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Wildlife Conservation on the Rangelands of Eastern and Southern Africa: Past, Present, and Future☆

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ABSTRACT

Our objective was to assess the status of the large native rangeland mammals in the eastern and southern African countries focusing on conservation strategies that will benefit the animals, their rangeland habitats, and the people who live in this region. Eastern and southern African rangelands are renowned for supporting a globally unique diversity and abundance of large mammals. This wildlife legacy is threatened by changing demographics, increased poaching, habitat fragmentation, and global warming, but there are reasons for optimism. After sharp declines from 1970 to 1990 across Africa, wildlife populations in some countries have subsequently increased due to incentives involving sport hunting and ecotourism. National parks and protected areas, which have been critically important in maintaining African wildlife populations, are being increased and better protected. Over the past 50 years, the number of parks has been doubled and the areas of several parks have been expanded. The major problem is that no more than 20% of the national parks and reserves set aside for wildlife are adequately protected from poaching. The southern African countries where wildlife has recently thrived have robust hunting and ecotourism programs, which economically benefit private landowners. Considerable research shows rural communities dependent on rangelands can be incentivized to participate in large mammal conservation programs if they can economically benefit from wildlife tourism, sport hunting, and the legal sale of animal byproducts. Community-based wildlife conservation programs can be economically and ecologically effective in sustaining and enhancing African wildlife biodiversity, including rhinos, elephants, and lions. Low-input ranching wild ungulates for meat and hunting may be an economically viable alternative to traditional range livestock production systems in some areas. However, in many situations, common-use grazing of livestock and wildlife will give the most efficient use of rangeland forages and landscapes while diversifying income and lowering risk.

Introduction

The countries of eastern and southern Africa are renowned for their diversity and abundance of wildlife, especially hoofed mammals, and large carnivores. Over the past 50 years, major changes have occurred in the status of wildlife populations in this region. The eastern (Kenya, Tanzania, Uganda) and southern African countries included here (Republic of South Africa—hereafter referred to as RSA, Botswana, Zambia, Zimbabwe, Namibia, Mozambique) are especially famous for the "big five" game animals (elephant [*Loxodonta africana*]; two species of rhinoceros, black [*Diceros bicornis*] and white [*Ceratotherium simum*]; leopard [*Panthera pardus*], lion [*Panthera leo*], and Cape buffalo [*Syncerus caffer*]). Several studies have recently become available on the status and conservation of wildlife, as well as the intricate relationships of people, wildlife, and rangelands in the eastern and southern African countries. However, articles reviewing this information are lacking. Our primary objectives are to assess the status of eastern and southern African wildlife populations and their rangeland habitats, focusing on the large mammals (especially the big five); discuss the importance of game parks and reserves; examine the roles of ecotourism and sport hunting in African wildlife conservation; and discuss management policies and strategies that can be implemented to conserve eastern and southern Africa's wildlife legacy and rangelands while also benefitting local ethnic communities. Our secondary objective is to identify important literature regarding wildlife conservation on rangelands in eastern and southern Africa.

Historical Perspective

For hundreds of years before the 1800s, the peoples of eastern and southern Africa were primarily pastoralists who herded cattle in

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coexistence with wildlife. A somewhat harmonious balance existed, but it was disrupted when Europeans began to settle in the region in the early 1800s (Pearce, 2010). The key event changing this balance was rinderpest, a deadly cattle virus brought to the Horn of Africa in 1887 by an Italian expeditionary force with infected cattle from Asia. Rinderpest spread quickly from Eritrea to Ethiopia and then to other parts of Africa, killing cattle and hoofed wild animals in immense numbers (Normile, 2008; Pearce, 2010). Indirectly, it also devastated human populations because their livelihoods heavily depended on meat and milk from their cattle, which were also used as draft animals (Phoofolo, 1993; Pearce, 2010). Roughly between one third and two thirds of the people in eastern Africa died from a combination of rinderpest and drought in the early 1890s (Phoofolo, 1993; Pearce, 2010). Wildlife populations recovered much more quickly than human populations in the period following the rinderpest epidemic. The high wildlife abundance, but low human population that occurred in eastern and southern Africa in the early 1900s, was a historical aberration caused by rinderpest. The rinderpest epidemic was an important factor in the rapid colonization of eastern and southern Africa, as well as in the limited resistance from most ethnic societies. The tsetse fly, which carries a virus (trypanosomiasis) causing sleeping sickness among cattle and humans, was positively impacted by habitat changes that occurred in response to the decimation of livestock herds by rinderpest (Pearce, 2010). This further delayed recovery of human populations and livestock numbers after the rinderpest epidemic subsided, but wild animals benefitted because they have some immunity to trypanosomiasis. During the latter half of the 20th century, rinderpest across Africa was gradually brought under control through cattle vaccination programs with the last major African outbreak in the 1982—1984 period (Spinage, 2003; United Nations, 2015). The United Nations Food and Agriculture Organization declared rinderpest formally eradicated worldwide in 2011 (McNeil, 2011). We refer readers to Sinclair and Arcese (1995), du Toit (2003), Collins and Burns (2007), Carruthers (2008), Reid (2012), and Sinclair et al. (2015) for detailed discussions of the history of human and wildlife interactions in the eastern and southern African region. Rinderpest, tsetse flies, and other disease impacts on African wildlife, livestock, and human populations are discussed by Osofsky (2005), Matthiessen and Douthwaite (2009), and Pearce (2010).

Colonial Settlement Period

Ivory, precious metals, gems, and slaves were the initial motivations for European countries (especially Great Britain) to explore and then colonize the eastern and southern Africa regions. The development of the steamship in the early 1800s greatly facilitated travel, trade, exploration, and colonization in the region. The early colonial era began in the 1830s, with initial settlements on coastal areas, followed by interior settlements after exploration, mostly by British explorers such as David Livingstone (1813—1873) (Jeal, 2001). Rapid settlement of interior eastern Africa began in 1903 with the construction of a railroad from the Kenya coast at Mombasa with termination at Kisumu on Lake Victoria in Uganda (Mwaruvie, 2006).

African Big Game Hunting Era

The abundance and diversity of wildlife was an important factor in attracting European settlers into the eastern and southern Africa region in the late 1800s. Several fortunes from ivory were made by European elephant hunters in the 1880—1915 period (Hunter, 1954; MacKenzie, 1988; Adams, 2004). Around 1910, abundant game animals in combination with more efficient sea and rail transportation initiated the colorful and romantic era of the African hunting safari led by a "white hunter" most associated with Kenya, Tanzania, and Uganda (Hunter, 1954; Herne, 1999; Balfour and Balfour, 2001; Adams, 2004). The famous East African hunting trip of Theodore Roosevelt in 1909 created a safari craze among wealthy sportsmen in Europe and the United States. In that era, African big game hunting was viewed as a highly fashionable aristocratic activity involving courage, stamina, skill with firearms, and sportsmanship (Hunter, 1954; Bonner, 1993; Herne, 1999). After World War I, the popularity of the eastern African hunting safari escalated due to the financial boom in the 1920s, improvements in transportation (the automobile), and communication infrastructure. The British government strongly supported safari hunting because it reduced the high populations of large dangerous animals that were an impediment to agricultural development and generated income through the sale of hunting licenses (Hunter, 1954). Safari hunting in Kenya reached its peak around 1963 when Kenya gained independence from Great Britain. In the early 1960s, Kenya still had abundant wildlife populations, infrastructure development had made prime hunting areas easily accessible, international airplane transportation facilitated travel, the United States had a booming economy, movies had romanticized the safari, and hunting was a favorite sport of some legendary American movie actors. Safari hunting suffered a setback in 1973 when Kenya banned elephant hunting followed with a ban on all big game hunting in 1977. However, it has continued into the present in several African countries, although it is no longer possible to take all the big five on a single hunt (Lindsey et al. 2007). We note the 1977 big game hunting ban in Kenya was primarily in response to rampant elephant and rhino poaching, coupled with pressure on Kenya from international animal welfare organizations rather than excessive legal sport hunting (Herne, 1999; Pack et al. 2013). As an example, in 1972 Kenya issued only 19—34 rhino hunting permits, but over 1 000 rhino horns were imported into Hong Kong from Kenya (Herne, 1999).

Wildlife Decline and Partial Recovery

Starting in the late 1960s, a combination of factors caused rapid declines in wildlife populations in several eastern and southern Africa countries. These factors involved, most importantly, escalated poaching but also a rapid human population increase, habitat loss and fragmentation, poorly regulated hunting, lack of wildlife protection in national parks, and civil wars in countries such as Mozambique and Uganda (Herne, 1999; Adams, 2004; Lindsey et al. 2007; Carruthers, 2008; Pack et al. 2013). Across Africa since 1970, a roughly 60% decline has occurred in large mammal populations on protected areas based on a study by Craigie et al. (2010). However, wildlife population trends varied greatly by region and country. On the basis of various estimates during the 1970s and 1980s, large high-value animals such as elephants, lions, and rhinos in Kenya decreased by 70% or more outside of national parks and declines near 40—70% occurred inside national parks (Norton-Griffiths, 2007; Nelson et al. 2009; Western et al. 2009; Ogutu et al. 2011; Martin, 2012, 2014). We have focused on Kenya because of its high popularity for safaris and the lack of quantitative data on wildlife trends in the 1970s and 1980s for other countries. However, we note Tanzania also experienced major wildlife population declines due to poaching in the 1970s and suspended hunting for some animals for a brief period (Pack et al. 2013).

Although excessive sport hunting and habitat loss are commonly blamed as major causes for the sharp declines in African wildlife populations in the 1980s and 1990s, the major problem was actually poaching (Herne, 1999; Pack et al. 2013). The number of animals legally taken by sport hunting in this period appears to be well under 10% of those taken by poachers and was generally at sustainable levels (Herne, 1999; Coogan, 2012; Pack et al. 2013). The amount of habitat that potentially could be occupied by the big five across Africa was still high through the 1980s. However, rapidly expanding globalization, government corruption, lack of funds for wildlife law enforcement, and inadequate international laws governing the rhino horn and ivory trade led to a severe poaching crisis (Herne, 1999; Coogan, 2012; Pack et al. 2013). Elephant population declines in Kenya actually accelerated in the 1974—1976 period (45% loss) following the 1973 sport hunting ban (Coogan, 2012; Pack et al. 2013). The hunting ban appears to have

increased elephant poaching as hunting operators had previously provided protection on lands in their concessions (Coogan, 2012; Pack et al. 2013). Tanzania, which quickly reinstated its hunting program after a brief ban, has much better maintained its wildlife populations than Kenya (Pack et al. 2013), which we will discuss in more detail later. We refer the reader to Coogan, (2012) for a detailed discussion of how political corruption and international pressure from animal welfare groups resulted in Kenya's decision to ban hunting in 1977.

Beginning in the early 1990s, a remarkable turnaround in wildlife populations began in some southern African countries, and it remains in progress (Bond et al. 2004; Lindsey et al. 2007; IUCN, 2016). However, the degree of increasing abundance varies considerably by country and animal species (Lindsey et al. 2007; Child, 2009). Important factors in the turnaround include increased protection for animals and their habitat; creation of private game reserves; strengthening of international agreements that restrict trade in endangered species and animal by-products (especially ivory and rhino horn); increase in number of national parks and bioreserves; expansion of several existing national parks; increased role of the United Nations Economic, Scientific, and Cultural Organization (UNESCO) in providing international protection to unique wildlife areas such as the Serengeti; the rise of ecotourism; and the development of game ranching for sport hunting and meat (Adams, 2004; Bond et al. 2004; Lindsey et al. 2007; Carruthers, 2008; Pack et al. 2013). As examples of the success of these measures, savanna and forest *(L. cyclotis)* elephants combined increased from about 400 000 to 700 000, white rhinos increased from about 8 000 to 17 000, and black rhinos increased from 2 400 to nearly 3 000 by 2005 (Lindsey et al. 2007). Populations of several African ungulates, other mammals, and bird species also increased significantly (Lindsey et al. 2007). The primary current conservation challenges involve rhino, elephant, and lion populations, which we will discuss later.

Wildlife Habitat Protection in African Countries

Large Areas Set Aside for African Wildlife

We do not view lack of habitat as a primary short-term threat to eastern and southern African wildlife, although in the long term this could change, due to human population increase and associated habitat fragmentation. Since 1980, a major positive step in world wildlife conservation has been the greatly expanded protection of endangered animals and their habitats. This has occurred through strengthened international wildlife laws and the establishment of large nature reserves and parks, especially in African countries. Wildlife-protected areas have been expanded more than fourfold in area over the past 40 yr and now cover approximately 15% of the world's land surface (Chape et al. 2008; Craigie et al. 2010; World Bank, 2014). Currently, nearly every African country has large areas set aside as national parks, nature reserves, conservancies, and other forms of protected areas (over 400 across Africa), to sustain and enhance wildlife biodiversity (World Bank, 2014; Wikipedia, 2017a). We refer the reader to Wikipedia, (2017a) for detailed descriptions of the various African wildlife protected areas and to the World Bank (2014) for the percentage of protected areas for different countries in the world. Although virtually every country has multiple protected areas, much more land is protected in the southern half of Africa than the northern half (World Bank, 2014). Namibia and Zambia lead in percentage of area protected (38%), with Tanzania (32%) in third, Botswana (29%) in fourth, and Zimbabwe (26.6%) in fifth places (World Bank, 2014). However, RSA (8.8%), Kenya (12.4%), Mozambique (17.2%), and Uganda (16%) all have large amounts of their land area under protection (World Bank, 2014). Kenya is a leader in number of national parks with 23, followed by RSA with 21, Zambia with 20, and Tanzania with 18. These four countries also have several large national reserves and other types of protected areas. People in local communities can inhabit reserves, but they are excluded from national parks. Over the past 20 yr, several African national parks have been expanded and new ones have been created. Even countries like Sudan, Ethiopia, and Angola that are not noted for wildlife tourism have large areas in national parks. A listing of the major national parks in eastern and southern African countries, based on land area and tourism importance, is provided in Table 1.

