Comparing the Effect of Various Landscape Changes on Disease Emergence

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INTRODUCTION

With the emergence of zoonotic diseases as a result of increased contact with vectors located in previously forested areas, anthropogenic landscape changes are becoming a larger part of epidemiology as the focus shifts from the epidemics to what instigates them. It is known that human-induced changes to the external environment are one of the leading causes of the reemergence and emergence of infectious diseases (Patz et al. 2000). Environmental change are shown to have a strong positive association with the emergence of **vector-borne zoonotic diseases** in particular (Gottwalt, 2015).

Goal of Research: Compare Zika Virus and Ebola Hemorrhagic Fever in terms of how landscape changes led to an increase in vector-host interactions.

How? Conduct spatial analysis of maps to identify similarities and differences in landscape use alongside death-to-case ratios of Zika and Ebola in their respective regions to improve our understanding of how landscape changes impact the emergence of infectious diseases.

Research Question: How do Zika Virus and Ebola Virus Disease compare in how anthropogenic landscape changes affects their vector-host interactions and emergence?

DATA

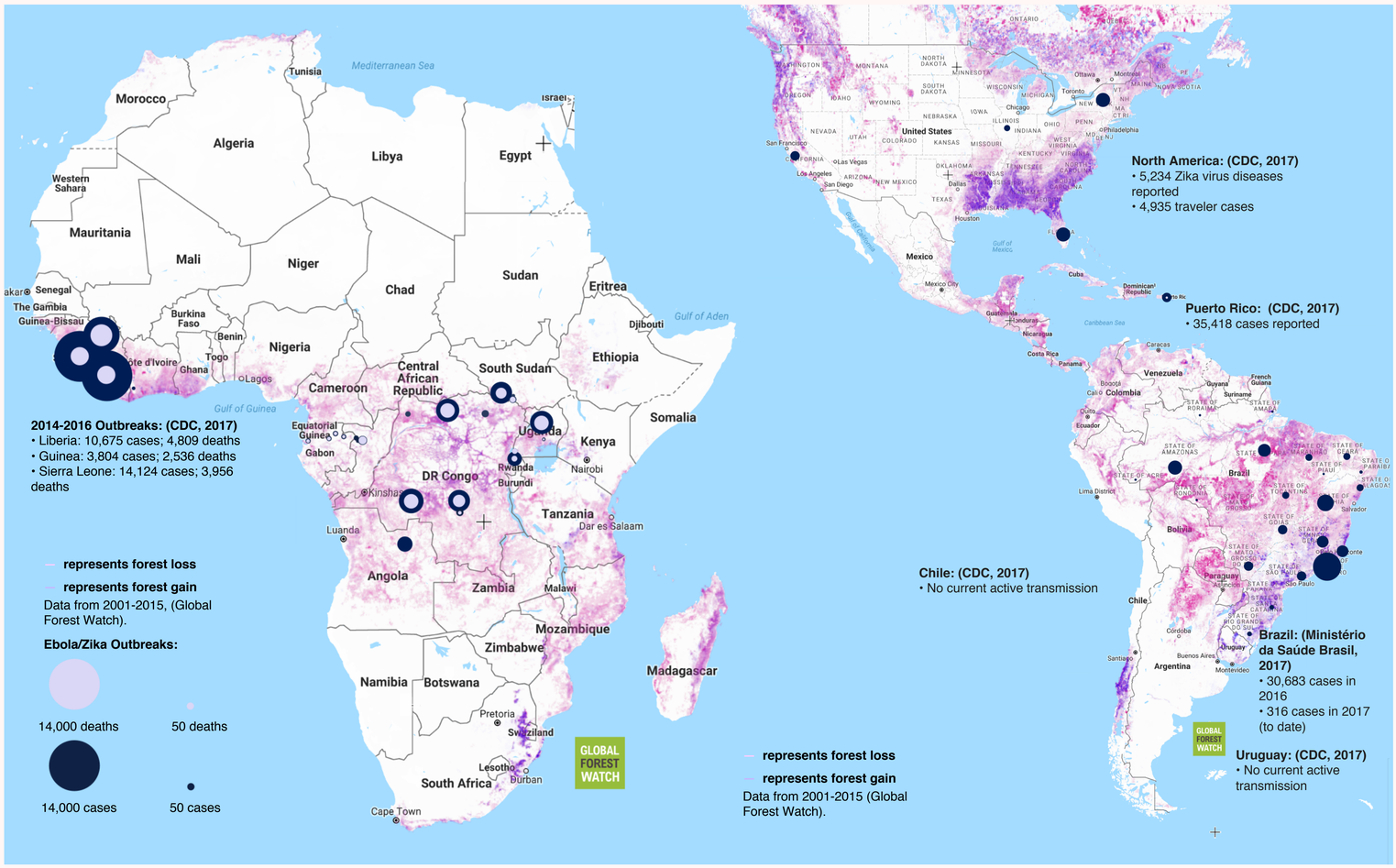

Figure 1: Deforestation in West and Central Africa and overlying distribution of Ebola cases with death-to-case ratio visually depicted per province or jurisdiction (CDC, 2017).

The type of land use annotations can be found in 'Raw Data'.
Forest Cover Data courtesy of (Global Forest Watch, 2017).

Size of outbreaks determined with y = 4 (*log*(x) - 0.8) + 5, where y equals the diameter of the circle and x equals the number of cases. 1 case marked with default of 5px diameter.

Figure 2: Deforestation in the Americas by jurisdiction/region (Central and South America) or states >100 cases (North America) (CDC, 2017).

Case counts for Zika Virus were not available except for Brazil, deaths unavailable (Ministério da Saúde Brasil, 2017).

Zika was not named reportable until February 17, 2016 in Brazil.

RAW DATA VIEWABLE HERE:

BACKGROUND AND SIGNIFICANCE

Human-induced changes to the external environment are one of the leading causes of the reemergence and emergence of infectious diseases. Two infectious diseases that have recently caused major and sensationalized epidemics are Zika virus and Ebola Hemorrhagic Fever, which are are both vector-borne zoonotic diseases.

