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Climate Variability and Its Impacts on Wildlife Ecosystems: A Study of Meru Conservation Area, Kenya

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Abstract
Climate variability is currently a major concern not only to conservationist but also to several other disciplines such agriculture and production sectors. The world's climate continues to change at rates that are projected to be unprecedented in recent human history. Climate change adds to the impact of land use change on species and ecosystems. Rising temperatures, rainfall variability, and new climatic regimes pose threats to biodiversity and human livelihoods alike. A study conducted at Meru Conservation area, Kenya established that that has been a climate variability which has over time affected wildlife populations, wildlife ecosystems and human livelihoods within and around the protected areas. This has however exposed wildlife conservation at a higher risk due to continuous loss of preferred habitats, movement corridors, dispersal areas and population decline.
Keywords: Climate Variability, Wildlife Populations, Wildlife Ecosystems, Human Livelihoods

1.0 Introduction

Protected areas should remain a cornerstone of global conservation efforts. However, the double impacts of climate change and biodiversity loss are major threats to achieving the millennium sustainable goals (MSGs), especially those relating to environmental sustainability, poverty alleviation, and food and water scarcity (The Heiz Centre, 2007). The national parks and reserves are changing into islands amidst the sea of changing land cover and land use activities coupled with climate change (Lopoukhine *et al.* 2012). This view is further supported by previous reports of IPCC, 2012; IPCC, 2013; IPCC, 2014 that climate change is expected to cause serious disruptions to earth's ecological systems, resulting in an overall loss of biodiversity and a reduction in the goods and services provided to humans. Further, (Hanner *et al* 2002; Lovejoy,2005 and Adger, 2006) established that the importance of biodiversity to wildlife and human well-being and the irreversibility of its loss, the depletion of biodiversity is one of the most important environmental threats that humanity faces.

The study focused on establishing the changes in climate elements that has occurred over time in Meru conservation area and the impacts of these changes on wildlife ecosystems. According to Jaetzold and Schmidt, (1983) and Otuoma (2004), the entire study area is classified to be in a similar ecological region (AEZ VI), Arid to semi arid receiving amount of annual rainfall ranging between 300-500mm. annually. The study based on the fact that availability of food in arid and semi arid areas and the distribution of wildlife population in the protected areas is a function of rainfall amount and distribution pattern. It is hypothesized in this study that wildlife populations in the ecosystem will reduce with the decline in rainfall amounts and distribution. Since not all wildlife species could be studied under the present endeavor, the African elephant (*loxodonta africana*) was selected as the evaluation species. The elephant was used because inter alia, 1) it is highly visible and easily counted during census 2) it is water dependent 3) it is very mobile and known to cause conflicts outside the parks when resources are missing and 4) their data is readily available since they have been highly studied. The approach is supported by Esikuri (1998) who argues in his study of African elephants that capacity of savanna areas to support elephant population is influenced by rainfall patterns, availability of water and human land use activities.

2.0 Study Area

The study was conducted at Meru Conservation Area, Kenya specifically in Meru National Park and Mwingi National Reserve and the adjacent land. These two protected areas which forms part of the complex Meru Conservation Area adjoins Bisanadi National Reserve and Kora National Park.

