Vector Hazard Report: Puerto Rico

Dengue, Chikungunya, Yellow Fever & Zika Virus Mosquito Vectors

NORTH ATLANTIC OCEAN

Caribbean Sea

Walter Reed Biosystematics Unit

Last updated by David Pecor April 2021
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Overview:

For the most up-to-date information about vector species, please visit the Walter Reed Biosystematics Unit Website.

The primary mosquito vector of dengue, chikungunya, yellow fever and Zika viruses on the island of Puerto Rico is *Aedes aegypti* (Linnaeus, 1762). However, *Aedes albopictus* (Skuse, 1894) and *Aedes mediovittatus* (Coquillet, 1906) have played significant roles in past outbreaks. Further complicating the issue is the recent detection of *Aedes vittatus* (Bigot, 1861) in the Caribbean. This vector species may be already present or may become established on the island in the near future. This report summarizes the biology, distribution and identification resources associated with these important vector species. Also included are maps of recently reported local disease transmission and links to additional resources such as guidance on surveillance and counter measures.

Historically, arbovirus outbreaks reported from Puerto Rico have an increased number of cases in the late summer and fall (August to September), which are the hottest and wettest months of the year in Puerto Rico. There have been outbreaks of dengue fever in Puerto Rico since 1963 and it continues to be endemic to the island today. The largest reported outbreak occurred in 2010 with over 25,000 locally acquired cases reported to the Centers for Disease Control and Prevention.

The spread of vector species such as *Aedes aegypti*, *Ae. albopictus* and *Ae. vittatus* around the world in the past 50 years is well documented and facilitated by a unique life trait: their eggs can survive desiccation. This trait allows eggs laid by these species to travel undetected in receptacles like used tires, or lucky bamboo plants, which are distributed throughout the world. When these receptacles are wetted (e.g. by rain, watering), the larva emerge and grow to adults in their new environment. In temperate or tropical environments conditions are highly suitable for populations to quickly become established.

Compounding this problem is that these mosquito species are capable of ovarian viral transmission – meaning that if the mother is infected with a virus, she can potentially pass it on to her offspring through her eggs. Each female mosquito lays 100-120 eggs, every 4-5 days (c.4-8 times in her life time of 1-3 months), and if she is infected, all her offspring emerge ready to infect the first person they bite. Reducing the exposure of infected people to mosquitoes requires the widespread availability of rapid diagnostic tests, effective treatment and most importantly, containment of the patients. Given that there is currently no vaccine or effective treatment for Zika virus, reducing the opportunity for mosquitoes to bite infected people is critical in slowing the continued spread of the disease.
Resources: Vector Borne Disease Threats in Puerto Rico

CIA Factbook: Puerto Rico

CDC Travelers Overview

CDC National & State Maps (Disease and vector surveillance reported to CDC)

CDC: Zika Virus and Complications

Global Aedes Insecticide Resistance Map (IRMapper)

Video Library:

Dengue and Chikungunya in Our Backyard: Preventing Aedes Mosquito-Borne Diseases

Zika Virus Prevention: Summary for General Public in Puerto Rico

Hunting for mosquitoes in Puerto Rico

Vector Surveillance and Control Resources:

Armed Forces Pest Management Board (AFPMB) Technical Guide # 47 Aedes Mosquito Vector Control

Armed Forces Pest Management Board (AFPMB) Technical Guide # 14 Personal Protective Gear & Equipment for Pest Management Personnel

Armed Forces Pest Management Board (AFPMB) Technical Guide # 48 Pest and Vector Surveillance

Environmental Protection Agency Mosquito Control: Controlling Mosquitoes at the Larval Stage

Fight the Bite for Protection from Malaria: Guidelines for DEET Insect Repellent Use

CDC: Guidelines for Aedes aegypti and Aedes albopictus Surveillance and Insecticide Resistance Testing in the United States

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Aedes (Stegomyia) aegypti (Linnaeus, 1762)

For diagnostic morphology, identification keys, exemplar DNA sequences, a full list of associated pathogens and detailed bionomics visit the WRBU Species Page

