Human Leprosy Risk Assessment

Introduction

Leprosy is a disease which can affect humans and is caused by a chronic granulomatous infection which can affect skin and peripheral nerves by causing skin lesions and neuropathy which can result in deformity. In the southern United States, nine-banded armadillos (*Dasypus novemcinctus*) are the only other known endemic host that can develop leprosy. Armadillos are a large natural reservoir for the disease and are capable of exposing humans to large numbers of *Mycobacterium leprae*, the causative agent of the disease. Extensive contact with armadillos has been related to some cases of human leprosy and more than half of the leprosy cases from clinics in Texas report some exposure to armadillos.

There are only about 150 new cases of leprosy reported in the United States each year, with approximately one-third of those cases being acquired from local sources and not from traveling abroad to leprosy-endemic areas. Most of these cases are from Texas and Louisiana. Leprosy is easily treated with drug therapy and early diagnosis followed by quick treatment is the most effective way to avoid the undesirable complications of leprosy, which can be socially stigmatizing. However, because leprosy is rare in the US, doctors are not always looking for it. Therefore, it is crucial for doctors that may be caring for patients with possible exposure to *M. leprae* to be aware that they may encounter this disease so an accurate diagnosis may be made and treatment can be started rapidly.

This analysis will determine areas of Texas where human-armadillo interaction is most likely based on human population density in suitable armadillo habitat, and these areas will be considered possible hotspots for armadillo transmission of leprosy to humans. This information can serve as a warning for humans in these areas that they are at an increased risk of an armadillo encounter and possible *M. leprae* exposure. This analysis will also include hospitals near these high risk areas where physicians should be informed of possible incoming cases so they can be better prepared to diagnose and treat leprosy.

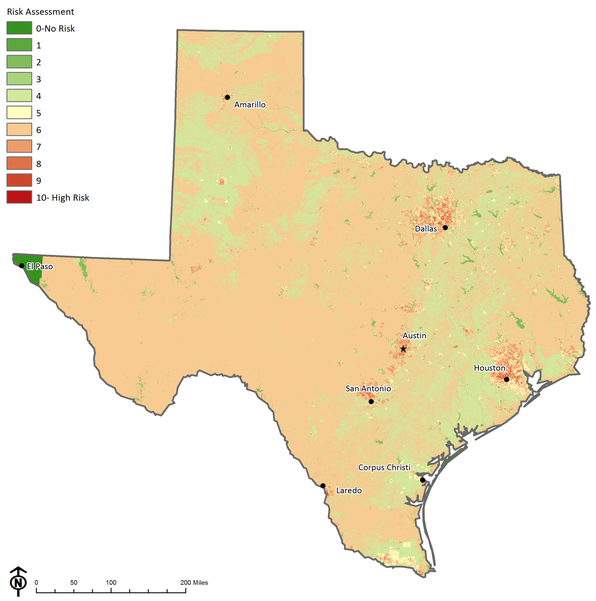

Figure 1. This final analysis depicts the risk of humans coming into contact with *M. leprae* through contact with Dasypus novemcinctus for each location within the state of Texas. Areas shaded in red have the highest risk, and areas shaded in green have the lowest risk

Methods

The main factors used in determining where high risk areas are located were human population density and armadillo suitable habitat. First, suitable armadillo habitat was determined using land cover data from the US Geological Survey and armadillo habitat importance from the IUCN Red List (see Figure 3). Next, population density was determined using data from the 2010 US Census (see Figure 4). Then, these two factors were added together to assess the risk of each location (see Figure 1) within current armadillo range (see Figure 2). Finally, locations that received a final risk score of 8-10 were considered "high risk" and hospitals within 15 miles of these locations were identified (see Figure 5).

Results & Conclusions

This analysis shows that the risk of human-armadillo interactions is relatively average across most of Texas, with the highest risk areas often being in major cities and the lowest risk areas encompassing the more rural parts of the state. One important limitation of this analysis is that it only accounts for suitable armadillo habitat, but not the actual distribution or density of armadillos. Because there is suitable habitat covering most of the state, this likely skewed the results to be more representative of where the highest densities of humans are.

An important management implication of the results of this analysis is the identification of hospitals that are located near the highest risk areas within the state. As leprosy is a disease that is easily treated if it is properly diagnosed early, it would be beneficial to notify these hospitals of the possibility incoming patients suffering from this disease. This may help doctors make accurate diagnoses of the disease much sooner. Also, in addition to educating the general public about the dangers associated with coming into contact with any species of wildlife, this analysis can identify areas where people should be especially cautioned about possible exposure to *M. leprae* through contact with armadillos (see Table 1).