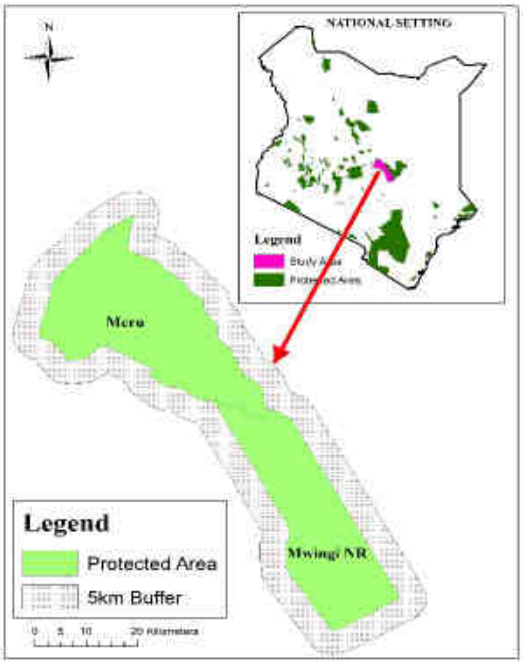

Figure 1: Map of the Study Area showing it location in Kenya

3.0 Methods

The study made use of the available rainfall data and elephant's census data in Meru national park(MNP) and Mwingi National reserve(MNR) from 1990 to 2016. Primary data was acquired by use of questionnaires and interview schedule from the local communities and leaders respectively. Four clusters were purposively selected around the protected areas based on the land use patterns of each individual community group. In each of the four clusters, 30 questionnaires were administered making a total of 120 respondents. Direct observation was also employed on identification of wildlife distribution and abundance, current land use types, park degradation and encroachments. Photographs were employed to capture data using digital camera. This helped in the classification of land uses in the area and as evidence of actual practices taking place.

4.0 Data Analysis and Presentation

The acquired rainfall and animal population data was analyzed using SPSS version 20. Pearson correlation coefficient test was carried out to establish the strength of a linear relationship between climate variables and wildlife. The responses from the questionnaire were analyzed and presented inform of percentages and graphs. The photographs taken were presented as figures in the study to illustrate the situation on the study area.

5.0 Results and Discussion

The Rainfall Pattern in MNP and MNR is Bi-Modal with the long rains running from mid March to Mid May while the short rains are experienced from October to December. The rainfall data available for MNP and MNR was from 1988 to 2016. This was the secondary data that was regularly recorded by the research department from the weather stations positioned within the protected areas. To support this secondary data, questionnaires were administered to the local communities and key informant to evaluate if they were aware of the current scenarios in climate variability and whether they could associate the variations in rainfall patterns in the area to changing climate. The survey also determined the implications of these changes on wildlife species and human livelihoods.

Upon investigation on whether climate change has contributed to decline in rainfall amount, 69.2% of the respondents supported while 30.8% disagreed that decline in rainfall amount was affected by climate change. However, upon validation from the existing data collected from the park, it was established that there has been a significant decline in the amount of rainfall received in the area from 1990 to 2014 from 1509mm to 335mm respectively. The figure below shows the trend rainfall amount received in the study area as it was recorded over the study period.

