

# Physical And Demographic Aspects of Dengue Fever Occurrences and Spread in Brazil

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## Introduction

Since the re-introduction of the *Aedes aegypti* mosquito to Brazil and the first case in the 1980s, (Mondini et al., 2005), Dengue Fever has become a major public health issue in Brazil.

Dengue is transmitted by the bite of the vector mosquito, and has a four day incubation period, before an infected person will develop a fever and rash, which he or she will recover from in approximately five days. Dengue Fever, itself, does not have a high mortality rate, but Dengue Hemorrhagic Fever (5% mortality rate), with an extra symptom of vascular permeability, blood loss, and Dengue Shock Syndrome (up to 40% mortality rate), where there is the loss of too much blood, resulting in hypertension, are where the majority of the Dengue deaths come from.

Due to the fact that the *Aedes aegypti* mosquito prefers areas with temperatures over 68° F (20° C, Nakhapakorn, "An Information value..." 2005), areas in Tropical and Subtropical climate regions have the highest volume of the vector mosquito. Brazil's location relative to the equator, makes it a "hot spot" for the vector mosquito and in effect Dengue.

The health concerns of Dengue, has caused health officials to track the disease as well as the development of models to help track the number of occurrences and spreads, in order to understand the disease's patterns and facilitate the optimization of resources in the eradication of the disease. Looking at different factors of the mosquito and human components of the disease, should be helpful in finding areas of risk for Dengue.

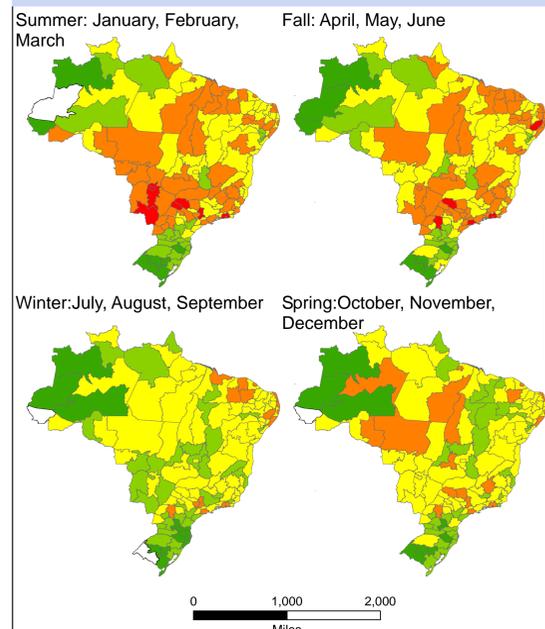
Certain factors that are important to these components are, seasonality, population, transportation methods, and the different biomes and climate zones. Seasonality is important because in many areas of Brazil the different seasons bring hotter and colder temperatures to an region where mosquitoes live, if a temperature falls below the *Aedes aegypti* desired temperature they will not be found in that region. The population of a region is important feature because where population density is higher there are more potential targets in an infected mosquito's life span, causing greater spread of Dengue. Transportation methods are important for both humans and mosquitoes, for humans, the movement of the disease from an infected region to an uninfected region, as well as the density of mosquitoes in an area. Finally the different biome and climate regions are important to the mosquitoes habitation and seasonal patterns.

## Methods

Using information on the number of cases in 2007 of Dengue Fever by region, from Brazil's Ministry of Health, along with information on population, biomes and climates from the Brazilian Institute of Geography & Statistics, to view how different types of physical and demographical (population) features cause the occurrences and spread of Dengue. Dengue occurrences and spreads are incredibly complex, to help simplify the correlation factors, a breakdown of the some of the physical and demographical factors was used. After using ArcGIS to visually display and edit the Shapefile data, Microsoft Excel was used to create graphs to show the correlation between the different factors (seasonal, population, proximity to roads, lakes, and river, and biome & climate areas) and the number of cases in different regions.

