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Ecological factors associated with abundance and distribution of mosquito vectors of rift valley fever virus during an epidemic period in isiolo, Kenya

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Abstract

Rift Valley fever (RVF) is a zoonotic disease caused by an RVF virus (RVFV) and occurs sporadically in sub-Saharan Africa and parts of the Middle East. Its epidemics cause far-reaching socioeconomic losses, particularly among rural communities that rely on livestock. The epidemics occur after periods of above-normal precipitation and flooding, which provide good conditions for mosquitoes, biological vectors of the virus, to develop into high populations. An entomological survey was conducted during an RVF outbreak in four villages in Isiolo in 2020–2021 and analysed to determine factors that influenced mosquito abundance and distribution. Mosquitoes were trapped using CDC light traps that were deployed at each site for 48 hours. Land cover data from the Landsat satellite imagery for the period 1990 to 2020 were analysed using Open source QGIS software and the Google Earth Engine and used with other variables to generate ecological factors for RVF modelling in the target area. Data obtained from unmanned aerial vehicles (UAV) images at the time of sampling were utilised to calibrate Landsat images obtained in 2021. The semi-parametric generalised additive model was used to analyse the data with the number of mosquitoes per trap per day being used as an outcome variable. The model was created with the UAV-calibrated land cover classes due to its better accuracy. A total of 5,307 mosquitos from 22 diverse species were trapped. Factors that were significantly associated with mosquito abundance were the standard deviation of the normalised difference vegetation index (NDVI), bare lands, mean MNDWI, curvature, and elevation. There was also a significant negative correlation between NDVI and rainfall quantity. The analysis showed the possible cause of RVF being floods rather than rainfall. The model developed would be useful for predicting the spatial distribution of potential RVFV vector breeding sites in the region. In addition, areas with varying levels of susceptibilities were created and interpolated to all of Isiolo county.

Keywords: Modelling , mosquitoes, remote sensing, rift valley fever

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