

# IMPACT OF CLIMATE CHANGE UPON UNGULATES AND BIODIVERSITY IN SUB-SAHARAN AFRICA

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## ABSTRACT

Africa is one of the most vulnerable regions in the world to climate change. Climate change poses a serious threat to the survival of many species and to the well-being of people around the world. Biodiversity in Africa is under threat from multiple stresses. Climate change is one of several pressures. Other threats include increasing land use conversion and subsequent destruction of habitat; pollution; and the introduction of exotic species. Land-use conversion from wild habitat to agricultural, grazing and logging uses, leads to habitat loss, fragmentation, and introduction of exotic species all of which adversely impact biodiversity. Given this multitude of stress factors on biodiversity, climate change may exacerbate the stress on environmental systems beyond recovery. The conservation of African biodiversity will ensure delivery of ecosystem goods and services necessary to human life support systems. An integrated approach to environmental management is needed to ensure sustainable benefits for Africa.

Key words: Biodiversity, diseases, human migration, large mammals migration, plant migration.

## RESUMEN

*Impacto del cambio climático sobre los ungulados y la biodiversidad en la zona subsahariana de África*

Africa es una de las regiones más vulnerables del mundo al cambio climático, que representa una seria amenaza para la supervivencia de muchas especies y el bienestar humano en todo el mundo. En África, la biodiversidad se ve amenazada por múltiples factores de estrés. El cambio climático es uno entre varios factores de presión. Entre otras amenazas se incluyen el aumento de la conversión del uso del suelo y la posterior destrucción del hábitat, la contaminación y la introducción de especies exóticas. El cambio en el uso del suelo de hábitat silvestre a uso para la agricultura, ganadería y explotación maderera conlleva la pérdida y fragmentación del hábitat y la introducción de especies exóticas, que tienen un impacto negativo sobre la biodiversidad. Dada esta multitud de factores de estrés para la biodiversidad, el cambio climático podría exacerbar el estrés sobre los sistemas ambientales hasta un punto en el que les sea imposible recuperarse. La

conservación de la biodiversidad africana garantizará la provisión de bienes y servicios ambientales necesarios a los sistemas que sustentan la vida humana. Se necesita un enfoque integral en la gestión ambiental para garantizar beneficios sostenibles para el continente africano.

Palabras clave: biodiversidad, enfermedades, migración humana, migraciones de grandes mamíferos, migración de plantas.

### **AFRICA'S CHANGING CLIMATE**

While the exact nature of the changes in temperature, precipitation, and extreme events is not known, there is agreement about the following general trends (Alcamo 1994).

- √ Global mean surface temperature is projected to increase between 1.5°C and 6°C by 2100.
- √ Sea levels are projected to rise by 15 to 95 cm by 2100.
- √ Climate change scenarios for Africa indicate future warming across the continent ranging from 0.2°C per decade (low scenario) to more than 0.5.
- √ °C per decade. This warming will be greatest over the interior of semiarid margins of the Sahara and central southern Africa (IPCC 2000, IPCC 2001).

As simulated by global climate models using a consistent set of emission scenarios according to the latest IPCC socioeconomic scenarios.

#### **A- IMPACTS ON ANIMALS**

Biodiversity in Africa is under threat from multiple stresses. Climate change is one of several pressures. Other threats include increasing landuse conversion and subsequent destruction of habitat; pollution; and the introduction of exotic (nonnative) species. Land-use conversion from wild habitat to agricultural, grazing and logging uses, for example, leads to habitat loss, fragmentation, and introduction of exotic species-all of which adversely impact biodiversity (Hulme 1996).

Given this multitude of stress factors on biodiversity, climate change may exacerbate the stress on environmental systems beyond recovery.

In addition, conservation areas are too few. In a survey of 39 African countries, a median 4 percent of the continental land surface is in formally

declared conservation areas (Mackinnon & Mackinnon 1986). The percentage of landscape that is conserved varies greatly among countries (from 17 percent in Botswana to none in 4 countries), as does the degree of actual protection offered within nominally conserved areas (Siesfried 1989). A very large percentage of African biodiversity occurs outside of formally conserved areas (especially in central and northern Africa) as a result of the relatively low rate of intensive agricultural transformation on the continent (Desanker *et al.* 2001).

These regions of unprotected biodiversity will be lost if a predicted massive expansion of agriculture and clearing of tropical forests occurs in Africa during the next century. Of additional concern is the protection of habitat along migration routes that must be secured before changes in land-use result in permanent loss of access by key wildlife species.

### ***1- Biodiversity***

Africa occupies about one-fifth of the global land surface and contains about one-fifth of all known species of plants, mammals, and birds in the world, as well as one-sixth of amphibians and reptiles.

Climate change has already affected the marine animals of Africa. Coral reefs in the Indian Ocean experienced massive bleaching in 1998, with over 50% mortality in some regions. Damage to coral reef systems has far reaching implications for fisheries, food security, tourism and overall marine biodiversity (Nicholls *et al.* 1999, Spalding 2001).

On land, animal biodiversity in Africa is concentrated in the savannas and tropical forests. Loss or alterations of terrestrial habitats by climate change will likely impact these species. Few detailed studies have been done on how climate change will affect terrestrial animals in Africa, but those that have been done demonstrate the potential extent of its impact. For example, climate change of the magnitude predicted for the twenty-first century could alter the range of African antelope species.

World antelope biodiversity -more than 90% of the 80 species- is concentrated in Africa (Macdonald 1987).

