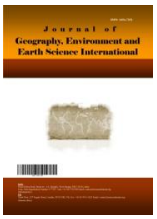

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# A Review of the Status of Rothschild's Giraffe Sub-Species Population in Africa

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Africa is the cradle of the world's giraffe species and the sub-species that keep evolving with more conservation approaches. However, the population of Rothschild's Giraffe (*Giraffa camelopardalis rothschildi*) has been impacted at different sects in the wild. The aim of this paper was to review the status of Rothschild's giraffe in Africa. A desktop descriptive review approach was used through perusal of different scholarly articles on giraffes. From the existing literature, this review exposes the effect of human effects on giraffes, climate change extremes on wildlife, ecological and significance of wildlife, and socio-economic impacts of communities on giraffes. The existing literature shows the impact of climate change extremes on giraffe habitats, with notable droughts, triggers of diseases, and unfit habitat migrations. Conservation of wildlife has to deal with socio-economic and ecological issues that are complex and, most of the time, overwhelming. We recommend the need for community engagement in conservation of wildlife resources and the development of climate prediction models to better understand climate extremes that happen and affect giraffe habits and population.

*Keywords: Climate change; human effect giraffe sub-species; Rothschild's Giraffes; socio-economic impacts.*

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## 1. INTRODUCTION

Giraffes (*Giraffa camelopardalis*) are even-toed mammals that are the tallest living land mammal and the largest ruminating mammal. Males weigh approximately 1,200 kilograms, while females weigh approximately 830 kilograms [1]. The savanna shrub woodlands are home to a range of giraffes with dominant tree species that serve as forage for the browser animals [2]. The West African giraffe inhabits the driest, hottest, and most open African habitats, whereas the Nubian giraffe and reticulated giraffe are found in the habitats of North-East Africa [3,4]. Giraffes feed on more than 20 plant species, with a home range of about 1.5 kilometres [5,6]. The ecology and population dynamics of giraffes are influenced by intrinsic and extrinsic factors. These factors include stress, poaching, predation, forage availability, human habitat encroachment, precipitation, resource competition, and mate competition. Giraffe populations are under threat, having declined by almost 40% in the last 30 years [7,8] (Muller *et al.,* 2018). This has led to the listing of the giraffe species as highly vulnerable, as per the IUCN Red List as of December 2016 [9,10,11]. Among the nine currently recognized subspecies of giraffes, these being, Angolan giraffe (*G. c. angolensis*); Kordofan giraffe(G. c. *antiquorum*); Nubian giraffe (G. *c. camepopardalis*); South African giraffe (*G. c. giraffa*); West African giraffe (*G. c. peralta; Reticulated giraffe* (*G.c. reticulate*); Rothschild's giraffe (*G.c. rothschildi*); Thornicroft's giraffe (*G.c. thornicrofti*);and Maasai giraffe (G. *c. tippleskirchi*), only the Rothschild's (G. *c. rothschildi*) and West African giraffe (G. *c. peralta*) are listed as endangered on the IUCN Red List [11]. These two subspecies have declined significantly over time and have lost majority of their natural habitat [12,13]. According to Galvin [14], African conservationists are struggling to develop new approaches to protect the continent's spectacular natural heritage, giraffes included. The main challenge, therefore, is to design strategies that will not only ensure the long-term viability of species and ecosystems but also be economically acceptable to local communities and the government. One approach that has gained considerable attention in recent years is the community-based conservation model. This is a model that transforms institutions with the goal of enhancing human social well-being and sustaining biodiversity through conservation development initiatives [15].

The Rothschild's giraffe (G.*c. rothschildi*) was first described by Sir Walter Rothschild in the 18th century. By then, these giraffes were ranging freely and abundantly across Kenya, Uganda, and Sudan. Currently, Rothschild's giraffe is extinct in Sudan and there is only a small population remaining in Kenya and Uganda [16]. The Rothschild's giraffe is an endangered subspecies globally, with approximately 1,500 individuals wandering in the wild [17]. Giraffe as a vulnerable species was up-listed in 2016 by the IUCN Red List [18]. However, in the year 2018, seven out of the nine subspecies were listed as shown (Table 1).

