Predicting spatial distribution of *Galleria mellonella* in Kenya using bioclimatic and remote sensing (seasonality) variables

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INTRODUCTION

Galleria mellonella (greater wax moth or honeycomb moth, Plate 1) feeds on the honeycomb of *Apis melifera* (honey bees), thus reducing hive productivity. It is important to understand factors that encourage or limit distribution and intensification of this pest. Vegetation seasonality and climatic variation are among key variables that affect *G. mellonella* distribution. We aimed to demonstrate the influence of remote sensing variables (seasonality) on the distribution of this pest; as well as the use of species diversity modelling techniques to identify its distribution through time and space.

Plate 1: *G. mellonella*

METHODS

- Sampling regions: Mt. Kenya, Kakamega, Mwingi, and the Coast in Kenya, during the wet and dry seasons (Figure 1).
- Correlative modelling was done using biotic, bioclimatic, and morphological variables.
- Biotic variables; calculated from NDVI time series data using TIMESAT: Bioclimatic variables; from Africlim data: Morphological variables; extracted from SRTM (90m resolution).
- A correlation coefficient of |r|>0.7 was used to remove collinearity between predictors.
- Area under curve (AUC) was used to test the analysis model performance.

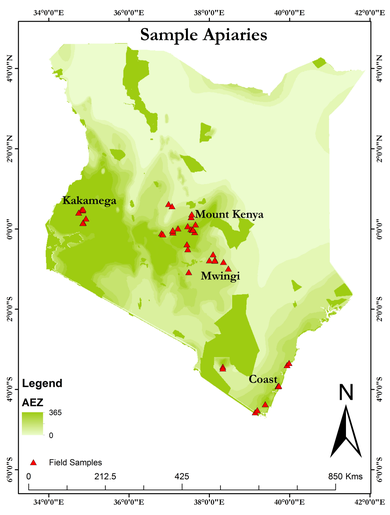

Figure 1: Distribution of study sites

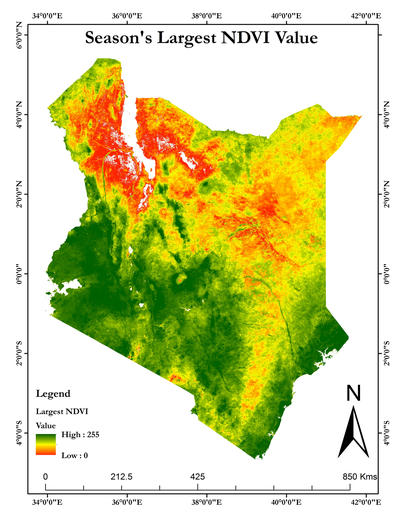

Figure 3: Largest NDVI value in the season

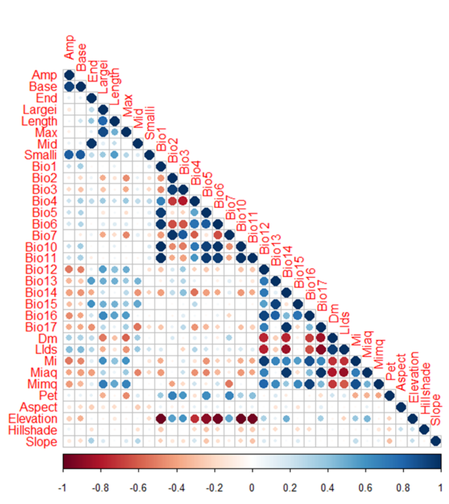

Figure 2: Collinearity matrix

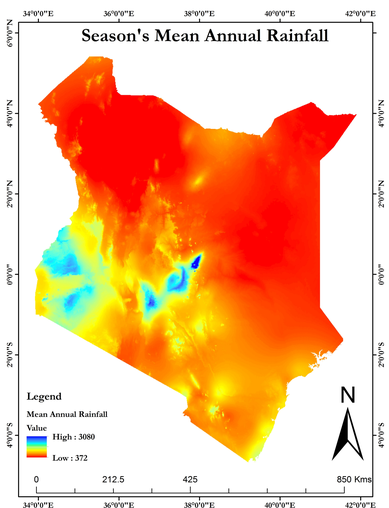

Figure 4: Mean annual rainfall

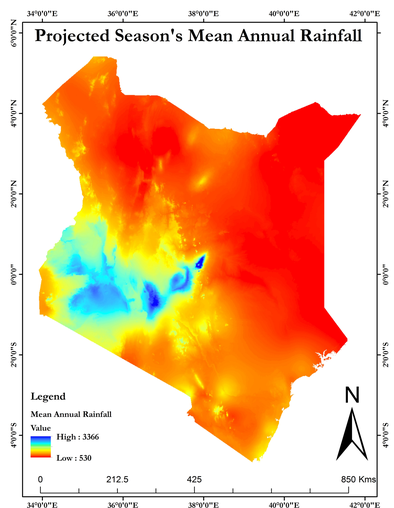

Figure 5: Projected (2055) mean annual rainfall

CONCLUSIONS

- Remote sensing predictors, especially largest NDVI in the season, influence *G. mellonella* distribution. Overall, bioclimatic variables contributed more than the biotic variables.
- With the changing climate and no interventions put in place, the pest problem will increase.