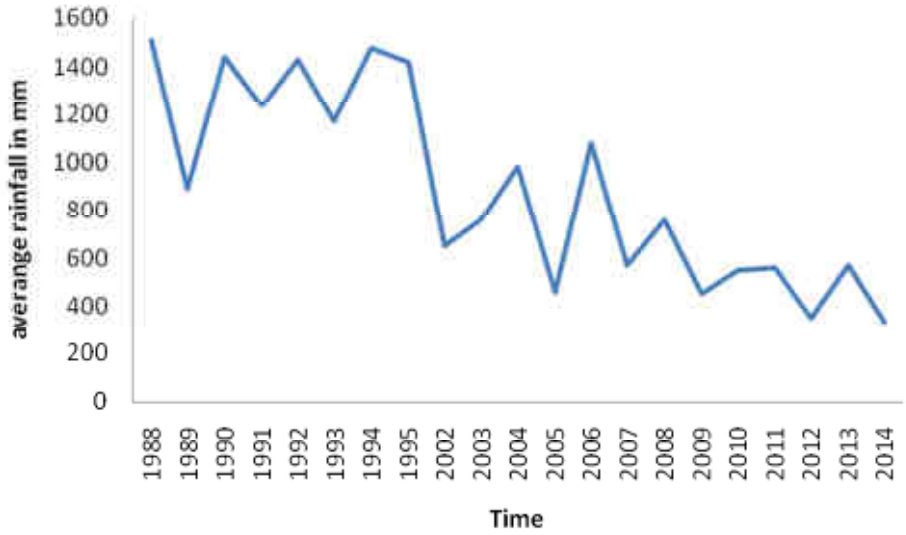

Figure 2: Trend in rainfall amount over the study period in MNP

The study findings revealed that there has been constant decline in the amount of rainfall that is received per annum. From these study findings, it is argued out that human land use activities in MNP and MNR have been affected further by climate variations where as observed, the changes in the amounts of rainfall have over the years resulted to prolonged drought and poor crop harvests. The outcome of these has influenced humans to carry out illegal activities such as grazing, charcoal burning and farming inside the protected areas as an adaptation strategy to the changing climatic regimes. These activities which are practiced both within and outside protected area boundaries provided alternative sources of livelihood to humans at the expense of changing wildlife habitats.

A Pearson correlation coefficient test confirmed a strong significant negative correlation between rainfall amount and wildlife population in both MNP and MNR ($r = -0.766$, $N=7$, $P<0.05$).

This test shows climate variability has had impacts on the wildlife ecosystems. Reduced amounts of rainfall and seasonal variations may have contributed to poor growth of preferred forage and domination of drought tolerant non palatable species of grass. In other cases, the land has been converted into bare land exposing loose soils to agents of soil erosion due to overgrazing and browsing. Some of the rivers such as Kathithi which flows across the park to Tana River were found to be dry especially during the seasons of prolonged drought. All these factors compel the wildlife to move and concentrate in areas that are closer to water, hence contributing to habitat degradation, competition, higher rate of predation and diseases or worse of death, hence reducing the population.

Further, low rainfall amount receievd in MCA in the recent years averraging to 350mm has resulted to prolonged drought which have had an adverse effects on wildlife. For instance, the recent drought experienced in 2009 and 2013 contributed to numerous death of wildlfe and compelling others such as elephants to migrate to other ecosystems like Mt. Kenya, Samburu and Laikipia(KWS, 2014). The figure below shows wildlife decline as a result of changes in rainfall amount that has in turn affected wildlife population in the study area.

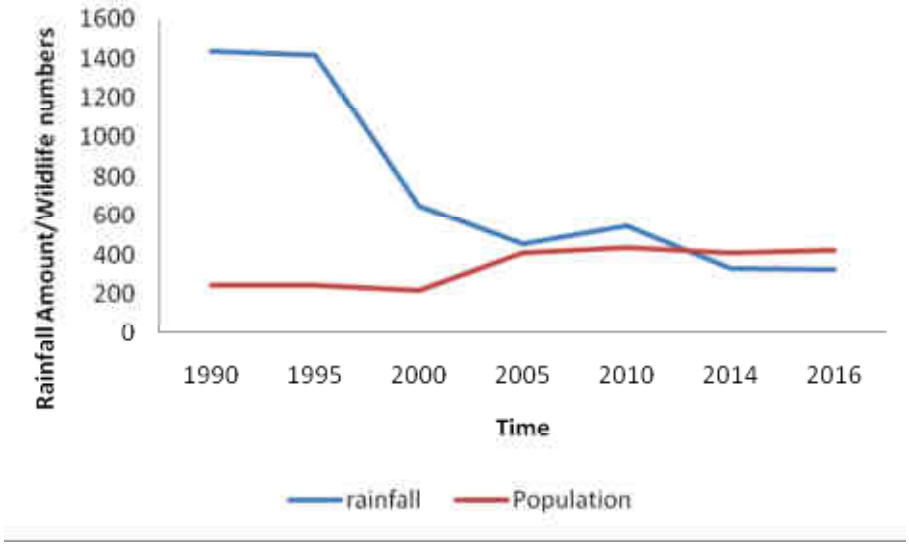

Figure 3: Trend on the effects of Rainfall on Wildlife Population

The study findings further established as a result of changes in rainfall amounts, charcoal burning and livestock encroachments became a main threat especially in MNR which is managed by the Kitui County government and KWS. This was identified as a response strategy for frequent and prolonged droughts. However, MNP was not affected by encroachment since there was an electric fence and regular patrols by the KWS rangers.