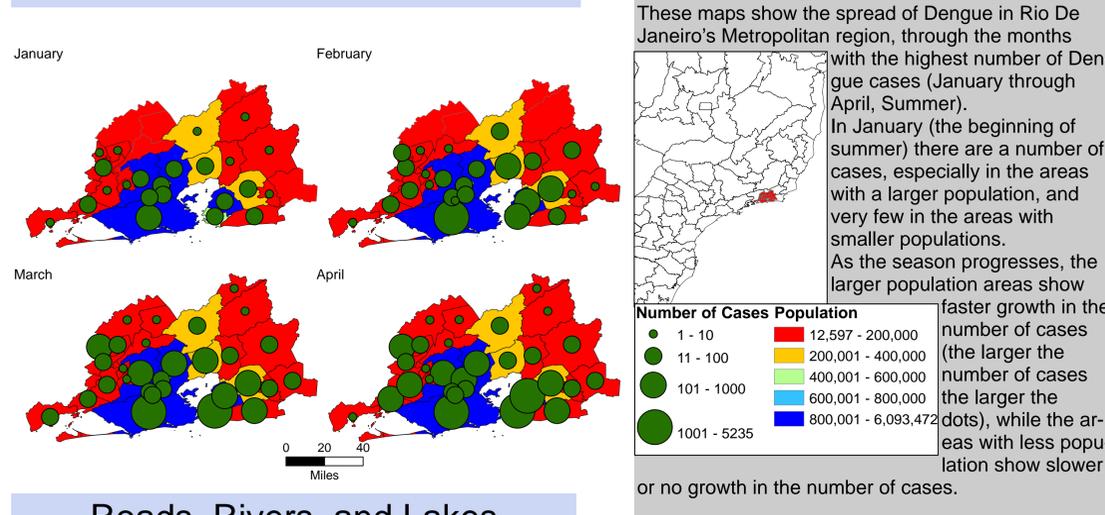
## Maps

### Seasonal Spread

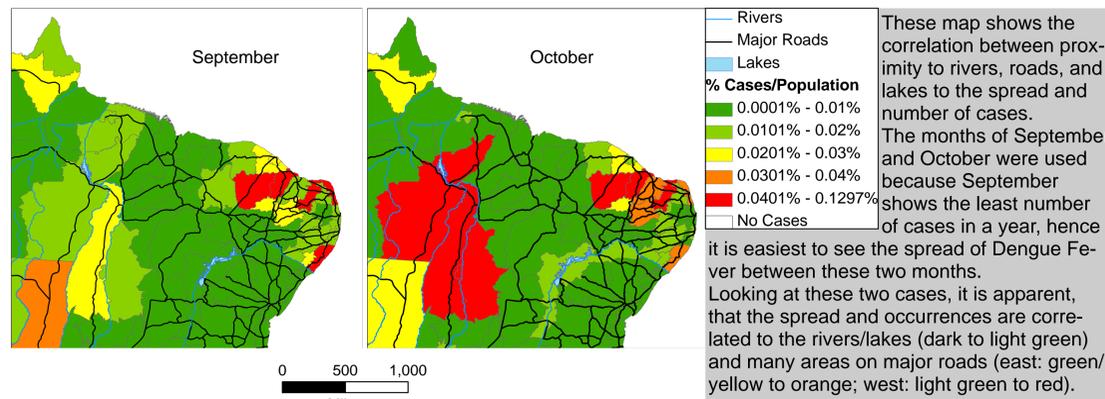


One of the biggest factors in the spread of Dengue is the season. In many parts of Brazil, seasons directly affect the climate. In the summer it is hotter and more humid, then in winter, when it is cooler and drier. Because the vector mosquito is very susceptible to the heat and humidity, during winter months there would be far less mosquitoes (in areas where there are four seasons, such as the more south regions) then in the summer months. Finally, due to the decrease in the amount of mosquitoes there are less cases in the winter then the summer.

