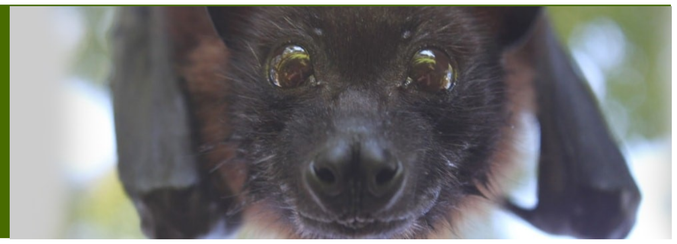
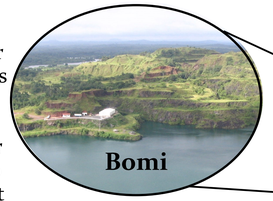
Ebola up to Bat

A risk assessment for the next big Ebola outbreak | Liberia

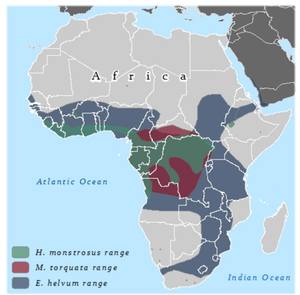


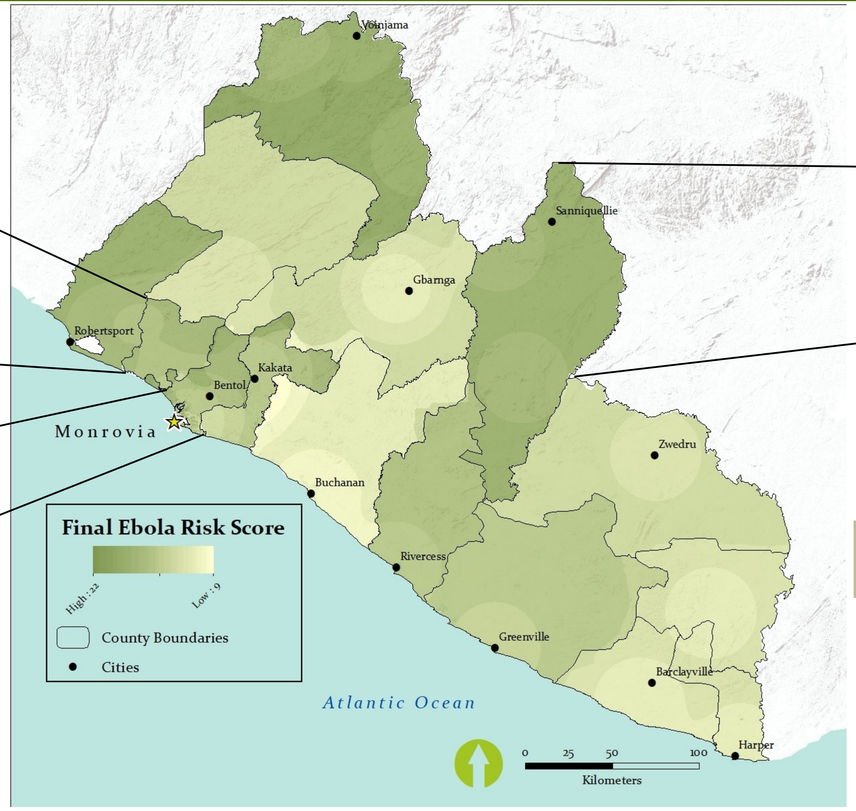
It Starts with Spillover...

In 2014 western Africa experienced an outbreak of Ebola Virus Disease, a disease which gravely endangered both humans and non-human primates in Liberia, Guinea, Sierra Leone, and Nigeria. The origins of Ebola Virus Disease are mysterious, but the current suspected reservoir of the virus is the fruit bat. Disease reservoirs are defined as the population in which a pathogen naturally lives, reproduces, and is maintained, and when they come into close contact with other species (such as humans) spillover events may occur in which the virus spills from reservoir to novel host. Despite significant attempts, fruit bats have not been confirmed as a disease reservoir for Ebola, though it remains the prevailing hypothesis because serum antibodies specific to Ebola have been found in at least three different bat species. These bat species are the straw-colored fruit bat (*Eidolon helvum*), hammer-headed fruit bat (*Hypsignathus monstrosus*), and the little-collared fruit bat (*Myonycteris torquata*).



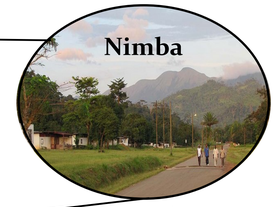
As human expansion pushes more and more people into closer contact with habitats containing bats and other wildlife, zoonotic disease outbreaks will inevitably continue to occur. In order to be ready for the next big outbreak, modeling of areas with the greatest vulnerability to outbreaks is crucial. By evaluating criteria such as population density, proximity to healthcare clinics, and metrics for bush meat consumption which may result in sporadic spillover events, we may stay one step ahead of the next big Ebola outbreak and be prepared to respond when it hits.