The disturbances as a result of climate variability has had impacts on wildlife ecosystems and human society as established in the study. According to the MNP community warden, reported cases of human wildlife conflicts increased by 16% from 2000 to 2015. These findings could be attributed to the changes in vegetation cover compelling wildlife to move to disperal areas that have since been settled or cultivated.

The figure below shows the distribution of livestock as a result of enchroachment in MNR and other PAs in MCA unlike in MNP where there are only few observed cases.

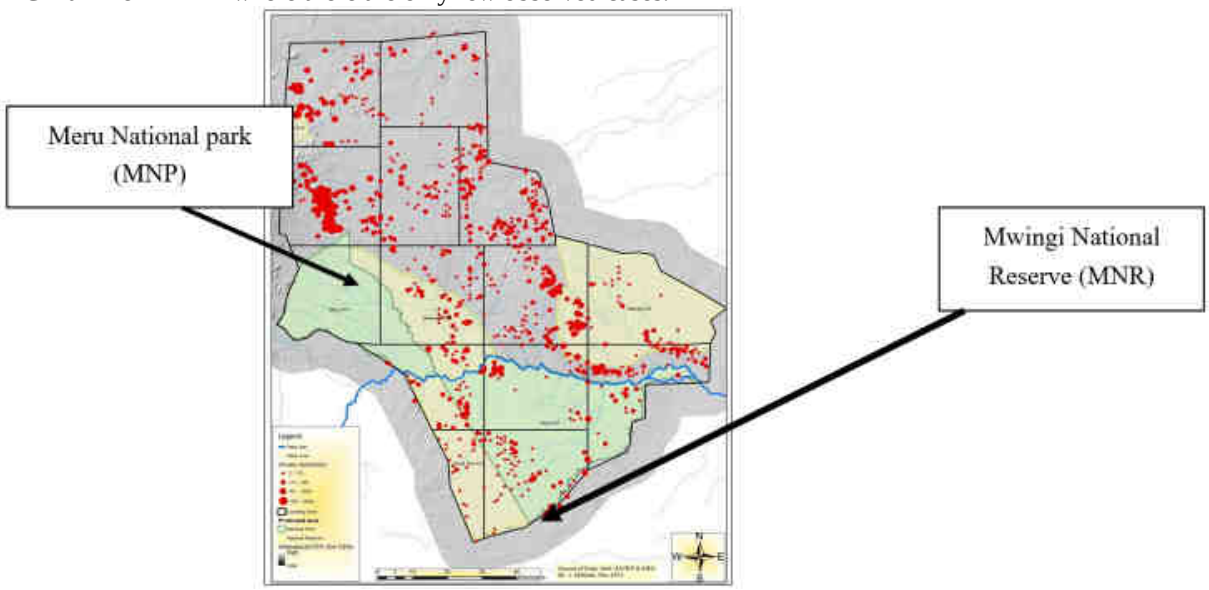

Figure 4: The distribution of Livestock in MNR (KWS, 2014)

From the figure above, it is observed with the dots that cases of sheep and goats (Shoats) encroachment was highly reported at Mwingi national reserve as compared to the adjacent Meru national park. This is attributed to the variation in the governance systems of the two protected areas. Meru national park is managed by Kenya Wildlife Service (KWS) while Mwingi national reserve is managed by Kitui County as a trustee.