Table 1
Primary protected wildlife areas in eastern and southern Africa denoting country, size, and world heritage status.

Wildlife-protected areas[1]	Country	Size[2] (ha)	World heritage sites
Chobe N. P.	Botswana	1 169 583	No
Moremi Game Preserve	Botswana	492 115	No
Amboseli N. P.	Kenya	39 206	No
Lake Nakuru N. P.	Kenya	18 908	No
Samburu N. P.	Kenya	16 501	No
Nairobi N. P.	Kenya	11 721	No
Tsavo East and West N. P.	Kenya	2 281 342	No
Masai Mara R.	Kenya	151 002	No
Gorongosa N. P.	Mozambique	3 770 000	No
Etosha N. P.	Namibia	2 227 469	No
Kgalagadi Transfrontier P.	R.S.A./Botswana	3 885 120	No
Kruger N. P.	R. S. A.	1 948 630	Yes
Selous Game Reserve	Tanzania	4 478 815	Yes
Lake Manyara N. P.	Tanzania	33 671	No
Tarangire N. P.	Tanzania	258 008	No
Kilimanjaro N. P.	Tanzania	168 873	Yes
Ngorongoro Conservation Area	Tanzania	809 481	Yes
Serengeti N. P.	Tanzania	1 476 346	Yes
Ruaha N. P.	Tanzania	2 026 333	No
Bwindi Impenetrable N. P.	Uganda	33 153	No
Kafue N. P.	Zambia	864 439	No
Hwange N. P.	Zimbabwe	1 464 609	No
Victoria Falls N. P.	Zimbabwe	12 331	No

[1] Subunits include Kalahari National Park in Republic of South Africa and Gemsbok National Park in Botswana.
[2] Area size is from Wikipedia, 2017a, b.

UNESCO and African Wildlife Protection

It is our observation that few people know that many of the world's unique natural and historic man-made wonders are protected under international law through UNESCO. This includes the most important of the African parks from a biodiversity/ecological uniqueness standpoint. UNESCO was formed in 1945 with the goals of designating and protecting world landmarks, historical sites, natural wonders, and man-made wonders (UNESCO, 2009). These wonders, referred to as "World Heritage Sites" by UNESCO, are protected by international law (1972 Convention Concerning the Protection of the World Cultural and Natural Heritage) (UNESCO, 2009; Wikipedia, 2017b). Therefore violators, including political leaders, military commanders, and other government officials, who directly or indirectly damage world heritage sites, are considered international criminals. They are subject to severe punishment if found guilty when brought before the International Court of Law at The Hague in The Netherlands. UNESCO has strong support from nearly all countries of the world. Only five countries (Somalia, Nauru, Liechtenstein, Timor-Leste, Tuvalu) do not belong to UNESCO. At present, a total of 1 052 World Heritage sites have been established and listed (UNESCO, 2017). Several of the African national parks including the globally famous Serengeti (Fig. 1) are world heritage sites.

Funding African Wildlife Protection and Conservation

Poaching Is Primary Threat to African Wildlife

The primary short-term threat for African wildlife is much more a problem of poaching than a lack of habitat, so we highlight the importance of increasing protection through law enforcement. Due to inadequate funds, roughly 20% of the land area in national parks and reserves receives active protection to prevent poaching (Mansourian

Figure 1. Serengeti white-bearded wildebeest *(Connochaetes mearnsi)* and plains zebra *(Equus quagga)* on the Serengeti National Park in Tanzania. The Serengeti, one of the world's top 10 natural wonders, is renowned for its wildlife and grassland landscapes. (Photo by Jerry Holechek.)

and Dudley, 2008; Lindsey et al. 2016). Consequently, due to inadequate law enforcement, most wildlife-protected areas in Africa are not functioning effectively (Craigie et al., 2010; Lindsey et al. 2014). Between 1970 and 2005, a 59% decline occurred in large animal populations across African protected areas (Craigie et al. 2010). The largest declines occurred in western African countries, with intermediate declines in eastern Africa. However, the southern African countries generally maintained or increased their populations. Although the findings from this study were disappointing, it was concluded that many species owe their existence to protected areas, so they are vital for wildlife conservation.

Law enforcement is focused on those areas where ecotourism and sport hunting are significant, which are primarily the national parks/reserves listed in Table 1. Outside of these protected areas, the welfare of wildlife depends heavily on the attitudes of indigenous people and how their livelihoods are impacted by wildlife (Norton-Griffiths, 2007; Conniff, 2009; Western et al. 2009; Ogutu et al. 2011; Lindsey et al. 2014). We share the view of several experts that the key to sustaining wildlife across Africa is to focus on making wildlife an important economic asset to ethnic communities. Ecotourism, sport hunting, bushmeat consumption, and the sale of animal by-products are the basic ways that rural African communities can benefit from wildlife conservation, which we discuss later.

Funding Sources for African Wildlife Conservation

Various African wildlife experts emphasize that inadequate funding is the major obstacle in establishing viable African wildlife protection and conservation programs (Lindsey et al. 2007, 2014, 2016; Cousins et al. 2008; Craigie et al. 2010; Pack et al. 2013). African governments in general do not financially support conservation programs outside of national parks and reserves. Therefore, alternative sources of conservation funding are necessary. An example of a successful funding source in the United States is the Pittman-Robertson Act, which levies a tax on sporting arms and ammunition (later expanded to other products) (Anderson, 2001; Bolen and Robinson, 2003; Pack et al. 2013). These funds are collected by the federal government and reapportioned to the states for use in wildlife conservation programs. A similar tax program could be developed in some African countries. Because of corruption, taxes to promote wildlife conservation in African countries would require strict supervision to ensure that these funds are assigned to specified wildlife conservation projects such as law enforcement, population monitoring, habitat improvement, species restoration, and community-based conservation projects. These programs should be developed with strict accountability rules and should be monitored by outside nongovernmental organizations. For a detailed discussion of how different countries finance wildlife conservation programs, a comparison of their relative effectiveness, and recommendations on how to enhance funding in African countries, we refer the reader to Pack et al. (2013). Law enforcement practices proven to be effective in different situations on African protected areas are discussed in detail by D'udine et al. (2016).

Another innovative approach is to allow landholders, community groups, and investors outside protected areas to lease and sell game animals to private operations involved in ecotourism and hunting (Wilson et al. 2016). In effect, this would establish a policy of devolving user rights, or ownership of wildlife, to landholders. This market-based incentive, principally through the lucrative big game hunting and ecotourism industries, would promote conservation actions including captive breeding of endangered species, restoration of wildlife species with restricted distributions, and increasing wildlife abundance. The policy of privatizing wildlife is firmly established in RSA but needs to be implemented throughout the region. We view ending the hegemony of some governments over wildlife resources to be critically important in developing sustainable conservation programs at the community level.

Payments for Ecosystem Services

Ecosystem system services are basic processes (e.g., climatic stability, biodiversity, water purification, nutrient cycling, air purification) essential for human life performed by natural or near natural landscapes (West, 1993). Direct payments by tourist companies to community landholders for provision of ecosystem services can be an effective tool to maintain wildlife habitat and conserve biodiversity (Norton-Griffiths, 2007; Nelson et al. 2009). Under this approach, communities are paid to voluntarily restrict activities harmful to wildlife such as permanent settlement, agricultural land conversion, and tree felling for charcoal production (Nelson et al. 2016). As an example, a consortium of tourist operators made direct monthly payments to a village located in a key wildlife dispersal area adjacent to Tarangire National Park in Tanzania (Nelson et al. 2009). As part of this arrangement, salaries and equipment were provided for four village scouts to participate in wildlife monitoring. Although settlement was restricted, seasonal cattle grazing could be continued because it did not conflict with wildlife conservation and was economically important to the community. We refer readers to Di Minin et al. (2016), and Pack et al. (2013) for additional discussion of funding approaches for wildlife conservation in Africa.

Importance of Ecotourism in Conserving African Wildlife

During the past 30 yr, wildlife ecotourism in the eastern and southern Africa region has become increasingly important economically, as well as in providing incentives for wildlife conservation. Wildlife ecotourism is defined as environmentally responsible travel involving viewing and photographing wild animals in their natural habitat (Newsome et al. 2005; Honey, 2008; International Ecotourism Society, 2017). It commonly involves an adventure travel tour package with a safari involving stays in eco-lodges or tent camps. Most wildlife tourists are from the United States followed by Western Europe, Canada, and Australia, although its popularity is growing in China and Japan. It has become one of the most prestigious forms of recreation in today's globalized world. Important features typical of wildlife ecotourism are visits to areas in high ecological condition, conservation education, contribution of funds for conservation, and minimization of deleterious effects on natural landscapes (Newsome et al. 2005; International Ecotourism Society, 2017).

The potential growth of ecotourism and wildlife ranching is best exemplified by RSA. This country is at the forefront in ecotourism because of its high-quality national parks and private wildlife reserves, excellent

quality and variety of tourist accommodations, stable government, and diversity of outdoor activities. In RSA, over half of ecotourism and 80% of nature conservation occurs on private lands (van der Merwe and Saayman, 2003).

Positives and Negatives of Ecotourism

Ecotourism has played an important role in sustaining and in some situations increasing wildlife in eastern and southern Africa. It has given economic value to many endangered animals and therefore provided critical incentives for conservation of wildlife and their habitat (Akama et al. 2011; INTOSAI, 2013; UNWTO, 2014; Schaul, 2014). Commonly recognized benefits of wildlife ecotourism include provision of income to local communities, generation of funds for wildlife conservation, provision of funds for African governments through tourist visas and national park user fees, generation of employment at various levels ranging from tour guides to staff needed for hotels/lodges, and generation of funds for antipoaching enforcement (INTOSAI, 2013, UNWTO, 2014).

Although the benefits are many, there are important criticisms of how wildlife ecotourism is typically conducted. Infrastructure such as roads, airports, and hotels/lodges needed for large-scale ecotourism have some adverse impacts on protected wildlife habitats (INTOSAI, 2013). Wildlife behavior modifications sometimes occur from increased disturbance and human interactions. An important criticism is that little of the money paid by wildlife tourists benefits local communities in terms of improving schools, sanitation, domestic water availability, and food production and as direct-income payments (Groom and Harris, 2008; Akama et al. 2011; INTOSAI, 2013; Somerville, 2015). However, the magnitude of this concern varies by country, by area within country, by community, and by tourist company (Groom and Harris, 2008; Rushby, 2011; Somerville, 2015). From a wildlife conservation standpoint, a Kenya study indicated that the spread was more important than the quantity of money derived from wildlife tourism (Groom and Harris, 2008). It was recommended that at least one member of every extended family receive some benefit from wildlife. An essential responsibility of the ecotourism companies is to make sure that ethnic land users/landholders actually receive significant monetary and nonmonetary benefits for wildlife conservation (Rushby, 2011; Somerville, 2015). When this does not occur, wildlife is often jeopardized regardless of legal protection (Hazzah et al. 2014; Quammen, 2014; Somerville, 2015). Conversely, the effectiveness of monetary and other incentives provided to pastoral communities by tourist companies to implement wildlife conservation practices has been well documented (Nelson et al. 2009; Rushby, 2011; Hazzah et al. 2014). Wildlife tourists can make an important contribution to wildlife conservation by selecting only ecotourism companies that validate they are providing a meaningful part of their profits to the ethnic landholders/landusers of the lands visited in their tours. Later, we discuss policy changes that will allow African communities to derive greater benefits from wildlife conservation and associated wildlife tourism. We refer readers to van der Merwe and Saayman (2003, 2005) for detailed economic assessments of the value of ecotourism on game farms in RSA.

Role of Sport Hunting in African Wildlife Conservation

How Sport Hunting Has Helped Wildlife Recovery

Sport hunting has played a major role in recovery and conservation of wildlife populations in some African countries. After considering wildlife conservation models used by different countries of the world, Pack et al. (2013) concluded those models involving controlled hunting were more effective in sustaining wildlife populations and their habitat than those in which hunting was banned. This poses the question of how hunting could contribute to wildlife conservation. The simple explanation is that hunting, when well managed, creates financial incentives for landholders to sustain game species and their habitat (Lindsey et al. 2006, 2007, 2012; Norton-Griffiths, 2007; Pack et al. 2013). Very importantly, it generates income that governments can use for wildlife conservation and protection (Pack et al. 2013). As a point of interest, we note that during the early 1900s, hunters played a key role in the establishment of wildlife-protected areas in various African countries (Fitter and Scott, 1978; Adams, 2004).

