial Africa was the primary reason for the establishment of this College (Schauer 2018; Scholte 2003). Since its inception, CAWM aimed to meet regional training needs within the fields of natural resource management primarily in wildlife management.

By 2018, CAWM had trained over 5000 students in wildlife biology, protected areas, and ecology and nature-based tourism fields from 28 African and 18 non-African countries. As an East African Community and Southern Development Cooperation (SADC) institution, CAWM has drawn students from the entire African region and beyond.

Responding to the ever-changing market demands and challenges of the present and future in technologies, skills, and tools, the College, in consultation with stakeholders (e.g., industry, academia, government authorities, donor agencies, and students), has been reforming its curricula. The review process has led to an introduction, removal, and merging of some modular programs at certificate, diploma, and degree and post-graduate diploma degree levels. The duration of offering courses has equally been adjusted and refined (maintained, lengthened, or shortened).

In part due to its importance in conservation and other nature-based programs, the content, structure, and length of wilderness programs offered by the College have been constantly revised and implemented. The College uses Tanzania's ecologically diverse prime conservation habitats such as the Serengeti, Mount Kilimanjaro, Lake Manyara, Tarangire National Parks, the Ngorongoro Conservation Area, Selous and Swaga game reserves, and coral reefs of the Indian Ocean as living laboratories for practical, hands-on skills training. Other field practical programs

offered at the College include drill and discipline that assist in integrating the students into a well-disciplined and cohesive unit, campsite selection and management, resources identification and interpretation, protected area planning, biological resources inventory, conservation biology, maintenance and vehicle maintenance, and wildlife utilization, which involves the shooting of huntable game. Taken together, these field-based programs prepare the students to be more engaged, motivated, versatile, and resourceful. The field programs also equip students with skills and attitudes to venture into conservation and tourism fields and serve successfully in the wildlife sphere.

The College generates a substantial amount of funds from student tuition fees, central government subventions, and conservation agencies such as TANAPA, NCAA and TAWA. The College is therefore well-equipped with a sufficient number of well-maintained tents and trucks, as well as experienced and knowledgeable lecturers, to regularly conduct student-centered wilderness training for the Technician Certificate for undergraduate students. The training provides exposure and experience to prepare students to perform the tasks of a protected area ranger and cognate fields upon graduation. In particular, this program exposes students to a range of activities and skills including the use of maps to navigate, application of Global Positioning System (GPS), walking and making physical checks of the feature, leadership skills, working cooperatively, problem-solving skills, and surviving alone in the wild (Katzenbach and Smith 1993). Wilderness programs underscore that a good team is flexible, reliable, committed, open to communication, willing to listen, able to solve problems, and gives respect to fellow team members.

The College's wilderness program expedition is comprised of three main sections, namely, the plain expedition, the solo expedition, and the summit expedition. While the participation of the first two expeditions is compulsory, the summit expedition to Mount Kilimanjaro is optional. It is made optional due to potential health ailments, injuries, and fatalities (trauma, musculoskeletal, soft tissue injuries, and infections such as upper respiratory infection) associated with mountaineering (Musa and Thirumoorthi 2015). As a result, only a small number of students are sufficiently determined to summit. However, all students are required to summit up to the second cave (3486 m). The modality of checking the competencies of a student in this program is chiefly through practical-test and observation (no paper-based exams).

5.2.1 The Conduct of the Plain Expedition Exercise

The students begin the wilderness training with a plain expedition. The expedition enables students to observe the altitudal zonations of mount Kilimanjaro, namely (a) montane forest, (b) subalpine heathland, (c) alpine, and (d) icefield each of which is different in plant species composition and structure. The main objective of the plain expedition is to build teamwork and test the physical stamina of students. A good team is known to be flexible, reliable, open to communication, and respectful of fellow team members. The students learn how to apply basic knowledge of

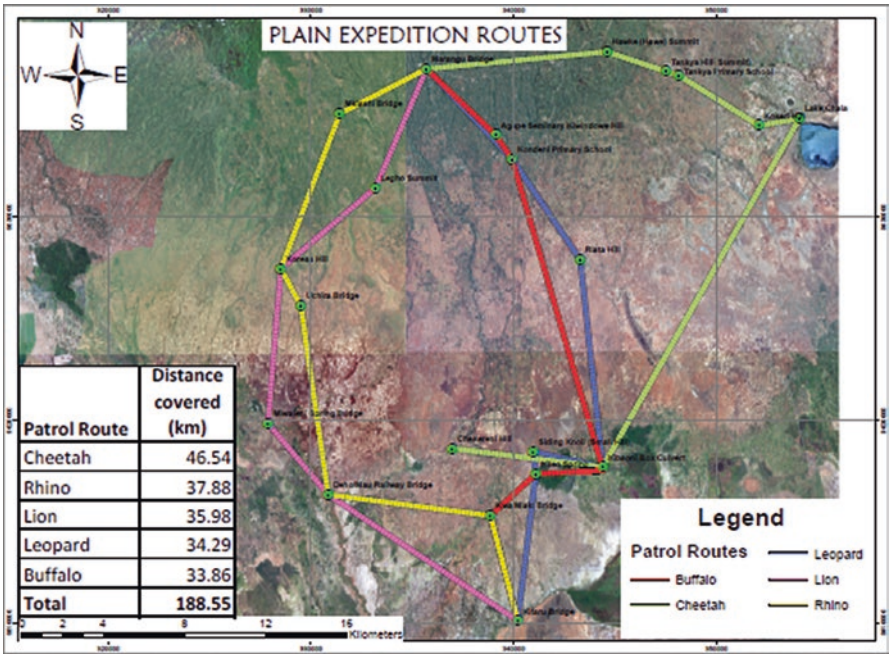
navigation including navigating with instruments such as a compass or GPS, and navigating using natural features such as the stars, the prevailing wind, shadows, and topography.

A day before the commencement of the plain expedition, doctors and nurses deliver a lesson addressing the basics of safety and first aid. Specifically, the session covers topics such as proper planning and desirable behavior to ensure safety during the expedition; understanding of potential hazards; the ability to render medical aid to oneself and team members; and how to address anxiety and fears. Furthermore, the session highlights how one can ease pain and suffering or prevent accidents, and how to prepare and proceed when a calamity strikes. Other first aid-related aspects covered include adequate knowledge on the treatment of ailments: shock; wounds; foreign objects in the eye, ear, and nose; chest injuries; insect stings and bites including snakebites; hyperthermia; heat injuries; dehydration; and hypothermia (CAWM 2018; Musa and Thirumoorthi 2015).

The plain expedition runs between the high elevation at Marangu Bridge (2200 m asl) and Kifaru Bridge (650 m asl) in the lower plains of Mount Kilimanjaro. Before embarking on the plain expedition, five groups consisting of 16–17 members each were established, and walking was done along trails, streams, and around fields. The groups were named after iconic African mammal species: Buffalo, Cheetah, Leopard, Lion, and Rhino. Each group was assigned a defined route to navigate. Each route had hypothetical numbers to which each respective group was to locate and record as they transverse. In organizing an expedition and for the success of the navigation, each group selected their group leader as well as a navigator, observers, a cartoonist, a quartermaster to ration the food supplies and locate the water points, and a sketch map drawer. On the first day, all students except the Cheetah group were driven from the College and dropped at Marangu Bridge. The Cheetah group commenced their expedition at Mamsera Junction. Along the way, each group was expected to make a Travel Control Plan (TCP), and sketch a route map with cartoons. The sketch maps had to take note of the natural features, topography, animals, birds, and weather observed along the route each day. To locate the next point, each group used GPS and a map.

The distance from one point to another varied from one group to another. For example, for the Buffalo group, a distance from Marangu Bridge to Agape Seminary is 2 km, while the Cheetah group walked 1.2 km from Mamsera point to the hilly Hawke (Hawe) summit. For safety concerns and to discourage walking at night, all walking was restricted between 07:30 and 18:30. If a group got lost, it was instructed to communicate with course instructors for assistance. A group lost some marks if (1) it split up; (2) arrived later at the camp for the day; (3) missed a clue on its route; (4) used bipedal means such vehicles, bicycles, and motorcycles; and (5) failed to prepare and hand over day travel plans, route, sketches, and cartoons.

The course instructors, comprising three lecturers and a medical attendant, visited the groups from 17:00 to 20:00 to assess the performance (e.g., when and where the group arrived and whether all members remained together) and to provide medication to sick members, if any. Instructors also took note of the vibrancy, comfort, collegiality, and team spirit of the group, and whether the group had prepared meals.



Patrol Route	Distance covered (km)
Cheetah	46.54
Rhino	37.88
Lion	35.98
Leopard	34.29
Buffalo	33.86
Total	**188.55**

Fig. 5.1 Routes for the plain expedition

The results of the assessment on the plain expedition indicate that three groups (Leopard, Buffalo, and Lion) arrived successfully to their points on time (before nightfall) on the first day. Two groups, namely, the Cheetah and Rhino groups, did not. The Rhino group had a sick patient on the second day, hence could not walk at a reasonable pace. On the second and third days, all groups arrived at their respective points on time. However, the Buffalo group used a motorcycle to carry firewood and a goat to slaughter, so a decision was made to subtract some marks. All groups were picked up by the College trucks on the morning of the third day at Kifaru Bridge (except the Cheetah group which was picked up at the foot of Chekereni railway junction) and driven to Rongai Forest for their solo expedition (Fig. 5.1, Table 5.1).

5.3 The Solo Expedition

The solo expedition (hereafter SOLO) took place around the Rongai Forest Project between the natural forest and the moorland and heath zone of the North Eastern elevation of Mount Kilimanjaro. We define SOLO as being alone, out of contact with other human beings for self discovery, to listen, to hear, and to see the invisible. SOLO gives students a rare opportunity to explore personal thoughts and feelings, to reflect quietly on one's relationship with others and discover the surrounding environment. Primarily, with a solo expedition, a student develops a self-belief, self-discipline, and courage to live alone in the wilderness, and thus be able to

Table 5.1 Routes for the plain expedition

Name of the group	Routes	Total distance traveled (km)
Buffalo	Marangu Bridge, Agape Seminary, Kiwindowe Hill, Kondeni Primary School, Kibaoni Box Culvert, Kileo Spring, Kwa Mlaki Bridge, Kifaru Bridge	33.86
Cheetah	Mamsera Junction, Hawke (Hawe) Summit, Tankya Hill (Summit), Tankya Primary School, Kokeri Hill, Lake Chala, Kibaoni Bridge/Box Culvert, Chekereni Hill	46.54
Leopard	Marangu Bridge, Kondeni Primary School, Riata Hill, Kibaoni Box Culvert, Siding Knoll (Small Hill) or Kilima cha Shauri, Kileo Spring, Kifaru Bridge	34.29
Lion	Marangu Bridge, Legho Summit, Koress Hill, Miwaleni Spring Bridge, Deho/Mau Railway Bridge,Kifaru Bridge	35.98
Rhino	Marangu Bridge, Mkiashi Bridge, Koresa Hill, Uchira Bridge, Deho/Mau Railway Bridge, Kwa Mlaki Bridge, Kifaru Bridge	37.89

improvise and look after oneself. In addition, it provides students with an ability to explore the environment and apply their maximum creativity and potentiality in order to survive in the wild (CAWM 2018).

Before embarking on the solo expedition, students were given a limited supply of food rations that had to sustain them for 1 day (potatoes and/or rice with beef and/or chicken). Students with medical issues received and prepared their food for their specific needs. Each student was given either a kitchen knife or a field pocketknife. At the beginning of 2500–3400 m of the moorland and heath zones, students were dropped off individually and positioned far apart (around 100+ m). Students were instructed to walk 10 m from the prescribed trail toward the forest and put a mark to signal the instructors. Students could move freely to identify and locate sources of water and materials for constructing a shelter or hut. On the southern side of the prescribed trail, a student could access a fresh running water point from the Kimengelia River. Communication (including visiting and calling from a distance) between students during the solo exercise was not allowed. To feel at peace in a strange and challenging environment and simulate a survival situation, items that may distract them such as wristwatches, radios, torches, reading materials, or any other such items, were also prohibited.

While conducting the solo expedition, each student was required to adhere to the basics of living in the wilderness. They were tasked to use their creativity to build a waterproof shelter (bivouac) using available natural materials at hand. The materials could be evergreen branches, sod, or bark. The suitable shelter should be protective against adverse weather conditions, oriented from the wind, and built away from the wildlife routes. In addition, the shelter should be attractive and blend in with the environment as much as possible.

Once the shelter was built, a student was expected to start a fire to keep warm with the fire pit on the lee side. They needed to be able to identify bark that would strip off the limb easily and make good kindling. To give better warmth, students were expected to use only dry, dead standing trees for firewood. Dead trees on the

ground tend to be wet and consequently burn poorly. Another consideration was the construction of a well-located pit latrine and garbage pit—also bearing in mind wind direction.

Thereafter, students were to construct a clean and attractive kitchen near the shelter with consideration of the wind direction as a precaution to fire hazards. Collectively, a student was expected to use his or her own creativity and initiatives to demonstrate how to prolong and increase survival given the limited resources available.

5.4 Data Collection

This study captures the students' perceptions of their wilderness experience on Mount Kilimanjaro. Both the plain and solo expeditions were conducted from April 4 to 15, 2018. Of the 87students, 76 were enrolled in the diploma program in wildlife management, and 11 in wildlife tourism. Male students were the majority by 62% in both programs. The small number of female students enrolled in wilderness programs indicates that the wilderness fields are still considered "a man's world" (Pomfret and Doran 2016) operating under masculine control (Carter 2000). However, statistics from the College enrollment indicate that the number of women entering wildlife-based programs has increased over the past 10 years. For example, in 2016 and 2017, out of 555 registered students 129 (23%) were females (CAWM 2018). This is in contrast to figures from the year 2000 when female students accounted for only 20% of Mweka's enrolled students. With ongoing practical measures to promote an increased number of female students, including giving women priority in campus accommodation, the College aspires to attract a considerable number of females in wilderness-related fields. Most of the participating students were in their mid-20s or early 30s. The youngest student was 21 and the oldest was 35. The majority of the students are fresh out of secondary schools, and a small number have worked in protected area government agencies such as the Tanzania Wildlife Management Authority (TAWA), the Tanzania National Parks (TANAPA), and the Ngorongoro Conservation Area Authority (NCAA) and subsequently have been in the field undertaking wilderness expeditions.

Of the 87 students who participated in the program, 63 (72%) (n = 42 males; n = 21 females) completed questionnaires. The questionnaires requested respondents' demographic characteristics, and had three-point Likert-scale questions about how they felt about the expedition, and what was the most enjoyable and the most difficult parts of the expedition. The administration of the questionnaire took place immediately after returning to the College. This gave students an opportunity to reflect on their experience with a short recall period.

The questions were of a 3-point Likert scale nature. However, a space was provided to substitute or add best word(s) or responses to describe their experience. The last question invited students to add extra responses on the general usefulness of the wilderness program.

To help the reader understand the source of the quotes without disclosing personal particulars of a participant, we have opted to code the course, major, gender, and age. The interview schedule was semi-structured and contained both open-ended and closed questions (Table 5.3). Survey data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20 for Windows. Descriptive statistics were used to obtain the frequency counts and percentages. The findings of this study would not only inform the CAWM, Mweka in particular about the effectiveness of such endeavors, but also be of practical value to other experiential higher learning institutions that are considering this type of curriculum development and undertaking.

5.5 Results

This section presents the results of the perceptions of students on both solo and plain expeditions. In an attempt to provide a more complete picture of what wilderness training meant for the students, the results are presented in both a narrative and quantitative form. The narrative form is supported by direct quotations from participants' responses. The study findings reveal that fieldwork is "doing outdoor in action" and that it provides students with a range of gains in knowledge, skills, and attitudes to become competent natured-based professionals.

5.5.1 Feeling About the Plain Expedition

Students were asked to rank their feelings after the plain expedition. A great deal of students described the plain experience as a typical and peaceful experience, but quite an engaging one. The opportunity to walk with colleagues in different terrains, and meet local farms contributed to experiencing a state of normalcy and peacefulness. "I generally enjoyed constantly walking with my fellow students for three consecutive days. X and X and X were very committed and flexible. I am thrilled" (Management, Male, 28 years). Another participant (Management, Female, 23 years) was excited because "…during the three days serious walk I got to see and appreciate for example the strengths of some of my classmates much more. I have learnt that one must be willing to help and be helpful. A passion to help and see the team doing well is core. Working together on any task is the secret." The kindness and welcoming spirit of local people who showed them the way and allocated them to cross their fields was a primary reason for the excitement of this participant: "We went through plains, mountains, hills and valleys and forests. We meet people, we crossed their fields and most of them were welcoming. It was great but tough" (Tourism, Male, 27 years).

On experience, approximately one-third of students ranked them as "thoroughly enjoyed" experiences, but found it hard walking a whole day with more than

Table 5.2 Feeling about the plain expedition (n = 63)

Feelings	Strongly agree n (%)	Agree n (%)	Strongly disagree n (%)
Normal	28 (44.4)	19(30.2)	7 (11.1)
Peaceful	0	52 (83.5)	0
Anxious	14(22.2)	6(9.5)	23 (36.5)
Excited	3(4.8)	3 (4.8)	57 (90.5)
Nervous	38(60.3)	14(22.2)	5(7.9)
Tedious	32 (50.8)	14(22.2)	2 (3.2)
Scary	48 (76.2)	5 (7.9)	10(15.9)
Friendly	0	0	49(77.8)
Easy	23(36.5)	17(27)	8(12.7)
Boredom	13(20.6)	15(23.8)	17(27.0)

15–20 kg of their own, group supplies, and possessions on their backs. A majority of students felt scared (74%) and nervous (60%) during the plain expedition (Table 5.2). It is worth noting that the exercise took place during the wet-rainy season (March–April are the wet months on Mount Kilimanjaro). Continuous rains throughout the first three consecutive days, climbing hills, crossing streams, and having one of the participants get sick made some of the students have a bad experience during the plain expedition. The feeling of having no sleep on the first two nights was the most common negative outcome.

5.5.2 Student Perceptions of Enjoyable Attributes of the Solo Expedition

The responses to the question relating to the enjoyable attributes of the plain expedition indicate that all students enjoyed the fact that the expedition tested their physical fitness and that it was adventurous. Approximately 95% of the respondents stated that the best thing about the expedition was that they had time to connect with nature. On physical fitness, one participant (Management, Male, 26 years) commented, "…coming down from Marangu Mtoni to Kifaru through Koresa Hill and Deho is truly rewarding and demanded a high level of fitness. It was the longest walk for me, but it has showed me I that am fit and able." Other attributes, such as being alone in the wild (82.5%), getting to make and know friends (80.9%), and knowing the strengths and weaknesses of colleagues (77.5%), were rated as the least enjoyable attributes. The high rate of the "being alone" aspect of the solo expedition is understandable due to the participants' spending a night alone in the wilderness without mobile phones, radios, and adequate food options (Table 5.3).

Table 5.3 Students perception of the solo expedition based on enjoyment (n = 63)

Enjoyment rating	Most enjoyable n(%)	Enjoyable n (%)	Least enjoyable n (%)
Tested physical fitness	33 (52.)	30(47.6)	0
Adventurous	14(22.2)	44(69.8)	0
Being alone in the wild	3 (4.8)	8 (12.7)	52(82.5)
Time to connect with nature	8 (12.7)	52 (82.5)	3(4.8)
Make and know friends	2 (1.6)	11 (17.5)	51 (80.9)
Becoming familiar with colleagues' potentials and weaknesses	2 (3.3)	12 (19.1)	49(77.5)

Table 5.4 Students' perception of solo expedition based on its difficultness (n = 63)

Attribute	Most difficult n(%)	Difficult n(%)	Least difficult n(%)
Being alone	12 (19.1)	42(66.7)	9(14.2)
Missing my phone and social media	2(3.3)	12(19.1)	51(80.9)
Missing my friends	2(3.3)	22(34.8)	39 (61.9)
Bad weather	61(96.7)	2(3.3)	0
Sleeping gazing at the stars	17(26.9)	33(52.4)	13 (20.7)
Wild animals	8(8.9)	23(36.5)	32(50.1)
Unable to make a shelter	2(3.3)	5(7.8)	56(88.9)
Limited food supply	2(3.3)	17(26.9)	44 (69.8)

5.5.3 Student Perceptions on the Difficult Aspect of the Solo Expedition

The student participants were asked to respond to the difficult aspects of their solo and plain expedition experiences (Table 5.4). The majority of the participants perceived being alone (85.8%) and sleeping gazing at the stars (79.3%) as the most difficult aspects of solo expedition. On being alone, a 23-year-old female in management commented: "I could don't much for myself. I grew up in town and it is my first time staying alone in the bush. I had no peace, I felt nervous." Other attributes such as the inability to make shelter (88.9%), missing phones and social media (80.9%), and the limited food supply (69.8%) were reported to be the least difficult things. On the inability to make shelter, a 22-year-old male in tourism wrote: "I really wanted to make a good hut but I found difficult to knot the poles. The surface was rocky and, it was difficult to make holes."

5.5.4 Student Perceptions on the Usefulness of Solo Expedition

Participants were asked to share the most useful lesson learned during the solo expedition. All students commented that locating features and places on the map, and creating shelter from natural locally available materials emerged as the most useful lessons learned during the expedition (Table 5.5). One participant (Management,

Table 5.5 Rating on the usefulness of lessons learned during the solo expedition

Lesson	Most useful n(%)	Useful n(%)	Least useful n(%)
Use of maps to navigate	47(74.6)	12(19.1)	4 (6.3)
Finding a location on the map	58(92)	5(7.8)	0
Identifying large physical features on the ground	16(25.4)	38(60.3)	9(14.3)
Using GPS to patrol	29(46)	33(52.4)	1(1.6)
First aid (able to render medical to oneself or others)	11(17.5)	48(76.2)	4 (6.3)
Knowledge of behavior of different species of wildlife	12(19.1)	32(50.8)	19(30.1)
Importance of knowing how to stay warm and keep out of the cold	0	21(33.3)	42(66.7)
Creating shelter from natural locally available materials	33(52.4)	30(47.6)	0
Importance of achieving and maintaining a good standard of physical fitness	4(6.3)	38(60.3)	21(33.3)
The importance of and the basic principles of teamwork	21(33.3)	34(53.9)	8 (12.8)

Male, 25 years) expressed his reaction this way: "I came to know the usefulness of the map. I can identify features like mountains and rivers on the map. I can read and use it. It has become much simpler." The ability to construct a good bivouac is one of the talked about aspects for this program; therefore, its success is a significant achievement for most students. Statements highlighting this included:

> Spending nights in the wild inside my own made house (bivouac) is something will never forget. It made me feel strong and that I survive in any wild area (Management, male, 25 years).
>
> I was afraid that it was terribly made but when my lecturer saw it (bivouac) he was impressed. That made me so happy because it took me much time to construct (Management, female, 23 years).

These experiences were followed by using maps to navigate (93.7%), identifying large physical features on the grounds (85.7%), rendering medical support to oneself or others (93.7%), and building teamwork and problem solving (87.2%). The high rate given to first aid was probably due to the 2-day intensive training prior to the expedition exercise that involved demonstrations in rendering medical service when situations that threaten survival occur unexpectedly. A minority of the students (33.3%) appeared unconcerned at the importance of the lesson teaching how to stay warm and out of the cold as being an important lesson. This is understandable because (a) during the time the weather condition at the moorland and heath zone was similar to that at the Mweka campus and (b) most of participants had enough cover including a raincoat.

On the usefulness of this wilderness skills training to students, most of the students (70%) responded that both solo and plain expeditions have huge relevance and application to their future careers and other parts of their life. In particular, the

students noted that the training has taught them useful lessons relevant to wildlife, tourism, and sister disciplines. Notable participant comments received on the usefulness of participating in wilderness program included the following:

> It taught me some fundamental things like the essence of adequate preparation and that logistical aspects are essential, including the importance of having the ABCs of first aid is important. I now have firsthand experience; I can do it and can explain why it is done (Tourism, female, 25 years).
>
> Our people are kind and helpful. It is good to ask locals when you transverse through dust roads, trails, rivers and streams, and fields from Marangu to your next point (Management, male, 23 years).
>
> Being a ranger and becoming a tour guide means a lot. It means being mentally and physically fit, sometimes living alone, walking long hours in the bushes. You kind of become wild (Tourism, Female, 27 years).
>
> I now have a perfect picture of Kili and its ecological zones which make it attractive to many visitors. I have come to love it more. KINAPA has to keep preserving it, protecting so that it can take care of us all including tourists (Tourism, male, 28 years).
>
> The valuable thing is I have known Mount Kili, I can talk about it, I can do walking and trekking safaris with easy (Tourism, male, 24 years).

5.6 Conclusion

The main focus of the field practical-based training offered at the College at Mweka is to produce resourceful and versatile personnel with a high standard of self-discipline who can immediately be operational in the conservation and tourism-based fields. Offering a mixture of the practical-oriented and theory programs is a response to the industry and public in Tanzania and beyond. Several national policy frameworks and development strategies instruct training institutions to address the widespread skill gaps within and across conservation and tourism fields (Anderson and Sanga 2019).

The responses of students on the wilderness expedition on Mount Kilimanjaro imply that Mweka graduates can engage in wilderness activities such as leading visitors on nature walks (i.e., bushwalking, hiking, trekking, and mountaineering safaris) in differing terrains and attractions in difficult conditions. Nature-based guides need wilderness skills to professionally deliver high-quality guided tours that enhance tourism experiences while reducing the chance for tourists to feel dissatisfied by the services provided while climbing the mountains (Melubo and Buzinde 2015; Tsaur and Teng 2017; Weiler and Black 2014). Working as field rangers (wildlife scouts and forest guards), for example, one needs to have the correct physical, mental, and moral fortitude to endure the stresses and hardships that such a career demands (Lotter et al. 2016).

It appears that participants have developed a strong vested interest in proper planning for field safaris that include having supplies, equipment, wilderness etiquette, safety, and weather condition preparation along the way (Powell et al. 2009). In addition, participants have come to realize the secret of surviving for days in the rough and dusty terrains is to work collaboratively. Collectively, wilderness training

promotes the students' appreciation and understanding of the wilderness area systems as well as instilling confidence in students in developing leadership capacities (CAWM 2018).

5.7 Recommendations for Research and Practice

For successful execution of this training program, we make three recommendations: First, substantial time and sufficient pre-departure training are vital for satisfactory and successful accomplishment of the fieldwork. A significant number of students are likely to have never had prior exposure to such skills as building huts of various kinds, long distance walking, rendering first aid, using GPS to navigate and collect data, and the mapping process. Most participants lacked the confidence to sleep independently in their shelters at night. The 2 days allocated for orientation before departure seem to be insufficient to cover important elements and aspects for this program. The College should allocate at least 3 days for adequate preparation for efficient fieldwork. Instructors should ensure that students know the aims and objectives of the fieldwork, what is required of them in the field, and be provided with supporting materials to learn about possible risks, prejudices, and stereotypes.

