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The Impact of Urbanization on Mosquito-Borne Viruses

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By Nikhita Puthuveetil

Introduction

Diseases like yellow fever, dengue, and Zika are rapidly emerging and reemerging all over the globe. Many of the viruses that causes these diseases use vectors to transmit the disease to different hosts. Of particular interest are the viruses that use arthropods as their vectors, otherwise known as arboviruses. Vectors can range from mosquitoes, ticks, sandflies, lice, and bedbugs. From this range of vectors, I chose to concentrate on mosquito-borne viruses.

The emergence of disease can be connected to urbanization and changes in land use. Interestingly enough, it seems that mosquito-borne viruses are largely unaffected by habitat destruction and deforestation. Rather, one could say that viral activity increases because of urbanization. The goal of my research was to find out why and how this phenomenon occurs. To do so, I analyzed and examined several journal articles on disease emergence, arboviruses, and vector species.

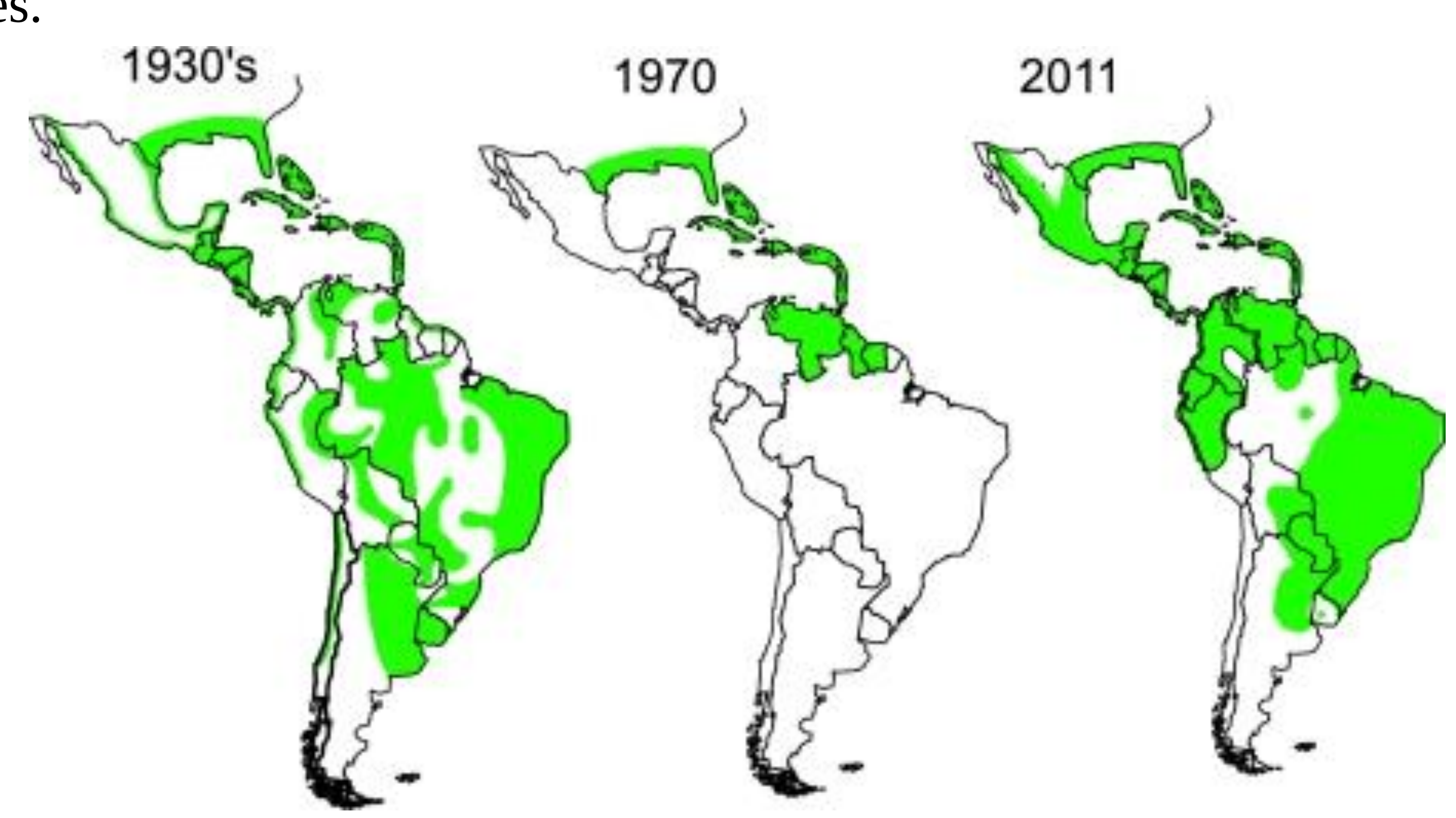

Figure 1: Emergence and reemergence of *Aedes aegypti* in South America.

