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Soil Geochemical Parameters influencing the Spatial Distribution of Anthrax in Northwest Minnesota, USA

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Abstract

Bacillus anthracis is the pathogenic bacterium that causes anthrax, which dwells in soils as highly resilient endospores. *B. anthracis* spore viability in soil is dependent upon environmental conditions, but the soil properties necessary for spore survival are unclear. In this study we used a range of soil geochemical and physical parameters to predict the spatial distribution of *B. anthracis* in northwest Minnesota, where 64 cases of anthrax in livestock were reported from 2000 to 2013. Two modeling approaches at different spatial scales were used to identify the soil conditions most correlated to known anthrax cases using both statewide and locally collected soil data. Ecological niche models were constructed using the Maximum Entropy (Maxent) approach and included 11 soil parameters as environmental inputs and recorded anthrax cases as known presences. One ecological niche model used soil data and anthrax presences for the entire state while a second model used locally sampled soil data (n = 125) and a subset of anthrax presences, providing a test of spatial scale. In addition, simple logistic regression models using the localized soil data served as an independent measure of variable importance. Maxent model results indicate that at a statewide level, soil calcium and magnesium concentrations, soil pH, and sand content are the most important properties for predicting soil suitability for *B. anthracis* while at the local level, clay and sand content along with phosphorous and strontium concentrations are most important. These results also show that

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