Status of African Sport Hunting

Sport hunting is allowed in 23 sub-Saharan African countries and is popular, widely practiced, and economically important. Abundant hunting opportunities are available for several wild ungulates but limited and expensive for the big five (Lindsey et al. 2007; Pack et al. 2013; IUCN, 2016). White rhinos are hunted on a limited basis in RSA (IUCN, 2016). In addition, a few conservation black rhino hunts, so named because most of the funds are channeled into rhino conservation projects, are auctioned by Namibia and RSA (Knight and Emslie, 2015; IUCN, 2016). Wealthy hunters can legally take Cape buffalo and leopard in several African countries (Lindsey et al. 2007; IUCN, 2016). Elephant and lion hunting are allowed in the southern African countries and Tanzania, although both are restricted and very costly ($35,000 to $75,000) (Lindsey et al. 2007; Pack et al. 2013).

Conservation Benefits of Sport Hunting

Sport (trophy) hunting for recreation is an important wildlife conservation tool because it gives wildlife value while leaving a relatively small footprint. However, it has staunch opponents that typically argue the killing of game animals for recreation is inhumane and morally wrong. We will focus on sport hunting as conservation and income tools. We refer the reader to Rinella (2014), Mathiesen (2015), Lindsey et al. (2016), Rivera (2016), Muposhi et al. (2016), and Nelson et al. (2016) for recent discussions on the controversies and ethics of African sport hunting. Some benefits of African sport hunting discussed by Lindsey et al. (2007) include generation of income in areas where alternatives such as ecotourism are not available, reduction of illegal hunting (poaching), provision of a tool for problem animal control, and high revenue yield per client with minimal environmental impact. Another benefit is that concessionaires holding hunting privileges in remote areas help prevent poaching (Pack et al. 2013). Sport hunting is compatible with other land uses such as livestock production, firewood extraction, and ecotourism when properly managed (Lindsey et al. 2007). Although sport hunting is regulated in countries of eastern and southern Africa where it is legal, there have been problems of overharvest of certain species (e.g., lion) and corruption in implementation in some countries (Lindsey et al. 2007; Leader-Williams et al. 2009; IUCN, 2016; Nelson et al. 2016). Kenya in 1977 and, most recently, Botswana in 2014 (on public lands) have banned sport hunting (Clotuche, 2014; Maruping-Mzileni, 2015; Saayman, 2015).

Modern sport hunting typically involves controls over various aspects of wildlife harvest, so populations are maintained or increased. These controls involve species that can be killed, numbers of animals that can be taken, locations where hunting is permitted, timing and length of hunting seasons, and permissible weapons (Anderson, 2001; Bolen and Robinson, 2003; Lindsey et al. 2007; IUCN, 2016).

Numerous examples from Eurasian, North American, and southern African countries indicate that sport hunting can play a critical role in wildlife conservation, including species considered rare and endangered. Sport hunting can generate funds for wildlife law enforcement and management, and it can create monetary incentives to sustain and improve wildlife habitat (Anderson, 2001; Bolen and Robinson, 2003; Lindsey et al. 2007, 2016; Norton-Griffiths, 2007; Pack et al. 2013; Adams, 2015; IUCN, 2016). Excessive harvest has contributed to the decline of certain wildlife species such as lion (Lindsey et al. 2012, 2013a, 2013b; Brink et al. 2016; Stein et al. 2016). However, wildlife population declines can also result when hunting is banned as

incentives and funds for conservation are diminished (Norton-Griffiths 2007; Lindsey et al. 2007, 2016; Conniff 2009; Pack et al. 2013; Adams 2015). We recognize that when animals become rare and endangered, complete protection is sometimes warranted. Wildlife, especially large predators, and grazing animals that compete with livestock for forage are typically viewed as liabilities to be eliminated unless landowners can generate income through the sale of hunting opportunities, animal by-products, and/or meat (Norton-Griffiths, 2007; Conniff, 2009, Kay, 2009; Nelson et al. 2013; Pack et al. 2013; Saayman, 2015; Christy, 2016).

Effects of Hunting on African Wildlife Populations

There is compelling evidence that complete bans of sport hunting can have adverse effects on wildlife populations. As an example, Kenya, which has banned hunting for 40 years, has a steep declining trend in wildlife populations (60 − 70% decline in large grazing and predatory animals outside protected areas) compared with upward trends in RSA, Namibia, and Zimbabwe, which have actively developed sport hunting over the past 3 decades (The Economist, 2007; Kay, 2009; Lansing, 2010; Nelson et al. 2013; Pack et al. 2013; Maruping-Mzileni, 2015). It has been well documented that many ethnic landuser/landholder groups in Kenya view wildlife as liability and lack incentives for wildlife conservation (Groom and Harris, 2008; Pack et al. 2013; Hazzah et al. 2014; Somerville, 2015). Large-scale poisoning by indignant landusers/landholders is emerging as a much more serious threat to African wildlife than any form of hunting (Barley, 2009; Torchia, 2017).

On the other hand, because of financial incentives involving hunting, wild herbivore populations on private lands in RSA increased from a half million in the 1960s to 6 million presently (Carruthers, 2008; Taylor et al. 2016). In Namibia, wildlife populations on private land doubled between 1970 and 2000 (Van Schalkwyk et al., 2010). This is because private landowners were granted legal ownership of game, which incentivized them to develop fee hunting programs in RSA and Namibia (Bond et al. 2004; Lindsey et al. 2007; Carruthers, 2008; Kay, 2009; Nelson et al. 2013; van der Merwe and Saayman, 2014). Wealthy sport hunters, primarily from the United States, have made game ranching a profitable enterprise that is economically competitive and compatible with livestock production (Bond et al. 2004; Lindsey et al. 2007; Cousins et al. 2008; Dry, 2011; Saayman et al. 2011; van der Merwe and Saayman, 2014; IUCN, 2016). In RSA, it has been well documented that wildlife ranches are making important contributions to the economy through taxes, employment, and demand for tourist services (hotels, restaurants, airlines) while sustainably providing game animals for trophy hunters (Bond et al. 2004; Patterson and Khosa, 2005; Saayman et al. 2011; van der Merwe and Saayman, 2014; Southwick Associates, 2015; IUCN, 2016). Legalization of white rhinoceros hunting in RSA has motivated private landowners to raise rhinos on their lands (Pack et al. 2013). This has been a major factor in white rhino numbers increasing from <100 in 1900 to around 20,000 today (Bond et al. 2004; Pack et al. 2013; IUCN 2016). We refer readers to Pack et al. (2013) for additional discussion of the effectiveness of hunting versus no-hunting models for wildlife conservation.

Big Five Conservation and Sport Hunting

The big five African game animals present a special management challenge because they are dangerous to humans but have the high values from sport hunting and wildlife tourism standpoints. Of the big five, leopard and Cape buffalo populations are holding up well in most parts of eastern and southern Africa (Lindsey et al. 2007; IUCN, 2016). However, there is major concern about the future of lion, elephant, and rhino populations, which we discuss later.

The existence of the big five outside of national parks and reserves depends heavily on sport hunting. Income from sport hunting has been a major incentive for certain countries (Tanzania, Zambia, Zimbabwe, Mozambique, Botswana, Namibia, RSA) to retain vast landscapes in native plant communities with minimal infrastructure (Bond et al. 2004; Leader-Williams et al. 2005; Lindsey et al. 2007; Nelson et al. 2013; Pack et al. 2013; IUCN 2016). Otherwise, these landscapes would be converted to more intensive agricultural uses that would drastically reduce or eliminate many species, especially the big five animals, along with cheetah *(Acinonyx jubatus)*, common hippo *(Hippopotamus amphibius)*, and Nile crocodile *(Crocodylus niloticus)*. In RSA, 6 million wild herbivores now occur on roughly 9 000 game ranches (Taylor et al. 2016). In Zimbabwe, expansion of controlled sport hunting has quadrupled wildlife populations (Bond et al. 2004) and doubled the amount of area available to large dangerous wildlife species, which would otherwise be restricted to national parks (Leader-Williams et al. 2005). Namibia, which has actively developed sport hunting, has had major increases in black and white rhinos, lion, elephant, mountain zebra *(Equus zebra)*, and several other wildlife species over the past 30 yr (Leader-Williams et al. 2005; Lindsey et al. 2007). Large blocks of wildlife habitat have also been set aside for ecotourism (Lindsey et al. 2007). However, many rangeland areas are poorly suited for ecotourism due to their remoteness, lack of infrastructure, and low wildlife diversity and density that can provide high-quality sport hunting (Lindsey et al. 2007). Without sport hunting, these lands for the most part would be converted to human-dominated landscapes (settlement, farming, intensive livestock production) that are incompatible with wildlife. Even in the most popular African tourism countries, the amount of land devoted to ecotourism is only a small portion (5%) of total wildlife habitat (Norton-Griffiths, 2007; Winterbach et al. 2015). We note that in RSA about 14% of the land area supports wildlife-based enterprises, compared with 6.3% declared as formal conservation areas (Kreuter et al. 2010).

Sport hunting provides an important mechanism to make large, dangerous animals such as elephant, Cape buffalo, hippo, lion, rhino, leopard, and crocodile an asset to indigenous people who have options of either eliminating or coexisting with these animals (Lindsey et al. 2007; Nelson et al. 2013). Further, sport hunting also provides an income-generating mechanism from the sale of animals that must be removed because they exceed rangeland carrying capacity and/or jeopardize human life (Lindsey et al. 2007). In most of eastern and southern Africa outside of national parks, ecotourism reserves, and game ranches, wildlife law enforcement is weak to nonexistent (Lindsey et al. 2007, 2014, 2016; Craigie et al. 2010). The attitudes and cooperation of indigenous people play a critical role in whether wild animals thrive or perish regardless of hunting bans and other laws directed toward protection (Lindsey et al. 2007, 2014; Norton-Griffiths 2007; Nelson et al. 2013).

Lion Conservation Issues

Local ethnic communities have a strong motivation to eliminate lions because they prey on both livestock and people. Keep in mind that Americans were quick to eliminate wolves *(Canis lupus)*, grizzly bears *(Ursus arctos)*, and mountain lions *(Puma concolor)* from farming and ranching areas for these same reasons.

Roughly, a 50% decline has occurred in African lion populations since 1993 (Bauer et al. 2015, 2016). This is attributed to human conflicts, habitat loss, and illegal or poorly controlled hunting (Nelson et al. 2013; Packer 2015a; Bauer et al. 2015, 2016). Current estimates of African lion populations range from 23 000 to 39 000 (IUCN 2012). Although lions live on unprotected and protected lands, they are increasingly being restricted to large, fenced, protected areas due to human conflicts (Fig. 2) (Pack et al. 2013; Packer 2015b). There is strong doubt lion populations can be sustained outside of national parks with or without hunting bans, unless major economic incentives are provided to local landholders (Lindsey et al. 2012, 2013a, 2016; Nelson et al. 2013; Pack et al. 2013). These incentives involve monetary payments and other benefits to local communities to sustain lions, compensation for livestock losses from lion depredation, and opportunities for income from sport hunting. All three strategies can be effective in lion

Figure 2. Female lion in Amboseli National Park at the base of Mount Kilimanjaro in Kenya. Over the past 20 yr, large declines have occurred in lion populations in most of Africa due to habitat loss, conflicts with humans, and poaching. Both ecotourism and sport hunting give lions value that help in their conservation. (Photo by Jerry Holechek.)

conservation but depend on vibrant ecotourism and sport hunting industries (Rushby, 2011; Lindsey et al. 2012, 2013a; Nelson et al. 2013; Hazzah et al. 2014).

Performance payment programs that reward tribal groups such as the Maasai in Kenya and Tanzania for having lions and other wildlife on their lands may be preferable to compensation programs for depredation losses (Wadhams, 2010; Hazzah et al. 2014). A detailed study on Maasai lands in Kenya over 8 yr found both types of interventions drastically reduced (>80%) the number of lions killed. However, the authors commented that direct performance payment programs appear more cost effective, easier to administer, and less likely to create the moral hazard of poor livestock care than programs providing compensation for livestock losses. It was concluded that lion conservation depends heavily on involvement of local people and should not rely on a single incentive. The incentives should be tailored to the specific values and culture of the relevant communities.

Sport hunting gives lions monetary value and provides a practical mechanism to remove problem lions preying on livestock and people. Kenya, which prohibits lion hunting, has experienced a drastic lion population decline (60—70%) since the 1970s (Western et al. 2009; Nelson et al. 2013; Bauer et al. 2015; Martin, 2015). Kenya currently has about 2 000 remaining lions, which were declining at around 100 animals per year (Barley, 2009). In Kenya, the ban on hunting has been ineffective in stopping the killing of lions on unprotected and protected lands (national parks and reserves) by local communities (Gathura, 2009; Hazzah et al. 2009; Somerville, 2015). Tanzania, which has more lions than any other country (about 16 800, 40% of African lions), has had smaller declines in lion populations than most other African countries including Kenya (Nelson et al. 2013; Bauer et al. 2015). Tanzania attributes its capability in sustaining high lion populations, in part, to legally regulated sport hunting, which gives them monetary value. RSA and Namibia have increasing lion populations because of relocation and reestablishment, along with associated fencing for sport hunting (Lindsey et al. 2013a; Nelson et al. 2013, Bauer et al. 2015).