Second, fieldwork in conservation areas provides an opportunity to identify priority areas for research projects (Durrant et al. 2004). Unfortunately, the research process was not part of the wilderness program. It is important that before departure students be oriented to approach the program from a "researcher eye" perspective, that is, to identify researchable topics and concepts during the study expedition. Concepts and topics could range from land-use changes, community-wildlife interface, conservation, mountaineering, tourism, landscape, leadership, to community on Mount Kilimanjaro and beyond. Findings gathered through such topics could contribute to the base of social and ecological information available for KINAPA and other protected areas (Durrant et al. 2004).

The College's practical wilderness training has been traditionally strong on Mount Kilimanjaro environs. For students who began their certificate course at the College and have been readmitted for diploma and degree levels may find this exercise boring, repetitive, and unchallenging. Tanzania has rich and distinct landscapes and habitats that support different collections of wildlife ideal for wilderness training. It is high time that the College explores other field sites within and outside Tanzania such as the open plain terrains and Maasai steppes for wilderness training exercises. We recommend that a physical reconnaissance and assessment of its suitability and safety should be carried out.

During the rainy season, the prescribed trails through the Montane Rongai Forest to the semi-alpine zone of Mount Kilimanjaro tend to close, making it invisible and impassable even by the College's Russian brand of KAMAZ trucks. The walking trail receives no regular maintenance because it is not frequented by trekkers. Water bars, logs, mounded soil, rock ditches, and tightened corners due to water erosion are also common along the moorland and heath zone. In addition, walking 26 km

back and forth carrying one's food supplies from the Rongai campsite to Cave Two (3486 m asl) became challenging for most students. In view of this, the College, in collaboration with the Rongai Forest Plantation and the Mount Kilimanjaro Park Management, should undertake regular maintenance of the prescribed trails.

Future research on wilderness skills could assess how students' demographic information (gender, age, place of residence, and past experience) influences their experience of wilderness experience. In addition, to further enhance understanding of how field safaris contribute to the conservation, tourism, and even to personal development, it would be important to investigate the students' perceptions of other field safaris undertaken by the College. Lastly, this study was conducted after the fieldwork (wilderness) experience. It would certainly be useful to try to elicit student responses prior to the wilderness training program or even after they have graduated.

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Chapter 6
Ecotourism Potential and Challenges at Lake Natron Ramsar Site, Tanzania

Rehema Abeli Shoo

Abstract Ecotourism is thought to carry the promise to generate funds for conservation and provide alternative livelihood opportunities that are consistent with conservation of nature. However, lack of careful ecotourism planning and appropriate management in protected areas may result in environmental deterioration and inequitable development among the local communities. This paper analyzes the ecotourism potential and challenges in contributing to local sustainable management and conservation of Lake Natron Ramsar Site. Data were gathered through questionnaire surveys to area's residents and foreign tourists, interviews with key informants, and field site observation. Findings show that Lake Natron has immense tourist attraction potentials that are important for ecotourism development. However, lack of a general management plan, inadequate funding at the operational level, lack of mechanisms to secure a fair distribution of ecotourism benefits, and poorly developed tourism infrastructural facilities to support diverse segments of tourists were identified as the main challenges associated with the management of ecotourism in the area. The paper suggests a design of an effective management structure that can effectively address the obstacles and ensure that ecotourism achieves its long-term economic and conservation goals.

Keywords Ecotourism · Lake Natron · Potential · Attractions · Challenges · Tanzania

6.1 Introduction

Protected areas in African countries offer attractions that have become the cornerstone of tourism. These protected areas provide a range of economic development opportunities through various recreational events such as game viewing, hunting

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safaris, nature walking or climbing, bird-watching, and enjoyment of aesthetic scenic beauty (Boo 1993; Alers et al. 2007). However, Srikosamatara and Brockelman (2002) report that protected areas in developing countries are faced with a number of generic problems that threaten the long-term survival of biodiversity.

Ecotourism is acknowledged as a suitable category of tourism in protected areas because it helps to ensure preservation of resources and generates economic revenue from land set aside for conservation. The International Ecotourism Society (2015) defines ecotourism as a "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education." However, Tisdell (2003) argues the actual gain from ecotourism is dependent on its effective planning and management. Studies have also shown that the revenue generated from ecotourism is particularly relevant to tropical developing countries whose incomes largely depend on revenues derived from its natural resources (Davenport et al. 2002; Kirkby et al. 2010). Davenport et al. (2002) further argue that governments of such countries are under great pressure to maximize rents from all lands and, without tourism revenue, they can rarely justify allocating adequate levels of funding for biodiversity conservation.

Tanzania is known for its rich biodiversity and unique flora and fauna. The country has designated over 30% of its land to a protected area network with the overall objective of biodiversity conservation and socioeconomic development of its people (MNRT 2007). For example, Lake Natron, in the Northeastern part of Tanzania, is one of the well-known protected areas in Tanzania that is managed for conservation and ecotourism. The lake shares a trans-boundary ecosystem with Kenya within the Great Rift Valley of the eastern African lakes and straddles two districts. The Ngorongoro District comprises the western half of the lake, and the newly established Longido District encompasses the eastern half (RAM 2008). Due to its ecological significance for water bird conservation, Tanzania recorded Lake Natron as a second Ramsar Site in 2001. The lake is the only significant and regular breeding site in East Africa, for approximately 2.5 million lesser flamingo (*Phoenicopterus minor*), accounting for 75% of the global population (BirdLife International 2007). Despite its biodiversity potential that is of exceptional value to the tourists, Lake Natron is facing a number of obstacles associated with the management of ecotourism. Some of these obstacles include lack of a general management plan to ensure development activities are compatible with conservation goals, inadequate funding of at the operation level, lack of mechanisms to secure a fair distribution of ecotourism benefits, and poorly developed tourism infrastructural facilities to support ecotourism operations. This paper provides an in-depth understanding of ecotourism at Lake Natron by exploring its current potential in contributing to conservation and the welfare of the local communities. The paper also explores the challenges associated with the management of ecotourism in the area.

6.2 Methods

6.2.1 Data Sources and Study Population

The study made use of both primary and secondary data sources. Primary data were obtained from various stakeholders who are either directly or indirectly involved in the management of Lake Natron. These include the local communities living in the adjacent villages to the lake, international tourists visiting the area, and key informants such as selected government officials, community leaders, tour operators, and nongovernment officials. Secondary data were acquired from textbooks, relevant journals, documents compiled by the various institutions, and community records located in the respective village government offices.

6.2.2 Sampling Procedures and Sample Size

The household survey involved selection of the study villages using purposive sampling. The purposive sampling technique, as the name suggests, requires the researcher to purposefully select the units that are investigated based on their judgment on particular characteristics that will adequately answer research questions (Palys 2008). Three villages out of seven were purposely selected based on the understanding that the local communities in each of the villages are heterogeneous in terms of the economic activities practiced activities that may influence their development preferences and the values attached to the lake and its surrounding environment. The sampling units (the heads of households) who participated in the survey as respondents were selected from the identified villages through a systematic sampling approach (Saunders et al. 2007). Using the villages' register books, the first household was randomly selected, and then subsequent households were chosen using a systematic interval until the desired sample size was reached. In total, 316 heads of households in the sampled study villages were surveyed.

Convenience sampling method was used to select a tourist sample. Convenience sampling is a non-probability sampling where the sampling units that are selected for inclusion in the sample are the easiest to access or conveniently available (Dörnyei 2007). The survey was carried out attempting to minimize any inconvenience to respondents during their holiday experience. To elicit interest in the research project, the researcher approached potential respondent(s) at appropriate locations, such as restaurants, where tourists were more likely to be comfortable spending time talking. In total, 155 tourists were surveyed. This study also purposely selected the key informants based on their knowledge on the research matter.

6.2.3 Data Collection Methods

Questionnaire survey was used to collect quantitative data from local residents living in the villages adjacent to the lake and international tourists visiting the area. Key informant interviews were also used to collect qualitative data from key informants such as government officials, village leaders, and tour operators. In addition, field site observation was employed in order to get detailed understanding of the social and biophysical settings.

6.2.4 Data Analysis

Data analysis for this study consisted of two parts. The first part involved the analysis of quantitative data using Statistical Package for Social Science (SPSS) version 20, whereby descriptive statistics were run to generate mean values, frequency counts, and percentages. The SPSS software program has been reported as suitable for dealing with numerical or quantitative data (Jennings 2001). The second part of the study required the use of content analysis to analyze qualitative data from interviews.

In this study, the content of interview data was classified into important themes of analysis that were identified to reflect the objectives of the study. Each theme presented an "idea," and all data related to a particular theme were included under that premise. The ideas were evaluated by making comparisons of responses and determining how frequently each of the categories appeared in order to draw conclusions.

6.3 Results and Discussions

6.3.1 Ecotourism Attractions and Activities at Lake Natron

Field site observation revealed that tourist attractions at Lake Natron area are primarily based on the naturally endowed resources of water bird species particularly the large population of the lesser flamingos and the beautiful landscape scenery containing diverse wildlife species of tourism importance. Apart from the lesser flamingos that are considered a key attraction in the area, Lake Natron also offers habitat for more than 100,000 other water birds, as well as supporting a small population of large mammals in the scenic area (RAM 2008). Another popular tourist attraction in the area is the *Mountain of God* (the Oldoinyo Lengai Mountain), the highest active volcano in Africa (ESIA 2007). The presence of mineral-rich hot springs and waterfalls in the area also add to the existing ecotourism potential. Besides the natural sites, Lake Natron area holds cultural significance because of

the unique Maasai culture. The escarpment bordering the lake on the western side also encompasses archeological sites that are characterized by some faunal remains (Domínguez-Rodrigo et al. 2002). The locations of various ecotourism attractions are shown in Fig. 6.1.

Tourist survey data revealed that tourists visiting Lake Natron participate in various ecotourism activities such as bird-watching, nature-walking through the landscape, hiking the Oldoinyo Lengai Mountain, and visiting the Maasai Cultural *bomas* to learn about their traditional way of life and buy mementos. Other activities include visiting the Lake's hot springs and archeological sites, such as the Engaresero footprint, in order to appreciate the signs of the earliest humans.

In addition, field site observations found that ecotourism activities are predominantly located in the southern part of Lake Natron, specifically in Engaresero village and around Mount Oldoinyo Lengai. It was further revealed that Engaresero village is the only village that has ecotourism facilities that provide different services to tourists. The household survey data showed that only 18% of local residents engage in various ecotourism-related activities such as working as lodge employees, local tour guiding, as well as making and selling local handcrafts to the visitors. These activities provide local people with opportunities to benefit directly from tourism activities conducted in the area.

Currently, Lake Natron plays a pivotal role in supporting tourism in northern Tanzania and has the potential to serve as a major tourist destination for ecotourism

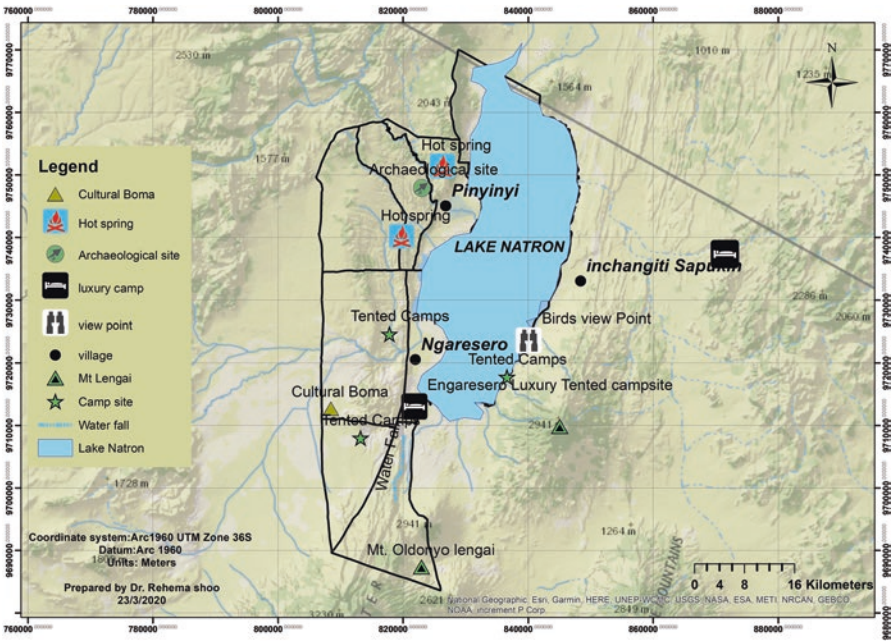

Fig. 6.1 Location of tourist attractions at Lake Natron

activities, especially for those tourists interested in walking safaris and watching flamingos (BirdLife International 2012).

6.3.2 *Tourist Ranking of Ecotourism Attractions at Lake Natron*

In an attempt to determine the importance of specific attractions at Lake Natron to foreign tourists, respondents were asked to rank the selected attractions using a 3-point Likert scale (1 being the most important attraction; 3 being the least important). Table 6.1 reports the frequency and mean values as a result of tourists ranking. Findings indicate that three out of eight attractions were more important to the tourists compared to the rest of attractions. These three attractions are the birds, local culture, and the Oldoinyo Lengai Mountain. The mean scores for such attractions were considerably lower than 2, indicating that most tourists perceived these attractions to be either very important or important. Birds were highly ranked (M = 1.4, SD = 0.68), followed by the local culture (M = 1.64, SD = 0.92), and the Oldoinyo Lengai Mountain (M = 1.81, SD = 0.94). Attractions such as waterfalls or the Rift Valley were less important as demonstrated by higher mean scores of 2.66 and 2.90, respectively.

The most important observation that should be highlighted regarding tourists' preferences for attractions is that birds were the most preferred attraction compared to the rest of attractions in the area. Based on this finding, certain managerial conclusions can be drawn. Protection of birds should be emphasized in the marketing and management of Lake Natron as a tourism destination. As Backman and Pott (1993) argue, many bird-watchers may spend more money on their trip in their quest to see rare birds or as many species as possible. Also, Lee et al. (2009) found that people experienced in bird-watching have a 20% larger willingness to pay for such services. Based on this premise, there can be no doubt that bird-watching has

Table 6.1 The frequency and mean ranking of attractions at Lake Natron by tourists on a 3-point Likert scale (1 being the most important attribute; 3 being the least important)

	Ranking						
Attractions	1 N	2 N	3 N	Mean	SD	Min.	Max.
Birds	94	46	15	1.40	0.68	1.39	1.60
People and culture	70	35	50	1.64	0.92	1.70	2.09
Mountain	63	36	56	1.81	0.94	2.01	2.31
Landscape	45	25	85	2.27	0.87	2.13	2.41
Lake Natron	32	40	83	2.35	0.79	2.22	2.47
Waterfalls	27	0	128	2.66	0.75	2.55	2.78
Large mammals	18	60	77	2.50	0.69	2.39	2.61
Rift Valley	6	1	148	2.90	0.42	2.84	2.97

potential to become a significant tourism market segment if it is promoted at Lake Natron.

6.3.3 Impact of Ecotourism at Lake Natron

This study sought to determine different ways in which ecotourism contributes in the conservation of Lake Natron resources as well supporting the livelihoods of the local communities. Interviews with village leaders at Lake Natron revealed that some of the ecotourism revenues from entrance fees and tourist activity fees are used to pay for the protection and management of tourist resources in the area through conducting anti-poaching activities. Data also indicate that the Ngorongoro District Council, through the village environmental committees, have organized meetings aimed at raising local community awareness on environmental values in order to heighten local understanding of the value of nature. The environmental awareness meetings are believed to influence local changes from the current unsustainable practices into environmentally conscious behavior and activities. Village leaders further revealed that ecotourism at Lake Natron directly supports local livelihoods by providing employment opportunities and indirectly through percentage shares that the village obtains from the entrance gate fees and land rent fees paid by lodge investors. The villages, especially the Engaresero village, make use of tourism revenues accrued at the village level to develop various community development projects. A number of social development projects including the construction of a cattle dam, nursery school, teachers' houses, health center, classrooms for a primary school, dormitory for a secondary school, culverts, and bridges were noted. Some children from destitute families have also been sponsored to pursue secondary education as a result of ecotourism income. Other benefits cited by village leaders include donations made by tour operators and lodge investors that include books for schools, medicines, and sleeping beds for the health center.

6.3.4 Perceived Importance of Ecotourism by Local Residents

The importance of ecotourism to the local residents at Lake Natron was determined by asking respondents to rank the statements on a 3-point Likert scale ranging from 1 point as "very important" to 3 points as "least important." Table 6.2 summarizes the responses of resident perception. The majority of households, totaling 95 (90.5%), in the Engaresero village (Mean = 1.01, SD = 0.62) were of the opinion that ecotourism has provided better social infrastructures; 77 (73.3%) (Mean = 1.68, SD = 1.02) of respondents believe that ecotourism has created jobs for the local people; 81 (77%) (Mean = 1.30, SD = 1.27) of households acknowledge the role of ecotourism in increasing medical and educational opportunities. Noting a divergent view, over 95% of household respondents in I/Sapukin village strongly believe that

Table 6.2 Perceived importance of ecotourism by local residents on 3-point Likert scale ranging from 1 (very important) to 3 (least important)

	Engaresero village (n = 105)					I/Sapukin village (n = 99)					Pinyinyi village (n = 112)				
	1	2	3			1	2	3			1	2	3		
	n	n	n	Mean[a]	SD	n	n	n	Mean	SD	n	n	n	Mean	SD
Improved social infrastructure	65	30	10	1.01	0.62	0	2	97	2.66	0.87	1	43	68	1.87	0.93
Provision of job opportunities	14	63	28	1.68	1.02	0	1	98	2.85	0.81	0	3	109	2.94	1.40
Provision medical and educational opportunities	26	55	24	1.30	1.27	0	0	99	2.96	0.75	0	0	112	2.98	0.67

[a]The higher mean score indicates lower importance

ecotourism has not provided economic benefits. Although a large proportion of respondents in Pinyinyi village, 45 (40%), were neutral in their opinion regarding the statement that ecotourism has improved their social infrastructure, the majority (over 90%) of household respondents did not acknowledge the contribution of ecotourism in either creating jobs or increasing medical and educational opportunities.

Perceived importance of ecotourism by local residents in protected areas has been noted as an important factor associated with the residents' attitudes toward protection of such areas (Singh et al. 2007). Household questionnaire surveys at Lake Natron found that local residents' perceptions on the importance of ecotourism varied among the surveyed villages. Most of the residents living in Engaresero village had a relatively positive perception of ecotourism compared to the rest of the study villages. This finding is not surprising because ecotourism benefits at Lake Natron are largely confined in Engaresero village where tourist activities take place due to the presence of tourism facilities. The local residents in Engaresero benefit from ecotourism either directly through employment opportunities and/or indirectly through improved social services and infrastructure. With the exception of Engaresero village, the rest of the study villages viewed ecotourism less favorably, possibly because they realize that ecotourism has not brought them equitable and sufficient benefits. This situation pose challenges for implementing conservation programs in the area as the majority of local residents are likely to have little or no incentive to protect the area because they do not benefit from tourism.

6.4 Challenges of Managing Ecotourism at Lake Natron

In spite of the importance of Lake Natron area for conservation and tourism, this study revealed a number of management challenges that imperil ecotourism development. Some of these obstacles operate at higher national levels, and others

originate directly from its management practices. According to Nelson (2003), these challenges undermine the ecotourism potential of Lake Natron and create an uncertain environment for community and private sector investments in resource management and tourism development. The main challenges are explained below.

6.4.1 Lack of a General Management Plan

Interviews with the Ramsar Site manager revealed that most of the challenges at Lake Natron are aggravated by the lack of a management plan to ensure management decisions are based on a clear understanding of the area's conservation goals and its long-term vision. The urgency for a management plan for Lake Natron is increased by the existence of widespread threats (both current and potential) from the development activities that are not compatible with the conservation objectives and values of the area. Yanda and Madulu (2005) report that the Rift Valley lakes of East Africa, including Lake Natron, have gone through significant anthropogenic land-use pressure and overexploitation of natural resources that have caused loss to the biological diversity that supports tourism. For example, a study by Gereta et al. (2003) shows that, despite the ecological importance of flamingos in Lake Natron, their survival has been threatened by unregulated anthropogenic land-use activities. The current study noted that dry season irrigation agriculture is expanding particularly for the local people living on the western side of the lake, with people utilizing water from the rivers that feed the lake. Continuing conversion of river flow to create small-scale irrigated arable land are likely to cause future environmental degradation and a subsequent loss of biodiversity resources. Degradation of the lake environment is further accelerated by the fact that majority of the local residents depend directly on the environmental resources for their basic needs. In the southern part of the lake where ecotourism activities are practiced, there is also increased population growth due to immigration, further contributing to pressure on these natural resources. Apart from the existing threats, ecotourism resources at Lake Natron have been threatened by potential threats such as the Tanzanian government plan to build a soda ash factory along the shore of the lake that will extract soda ash from the lake (BirdLife International 2012). This development activity is likely to cause an influx of people to the area increasing pressure on natural resources and resulting in the loss of suitable conditions for water birds, especially the lesser flamingos whose survival depends entirely on the lake and its unique hydrochemistry.

Interviews with the Ramsar site manager further revealed that poor management of the biodiversity resources at Lake Natron is partly contributed by the lack of a holistic approach among different parties (the local government council, central government, local people, investors, and non-government organizations) for access to and control of ecotourism resources. Nelson (2003) noted that the local communities, as key stakeholders in managing Lake Natron, strive to control their lands

and access to the resources therein. At the same time, district governments often try to capture a greater portion of the tourism revenue, while the central government claims the overall jurisdiction. The private sector itself is riddled with similar conflicts, as individual tourism operators negotiate for positions at the local level, and, in theory, tourist hunting conflicts with non-consumptive wildlife forms of tourism such as photographic safaris (Kobb et al. 2000). These conflicts fuel uncertainty among all stakeholders, especially the private sector, with regard to the current direction and future viability of ecotourism. In addition, different NGOs operating in the area have conflicting strategies in promoting their agenda. One commonality among all NGOs is the desire to empower the local community economically. However, while some promote livelihood security through ecotourism, others promote the same goal through encouraging increased livestock. For example, while the then Wildlife Conservation Society of Tanzania (WCST) implemented a set of environmentally friendly community micro-livelihood projects, the Oxford Committee for Famine Relief (OXFAM) works toward poverty reduction among pastoralists by improving livestock production and restocking destitute families to allow them build up herds that can sustain the household. This situation is entirely different from the integrated planning and management approach required by the ecotourism concept that tries to overcome the fragmentation inherent in existing management approaches by meeting the needs and visions of all concerned users as well as the environment (Kirkby et al. 2010). Coordinating and communicating this agenda could make their mutual interest a common objective so that Lake Natron management becomes jointly and viably managed for sustainable livelihood development and biodiversity conservation.

6.4.2 Inadequate Funding at the Operational Level

Management of ecotourism resources at Lake Natron is also characterized by insufficient allocation of the funding resources. At the moment, Lake Natron is funded entirely by government sources. The Danish International Development Agency had provided financial resources to supplement government funding for the area since 2001. However, its funding scheme has phased out. Although the government provides an annual operating budget for the implementation of various management activities in the area, it is not clear how it decides on the amount of funds that Lake Natron receives annually, as the budget tends to vary every year. As a result of insufficient funding, Lake Natron management is unable to secure long-term investment plans. Reliance on government funding has been noted as problematic for many protected areas, and insufficient budget allocations emphasize the importance of individual protected area managers to develop methods to increase their revenue using alternative means such as income from tourism sources (Thomas and Middleton 2003). Wearing and Neil (1999) argue that ecotourism should contribute to the cost of protecting and managing the natural areas. However, at the moment, ecotourism at Lake Natron does little in offsetting the management cost.

6.4.3 *Lack of Mechanisms to Secure a Fair Distribution of Ecotourism Benefits*

In addition to funding struggles, this study also found that Lake Natron lacks mechanisms to secure a fair distribution of ecotourism benefits, and ecotourism has created an uneven distribution of benefits among different stakeholders involved in managing the area. At the moment, the lodge owners are the primary beneficiaries of tourist spending, while many local people do not receive economic benefits due to a lack of direct contact with the tourists and the established ecotourism business enterprises. Unequal distribution of benefits among the local residents living in the villages adjacent to the lake is also attributed by the fact that ecotourism potential at Lake Natron has not been fully utilized. Field site observation discovered that ecotourism activities and benefits are confined to only one village located in the southern part of the lake. This is due to problems such as poor accessibility to other villages, lack of tourism facilities, and insufficient marketing. Likewise, most employment opportunities to the lodges were taken by men, outsiders (immigrants), and a few local elites, a situation that has effectively marginalized other groups within the community in respect to ecotourism activities. Scheyvens (1999) reports that the signs of local disempowerment are visible when ecotourism merely results in small gains and most profits go to outside operators, while others cannot find a way to share these benefits because of lack of capital and lack of appropriate skills.

It was further noted that, although local communities at Lake Natron have extensive knowledge of their areas' cultural and natural resources which are important in ecotourism, many tend to have limited access to capital and lack the necessary skills to engage in and run ecotourism businesses. High poverty levels among residents at Lake Natron, as measured by low-income levels, means villagers generally have small savings and lack access to capital necessary to initiate and establish ecotourism enterprises. Bookbinder et al. (1998) note that the ability of the members of communities to capture the benefits from ecotourism is rarely ensured if the majority lack appropriate skills to be employed in the established tourist lodges. Ecotourism as a development and conservation strategy is expected to contribute to natural resource conservation and to enhance the long-term prospects of the local communities by providing them with income-earning opportunities (Wall 1997). However, many local inhabitants in the villages surrounding Lake Natron either do not generate income, or they receive little income from ecotourism compared to other economic activities such as livestock-keeping and crop-farming.

6.4.4 *Poorly Developed Tourism Infrastructural Facilities to Support Ecotourism Operations*

Information on tourists' perceived quality of facilities and services, as well as their general perception of Lake Natron as a tourist destination, was an indispensable facet of this survey because it directly impacts the consumption of goods and

Table 6.3 Rating of facilities and services at Lake Natron by tourists (N = 155)

Facility and services	Very good N (%)	Good N (%)	Bad N (%)	Very bad N (%)
Accommodation	26 (17)	34 (22)	82 (53)	13 (8)
Accessibility	9 (6)	65 (42)	56 (36)	25 (16)
Food and beverage	57 (37)	96 (62)	2 (2)	0
Sanitation	16 (10)	50 (32)	83 (54)	6 (4)
Guiding services	5 (3)	36 (23)	93 (60)	35 (23)
Security	10 (7)	25 (16)	99 (64)	21 (14)
Information about the site	10 (7)	26 (16)	78 (50)	43 (28)
Bird-watching facilities	2 (2)	7 (5)	55 (36)	56 (36)

services and the decision of tourists to return. Tourist survey noted poorly developed tourism infrastructural facilities to support diverse segments of tourists and ecotourism operations as one of the challenges that diminish the recreational quality of Lake Natron. Such information was obtained by asking tourists to rate different facilities and services offered at Lake Natron (see Table 6.3). Although over 90% of visitors were generally satisfied with services such as food and tour guiding, several areas for improvement were noted. According to the findings, more than 75% of the tourists complained about poor accommodation facilities, lack of bird-watching facilities, inadequate information about the site, and lack of safety precaution measures when climbing the mountain.