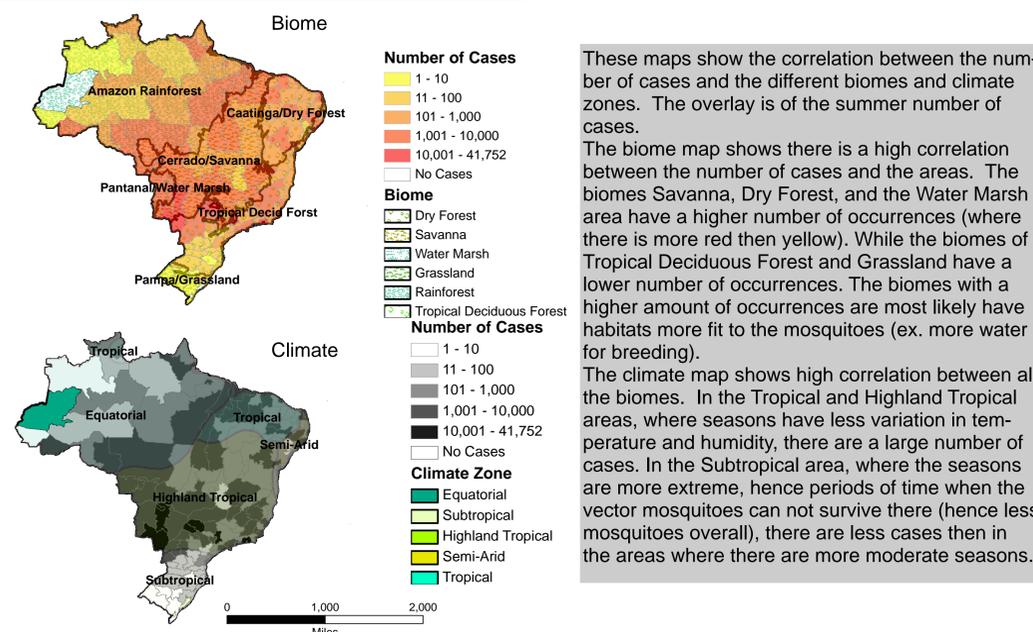
## Population Spreads



## Roads, Rivers, and Lakes



## Biomes and Climates



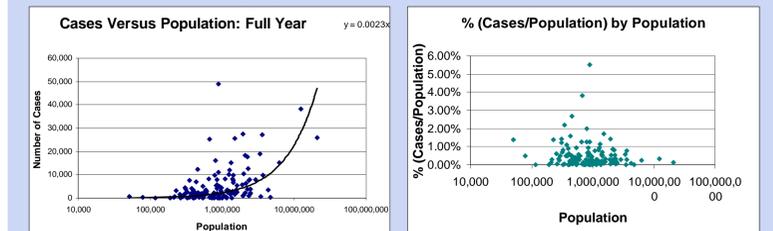
## Results

After examining the maps and graphs to see the correlation between the spread and number of occurrences of Dengue and different physical and demographic properties of Brazil, this correlation is shown below:

	Seasonal	Population	Roads, Rivers and Lakes	Biome	Climate
Correlation	High	High	Medium	Medium	High

**Seasonal:** Due to seasonal changes in the temperature and humidity, there is a high correlation between the seasons and the number of occurrences and spread of Dengue fever. In warmer and/or more humid seasons, over all of Brazil, there are a higher number occurrences and greater spread of Dengue Fever then in colder and drier months.

**Population:** The correlation of the number of cases versus population cannot be completely determined by this study. In larger cities there are more cases of Dengue Fever, but looking at the rates of cases by population, there is no clear correlation between population and how many people are affected (see below).



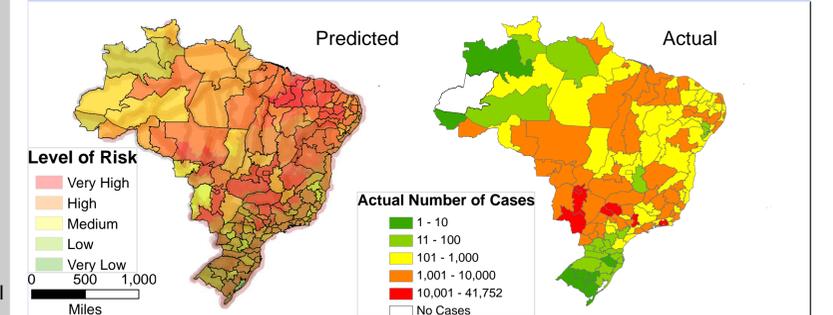
In larger cities, Dengue spreads more rapidly then in the smaller population regions (see above). But this is more likely due to population density then strictly the number of people. The reason the population density has much more to do with the amount of spread is due to the rates of mosquito travel and lifespan then the total amount of people does.

**Roads, Rivers, and Lakes:** There is a correlation between the spread of Dengue and the roads, rivers, and lakes. This is due to two facts, one is that roads and rivers are used for human transportation, hence the transportation of the disease in human form. The second being that there are more mosquitoes around rivers and lakes (mosquitoes use water as breeding grounds), hence the transportation by mosquitoes and mosquito density of an area is greater.

**Biomes and Climates:** In the biomes which are more "tree covered" then other biomes (hence wetter), there are greater number of cases and a higher spread of Dengue then ones which are drier.

The climate has a greater effect on the occurrences and spread (as talked about above in the seasonal section). Climate regions with more moderate seasons have higher occurrences and spread then climate regions with more extreme seasons, due to the temperature preferences of the vector mosquito.

**Overall:** By putting together the different factors for the occurrences and spread of Dengue Fever, a model can be made for the number of occurrences and spread in any general area in Brazil. This model could be used in order to target and treat high risk areas better, so there is less spread and total number of occurrences in Brazil. An un-weighted example of a model is shown below (the Actual data is Summer 2007):



## Conclusions

The correlations between the factors and Dengue occurrence and spread, show high risk areas for Dengue. Some of these areas though have low number of cases, this could be for many reasons, such as immunity, isolation of groups of people, or better use of mosquito nets. By looking at these areas, public health officials could bring techniques used these areas into areas of high risk with higher number of cases of Dengue Fever. A more comprehensive study could also be done using smaller time periods and more accurate, if not exact, data on the location of cases, to track the spread more accurately, as well as getting more quantitatively accurate results.

Acknowledgments: Statistics of the Number of Dengue Cases and Map of Brazil: Anthony Stevens, Universidade Federal do Rio Grande do Sul/Ministry of Health of Brazil  
Sources: Biome & Climate Maps and Population Statistics: Brazilian Institute of Geography and Statistics, www.ibge.gov.br & mapas.ibge.gov.br; Rivers, Roads, and Lakes: GfK Geomarketing Mondini et al., "Spatial Analysis of dengue transmission in a medium-sized city in Brazil," 2005  
Nakhapakorn et al., "An information value based analysis of physical and climatic factors affecting dengue fever and dengue hemorrhagic fever incidence," 2005  
Projection (All): Polyconic (world) Units (All): Decimal Degrees