## 2. HUMAN IMPACT ON ROTHSCHILD'S GIRAFFE

Giraffe populations, like those of many wildlife species, have continued to decline both inside and outside protected areas in Africa [19]. This decline has been attributed to the high rate of human population growth and settlement,

**Table 1. Giraffe sub-species status**

| **IUCN Red List** | |
|---|---|
| **As a species:** | Giraffe Vulnerable |
| **The listed subspecies:** | |
| West African giraffe - | Identified as Vulnerable |
| Thornicroft's giraffe - | Identified as Vulnerable |
| Rothschild's giraffe - | Identified as Near Threatened |
| Reticulated giraffe - | Endangered |
| Nubian giraffe - | Critically Endangered |
| Kordofan giraffe - | Critically Endangered |
| Angolan giraffe - | Least Concern |

*Adopted from GCF, 2019*

recurrent droughts, expansion of large-scale farming, habitat loss, fragmentation and encroachment, severe poaching and other land use changes [20]. According to Burger et al. [7] and Fetene *et al.*, [21], the increase in agricultural activities and the rapid rise in human populations in Africa are the main causes of unprecedented land fragmentation and natural habitat destruction, hence the disturbance of wildlife populations, including giraffes. Fragmentation of habitats is a contributor to heavy degradation of biodiversity and this exposes species to the high risk of genetic inbreeding through segregation of populations [22,23]. Across Africa, giraffes have been affected greatly by land fragmentation, leading to the increasing restriction of their range since the 1800s. Giraffe populations have been reduced by 40% in the last thirty years, from an estimated 150, 000 individuals in 1985 to around 98,000 in 2015.This decline has led to the giraffe species' listing in 2016 as vulnerable on the IUCN Red List of threatened species [11].

## 3. ECOLOGICAL AND ECONOMIC IMPORTANCE OF ROTHSCHILD'S GIRAFFE IN AFRICA

The interests of the stakeholders dictate the values of wildlife that could be direct or indirect [24]. Direct values entail the consumptive use of nonmarket products such as fuel wood and game meat. This also includes the productive use of wildlife as well as the commercial value of timber and fish products. The indirect values of wildlife include aesthetic value and scientific research. Wildlife also has the option value to maintain its availability for the future. This includes, but is not limited to, the ethical feelings of the existence of wildlife for people [25-27]. Decision makers and the communities that live adjacent to any protected area regard, financial profitability, economic yield, and environmental sustainability as the aspects of conservation that have the highest value for wildlife. The importance of wildlife in general includes its economic, ecological, and socio-cultural importance [28]. It is also important to note, that wildlife has negative impacts on man. These include crop damage and livestock depredation. The capacity of the ecosystem to maintain soil fertility and micro-climate, absorb pollutants, purify water and provide other ecological services as wildlife interacts continuously with all the components of the entire ecosystem defines the ecological value of biodiversity [29]. The ecological value of wildlife in natural habitats is a direct effect on the physiognomy of habitats. For example, the ecological role of giraffes in the African bushlands is to open these areas as well as regulate and stimulate the growth of new shoots and new vegetation [30,31]. This ensures that open habitats do not become subject to bush encroachment and eventually turn to closed forests/woodland. Such changes can cause the disappearance of some species as well as allow some forest wildlife species to thrive. Wildlife plays an important role in seed dispersal. For example, migratory bird species can disperse seeds over long distances just like bats and monkeys can disperse fruit-bearing plant species of trees through their droppings [32].