According to the findings, most tourists are pleased by the levels of food and beverage services provided at Lake Natron. However, the current state of essential tourist infrastructural facilities that range from information centers, sign posting, accommodation, access roads, and bird-watching facilities present an obstacle for ecotourism development at Lake Natron. Dwyer and Kim (2003) argue that the prosperity of a destination's tourism is highly related to its provision of quality services, as perceived by tourists. Lack of basic tourist facilities and low-quality services at Lake Natron may reduce the desire of tourists to return and consequently weaken the financial base of the area. Furthermore, Alegre and Jaume (2010) revealed that poor infrastructural facilities make a tourist destination less attractive, and therefore investment in proper infrastructure is a necessary precondition for a tourist destination to become appealing to an international tourist market.

On the other hand, a good quality of services received by a tourist may increase the perception of "trip value" and in turn increase the likelihood of tourists to visit the destination again or recommend the destination to prospective visitors (Chadee and Mattsson 1996). While it may be argued that lack of proper and adequate accommodation may make Lake Natron lose its competitive position as a tourist destination, large-scale investments in modern hotels and restaurants around the area will involve significant alteration of the environment and encourage overexploitation of resources, which in the long-run destroys ecotourism itself. However, Eadington and Smith (1992) argued that private investors could be encouraged to carry out proper planning prior to investing in such business. Therefore, this could

be an important aspect to note in any future proposal for the provision of sophisticated accommodation in the area.

Tourists also criticized the fact that the area does not provide safety precautionary measures for tourists climbing the very dangerous Oldoinyo Lengai Mountain. Tourists' perception of safety and security at a destination has been reported to significantly influence their choice of destination (Milman and Pizam 1995). In other words, a good safety image for the destination can attract more visitors to a particular destination. From these findings, it can be argued that more needs to be done by the management of Lake Natron to improve the destination image as far as safety is concerned. This will be necessary in order to increase tourists' length of stay and the likelihood of repeat visits. Similarly, even though birds might be plentiful in the lake, bird-watching at the lake may be challenging due to a lack of viewing facilities. It is also apparent that visitors do not learn much about Lake Natron because of poor information about the site. This calls for the need to enhance bird-watching experiences and improve information of the area by establishing bird-watching facilities, a tourist information center, and visual aids such as posters to reinforce the tourists' learning process. According to Lindsay (2003), tourists on short visits and those visiting for the first time are usually able to learn about a place very quickly if there is enough information about the site. This is important for Lake Natron, in order to improve the satisfaction of short-stay visitors especially those who often stop over very briefly while en route to other tourist destinations such as Serengeti National Park.

In addition, interviews with the tour operators at Lake Natron recorded complaints about the poor quality of the local tour guides as many operate without any training. Recently, the Engaresero village management established a tourism office to enable the community to accrue revenue from ecotourism as a whole while providing employment to selected individuals. The office employs local guides and restricts tour operators from bringing their own guides from outside the village. This office also charges tourists the guiding fees as well as fees for each activity they participate in. However, the Engaresero village office currently lacks a plan with clear mechanisms for managing tourism. This adds cost to the tour operators who normally offer packages with tour-guided activities for which customers have already paid. With the centralized new office, tour companies now have to buy services for which they cannot guarantee quality. These interview responses give evidence for the need to undertake improvement plans relative to the current organization of tourist activities and the fee charging system.

6.5 Conclusions and Recommendations

Despite the management challenges presented above, there are many opportunities for Lake Natron to grow into a major ecotourism site and provide sufficient economic incentives for people living in the adjacent villages. Prospects for growth of ecotourism at Lake Natron are associated with its conservation status. As a

well-known Ramsar site, Lake Natron has the potential to attract international support for the conservation and wise use of its resources. However, being a Ramsar site is not sufficient to realize the full economic potential of ecotourism. It requires a meaningful management reform of existing mechanisms that can effectively address the real obstacles of ecotourism and ensure that ecotourism achieves its goal. In designing an effective management structure that can support long-term economic and environmental benefits of ecotourism, consideration should be given to the following recommendations:

Readjust the current mechanisms for the distribution of ecotourism income so that such benefits are shared equitably, and sufficient revenues are obtained to pay for necessary management costs. This requires a proper balance of the benefits derived from ecotourism activities that have the potential to increase local support for conservation, as well as increasing conservation effectiveness. The current distribution gap is likely to discourage conservation support from the local people whose activities are the main forces degrading the environment. Revenues from tourism can be increased by making Lake Natron a more interesting destination with diverse and high-quality activities and services, tempting tourists to stay longer.

Closely linked to the above point is the need to increase the capacity of communities so that they are able to take more control of ecotourism with improved participation in planning, management, and direct sharing of benefits. Skills' training is also important to support the ability of local communities to engage with the private sector in order to exploit of different ecotourism business opportunities.

Furthermore, although ecotourism requires little infrastructure, it is recommended that efforts be made to improve infrastructure and interpretation facilities that are crucial to ecotourism development. Such efforts might include, among other things, establishing an information center and a well-planned network of bird-watching facilities to provide access to various habitats and improve the bird-watching experience.

There is also a need to establish efficient and effective institutional arrangements for coordinating and strengthening collaboration among various stakeholders at national, local, and user levels. The multi-stakeholder situation of Lake Natron management means that the problems are complex, and enhancing cooperation is important to understand the interests and issues that are at stake when dealing with conservation and livelihood. It is also essential that all development plans and projects operating in the area are integrated and harmonized with the primary objective of biodiversity conservation and sustainable local development. In this regard, it is vital that the central government work closely with the district level officers who are responsible for directing and supervising all development work in the district, by integrating the management of Lake Natron in the existing local government structure and operations of the district.

Finally, a range of management activities and implementation of action plans can only be realized if adequate funding is available. The central government should ensure that Lake Natron obtains adequate funding support to enhance its environmental conservation goals by exploring other sources of funding. For example, the government through the Ministry of Natural Resources and Tourism can encourage

the area to generate more revenue from ecotourism by improving its facilities and services with the final goal of enticing tourists to stay longer at the destination. The income collected could be used to further improve the management and maintenance of the unique features of Lake Natron, as well as to maintain the place as one of the world's important lesser flamingo breeding sites.

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Chapter 7
Poachers' Strategies to Surmount Anti-poaching Efforts in Western Serengeti, Tanzania

Alfan A. Rija and Jafari R. Kideghesho

Abstract Poaching is increasingly threatening the survival of numerous species in protected areas. However, information on how poachers work afield is sparse—especially in East Africa. Understanding how and where poachers work is an important step toward improving wildlife ranger patrols and, therefore, success of law enforcement practices. This study used observations from two years of fieldwork in the Serengeti ecosystem in northern Tanzania and volunteered information from ex-poachers to highlight poachers' tactics and adaptability to avoid detection and arrest while committing crimes. Using available theories in criminology and socio-sciences, we uncovered ten strategies that poachers employ to avoid detection and arrest by rangers, sustain wildlife poaching, and supply wildlife products to illegal wildlife markets. We argue that increasing wildlife crimes related to bushmeat and high-value trophies such as ivory and rhino horns may have influenced adaptability in the strategies employed by poachers while operating afield. Possible options for improving detection of illegal activities afield, therefore reducing the supply of wildlife products to illegal markets, and saving the target species from decline are discussed. This information has a potential to improve wildlife crime detection and prevention by the wildlife rangers. It is also important for programs aiming at curbing wildlife crime within and outside the protected areas.

Keywords Poachers · Protected areas · Wildlife crime · Anti-poaching · Serengeti · Tanzania

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7.1 Introduction

Wildlife crimes including poaching, logging, and livestock grazing are threatening the survival of species in many protected areas globally (Critchlow et al. 2015) and are driving some species to the brink of extinction (Tranquilli et al. 2012). Over the past decades, a catastrophic decline of large mammals in Africa has been reported for lions (*Panthera leo*) (Hance 2012), African elephant (*Loxodonta africana*) (Chase et al. 2016), black rhino (*Diceros bicornis*), mountain gorilla (*Gorilla beringei beringei*), and Grevy's zebra (*Equus grevyi*) (AWF cited in Kideghesho 2016). Economic hardship, increasing market demand, and failure of wildlife conservation to compete effectively with other economic options are important drivers of illegal activities in protected areas (Knapp 2012; Kideghesho 2016).

It is widely acknowledged that efforts to combat wildlife crime in protected areas, especially in developing countries, are hindered by limited financial resources (Albers 2010; Wilkie et al. 2001; Kideghesho 2016) and the spatial extent of protected areas and topographic barriers within the limit of effective patrols (Plumptre et al. 2014). Existing and emerging strategies employed by poachers to avoid detection and arrest by law enforcers poses another challenge (Herbig and Warchol 2011). Such a challenge undermines the success of patrols and, therefore, of law enforcement programs, thus causing a potential loss of resources invested in conservation work (Fischer et al. 2014; Rauset et al. 2016). Furthermore, increased global internet accessibility and the subsequent access to online markets have also fueled illegal trade of high-valued wildlife products such as ivory and rhino horn (Sonricker Hansen et al. 2012). Illegal trade in wildlife products such as bushmeat—estimated at 260 tons per annum (Chaber et al. 2010)—plays a big role in the dynamics of poaching in protected areas today (Rija 2017).

It is increasingly being acknowledged that the current conservation efforts and strategies in protected areas hardly match the rate at which species are declining (Butchart et al. 2010; Tittensor et al. 2014). This has prompted a need for additional investment in fighting the crimes and adoption of new and more effective strategies (Watson et al. 2016). Understanding of the pattern of poaching and the behavior of poachers is essential in furnishing the conservation authorities with information required in devising plans for effective anti-poaching patrols in protected areas. In this chapter, we examine the behavior of poachers using human behavioral science that considers new technologies and international dynamics in illegal wildlife trade. We draw upon experience of Serengeti ecosystem in northern Tanzania to understand strategies employed by poachers involved in bushmeat poaching to avoid detection and arrest by protected area rangers.

Behavioral biology has long been recognized as an important component of managing conservation crisis (Buchholz 2007). Yet, its application has remained limited on understanding how human behavior complicates conservation efforts in protected areas (Veríssimo 2013). In recent days, where human activities are increasingly changing owing to the improved technology (e.g., transportation, communication, and social development), it is apparent that such changes are associated with some negative effects on the natural ecosystems (Mwampamba et al. 2016).

For example, the opening and improvement of infrastructures including roads and railway lines has caused an increase of poaching of wild mammals and destruction of wildlife habitats across the tropics (Haines et al. 2012; Laurance et al. 2009; Shaffer and Bishop 2016; Subedi and Subedi 2017).

7.1.1 Framing the Issue and the Model of Analysis

Patrolling is an integral component of law enforcement that remains crucial in conservation work (Rauset et al. 2016; Tranquilli et al. 2014) and is one of the activities with a significant budgetary allocation in protected areas (Jachmann 2008; Plumptre et al. 2014). Effective ranger patrols and combating poaching by rangers in the field need to be informed by data on how and what exactly poachers do in the field. Such information is still lacking in most protected areas located in the developing countries, a problem that has partially contributed to the persistence of animal poaching and illegal bushmeat trade (Lindsey et al. 2013). Moreover, the widespread variability in the micro-poaching tactics (due to cultural diversity) employed by poachers and used in different regions have complicated the use of information obtained from one region to combat poaching elsewhere (Aziz et al. 2017; Becker et al. 2013; Fischer et al. 2014).

Lack of such locally specific information and failure of scientists to communicate such data to managers and rangers working in the field have further undermined any potential improvement of the ranger patrol strategies. Such data are missing for most flagship wildlife ecosystems in Tanzania including the Serengeti, where despite being researched extensively for over 60 years, poaching incidents have remained high and threaten the survival of wildlife and the long-term persistence of this iconic ecosystem. In this study, we use a conceptual approach based on Situational Crime Prevention strategies used in pursuing patterns of crack dealing and associated crimes (Jacques and Reynald 2012; Johnson and Natarajan 1995; VanNostrand and Tewksbury 1999) to understand how wildlife poachers in Serengeti work. Describing where these crimes occur has potential for improving wildlife ranger enforcement practices and subsequently reduce poaching significantly.

The Serengeti is an important protected area in Africa where wildlife crime, particularly poaching, is endemic. Between 10% and 12% of the wildlife population in the area is estimated to be poached annually (Rentsch and Packer 2014; Rija 2017). Previous studies on poaching in this ecosystem focused on poaching prevalence and bushmeat consumption behavior of adjacent communities (Loibooki et al. 2002; Ndibalema and Songorwa 2007; Nuno et al. 2013; Knapp 2012). These studies have improved our understanding of the extent of the problem within the local communities—the drivers of the problem on the demand side. However, they are limited in approaches of poaching prevention within the protected areas where some large mammals (e.g., buffalo, giraffe, etc.) are declining (Metzger et al. 2010; Strauss et al. 2015).

We employed recent field observations made over two years of research on illegal activities in the Serengeti ecosystem to uncover and describe the strategies employed by poachers to evade detection by the anti-poaching rangers. This information will inform the protected areas authorities the best ways to improve the ranger patrol activities. It is also useful for researchers interested in studying patterns of illegal activities in other protected areas where illegal hunting of wildlife is widespread.

7.2 Materials and Methods

7.2.1 Study Area

This study was conducted in the western part of the Serengeti-Mara ecosystem within and around Serengeti National Park, Ikorongo, Grumeti, Kijereshi, and Maswa Game Reserves; and IKONA Wildlife Management Area (WMA) (Fig. 7.1). Serengeti National Park, spanning an area of 14,763 km^2, is the third largest national park in Tanzania after Nyerere (30,893 Km^2) and Ruaha (20,226 km^2), both located in the southern part of Tanzania. Tanzania's national parks are under the jurisdiction of Tanzania National Parks (TANAPA). The four game reserves—Ikorongo (602 km^2), Grumeti (2000 km^2), Kijereshi (65.7 km^2), and Maswa (2200 km^2)—are managed under Tanzania Wildlife Management Authority (TAWA). The IKONA WMA (242.3 km^2) is managed by local communities with the support of the Wildlife Division.

The selection of study area was based on persistent and high poaching incidences (Arcese et al. 1995; Hilborn et al. 2006; Rija 2017); prevalence of illegal bushmeat consumption behavior by the adjacent communities (Loibooki et al. 2002; Ndibalema and Songorwa 2007; Nuno et al. 2013); evidence of detrimental effects of poaching on a number of wildlife species such as giraffe (*Giraffa camelopardalis*), buffalo (*Syncerus caffer*) and zebra (*Equus burchelli*); and the urgent need to improve conservation in this flagship ecosystem (Metzger et al. 2010; Rija 2017; Strauss et al. 2015).

Most of the parts of the study area are covered by extensive plains of semiarid savanna with smaller areas of riverine forests in the central, eastern, and western parts. Mixed *Acacia* and *Commiphora* woodland vegetation extends over much of the central and northern parts with some occasional large open grasslands (Reed et al. 2009). The southern and eastern areas receive an average annual rainfall of 500 mm that increases to over 1200 mm in the north and west, peaking mainly during the wet season between November and May (Sinclair and Arcese 1995).

The diverse habitats characterizing Serengeti have made it exceptionally rich in wildlife species. It is home to the largest herbivore and carnivore populations in the world. The area is unique for its herbivore migrations involving wildebeest (*Connochaetes taurinus*) (Fig. 7.2), zebra (*Equus burchelli*), and Thomson's gazelle (*Gazella thomsoni*). Furthermore, it inhabits large populations of resident herbivores like eland (*Taurotragus oryx*), African buffalo (*Syncerus caffer*), giraffe (*Giraffa camelopardalis*), Grant's gazelle (*Gazella granti*), impala (*Aepyceros*

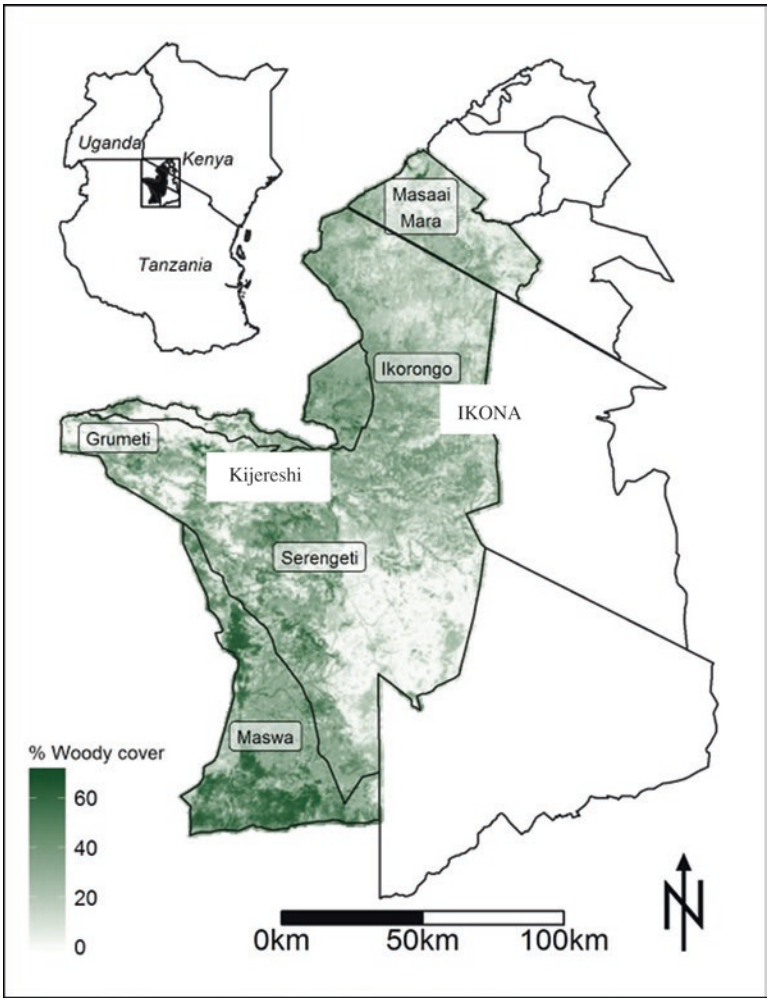

Fig. 7.1 Location of the Serengeti-Mara ecosystem with the four protected areas: Serengeti National Park, and four game reserves—Ikorongo, Grumeti, Kijereshi and Maswa—where this research was conducted

melampus), hartebeest (*Alcelaphus buselaphus*), topi (*Damaliscus korrigum*), warthog (*Phacochoerus aethiopicus*), and waterbuck (*Kobus ellipsiprymnus*). The area is also famous for populations of large carnivores including lion (*Panthera leo*), leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus*), and hyena (*Crocuta crocuta*). In addition, it is popular for other species of global significance including elephant, hippo (*Hippopotamus amphibius*), wild dogs (*Lycaon pictus*), and rhino (*Diceros bicornis*).

The study area is home to over 30 tribes living in multiethnic communities. The main tribes are Ikizu, Sukuma, Taturu, Ikoma, Kurya, Jita, Natta, and Issenye. These

Fig. 7.2 Wildebeest (*Connochaetes taurinus*)—a keystone species defining a great migration of the Serengeti

ethnic groups are typically agropastoralists i.e., relying on crop cultivation and livestock keeping. However, high diversity of wildlife species in the area has made illegal hunting an important economic and livelihood option (Fischer et al. 2014). Besides having a cultural significance among the tribes (Kaltenborn et al. 2003, 2005), illegal hunting for bushmeat is pursued for subsistence, market demand within and outside the study area, and as a coping strategy against economic hardship (Campbell and Hofer 1995; Kideghesho et al. 2005; Loibooki et al. 2002; Knapp 2012). The decision to engage in illegal hunting is mainly prompted by the fact that the benefits of the activity exceed by far those generated from other economic options pursued in the area (Knapp 2012).

7.2.2 Data Collection by Field Observations and In-Depth Interviews

The study employed the Situational Crime Prevention (SCP) approach to understand the spatial extent of illegal activities in the study areas and how poachers work afield. SCP is a process of multiple stages that seeks to understand where, when, and how crime incidents occur (Clarke 2009). It involves assessing the opportunities

that specific situations offer for crime. The approach seeks to minimize the damages caused by crime through altering immediate or situational factors in the environments where crime regularly occurs. In conservation crimes such as poaching, this could entail increasing patrol intensity, patrol frequency, and extent of coverage within protected areas. We used this concept to generate these data. Field observations were made and recorded along systematic rectangular transects (at least 8 km, n = 88) as part of a larger conservation research program in this ecosystem (refer to Rija 2017 for detailed methods where all evidence of poaching were recorded (Fig. 7.2)).

Transects were walked across the ecosystem covering 920 km. Along each transect, we geo-referenced all evidence of poaching (e.g., presence of live wire snares, snare traces, carcasses of animals killed by poachers, tracks of motorcycle and foot prints, and grazing of livestock), and photographs of all evidence of illegal activities were taken using a digital camera (Lumix-Panasonic). Field observations were made over 10 months of research distributed over 2 years covering 5 months—June to December—each in 2015 and 2016. These data are fresh and new from the field and have not been published. The time since data collection to date is too short for the strategies to have changed. The field observations were complemented by discussions with rangers on how they generally feel about their performance in patrols to deter poaching. They were specifically asked to explain the difficulties they encounter during their patrols and whether these difficulties resulted from strategies employed by poachers.

We also used semi-structured interviews to collect data from four arrested poachers (following a previous study by Loibooki et al. (2002) in this ecosystem) held in Mugumu Police Station in Serengeti to establish the strategies they employed to avoid arrest by rangers and other life-endangering threats in the field. The interviews with the arrested poachers lasted for 1 h (about 15 min per poacher). Permission to talk to the arrested poachers was first sought from police officials after explanation of the purpose and rationale of this study. We also obtained consent from poachers themselves. We did not ask the poachers any information that would identify them personally (e.g., name, village of domicile, etc.) to ensure safety and encourage cooperation during the interviews. However, we asked them about the district they belong to, hunting sites they were arrested within the Serengeti ecosystem, and their strategies they employ to avoid detection and arrest in the protected areas. All four poachers willingly volunteered to share the information with researchers. The interview method used is a common practice for arrested poachers in protected areas.

Finally, to collect more information about the poachers' behavior while in the field, we conducted an in-depth interview with a group of ten ex-poachers who voluntarily stopped poaching and decided to engage in other livelihood activities. Identification of the ex-poachers was made possible by the help of the NGO—Peace for Conservation. We sought permission from Peace for Conservation to interview these retired poachers, and consent from them was obtained before the interviews. The ex-poachers interviewed came from four districts: Serengeti (4), Bunda (2), Maswa (2), and Magu (2) that surround the Serengeti ecosystem and where illegal hunting pressure emanates (Loibooki et al. 2002; Ndibalema and Songorwa 2007;

Knapp 2012). This information was important for any targeted potential conservation measures in these districts. Participation in the interviews was strictly voluntary. Of the 13 names identified, three ex-poachers declined to share any information. The remaining ten ex-poachers voluntarily participated in an in-depth interview that lasted for 25–40 min. All the conversations were audiotaped, and the tapes were then destroyed after analysis.

To understand where illegal activities are happening in the study areas (or where the poachers go), we produced a spatial distribution map of all illegal activity records using geographical information system (GIS) functions built in R statistical software (R-version 3.2.5, a freely available tool for download from web). Furthermore, by using observation records of illegal hunting in the field and data from interviews transcribed verbatim, we detailed the strategies used by poachers that aim at avoiding detection and arrest by rangers in the field.

7.3 Results

7.3.1 Distribution of Wildlife Crimes

We found a widespread distribution of illegal activities across the ecosystem with the poaching of animals showing higher abundance and wider coverage than other types of wildlife crimes (Fig. 7.3). There was a higher incidence of wildlife crimes recorded in the national park (at least three incidences per km) than in game reserves in the ecosystem. These data suggest that poachers conduct illegal activities in virtually all parts of study area. They also suggest that poacher deterrence by rangers in the area is limited.

7.3.2 Strategies Used to Avoid Detection and Arrest by Perpetrators of Wildlife Crimes in the Field

The field observations, complemented by information from the ex-poachers and arrested poachers, uncovered ten strategies employed by illegal hunters in committing criminal activities in the Serengeti ecosystem.

1. *Concealment of evidence of poaching*

Our field surveys showed that hiding of carcass remains from poached animals is done on tree twigs, underground holes, caves, rivers, or under-shades of shrubs (Fig. 7.4). According to ex-poachers, concealing evidence was necessary for a number of reasons: first, poachers aim to destroy signs that are often used by the park rangers to detect poaching and track down poachers; second, they shun other animals such as hyena and vultures away from getting closer to the poaching scenes as

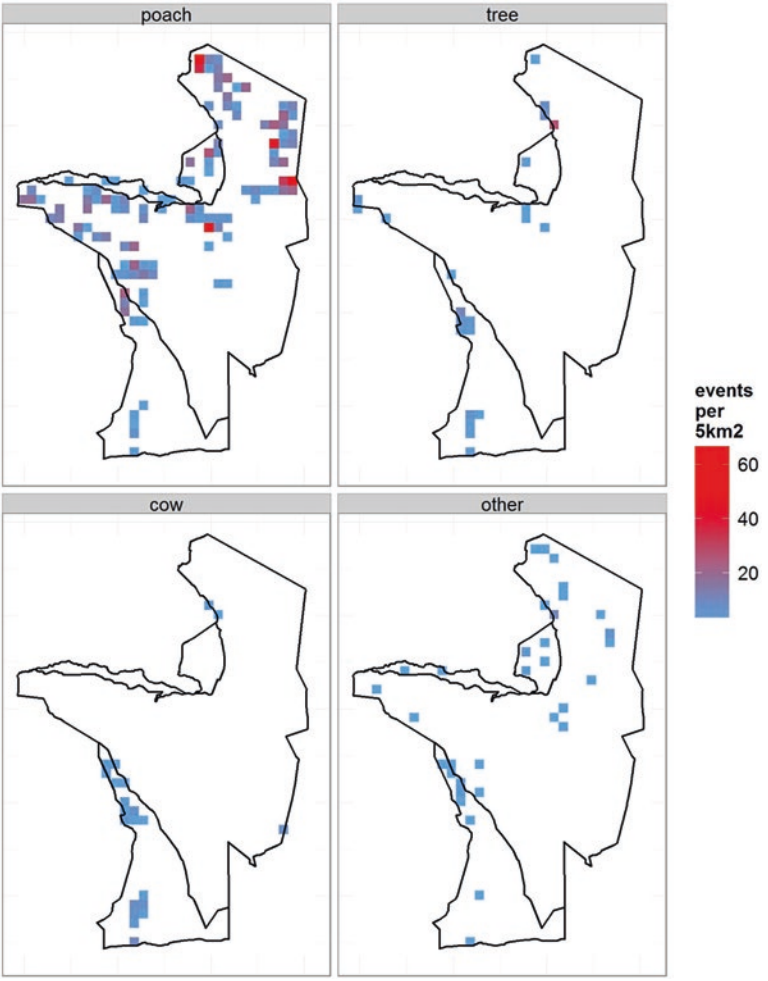

Fig. 7.3 Spatial distribution and abundance of illegal activities recorded along the surveyed transects across the Serengeti ecosystem. Illegal activities include poaching of wild animals (top left), illegal logging (top right), illegal livestock grazing (bottom left), and others (bottom right), which include motor cycle tire prints, human foot prints, and human properties (e.g., cloth, shoe, watch, left in the park by poachers)

these are known to be used by rangers as indicators of illegal activities; and, third, some evidence are used as locators back to similar sites in future poaching excursions.