Rank	County	Risk Score
1	Nimba	17.68
2	Montserrado	16.75
3	Bomi	16.43

Methodology



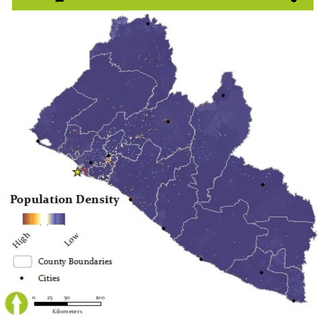
This vulnerability analysis of future Ebola outbreaks in Liberia considered a variety of factors including: population density, counties with high numbers of Ebola cases in the 2014 outbreak, counties with high numbers of Ebola deaths in the 2014 outbreak, healthcare clinic density, and poverty levels across counties as a proxy for food security levels. All file layers were converted to rasters, and run through the Reclassify tool using a scale of 1 (low) to 5 (high). All layers were then analyzed using the Raster Calculator tool, and Zonal Statistics. Each county was assigned an average risk score (between 22 and 9), and ranked to determine those counties most vulnerable to future Ebola outbreaks.

Results and Conclusions

The results of this analysis have identified the three counties most vulnerable to Ebola outbreak: Nimba, Montserrado, and Bomi. Nimba is in the most rural of the top three counties, while Montserrado and Bomi are both in areas of higher population density with more large cities. Ebola vulnerability is likely to be higher in these areas due to the higher potential for transmission in dense settlement. Rural Nimba had the lowest density of healthcare clinics, putting it in an equally vulnerable state. All three counties had a high number of Ebola cases during the 2014 outbreak, and Montserrado and Bomi had a high number of Ebola related deaths as well.

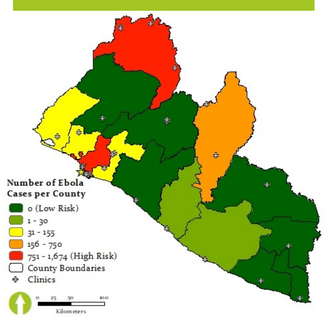
This analysis sheds light on areas that should be most targeted for Ebola outbreak prevention and preparations. By identifying the most vulnerable areas in Liberia to future disease outbreak, targeted intervention plans and healthcare infrastructure development can be implemented. Additionally, future research on fruit bat movement would greatly benefit the field by shedding light on spillover events between species.

Population Density



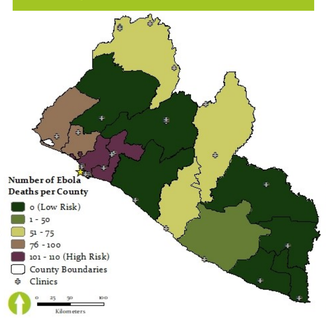
Population density has important ramifications for disease outbreaks due to the transmissible nature of the virus between people. This was calculated across Liberia using the Reclassify tool on a scale from 1 (low) to 5 (high), and was then run through the Raster Calculator tool for analysis.

2014 Ebola Cases



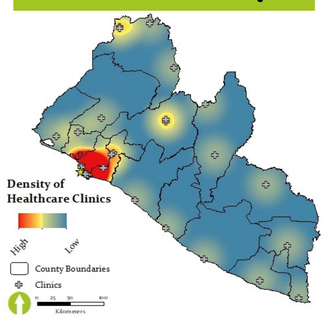
During the 2014 Ebola outbreak, cases were mapped to establish areas of future potential vulnerability in future outbreaks. Number of Ebola cases per county was calculated using the Reclassify tool on a scale from 1 (low) to 5 (high), and was then run through the Raster Calculator tool for analysis.

2014 Ebola Deaths



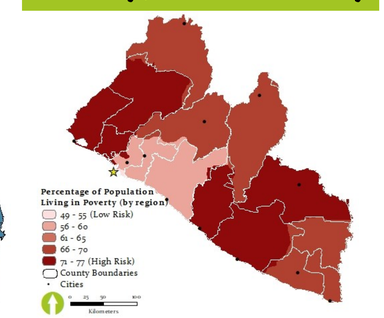
Ebola mortality during the 2014 outbreak also gives insight to the areas most vulnerable to Ebola and with decreased access to healthcare. Number of Ebola deaths per county was calculated using the Reclassify tool on a scale from 1 (low) to 5 (high), and was then run through the Raster Calculator tool for analysis.

Clinic Density



Density of healthcare clinics has implications for treatment and therefore vulnerability to Ebola outbreaks. The Kernal density tool was first used to determine clinic density. The Reclassify tool on a scale from 1 (low) to 5 (high) was used, and run through the Raster Calculator tool for analysis.

Poverty/Food Security



Percentage of those living in poverty was used as a proxy to estimate consumption of bushmeat, which puts individuals at higher risk of disease spillover events. This was calculated by county using the Reclassify tool on a scale from 1 (low) to 5 (high), and was run through the Raster Calculator tool for analysis.

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Projection: Africa Lambert Conformal Conic

Data Sources: IUCN Red List of Threatened Species, Humanitarian Data Exchange, Worldpop.org, Data.gov, ESRI Datamaps 10

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