ABSTRACT

Anthrax is a widely known zoonotic disease caused by *Bacillus anthracis*, a gram positive, and spore forming aerobic bacteria. In livestock, anthrax is usually peracute and highly fatal whereas in humans it is a subacute disease and fatal if not treated immediately. The disease is prevalent world-wide. Anthrax is one of the top ten livestock diseases in India and so forecasting the outbreak of this disease by modelling is very useful in saving the livestock and thereby preventing the economic loss to the livestock farmer specifically and country in general. In this study, the data on the outbreak reports of anthrax in livestock in Karnataka from 2000 to 2016 have been analysed. An attempt has been made to develop the statistical forecasting models at three different levels – district level, taluk level and village level. Further, at district level, statistical model was developed for disease-presence only data; at taluk level, statistical models were developed for disease-presence only data as well as disease-presence-absence data (Species distribution models); at village level, species distribution models were developed for disease-presence-absence data. To develop disease-presence only model at district and taluk levels, in the risk factor domain, amount of rainfall, relative humidity, temperature, anthropogenic variables, soil pH, type and nutrients were collected retrospectively. Further, remote sensing variables like Normalized Difference Vegetative Index (NDVI) and Land surface temperature (LST) were collected using Moderate Resolution Imaging Spectro-radiometer (MODIS) tools. Prediction models of anthrax outbreaks in Karnataka using count models *viz.*, Poisson, Negative Binomial and Zero truncated models were developed. The prediction models were tested for goodness-of-fit using Chi-square test. The models were evaluated using Akaike information criterion (AIC), AIC for correction (AICC) and Bayesian Information Criterion (BIC). A risk map forecasting the outbreaks of anthrax at district and taluk level was also generated. To develop Species Distribution Models, LST, NDVI; climate variables *viz.*, cloud cover, potential evapotranspiration, precipitation, relative humidity, mean temperature, minimum temperature, maximum temperature, vapour pressure, wet day frequency, wind speed and livestock population were considered as risk factors. The models were evaluated using evaluation statistics *viz.*, Cohen's Kappa, Receiver Operating Characteristic (ROC) and True Skill Statistic (TSS). Among the disease-presence only models, Zero-Truncated Poisson model provided the best fit for the data on the outbreak of anthrax. An attempt has been made
to explain how various factors influence the outbreak of anthrax. Among Species Distribution models, Random Forest emerged as the best fitting model. At village level, SDMs with good predictive power (based on evaluation statistics) were combined to develop average prediction model. This model will be a powerful statistical tool in the hands of the policy makers and Veterinarians for a better control of anthrax with minimum use of resources.