Methods

A collection of papers were analyzed and examined to better understand the factors that influence disease emergence, arboviruses, and vector species. I examined several mosquito studies to learn how mosquitoes and arboviruses interact and how they are affected by the changes in the environment. I also studied articles which addressed different factors that influenced disease emergence such as deforestation, the construction of infrastructure, and poaching. Additionally, I searched for articles which proposed theories as well as solutions for disease emergence.

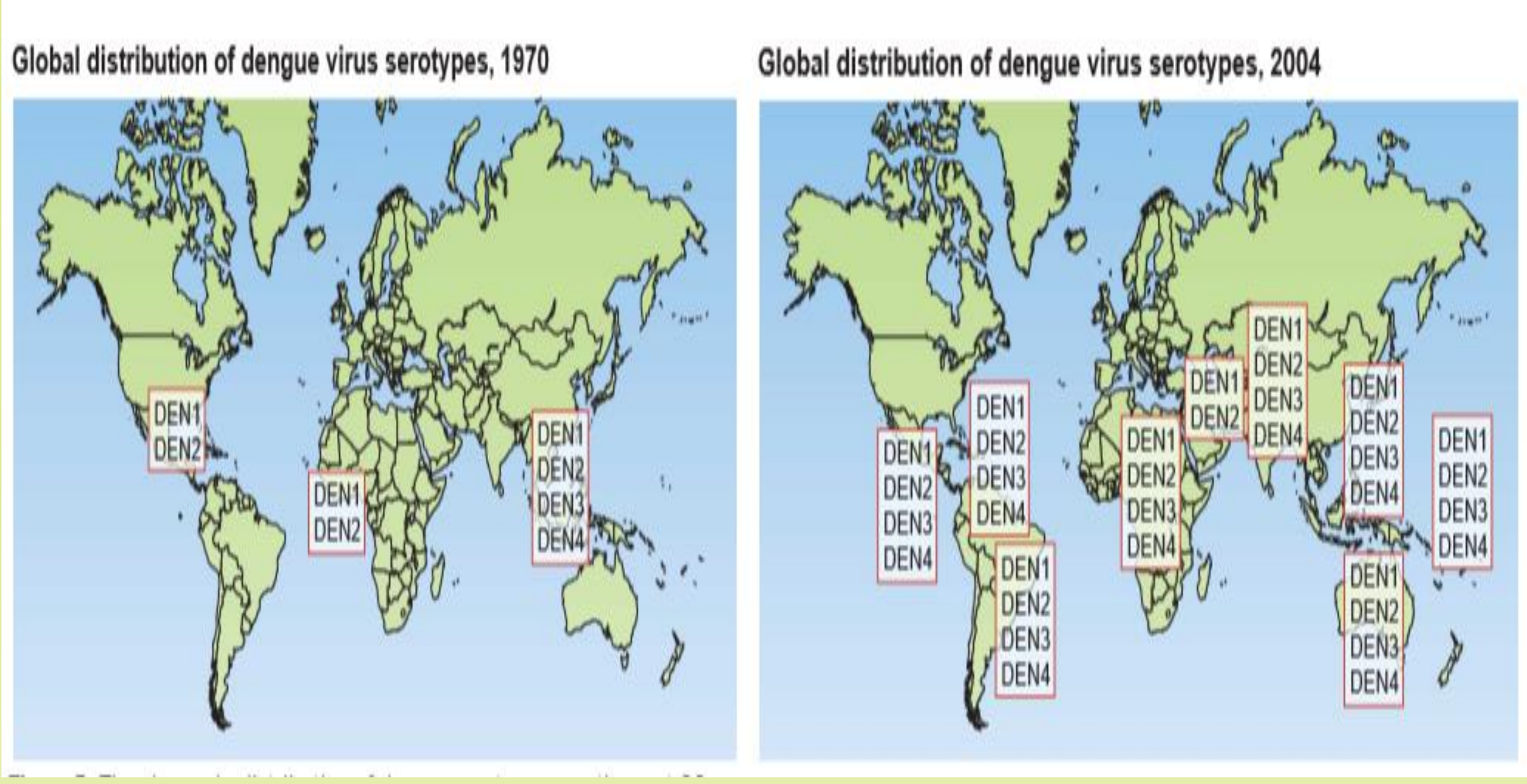

Figure 2: Change in dengue virus serotypes from 1970-2004.