Our fieldwork observations uncovered that this strategy is spatially distributed across the ecosystem, despite a great cultural diversity of the communities where potential illegal hunters originate. This confirms poachers' assertions that some hunting skills are transferred among poachers afield during hunting trips.

Fig. 7.4 Images of skulls of wild animals hidden by poachers in tree branches to avoid detection by the park rangers in the Serengeti ecosystem. Right image is a wildebeest skull, and warthog and buffalo skulls in the left image observed during the field surveys. Photographs by Alfan Rija and Hilary Matemu

2. *Placing sharp objects on the ground or itching plants on the paths*

Our observations in the field did not uncover any sharp objects placed on the ground to obstruct rangers as they perform their duties. However, rangers and ex-poachers revealed that placing or burying objects with sharp points such as nails, pieces of metal, or spears pointing upward with the intention of wounding the rangers as they patrol in the bush was one of the common strategies. This, consequently, delays or forces the rangers to suspend the anti-poaching operations once wounded. In some cases, poachers put the pods or powder of the plant known as velvet bean (*Mucuna pruriens*) (known as *upupu* in Swahili) along the areas frequently used by rangers. This plant is a tropical legume native to Africa causing severe itching when the pods are touched (Fig. 7.5).

One of the ex-poachers admitted that poaching being a risky undertaking necessitates a "do or die" approach against rangers. Sometimes poachers are compelled to face and fight the rangers in the bush and, consequently, result into wounding or killing of the wildlife rangers.

Fig. 7.5 Velvet bean (*Mucuna pruriens*)—a plant with itching property used by poachers against rangers

3. *Use of motorcycles to aid poaching and facilitate escape on grass plains*

Adapting tools and other aides of poaching is an increasing challenge in conservation, especially in the twenty-first century, characterized by a rapid increase of transport and communication technologies. In the late twentieth century, poachers in the Serengeti hunted in large groups and with the aid of dogs at night (Kaltenborn et al. 2005). Such hunting activities occurred mainly on grass plains by chasing and spearing animals on foot. More recently, however, motorcycles are increasingly replacing dogs and on-foot hunting. Interviewed poachers and ex-poachers acknowledged that motorcycles have increased in recent years, though illegal hunters do not necessarily need to own motorcycles to carry out their activities. Motorcycles can be borrowed from other people on agreement that the benefits obtained from the crime are shared. Essentially, motorcycles have made it easier for poachers to supply bushmeat to meet urgent demands, and their use in hunting is perceived to be a safer method than hunting on foot because of the ability to escape when detected by park rangers.

Our field observations of motorcycle tire prints (Fig. 7.3) suggested that this strategy is widely used to access various plain areas across the ecosystem. Poaching from motorcycles is done during the early morning, late evening, and sometimes under moonlight when ranger activities are perceivably low, and it is easier to quickly escape danger from approaching rangers. Despite posing a challenge, motorcycle confiscation has increased by more than double over the past decade (Fig. 7.6), suggesting that rangers are combating this challenge.

Fig. 7.6 Confiscated motorcycles at one of the ranger stations in the Serengeti ecosystem. Zebra and eland are targeted by poachers using motorcycles (Photographs by Alfan Rija)

4. *Dressing poached carcass with intent to evade suspicion by rangers*

Animal carcasses are an important artifact used in forensic investigations, including research on illegal hunting in protected areas. However, gathering evidence of wildlife death by illegal hunters within protected areas is fraught with several challenges including the age of a carcass (which may determine carcass or skeleton decomposition), inflicted injury on the carcass, and presence of secondary predators such as lion and hyena (which can potentially destroy evidence through breakdown of the skeletal bones). Crucially, poachers in the Serengeti ecosystem may have learned through experience to dress the carcasses in a way that dilutes the rangers' attention and evade poaching suspicion by stripping off meat from the carcass and leaving the skeleton intact. This is a feeding behavior that can suggest predation by lion (Fig. 7.7).

The carcass processing behavior was observed mostly for large mammals such as buffalo, and the poachers arrested confirmed this to be a common practice in the study area. On further probing, the ex-poachers revealed that stripping off the meat has the goal of increasing their safety by hastening skeletal drying to deter vultures and by deceiving the anti-poaching rangers by creating the appearance that the animal's death was caused by predation. Stripping off meat also helps to reduce the food resources on the skeleton to avoid the mammal scavengers like hyenas that may lead to poaching suspicion by the patrolling rangers. Such carcass dressing skill appears to be communicated across the poachers community through storytelling and field practices upon conducting group hunting in the ecosystem.

5. *Extermination of scavenger birds to avoid detection*

Bird scavengers are the first to arrive at a carcass due to their great vision and communication behavior (Kane and Kendall 2017). Poachers have learned the practice of using these species among the rangers to locate sites of animal mortality and explore the reason for the death. By applying this knowledge, they (poachers) have resorted to deliberately kill the birds that land at a scene where poaching is

Fig. 7.7 Stripped off carcasses of buffalo hunted illegally in the study area

successful. Our field observations recorded four poisoning incidences inside Serengeti National Park (Fig. 7.8), suggesting that vulture killings associated with illegal bushmeat hunting may be widespread. Furthermore, information from the ex-poachers suggest that besides helping to evade detection, the vultures are also killed for their body parts that are used for fetish and traditional medicines or witchcraft purposes among some communities living around the study area.

6. *Night ambush-poaching with sharp Pangas*

In occasions when ranger patrol activities are high and the chances for conducting poaching trips are perceivably minimal or impossible, poachers resort to ambush animals during the nights with sharp bush knives popularly known as *pangas*. Such a strategy is used on a quick night trip with the aid of strong light torches. Poachers ambush a group of animals on short grass plains or shrub- grassland by attacking on the back or hind leg, killing or injuring it before the animal is put down and slaughtered. Our fieldwork observed several old carcasses of wildebeest and zebra with signs of machete cuts on their spines and legs, suggesting that some animals, despite being severely injured, do escape the poachers after an initial machete attack, but they eventually die (Fig. 7.9).

7. *Camping on hilltops and away from their trapping sites*

Various attributes are known to raise fears among the poachers during hunting excursions including encountering dangerous animals such as lion and apprehension by anti-poaching rangers (Knapp 2012). Our conversation with the ex-poachers indicated that the choice of where to set up hunting camps matters greatly when planning for a poaching trip. In their opinion, hilltops and secluded corners are the most suitable places for camping. It is not uncommon for a hunting camp to be at least 3 km away from the trapping sites to minimize the chances for the camp being easily located by the rangers. Furthermore, poachers minimize the fear of

Fig. 7.8 Extermination of the scavenger birds by poisoning as one of the tactics used by the poachers in protected areas to avoid detection by the rangers as observed during the field surveys in the study site. Many raptors (e.g., tawny eagles) (**a**—bird in moribund) and scavenger birds, mainly vultures (**b**), are targeted by poachers. The red arrow shows a fresh meat stripped off eland carcass laced with poison left to kill the birds. (**c**) shows semi-processed vulture heads at one of the poacher camps in the study area, suggesting that some poisoned vultures are collected for use in traditional medicine. Photographs by Alfa Rija and Hillary Matemu

Fig. 7.9 A wildebeest severely injured by poacher's machete observed after escaping night ambush and cut technique used by poachers in the Serengeti ecosystem. Poachers target spine and legs to kill animals during night poaching trips. Photograph by Alfa Rija

apprehension by regularly changing hunting camps between hunting trips, especially after a successful hunt, or by abandoning camps when they are detected by the rangers. In our fieldwork, we observed most hunting camps were located either under caves or in thick vegetation growing in mountainous or hilly areas. Some of these areas are difficult to reach—particularly by rangers who may be patrolling on foot—and are thus used as deterrents for the approaching rangers. Despite this,

some rangers in the Serengeti ecosystem bravely follow the poachers to these difficult sites.

8. *Overnight set and removal of wire snares*

Successful hunting is decidedly a measure of bravery and esteem earned among hunting communities living around Serengeti National Park (Kaltenborn et al. 2008; Kideghesho 2008). When poachers perceive potential dangers during preparation for a hunting trip, perhaps for fear of apprehension or other reasons, they shorten the length of the hunting trip. Poachers target sites with a high concentration of animals, often within workable distances, for a short trip in the same night. To ensure the trapping is successful, unlike for a long hunting trip where wire snares are left to catch animals passively, on a short night trip, poachers chase animals into the snare lines, removing the catch and the snares altogether from the sites. This hunting strategy was observed mostly in areas bordering human settlements, normally within 5 km of the protected area borders.

9. *Use of mobile phones*

Increasing communication technologies, particularly the use of mobile phones, is an emerging tool in wildlife crimes. This tool is also a challenge in combating wildlife crime successfully within the protected areas. Based on our field observations, traces of used airtime voucher papers were encountered in poaching camps, and some voucher papers were observed along transect walks suggesting that poachers use mobile phones to communicate with peers in the field or with family members back home. Exploring further on the use of mobile phones, the ex-poachers confirmed that mobile phones have been a useful tool in facilitating poaching in recent years. Poachers use mobile phones in a poaching cycle: first, when planning a hunting trip to communicate with peers and explore possible suitable hunting sites; second, in the field to organize bushmeat porters from their villages when hunting is successful; and third, to inform poaching peers if there is a danger of apprehension by park rangers. Furthermore, mobile phones are used by a few corrupt and dishonest wildlife officers to communicate the anti-poaching plans and operations to poachers.

7.4 Discussion

Results from our study provide a new empirical information on where the poachers go (spatial distribution of poaching) and how poachers work afield in an African context. This study advances the scope of knowledge on the poacher's behaviors that aid wildlife crimes in the face of the current poaching crisis in protected areas (Moreto and Lemieux 2015; van Uhm and Moreto 2017). Our finding that poachers conceal remains of poached animals is broadly similar to the hiding of firearms in secluded areas such as tree caves, muddy areas, etc. by poachers in Florida when they suspected wildlife officers around (Eliason 2008) and the stashing of drugs and

shifting of word usage by street sellers to avoid being detected and arrested by police officers in US cities (Johnson and Natarajan 1995; VanNostrand and Tewksbury 1999).

The use of mobile phones to facilitate poaching and avoid detection revealed in our study is similar to the misconduct by corrupt rangers who inform poachers about the whereabouts of animals to assist them to avoid being detected by the anti-poaching patrols in Uganda's Queen Elizabeth National Park (Braga et al. 2014). We suggest that our study extends the literature on wildlife conservation by illuminating on the hidden strategies by poachers that may have been complicating the war against poaching and thus contributing to the continued supply of the wildlife products to the illegal wildlife markets.

The nine strategies employed by the poachers to evade detection and arrest by rangers, which are adapted according to situation and times, are broadly similar to the strategies used by crack dealers to commit social crimes reported elsewhere in the USA (Johnson and Natarajan 1995; VanNostrand and Tewksbury 1999). Such strategies essentially undermine the effectiveness of conventional anti-poaching patrols in protected areas. The information from the arrested poachers and ex-poachers revealed that poaching is a risky undertaking, sometimes posing a threat to life. Notably, the fears of apprehension by the rangers and, subsequently, imprisonment were the most critical issues that were driving poachers to exercise great vigilance when conducting illegal activities in the protected area. This reality supports results from previous studies in the Serengeti ecosystem. According to Knapp (2012), poachers remained in a hideout for about 88% of their time on a day when detected by patrol rangers and would exit the park immediately after the rangers left. The remaining 12% of the time was spent fearing other life-threatening cases such as dangerous animals (lion and elephant).

In this study, views from the ex-poachers suggested that during a poaching trip, poachers confront several challenges including extreme weather conditions in the wild, walking long distances to access suitable hunting sites in the protected areas, risk of being attacked by dangerous animals, risks of being injured or killed when collecting snare-trapped animals, and being caught by the park rangers. These challenges may suggest that illegal hunting is a great burden to a poacher. This prompts an important question on why poachers still participate in poaching despite these challenges.

Analysis on the impact of illegal bushmeat hunting on the wildlife population indicated that the total economic benefits to an individual poacher engaging in illegal hunting twice a month is far greater than benefits derived from other livelihood activities (Rija 2017). Similarly, a study by Knapp (2012) showed that earnings from the illegally obtained bushmeat in western Serengeti villages were three times greater than those generated from other alternative sources of income. If this holds true for most poachers around the Serengeti ecosystem, then the hidden strategies revealed in the present study may help to explain why poaching is such a persistent problem in this ecosystem.

The adaptability of poaching strategies may be attributed to three reasons. First, the fears of being apprehended and the high costs associated with it force poachers

to adapt to specific strategies that will minimize chances of being detected by the rangers. Supporting this, Knapp (2012) found that poachers who have been arrested and sentenced to jail incurred high losses of their previously accumulated money and properties (e.g., cow, farmlands, etc.) and experienced significant deterioration of their household welfare following their absence at their homes. In our study, this situation was mentioned as the worst consequence one could encounter.

The second reason poachers adopt special strategies to evade detection can be attributed to an increased anti-poaching patrol efforts in protected areas in the Serengeti ecosystem. Although in a longitudinal study, Hilborn et al. (2006) reported increased anti-poaching resources and patrols to have been responsible for the recovery of previously poached large wild herbivores, but poaching for bushmeat did not stop in the period under investigation (Campbell and Hofer 1995; Loibooki et al. 2002). The increase in anti-poaching efforts does not necessarily lead to improved deterrence because poachers can change the location of activities based on the ranger patrol routine (Moreto and Lemieux 2015). This is a strategy that has been reported in social criminology, particularly among street crack dealers in New York, following deployment of police crackdowns (Johnson and Natarajan 1995). In Nyungwe National Park, Rwanda, for example, poaching incidences have been observed to increase in zones that were not frequently patrolled (Moore et al. 2017), or during times when the game rangers were not working such as public holidays. In the Serengeti ecosystem, poaching incidences were found to increase as a result of distracted patrols due to high tourism activities (Rija 2017). This suggests that poachers substantially adapt or simply displace their hunting strategies to suit local situations and to sustain the bushmeat supply to the illegal wildlife markets.

Third, the "middlemen" involved in the illegal bushmeat trade may have been driving the rapid use of new poaching tools. In our interviews with the ex-poachers, it was confirmed that some of the motorcycles used in poaching were not owned by the illegal hunters but were acquired from middlemen involved in the illegal bushmeat trade cartels. Similarly, one of the ex-poachers confessed to have previously received financial support from middlemen for food supplies and ammunitions in order to hunt elephant illegally for ivory. These schemes underscore the complexity of the problem and the necessity of developing a multipronged strategy to tackle these wildlife crimes afield.

7.5 Recommendations

Knowledge on how the poachers operate when carrying out illegal hunting in protected areas is crucial if the conservation authorities are to effectively curb this crime. The information presented in this chapter could inform field rangers and wildlife managers as they seek to improve the conventional patrol strategies and increase detection and poaching deterrence. We offer the following options for consideration as steps toward improving the performance of the current law enforcement practices.

First, ranger effectiveness needs to be improved through retooling the parks' anti-poaching programs with necessary equipment such as night vision goggles, patrol vehicles, and construction of observation points. The presence of this equipment will improve the detection of poachers who employ night ambush and animal-cut strategy. Although the spatial distribution of poaching is currently widespread across all protected areas in the ecosystem, some protected areas receiving disproportionately low patrol efforts have been targeted more frequently (Rija 2017). This suggests that poachers modify their activities in the Serengeti ecosystem to adapt to the distribution of the ranger patrol efforts. For example, there are significantly more anti-poaching resources (i.e., funds, equipment, rangers per unit area) in the Ikorongo and Grumeti Game Reserves than in Serengeti National Park and Maswa Game Reserve. Thus, poachers tend to hunt more frequently in the latter two protected areas (Rija 2017). Reducing poaching across the protected ecosystem will require investment in terms of equipment to reduce the possibility of displaced poaching activities in areas which are accorded low efforts in patrol.

Second, systematic monitoring of illegal activities to improve patrol effectiveness in the protected area is vitally important. In most of the protected areas, conventional patrol practices are based on routine and *ad hoc* patrols that are seldom informed by previous poaching events. Due to inadequate rangers and vehicles, such patrols often tend to concentrate on the same areas of the parks, predominantly in sites close to ranger stations, leaving other areas unattended (Plumptre et al. 2014). Consequently, poachers take advantage of this to adapt and target the minimally patrolled areas for their criminal acts. We recommend improving the current patrol practices in protected areas by making them more systematic and by ensuring that data on poaching behavior are collected using known methods to inform the planning of future anti-poaching patrols. For example, the protected areas' anti-poaching programs could adopt the use of transect surveys in their plans for collection of systematic data each month. When patrols are conducted following systematic methods over a long term, rangers could generate data which could inform anti-poaching programs and improve effectiveness of the patrols. Such data have been shown to significantly increase poaching deterrence in a Ugandan park (Critchlow et al. 2016).

Third, there is a need to increase integration of intelligence-led patrols into the anti-poaching programs in all protected areas to improve deterrence. The aim of the anti-poaching activities is to deter and prevent poaching and save species from catastrophic decline caused by poaching. However, rangers can only achieve this goal if they are linked with the intelligence work to detect illegal plans and intercept them before killing of animals occurs. This is particularly important given the adaptability of the poachers to numerous strategies, the distinct possibility of the poaching events going unnoticed, and the very low snare detectability by the rangers in this ecosystem (Rija 2017).

There appears to be an unutilized opportunity of linking intelligence work with the protected areas' outreach programs to allow for more targeted outreach activities that are even more effective to conservation. For example, in our interviews, the ex-poachers challenged the current outreach programs focusing on provision of

social services, such as classrooms and dispensaries, as a strategy of encouraging local communities to support wildlife conservation efforts. While these services improve peoples' welfare in the villages, the ex-poachers perceived this approach to bear minimal impact on conservation, particularly in reducing the number of people engaged in poaching. The approach is criticized for failure to address the real problem that drives poaching, i.e., poverty and limited livelihood options. The outreach programs should, therefore, be targeted to convert individual poachers (the poaching community) into pro-conservationists by providing them with sustainable economic alternatives. Other studies have also challenged the approach citing it as one of the major flaws in many community-based natural resources management programs (Kideghesho 2006; Songorwa 1999; Gibson and Marks 1995).

7.6 Conclusion

This chapter has uncovered the hidden behavior and strategies of poachers that contribute to the persistence of illegal bushmeat hunting in the Serengeti ecosystem. The information presented here is important to both field rangers and wildlife managers and to the researchers interested in spatial distribution of illegal activities in protected areas. By understanding the strategies used by the poachers, the rangers in the field will greatly improve their patrols, which in turn will improve detection of more infractions, and thereby improve poaching deterrence in protected areas. This information, together with the suggested strategies, will help to reduce the illegal bushmeat supply to the growing illegal wildlife market globally.

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Chapter 8
Community Governance of Wildlife Resources: Implications for Conservation, Livelihood, and Improvement in Democratic Space

Alex W. Kisingo and Jafari R. Kideghesho

Abstract The past three decades have seen increased involvement of communities in the governance of wildlife resources. In northern Tanzania, communities have been involved in wildlife conservation in a variety of ways, from the establishment of Community Wildlife Management Areas, establishment of conservation easements in village lands, to the establishment of land trusts and setting aside areas for wildlife based investments in villages. This chapter presents findings from a number of studies on community involvement in protected area governance in Northern Tanzania. The chapter adopts a V^3 leadership model in analyzing data from key informant interviews, focused group discussions, and a review of relevant documents in villages, districts, and community-based organizations (CBOs). The outcome of these initiatives, although not very impressive, does indicate a gradual change in some key aspects. In conservation, there have been increases in the sizes of land under conservation estate and a notable improvement in populations of key species. With regard to livelihood improvement, there are notable changes as some community members access both direct and indirect employment from wildlife-based organizations and enterprises, as well as the involvement of community members in micro-finance enterprises and wildlife based entrepreneurship. With regard to social benefits, there is more empowerment for community members and more involvement in advocacy and voicing their concerns. This is highly attributed to the involvement and training they received in the establishment of wildlife conservation areas from land use planning to governance and leadership training. There are great achievements, but there are also some notable setbacks. Some notable setbacks include possibilities of power capture by elite groups, recentralization tendency, and inadequate financial management by community-based organizations that give room for corrupt practices and embezzlement.

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8.1 Historical Perspectives of Conservation in Tanzania

Conservation in Tanzania dates back to the pre-colonial period (before the eighteenth century) when traditional leaders controlled access to wildlife resources for their people. During this period, wildlife use was mainly done to provide meat to communities and some traditional objects like skins for chiefs and traditional dancers. Thus, things changed with the establishment of the "modern protected area concept," mainly during Germany colonial times. Like anywhere else in the global south, past establishment of PAs aimed at the perpetual preservation of the fauna without undue interference from natives' rights or their economic development (Hingston 1931). This approach has negatively impacted livelihoods of the people through forced displacement and denial of access to natural resources that are vital to human needs (McShane et al. 2011). It is estimated that over 85% of PAs establishments in Latin America and sub-Saharan Africa were associated with state expropriation of customary tribal lands, which involved dismantling of villages and exiling communities (Lockwood 2010; Veit et al. 2008; Hess 2001). In many areas of eastern and southern Africa, communities were excluded from their traditional ancestral lands and resources to pave way for establishment of wildlife protected areas to serve the needs and aspiration of white populations. In East Africa, pastoralists were disempowered, marginalized, denied their needs, and received unwelcome attention from wildlife management institutions (Sachedina 2008; Borrini-Feyaraband and Tarnowski 2005). In many areas, this disempowerment has resulted in many threats to the survival of wildlife and their habitats, including loss of support to conservation from communities, large-scale environmental degradation, encroachment, and poaching (Kisingo 2013). In addition to threats to conservation, this disempowerment resulted in many injustices to local communities that include loss of rights to ownership of wildlife resources and widespread poverty. It is these past histories that have resulted in PAs being associated with poverty among neighboring communities (Kisingo 2013).

8.2 Protected Areas and Community Governance of Wildlife

Protected areas establishment and management are considered a cornerstone of biodiversity conservation strategies (Gurung 2010). However, even with the establishment of protected areas in Africa, it is apparent that these areas cannot hold the entire resources required for wildlife, and therefore most wildlife resources are still located outside formal protected areas. With increased human population around

these areas, there are more and more challenges in managing wildlife outside protected areas with greater degrees of human wildlife conflicts in place. Tanzania has experienced challenges in managing wildlife resources outside formal protected areas as a result of dwindling capacity to finance the conservation sector, and increased human population, in particular close to wildlife rich areas. Such challenges led to the emergence of community-based natural resources management (CBNRM). CBNRM in Tanzania's wildlife sector took the form of Wildlife Management Areas (WMAs) aimed at conserving wildlife and deriving economic opportunities to neighboring communities. Today, scholars are debating on the success of the WMA concept in three main fronts, i.e., conservation, social empowerment, and socioeconomic development (Kisingo 2013). Establishment of WMAs and the fundamental shift in philosophy and perspective that this represents in Tanzania is a significant achievement (USAID 2013). However, according to TNRF (2011), the WMAs have fallen below expectations of many stakeholders where sufficient realization of promised socioeconomic benefits, democratic governance, and conservation outcomes are still far-fetched.

Some studies on WMAs have assessed their contribution to community livelihood (e.g., USAID 2013; Makupa 2013), while others have looked at different attributes of governance in some WMAs (e.g., Kisingo 2013; Robinson et al. 2012; Mwakaje et al. 2013). For instance, the nationwide evaluation of WMAs by USAID in 2013 found the main benefits of WMAs to include increased protection of ecologically important wildlife areas, increased financial benefits to central and local government authorities, more empowerment to communities through better frameworks to manage their lands, acquisition of legal user rights to wildlife resources, and some share of financial benefits being realized by villages from wildlife-based investments.

8.3 Governance Challenges in Community Wildlife Management Areas

Despite what is considered as benefits from establishment of WMAs, they are still faced with governance challenges. In a study by USAID 2013, some WMA leaders clung to power despite their poor governance practices, most WMAs lacked efficient recordkeeping, there was a lack of awareness on the part of villagers on issues on wildlife and WMAs, the establishment of WMA budgets were unrealistic and not based on planning or realistic analysis, and power was captured by elected community representatives rather than having it rest with the village councils. These findings support the findings by Kisingo (2013) that the establishment of a protected area as community based does not necessarily imply better governance outcomes.

When comparison was made for community perception of governance effectiveness in Wildlife Management Areas of Ikona and Makao, it was revealed that there was no difference to PAs under government agencies (Kisingo 2013). Community

perceptions on governance of a PA depend to a greater extent on their view of how their values and aspirations are realized, not just the governance model used. Some additional challenges identified by USAID (2013) include inadequate awareness of the WMA by villagers, and interference by government on issues at the jurisdiction of WMA leadership resulting in a setback in the devolution of wildlife-related decision-making authority. Other challenges include inadequate checks and balances for WMAs to prevent abuse of responsibilities and power by WMA leaders at the expense of communities; inadequate transparency and accountability among WMA stakeholders; incomplete devolution of responsibilities by government to WMA leadership, particularly for issues such as control of investments and allocation of hunting blocks within WMAs; co-optation by district governments; and lack of mechanisms for villages to withdraw from WMAs.

Despite the abundance of literature regarding WMAs, there is lack of studies that have holistically evaluated governance of WMAs with links to outcomes on social development, social empowerment, and conservation outcomes. Lack of such analysis makes it difficult to strongly identify the observed successes of WMA establishment and operations. It is a central point of proposition for this chapter that WMAs have improved community through social empowerment, such as the ability to deal with conflicts, promote understanding of basic rights, encourage understanding of roles and responsibilities of different actors, and support understanding of values and reason for conservation of wildlife and their habitats. This chapter employs a V^3 model in unpacking the outcomes of WMAs through a comparative study of villages around three WMAs of Burunge, Makao, and Ikona in Northern Tanzania. This chapter assesses the WMA governance based on three outcomes, namely, (1) social empowerment or bargaining power, (2) conservation, and (3) socioeconomic development.

8.4 Introduction to V^3 Framework

In analyzing the achievements of wildlife-based CBNRM in northern Tanzania, we adopted the use of a V^3 framework as proposed by the African Leadership University. Under this framework, leadership and governance is viewed from three angles: the first component is *value* that focuses on creating significant opportunities for all. This aspect emphasizes the need to capitalize on human decision-making, having in place opportunity minded approaches in conservation; the second component is *virtue* that emphasizes doing right by self, others, and the world by engaging in ethical decision-making, empathy, and care to others, while leveraging the diversity of other actors; the third component is *Vision*. Under *vision*, one is expected to see and be inspired by a better future through such aspects as creativity, boldness and risk-taking, and networking. Using a V^3 model, community involvement in conservation in the three Wildlife Management Areas has demonstrated mixed outcomes, particularly when one looks at conservation, livelihood, and democratic governance aspects.

There is a general agreement that WMAs have brought about improvement in democratic governance in participating villages. Leadership in WMAs is commonly seen as an elected body of representatives referred to as an Authorized Association (AA). The AA consists of representatives elected from WMA member villages. This is the decision-making body for WMA matters on behalf of all the people in member villages. Elections for AA members are conducted for most WMAs every 5 years, and a minimum of 30% of members must be women.