Giraffes and other animals play a critical role in pollination of certain plants as it is also done by insects, birds and bats [33]. There are species of wildlife that also have detrimental ecological impacts on various habitats, such as, in the savanna ecosystems where animal communities are dominated by a few large species like buffalo, wild beasts, hippopotamus and elephants, habitats are heavily affected when their carrying capacities are exceeded [34], Cumming, 1982). In other cases, the habitat destruction by elephants is too severe that it threatens the survival of other wildlife species. For example, the destruction of *Acacia seyal* in Weza National Park in Cameroon by elephants, particularly around watering points during the dry seasons, has adversely affected the survival of giraffes and other species in the park as they all depend heavily on these tree species [35,36].

Large herbivores cause many other negative ecological impacts on habitats, such as buffalos and hippopotamus, which inflict a lot of injuries and, to an extent, death on humans who form part of the ecosystem interaction processes [37]. There are also the effects of "modified ecosystems", which is the change in the landscape where people and wildlife play a major role in ecosystem adaptation and change. This has a major impact on ecosystems in the long run. Overgrazing and over browsing of vegetation by wildlife also occurs sporadically in some habitats, thus leading to their degradation. This can lead to the crashing of populations of large herbivore species. According to Leuthold et al. (1978), the elephant population in Tsavo National Park crashed due to the elephants' exceeding the carrying capacity of the park due to the severe drought that was experienced.

Wildlife can also be used to assess the quality of the environment. For example, some species of birds and butterflies are used as indicators of the health status of an ecosystem. Birds of prey in an ecosystem would highlight environmental problems such as poisoning, pollution or even disease [38,36]. In most African countries, wildlife is a key informal source of capital creation. Some of these wildlife values cannot be quantified in terms of aesthetic, educational, ecological, or ethical values.

Wildlife ranching by the private sector, as it has been demonstrated in South Africa and Kenya, not only contributes to wildlife conservation but also provides revenue and livelihoods to the communities. A good example is the income generated globally from wildlife ranches, which is made up of eco-tourism (10%), wild animal sales (10%) and hunting (80%) [39,40].

## 4. LOCAL COMMUNITIES' SOCIO-ECONOMIC IMPACTS ON GIRAFFES

Conservation of wildlife in Kenya has to deal with socio-economic and ecological issues that are complex and, most of the time, overwhelming [41]. One issue that is of major concern in Kenya is the rampant snaring of giraffes and other wildlife species by the local communities during the dry seasons due to inadequate food supplies. According to Ariya [42], two million metric tons of bush meat are harvested annually in Africa.

Wildlife poaching and hunting is another conservation concern proliferated by humans, leading to a population decline of the harvested species [43]. It is also regarded as a human livelihood issue as it leads to the loss of wildlife, which is a resource that local communities depend on. Many people that live right next to these national parks and national reserves have lost connections with their national government and, therefore, most of them lack adequate income, if any at all [44,45]. The abject poverty experienced by most of the local communities is the driving factor that leads them to bush meat harvesting and consumption [46,47,48]. In Mwea National Reserve and Ruma National Park, the situation is worsened by the fact that cattle rearing and agriculture have never been a viable source of livelihood for the communities due to a number of factors such as tsetse fly infestation, predators such as hyenas, and crop raiding by primates.

## 5. CLIMATE CHANGE IMPACTS ON ROTHSCHILD'S GIRAFFE

Climatic accumulation impacts on biodiversity have been evident from cyclic droughts and lack of water and forage for giraffes and other large herbivores in protected areas [49]. Modelled climate change impacts have also shown that climate variability has caused major changes to the distribution of many species, plants and animals. This has led to severe range contractions and the extinction of a variety of species [20]. Changes in terrestrial species include phenology experienced in leaf unfolding, date of flowering, time of reproduction and migration, distribution of species, as well as changes in plant community structure. Wildlife also exhibits population fragmentation and isolation when their habitats are also fragmented due to climate change [50].