An important question currently being studied by wildlife scientists is what level of lion harvest optimizes sustainable lion populations, maintains prey species, and minimizes human wildlife conflicts (Cousins et al. 2008; Lindsey et al. 2012; Loveridge et al. 2016). A major issue relating to lion harvest is that too many lions can adversely impact other wild animal populations (Cousins et al. 2008). However, currently overharvest of lions is considered to be a bigger problem than underharvest on many areas where sport hunting is permitted. On the Hwange National Park in Zimbabwe, a detailed long-term study found reducing the level of lion trophy hunting resulted in a 62% increase in the number of lions (Loveridge et al. 2016). This study provided evidence that poorly regulated trophy hunting can adversely impact lion populations and their behavior. However, the authors did state that well-regulated quotas on lion harvest may be compatible with their conservation. It was noted that lion populations can quickly recover when overharvest is curtailed due to their high fecundity rate. Several papers point out that while overharvest by sport hunting has contributed to lion declines in some situations, it has also been an important factor in giving them value that encourages their conservation (Lindsey et al. 2012, 2013a, 2016; Nelson et al. 2013; Pack et al. 2013; Brink et al. 2016). This was why the US Fish and Wildlife Service in October 2016 resumed legal lion trophy imports from RSA, which has successfully implemented an approved lion conservation plan. Lion harvest strategies that can be used to avoid overhunting are discussed in detail by Lindsey et al. (2012, 2013a), Nelson et al. (2013), and Brink et al. (2016). We refer the reader to Packer (2015b) for a comprehensive perspective on African lion status and conservation approaches.

Elephant Conservation Issues

Management of elephant populations is one of the major and most contentious wildlife conservation challenges in eastern and southern Africa. Although elephant populations have generally been declining in northern Africa, the opposite situation exists in much of southern Africa, where numbers are high, stable, or increasing (Blanc, 2008; Chase et al. 2016). Botswana leads in savanna elephant numbers with an estimated 130 000, followed by Zimbabwe with 82 000, RSA with 17 000, and Mozambique with 10 000 (Chase et al. 2016). Our recent observations are consistent with Duffy (2010), Barrett (2012), Moseley (2013), Jammot (2015), and Constable (2016) that some national parks and reserves, as well as community lands in Africa, are overstocked with elephants. Although high elephant populations may seem desirable, there is concern that in certain areas they are causing rangeland degradation, reducing habitat quality for other wildlife, damaging crops grown by villagers, reducing forage for livestock, and endangering human lives (Fig. 3) (Cousins et al. 2008; Duffy, 2010; Moseley, 2013; Jammot, 2015). Poisoning of waterholes to kill elephants and other animals by disgruntled pastoral community members and poachers is a serious emerging threat to Africa's wildlife (Torchia, 2017). This problem could rapidly escalate like the poisoning problem with lions if measures are not soon taken to make elephants an asset rather than a liability to local communities.

Figure 3. This exclosure on the Amboseli National Park in Kenya, taken in June 2008, shows the potential effects of elephants on vegetation. (Photo by Jerry Holechek.)

Figure 4. Greater kudu *(Tragelaphus strepsiceros)*, like many other African antelopes, occur in scrublands and woodlands where browse is the principal forage. (Photo by Jerry Holechek.)

Elephant Conservation Strategies

The most practical solution to problems caused by excessive elephant populations is to reduce numbers to carrying capacity by culling or translocation, although the latter option will not be economically feasible in many situations. Sport hunting, sale of ivory, and consumptive use can make elephants a major economic asset rather than a liability to pastoral/subsistence agricultural communities (Bonner, 1993; Duffy, 2010; Jammot, 2015). However, there is considerable opposition to sport hunting of elephants from environmental groups, mostly in the United States and Europe (Russo 2014; Jammot, 2015). Nevertheless, sport hunting of elephants does legally occur in certain eastern and southern African countries such as RSA, Namibia, Mozambique, Tanzania, and Zimbabwe. Although the Conference on International Trade in Endangered Species (CITES) bans the sale of ivory, considerable illegal ivory trade occurs, aided by corrupt officials (Duffy, 2010; Christy, 2016). There is growing support for changing the laws and policies so that pastoral communities can economically benefit from elephants through sport hunting, consumptive use, and sale of ivory. The opponents' concern is that elephants will be excessively harvested, leading to declining populations as occurred before the CITES ban on ivory trading in 1989. Before 1989, when ivory sales were legal, the income went almost entirely to a few privileged people outside pastoral communities (Adams and McShane, 1992; Bonner, 1993; Duffy, 2010). Therefore, villagers had no incentive to sustain elephant populations and had justifiable reasons to resent them. We refer readers to Pack et al. (2013) and Christy (2016) for more detailed discussions of African elephant conservation issues with a focus on poaching problems, the ivory trade, and the role of CITES in elephant protection.

Rhino Conservation Issues

The decimation of global rhino populations is one of the greatest tragedies involving wildlife over the past 50 yr. Since 1970, the global rhino population has dropped by more than 90% due primarily to poaching for its horn (Emslie et al. 2012). Between 1960 and 1995, poachers reduced the black rhino population in Africa by 98%, with only 2 500 animals remaining (Emslie et al. 2012). For the past 20 yr, major recovery programs have been under way for rhinos in both Africa and Asia, but since 2007 they have been jeopardized by a resurgence in poaching (Pack et al. 2013; Christy, 2016).

The high-profile rhino poaching problem in large part is due to the exclusion of local communities from the economic benefits of rhino conservation and harvest. In terms of monetary value, rhinos are arguably the world's most valuable land animal because of the high value of their horn, high status as trophies with sport hunters, and importance as a cornerstone animal on African ecotourism areas (Harris and Freeman, 2013; Pack et al. 2013; Christy, 2016; t'Sas-Rolfes, 2016). Mature white and black rhinos have a value of about $350 000 for their horn alone, which can be sustainably removed without harming the animal (Christy, 2016). Sport hunters are willing to pay more than $200 000 to legally hunt a wild black rhino in its natural habitat (Knight and Emslie, 2015). Alternatively, green hunts are available in which the rhino is shot with a tranquilizer dart gun rather than killed. Thus, African rhinos are potentially a major source of income for communities deriving their livelihoods from rangelands (Harris and Freeman, 2013; Christy, 2016; t'Sas-Rolfes, 2016). However, because of laws governing land and wildlife ownership, along with restrictions on international trade in rhino horn by CITES, rhinos are viewed more as a liability than an asset by many African communities. This is because they can be a dangerous animal, a potential competitor with livestock for forage, and can put ranchers and law enforcement officers in jeopardy from poaching syndicates. Resentment over the loss of tribal lands for parks and reserves without compensation is a primary reason local people are commonly willing accomplices to rhino poaching operations (Duffy, 2010). The actual poachers are typically impoverished local people who receive a minor payment ($100 to $5 000) for killing a rhino and selling its horn to criminal syndicates that market it in Asian countries such as China, Taiwan, Vietnam, or Thailand (Duffy, 2010; Christy, 2016; t'Sas-Rolfes, 2016). Even though poachers can be shot on sight by game wardens in several African countries and penalties for convicted offenders can be severe, this has not been an effective deterrent to rhino poaching. Local communities tend to be sympathetic to poachers and may depend on poaching for income. To reverse this situation, a fair percentage of profits generated from rhino conservation programs must be apportioned to local communities so that they are incentivized to protect rhinos and discourage community members from poaching (Harris and Freeman, 2013; Christy, 2016; t'Sas-Rolfes, 2016).

Rhino Farming as a Conservation Tool

Horns can be easily removed from rhinos without harmful effects, just as wool can be removed from sheep. Rhino horn is quickly regrown. It is argued by some conservationists that if the CITES trade ban on rhino horn was modified to allow its commercial production, there would be a major incentive to increase rhino populations (Duffy, 2010; Child, 2012; Biggs et al. 2013; Christy, 2016; Mahoney, 2017a and 2017b). Concurrently, poaching would be reduced due to an increased rhino horn supply, making poaching less profitable. Rhino owners would have more funds to protect rhinos from poaching and would be incentivized to raise more of them. Stiff trade sanctions on countries involved in illegally selling rhino horn have been proposed, but this may be less practical and effective than allowing commercial rhino horn production.

On the basis of experiences with crocodiles in Africa and vicuña *(Vicugna vicugna)* in South America, commercial farming of rhinos could be effective in reducing poaching and facilitating population recovery. In the 1950s, crocodiles in southern Africa were decimated by poaching because of the high value of their hides for leather (Cott and Pooley, 1971). However, the development of commercial crocodile farming in the 1960s minimized the poaching problem (Revol, 1995). Crocodiles are now abundant on many eastern and southern Africa game parks and reserves, and they are common in several rivers, lakes, and marshlands that are not under protection. In the United States, crocodile and alligator farming has been important in population recovery since the 1960s (Moyle, 2013.) The vicuña in South America provides another example of how legalization of farming (wool) could facilitate rhino recovery, although this approach has critics (Nowak, 2015). An economic model of rhino farming impacts on poaching by Bulte and Damania, (2005) gave an uncertain outcome regarding

whether it would decrease or increase poaching. Rhino farming appears to be a last resort option if other measures such as development of synthetic rhino horn, improved law enforcement, possible trade sanctions, and campaigns to change Asian consumer behavior fail. Child (2012) and Biggs et al. (2013) make compelling arguments that allowing a regulated legal trade in rhino horn, legalizing rhino horn farming, and devolving the ownership of rhinos to private, communal, and state landholders would alleviate the poaching problem and allow rhino population recovery.

If poaching was brought under control, rhino populations in many areas of Africa could rapidly be restored if restocking occurred because extensive habitat remains (Pack et al. 2013). There are now black and white rhino captive breeding programs on privately owned Texas rangelands to provide a reserve of animals for restocking native lands in Africa (Forsyth, 2015). A similar program is underway in Australia (Verhagen, 2016). However, the rhino poaching problem must be resolved before restocking is feasible. We refer the reader to Pack et al. (2013) for a more detailed discussion of potential strategies involving both hunting and no-hunting models for recovery of African rhino populations.

Importance of Community ownership and Management in African Wildlife Conservation

A major problem confronting southern African wildlife is that wildlife ownership is generally at the state rather than local community level. We do recognize RSA and Namibia as exceptions where landowners are major owners of wildlife. Protection of wild animals and their habitat heavily depends on the commitment of people at the local level to wildlife conservation (Lindsey et al. 2007, 2014; Duffy, 2010; Nelson et al. 2013; Pack et al. 2013). Much of Africa consists of diverse ethnic communities with their own cultures, customs, and languages. These ethnic groups in many cases lack formalized legal ownership of their historic tribal lands and associated water, minerals, wood, and wildlife resources, on which they depend for their livelihoods (Lindsey et al. 2007; Pica-Ciamarra et al. 2007; Rass, 2012; Holechek et al. 2017). Pastoralism and small-scale farming typically play key roles in providing livelihoods for these ethnic groups (Pica-Ciamarra et al. 2007; Rass 2012). However, ecotourism and sport hunting in many cases could also become major sources of income if legal rights to land and wildlife ownerships were established (Lindsey et al. 2007; Pack et al. 2013; Holechek et al. 2017). We consider pastoralism to be highly compatible with wildlife conservation when it is practiced using scientific range management principles in multispecies grazing programs. However, the political/economic system must facilitate pastoralism in generating income from wildlife, as well as livestock. In most cases, African pastoral communities have limited or no potential to generate income from wildlife due to the political frameworks in the various countries (Lindsey et al. 2007, 2014; Norton-Griffiths, 2007; Duffy, 2010; Nelson et al. 2013).

There are several cases in which African parks and wildlife reserves established over the past 40 yr for ecotourism resulted in displacement and relocation of long-established ethnic communities (Duffy, 2010). These actions compromised or ended their subsistence lifestyles by depriving them of historical grazing and hunting lands. Promised benefits such as education and health services, along with income from ecotourism and sport hunting, never materialized (Duffy, 2010). African governments have typically relegated hunting and ecotourism concessions on community lands to extraneous operators and foreign investors, causing resentment among villagers and pastoralists (Duffy, 2010).