Establishment of WMAs require a great deal of preparation including preparing a village land use plan for each prospective WMA village, and decisions on how land should be allocated for conservation in their village lands alongside settlements, farming, and livestock grazing areas. This is followed by an application to the director of Wildlife for permits to start engaging in wildlife management. Once the permits are granted, inventories of wildlife resources in their areas are conducted, and a Resource Management Zone Plan is prepared that will serve as an interim management guide until the preparation of the General Management Plan is accomplished. AAs will need to elect leaders and have a constitution in place. Once all the requirements are met, the AA may apply for a User Right from the Director of Wildlife to use and conduct business dealings in wildlife. For all these processes, community members and elected leaders go through a number of awareness raising and capacity-building programs. Furthermore, their attendance to various meetings and workshops enlighten them on various issues such as their land rights and the resources therein.

Throughout the WMA establishment process, community members and leaders are provided with a variety of training, particularly on governance and management of conservation areas, financial management, and accountability. Such trainings are offered to village governments, WMA AA representatives, WMA AA Board of Trustees, and District Natural Resources Advisory Boards. Interviews with key informants in the three WMAs attributed considerable impacts due to the training on the way natural resources were managed. In Ikona and Makao, WMAs provision of books of accounts increased financial discipline and transparency in record keeping. Key informants state that improvement in governance has made villagers to question various issues concerning the WMA, a significant result in terms of empowerment. There is also an agreement that even WMA member villages have become more accountable with income accrued from WMA. However, this improvement is still in the low levels as there are still instances where funds are used for unbudgeted activities, and some WMAs books of accounts have not been audited for several years. There are important achievements, but there are also some notable setbacks. Some of these additional setbacks include possibilities of power capture by elite groups, a recentralization tendency by the central government by taking the previously devolved ownership and rights to themselves, and inadequate financial management by community-based organizations that give room for corrupt practices and embezzlement.

With regard to *virtue*, WMAs made conservation empathetic to the needs of local communities who would otherwise remain locked away from opportunities arising from utilization of wildlife resources. Several WMA member villages have

established a number of services that provide relief to local community members. Such services include construction of social infrastructures such as schools and health facilities, establishment of supporting funds for sponsoring students from member villages at various levels of education, and supporting burial services. These contributions, particularly in building social infrastructure, mean that community members were no longer required to contribute family income to social projects, allowing those funds to be used for other basic needs and investments at family levels. A lack of revenue reinvestment accrued from WMAs in economic enterprises remains a concern. This is an area that needs to be explored so as to bring about a multiplier for the funds accrued from conservation. Investing in economic enterprises that generate more income and employment for local communities is in line with the V^3 component of value because investment creates tangible benefits to the people by tuning into the markets and working to satisfy people's needs, wants, pains, and beliefs in order to begin creating value for them (www.alusb.com).

Furthermore, in the case of *value*, villages that are a part of WMAs are increasingly involved in livelihood improvement programs. WMA facilitating NGOs (e.g., FZS, Chemchem Foundation, Honey Guide Foundation, Nature Conservancy), investors, and local government authorities have invested a great deal of effort in improving income standards of community members. In the case of Ikona and Makao villages, involvement in micro-financing enterprises through Community Conservation Banks (COCOBA) has greatly increased the financial capacity of community members. In Robanda and Bonchugu villages, community members have over six groups per village with an average membership of 30. Such groups had in their circulation a capital of about 70 million TZS (equivalent to 30,000US$) by June 2018. This is a great support to community livelihood, as group members are able to get soft loans without the numerous bureaucratic procedures required from conventional banks. Financial empowerment is a tremendous asset in value creation for communities living with wildlife. Community-based conservation works well when villages and landowners are given rights over wildlife resources, thus potentially maximizing the value of wildlife in comparison to other land uses and ensuring that those people at the base of the pyramid (village level 100%) also benefit (Kideghesho et al. in press).

With regard to *vision*, many of the achievements are seen as long-term benefits to conservation and community livelihood. Much has been written about livelihood in previous sections, including involvement in micro-financing enterprises and wildlife-based entrepreneurship ventures and access to employment opportunities and availability of markets for local produce. With regard to conservation, the long-term vision is to maintain the integrity of particular ecosystems sustainably. With pending future WMAs, more areas have been set aside for conservation, thereby increasing the size of land under conservation (Kisingo 2013). Furthermore, WMAs have helped to reclaim areas that were previously used as dispersal areas and migratory corridors in particular ecosystems. For instance, there was a great concern that the Tarangire–Manyara Ecosystem was becoming fragmented as more and more human activities were blocking the migratory corridor for wildlife between the two

core protected areas in the ecosystem (i.e., Tarangire and Lake Manyara National Parks). However, establishment of the Burunge WMA has to a greater extent revived the corridor, and already there are more animals observed crossing between the two protected areas (Eustace et al. 2018). In the Serengeti ecosystem, areas that were previously used for livestock grazing are currently harboring sizeable wildlife populations that are already attracting investment in tourism-related business. This is a long-term vision achievement. In areas where wildlife was already decimated, we see increased populations of key species such as elephants, giraffes, buffalo, and lions (Kisingo 2013). Despite some challenges that include encroachment, poaching, spread of invasive species, and increased human–wildlife conflicts (Eustace et al. 2018), the involvement of communities in WMAs has greatly improved conservation outcomes.

In summary, the outcomes of WMA initiatives, although not particularly impressive, do indicate a gradual change in some key aspects:

- In conservation, there has been an increase in the sizes of land under conservation estate and a notable improvement in populations of key species.
- With regard to livelihood improvement, there are notable changes as some community members access both direct and indirect employment from wildlife-based organizations and enterprises, as well as community member involvement in micro-finance enterprises and wildlife-based entrepreneurship.
- With regard to social benefits, there is more empowerment for community members and more involvement in advocacy and voicing their concerns in various settings. This is highly attributed to the participation and training they received in the establishment of wildlife conservation areas from land use planning to governance to leadership training.

8.5 Conclusion

Success in community governance of wildlife resources is highly dependent on ensuring decision-making over these resources is vested within the communities. Success should ensure achievement of the three leadership facets of vision, value, and virtue in decision-making. Communities need to be involved in plotting the future of their areas and resources therein. This sort of involvement in northern Tanzania, despite various challenges encountered, has managed to improve aspects within these three facets: first, improved contribution of income accrued from wildlife to the livelihood of communities; second, the contribution it has had in reducing threats to wildlife, especially by adding on the size of land area under wildlife conservation; and third, improvement in democratic governance for communities participating in CBNRM.

CBNRM works well when villages and landowners are given rights over wildlife resources and potentially maximize the value of wildlife in comparison to other land uses, and also it ensures that this value reaches the people at the base of the pyramid

(village level 100%) (Kideghesho et al. in press). What must accompany this ownership is the proper governance of these rights to ensure that all those affected by conservation decisions make them appropriately, and therefore, avoiding a top-down approach to decision-making that comes from the past colonial era.

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Chapter 9
Land Cover and Landscape Changes in the Kwakuchinja Wildlife Corridor Adjacent to Road A-104, 2002 to 2017

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Abstract The Kwakuchinja Wildlife Corridor in northern Tanzania connects Lake Manyara National Park with Tarangire National Park. In 2005, an existing road was paved and raised to improve the connection between the towns of Arusha and Babati. However, the road's improvement may impact animal movement between the two national parks by providing a physical obstacle and opening up the area to more human settlements. This study examines satellite remote sensing data to estimate land cover changes adjacent to the road in a 50–2000-m buffer before and after the road was paved in 2002 and 2017, respectively. Classified maps were generated using Landsat 5 and Landsat 8 data, and a drone orthophoto was created to visualize accuracy of the 2017 classified map. Results indicate changes in both land cover and landscape metrics. While there were large increases in agricultural activity throughout the buffered area, bare ground or grass decreased from 50% to approximately 12%. All landscape metrics measured for the two dates—Shannon Diversity Index, Simpson's Diversity Index, Landscape Patch Index, and Patch Density—described a simpler and less aggregated landscape that may affect animal movement through the corridor.

Keywords Kwakuchinja Wildlife Corridor · Google Earth Engine · Landsat 5 · Landsat 8 · Land cover change

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9.1 Introduction

Wildlife corridors are essential to animal movement. Corridors assist the movement of animals through dangerous or inhospitable lands and facilitate continuity between isolated populations (Bennett et al. 1994). Further, corridors help in dispersal and movement of individuals between different habitats for breeding, shelter, food, and other activities (Yadav et al. 2012). Wildlife corridors are often at risk due to increasing human population and land cover conversion from natural landscapes to other kinds of land cover, such as agriculture, to meet the growing demand for human food production (Khanna et al. 2001; Yadav et al. 2012). This is true in Tanzania where the country is experiencing rapid changes in its human population structure and economy (Wynants et al. 2018). Decreasing forests and grasslands and additional land cover changes create daunting challenges for wildlife (Khanna et al. 2001).

Tanzania is well known for its substantial diversity of plants and animals that exist in a large variety of habitats. This diversity is protected through an extensive network of national parks and other conservation areas throughout the country (Stanley et al. 2007). Tanzania's Kwakuchinja Wildlife Corridor (KWC) connects Lake Manyara National Park to the north and west with Tarangire National Park to the south and east. The animals migrate seasonally between the two parks. Increased agricultural and mining activities in the corridor are gradually impeding traditional migration routes and areas (Mwalyosi 1991). Conflicts between humans and wildlife arise in these areas because animals destroy crops as they move through their traditional routes. The KWC has experienced a substantial amount of land cover/land-use conversion (Martin et al. 2019). This conversion is in part the result of the paving and elevating of road A-104 that connects towns of Arusha and Babati. In many developing countries, wildlife conservation is of little interest to rural populations, and many conservation areas have survived simply because they are located on less desirable lands (Mwalyosi 1991). However, road construction and other events may open up these lands to new development. Further, as human population continues to increase, even the most marginal lands will probably be settled by humans (Mwalyosi 1991).

Remote sensing data and techniques coupled with Geographic Information Systems (GIS) provide useful tools to generate valuable information about land cover and land-use change. In northern Tanzania between 1998 and 2016, Landsat remote sensing data have been used to examine land cover in the region to find areas of soil erosion risk (Wynants et al. 2018). Many other studies have implemented remote sensing to study wildlife corridors. Nandy et al. (2007) used Landsat data to assess the Chilla–Motichur wildlife corridor in Rajaji National Park in India. They estimated substantial corridor loss between 1972 and 2005. Another study in central India (Yadav et al. 2012) used Landsat to study the Nagzira–Navegaon corridor. The study found multiple land cover changes within the corridor between 1990 and 1999. Bergl et al. (2012) studied potential habitat and dispersal corridors of the critically endangered Cross River gorilla (*Gorilla gorilla diehl*) in Nigeria using Landsat 7 data. The authors found additional forested areas where River Gorillas may be supported provided anthropogenic pressures are reduced. Khanna et al. (2001)

examined corridors in the Rajaji-Corbett Elephant reserve with Landsat and Indian Remote Sensing satellite data. The authors found that corridors within the reserve were used and degraded rapidly by activities such as cattle grazing.

9.1.1 Hypothesis and Objectives

Martin et al. (2019) demonstrated that land-use/land cover change and analysis can be determined using open source or otherwise "free" applications and datasets by examining changes in the KWC from 2002 to 2017. This study used the same land cover data. However, the chapter only examines the changes from 50 to 2000 m around road A-104 or the areas where most human modification of the corridor would probably occur, and not the entire area of the corridor in the context of a from-to change analysis and landscape metrics. The chapter seeks to explain the amount and kinds of change—including the structure of the changes—in the vicinity of the road. The chapter is built on the working hypothesis that land cover adjacent to road A-104 in the KWC has changed, and that these changes can be measured using satellite remote sensing data and techniques. Further, the landscape structure surrounding A-104 has changed and these changes can be measured using landscape ecology metrics.

9.2 Methods

9.2.1 Study Area

The KWC serves as the principal wildlife corridor between Tarangire National Park to the east and south and Lake Manyara National Park to the north and west (Fig. 9.1). The main land uses in the area are agriculture, pastoralism, mining, and wildlife conservation (Mwalyosi 1991), and the area is home to at least three ethnic groups in five subvillages (Hariohay and Roskaft 2015). Natural vegetation in the corridor consists of woody scrubland, grasslands, and woody savanna. KWC is a corridor for many large mammals, including endangered African elephant (*Loxodonta africana*) (Caro et al. 2009; Jones et al. 2012; Hariohay 2013 (Fig. 9.2), cheetah (*Acinonyx jubatus*), leopard (*Panthera pardus*), black rhinoceros (*Diceros bicornis*), and many others (Shemweta and Kideghesho 2000; Caro et al. 2009; Hariohay 2013; Martin et al. 2019). The corridor is split by the road, A-104, that connects the city of Arusha to the north and the town of Babati to the south. Arusha is the capital of the Arusha region and the gateway town for the northern Tanzania Safari Circuit, while Babati is the capital town for Manyara region and strategically located to other major towns such as Singida and Dodoma. A-104 was paved and elevated in 2005 causing increased and faster traffic and providing more opportunities for human encroachment (Fig. 9.3).

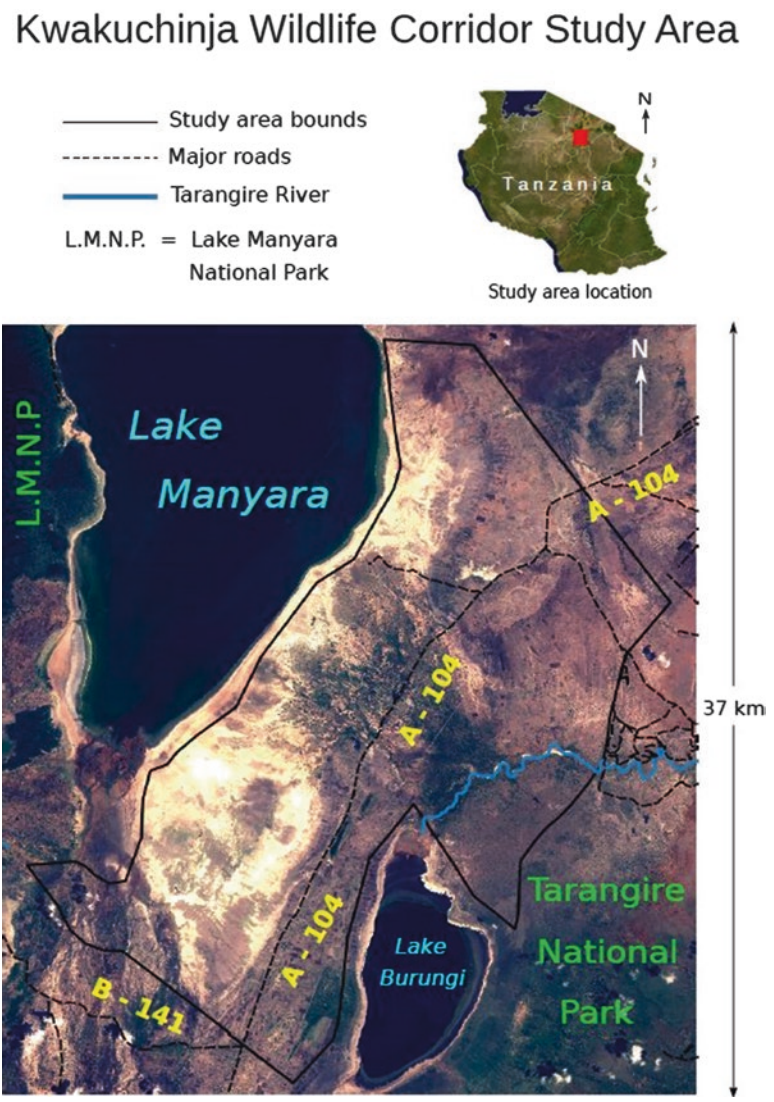

Fig. 9.1 Map of the study area

Fig. 9.2 The red arrows point to endangered African elephant footprints located approximately 75 m west of road A-104. (Photo by R. Jensen in May 2018)

Fig. 9.3 Road A-104 that divides the Kwakuchinja Wildlife Corridor. The road was paved and elevated in 2005. (Photo by R. Jensen in May 2018)

9.2.2 Remote Sensing Data

Many satellite-based remote sensing imagers provide data with adequate spatial resolution for examining land cover changes (Gillanders et al. 2008). Two of these sensors satellite imagers are Landsat 5 and Landsat 8 that were used to classify land-use/land cover data for this study in 2002 and 2017, respectively. The Landsat 5 satellite was launched 1 March 1984 by the United States' National Aeronautics and Space Administration in a circular, sun-synchronous orbit at an altitude of 750 km. It images all of Earth every 16 days with the thematic mapper (TM) sensor. TM images with seven multispectral bands in the following regions of the electromagnetic spectrum: blue, green, red, near infrared, shortwave infrared 1, shortwave infrared 2, and thermal infrared. The spatial resolution of all bands, except for the thermal infrared band, is 30 m. The swath width (footprint) of TM data is 185 km (USGS 2019). The Landsat 8 satellite was launched 11 February 2013 on an Atlas-V 401 rocket. It images in 11 bands including blue, green, red, near infrared, two shortwave infrared bands, two thermal bands, a panchromatic band, a coastal/aerosol band, and a cirrus band. The blue, green, red, near infrared band, shortwave infrared bands, coastal/aerosol, and cirrus bands each have a spatial resolution of 30 m. The panchromatic band has a resolution of 10 m and the thermal bands have a resolution of 100 m (NASA 2019).

All bands except for the thermal, panchromatic, coastal/aerosol, and cirrus bands were used in the analysis. Both the 2002 and 2017 datasets were classified using Google Earth Engine and an Isodata unsupervised classification procedure. Initially, between 10 and 15 clusters were computed and then aggregated to account for actual land-use/land cover classes common to the two dates. Land-use/land cover classes for each date were inclusive in the following classes: bare ground and sparse vegetation, mixed woody savanna with some agriculture, agriculture with some grassland, and woodland.

A 50–5000 m buffer was created around A-104. Fifty meters was determined sufficient to reduce the impact of the road itself and the immediate shoulder area around the road. Two thousand meters was determined because there is generally very little human impact beyond 2 km from the road. Land cover was extracted and analyzed within this buffer.

Drone data were acquired with a DJI Mavic Pro on 26 January 2018 over an area of the corridor that was considered to be representative of relatively natural corridor area. This area was inclusive of the College of African Wildlife Management field camp in the corridor. A total of approximately 225 georeferenced images were acquired 121 m above ground level during the drone flight. These images were then processed to create an orthophoto and digital surface model in Pix4D. The orthophoto provides an additional perspective on the classification and its accuracy. In addition, it provides a different perspective from overhead imagery to visualize the landscape.

9.2.3 Landscape Metrics

After the classified maps were generated and the area within the buffer zone was extracted, the buffer areas were converted to GeoTiffs for landscape metric analyses. The landscape metrics were calculated using Fragstats, a free program provided by the University of Massachusetts that calculates a large variety of landscape metrics to examine spatial patterns (Fragstats 2019). Several landscape metrics were calculated to determine landscape structure for both years: Shannon Diversity Index, Simpson's Diversity Index, Landscape Patch Index, and Patch Density.

Shannon Diversity Index accounts for abundance and evenness of the different patches present in a landscape. Shannon's Diversity Index (SDI) values equal zero when the landscape has only one patch and increase as the patch types increase and/or patch evenness increases (UMASS 2020). Simpson's Diversity Index (SiDI) is another measure of diversity that accounts for the number and abundance of patches in a landscape. Like SDI, SiDI values equal 0 if the landscape contains only one patch. SiDI values increase to 1 as patch types and patch evenness increase. The Landscape Shape Index (LSI) increases from 1 as the various patch types in the landscape become disaggregated. Patch Density (PD) is equal to the number of patches in the landscape divided by the total landscape area. Interspersion Juxtaposition Index values are close to 0 with the distribution of landscape patch adjacencies becomes uneven.

Classified remote sensing data have been used to calculate landscape metrics in a variety of settings. Ji et al. (2006) determined forest fragmentation using temporal Landsat data. Fichera et al. (2012) used landscape metrics to better understand land cover and landscape changes while linking them to natural and social processes following the Irpinia earthquake in 1980. Lung and Schaab (2006) used landscape metrics and multi-date remote sensing data to examine fragmentation and disturbance in the west Kenyan rain forests.

9.3 Results and Discussion

9.3.1 Land Cover Changes in the Buffer Area

Bare ground and sparse vegetation made up about half of the land cover in 2002 (50.32%). In 2017, 22% of this area remained the same, while 51% was converted to mixed woody savanna with some agriculture, and 27% was converted to Agriculture. Mixed woody savanna with some agriculture accounted for 18.27% of the landscape in 2002. The majority of this land cover type remained the same in 2017 (64%). Approximately 27% of this area was converted to agriculture, 6% to bare ground, and 2% to woodland. Areas classified as Agriculture in 2002 consisted

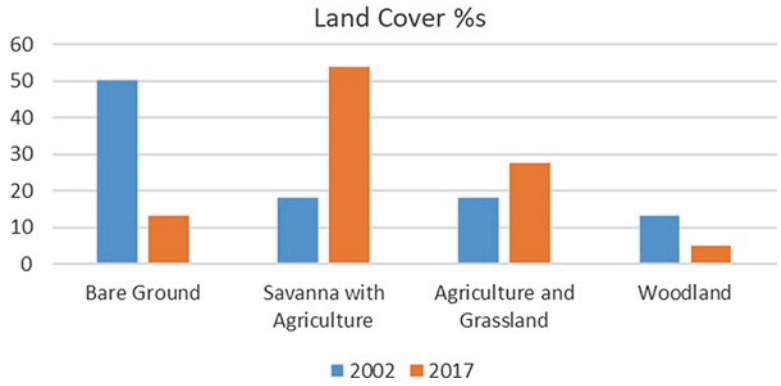

Fig. 9.4 Land cover percentages in 2002 and 2017

of 18.29% of the total landscape. Of these areas, approximately 47% remained agriculture and 51% was converted to mixed woody savanna with some agriculture. Finally, only 13% of the landscape was classified as woodland in 2002. About 55.19% of this area was converted to mixed woody savanna with some agriculture, 34% remained woodlands, 6% was converted to bare ground and sparse vegetation, and 4% was converted to agriculture. Figure 9.4 shows the percentages for both years in every category.

Perhaps the most concerning change between the 2 years was the increase of agricultural areas in the buffer area. Both savannah with agriculture and "agriculture and grassland" increased indicating that general agriculture activity increased throughout the study area. Further, woodland area decreased between the two dates. Increased agriculture and decreased woodland may cause decreased animal movement throughout the corridor.

9.3.2 Drone Data

The drone data acquired in January 2018 matches well with the 2017 land cover classification as visualized in Fig. 9.5. The areas classified as woodland forest in the classified map overlay with the woodland forest areas on the orthophoto. Further, mixed scrub/shrub woodlands line up those areas on the orthophoto.

9.3.3 Land Cover Metrics in the Buffer Area

The land cover metrics were also different between 2002 and 2017. Patch density decreased from 66.4 to 41.4 indicating that the number of landscape patches decreased or that patches became larger and/or more contiguous. This is consistent

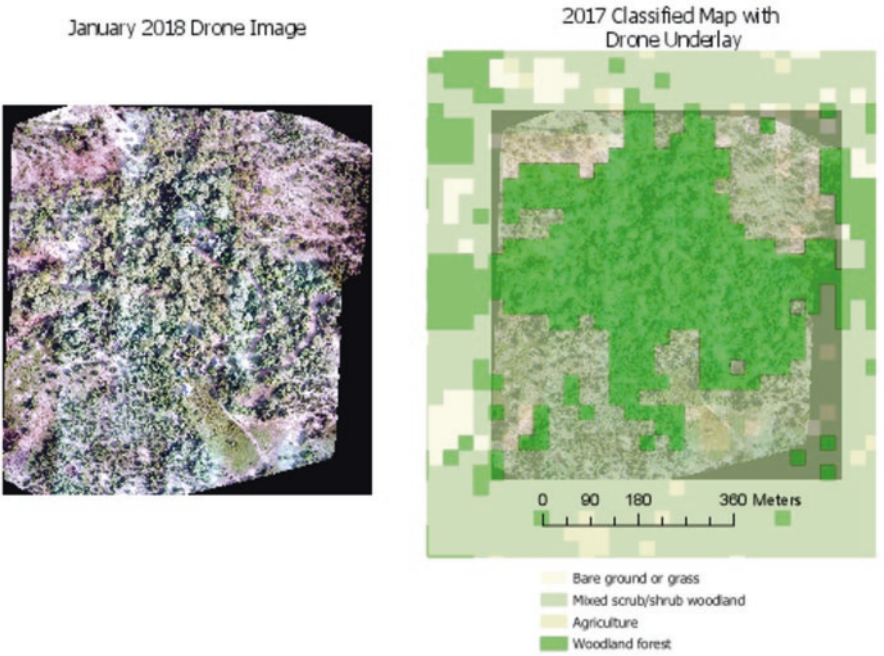

Fig. 9.5 Comparison of the drone image acquired in January 2018 and the 2017 classified map

with the landscape becoming more simple or homogeneous and is probably indicative of human alteration of the landscape. Landscape shape index also decreased from 46.4 to 38.4. This indicates that the landscape was more disaggregated in 2002 than in 2017. Shannon Diversity Index decreased from 1.23 to 1.12. This is another indicator that the landscape was more "uneven" in 2002 than in 2017. The same conclusion can be made from Simpson's Diversity Index decrease from 0.66 to 0.62 and Interspersion Juxtaposition Index decreased from 87.2 to 66.8.

Each of the land cover metrics indicates a more complex and uneven landscape in 2002 than in 2017. The lack of complexity—and its accompanying relatively large patch sizes—may hinder animal movement. This may especially be the case when animals rely on varying types of land cover and landscape shapes as they traverse the corridor.

9.4 Conclusions

The KWC has experienced a substantial amount of land cover and landscape changes adjacent to road A-104 between 2002 and 2017. These changes were discovered by examining land cover and land cover patterns 2 km around A-104. The most significant land cover changes were from bare ground to "savanna with some

agriculture" and "agriculture with some grassland." Several landscape metrics were also calculated for the area with values generally indicating a more even or homogeneous landscape from 2002 to 2017. These kinds of landscape structural changes are indicative human activities that homogenize flora and fauna (Olden 2006). However, as more people enter into the corridor and they become less reliant on the land for their livelihoods, patch boundaries throughout the corridor will probably become even less distinct (Forman 1995). As time passes, the local economy diversifies, and residents become less dependent on the land, land cover and landscape structure will almost certainly become more homogenized throughout the KWC (McKinney 2008).

This study has demonstrated that remote sensing data and techniques and landscape metrics can be used to study land cover and landscape change in the wildlife corridor through time. These same types of methods may be used to study other wildlife corridors and other areas throughout the world.