## **2- *Bird migration***

About one-fifth of African bird species migrate on a seasonal basis within Africa, and an additional one-tenth migrate annually between Africa and the rest of the world. One of the main intra-Africa migratory patterns is flown by waterfowl, which spend the austral summer in southern Africa (Hockey 2000).

## **3- *Large mammal migration***

The vast herds of migratory ungulates -rhinos, swine, and elephants among others- in east and southern Africa remain a distinguishing ecological characteristic of the continent. A major migratory system is located in the Serengeti area of Tanzania and the Masai-Mara region of Kenya (Macdonald 1987).

Reduced large-mammal migratory systems persist in the Kalahari (Botswana, South Africa, and Namibia) and Etosha (Namibia) areas of southern Africa. Typical migrations involve regular movement between dry-season and wet-season grazing areas, and are therefore sensitive to climate change. The impact of climate change on these systems is uncertain, but they could be compromised by climate change in the presence of additional land-use pressures.

## **4- *Biodiversity***

Africa's biodiversity is concentrated in several unique native environments. The Cape Floral Kingdom (fynbos), which occupies only 37,000 km<sup>2</sup> at the southern tip of Africa, has 7,300 plant species-of which 68 percent occur nowhere else in the world. The adjacent Succulent Karoo biome contains an additional 4,000 species, of which 2,500 are native (Gibbs 1987).

These two floral biodiversity hot spots occur in winter rainfall regions and would be threatened by a shift in rainfall seasonality. For instance, a reduction in winter rainfall or an increase in summer rainfall would alter the fire regime that is critical to the life cycle in the fynbos. Other important floral regions affected by global warming include Madagascar, the mountains of Cameroon, and the island-like Afromontane habitats that stretch from Ethiopia to South Africa at altitudes above about 2,000 m.

Montane centers of biodiversity are particularly threatened by increases in temperature because many contain isolated plant populations with no possibility

of migration. Several thousand species of plants are potentially affected (Hulme *et al.* 2001).

### ***5- Plant migration***

As the climate changes, plants will naturally attempt to adapt by migrating, assuming the landscape is not too fragmented (Cowling *et al.* 1998). However, given that most of the land in Africa is inhabited by humans, not all species will be able to migrate. From a conservation management perspective, this indicates that creating avenues of migration for critical plant groups might be a useful hedge against destructive changes in climate. Unfortunately for some regions, such as the fynbos, which is at the edge of the continent, there are limited options for migration (Bond & Van Wilgen 1996).

## **B- IMPACTS ON HUMANS**

### ***1- Biodiversity loss***

Biodiversity is an important resource for African people (WRI 1996). Uses are consumptive (food, fiber, fuel, shelter, medicine, wildlife trade) and nonconsumptive (ecosystem services and the economically important tourism industry). Given the heavy dependence on natural resources in Africa, many communities are vulnerable to the biodiversity loss that could result from climate change. The impact of climate change on humans will also be compounded by climate change-induced alterations of agriculture, water supply and disease (Warsame *et al.* 1995, Lindsay & Martens 1998).

### ***2- Agriculture***

Most of Africa relies on rain-fed agriculture. As a result, it is highly vulnerable to changes in climate variability, seasonal shifts, and precipitation patterns (Kremen *et al.* 2000).

Any amount of warming will result in increased water stress. Roughly 70 percent of the population lives by farming, and 40 percent of all exports are agricultural products. One-third of the income in Africa is generated by agriculture. Crop production and livestock husbandry account for about half

of household income. The poorest members of society are those who are most dependent on agriculture for jobs and income (Odingo 1990, FAO 1999).

### ***3- Human migration***

Semi-arid areas of the Sahel, the Kalahari, and the Karoo historically have supported nomadic societies that migrate in response to annual and seasonal rainfall variations. Nomadic pastoral systems are intrinsically able to adapt to fluctuating and extreme climates, provided they have sufficient scope for movement and other necessary elements in the system remain in place. However, the prolonged drying trend in the Sahel since the 1970s has demonstrated the vulnerability of such groups to climate change: they cannot simply move their axis of migration when the wetter end already is densely occupied and permanent water points fail at the drier end. The result has been widespread loss of human life and livestock, and substantial changes to the social system.

Given the multitude of stress factors on biodiversity, climate change may exacerbate the stress on environmental systems beyond recovery.

## **RECOMMANDATIONS**

To stop the degradation of the planet's natural environment and to build a future in which humans can live in harmony with nature, by:

- √ to ensure that industrialised nations make substantial reductions in their domestic emissions of carbon dioxide -the main global warming gas- by 2010.
- √ to promote the use of clean renewable energy in the developing world.
- √ to reduce the vulnerability of nature and economies to the impacts of climate change.
- √ conserving the world's biological diversity in poor countries.
- √ ensuring that the use of renewable resources is sustainable in developing countries as well.
- √ promoting the reduction of pollution and wasteful consumption.

## CONCLUSION

Climate change will have significant impacts on biodiversity and food security in Africa (Mace *et al.* 1998). Therefore, substantial reductions of heat-trapping gas emissions in developed countries and adaptation strategies are crucial. For example, biodiversity must be managed to ensure that conservation is occurring both inside and outside of parks and reserves, and that adequate habitat is preserved to enable species -plants, animals and humans- to migrate. The conservation of African biodiversity will ensure delivery of ecosystem goods and services necessary to human life support systems (soil health, water, air, etc...). An integrated approach to environmental management is needed to ensure sustainable benefits for Africa.

Climate change poses a serious threat to the survival of many species and to the well-being of people around the world.

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