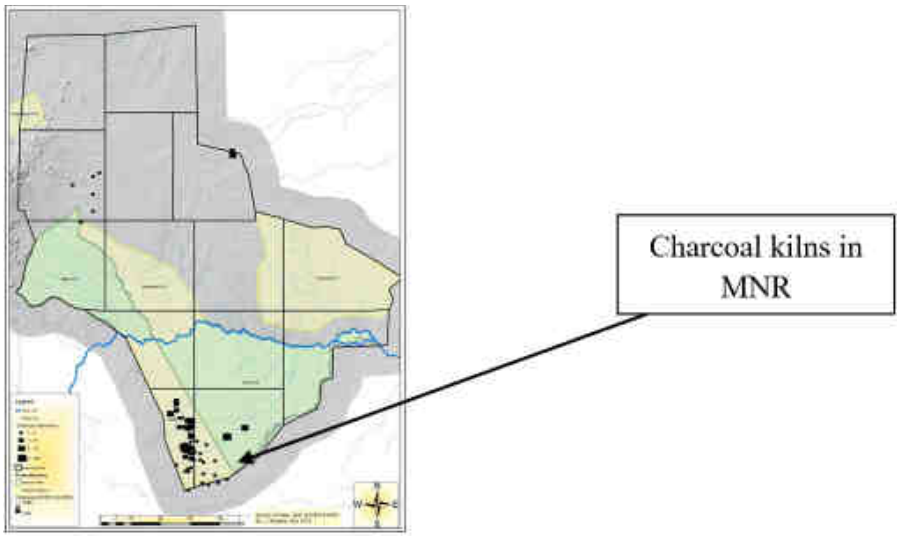

Figure 5: The distribution of charcoal burning Areas in MCA (KWS, 2014)

During the study, the respondents reported that there has been regular crop failure prompting them to alternatives such as charcoal burning, and other income generating ventures. While on the western part of the MCA, communities have intensified the use of water for irrigation from the rivers such as kathithi which is one othe rivers that waters MNP. The increase in water abstraction results to drying up of such rivers as shown in the photo below that was taken in the study area. This has cotributed to human-wildlife conflicts as the animals get outside the PA in search of water. However, the changing trend in climate results to continous drought it is anticipated these swamps and rivers may dry up due to land use pressure on the upstream catchment areas. These findings agrees with the study by Nyaoro (1999) that conflicts on water resources will tend to rise with increase in demand while the volumes in rivers declines.

Figure 8: a). Abstraction of Kathithi river upstream b). Dry Kathithi river as it enters the park downstream

Upon further investigation, the study established that reported cases of human wildlife conflicts were higher 87% during the dry spells as compared to wet seasons 13%. This is because most of the species such as buffaloes, elephants, baboons were found to move out of the park boundary in search of forage. In view of these findings, the increasing rates of conflicts are an outcome of the vulnerabilities brought about climate change that is impacting on human livelihood and wildlife. This study observation agrees with that by Gupta et al, (2017) that conflicts could increase vulnerability, lessen opportunities for adaptation and reduce support for species management. In their study, Okello and Kiringe (2004) found out that communities living adjacent to protected areas are highly prone to such threats, which may occasionally hinder their support to conservation.

6.0 Conclusion

From the above findings, the study of this objective hereby conclude that climatic variations in the study area have resulted to changes in vegetation cover and facilitated alternative land use options by local communities as coping strategies which have negative impacts to wildlife conservation. Wildlife populations on the other hand have declined in both MNP and MNR due these changes. For instance, annual census for the elephants population in MCA has been increasing over time, a factor which is associated with changes in habitat and disturbances by humans. Interestingly, vegetation along the rivers and wetlands outside the PA boundaries has increasingly been reclaimed for farming of Miraa(*Catha edulis*) and horticultural crops. The livestock keeping community in Rapsu, Kaningo and Ntoroni blocks on the other hand have been found to drive their livestock into

the park during the dry spells for water and fodder. However, since climate change is an ongoing phenomenon, it is considered in this study that the protected area managers and other conservation agents should establish mitigation measures that will reduce the effects of climate change as well as providing alternative land use options that are environmentally sustainable.

Conflict of Interest

The author hereby declares there is no conflict of interest in regard to publication of this research

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