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Chapter 10
Dry Season Wildlife Census in Mkomazi National Park, 2015

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Abstract Transect lines were laid down in Mkomazi National Park for the wild animals ground count exercise. This technique is applied as a ground truth of population density of animals. Forty transects were set to represent all major habitats, including grasslands, woodlands, forests, shrub land, scrubland, and riverine. Program DISTANCE was employed for data analysis. Normal cosine function was applied without any truncation from which mean population densities of each species were calculated separately with standard errors, encounter rate, and detection probability. A total of 22 species mean population densities were estimated, whereby African buffalo (*Syncerus caffer*) was leading, while gerenuk (*Litocranius walleri*) was the least. The Park is well protected at the core zone; however, areas close to boundaries are facing frequent disturbances from humans. Since some species of animals such as large carnivores and elephants were not observed, camera traps should be used to estimate carnivore population, whereas dung counts can be used to estimate elephant density. Continual investment in anti-poaching operations by managers is important to keep safeguarding habitats for wildlife. We recommend the use of these results as a benchmark for future population estimates, and these 40 transects be regarded as standard in future counting.

Keywords Terrestrial mammals · Somali-Maasai · Zanzibar-Inhambane · DISTANCE

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10.1 Introduction

Assessment of the population status of biota is necessary for proper application of different management approaches. Wildlife inventories are important for resource monitoring, management planning, trend analysis, future prediction, and assessment of habitat carrying capacity (Buckland et al. 2004). Objective wildlife inventories require reliable and up-to-date analytical methods to determine population density, status, and distribution. Animal census was conducted on March 2015 in Mkomazi National Park to determine wildlife population densities. The Park is known for its unique habitats composed of a mosaic of vegetation and landforms that are crucial for supporting a range of remarkable and unique species of wildlife. The Park, located in northern Tanzania and sharing borders with Tsavo West National Park in Kenya, represents a transboundary wildlife management whereby two countries share knowledge, challenges, and experiences in conservation. Administratively, Mkomazi National Park falls in Kilimanjaro and Tanga regions and is located at latitude 4° 11″–4° 25″ South and longitude 37° 41″–38° 45′ East. It is composed of areas of the former Mkomazi and Umba Game Reserves.

Mkomazi National Park has a complex history with periods of vast exposure to human disturbances during the game reserve era to the current highest protection status under the national park regime. At the time when the area was under the game reserve conservation category, poachers, pastoralist, and other illegal users of resources highly impacted the site causing major changes in resources (Coe 1999). These changes in resources included decimated wildlife species population, changed animal behavior, and deterioration in vegetation with visible signs such as bare land, erosion, and invaders, just to mention a few. This caused park stakeholders to propose a change in conservation status to a national park. The current parks' wildlife population is a function of the changes in management regime. Forests, woodlands, grasslands, shrublands, and scrublands are among the vegetation types in the park that in turn influence wildlife population sizes and distribution. To augment the changed management regime, artificial watering points in the form of waterholes were excavated for water supply during dry season. Today, it has become a common phenomenon to encounter huge concentrations of animals around these water points during dry season.

Mkomazi National Park lies in a transitional zone between Somali Maasai Regional Centre of Endemism and Zanzibar-Inhambane Coastal Forest Mosaic. Similar to comparable areas, the Park receives a bimodal rainfall pattern with the short rains from October to December and the long rains from March to May. The Park receives a highly varied average rainfall between 300 and 1500 mm per annum, largely as an influence of a large variation in park altitude, i.e., between 630 and 1594 m above sea level (Coe 1999). Apart from rainfall, mean annual temperatures in the park are also largely determined by altitude, with mean minimum temperatures between 9.4 and 17.5 °C and mean maximum temperatures between 29 and 37.8 °C.

10.2 Methodology

Before engaging in actual data collection, 40 line transects were planned in the park with their starting and ending GPS coordinates recorded (Appendix 2). These transects were designed to take into account all habitats in Mkomazi National Park (Fig. 10.1). Forty transects were thought to be versatile enough to maximize census intensity, and thus increase accuracy in density estimates. Use of relatively large sample sizes is recommended in areas of low encounter rate of wildlife (Plumptre 2000). Transect lines ranged from 5 to 15 km long. Transects were set in representative areas based on their accessibility. This sampling design is a good compromise between methodological and implementation constraints and should allow for reliable estimates of wildlife population abundance (Gaidet et al. 2003). Transect widths were not fixed during counting since program DISTANCE, which was used for data analysis, requires each perpendicular distance to be determined accurately at the time of animal sighting. To avoid recounting, we collected all transects data within 2 days. This requirement led to the use of 60 people to cover 20 transects per day, with field technical supervisors working closely with park management.

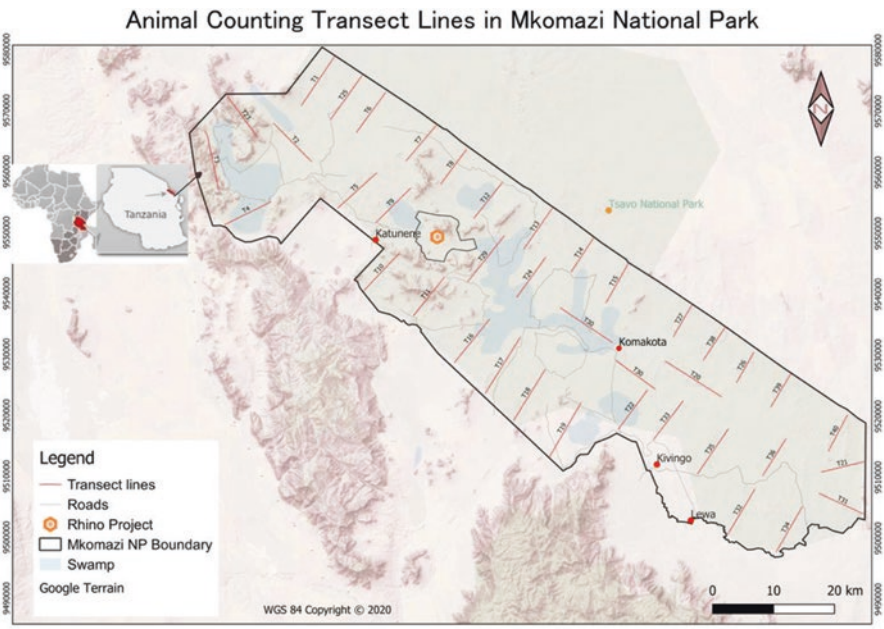

Fig. 10.1 Transect layout map of Mkomazi National Park for 2015 ground counting

10.3 Data Collection

Data collection was done on March 7th and 8th in 2015, with a team of three people walking a single transect line each day. The counting crew in each transect was composed of one transect cutter, a data recorder, and an armed park ranger. However, during counting, all members of the team participated in the exercise. This helped in using the knowledge and experience of each member of the counting team. A series of trainings were conducted by an expert before actual counting. Training included the use of equipment, field conditions, endurance, leadership, and wilderness skills. Furthermore, orientation to various measurements and estimation techniques, first aid, and identification skills were imparted to counting crew.

We utilized the morning hours during wildlife counting in Mkomazi National Park when wildlife is active and when there is a high chance of encountering animals. From the camping site at Maore, it was simple to distribute 20 teams to the southern part of the Park during day 1 and to the northern part during day 2. For the said team, the distance used for data analysis is the actual distance covered by the counting team.

The counting team walked quietly along the transect stopping whenever animals were observed. This was necessary in order to conform to one of the program DISTANCE assumptions that animals do not respond to inventory teams before they are detected. In each transect, the starting time and ending time were recorded with the distance from the transect base whenever a species was spotted. Perpendicular distances from the transect line to the observed animals, number of animals seen for each species, the habitat in which the animal was seen, GPS coordinates at the observation point, weather conditions, group characteristics where applicable, and any other comments related to wildlife were recorded at each observation point. However, before resuming day 2 counting, a debriefing exercise was conducted and teams shared experiences while reporting counting progress, successes, and challenges during the first day.

10.4 Data Analysis

We used the program DISTANCE version 6.0 (Thomas et al. 2010), which is a free software, to estimate the density of all animal species identified. Program DISTANCE was selected due to its robust nature in estimating populations and providing results and interpretation better than manual computation (Thomas et al. 2010). Program DISTANCE assumes that (a) objects directly on the line or point are always detected, i.e., ($g(0) = 1$) (Fig. 10.2); (b) objects are detected at their initial location prior to any movement in response to the observer; and (c) distances are measured accurately. Raw data from the field was typed into an excel data frame following the DISTANCE recommended file format. Data were explored as recommended by Buckland et al. (1993) using histograms of detection probability versus

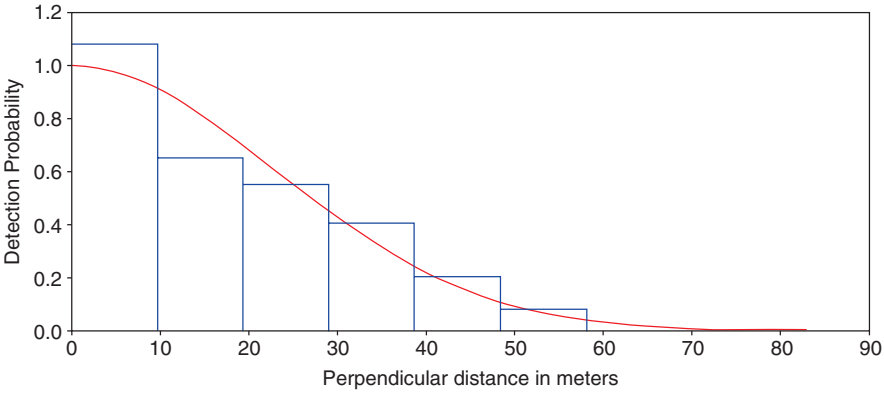

Fig. 10.2 Association between detection probability (g(0)) and perpendicular distances in program DISTANCE. The figure shows that at distance 0 from the transect line, detection probability = 1

perpendicular distance in (m) to determine whether to truncate for outliers and improve estimates of detection function g(0), and to analyze candidate models and choose the best-fit model of the detection function. There were no outlying observations in the data; hence, we did not truncate. We used half normal cosine function in DISTANCE 6.0 and selected the best model based on Akaike information criterion (AIC) values (Akaike 1973). Data presented are mean population densities per square kilometer, detection probabilities, and encounter rates with their associated 95% confidence limits.

10.5 Results and Discussion

We managed to count 22 species of wild animals in 40 transects in Mkomazi National Park, including ungulates, carnivores, lagomorphs, and reptiles. Some species were repeatedly observed, while others had limited observations. We covered a total of 326.35 km for all transects, and all transects were included in each species analysis. Some animal species such as African lions, leopards, wild dogs, elephants, and waterbuck were not encountered. This must be carefully interpreted, since missing a species cannot be understood as a conclusion of species absence. Detailed results for each species are presented below.

10.5.1 Ungulates

10.5.1.1 Lesser Kudu (*Tragelaphus imberbis*)

This is a symbolic species in Mkomazi National Park. Although it is popularly known to have low numbers in other protected areas in Tanzania, results from this counting indicate that the density of Lesser Kudu in Mkomazi is 1.198 ± 0.510 animals per square kilometer at a detection probability of 3.9 and encounter rate of 96.1. This number is relatively stable as Lesser Kudu are mostly found in woodlands.

10.5.1.2 Giraffe (*Giraffa camelopardalis*)

There were 1.165 ± 0.808 giraffes per square kilometer in Mkomazi National Park, mostly distributed in *Acacia* woodlands. Detection rate of this species was 7.1 with an encounter rate of 92.9. As per analysis, there were enough observations to guarantee reasonable results. Although not every habitat of the Park is utilized by this species, it seems to be well protected.

10.5.1.3 Eland (*Tragelaphus oryx*)

Results show Eland density of 0.728 ± 0.399 per square kilometer, detection probability of 1.5, and encounter rate of 98.5. This animal is among very important megafauna and an important grazer in the Park. Their grazing in this ecosystem is an excellent deterrent for herbaceous vegetation by controlling fuel load and reducing fire intensities. This species was encountered in large herds of up to 30 individuals, and seems to be well protected.

10.5.1.4 Cokes Hartebeest (*Alcelaphus buselaphus*)

Although not uniformly distributed in the Park and skewed toward open grasslands, Cokes Hartebeest density was pegged at 0.748 ± 0.426 animals per square kilometer. These animals are highly sensitive to human approaches, hence the need to maintain large distances. The species had an encounter rate of 96.5 and detection probability of 3.5. However, this species population seems to be well protected in the Park.

10.5.1.5 Kirk's Dik-dik (*Madoqua kirkii*)

In Mkomazi National Park, Kirki's dik-dik density was estimated to be 3.197 ± 0.664 per square kilometer at a detection probability of 17 and encounter rate of 83. This species is relatively small in size among ungulates, but an important species and stable in semiarid areas like Mkomazi National Park. The species also flourish well in human disturbed environments. Resources for this species in the Park are stable with less disturbance, hence supporting this high density of species.

10.5.1.6 Bohor Reedbuck (*Redunca redunca*)

The results reveal a density of 0.136 ± 0.106 bohor reedbuck per square kilometer in Mkomazi National Park. Detection probability for this species was 20 and encounter rate was 80. However, the number of observations was relatively small (i.e., 4 observations out of 40 samples). As a result, standard errors are inflated in this result. The secretive nature of this species and habitat selection behavior may explain this low number of observations.

10.5.1.7 Impala (*Aepyceros melampus*)

Impala density in Mkomazi National Park was estimated to be 0.135 ± 0.105 animals per square kilometer. The species was characterized by detection probability of 13.8 and encounter rate is 86.2. There were enough observations to guarantee authentic results in this analysis. This species prefers to utilize ecotones where there are enough resources for their survival. The species is limited to a few areas of the Park.

10.5.1.8 Plains Zebra (*Equus quagga*)

Results of this study revealed 1.626 ± 1.099 zebra per square kilometer at a detection probability of 2.6 and encounter rate of 97.4. This is a common species in open grasslands aggregating in large numbers. They are popularly known to associate with wildebeests, and they facilitate each other in feeding. However, in Mkomazi National Park as there are no wildebeest, the zebra appear to dominate the grasslands with scant observed association with Coke's Hartebeests. The population of this species seems to be healthy and well protected.

10.5.1.9 African Buffalo (Syncerus caffer)

Cape Buffaloes are among large grazing ungulates and are a prey base for large carnivores such as lions. The species utilize almost all habitats of the Park, and hence, they are highly visible in many areas. There were 3.247 ± 2.456 buffaloes per square kilometer at a detection probability of 19.2 and encounter rate of 80.8. Buffalo population is well protected and in good numbers. It is a very important grazer shaping savannah herbaceous plants in the Park.

10.5.1.10 Bushbuck (*Tragelaphus scriptus*)

Results show that there were 0.613 ± 0.654 Bushbuck per square kilometer with detection probability of 11 and encounter rate of 89. Observed number of this species was too small, hence, inflating the standard error. However, as per species habitat selection, the population is well managed.

10.5.1.11 Fringe-Eared Oryx (*Oryx beisa*)

The density of fringe-eared oryx was 2.072 ± 1.699 with detection probability of 4.8 and encounter rate of 95.2. The density seems to be high considering their conservation status. The species maintain very long flight distances. Mkomazi National Park as a semiarid area offers a perfect habitat for this species with enough resources and all other important habitat requirements.

10.5.1.12 Blue Duiker (*Philantomba monticola*)

Blue duiker density was estimated to be 0.306 ± 0.234 per square kilometer with an encounter rate of 63.3 and detection probability of 36.7. The number of observations, i.e., 4 out of 40 samples, signifies the reason for having large standard error.

10.5.1.13 Warthog (*Phacochoerus africanus*)

There were 0.354 ± 0.188 Warthogs per square kilometer at a detection probability of 11.4 and encounter rate of 88.6. Utilizing variable plant parts, these species flourish in many areas of the Park.

10.5.1.14 Bushpig (*Potamochoerus larvatus*)

The density of bushpig in Mkomazi National Park was estimated to be 1.1065 ± 1.1169 per square kilometer with an encounter rate of 99.1 and detection probability of 0.9. This species was only observed in one transect owing to their forested habitat preference.

10.5.1.15 Gerenuk (*Litocranius walleri*)

Gerenuk density was estimated to be 0.066 ± 0.032. Low level of observation, i.e., 5 observations out of 40 samples, might be contributed to their low numbers and limited habitats. Encounter rate of 81.7 and detection probability of 18.3 was also estimated by program DISTANCE.

10.5.2 Lagomorphs

10.5.2.1 Scrub Hare (*Lepus saxatilis*)

Scrub hare density was estimated to be 0.766 ± 0.452 with an encounter rate of 76.2 and detection probability of 23.8. Total observations were 5 out of 40 samples, also characterizing this as a low observation number. However, the habitat was observed to be suitable for them.

10.5.3 Carnivores

Only two species of carnivores were registered in Mkomazi National Park during this inventory. These were the Golden Jackal and the Banded Mongoose. Large carnivores such as African lions, hyenas, and leopard were not observed. The reason might be that counting was conducted during the day when most of carnivores are less active. However, hyenas and lions' calls and spoors were noted around the campsites and during transect walks. Other techniques for counting carnivores, such as the use of camera traps, need to be employed to ensure their detection.

10.5.3.1 Golden Jackal (*Canis aureus*)

There were 0.306 ± 0.321golden jackals per square kilometer at a detection probability of 11.4 and encounter rate of 88.6. The number of observation was too small, i.e., 2 observations out of 40.

10.5.3.2 Banded Mongoose (*Mungos mungo*)

Banded mongoose density was 1.149 ± 0.823 per square kilometer with an encounter rate of 95.1 and detection probability of 4.9. Deserted termite mounds provided good hideouts and important dens for packs of this species.

10.5.4 Primates

10.5.4.1 Vervet Monkeys (*Chlorocebus pygerythrus*)

Density of 0.204 ± 0.210 vervet monkeys per square kilometer was estimated in Mkomazi National Park. Detection probability for this species was 5.9, and encounter rate was 94.1. The number of observations was also very low, i.e., 4 observations out of 40 samples, increasing the standard error of the estimate.

10.5.4.2 Olive Baboons (*Papio anubis*)

Results of this analysis show that olive baboon density was 0.613 ± 0.622 animals per square kilometer at a detection rate of 4 and encounter rate of 96. Also, the number of observations was small, therefore, increasing the standard error.

10.5.5 Reptiles

10.5.5.1 Savannah Monitor Lizard (*Varanus exanthematicus*)

Density of this species was 0.204 ± 1.728 per square kilometer at detection probability of 31.5 and an encounter rate of 68.5. Number of observation was 2 out of 40 samples influencing the confidence limits.

10.6 Conclusion

Wildlife managers are obliged to conduct frequent inventories to enumerate wildlife species under their custody. This study has managed to estimate the density of 22 species of wildlife including ungulates, carnivores, primates, lagomorphs, and reptiles. The populations of most species identified and counted seem to be stable. The wildlife habitat of Mkomazi National Park is also well protected, except for some cases of areas close to the Park boundary where a number of livestock signs were encountered in the park. We did not encounter some important wildlife species such

as African elephants, African lion, leopards, and wild dogs. This should not be interpreted as determinant that these animals are absent in this area. Elephant dung were recorded in some transects, whereas lions' and hyenas' calls were prominent during the nights and during counting. The park size, which is 3245 km^2, also encompasses the rhino sanctuary which is 54 km^2 in size. Apart from black rhinoceros, the fenced area of the rhino sanctuary also contains other species of wildlife. Animals in the sanctuary were not counted; hence, extrapolations of the total population size of the area should exclude the area of the sanctuary.

We recommend that carnivore counting should be conducted using camera traps to establish the minimum population size, whereas the estimate of African elephants should be accomplished using dung counts. We also recommend that Park management intensify anti-poaching operations, especially in those areas close to the Park boundary where incidences of encroachment and poaching were recorded. This will help to stabilize and ultimately increase the population status of wildlife of this area. We propose that the transects in this study be used in future counting, and findings be used as the baseline for future monitoring of populations in this area.

Acknowledgments We extend our appreciation to a number of people who facilitated the smooth running of this exercise: first, Tanzania National Parks for logistic and financial support for this counting exercise. We are also thankful to the management team of Mkomazi National Park, as they were good planners and welcoming hosts during this exercise. All people who participated during field counting operation deserve a special recognition, as their devoted time and endurance in this exercise were crucial inputs.

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Chapter 11
Using MODIS Yearly Land Cover Data to Study Vegetation Changes in Mkomazi National Park 2001 to 2013

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Abstract Mkomazi National Park in northeastern Tanzania was gazetted to a national park in 2008 by upgrading the Mkomazi-Umba Game Reserves. It is possible that national park policy, management, and additional park visitors may change the vegetation within the park. This study examines vegetation changes in Mkomazi National Park using MODIS yearly land cover data and scripts in Google Earth Engine for 2001 and 2013. Results indicate few significant changes in land cover between the two dates. However, grasslands increased by approximately 13% between the 2 years (69–82%), and there were many additional smaller changes. The relatively subtle changes in Mkomazi National Park's vegetation cover between 2001 and 2013 are most likely reflective of the subtle changes in land management policy after its conversion from two separate game reserves.

Keywords Mkomazi National Park · Google Earth Engine · Land cover change

11.1 Introduction

National parks are places where people negotiate peace treaties with nature (Quammen 2016) and play an important role in counteracting environmental degradation (Sanchez-Azofeifa et al. 2002). In many places, national parks contain the most identifiable natural features in a given country (Sellars 1997). However, as

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national parks grow in popularity, human development and human activities can exasperate stressed fauna populations (Herrero et al. 2001), even as the parks are increasingly expected to generate income through tourism and tourism activities (Hubner et al. 2014). Further, many local communities often depend on tourism and ecotourism income for their livelihoods (Newsome and Hassell 2014). The competing missions of national park management—providing safe and suitable habitat for wildlife while also providing ample tourist and ecotourist activities and income—represent a challenge for national park policy makers and land managers. National parks are becoming more popular throughout the world following the growth of ecological tourism. However, tourism and outdoor recreation are considered two of the main threats to protected areas (Juutinen et al. 2011). Therefore, the establishment and management of national parks can be a highly contested process due to conflicting goals associated with the protection of natural resources and the need to provide access to those resources for tourists (Haukeland 2011).

Mkomazi National Park in northeastern Tanzania was transitioned from Mkomazi-Umba Game Reserve to a national park in 2008. Some local pastoralists were allowed to use some of the reserve's area for grazing until the final years as a game reserve. In particular, residence within the game reserve was permitted for some Parakuyo pastoralists who lived in the reserve with several thousand cattle. However, the reserve contains many excellent pastures, and these pastures and other areas were used by others for hunting and to gather wood for fuel. It is estimated that in 1984, there were almost 100,000 cattle living in the reserve or near its borders (Brockington and Homewood 2001). In 1988, Tanzania's Department of Wildlife reasserted control of the reserve and evicted all those living inside it (Homewood and Brockington 1999). Further, the Department of Wildlife prohibited any resource use within the park. The reason given for the eviction was that those living inside the park were damaging the reserve's environment (Mangubuli 1991). Despite the earlier eviction, it is estimated that between 5000 and 10,000 people were displaced when the reserves were made into a national park (Cernea and Schmidt-Soltau 2006) as Tanzania's national park policy precludes local citizen's use of park resources.

One of the most easily identifiable outcomes of national park policy and management is a park's vegetation characteristics and changing vegetation dynamics. As policy makers and land managers implement national park policy, vegetation will probably change to conform to policy. In particular, in Tanzania national park, regulations have visible impacts on vegetation, landscape, and wildlife distributions throughout the country (Brockington et al. 2008). Therefore, the ability to study vegetation change is important to determine if policy is affecting conditions in the park. Remote-sensing data and techniques provide a useful workflow to study vegetation and vegetation changes, and they have been used to study vegetation in a large variety of national parks. For example, remote sensing was used to study tropical deforestation in and around national parks (Fawzi et al. 2018; Sanchez-Azofeifa et al. 2002); examine land cover changes in national parks (Wang et al. 2009);

identify land-use activities around a wildlife reserve (Ahmad et al. 2018); determine historical and current trends in woody vegetation cover (Eckhardt et al. 2000); study alpine treeline patterns (Klasner and Fagre 2002); and examine vegetation patterns in Tanzanian National Park from 1918 to 1982 and from 1982 to 1994 (Pelkey et al. 2000).

11.1.1 Hypothesis and Objectives

This chapter studies vegetation changes between 2001 and 2013 in Mkomazi National Park using satellite remote-sensing data. Mkomazi was made a national park in 2008, so these dates represent 7 years before and 5 years after this date. This chapter is based on the hypothesis that vegetation has changed in the park because of its conversion from a game reserve to a national park.

11.2 Methods

11.2.1 Study Area

As noted above, Mkomazi National Park was established as a national park in northeast Tanzania in 2008. Mkomazi National Park sits at about 4 S and between 38 and 39 E. It is adjacent to Kenya's Tsavo National Park to the north (Russell-Smith 2002; Fig. 11.1). Formerly, this area was a game reserve. In general, game reserves in Tanzania are managed to allow for direct consumptive utilization of resources in a sustainable way, mainly through allocation of hunting blocks for game hunting. On the other hand, national parks are primarily for nonconsumptive utilization whereby only certain activities such as game viewing, walking safaris, and photographic tourisms are allowed—especially on regulated game hunting. These guided opportunities in game reserves are typically more expensive than opportunities provided in national parks.

Natural vegetation in the 3245-km^2 park consists primarily of grasslands, woodlands, and brushlands. The park experiences two rainfall periods each year: the short rains from October to November and the long rains from March to May. This bimodal rainfall pattern is the result of the seasonal movement of the intertropical convergence zone (ITCZ). The ITCZ is at its northernmost point in July, and east Africa is typically dry during this time. As the ITCZ moves south, it brings rain in October and November before reaching its southernmost extent. The ITCZ moves back north at the beginning of each year, bringing additional rain between March and May (McWilliam and Packer 1999).