Community-Based Natural Resource Management

We believe Community-Based Natural Resource Management (CBNRM) has much potential to sustain and enhance wildlife populations and biodiversity on southern Africa rangelands that are not part of national parks and reserves. It involves integrating conservation and economic benefits for pastoral/subsistence farming communities that derive their livelihoods from livestock grazing and/or rain-fed crop production (Tsing et al. 1999, Twyman, 2000, Child et al. 2010). A specific ethnic group typically controls these lands such as the Maasai in Kenya or the Zulu in South Africa. The primary concepts in CBNRM are that communities should be allowed to manage the wildlife on their lands and benefit financially from doing so (Tsing et al. 1999; Twyman, 2000). Key premises are that people will conserve a resource only if the benefits exceed the costs of conservation and that people will conserve a resource linked directly to their quality of life. The problems in actual application of CBNRM involve conflicts of interest, avoiding exclusion of less influential community members, and the erosion of involved local institutions (Twyman, 2000; Campbell et al. 2001). Optimizing objectives of socioeconomic development, biodiversity protection, and sustainable use of natural resources can be a formidable, contentious task, especially among people with limited literacy. Although they have imperfections, the United Nations, World Bank, World Wildlife Fund, and various nongovernmental conservation organizations are all supportive of CBNRM, because of its potential to simultaneously enhance wildlife conservation and alleviate poverty. Under CBNRM, sport hunting, distribution of meat from culled animals to community members, selling of wildlife by-products, and wildlife tourism can be used to enhance household income, as well as generate funds for schools, wells, solar heat and electricity, and sanitation facilities. Except for RSA, Namibia, and Zimbabwe, strong government support for CBNRM in Africa has been lacking. CITES restrictions on the sale of ivory and rhino horn are another impediment to CBNRM. Federal governments control sport hunting across eastern and southern Africa, with various communities generally excluded from sharing the revenue from the sale of licenses/tags (Lindsey et al. 2007, 2014). Outsiders are commonly given the hunting concessions on community lands. Nevertheless, CBNRM has given several communities incentives to conserve wildlife (Barnes et al. 2002; Kreuter et al. 2010). Meat from surplus or culled animals and employment in local ecotourism and sport hunting operations or as rangers and tour guides for national parks and reserves have been the primary realized benefits. We refer the reader to Child et al. (2010) for a detailed review of the evolution of CBNRM in southern Africa and future strategy recommendations.

The Savé Story

In RSA, Namibia, and Zimbabwe, several wildlife conservancies have been effective in achieving goals of both wildlife conservation and improving human living conditions. Kreuter et al. (2010) provide three case studies of wildlife conservation under CBNRM in southern Africa. We have chosen the Savé Wildlife Conservancy in Zimbabwe as an example because it has been widely publicized, its history has been well documented, it has received several awards, it is the world's largest nature conservancy (350 000 ha), and it integrates both communal and private land (Alessi and Alessi, 1999; Lindsey et al. 2007; Kreuter et al. 2010; CIC 2016). We refer the reader to Kreuter et al. (2010) for a detailed critique of the history, success, and problems of the Savé Conservancy. The Savé area was converted to a nature conservancy devoted to the restoration of rangeland habitats and wildlife populations in 1992. Previously it was a large livestock ranch with degraded rangeland and depleted wildlife. A long-term plan was developed to foster ecotourism through sustainable wildlife use that involved removal of livestock and fences. A critical foresight was that of sharing economic benefits with surrounding communities, which were densely populated and impoverished. It was recognized by the founders that local community support would be needed for the project to be successful. The conservancy presently plays a major role in managing critically endangered species, such as rhinos and lion. Conservation and research programs have been implemented for several species, including leopard and

Cape hunting (painted) dog *(Lycaon pictus)*. The conservancy supports diverse, thriving wildlife populations composed of more than 4 000 buffaloes, 1 600 elephants, and more than 160 black and white rhinos. Poaching is under control due to the highly trained antipoaching unit and its close ties to local communities, which cooperate in reporting poaching. Cultural tourism and the sale of artisanal products are also important sources of employment to communities within the conservancy. The Savé has well established and respected ecotourism and big game hunting programs.

Despite its conservation successes, the future of the Savé is in doubt. Human encroachment has occurred on 25% of the area in the southern half of the Savé due to Zimbabwe political policies involving land nationalization and population resettlement (Kreuter et al. 2010). Breakdown of local institutions is an important CBNRM problem in Zimbabwe (Campbell et al. 2001). The success of wildlife conservancies in RSA and Namibia is considered higher than in Zimbabwe because property rights are more secure (Barnes et al. 2002; Kreuter et al., 2010). In Namibia, Barnes et al. (2002) documented that conservancies applying CBNRM have been economically effective at local levels, have helped conserve wildlife, and have contributed positively to national development. A detailed review of the economic, social, and conservation value of nature conservancies in RSA and Namibia is provided by Taylor et al. (2016).

Combining CBNRM and Localized Development

In our experience, CBNRM has the most potential for success when combined with localized development projects as discussed by Holechek et al. (2017). The goals of these projects are to improve living conditions, education, healthcare, and incomes of communities, while concurrently enhancing conservation of wildlife, soil, and water resources. Family planning assistance, equal education for both genders, empowerment of women, food self-sufficiency, development of renewable energy, improved sanitation, and development of hand crafts are important components of these projects (Heinberg and Fridley 2016; Holechek et al. 2017). Empowerment and education of women is an especially important part of localized development (Coppock et al. 2011; Coppock and Desta, 2013). In pastoral African cultures, women are often the leaders of collective action groups involved in conservation, education, healthcare, and family planning programs. When significant improvement occurs in their education and quality of life, people have more capability to conserve and improve, rather than unsustainably exploit natural resources on which they depend.

African Rangelands, Wildlife, and Food Security

Food security is a major concern across Africa because of its rapidly increasing human populations, coupled with lagging food production in several countries (Cribb, 2010; Brown, 2012). Sub-Saharan Africa has the highest number and percentage of undernourished people in the world (Cribb, 2010; Brown, 2012; World Hunger Education Service, 2013). Since the 1990s, serious consideration has been given to using African wildlife as a primary source of meat (Ntiamoa-Baidu, 1997). Wild meat or "bushmeat" (meat from wild terrestrial vertebrates derived from subsistence or commercial hunting) has been a human source of "free" meat for millennia. Historically, it has been readily available in local markets and is now globally in demand. Presently, bushmeat is mostly illegal and there is concern that unsustainable harvest (overhunting) will result in regional wildlife extirpations (Lindsey et al. 2013b; Ripple et al. 2016). Increasing or even sustaining livestock production in many regions of Africa may not be economically or environmentally viable because of land degradation, global warming, poor soils, and erratic rainfall. Africa's rapidly increasing human population compounds problems relating to bushmeat and livestock production. Meat affordability, as well as availability, is a growing problem for many African communities, which is discussed in some detail by Holechek et al. (2017).

Growing human populations, increasing middle class wealth, improved hunting technologies, and improved transportation in developing nations, in combination with rising global demand for food and other products from wild animals, is jeopardizing the future of many wildlife species (Heubach, 2016; Ripple et al. 2016). Conservation actions to provide sustainability of African wild mammals used as bushmeat are discussed by Pack et al. (2013), Heubach, (2016), and Ripple et al. (2016). These include more legal protection of wild animals, development of funding, incentives and programs for wildlife management, provision of alternative foods to communities relying on bushmeat, education and family planning, development of international policies that discourage demand for threatened wildlife as a source of food and other products, and increased wildlife law enforcement. Critical strategies advocated by Ripple et al. (2016) for sustainable bushmeat production in large part follow our discussion of community-based natural resource management and localized development. Approaches that benefit both local people and wildlife will be necessary to avoid a future of hungry, desperate people inhabiting "empty landscapes" (Ripple et al. 2016).

African Game Animals as a Meat Source

Many species of African wildlife, when properly managed, have shown potential as a higher-quantity, lower-input source of meat compared with traditional livestock ranching (Dasman and Mossman, 1961; Hopcraft, 1986, 2000; Grootenhuis and Prins, 2000; Eves and Ruggiero, 2002). In most arid and semiarid parts of Africa, native ungulates in many ways are better adapted to range conditions than livestock. Bushmeat has long been a key component of food security for poor, marginalized African communities. This is especially the case in sub-Saharan Africa, where more than 500 species (primarily wild ungulates and rodents) are consumed (Redmond et al. 2006). For example, pastoral, impoverished ethnic groups in the Serengeti area of Tanzania still hunt large- and small-sized wild mammals for nutritional and income purposes (Mfunda and Røskaft, 2010). There is a growing market for bushmeat in African urban middle- and upper-class communities as a luxury and/or health food, with purported medicinal properties. Hence, because it has commodity value, bushmeat can be a major source of cash revenue. Where it is a primary source of protein, bushmeat can be a critical safety net during food shortages caused by drought, economic downturns, and political instability. We refer the reader to for a detailed comparison of the nutritional values of several African species used as meat sources.

In summary, it is probable some African rangelands can be more productive in terms of human protein needs, if bushmeat is emphasized over domestic livestock production. Therefore, it has potential as another form of game ranching and wildlife cropping. Common-use grazing involving stocking with combinations of wild and domestic animals, based on rangeland research studies, may maximize meat production and financial returns in other situations. An example of a successful common-use wildlife/livestock grazing program under community-based natural resource management in the Rift Valley of Kenya is provided by Tyrrell et al. (2017).

Economics of African Wildlife Ranching

Studies on the economic effectiveness of African wildlife ranching indicate many variables determine how its profitability will compare with conventional livestock operations. Economic research on semiarid savanna rangeland in Zimbabwe by Kreuter and Workman (1994, 1996) did not support claims that wildlife ranching was more profitable than cattle ranching on areas with sparse wildlife populations, under the price/cost and government regulatory conditions of the early 1990s. However, in areas with abundant wildlife populations, mixed

cattle/wildlife operations were at least as profitable as cattle-only operations. It was concluded that mixed cattle/wildlife operations were financially, economically, and ecologically optimal where wildlife was abundant. This was because these operations involved lower stocking rates and spread ranching risks. In this study, the authors acknowledged that government policy, the mix of wild animal species, and the ranching cost/price structure influenced results. High-hunting-value animals such as buffalo, elephant, and lion were not present on either low or high wildlife abundance areas, which lowered wildlife profitability. A key conclusion was that many factors are involved in determining whether livestock-only, wildlife-only, or mixed operations will be most profitable on semiarid southern African rangelands. Therefore, broad generalizations in many cases will not apply. Each situation must be assessed independently in terms of government policies, the cost/price structure, the mix of wildlife species available, the abundance of wildlife species, land ownership, and the culture of local communities.

Community outreach programs oriented toward socioeconomic development that link biodiversity conservation inside and outside of protected areas should receive more evaluation and emphasis (Wells and McShane, 2004). Low-input wildlife production systems are an alternative to traditional domestic livestock ranching, and they have potential to elevate rangeland productivity, enhance conservation of biodiversity, and alleviate poverty and hunger. However, more studies such as those of Kreuter and Workman (1994, 1996) are needed to evaluate the socioeconomic effectiveness of these approaches. We refer the reader to Taylor et al. (2016) for a detailed review of the economic, social, and conservation value of wildlife ranching in RSA, including recommendations for the future.

Woody Plant Encroachment and Wild Ungulates

Woody plant encroachment and dominance is becoming a major problem in many African arid and semiarid ecosystems. One of the major African challenges is increasing livestock production on rangelands where woody species are replacing grasses (Estell et al. 2012). The common management response has been to increase domestic ungulate numbers, especially goats. This often further damages rangelands along with causing extreme wildlife declines (Ogutu et al. 2016). Managing for the wide diversity of African wildlife, especially antelopes that consume a broad range of shrubs, is an alternative management approach to increasing goat numbers that needs to be evaluated in terms of meat offtake, management inputs, rangeland productivity, and environmental sustainability (Fig. 4). Developing breeds of goats, sheep, and cattle through genetic selection that are efficient shrub consumers will be a slow, uncertain process. Selecting native ungulates for semidomestication for efficient use of arid shrublands may be more effective and quicker than developing better adapted livestock (Mysterud, 2010). However, in our opinion, both strategies should be pursued. We refer the reader to Smit (2004) for a detailed review of woody plant encroachment problems and restoration approaches using tree thinning in southern Africa.

Conclusion

We view the future for southern Africa wildlife as one of both peril and hope. The primary long-term peril is that at the present growth rate (near 2.2% per yr), the human population across Africa will likely double in the next 35 − 40 yr. There is growing alarm over the rapid human population increase occurring in Africa (Conniff, 2014; Rieff, 2015; Ban, 2016; Holechek et al. 2017). Resources to support the drastic population increases in African countries are generally meager (Cribb, 2010; Brown, 2012; Rieff, 2015; United Nations, 2015). At present, about 40% of the people in eastern and southern Africa are impoverished and exist on $1.25 or less per day (Simmons, 2015). Most of the land is semiarid to arid with few rivers that can be dammed for irrigated agriculture and hydropower. Only 10—15% of the land can be sustainably farmed (CIA, 2017). Large-scale industrial development has so far not occurred in most of the eastern and southern African regions due to political instability and corruption that discourages foreign investment, lack of infrastructure, lack of education and workforce skills, cultural resistance to modernization, and oversupply of basic goods from eastern Asian countries (Alpert, 2013; Rieff, 2015; Holechek et al. 2017). If human living conditions sharply deteriorate, some countries in eastern and southern Africa could devolve into failed states, such as Somalia and South Sudan (Brown, 2011; Rieff, 2015; Ahmed, 2017). Poorly regulated hunting and poaching to meet basic human survival needs could quickly decimate wildlife populations if a major food and/or energy shock jolted the world economy or sustained drought occurred. Reduced numbers of wild animals and political instability in Africa, coupled with declining income in Western countries from a new financial crisis, would adversely impact ecotourism and sport hunting. Without vibrant ecotourism and sport hunting, we consider the future of eastern and southern African wildlife to be precarious.