CURRENT RESEARCH: Exploring this relationship more than exposures since it is accepted that deforestation and other land use changes increase the prevalence of similar diseases (Smithsonian, 2016). Past trends in similarly zoonotic diseases and current day research reveal there is a positive association between zoonotic, vector-borne diseases and deforestation of a region (Gottwalt, 2015).

THIS RESEARCH:

❶ Similarities and differences in landscape changes on two different continents that affected host-vector interactions, leading to the emergence of Ebola in Africa and Zika in South America.
❷ Trends in these regions prone to high levels of **deforestation, urbanization, and agricultural changes**, which would offer insight into vector-host interactions at an epidemiological level.
❸ How this then impacts host-viral interactions.

RESEARCH METHODOLOGIES

Collect data about cases and deaths and orient in terms of place and time

Collect data about deforestation in specific jurisdictions: total tree cover, % tree cover, net tree cover loss, tree cover gain, and year-specific loss

Analyze statistical significance + compare with types of landscape changes to find trends

JARGON

Anthropogenic landscape changes: originating from human activity, typically of environmental pollutants; referenced in relation to deforestation/other changes
Vector: any agent that carries and transmits a disease; can also be a reservoir, meaning they naturally harbor that disease
Zoonotic: spread from animals to humans

RESULTS

General Overview: By observing the overlap in areas of heavy deforestation for both Zika and Ebola and where disease spreads, the conclusion that the two must correlate can be drawn. However, seeing the trends in deforestation data per hectare, outbreaks did not overlap to years of heavy deforestation though the did start from when humans began spreading out into areas where they could contact vectors. Since deforestation is not the only cause of increased human interaction, it is likely that deforestation was a factor that increased exposure but cannot be named as the sole reason for emergence.

Statistical Significance: Data between jurisdictions can not be compared due to variations in research methodologies and therefore must be considered independently. Data prior to 2001 does not exist in this database, and makes it difficult to draw any conclusions due to the possibility of a confounding variable.

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