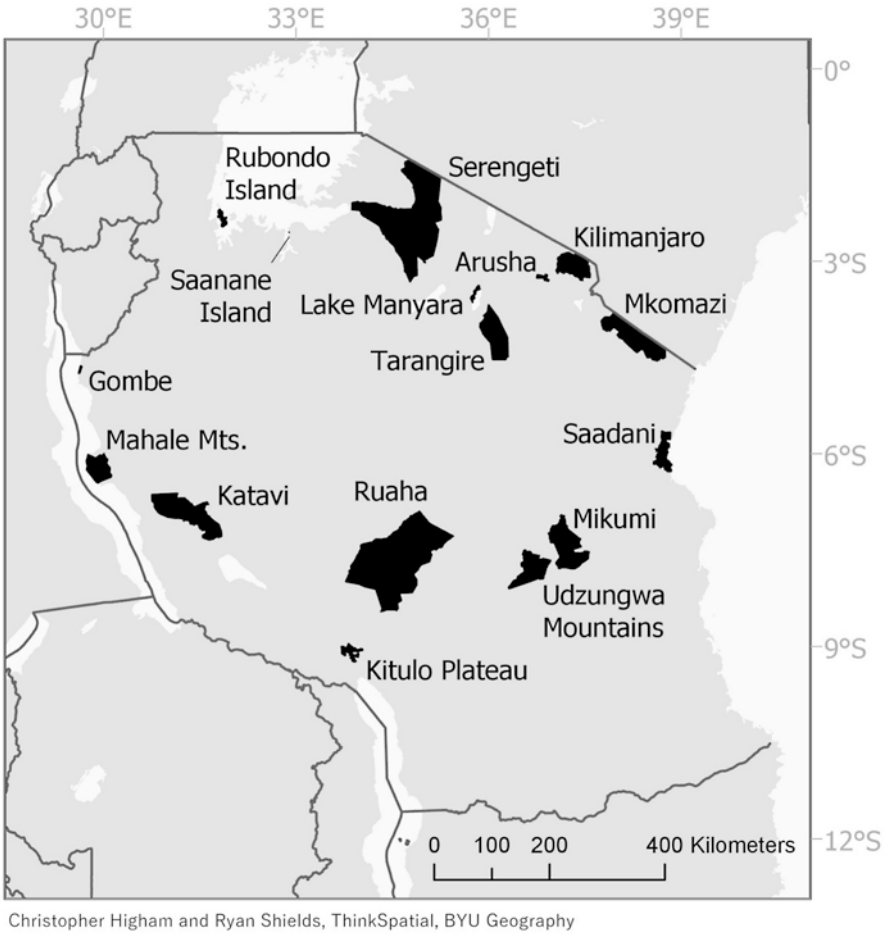

Fig. 11.1 Map of Tanzania's national parks. Mkomazi is located in the northeast part of the country adjacent to Kenya

11.2.2 MODIS Remote-Sensing Data

Yearly composite land cover data derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) were analyzed. The yearly MODIS Land Cover Type Product (MCD12Q1) provides global land cover data with a 500-m spatial resolution. While 500-m data are somewhat coarse, the availability of these datasets and their ease of use in cloud-based Google Earth Engine (see below) make them good datasets for relatively large area studies.

Image classification is a primary remote-sensing process to classify spectral values to land cover classes on Earth's surface (Zhang and Roy 2017). The MODIS land cover data were determined with a supervised classification algorithm that uses

a training site database generated from high spatial resolution imagery and ancillary data (Friedl et al. 2010). The training site database is continuously augmented and maintained to provide up-to-date land cover classes. MODIS data used in the yearly classification include composited 8-day MODIS composite data, normalized BRDF-Adjusted Reflectance (Sanchez-Azofeifa et al. 2002), and MODIS Land Surface Temperature (Wan et al. 2002). The final classification is generated with a decision tree classification algorithm and a technique to improve classification accuracy known as *boosting*. The decision tree classification method examines each band of the training data and identifies a single criterion that best segments part of the training data into a certain class or classes (these subsets are called *leaves* of the tree). It repeats the process for each resultant leaf, splitting it into two leaves, until a stopping criterion is reached—usually a certain number of leaves (Breiman et al. 1984). When classifying, the algorithm traverses the tree of criteria until it ends at a leaf and gives the pixel the classified value that the plurality of pixels in that leaf have. Land cover percentages in the corridor were extracted from the yearly land cover data in 2001 and 2011. Land cover classes found in the study area included grasslands, croplands, cropland/natural vegetation mosaic, deciduous broadleaf forest, mixed forest, closed shrublands, open shrublands, woody savannas, and savannas. For a complete discussion on how the MODIS Land Cover Type product is generated, please see Friedl et al. (2010).

The MODIS land cover data have been found to have an overall accuracy of 75% (Friedl et al. 2010). MODIS data have been used in a large variety of studies. Hansen et al. (2008a, b) used MODIS to identify areas of likely forest cover loss in tropical regions. They stratified the humid tropics into areas of low, medium, and high probability of forest clearing. Fuller et al. (2008) mapped forest cover in Kalimantan, Indonesia, with MODIS data. They found that almost 3 million hectares of forest were lost there after the El Nino event of 1997–1998. MODIS was used to detect forest harvest-level disturbance between 2000 and 2004 in Northern Maine (Jin and Sader 2005). Coops et al. (2009) applied a disturbance index informed with MODIS data to monitor land dynamics over time in Canada. MODIS data have also been implemented to monitor grassland and forest disturbance on the North Island of New Zealand (de Beurs et al. 2016), detect forest disturbance in the United States' Pacific Northwest (Sulla-Menashe et al. 2014), assist in the systematic monitoring of forest area and change in the Congo Basin (Hansen et al. 2008a, b), and monitor the phenology of a broadleaf forest in Wisconsin (Ahl et al. 2006).

11.2.3 Google Earth Engine

Google Earth Engine (EE) is an advanced cloud-based spatial geoprocessing platform. Google provides EE to analyze data and develop algorithms at the global scale, increase the use of *big data* in remote sensing, enable high-impact data-driven science, and make progress on global issues that need to analyze large geospatial datasets. EE has access to a petabyte-scale catalog of publicly available data, such

as MODIS and Landsat TM data (Gorelick et al. 2017). Researchers can access EE and its datasets on either an Application Programming Interfaces for JavaScript and Python (hosted on GitHub) or via an online code editor with an integrated development environment that uses the JavaScript API (https://code.earthengine.google.com). Data retrieval and analysis in this study were completed in the online code editor.

The boundary of Mkomazi National Park was provided by the Tanzanian National Park Authority (TANAPA) and imported into EE as an asset. The asset was then used to extract land cover in the park from the MODIS Land Cover Product. The name of the annual MODIS Land Cover Product used in this study was MODIS/051/MCD12Q1/. Box 11.1 contains the code used to extract the land cover data from the MODIS product and display each land cover type for the year 2011. The code also exports a GeoTIFF of the study area that can be analyzed further in other remote sensing or GIS applications (e.g., ArcGIS Pro, Environment for Visualizing Images).

Box 11.1: Code Used in Google Earth Engine to Extract Land Cover Percentages of Mkomazi National Park

```
// Import variables
var globcover = ee.Image('MODIS/051/MCD12Q1/2011_01_01'),
  geometry2;
// Center the map
Map.setCenter(38.17, -4.17, 9);
// Extract the landcover band
var landcover = globcover.select(['Land_Cover_Type_1']);
// Clip the image to the polygon geometry
var landcover_roi = landcover.clip(geometry2);
// Add a map layer of the landcover clipped to the polygon.
Map.addLayer(landcover_roi);
// Print out the frequency of landcover occurrence for the
polygon.
var frequency = landcover.reduceRegion({
  reducer:ee.Reducer.frequencyHistogram(),
  geometry:geometry2,
  scale:500
});
var dict = ee.Dictionary(frequency.get('Land_Cover_Type_1'));
var sum = ee.Array(dict.values()).reduce(ee.Reducer.
sum(),[0]).get([0]);
var new_dict = dict.map(function(k,v) {
  return ee.Number(v).divide(sum).multiply(100);
});
```

(continued)

Box 11.1 (continued)

```
print('Land Cover (%)',new_dict);
// Export a cloud-optimized GeoTIFF.
Export.image.toDrive({
  image: landcover,
  description: 'imageToCOGeoTiffExample',
  scale: 500,
  region: geometry,
  fileFormat: 'GeoTIFF',
});
```

11.2.4 Postclassification Change Detection

After exporting the land cover maps for the different years, the maps were input into a geographic information system to extract the exact boundary of the park and then perform from-to change detection between the two dates using postclassification change detection. Postclassification change detection compares classified maps between two dates that were created independently (Mas 1999). Each date's classification contains the exact same classes. Postclassification change detection provides the nature of the changes via a from-to change detection matrix. Postclassification change detection was determined to be the most accurate change detection technique when compared with multidate spectral change comparisons when examining changes in the region of Terminos Lagoon in the Mexican state of Campeche (Mas 1999).

11.3 Results

Overall vegetation trends were similar in Mkomazi National Park in 2001 and 2013. Grasslands, savannas, cropland/natural vegetation mosaic, woody savannas, and open shrublands made up 96.4% and 99.7% of the land area in 2001 and 2013, respectively. However, there were some land cover changes among these five classes. Table 11.1 lists the from-to changes in land cover and total area of land cover classes for the two dates. The table only includes the five land cover classes described above because of the very large percentages that these five land cover classes make up in both years. The biggest change in land cover was an increase of grasslands from 69% of the national park in 2011 to 82% of the park in 2013

Table 11.1 From-to change matrix of the five dominant land cover classes in 2001 and 2013

2013								
		Open shrublands	Woody Savannas	Savannas	Grasslands	Cropland/natural vegetation mosaic	Total	
2001	Open shrublands	425	125	300	4875	675	6400	1.95%
	Woody Savannas	100	2475	1450	3325	700	8150	2.48%
	Savannas	1325	2725	4375	23950	4450	36975	11.27%
	Grasslands	10725	650	6575	205675	4000	228000	69.47%
	Cropland/natural vegetation mosaic	250	2125	4550	22950	7000	36975	11.27%
	Total	13325	9375	18200	268825	17525		
		4.06%	2.86%	5.55%	81.91%	5.34%		

Note the large amount of land that was converted to grassland from savannas and cropland/natural vegetation mosaic

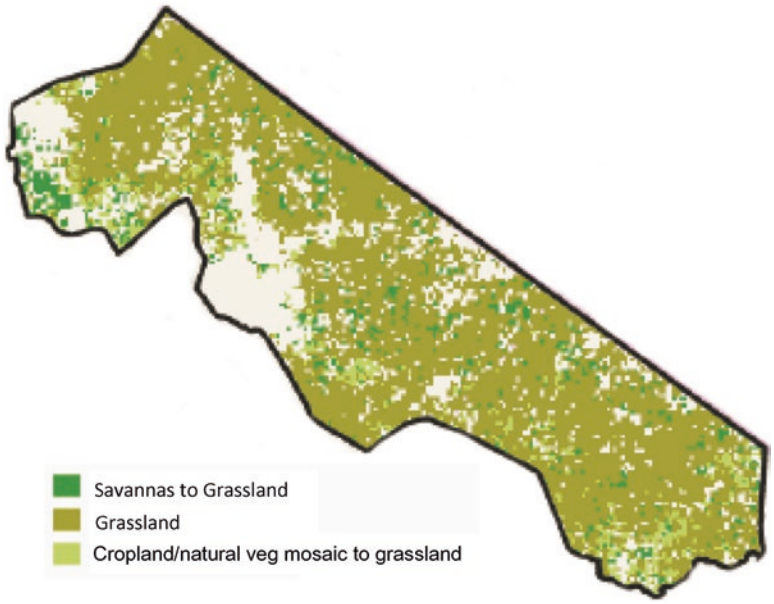

Fig. 11.2 Map of the area that remained grassland and the areas that changed from savannas to grassland and cropland/natural vegetation mosaic to grassland. Much of Mkomazi National Park (~82%) was classified as grassland in 2013

(Fig. 11.2). This represents an increase from 228,000 to 268,825 hectares. Most of the area that was converted to grassland were savannas (23,950 hectares converted) and cropland/natural vegetation mosaic (22,950 hectares converted). These changes represent the bulk of the land cover changes in Mkomazi National Park between 2001 and 2013. The changes are also reflected in the decrease of both cropland/natural vegetation mosaic (11–5%) and savannas (11–6%). Open shrublands increased from 2% (6400 hectares) to 4% (13,325 hectares). Woody savannas maintained similar area percentages on the two dates (2.5% in 2001 and 2.9% in 2013). While these changes are relatively small, they probably reflect the changing land management policies implemented in the park after its upgrade to a national park in 2008.

11.4 Conclusions

National parks are substantial investments that governments make in the environment. These investments require active and effective management practices and policy that can affect vegetation and other characteristics throughout the parks. The relatively subtle changes in Mkomazi National Park's vegetation cover are most likely reflective of the subtle changes in land management policy after its

conversion from two separate game reserves. Remote-sensing data and techniques can provide timely analysis of vegetation properties. Google Earth Engine provides the necessary datasets, interface, and tools to rapidly evaluate vegetation and vegetation dynamics throughout the world. In particular, the methods, data, and tools used in this chapter could be implemented to study vegetation dynamics in national parks and other protected areas.

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Chapter 12
Conservation of Large Mammals in the Face of Increasing Human Population and Urbanization in Tanzania

Jafari R. Kideghesho, Gideon A. Mseja, Oliver C. Nyakunga, and Hamad I. Dulle

Abstract Tanzania, like many other developing countries, has experienced rapid population growth and urbanization in the past five decades. Its population has grown from 8,000,000 in 1961 to over 50,000,000 currently, and this population is projected to double in the next two decades. This growth is also notable around the wildlife-protected areas. Using existing literature and personal experience, this chapter reviews the major aspects related to wildlife conservation in relation to human population growth and urbanization. Using examples from different parts of Tanzania, this chapter provides highlights on the trends and causes of human population growth and urbanization in areas bordering wildlife-protected areas and the effects brought about by these trends. The chapter presents the repercussions caused by these trends on the population of large mammals and other wildlife species. Recommendations are provided on how best to minimize the negative impacts that human population growth and urbanization cause on large mammals.

Keywords Large mammals · Human population growth · Urbanization · Wildlife protected areas · Tanzania

12.1 Introduction

Conservation concern over large mammals is growing globally, largely due to their ecological importance and vulnerability to extinction (Morrison et al. 2007; Di Marco et al. 2014; Craigie et al. 2010; Ripple et al. 2015; Diplock et al. 2018). Large mammals are also a big tourism draw offering opportunities for both

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photographic tourism and trophy hunting, and consequently, contributing significantly to local and national economies (Okello and Grasty 2009; Naidoo et al. 2011; Arbieu et al. 2017; Maciejewski and Kerley 2014; Baldus and Cauldwell 2004; Lindsey et al. 2007a, b).

Despite several decades of conservation efforts, large mammals are increasingly being subjected to a risk of extinction globally. Since the 1970s, a quarter of the global populations of carnivore and ungulate species have declined toward extinction (Di Marko et al. 2014), while the populations of African large mammals are estimated to have fallen by 60%, both within and outside the protected areas (Craigie et al. 2010). In East Africa, long-term data collected in the past 50 years show a drop of large mammal populations to less than 50% (Craigie et al. 2010; Diplock et al. 2018).

The risk of extinction is well documented for individual species of large mammals including umbrella and keystone species. For instance, Africa has lost over 60% of its lion (*Panthera leo*) population (almost 100,000 animals) that survived in the past 50 years (Hance 2012). The species is currently considered extinct in Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Mali, Rwanda, and Togo (Riggio et al. 2013). The population of African elephant (*Loxodonta africana*) dropped from 3 to 5 million in the 1930s and 1940s, to 1.3 million in the 1970s (WWF 2015), and to approximately 350,000 in the early 2010s (Skinner 2014; Chase et al. 2016). The black rhino (*Diceros bicornis*) population declined to 2.4% of the 1960 population (Emslie 2012). The declining trend is also recorded for mountain gorilla (*Gorilla beringei beringei*) and Grevy's zebra (*Equus grevyi*). The population remaining for the two species is below 900 and 2000, respectively (AWF cited in Kideghesho 2016a, b).

The decline of large mammals is attributed to growing anthropogenic-induced stresses on habitats and species; the main drivers being population growth and urbanization (Di Marco et al. 2014; Daskin and Pringle 2018). Human population growth and urbanization have been taking place in tandem with habitat conversion to alternative uses, such as settlements, croplands, factories, and other infrastructures (Songorwa 2004; Kideghesho et al. 2006; Hance 2012). The 60% loss of lion population in recent years is attributed to a loss of over 80% of the species' historic range (Riggio et al. 2013), and retaliatory or preemptive killing for protection of human life and livestock (Ikanda and Packer 2008; Lyamuya et al. 2014).

About 75% of the Earth's ice-free land is considered to have been altered by humans to some degree since the beginning of twenty-first century (Watson et al. 2016), and two thirds of these human-altered areas have completely lost their native vegetation (Pardini et al. 2017). In the past 10,000 years ago, large mammals, including elephants, tigers, rhinos, whales, and kangaroos, made up over 99% of the mass of all the mammals on the earth, while the proportion of humans, livestock, and pets was only below 1% (Population Media Centre 2011; Ripple et al. 2015). Currently, 96–98% of the earth's mammals are composed of humans, pets, and livestock, leaving the wild-land mammals declining to less than 5% (Fig. 12.1). Recent studies have reported a loss of about 70% and 75% of Africa's forest and savanna

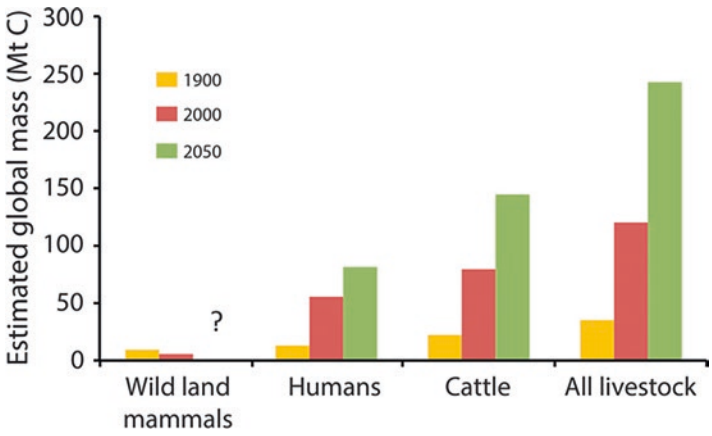

Fig. 12.1 Global change in the collective mass for wild mammals, humans, cattle, and all livestock for the years 1900–2050

ecosystems, respectively (Hance 2012). The two ecosystems constitute critical habitats for large mammals.

Correspondingly, wildlife killing, pollution, and the introduction of exotic species increase with the increasing human population (Campbell and Hofer 1995; Milner-Gulland and Bennett 2003; Metzger et al. 2010; Bitanyi et al. 2012). Many wild mammals are killed, legally or illegally, for their meat and trophies to meet an increasing demand for sustenance and commercial purposes (Riggio et al. 2012; Campbell and Hofer 1995; Milner-Gulland and Bennett 2003; Metzger et al. 2010; Bitanyi et al. 2012; Kideghesho 2016a, b; Ripple et al. 2016). On the other hand, as habitats shrink due to expansion of human activities and urban land cover, interactions or contacts between humans and wildlife increase. Subsequently, human–wildlife conflicts become evident through crop damage, livestock depredation, and wildlife-induced accidents. Occasionally, people resort to preemptive or retaliatory killing against problem or dangerous animals (Ikanda and Packer 2008).

The population growth in wildlife areas is attributed to both immigration and natural increase (Campbell and Hofer 1995; Kideghesho et al. 2006; Metzger et al. 2010). The need for agricultural and grazing land, mining resources, easy access to bushmeat and other wildlife resources, and employment opportunities are cited as the major population-pull factors to wildlife-rich areas (Campbell and Hofer 1995; Metzger et al. 2010; Bitanyi et al. 2012).

Urbanization is directly correlated to human population growth. Urban areas constitute one of the fastest growing land-use types. The increasing trend of urbanization extends to wildlife areas and, thus, poses a critical management challenge to biodiversity and large mammals, in particular (McKinney 2008; McDonald et al. 2008; Seto et al. 2012). The global urban land cover in the vicinity of protected areas is projected to triple by 2030 (McDonald et al. 2008; Güneralp and Seto 2013; Elmqvist et al. 2016).

The rate of increase in urban land cover is predicted to be the highest in Africa at 590% over the levels observed in year 2000 (Seto et al. 2012) with the urban land-cover near-protected areas increasing by almost 20 times (Elmqvist et al. 2016). Africa's urban land within the boundaries of protected areas in the year 2000 was about 500 km^2. However, by 2030, urbanization within 50 km of protected areas on the continent is projected to exceed 140,000 km^2 (Güneralp et al. 2017). Impacts of urbanization are expected to hit the protected areas located in poor countries where institutional capacity is insufficient to adapt to new anthropogenic-induced stresses (McDonald et al. 2008).

Increasing urban land cover close to protected areas reduces effective conservation areas through the outright loss of wildlife habitats, habitat degradation, and fragmentation (McKinney 2008; Seto et al. 2012; Elmqvist et al. 2016). Other critical wildlife areas, such as wildlife corridors and dispersal areas, also suffer from urbanization (Caro et al. 2013; Jones and Davenport 2009; Jones et al. 2009; Davenport et al. 2010). The ultimate impact is extinction of native species and biodiversity loss (McDonald et al. 2008; McKinney 2008; Seto et al. 2012; Elmqvist et al. 2016; Giineralp et al. 2015).

Scientific predictions indicate that by 2030, impacts of urbanization on habitats will affect over 25% of vertebrate species classified by IUCN as endangered or critically endangered (Güneralp and Seto 2013). The species under threat include 139 amphibian species, 41 mammalian species, and 25 bird species (Seto et al. 2012). Africa and Europe have the highest proportions of species facing a risk from urbanization at 30% and 33%, respectively. McDonald et al. (2014) estimate about 80% loss of vertebrate species in all global ecoregions to every 10% expansion of urban land cover. Tanzania's wildlife species, including large mammals, are equally facing uncertain future due to stresses induced by human population growth and rapid urbanization.

This chapter recognizes the importance of Tanzania in terms of biodiversity hotspots and diversity of large mammals, along with efforts in place to protect these assets. Drawing examples from different parts of Tanzania, the drivers and impacts of human population growth and urbanization on the conservation of large mammals are reviewed. Figure 12.2 provides a scope of the review and discussion of these drivers and impacts.

12.2 Tanzania: Large Mammals and Conservation Efforts

Tanzania, having 6 of the 25 globally known biodiversity hotspots, is home to about 20% of Africa's large mammals (URT 2014). The mammals and other wildlife groups have elevated the country as a globally popular tourism destination. Consumptive and nonconsumptive forms of tourism are, by large, supported by wildlife, particularly large mammals, including elephants, rhinos, lions, leopards, and buffaloes. In the 2016 and 2017 financial years, the tourism sector accounted for 17.5% of the GDP and 25% of foreign exchange, ranking second after agriculture

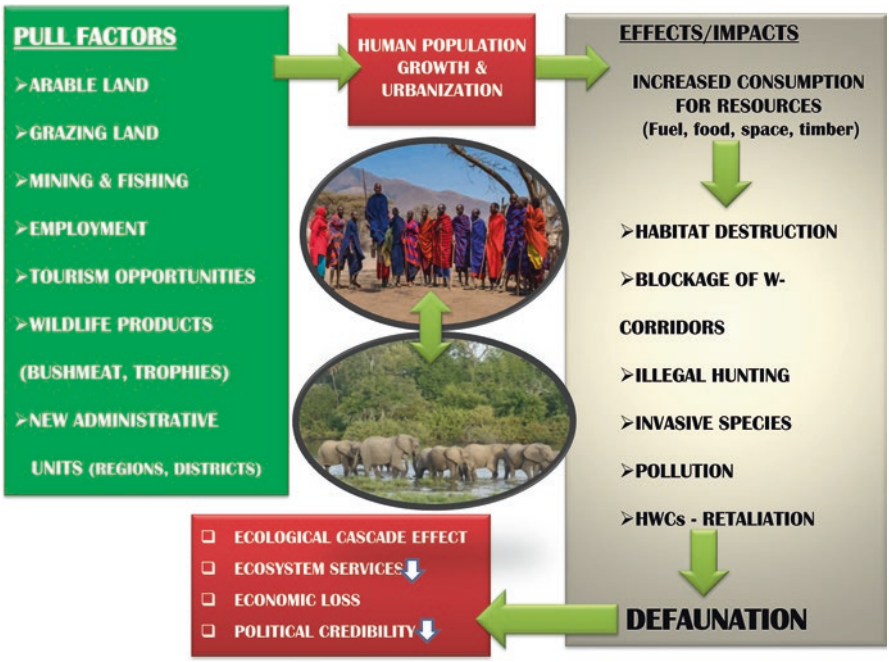

Fig. 12.2 The pull-factors and effects of human population growth and urbanization

Table 12.1 Coverage of wildlife-protected areas under different categories

PA category	No. of PAs	Land area (km^2)	% of land area
1. National parks	16	57,167.50	6.05
2. Ngorongoro Conservation Area	1	8292.00	0.88
3. Game reserves	28	114,782.97	12.15
4. Game controlled areas	44	58,565.02	6.12
5. Ramsar sites	4	48,670.00	5.2
6. Wildlife management areas	38	29,518.40	3.00

Sources: URT (2018a)

(WWF 2015). The earnings from tourist hunting between 2011 and 2016 amounted to approximately US$ 145 billion (URT 2018a).

Recognizing the importance of wildlife in Tanzania's economy, the country has devoted over 30% of its land area for protection of wildlife. The areas under protection fall under different categories, namely, national parks, Ngorongoro Conservation Area, game reserves, game controlled areas, Ramsar sites nature reserves, and wildlife management areas (Table 12.1).

However, efforts that are being invested to conserve wildlife populations are often compromised by numerous challenges. There are documented declines of wildlife populations in many ecosystems of Tanzania due to illegal hunting, habitat loss, and wildlife diseases (Masanja 2014; Kideghesho 2016a, b; Mtui et al. 2017). Research-based literature indicates a clear linkage between human population growth and the level of these threats (Campbell and Hofer 1995; Songorwa 2004; Milner-Gulland and Bennett 2003; Metzger et al. 2010; Bitanyi et al. 2012).

12.3 Human Population Growth and Urbanization Trends

Tanzania has high rates of human population growth and rapid urbanization. The population has quadrupled from 12,313,469 in 1967 to 55,890,747 in 2019 (NBS 2020). The urban population has increased at approximately twice the rate of population growth or about 3% p.a., raising urbanization from approximately 6.3% in 1967 to over 33.8% in 2017 (World Bank 2019; Table 12.2).

Human population growth close to wildlife areas is mainly linked to human migration. Migration from one geographical locality to another is often employed as a strategy to respond to shocks, sustain livelihoods, and adapt to environmental changes (Walsh 2007; Kikula 1996; Rusengula 2014). Besides ecological benefits, Tanzanian ecosystems offer a variety of livelihood opportunities through good agricultural land, mineral resources, wildlife and forest products, arable and grazing lands, and space for settlements. The Tanzanian ecosystems are, therefore, major recipients of the human population from different parts of Tanzania.

12.4 Drivers of Human Population Growth and Urbanization

Drivers of human population growth and urbanization in the vicinity of wildlife-protected areas have political, economic, and social dimensions. Some of the factors include availability of natural resources (e.g., wildlife, fish, and minerals), suitable

Table 12.2 Human population growth and urbanization trends in Tanzania (1967–2017)

Year	Total population	Urban population	Percent urban	Urban growth rate
1967	12,313,469	786,567	6.4	
1978	17,512,610	2,412,902	13.8	10.2
1988	23,095,878	4,247,727	18.4	5.7
2002	34,569,232	7,943,561	23.1	4.5
2012	44,928,923	13,305,004	29.6	5.2
2017	52,554,628	17,605,800	33.1	5.3

land for agriculture and livestock grazing, employment and other economic opportunities created by tourism, and formation of new administrative units. These factors are briefly discussed below.

12.4.1 Availability of Wildlife Resources

The Tanzania ecosystems attract people wishing to capitalize on the potentials offered by wildlife resources. Investment in wildlife-based tourism provides employment opportunities in hotels, tour companies, hunting industry, and self-employment through selling of souvenirs, investing in shops, bars, and other enterprises. Besides employment opportunities, wildlife products other such as buishmeat and trophies attract people to the areas. A case in point is Serengeti National Park where bushmeat is linked to population increase and increased settlements close to park boundaries (Bitanyi et al. 2012; Kideghesho et al. 2007).