The positives for eastern and southern African wildlife are that the animals are both culturally and economically of great importance to many rural communities. Livestock and wildlife production from rangelands can be complementary with sound range management. Together, they can increase food and income to many rural communities across eastern and southern Africa. Income from wildlife ecotourism and sport hunting is presently critical in providing foreign exchange currency to most eastern and southern African countries. Large areas of lands have been set aside for wildlife throughout this region. There are many innovative options related to ecotourism, sport hunting, and sale of animal by-products that can make wildlife a major source of income to rural communities. If legalized and carefully regulated, the sale of both ivory and rhino horn could potentially play an important role in elephant and rhino conservation. However, it is critical that the income generated is apportioned primarily to pastoral communities that inhabit the lands outside of national parks and reserves. These nonprotected lands can provide additional habitat for rhino, elephant~~s~~, and several other endangered wildlife species.

At present, no more than 20% of the protected area in eastern and southern Africa receives adequate law enforcement (Lindsey et al. 2014, 2016). Roughly $300 to $500 million is annually spent, but $2 to $3 billion is needed for adequate law enforcement and management of protected areas. Most of the funding for protection comes from ecotourism and sport hunting, rather than African governments. A major challenge is to find additional sources of funds from the world community for adequate law enforcement and management in African national parks and reserves. Secondly, it is essential these funds arrive where they are intended and not siphoned off along the way. We refer the reader to Lindsey et al. (2014, 2016) and Pack et al. (2013) for ~~a~~ detailed discussion of the funding problem and possible ways to improve funding and performance of African protected areas.

The rapid human population growth and static to declining living conditions for most rural African communities is causing alarm, especially after the epic 2015 migrant crisis in Europe (Brown, 2011, 2012; Conniff, 2014; Rieff, 2015; Allen, 2016; Ban, 2016; Ahmed, 2017; Holechek et al. 2017). Several development experts warn of a major humanitarian crisis if there are no major policy directives and commitments by the developed countries to slow human population growth and improve living/environmental conditions across Africa (Cribb, 2010; Brown, 2011, 2012; Rieff, 2015; Ban, 2016; Ahmed, 2017; Holechek et al. 2017). We believe that CBNRM combined with sustainable localized development programs can be an effective approach in accomplishing goals of slowing population growth, improving living conditions, improving soil and water resources, conserving rangelands, and conserving wildlife in eastern and southern African countries. However, both funding and expertise for these projects will have to be drastically expanded for them to make a meaningful difference. African and international governments, as well as nongovernmental international aid organizations, must cooperate in funding, coordinating, and

establishing already proven successful natural resource management programs at the community level.

Formalized community ownership of land and wildlife does not occur throughout most of the region (Lindsey et al. 2007; Pica-Ciamarra et al. 2007; Brown, 2011, 2012; Shen and Sun, 2012; Jenet et al. 2016; Holechek et al. 2017). This is the primary cause of many disputes among various ethnic groups and between ethnic groups and their governments. In our view, providing communities legal rights to their historical grazing/farming lands is an essential step in setting the stage for rangeland and wildlife conservation through CBNRM and localized sustainable development.

The tremendous diversity and abundance of wildlife in eastern and southern African countries is one of the world's most spectacular natural wonders. It will be an epic tragedy for future generations if this world heritage is destroyed through forces of overpopulation, political instability, greed exacerbated by corruption, unsound natural resource use, and ethnic conflict over natural resources. The affluent, developed countries of the world can do much to help sustain Africa's wildlife legacy by providing funds, expertise, and other incentives for wildlife conservation, rangeland management, CBNRM, and local development projects. Very importantly, they can block African development projects that have large-scale adverse impacts on wildlife habitat and other natural resources, displace native peoples from their lands, and negatively impact ecosystem services. In our opinion, education, family planning, and wildlife protection from poaching should receive heavy emphasis in sub-Saharan African development programs funded by various government and non-governmental international aid organizations. We are encouraged by the actions taken so far by UNESCO, the United States, the European Union, and the regional countries themselves. However, much more will have to be done in the future to secure eastern and southern Africa's wildlife and rangeland legacy. We believe educating people across the globe on the status and needs of African wildlife and rangelands is a critical part of conservation. Much can be done to improve living conditions for people and wildlife in African countries if judicious incentives, policies, education, and financial assistance programs are provided. In closing, we consider it essential that local communities receive monetary and other benefits from wildlife conservation on the lands they use for their livelihoods.

References

Adams, W.M., 2004. Against extinction, the story of conservation. Earthscan, London, England, p. 311.

Adams, J.S., 2015. Killing in the name of conservation: can trophy hunting help save Africa wild?. Available at:. thebreakthrough.org/index.php/issues/biodiversity/killing-in-the-name-of-conservation. Accessed 1 June 2015

Adams, J.S., McShane, T.O., 1992. The myth of wild Africa. W. W. Norton and Company, New York, NY, USA, p. 278.

Ahmed, N.M., 2017. Failing states, collapsing systems: biophysical triggers of political violence. Springer, New York, NY, USA, p. 110.

Akama, J.S., Maingi, S.W., Camongo, B.A., 2011. Wildlife conservation, safari tourism, and the role of tourism in Kenya: a postcolonial critique. Tourism Recreational Research 36, 281–291.

Alessi, M., Alessi, D., 1999. Private conservation and black rhinos in Zimbabwe: the Savé Valley and Babiana conservancies. Competitive Enterprise Institute, Washington, D.C., USA, p. 12.

Allen, K.L., 2016. The population problem: not as bad as you might think. Resilience Available at: http://www.resilience.org/stories/2016-11-01/the-population-problem-not-as-bad-as-youmight-think/. Accessed 1 November 2016, p. 280.

Alpert, D., 2013. The age of oversupply. Portfolio/Penguin, New York, NY, USA, p. 280.

Anderson, S.H., 2001. Managing our wildlife resources. 4th ed. Prentice Hall, Upper Saddle River, NJ, USA, p. 540.

Balfour, D., Balfour, S., 2001. Simply safari. Abbeville Press, New York, NY, USA, p. 192.

Ban, Z., 2016. Malthusian catastrophe unfolding across ME-Africa region, with Egypt as a case study. Available at: https://seekingalpha.com/article/4024083-malthusian-catastrophe-unfolding-across-africa-region-egypt-case-study. Accessed 16 November 2016.

Barley, S., 2009. Kenya's lions could vanish within 10 years. The New Scientist Available at: https://newscientist.com. Accessed 16 October 2017.

Barnes, J.I., MacGregor, J., Weaver, L.C., 2002. Economic efficiency and incentives for change within Namibia's community wildlife initiatives. World Development 29, 589–600.

Barrett, P., 2012. The elephant in the room (well one of them). Available at: https://2paragraphs.com/2012/08/africa-the-elephant-in-the-room-well-one-of-them/. Accessed 29 May 2012.

Bauer, H., Chapron, G., Nowell, K., Henschel, P., Funston, P., Hunter, L., MacDonald, D.W., 2015. Lion *(Panthera leo)* populations decline rapidly across Africa except in intensively managed areas. Proceedings of the National Academy Science 112, 14895–14899.

Bauer, H., Packer, C., Funston, P.F., Henschel, P., Nowell, K., 2016. Panthera leo. The IUCN Red List of Threatened Species 2016, e.T15951A107265605 https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T15951A107265605.en Available at: Accesed 10 March 2017.

Biggs, D., Courchamp, F., Martin, R., Possingham, H.P., 2013. Legal trade of Africa's rhino horns. Science 339, 1038–1039.

Blanc, J., 2008. Loxodonta africana. The IUCN Red List of Threatened Species 2008: e.T12392A3339343 https://doi.org/10.2305/IUCN.UK.2008.RLTS.T12392A3339343.en Available at: Accessed 10 March 2016.

Bolen, E.G., Robinson, W.L., 2003. Wildlife ecology and management. 4th ed. Prentice Hall, Upper Saddle River, NJ, USA, p. 605.

Bond, L., Child, B., de la Harpe, B., Jones, B., Barnes, J., Anderson, H., 2004. Private land contribution to conservation in South Africa. In: Child, B. (Ed.), Parks in transition. Earthscan, London, England, pp. 29–61.

Bonner, R., 1993. At the hand of man: peril and hope for Africa's wildlife. Alfred A. Knopf, New York, NY, USA, p. 320.

Brink, H., Smith, R.J., Skinner, K., Leader-Williams, N., 2016. Sustainability and long-term tenure: lion trophy hunting in Tanzania. PLoS ONE 11 (9), e162610.

Brown, L.R., 2011. World on the edge. W. W. Norton and Company, New York, NY, USA, p. 240.

Brown, L.R., 2012. Full planet, empty plates. W. W, Norton and Company, New York, p. 144.

Bulte, E.H., Damania, R., 2005. An economic assessment of wildlife farming and conservation. Conservation Biology 19, 1222–1233.

Campbell, B., Mandondo, A., Nemarundwe, N., Sithole, B., de Jong, G.W., Luckart, M., Matose, F., 2001. Challenges to proponents of common property resource systems: despairing voices from the social forests of Zimbabwe. World Development 29, 589–600.

Carruthers, J., 2008. Wilding the farm or farming the wild? The evolution of scientific game ranching in South Africa from the 1860's to the present. Transactions of the Royal Society of South Africa 63, 160–181.

Chape, S., Spalding, M., Jenkins, M., 2008. The world's protected areas: status, values, and prospects in the twenty-first century. University of California Press, Berkeley, CA, USA, p. 376.

Chase, M.J., Schlossberg, S., Griffin, C.R., Bouche, P., Djiene, S.W., Elkan, P.W., Ferriera, S., Kohi, E., Landen, K., Omondi, P., Selier, J., Sutcliffe, R., 2016. Continent-wide survey reveals massive decline in African savanna elephants. Peer J 4, e2354.

Child, B., Suich, H., Child, B., Spenceley, A., 2009. Grame ranching in Zimbabwe. Evolution and innovation in wildlife conservation. Earthscan, London, England, pp. 127–146.

Child, B., 2012. The sustainable use approach could save South Africa's rhinos. South African Journal of Science 108, 1–4.

Child, B., Barnes, G., Weingast, B.R., 2010. The conceptual evolution and practice of community-based natural resource management in southern Africa. Past, present and future. Environmental Conservation 37, 283–295.

Christy, B., 2016. Deadly trade. National Geographic Magazine 230, 56–81.

CIA (Central Intelligence Agency), 2017. Land use. CIA world factbook. Available at: http://www.cia.gov. Accessed 13 February 2017.

CIC (International Union for Game and Wildlife Conservation), 2016. Savé Valley Conservancy praised for its conservation of wildlife, receives Markhor Award. Available at:. http://www.cic-wildlife.org. Accessed 16 December 2016.

Clotuche, P., 2014. Botswana's hunting ban: bushmen starve, trophy hunters carry on. Survival International Available at: https://www.survivalinternational.org/news/10112. Accessed 16 September 2016.

Collins, R.O., Burns, J.M., 2007. A history of Sub-Saharan Africa. Cambridge University Press, New York, NY, USA, p. 406.

Conniff, R., 2009. The growing specter of Africa without wildlife. Environment 360. Available at: http://e360.yale.edu/features/the_growing_specter_of_africa_without_wildlife. Accessed 27 August 2009.

Conniff, R., 2014. Africa's hidden population explosion is bad news for humans and wildlife. Take Part. Available at: http://www.takepart.com/feature/2014/09/17/africas-hidden-population-explosion-bad-news-humans-and-wildlife. Accessed 17 September 2014.

Constable, H., 2016. The country with too many elephants. BBC News. Available at: http://www.bbc.com/earth/story/20160908-the-country-with-too-many-elephants. Accessed 12 September 2016.

Coogan, J., 2012. Kenya's 35-year hunting ban: for what? African Hunting Gazette. 17:2. Available at: http://www.africanhuntinggazette.com.

Coppock, D.L., Desta, S., 2013. Collective action, innovation, and wealth generation among settled pastoral women in northern Kenya. Rangeland Ecology & Management 66, 95–105.

Coppock, D.L., Desta, S., Tezera, S., Gebru, G., 2011. Capacity building helps pastoral women transform impoverished communities in Ethiopia. Science 334, 1394–1398.

Cott, H.B., Pooley, A.C., 1971. Crocodiles: the status of crocodiles in Africa. Proceedings of the first working meeting of crocodile specialists vol. 2. International Union for Conservation of Nature, Gland, Switzerland.

Cousins, J.A., Sadler, J.P., Evans, J., 2008. Exploring the role of private wildlife ranching as a conservation tool in South Africa: Stakeholder perspectives. Ecological Society 13, 43.

Craigie, I.D., Baillie, J.E.M., Balmford, A., Carbone, C., Collen, B., Green, R.E., Hutton, J., 2010. Large mammal population declines in Africa's protected areas. Biology Conservation 143, 2221–2228.

Cribb, J., 2010. The coming famine. University of California Press, London, p. 248.

Dasman, R.F., Mossman, A.S., 1961. Commercial utilization of game animals on a Rhodesian ranch. Wild Life 3, 7–14.