Figure 3: A photograph of *Aedes aegypti*. This mosquito transmits dengue, yellow fever, and Zika.

Results

Urbanization and land use are largely responsible for arbovirus emergence. To adapt to the changing environment, arboviruses often use several survival mechanisms:

1) Arboviruses have primary vectors, but they also use multiple vectors to transmit diseases. These can include different organisms or different members of a species. Mosquito-borne viruses can also switch principal vectors over time as a response to the change in environment.

2) Arboviruses are extremely hard to detect. Symptoms of an arboviral infection can vary from mild to hemorrhagic. Arboviruses can exist in its vector for the vector's entire lifetime without any signs of symptoms from the vector.

3) Arboviruses can mutate rapidly, therefore, solutions like vaccines are only useful for a limited amount of time.

4) Most mosquitoes are zoophilic: they prefer animals over humans for hosts. Therefore, controlling arbovirus emergence through maintaining human population size will have no effect.

5) Even so, some mosquitoes, such as *Aedis aegypti* which transmits the dengue virus, can become anthropophilic and prefer humans over animals. Consequently, urbanization and high human populations raise mosquito populations and in turn, raise mosquito-borne virus activity.

Arbovirus emergence is reliant on vector species. Vectors can be influenced by a variety of factors which include land use and urbanization, climate change, and extreme weather conditions. Arbovirus emergence can also be controlled by bird migration and invasive species.

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Conclusion

The goal of my research was to find out why and how mosquito-borne viruses prevail despite urbanization and the changes in land use destroying their habitats. After analyzing several journal articles on disease emergence, I found that viruses employ survival mechanisms to adapt to urbanization and anthropological land, several of which include the survival strategies of their vector mosquito species.

In order to minimize global disease emergence, it is crucial to understand the factors that influence disease emergence and how to control these factors. Having awareness of the survival strategies of both mosquito-borne viruses and mosquitoes can lead to development of tailored mosquito and virus control programs and procedures. Hopefully, with knowledge of arbovirus emergence, epidemics of old diseases like dengue, yellow fever, and Zika can be prevented and efforts can be made to find long-term treatments to prescribe to patients with mosquito-borne diseases.