Regarding the effect of climate change on biodiversity, the prolonged drought of 1992–1996 ended up reducing rainfall in Kenya's Rift Valley Lake systems by almost half per year [51]. In the Maasai Serengeti ecosystems, a reduction in rainfall and near high heat records were experienced as well as it was observed in the rest of equatorial East Africa between 1993 and 1997. This affected giraffes and other large herbivore species greatly. Therefore, vegetation may completely disappear due to increased drought, hence increasing the rate at which herbivore species become extinct, particularly those that depend on grasses. Desiccation of soils has major effects on primary productivity; hence, it reduces biomass by 10-30% and also causes further changes in litter fall and nutrient cycling [52]. A projected reduction in precipitation coupled with drought severity would lead to reduced forage and water volumes in rivers for the giraffes in their ranges. This eventually leads to wildlife deaths, increased rates of species extinction, and increased human-wildlife conflicts [53].

Activities such as cultivation, ecosystem fragmentation, and development of urban areas would have a negative impact on giraffe ranges. Human activities that influence radiation transfer and absorption on the earth's surface within the atmosphere cause climate change. These include: deforestation and the use of fertilizers. Both contribute heavily to localized climate change that affects biodiversity and large herbivores in general [54].

Climate change also affects the living patterns of vectors that cause diseases, leading to the spread of diseases among wild herbivore species like giraffes as well as human beings, such as rinderpest and anthrax outbreaks, hence leading to the decline of populations [55]. Climate change also causes flooding conditions as well as air pollution that cause morbidity and eventual deaths to both people and wild herbivores. Changes in temperature and humidity due to climate change can easily bring about shifts in species' geographical range, hence the need for species to have the ability to respond to climate change by occupying new territory, changing their physiologies, and adapting to changes [56]. Climate change has resulted in giraffes and other animal species becoming very vulnerable to predisposed ecological risky disasters [57,58]. The ability of species to adapt to climate change is heavily influenced by local factors such as biodiversity, topography, the presence of invasive species, and landscape fragmentation. The future management of ecosystems that support biodiversity depends heavily on the understanding of the range of natural variability and ecosystem responses.

In Africa, climate change is bound to cause frequent and severe droughts in semi-arid and arid ecosystems [59]. Through seasonal increases in air temperatures and precipitation changes, climate change affects ecosystems directly, resulting in severe droughts and fires [32]. Climate change also leads to biodiversity drifts that affect the distribution of species. These changes inhibit the resource availability and access and the quality that humans and animals are primarily dependent on, affecting conservation and management efforts [60].

## 6. CONCLUSION

The shift and fragmentation of wildlife resources have posed a danger to fauna. Rothschild's giraffe habitats keep being degraded by the pressure of human effects. In addition, climate change extremes have impacted biodiversity, exposing wildlife to vulnerabilities like drought, disease, and unavoidable migration patterns. This, in turn, affects the immediate response of giraffes to these untimely environmental changes.

Human activities like cultivation, ecosystem fragmentation, and development of urban areas would have a negative impact on giraffe ranges. These effects compromise giraffe population patterns in African conservation areas that include parks, reserves, and sanctuaries.

Stakeholders influence wildlife values. These values could be either directly or indirectly. Direct values include the use of nonmarket products such as game meat, while indirect values include the utilization of wildlife as a source of income. Aesthetic value and scientific research are two examples of wildlife's indirect benefits. Other aspects of wildlife's option value include the ethical feelings associated with the existence of wildlife for people.

## 7. RECOMMENDATIONS

1. Encourage adequate community participation in the use of wildlife resources without jeopardizing wildlife habitats that support Rothschild's giraffes.
2. Establish long-term prediction centers for climatic aspects that best demonstrate the effects of climate extremes on fauna and flora. This could enhance adequate mitigation responses to climate change effects.
3. Improve proper wildlife resource conservation models in which the community assumes stakeholder identity in order to limit competitive human effects on wildlife habitats that harm the Rothschild's giraffe population.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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