Di Minin, E., Leader-Williams, N., Bradshaw, C.J., 2016. Banning trophy hunting will exacerbate biodiversity loss. Trends in Ecology and Evolution 31, 99–102.

Dry, G., 2011. Wildlife ranching in perspective. Wildlife Ranching 2011, 24–27.
D'udine, F., Henson, D.W., Malpas, R.C., 2016. Wildlife law enforcement in sub-Saharan protected areas. Monographic Series no. 10. International Union for Conservation of Nature, Gland, Switzerland, p. 98.
Duffy, R., 2010. Nature crime: how we're getting conservation wrong. Yale University Press, London, England, p. 288.
du Toit, J., 2003. The Kruger experience: ecology and management of savanna heterogeneity. Island Press, Washington, D.C., USA.
Emslie, R., Milliken, T., Bibhab, T., 2012. African and Asian rhinoceroses-status, conservation and trade. CITES CoP16 Doc. 54 Annex 2.
Estell, R.E., Havstad, K.M., Cibils, A.F., Hendrickson, E.L., Anderson, D.M., Schrader, T.S., James, D.K., 2012. Increasing shrub use by livestock in a world with less grass. Rangeland Ecology & Management 65, 553–562.
Eves, H.E., Ruggiero, R.G., 2002. Antelopes in Africa: Bushmeat, game meat and wild meat: a question of sustainability. In: Mainka, S., Travedi, M. (Eds.), Links between biodiversity, conservation, livelihoods and food security: the sustainable use of wild species for meat. IUCN, Gland, Switzerland, pp. 73–84.
Fitter, R.S., Scott, P.M., 1978. The penitent butchers: the fauna preservation society 1903-1978. Collins, London, England, p. 48.
Forsyth, J., 2015. Out of Africa: Texans offer sanctuary to endangered rhinos. Reuters. Available at: out-of-africa-texans-offer-sanctuary-to-endangered-rhinos-idUSKBN0O418P20150519. Accessed 19 May 2015.
Gathura, G., 2009. Why Maasai's prefer killing lions to compensation. Standard Media. Available at: https:/standardmedia.co.ke. Accessed 10 October 2017.
Groom, R.J., Harris, S., 2008. Conservation on community lands: the importance of equitable revenue sharing. Environmental Conservation 35, 242–251.
Grootenhuis, J.G., Prins, H.H.T., 2000. Wildlife utilization: a justified option for sustainable land use in African savannas. In: Prins, H.T., Grootenhuis, J.G., Dolan, T.D. (Eds.), Wildlife conservation by sustainable use. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 470–483.
Harris, J., Freeman, R.E., 2013. A business model to save the rhino. The Washington Post. Available at: https://www.washingtonpost.com/business/a-business-model-to-save-the-black-rhino/2013/03/14/983f3194-8b4d-11e2-9f54f3fdd70acad2_story.html?utm_term=.209ceec560b1. Accessed 15 March 2015.
Hazzah, L., Dolremy, S., Naughton, L., Edwards, C., Mwebi, O., Kearney, F., Frank, L., 2014. Efficacy of two lion conservations programs in Maasailand, Kenya. Conservation Biology 28, 851–860.
Hazzah, L., Mulder, B.M., Frank, L., 2009. Lions and warriors: Social factors underlying declining African lion populations and the effect of incentive-based management in Kenya. Biology Conservation 142, 2428–2437.
Heinberg, R., Fridley, D., 2016. Our renewable future. Island Press, Washington, DC, USA, p. 226.
Herne, B., 1999. White hunters: the golden age of the African safaris. Henry Holt and Company, New York, NY, USA.
Heubach, K., 2016. Sustainable use of biodiversity: the case of bushmeat hunting. Network-Forum for Biodiversity Research Germany (Nefo), Berlin Available at:. http://www.biodiversity.de/sites/default/files/products/factsheets/nefo_fact_sheet_sbstta20_6_sub.pdf. Accessed April 2016.
Holechek, J.L., Cibils, A.F., Bengaly, K., Kinyamario, J.L., 2017. Human population growth, African pastoralism, and rangelands. Rangeland Ecology & Management 70, 273–280.
Honey, M., 2008. Ecotourism and sustainable development: who owns paradise?. 2nd ed. Island Press, Washington, DC, USA, p. 568
Hopcraft, D., 1986. Wildlife land-use: a realistic alternative. In: MacMillan, S. (Ed.), Proceedings of the wildlife/livestock interface on rangeland. Inter-African Bureau of Animal Resources, Nairobi, Kenya, pp. 93–101.
Hopcraft, D., 2000. Wildlife land use and the great experiment. In: Prins, H.T., Grootenhuis, J.G., Dolan, T.D. (Eds.), Wildlife conservation by sustainable use. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 267–275.
Hunter, J.A., 1954. Hunter. Hamish Hamilton. p, London, England, p. 242.
International Ecotourism Society, 2017. What is ecotourism? International Ecotourism Society. Available at: http://www.ecotourism.org/what-is-ecotourism. Accessed 14 February 2017.
INTOSAI (International Organization of Supreme Audit Institutions), 2013. Impact of tourism on Wildlife Conservation. Available at:. http://www.environmental-auditing.org/LinkClick.aspx?fileticket=ecrH%2bPLw7Cc%3d&tabid=128&mid=568. Accessed 14 February 2017.
IUCN (International Union for Conservation of Nature), 2012. Red list of threatened species. Version 2012.2. International Union for Conservation of Nature, Gland, Switzerland.
IUCN (International Union for Conservation of Nature), 2016. Informing decisions on trophy hunting. Briefing paper (April 2016). International Union for Conservation of Nature, Gland, Switzerland.
Jammot, J., 2015. Elephant rampage: unintended consequence of Botswana hunting ban. Biznews. Available at: https://www.biznews.com/undictated/2015/05/04/elephant-rampage-unintended-consequence-of-botswana-hunting-ban/. Accessed 5 April 2015.
Jeal, D., 2001. Livingstone. Yale University Press, London, England, p. 456.
Jenet, A., Buono, N., DiLello, S., Gomarasca, M., Heine, C., Mason, S., Nori, M., Saavedra, R., VanTroos, K., 2016. The path to greener pastures: pastoralism, the backbone of the world's dryland. VSF International. Available at: http://vsf-international.org/the-path-to-the-greener-pastures-pastoralism-the-backbone-of-the-worlds-dry-lands. Accessed 2 February 17.
Kay, C.E., 2009. Kenya's wildlife debacle: the true cost of banning hunting. Mule Deer Foundation Magazine 27, 22–27.
Knight, M., Emslie, R., 2015. Black rhino hunt: why killing one bull is worth it for conservation. CNN news. Available at: http://www.cnn.com/2015/05/21/opinions/rhino-hunt-is-conservation/index.html. Accessed 21 May 2015.
Kreuter, U., Peel, M., Warner, E., 2010. Wildlife conservation and community-based natural resource management in southern Africa's private nature reserves. Society for Natural Resources 23, 507–524.
Kreuter, U.P., Workman, J.P., 1994. Government policy effects on cattle and wildlife ranching in Zimbabwe. Journal of Range Management 47, 264–269.
Kreuter, U.R., Workman, J.P., 1996. Cattle and wildlife ranching in Zimbabwe. Rangelands 18, 44–48.
Lansing, D., 2010. Should hunting be allowed in Kenya? David Lansing. Available at: http://davidlansing.com/should-hunting-be-allowed-in-kenya/. Accessed 16 September.
Leader-Williams, N., Baldus, R.D., Smith, R.J., 2009. The influence of corruption on the conduct of recreational hunting. In: Dickson, B., Hudson, J., Adams, J. (Eds.), Recreational hunting, conservation and rural livelihoods. Wiley-Blackwell, Oxford, England, pp. 296–316.
Leader-Williams, N., Milledge, S., Adcock, K., Brooks, M., Conway, A., Knight, M., Mainka, S., Martin, E., Teferi, T., 2005. Trophy hunting of black rhino *(Diceros bicornis)*: proposals to ensure its future sustainability. Journal of Sustainable Tourism 8, 1–11.
Lindsey, P.A., Alexander, R., Frank, L.G., Mathieson, A., Romanach, S.S., 2006. Potential of trophy hunting to create incentives for wildlife conservation in Africa where alternative based land uses may not be viable. Animal Conservation 9, 283–298.
Lindsey, P.A., Balme, G.A., Booth, V., Midlane, N., 2012. The significance of African lionsfor the financial viability of trophy hunting and the maintenance of wild land. PLoS One 7 (1), e29332.
Lindsey, P.A., Balme, G.A., Funston, P. J. Henschel. P. H., and Hunter, L., 2016. Life after Cecil: channeling global outrage into funding for conservation in Africa. Conservation Letters 9, 296–301.
Lindsey, P.A., Balme, G.A., Funston, P., Henschel, P., Hunter, L., Madzikanda, H., Midlane, N., Nyirenda, V., 2013a. The trophy hunting of African lions: scale, current management practices, and factors undermining sustainability. PLoS One 8 (9), e73808.
Lindsey, P.A., Balme, G.A., Becker, M., Begg, C., Bento, C., Bocchino, C., Dickman, A., Diggle, R.W., Eves, H., Henschel, P., Lewis, D., Marnewick, K., Mattheus, J., McNutt, J.W., McRobb, R., Midlane, N., Milanzi, J., Monley, R., Murphee, M., Opgene, V., Phadima, J., Purchase, G., Rentsch, D., Roche, C., Shaw, J., van der Westhuizen, H., Van Vliet, N., Zisadz-Gandiwa, P., 2013b. The bushmeat trade in African savannas: impacts, drivers, and possible solutions. Biology Conservation 160, 80–96.
Lindsey, P.A., Nyirenda, V.R., Barnes, J.L., Becker, M.S., McRobb, R., Tambling, C.J., Taylor, W.A., Watson, F.G., t'Sas-Rolfes, M., 2014. Underperformance of African protected area networks and the case for new conservation models: insights from Zambia. PLoS One 9 (2), e94109.
Lindsey, P.A., Roulet, P.A., Romanach, S.S., 2007. Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. Biology Conservation 134, 455–469.
Loveridge, A.J., Valeix, M., Chapron, G., Davidson, Z., Mtare, G., MacDonald, D.W., 2016. Conservation of large predator populations: demographic and spatial responses of African lions to the intensity of trophy hunting. Biology Conservation 204, 247–254.
MacKenzie, J.M., 1988. The empire of nature: hunting, conservation and British imperialism. Manchester University Press, Manchester, England, p. 340.
Mahoney, S., 2017a. Trade them to save them? Sports Afield 240, 40–42.
Mahoney, S., 2017b. Shane Mahoney discusses if devaluing rhino horn will save the species. Conservation Matters. Available at: http://conservationvision.com. Accessed 16 February 2017.
Mansourian, S., Dudley, N., 2008. Public funds to protected wildlife areas. World Wildlife Fund, Gland, Switzerland.
Martin, G., 2012. Game changer: animal rights and the fate of Africa's wildlife. University of California Press, Berkeley, CA, USA, p. 249.
Martin, G., 2014. Kenya: wildlife loved to death. African Indaba 12, 1–3.
Martin, G., 2015. Lionizing Cecil makes us feel good, but a trophy hunting ban will accelerate slaughter. California Magazine: p. 3, Available at: https://alumni.berkeley.edu/california-magazine/just-in/2015-10-08/lionizing-cecil-makes-us-feel-good-trophy-hunting-ban-will. Accessed 10 December 2015.
Maruping-Mzileni, N., 2015. Hunting in Africa: to ban or not to ban is the question. The conversation: p. 3, Available at: https://theconversation.com/hunting-in-africa-to-ban-or-not-to-ban-is-the-question-44269. Accessed 16 September 2016.
Mathiesen, K., 2015. The idea that hunting saves African wildlife doesn't withstand scrutiny. The Guardian. Available at: https://www.theguardian.com/environment/2015/may/20/the-idea-that hunting-saves-african-wildlife-doesnt-withstand-scrutiny. Accessed 20 May 2015.
Matthiessen, P., Douthwaite, B., 2009. The impact of tsetse fly control campaigns on African wildlife. Oryx 19, 202–209.
McNeil, D., 2011. Rinderpest, scourge of cattle, is vanquished. New York Times. Available at:http://www.nytimes.com/2011/06/28/health/28rinderpest.html. Accessed 18 September 2017.
Mfunda, E.M., Røskaft, E., 2010. Bushmeat hunting in Serengeti, Tanzania: an important economic activity to local people. International Journal of Biodiversity Conservation 2, 263–272.
Moseley, W.G., 2013. Too many elephants in African parks? Aljazeera. Available at: http://www.aljazeera.com/indepth/opinion/2013/04/2013416113911163191.html. Accessed 20 April 2013
Moyle, B., 2013. Conservation that's more than skin-deep: alligator farming. Biodiversity Conservation 22, 1662–1667.
Muposhi, V.K., Gandiwa, E., Bartels, P., Makuza, S.M., 2016. Trophy hunting, conservation, and rural development in Zimbabwe: issues, options, and implications. International Journal of Biodiversity 2016 (2016), 16 8763980.
Mwaruvie, J.M., 2006. Kenya's forgotten engineer and colonial proconsul: Sir Percy Girouard and departmental railing construction in Kenya. Canadian Journal of History 41, 1–22.