12.4.2 Demand for Arable and Grazing Lands

Suitable land for agriculture, water, and grazing is one of the important factors attracting human populations to protected areas. Population growth, urbanization, and land conversion to different uses in many parts of the country have rendered the available land scarce and, therefore, these parts can no longer support people's livelihoods. This situation forces people to migrate and settle in new areas that can support their livelihood strategies.

The migration to wildlife-rich areas in search of pastures, arable land, and water is more notable among the major pastoral/agro-pastoral communities such as Sukuma, Maasai, Barbaig, Kurya, and Taturu (Tenga et al. 2008; Mwambene et al. 2014; Mtui et al. 2017; Rusengula 2014). For example, the Sukuma moved to Lake Rukwa Basin from the Lake Zone in 1967 and later to Usangu and Morogoro plains in 1972 (Mwambene et al. 2014). In the 2000s, after eviction from Ihefu Wetland (Usangu), they moved to Rufiji (Rusengula 2014), Lindi, and Ruvuma (Mwambene et al. 2014). The Maasai and Barbaig from northern Tanzania moved to Morogoro and Usangu plains before independence (Mwambene et al. 2014; Walsh 2007). Currently, the Sukuma and Maasai tribes are dominant in Kilombero Valley practicing agriculture and livestock keeping (Kabuye 2015). In the late 1990s, pastoralists from northern Tanzania settled in the open area south of the Katavi National Park while grazing cattle illegally inside the Park (Mtui et al. 2017).

12.4.3 Mining Opportunities

Along with hosting a variety of wildlife species, some areas are equally rich in mineral deposits. Some of these deposits are found in protected areas, wildlife corridors, and dispersal areas. Mineral deposits are found in or close to national parks (e.g., Serengeti, Katavi, and Lake Manyara) and game reserves (e.g., Kigosi, Muhesi, and Moyowosi). The presence of mineral deposits causes an influx of artisanal miners, especially young people, from different parts of Tanzania who perceive this as an opportunity to exit poverty.

12.4.4 Formation of New Administrative Units

Reclassification of new urban areas, mainly due to formation of new administrative units is not uncommon practice in Tanzania. The number of administrative regions in Tanzania mainland has grown from 17 in 1967 to 26 in 2016, an increase of 53%; districts increased from 85 to 185, equivalent to 118% (Table 12.3). In 2003, Manyara Region was created out of a portion of Arusha Region, followed by four more regions in 2012, namely, Geita, Katavi, Njombe, and Simiyu. Songwe Region was created from the western part of Mbeya Region in 2016. New administrative regions are formed in tandem with lower administrative units (districts, divisions, wards, and villages).

Formations of new administrative units attract populations to fill the newly created administrative and operational posts in the areas. Besides civil servants and their families, the new units also attract people wishing to take advantage of emerging economic opportunities and social services, such as business ventures, informal employment, water, and better health facilities. For instance, until 1974, Maasai land formed one administrative unit – the Maasai District. In 1967, the District had a population of 106,892 (Omri-Pack 1998). Out of this District, five new districts (Monduli, Ngorongoro, Kiteto, Simanjiro, and Longido) were established, and as of the 2012 population census, they had a total population of 1,002,875 (Table 12.4).

All districts above are endowed with wildlife resources, but they are also subjected to human pressure through poaching, habitat destruction, and blockage of

Table 12.3 Trends of administrative units in Tanzania (1967–2018)

Year	No. of regions	No. of districts	No. of urban areas
1967	17	85	32
1978	20	95	110
1988	20	(?)	c. 170
2002	20	129	(?)
2012	25	159	c. 600
2018	26	185	(?)

Sources: URT (1967, 1988, 2002, 2012)

Table 12.4 Population of selected districts bordering Tanzanian important wildlife areas in 1967 and 2012

Former district	Human population 1967	New districts	Human population 2012	% increase (1967–2012)
Maasailand	106,892 (Omri-Pack 1998)	Ngorongoro	199,879	853.8
		Monduli	182,275	
		Simanjiro	209,420	
		Kiteto	286,741	
		Longido	141,244	
Serengeti	158,984	Serengeti	282,080	267.6
		Bunda	250,050	
Ulanga	100,700	Ulanga	169,853	192.3
		Malinyi	128,460	
Biharamulo	73,301	Biharamulo	323,486	839.4
		Chato	365,127	
Magu	243,822	Magu	299,759	106,44
		Busega	203,597	

Source: www.citypopulation.de

migratory corridors. Some game controlled areas have lost their conservation value following increasing settlements and transformation into urban centers (e.g., the Headquarter of Kiteto and Hai Districts). However, the ecological impacts caused by formation of new administrative units (i.e., regions, districts, divisions, wards, and villages) have received minimal attention in scientific research.

12.5 Negative Impacts of Human Population Growth and Urbanization on Large Mammals

12.5.1 Loss or Weakening of Conservation Status to Some Protected Areas

With increased population, wildlife habitats and corridors are transformed into settlements, infrastructures, and croplands. Furthermore, demand for fuelwood, building material, furniture, and wildlife products (e.g., bush meat) increases (Kideghesho 2015). Some lands, previously gazetted as protected areas due to high diversity and concentration of large mammals, have remained as "parks in paper" since they are currently dominated by settlements and other infrastructures with virtually no wildlife species. Examples are Sanya-Lalatema, Mwadui Diamond and Mto wa Mbu Game Controlled Areas.

In Ngorongoro Conservation Area, the fate of Multiple Land Use Model, adopted in 1959, to take on board the conservation of wildlife, tourism development, and

interests of the resident pastoralists, is uncertain. The population in the protected areas has increased from approximately 8,000 when the area was established in 1959 to 93,136 today, an increase of over 1000%. This increase has been accompanied by a number of undesirable effects, including decrease of livestock per capita, increased invasive/unpalatable forage species, decreased food security and nutritional status, and conflicts due to perception held that wildlife is being accorded more priority at the expense of people (Galvin et al. 2015).

12.5.2 Blockage of Wildlife Corridors

One of the impacts of human population growth in Tanzania's large mammals is blockage and loss of wildlife migratory corridors (Hassan 2007; Kideghesho et al. 2006; Jones et al. 2009; Davenport et al. 2010). The fact that Tanzania conservation laws do not provide any legal protection to wildlife corridors has subjected them to further anthropogenic pressures. Consequently, the ecological roles of corridors in maintaining the viability of isolated populations, conserving ecosystem functionality, and preventing habitat degradation are undermined. Most of the corridors that previously linked protected areas are either already lost or critically threatened (Table 12.5).

A detailed assessment of wildlife corridors across the Tanzania mainland by Jones et al. (2009) identified 31 corridors linking different protected areas. Of these, 24 (77%) were classified to be under "extreme" or "critical" condition, implying that they were predicted to cease being functional within 5 years in the absence of some form of intervention (Caro et al. 2013; Jones et al. 2009, 2012; Davenport et al. 2010).

12.5.3 Growing Pressure to Degazette the Protected Lands

Human population growth and rapid urbanization have reduced land available for agriculture, livestock, settlements, and other livelihood-supporting activities. Consequently, encroachment into protected areas has been adopted as a strategy to surmount this scarcity. Virtually, all wildlife and forest-protected areas have villages or farms located within participating in illegal activities (Table 12.6; Fig. 12.3).

Encroachment into protected areas is frequently accompanied by antagonism between the protected areas' staff and the local communities. There are known cases where the lives of protected area staff have been threatened or government vehicles destroyed when staff were discharging their responsibilities (personal experience). Besides ongoing encroachment in many protected areas, local people sharing borders with protected areas often exert enormous pressure on government by demanding the opening of protected lands for community use (Kideghesho et al. 2005, 2006). An example of this scenario is the Maswa Game Reserve whose

Table 12.5 Examples of wildlife corridors under threats in Tanzania due to expansion of human activities

Corridor	Species	Threats
Kilimanjaro-Amboseli (Kitendeni)	Elephants, zebra, wildebeest, Thomson's gazelles, and Grant's gazelles	Agriculture
Selous-Niassa	Elephants, wild dogs, buffalo, eland, impala, greater kudu, hartebeest, Roosevelt sable antelope, hippopotamus, leopard, lion	Settlements, land conversion for agriculture, and settlements on the major migratory routes lead to fragmentation of the ecosystem and increased human–wildlife conflicts; illegal logging, high-value poaching of ivory, uncontrolled fires, and prospecting/mining for uranium and other minerals
Manyara Ranch-Lake Natron (TNP to Lake Natron)	Wildebeest, zebra, elephant, giraffe, buffalo, and eland	The most immediate threat is increasing cultivation. Plans to tarmac the road to Loliondo via Natron are likely to negatively impact wildlife movement
Loazi-Ntantwa-Lwafi	Chimpanzee	Deforestation for charcoal manufacture, agriculture, poaching, and bushmeat (including chimpanzee) is exported from Tanzania across Lake Tanganyika for sale in the Democratic Republic of Congo
Udzungwa-Ruaha	Elephants, leopard, hyena, greater kudu impala, buffalo, and giraffe	Poaching, habitat clearing for farms, extensive grazing, irrigation schemes, and onion cultivation
Tarangire-Simanjiro	Migratory species are zebra, wildebeest, hartebeest, and oryx, and they move between 10 and 110 km out of the park	Agricultural expansion, bushmeat hunting, and resident hunting have reduced wildebeest, hartebeest, and oryx populations by 88%, 90%, and 95%, respectively
Mkungunero/ Kimotorok	Elephants, wildebeest, gerenuk, lesser kudu, and wild dogs	Agricultural expansion and settlements
Udzungwa-Mikumi	Elephant, buffalo, sable, waterbuck, and other large mammal species	Poaching, clearing of habitat for farms and settlements
Tarangire-Manyara (Kwakuchinja) corridor	The corridor was once vital to 25 large mammal species, some of which (including elephant) move between the two parks. Some populations of bushbuck, impala, and vervet monkey	Agriculture, livestock keeping, expansion of settlements, phosphate mining, cattle holding, and fishing. Eight large mammal species are locally extinct: eland, hartebeest, buffalo, oryx, lesser kudu, cheetah (*Acinonyx jubatus*), leopard, and lion
The upper Kitete/ Selela	Corridor is utilized by elephant, buffalo, and other large mammals	The increased human settlement and cultivation caused interruption to the movement of large mammals from the northern highland FR to the lowlands below the escarpment. Even though cultivation was stopped, homes, domestic livestock, and cattle dips still exist in the corridor. All areas adjacent to the corridor are settled and cultivated by local people

Table 12.6 Villages located or conducting economic activities inside the selected protected areas

Protected area	Villages located inside the protected area
1. Katavi National Park	Situbwike subvillage (82 households)
2. Kilimanjaro National Park	Lerang'wa, Kitendeni, Irkaswa, and Kamangwa
3. Liparamba Game Reserve	Ndondo-Jangwani (60 households living inside); Mitomoni, Mseto, Liparamba, Mipotopo (farming activities)
4. Mahale National Park	Sibwesa, Kalilani
5. Mkungunero Game Reserve	Arkasupai-Kimotorok (Simanjiro), Maasasi, and Lombenek-Irkiushibour (Kiteto District) and Msumbiji, Maasasi and Lombenek–Kisondoko (Kondoa District)
6. Moyowosi-Kigosi	Ilunde village (illegal livestock grazing)
7. Mpanga-Kipengele Game Reserve	Machimbo, Kigala, Igomelo, Ikuwo, Imalilo (Makete District), Wangama, Luduga, Mpanga Mpya, Malangali, Mambegu, Wangamiko (Wang'ingombe District)
8. Serengeti National Park	Mbalibali, Bonchugu, Bisarara, Nyambuli, Machochwe, Nyamakendo, Marenga, Mbirikili (Serengeti District), Matongo (Bariadi District), Vijiji vya Masanga, Kegonga, and Gibaso (Tarime District)
9. Swaga Game Reserve	Handa, Mkulu, Mongoroma, Banguma, Thawekwa
	Lahoda-Kilamboo, Serya, Mtiriangwi, Mukulu na Bugutole
10. Tarangire National Park	Kimotorok, Gedamar, Gijedbung, Ayamango

Fig. 12.3 A part of Situbwike subvillage inside Katavi National Park, Tanzania

boundaries were realigned three times causing 15% loss of the original area (Kideghesho et al. 2013). Despite this, the game reserve still experiences encroachment from pastoralists and farmers (Masinde, personal communication).

The demand for conversion of protected land to alternative uses has backing from the politicians and government leaders. Intense debates and pressure over the need to degazette the protected areas often dominate the Tanzanian parliamentary sessions, especially when the budgets for the Ministry of Natural Resources and Tourism are tabled. During the sessions, the pastoralists come to Dodoma[1] to meet Members of Parliament (MPs) and lobby for support as they seek government intervention to allow livestock grazing inside the protected areas. This demand has often won popular support from MPs hailing from those areas where cattle-keeping is the main economic activity. In one of the parliamentary sessions, one MP lamented:

> Sioni hoja ya msingi ya kukataza ng'ombe wasichungwe ndani ya hifadhi. Ng'ombe hali hata sungura wala hali miti. Anachokula Ng'ombe ni nyasi. (Swahili words literally meaning: There is no logic to prohibit livestock grazing inside the national park. Neither does a cow eat a rabbit nor a tree. It eats grasses.)

On 25 June 2018, it was reported that Manyoni residents backed by their MP requested Deputy Minister for Natural Resources and Tourism to degazette a part of Rungwa–Kizigo–Muhesi GR in order to provide land for agriculture and livestock grazing and to allow them to benefit from gold deposits in the area (ITV 25 June 2018).

On March 10, 2018, the President of the United Republic of Tanzania approved the amendment of the boundaries of the protected areas instead of evicting the communities in 366 villages established inside the protected areas. He also directed that the protected areas that are devoid of wildlife be degazetted and distributed to communities nearby to settle in. The President's decision seems to have emerged from his recognition of the importance of agricultural and livestock sectors economics and concern over the livelihoods of herders and peasants. This followed the remarks he made on March 10, 2018, that Tanzania's population has risen over fivefold from 10 million at independence in 1961 to over 54 million people today. He vowed Government commitment to support peasants and herders and create a conducive environment for Tanzanians to engage effectively in production. "To achieve this goal the Government is considering giving out sufficient land to the people" (Kideghesho 2020).

It is indisputable that for centuries, herders and some peasants in Tanzania and elsewhere in Africa have been victims of conservation policies. Therefore, the President's decision can be considered as rational and inevitable, though this will bear some repercussions on large mammals through the loss of habitats, dispersal areas, and corridors. However, as the President correctly put, his decisions should not be taken as a free license to graze and allow further encroachment into protected areas. Rules of the game should be in place to realize a "win–win" scenario (Kideghesho 2020).

[1] Dodoma is Tanzania's capital city and Government Headquarters where the parliamentary sessions take place.

12.5.4 Escalating Human–Wildlife Conflicts

Besides encroachment, increased proximity between protected areas and human landscapes increases physical contact between humans and wild animals. Farms on wildlife corridors, dispersal areas, and areas at the edge of the protected area boundaries are prone to destruction by wild animals. Likewise, risks of livestock depredation and wildlife-induced accidents to people are higher in areas that are rich in wildlife. Occasionally, people respond to damage and costs caused by wildlife through retaliatory killing by spearing or poisoning the problematic and dangerous species. The cases of retaliatory killing have been reported in different parts of the country as shown in Table 12.7 (also see Fig. 12.4).

Table 12.7 Examples of reported incidences of retaliatory killing of wildlife species in Tanzania

Area	Species, when, and number	Source
1. Tarangire-Manyara ecosystem	From 2004 to 2013: A total of 226 lions (an average of 25 lions per annum) killed in retaliation for livestock depredation. In 2015: 6 lions were killed	Tarangire Lion Project cited in http://www.thecitizen.co.tz/News/national/Lion-attack-victims-flee-hospital-at-night/.... The Citizen, January 5, 2015
2. Nyichoka village (Western Serengeti)	2018: 11 lions	https://www.ippmedia.com/en/news/kingwangalla-orders-arrest-lion-killers-serengeti
3. Loliondo Game Controlled Area (Kertalo and Orkiu villages near the Serengeti National Park border)	September 2012: Over 40 rare wild dogs killed in the Loliondo Game Controlled Area by people claiming that the animals killed 157 goats and 4 cows which belonged to them. The people lit fires in the caves in which the dogs lived	https://www.serengeti-wildlife.com/.../40-wild-dogs-killed-in-ngorongoro-tanzania
4. Ngorongoro Conservation Area	2016: Eight lions were speared to death by villagers after they strayed out of the Ngorongoro Conservation Area	http://www.xinhuanet.com/english/2016-04/20/c_135294332.htm
5. Ruaha National Park	14th February 2018: Mass poisoning incident leaved 6 lions and 74 vultures dead near Ruaha National Park, Tanzania	Ruaha Carnivore Project: https://www.facebook.com/ruahacarnivoreproject/posts/1885442098195035

Fig. 12.4 Retaliatory killing – 6 of the 11 lions which were killed by Nyichoka villagers, Western Serengeti

12.5.5 Increased Wildlife Crime

Numerous studies have correlated human population growth and wildlife crime in Tanzania's wildlife areas. For example, illegal hunting in the Great Serengeti Ecosystem has been growing annually to cater for the increased demand of bushmeat. Illegal hunting is used as a coping strategy against poverty and lack of employment among the youth entering the job market (Campbell and Hofer 1995; Loibooki et al. 2002; Kideghesho et al. 2005; Knapp 2007; Bitanyi et al. 2012).

Wildlife crimes also occur in areas beyond the vicinity of the wildlife-protected areas, especially urban areas. The urban populations provide market for wildlife products including bushmeat. Growing population in these areas increases demand and, consequently, raises the price. The higher price stimulates more poaching in order to meet demand of products to potential consumers. Furthermore, the low capacity of the employment sector to absorb a majority of the youth entering the job market annually forces some of the unemployed youth to resort to poaching as a way of earning a living (Kideghesho 2016a).

12.5.6 Decline of Population of Large Mammals

Destruction of wildlife habitats, blockage of wildlife corridors, human–wildlife conflicts, and wildlife poaching have all worsened due to human population growth and rapid urbanization, leading to a decline and extinction of large mammals (Brashares et al. 2001; Hassan 2007; Jones and Davenport 2009; Kideghesho et al. 2006; Kideghesho and Msuya 2012; Mtui et al. 2016). A case in point is Kilombero

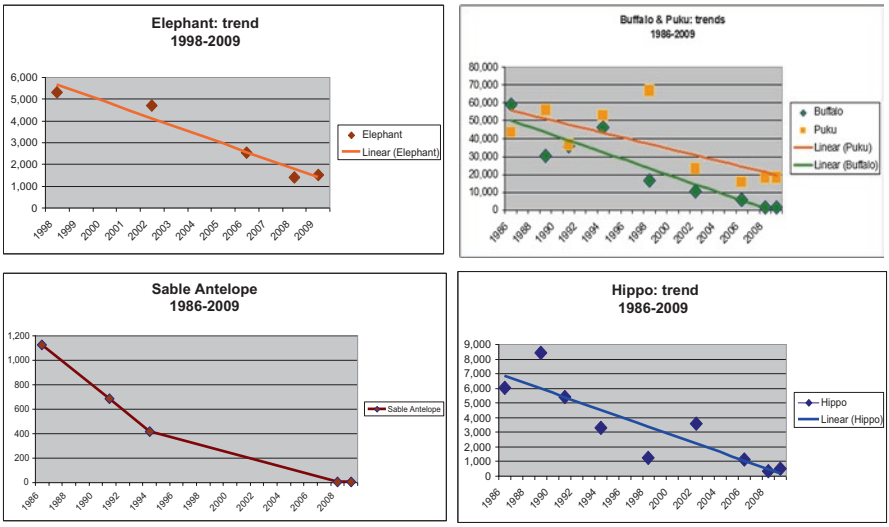

Fig. 12.5 Trends of five large mammals in Kilombero Game Controlled Area (1986–2009)

Game Controlled Area where human population growth over the past three decades has led to an expansion of agriculture and pastoralism at the expense of large mammals, including elephants, sable antelope, puku, hippo, and buffalo (Fig. 12.5).

An influx of refugees from Rwanda, Burundi, and the Democratic Republic of Congo to the western part of Tanzania in the 1990s serves to expound the impacts of population growth on large mammals. Destruction of wildlife habitats and poaching, enhanced by availability of firearms from the war-waged countries, caused a dramatic decline of large mammals in Burigi-Biharamulo Game Reserves. In 1998, census indicated a decline of the ungulate population to 10% of the population that was recorded in 1990 (Jambiya et al. 2007; Stoner et al. 2007; Kideghesho and Msuya 2012; Kideghesho et al. 2013). Thirteen species that were hunted for bushmeat were affected, including buffalo (*Syncerus caffer*), bush buck (*Tragelaphus scriptus*), eland (*Tragelaphus oryx*), hartebeest (*Alcelaphus lichtensteini*), impala (*Aepyceros melampus*), reedbuck (*Redunca redunca*), roan antelope (*Hippotragus equines*), sable antelope (*Hippotragus niger*), sitatunga (*Tragelaphus spekii*), topi (*Damaliscus korrigum*), waterbuck (*Kobus ellipsiprymnus*), warthog (*Phacochoerus aethiopicus*), and zebra (*Equus burchelli*) (Jambiya et al. 2007; Kideghesho et al. 2013).

12.5.7 Ecological Cascade Effect

In many ecosystems, loss of large mammal species is associated with a risk of an ecological cascade effect (Ripple et al. 2015; Ripple et al. 2016; Poulsen et al. 2018; Diplock et al. 2018; Daskin and Pringle 2018). Cascade effect is defined as a series

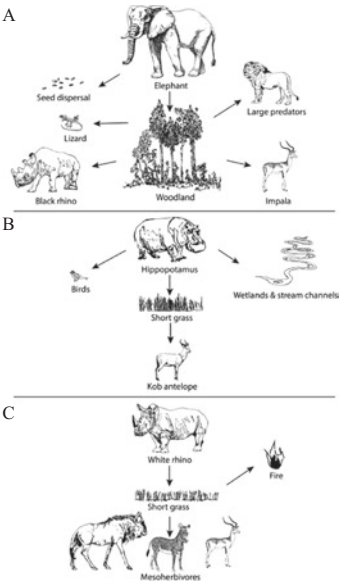

Fig. 2: Conceptual diagrams showing the effects of elephants, hippopotamus, and rhinoceros on ecosystems.

A. African elephants (*L. africana*) convert woodland to shrubland, which indirectly improves the browse availability for impala (*A. melampus*) and black rhinoceros (*D. bicornis minor*). By damaging trees, African elephants facilitate increased structural habitat complexity benefiting lizard communities. Predation by large predators (for example, lions) on small ungulates is facilitated when African elephants open impenetrable thickets. African elephants are also great dispersers of seeds over long distances.

B. Hippopotamus (*H. amphibius*) maintain pathways in swamps, leading to new channel systems. Areas grazed by hippopotamus are often more nutritious, which benefits kob (*K. kob*). Mutualism and semi-parasitism between hippopotamus and birds have also been shown, via the latter eating insects on hippopotamus.

C. White rhinoceros (*C. simum*) maintain short grass patches in mesic areas, which increases browse areas for other grazers (impalas, wildebeests, *C. taurinus*, and zebra, *Equus burchelli*) and changes fire regimes.

Source: Ripple et al. (2016).

Fig. 12.6 The ecological importance of keystone species on survival of co-occurring species

of secondary extinctions that is triggered by the primary extinction of a key stone species in an ecosystem. The conceptual diagram (Fig. 12.6) demonstrates the ecological importance of keystone species on the survival of co-occurring species.

Documentation showing the ecological cascade effects caused by loss of large mammals is either inadequate or lacking in Tanzania. However, based on scientific judgment and experience from elsewhere in the world, it is unlikely that Tanzania has escaped this scenario, having lost some of its keystone species, including elephant and rhino, in some localities.

12.5.8 Economic Loss

The tourism sector in Tanzania excels because of the diversity of large mammals as a principal resource. Therefore, it is apparent that their loss will have a detrimental impact on the local and national economy. Over 80% of the country's tourism is supported by wildlife, particularly large mammals, including elephants, rhinos, lions, leopards, and buffalo. In the 2016–2017 financial year, the tourism sector accounted for 17.5% of the GDP and 25% of foreign exchange, ranking second after agriculture (WWF 2015). *The 2018 Tourism Statistical Bulletin* released by the Ministry for Natural Resources and Tourism (URT 2018b) indicates that a number of tourists visiting wildlife-protected areas and other attractions in the country grew

from 1,137,182 in 2015 to 1,505,702 in 2018, an increase of 32.4%. The county's tourism earnings rose by 26.8% from USD 1901.95 million recorded in 2015 to USD 2412.30 million in 2018. The tourism sector creates 600,000 direct jobs and over a million indirect jobs.

Besides game viewing, tourist hunting is another popular form of wildlife utilization. The hunting industry has grown considerably in the past two decades, and Tanzania is among the leading hunting destinations in the world. The earnings from tourist hunting between 2011 and 2016 amounted to approximately 145 billion Tanzanian Shillings (URT 2018a). Other forms of wildlife utilization permitted in Tanzania are resident hunting and wildlife farming and ranching.

12.6 Conclusions and Recommendations

In the face of growing human population and rapid urbanization, conservation of wildlife resources, particularly large mammals, is increasingly becoming a challenge. As human population increases, the demand for natural resources, plants, and wildlife resources also increases. When humans seek to meet these demands, they destroy the habitats, migratory corridors, and dispersal areas, and they overexploit the wildlife resources including large mammals. On the other hand, conversion of wild lands to urban land cover leads to loss of wildlife habitats, especially if it occurs in the vicinity of, or within the wildlife reserves. Urban areas are also important markets for wildlife products, including bushmeat.

In order to realize effective conservation of large mammals in the face of growing anthropogenic pressures resulting from population growth and rapid urbanization, and consequently avoid negative effects associated with their loss, multiple strategies should be employed. These strategies, among others, should aim at:

- Treating human population growth as a matter of urgency and a cross-cutting issue.
- Reducing a need for more land conversion by improving agriculture, the biggest employer in rural areas. The strategy should be to use small acreage to produce more.
- According adequate and legal protection status to wildlife corridors to prevent further encroachment.
- Preparing and implementing land-use plans to preclude conversion of wildlife habitats to uses that are incompatible with wildlife conservation.
- Improving people's living standards through provision of alternative and sustainable livelihood strategies that do not involve destruction of wildlife areas or illegal hunting.
- Implementing policy decisions to shape the long-term effects of urbanization in the vicinity of protected areas.
- Implementing policies that promote wildlife conservation as important land use capable of competing effectively with land uses that are ecologically destructive.

- Subsidizing goods and services that will motivate people to refrain from activities that negatively impact wildlife habitats and species.
- Devising a compensatory scheme for losses that communities incur from wildlife damage in order to prevent retaliatory killing and other actions which are harmful to wildlife.
- Promoting and supporting further studies on impacts of human population growth and urbanization to uncover more facts and solutions for effective conservation of large mammals.

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