UNIVERSITY OF NAIROBI

ASSESSING THE IMPACTS OF CLIMATE VARIABILITY AND CLIMATE CHANGE ON BIODIVERSITY IN LAKE NAKURU, KENYA

BY

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Declaration

This dissertation is my original work and has not been presented for the award of a degree in the University of Nairobi or any other University

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Abstract

Hydrological systems are potentially very sensitive to changes in climate. Recently, attention has been mainly drawn to the rising global temperatures; however, over the past century, human livelihoods have substantially been directly affected by changes in the regional hydrological balance. Lake Nakuru is one example of a hydrological system which has seen its water levels increasing since September 2010 during the beginning of the short rains making it the first lake in the Rift Valley bursting its banks, leading to decreased electrical conductivity levels as a result of water dilution. All flamingos left the lake, initially settling in the Lake Oloidien a small alkaline lake south of Lake Naivasha and Lake Bogoria. The increased water levels led to change in aquatic life and biodiversity, including submersion of habitats adjoining the lake and have therefore had major ecological implications on the lake and its environs.

This study, therefore, assesses the impacts of the increased water levels and the flooding of Lake Nakuru and its surrounding areas on biodiversity, specifically, the phytoplankton and lesser flamingo communities, owing to climate change and climate variability. The study focused on reviewing and analysing observed climatic records from 2000 to 2014, obtained from the Kenya Meteorological Department, especially temperature, precipitation and evaporation of Lake Nakuru in order to assess how climate variability and climate change has contributed to the increased lake levels, monitoring and reviewing information on the state of past and present records of the lesser flamingo and phytoplankton communities of Lake Nakuru was undertaken, with the data sets obtained from the Kenya Wildlife Service and National Museums of Kenya database. Several methods were employed in order to determine the past and current trends of climatic parameters (temperature, precipitation and evaporation), and also for the physicochemical characteristics of Lake Nakuru (conductivity, phytoplankton, lesser flamingos and the lake depth). These included time series analysis, trend analysis and the Pearson’s correlation analysis was used to correlate the changes in lake conductivity to changes in population estimates of the lesser flamingos and the phytoplankton. Data set extracted from the Coupled Model Intercomparison Project Phase 5 (CMIP5) (IPCC Fifth Assessment Report (AR5) Atlas subset) models were subjected to time series analysis method where the future climate scenarios of near surface temperature, precipitation and evaporation were plotted for the period 2017 to 2100 (projection) for RCP2.6 and RCP8.5 relative to the baseline period 1971 to
2000 in Lake Nakuru were analysed. The results were used to assess the impact of climate change on the lesser flamingos and phytoplankton abundance.

It was observed that there was an increase in the mean annual precipitation during the study period (2009 to 2014) which caused the increase in the lake’s surface area from a low area of 31.8 km² in January 2010 to a high of 54.7 km² in Sept 2013, indicating an increase of 22.9 km² (71.92% surface area increase). Mean conductivity of the lake also decreased leading to the loss of phytoplankton on which flamingos feed causing them to migrate. A strong positive correlation between conductivity and the lesser flamingo population was observed implying that low conductivity affects the growth of phytoplankton and since the lesser flamingos depend on the phytoplankton for their feed, this subsequently demonstrated that the phytoplankton density could be a significant predictor of the lesser flamingo occurrence in Lake Nakuru. There was also a strong positive correlation observed between phytoplankton and the lesser flamingo population which confirms that feed availability is a key determining factor of the lesser flamingo distribution in the lake.

It is projected that there would be an increase in temperatures, precipitation and evaporation for the period 2017 to 2100 under RCP2.6 and RCP8.5 relative to the baseline period 1971 to 2000 obtained from the Coupled Model Intercomparison Project phase 5 (CMIP5) multi-model ensemble. As a result, it is expected that the lake will further increase in surface area and depth by the year 2100 due to increased precipitation thereby affecting the populations of the lesser flamingos and phytoplankton, as the physicochemical factors of the lake will change as well during the projected period.

Recommendations that can be taken to contribute to the country’s biodiversity resources, specifically in Lake Nakuru through climate change mitigation and appropriate adaptations have been provided. They include: In order to assess the variability in climate, continuous monitoring and analysing meteorological parameters in the lake basin is suggested; government policy on illegal water abstractions and massive afforestation of indigenous trees need to be enforced in order to enhance precipitation regularity so as to sustainably utilize and manage Lake Nakuru’s waters; Climate vulnerability assessments need to be carried out in order to come up with mitigations and adaptations measures unique to Lake Nakuru basin to inform the measures that
need to be taken in order to minimize the negative impacts of climate vulnerability/change, and exploit the beneficial ones.