Mysterud, A., 2010. Still walking on the wild side? Management actions as steps toward'semi-domestication' of hunted ungulates. Journal of Applied Ecology 47, 920–925.
Nelson, M.P., Bruskotter, J.T., Vucetich, J.A., Chapron, G., 2016. Emotions and ethics ofconsequence in conservation decisions: lessons from Cecil the lion. Conservation Letters 9, 302–306.
Nelson, F., Foley, C., Foley, L.S., Leposo, A., Loure, E., Peterson, D., Peterson, M., Peterson, T., Sachedna, H., Williams, A., 2009. Payments for ecosystem services as a framework for community-based conservation in northern Tanzania. Conservation Biology 24, 78–85.
Nelson, F., Lindsey, P., Balme, G.A., 2013. Trophy hunting and lion conservation: a question of governance? Cambridge Core 47, 1–20.
Newsome, D.R., Dowling, K., Moore, S., 2005. Wildlife tourism. Channel View Publications, Toronto.
Normile, D., 2008. Driven to extinction. Science 319, 1606–1609.
Norton-Griffiths, M., 2007. How many wildebeest do you need? World Economy 8, 11–64.
Nowak, K., 2015. Legalizing rhino horn trade won't save the species, ecologist says. National Geographic. Available at: http://news.nationalgeographic.com/news/2015/01/150106-rhino-poaching-south-africa-animals-conservation/#close. Accessed 6 August 2015.
Ntiamoa-Baidu, Y., 1997. Wildlife and food security in Africa. FAO conservation guide 33. Food and Agricultural Organization of the United Nations, Rome, Italy.
Ogutu, J.O., Owen-Smith, N., Piepho, H.P., Said, M.Y., 2011. Continuing wildlife population declines and range contraction in the Mara region of Kenya during 1977-2009. Journal of Zoology 285, 99–109.
Ogutu, J.O., Peipho, H.-P., Said, M.Y., Ojwang, G.O., Njino, L.W., Kifugo, S.C., Wargute, P.W., 2016. Extreme wildlife declines and concurrent increase in livestock numbers in Kenya: what are the causes? PLoS One 11 (9), e0163249.
Osofsky, S.A. (Ed.), 2005. Conservation and development interventions at the wildlife/livestock interface. Paper No. 30. International Union for the Conservation of Nature, Gland, Switzerland.
Pack, S., Golden, R., Walker, A., 2013. Comparison of national wildlife management strategies: what works where, and why? Wildlife Consulting Associates, Santa Rosa, CA, USA
Packer, C., 2015a. Lion populations are declining rapidly across Africa, except inintensively managed areas. Proceedings of the National Academy of Science 112, 14894–14899.
Packer, C., 2015b. Lions in the balance: maneaters, manes and men with guns. University of Chicago Press, Chicago, IL, USA.
Patterson, C., Khosa, P., 2005. A status quo study on the professional and recreational hunting industry in South Africa. Ministry of Environmental Affairs and Tourism, Pretoria, South Africa.
Pearce, F., 2010. Why Africa's national parks are failing to save wildlife. Environment 360. Available at: http://e360.yale.edu/features/why_africas_national_parks_are_failing_to_save_wildlife. Accessed 19 July 2010.
Phoofolo, P., 1993. Epidemics and revolution: The rinderpest epidemic in late nineteenth century southern Africa. Past and Present 138, 112–143.
Pica-Ciamarra, U., Otte, J., Chilonda, J., 2007. Livestock prices, land and rural conflict in sub-Saharan Africa. Land Reform, Land Settlement, and Cooperatives 18–33.
Quammen, D., 2014. Can good come from Maasai lion killings in the Serengeti? National Geographic. Available at: http://news.nationalgeographic.com/news/2014/04/140428-serengeti-ngorongoro-conservation-area-tanzania-lions-maasai-craig-packer-lion-guardians-world/. Accessed 10 October 2017
Rass, N., 2012. Policies and strategies to address the vulnerability of pastoralists in sub-Sahara Africa. Pro-poor livestock policy initiative paper No. 37. United Nations Food and Agriculture Organization, Rome, Italy.
Redmond, I., Aldred, T., Jedamzik, K., Westood, M., 2006. Recipes for survival: Controlling the bushmeat trade. Ape Alliance and World Society for the Protection of Animals, Cambridge, England.
Reid, R.S., 2012. Savannas of our birth: people, wildlife and change in East Africa. University of California Press, Berkeley, CA, USA.
Revol, B., 1995. Crocodile farming and conservation, the example of Zimbabwe. Biodiversity Conservation 4, 299–305.
Rieff, D., 2015. The reproach of hunger. Simon and Schuster, New York, NY, USA, p. 402.
Rinella, S., 2014. Addressing the African big game hunting controversy. Meateater. Available at: http://www.themeateater.com/2014/addressing-african-big-game-hunting-controversy/. Accessed 22 July 2014.
Ripple, W.J., Abernethy, K., Betts, M.G., Chapron, G., Dirzo, R., Galetti, M., Levi, T., Lindsey, P.A., Macdonald, D.W., Machovina, B., Newsome, T.M., Peres, C.A., Wallach, A.D., Wolf, C., Young, H., 2016. Bushmeat hunting and extinction risk to the world's mammals. Royal Society of Open Science 3, 160498.
Rivera, M., 2016. Is hunting ever defensible? About.com. Available at: http://www.about.com. Accessed 7 July 2016.
Rushby, K., 2011. Bright new start: how the Masai are finally profiting from tourism. The Guardian: p. 6, Available at: https://www.theguardian.com/travel/2011/jan/29/kenya-masai-mara-safari-conservation. Accessed 10 October 2011.
Russo, C., 2014. Controversy swirls around the recent U.S. suspension of sport-hunted elephant trophies. A voice for elephants. National Geographic: p. 5, Available at: https://voices.nationalgeographic.org/2014/05/06/controversy-swirls-around-the-recent-u-s-suspension-of-sport-hunted-elephant-trophies/. Accessed 5 June 2014.
Saayman, M., 2015. Why a ban on hunting in Botswana isn't the answer to challenges facing the country. The Conversation: p. 4, Available at: https://theconversation.com/why-a-ban-on-hunting-in-botswana-isnt-the-answer-to-challenges-facing-the-country-44793. Accessed 7 August 2015.
Saayman, M., van der Merwe, P., Rossouw, R., 2011. The impact of hunting for biltong purposes on the SA economy. Acta Commercii 11, 1–12.
Schaul, J.C., 2014. Conserving wildlife through responsible tourism: an interview with Dr Michael Hutchins. National Geographic Voices. Available at: https://voices.nationalgeographic.org/2014/07/01/conserving-wildlife-through-responsible-tourism-an-interview-with-dr-michael-hutchins/. Accessed 5 August 2015.
Shen, X., Sun, X. (Eds.), 2012. Untying the land knot: making equitable, efficient and sustainable use of industrial and commercial land. The World Bank, Washington, DC, USA.
Simmons, K., 2015. Sub-Saharan Africa makes progress against poverty but has a long way to go. Pew Research Center Factbook. Pew Research Center, Washington, DC, USA, p. 3.
Sinclair, A.R.E., Arcese, P. (Eds.), 1995. Serengeti II: Dynamics, management, and conservation of an ecosystem. University of Chicago Press, Chicago, IL, USA.
Sinclair, A.R.E., Metzger, K., Mduma, S., Fryxell, J.M. (Eds.), 2015. Serengeti IV: sustaining biodiversity in a coupled human-natural system. University of Chicago Press, Chicago, IL, USA.
Smit, G.N., 2004. An approach to tree thinning to structure South Africa savannas for long term restoration from bush encroachment. Journal of Environmental Management 71, 179–191.
Somerville, K., 2015. Livelihoods vs. lions: How can wildlife be made to pay? African Arguments. Available at: https://www.facebook.com/africanarguments. Accessed 10 October 2017.
Southwick Associates, 2015. Economic contributions of hunting-related tourism in eastern and southern Africa. Southwick Associates, Fernandina Beach, FL, USA, p. 60.
Spinage, C.A., 2003. Cattle plagues: a history. Springer, New York, NY, USA, p. 765.
Stein, A.B., Athreya, V., Gerngross, P., Balme, G., Henschel, P., Karanth, U., Miquelle, D., Rostro-Garcia, S., Kamler, J.F., Laguardia, A., Khorozyan, I., Ghoddousi, A., 2016. *Panthera pardus*. (errata version published in 2016). The IUCN Red List of Threatened Species 2016, e.T15954A102421779 Accessed 10 March 2017.
Taylor, A., Lindsey, P.A., Davies-Mostert, H., 2016. An assessment of the economic, social, and conservation value of the wildlife ranching industry and its potential to support the green economy of South Africa. The Endangered Wildlife Trust, Johannesburg, South Africa.
The Economist, 2007. Bring back hunting? The Economist Newspaper. Available at: http://www.economist.com/node/9199799. Accessed 17 May 2007
Torchia, C., 2017. Poachers target African lions, vultures with poison. Associated Press. Available at: http://kls.com. Accessed 16 October 2017.
t'Sas-Rolfes, M., 2016. Rhino poaching: what is the solution? The Solutions Journal 7, 38–45.
Tsing, A.L., Brosius, J.P., Zerner, C., 1999. Assessing community based natural resource management. Ambio 28, 197–198.
Twyman, V., 2000. Participatory conservation? Community based natural resource management in Botswana. The Geographic Journal 166, 323–335.
Tyrrell, P., Russell, S., Western, D., 2017. Seasonal movements of wildlife and livestock in a heterogenous pastoral landscape: implications for coexistence and community based conservation. Global Ecology Conservation 12, 59–72.
UNESCO (United Nations Educational, Scientific, and Cultural Organization), 2009. UNESCO: building peace in the minds of men and women—history. Available at:. https://www.unesco.org. Accessed 14 January 2017.
UNESCO (United Nations Educational, Scientific, and Cultural Organization), 2017. Worldheritage list. UNESCO World Heritage Center, Paris. Available at: https://www.unesco.org. Accessed 22 January 2017.
United Nations, 2015. World population prospects. United Nation Population Division. United Nations, New York, NY, USA.
UNWTO (United Nations World Tourism Organization), 2014. UNWTO annual report, 2014. Available at: http://www.unwto.org. Accessed 28 January 2017.
van der Merwe, P., Saayman, M., 2003. Determining the economic value of game farm tourism. Koedoe 46, 103–112.
van der Merwe, P., Saayman, M., 2005. Game farms as sustainable ecotourist attractions. Koedoe 48, 1–10.
van der Merwe, P., Saayman, M., 2014. The economic impact of hunting: a regional approach. South African Journal of Economy Management Science 17, 379–395.
Van Schalkwyk, D.L., McMillin, K.W., Witthuhn, R.C., Hoffman, L.C., 2010. Thecontribution of wildlife to sustainable natural resource utilization in Namibia. Sustainability 2, 3479–3499.
Verhagen, S., 2016. 80 rhinos headed for Australia in bold move to save species. Australian Geographic. Available at: http://www.australiangeographic.com.au/news/2016/04/80-rhinos-headed-for-australia-in-bold-move-to-save-species. Accessed 7 April 2016.
Wadhams, N., 2010. Farmers vs. lions: a battle to the death in Kenya. *Time*. Available at: http://content.time.com/time/world/article/0,8599,1989669,00.html. Accessed 10 October 2017.
Wells, M.P., McShane, T.O., 2004. Integrating protected area management with local needs and aspirations. AMBIO 33, 513–519.
West, N.E., 1993. Biodiversity of rangelands. Journal of Range Management 46, 2–14.
Western, D., Russell, S., Cuthill, I., 2009. The status of wildlife in protected areas compared to non-protected areas in Kenya. PloS ONE 4 (7), e6140.
Wikipedia, 2017a. List of national parks in Africa. Wikipedia, the free encyclopedia. https://en.wikipedia.org/wiki/List_of_national_parks_in_Africa. Accessed 21 February 2017.
Wikipedia, 2017b. World heritage sites. Wikipedia, the free encyclopedia. Available at: https://en.wikipedia.org/wiki/World_Heritage_Site. Accessed 15 January 2017.
Wilson, G.R., Hayward, M.W., Wilson, C., 2016. Market-based incentives and private ownership of wildlife to remedy shortfalls in government funding for conservation. *Conservation Letters*. https://doi.org/10.1111/conl.12313.
Winterbach, C.W., Carolyn, W., Michael, J.S., 2015. Wildlife abundance and biodiversity as indicators of tourism potential in northern Botswana. PloS ONE 10 (8), e135595.
World Bank, 2014. Terrestrial protected areas by country (% of total land area). World Bank, Washington, DC, USA.
World Hunger Education Service, 2013. 2013 World hunger and poverty facts and statistics. Available at: https://www.mvschools.org/cms/lib03/CA01001212/Centricity/Domain/135/World%20Hunger%20and%20Poverty%20Facts%20and%20Statistics%20by%20World%20Hunger%20Education%20Service.pdf. Accessed 12 April 2017.