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GEOB 479: Research in GIS
Health Geography

The article documents a research effort that synthesized remote sensing and GIS techniques to assess the human risk from the Sin Nombre virus (SNV), the agent associated with hantavirus pulmonary syndrome. Deer mice, the primary rodent host, were studied in 144 field sites in the Walker River Basin in western Nevada and east-central California from 1995 to 1998. Spatial patterns and statistical relationships between site characteristics and infection rates were analyzed to retroactively classify the infection status of rodents in order to estimate prediction accuracy. These predictions could then be used to identify landscape characteristics where people are most likely to contract SNV.

Remotely sensed images generated from Landsat Thematic Mapper were used to generate 100 hectare unit maps of eight vegetation types (ex: alpine, desert scrub, grass scrub, coniferous forest) to act as indicators of environmental characteristics like moisture, soil type, and elevation. Slope, vegetation density and hydrology were acquired by integrating a USGS DEM, the USGS 1:100,000 scale digital line graph dataset, and the normalized difference vegetation index (NDVI). The presence of SNV infections was inferred from antibody data, classifying sites into “Status 1” (one or more antibody-positive animals) and “Status 2” (two or more antibody-positive animals, or 10% antibody seroprevalence). Each Status is then classified as either positive (active infection present) or negative (active infection absent).

Each GIS variable was categorized according to its relevance to each of the eight vegetation types; for each vegetation type, the relevant variables were divided into high and low ranges. These binary classes were then intersected in GIS to produce distinct strata (environmental conditions) for each vegetation type. A canonical linear discriminant function analysis (DFA) was then employed to examine relationships between infection status and the landscape variables and classify sites retroactively according to their expected infection status. Two analyses were formulated: the vegetation approach was based on possible relationships between infection status and a pre-existing vegetation classification that may be relevant to SNV infections, and the DFA which generated a linear function that distinguished the properties of positive and negative sites. The vegetation approach analysis provided an overall accuracy of

76% for Status 1 and 59% for Status 2. Positive classification was more accurate than negative classification for both classes as well. The DFA produced an overall accuracy of 74% for Status 1 and 82% for Status 2. Negative classified sites were more accurate than positive. Negative sites were associated with low elevations and sparse vegetation, which occurs most often in salt desert scrub. Positive sites were of higher elevation with more dense but less uniform vegetation, while slope and distance to stream factors were less important.

Some issues with the study are related to the modest degree of measurement error in obtaining population levels. Relative deer mouse population was estimated by counting the number of animals captured during a trapping season: is this a logical method of interpolation? The trapping took part over three days: this may not be long enough to capture an accurate measurement of total mouse populations. If the mice were released after capture, they may have been captured again, distorting infection and population statistics. The study was unable to incorporate weather and climate data as well, due to the sparse network of monitoring stations in the area.

We gave this paper an eight out of ten: the high accuracy of the predictions represents the authors' sound logic. The discriminant function analysis is a good choice because it determines if a set of variables is effective in predicting categorical (landscape type in this case) membership. Furthermore, the authors note complicating factors: rapid rodent population turnover, noninfectious but antibody-positive mice, and migration. They opted for a large sample size to capture the element of ecologic diversity and to provide statistical replicates of sites with similar characteristics,and sampling of rodents and vegetation types was kept systematic. They compare the strengths and weaknesses of both analyses, the remote sensing images, and GIS variables. Most shortcomings of the paper were already recognized, and referenced in their margin of error.