Top Ten Counties with Highest Risk

County	Minimum Risk Score	Maximum Risk Score	Average Risk Score	Total Population
Dallas County	2	10	6.28	2,632,111
Tarrant County	2	10	6.12	1,994,371
Hays County	2	10	6.08	228,906
Harris County	2	10	6.07	4,532,372
Ector County	2	9	6.00	176,512
Jeff Davis County	2	6	5.99	24,921
Terrell County	1	6	5.98	21,468
Presidio County	1	6	5.98	13,321
Crockett County	2	6	5.97	32,976
Edwards County	2	6	5.97	36,711

Table 1. This table gives information about the ten counties in Texas with the highest risk for human-armadillo interaction including highest and lowest risk score within each county, average risk score for each county, and the total population living within each county.

Analysis Factors

Armadillo Range

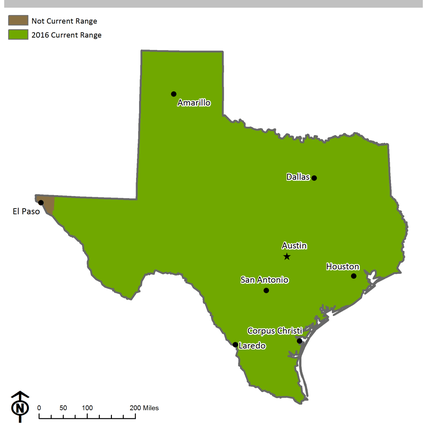

Figure 2. This map depicts the current range of Dasypus novemcinctus, as of 2016 according to the IUCN Red List.

Armadillo Suitable Habitat

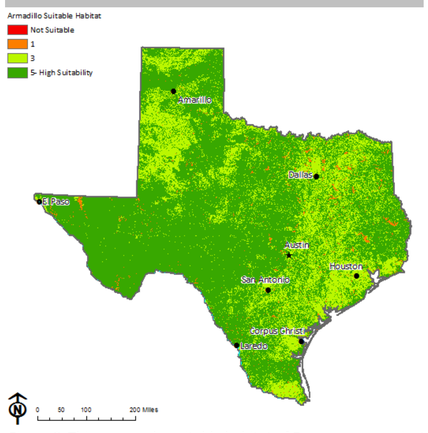

Figure 3. This map ranks suitable habitat of Dasypus novemcinctus based on land cover and habitat importance factors from IUCN Red List.

Human Population Density

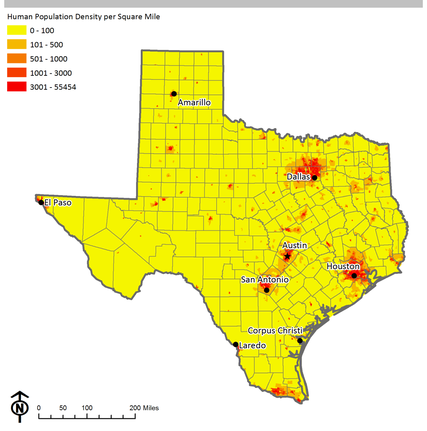

Figure 4. This map shows human population density according to data from the 2010 US Census.

Management Implication

High Risk Hospitals

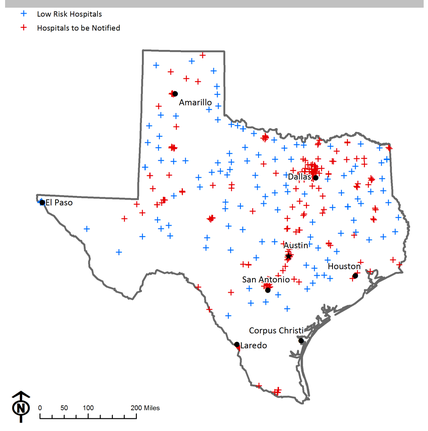

Figure 5. This map shows hospitals within the state of Texas. There are 264 hospitals marked in red, these are within 15 miles of high risk areas and may see incoming cases of leprosy.

Data Sources:

US Census Bureau, Texas Parks & Wildlife Department, US Geological Survey, ArcGIS Online, IUCN Red List

Projection:

NAD_1983_Texas_Statewide_Mapping_System

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