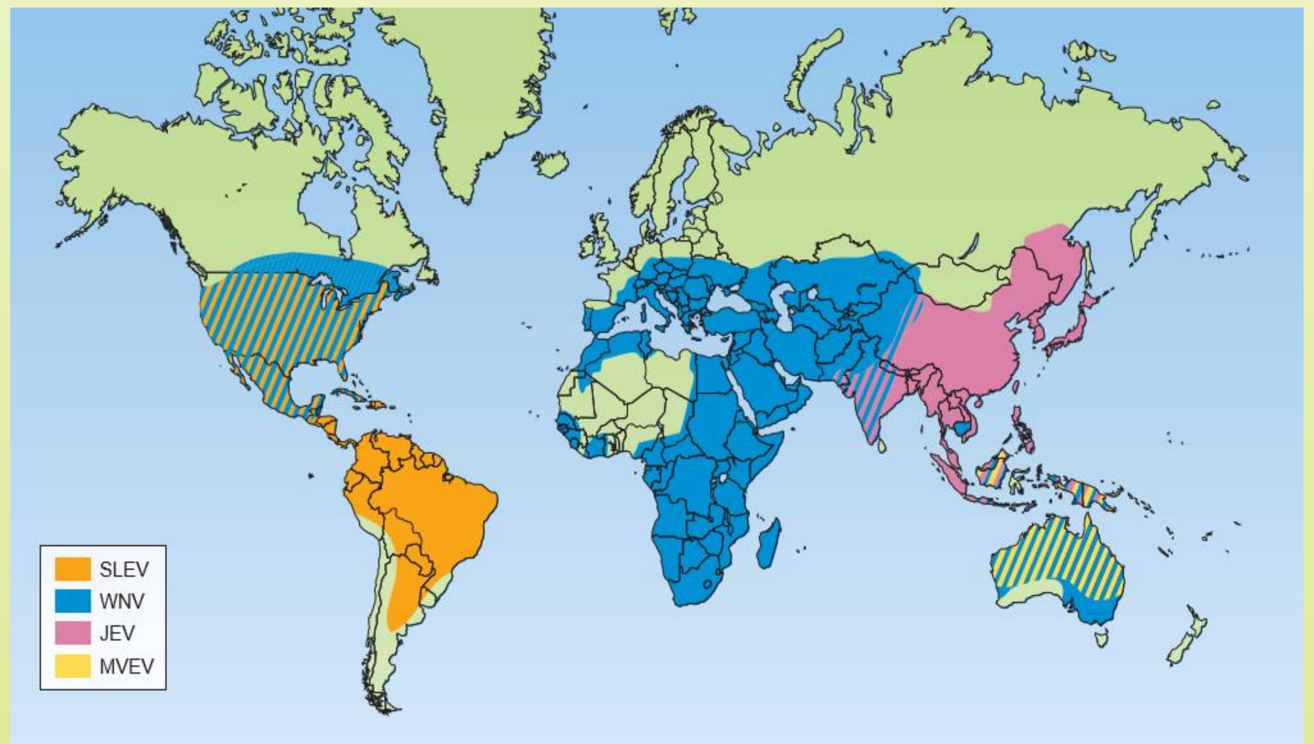

Figure 4: Map of global distribution of major serological groups of Japanese encephalitis virus. In orange is St. Louis encephalitis virus, in blue is West Nile virus, purple is Japanese encephalitis virus, and in yellow is Murray Valley encephalitis virus.

Acknowledgements

I would like to thank Professor Prichard for demonstrating how to gather scholarly research related to my topic and guiding me through the research process.

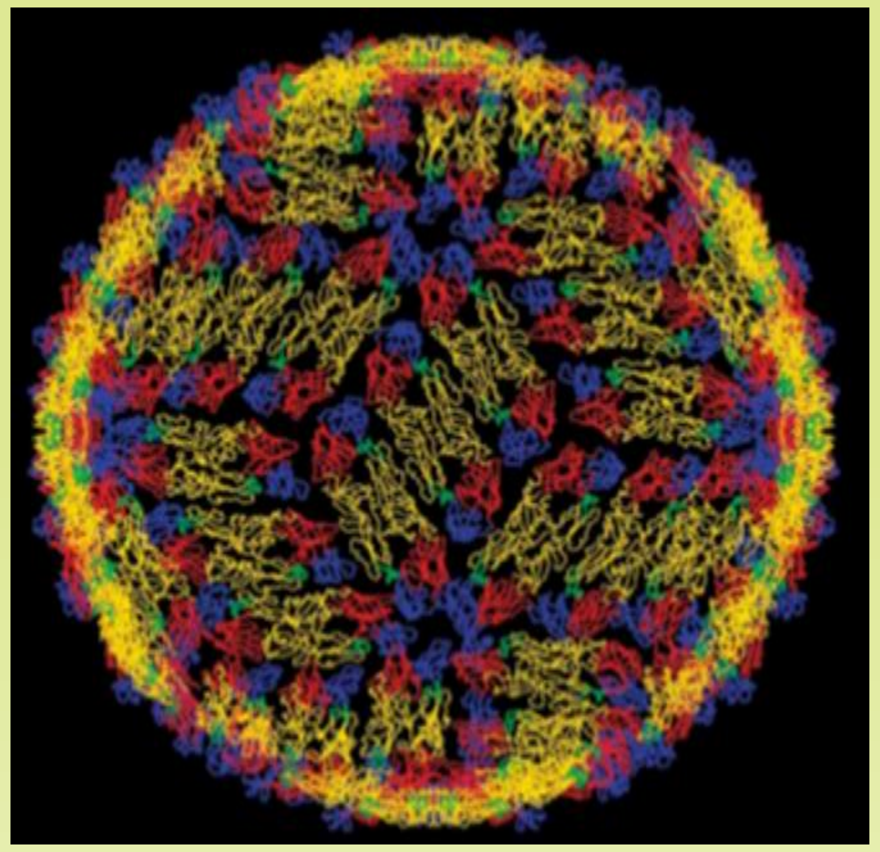

Figure 5: Model of a mature dengue virus.