OBJECTIVES

- To predict the spatial distribution of *G. mellonella* in Kenya.
- To investigate the influence of seasonality on the spatial distribution of *G. mellonella.*
- To project the spatial distribution of *G. mellonella* to the future (2055).

RESULTS

- Most of the biotic and morphological variables were not correlated while collinearity affected some of the bioclimatic variables (Figure 3).
- An average specificity area under curve (AUC) of 0.946 was obtained for *Galleria mellonella* developed over ten runs, indicating a high model accuracy (94.6%).
- NDVI seasonality derived from remote sensing (largest NDVI value in the season shown in Figure 3 had a substantial influence on the model, contributing to 34.8% of the prediction.
- Regions with high NDVI values and mean annual rainfall (Figures 4 and 5) such as Mt. Kenya and Kakamega showed high presence probability (Figure 6) (corroborating field data) advancing over time to 2055 (Figure 7).
- Overall, bioclimatic variables contributed to 58.3% of the variables, and biotic variables to 40.4%.
- Because climate change will affect the future distribution of *G. mellonella*, some regions with “no presence to low occurrence” probabilities will advance to “high occurrence” areas, as conditions become more favourable for the pest towards 2055 (Figure 7).

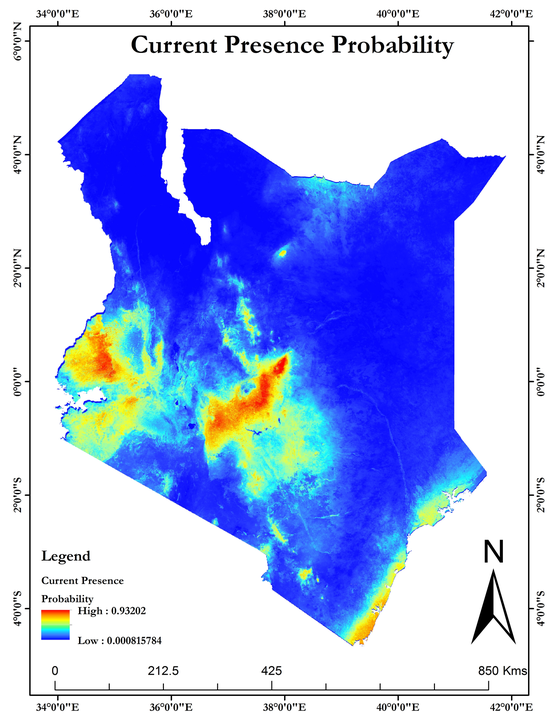

Figure 6: *Galleria mellonella*’s presence

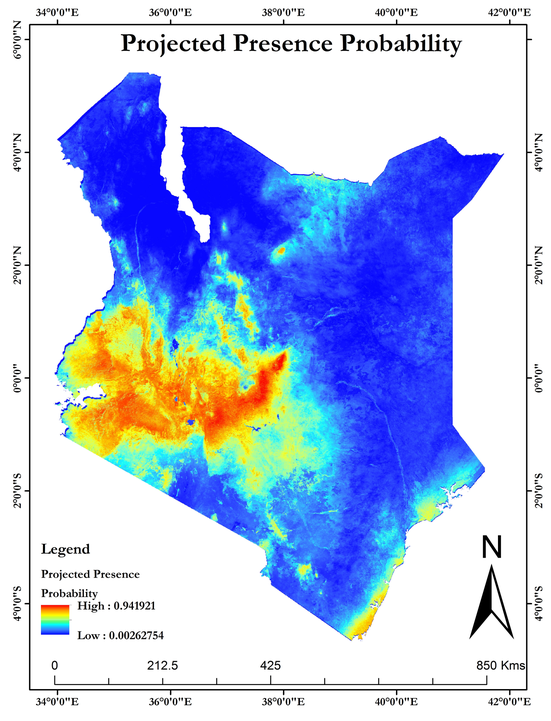

Figure 7: *Galleria mellonella*’s predicted presence

IMPACT

- The study has contributed to understanding the distribution of *G. mellonella*, one of the major hindrances to the increase of *Apis mellifera*.
- Control measures will best be put in place with sufficient prior knowledge on the possible locations of the pest, and the extent of the threat.

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