Aedes aegypti are found in close association with humans, making them an extremely efficient vector of many arboviruses. Larvae are found in common water-collecting containers around homes such as buckets, tires, flower pots and refuse. Human socioeconomic factors play a role in Ae. aegypti abundance. Studies have demonstrated that communities of lower socioeconomic status support higher populations of Ae. aegypti, as well as other important vector species. In Puerto Rico, recent Ae. aegypti population surges have been associated with large numbers of abandoned houses that were the result of mass evacuations during Hurricane’s Maria & Irma (2017) and Dorian (2019). Productivity of individual larval sites is influenced chiefly by the availability of water and organic material for food. Females are day-time biters and not active at night. Pyrethroid resistant populations of Ae. aegypti have been detected in Puerto Rico. It has been demonstrated that these resistant populations require significantly higher concentrations of pyrethroids to reduce attack rates. Adult Ae. aegypti are easily distinguishable from other mosquito species by their striking black and white coloration and distinctive lyre-shaped white scale pattern on the scutum.
For diagnostic morphology, identification keys, exemplar DNA sequences, a full list of associated pathogens and detailed bionomics visit the [WRBU Species Page](#)

*Aedes albopictus* are less abundant in urban areas as compared to *Ae. aegypti*, but pose a significant threat in peri-urban and rural environments. This species will readily feed on humans or animal hosts and is capable of transmitting a number of arboviruses to humans. Females feed during the daytime and generally require more bloodmeals than *Ae. aegypti* to produce eggs, increasing the risk of disease transmission. *Aedes albopictus* has very quickly established a global distribution due to its ability to dry its eggs for long-periods of time. Eggs can be laid in human containers but also potted plants and tires. The eggs can stay dry for months while these items travel to different parts of the world and hatch quickly after exposed to water again. *Ae. albopictus* is also more tolerant to lower temperatures and may outcompete *Ae. aegypti* in some areas. Both these species have played dominant roles in all major vector-borne disease outbreaks in Puerto Rico in the last 20 years. *Aedes albopictus* has a similar white/silver and black pattern but can be distinguished from *Ae. aegypti* by a narrow median-longitudinal white stripe on the scutum.
Aedes (Gymnometopa) mediovittatus (Coquillett, 1906)

For diagnostic morphology, identification keys, exemplar DNA sequences, a full list of associated pathogens and detailed bionomics visit the WRBU Species Page

Aedes mediovittatus has long been known as a maintenance vector of dengue virus in Puerto Rico. It is capable of transovarial infection of its offspring to maintain dengue virus (DENV-1) in rural populations during interepidemic periods. Although it has been demonstrated that Ae. mediovittatus is a poor vector of dengue to humans as compared to Ae. aegypti, its role in maintaining the virus in nature means it must also be considered when developing plans to reduce dengue infection risk. Females will feed on humans but also target a variety of other mammals as well as birds. This species is mostly found in rural, forested areas but has been detected in urban and peri-urban environments. Larval sites are generally natural and not associated with humans. Aedes mediovittatus is also white/silver and black colored but can be distinguished from Ae. aegypti and Ae. albopictus by using two characters: 1. Scutum: A silver/white median stripe and two longitudinal stripes. 2. Hindtibia: White patch of scales about 1/3 distance from base.


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**Aedes (Fredwardsius) vittatus (Bigot, 1861)**

For diagnostic morphology, identification keys, exemplar DNA sequences, a full list of associated pathogens and detailed bionomics visit the [WRBU Species Page](#).

Aedes vittatus has not been detected in Puerto Rico at the time of writing, however there is a high likelihood this vector may already be established or may soon be. For more information about this important vector including its initial detection by U.S. military entomologists view the WRBU Spotlight Report: *Aedes vittatus – first incursion into the New World*. This species can easily be recognized by the scale pattern on the scutum of 6 white/silver spots.

Like *Ae. aegypti* and *Ae. albopictus*, *Ae. vittatus* is an effective vector of the top four *Aedes* fever viruses – chikungunya, dengue, yellow fever and zika viruses. In Jaipur district (India), 20% of *Ae. vittatus* larvae test showed evidence of vertically transmitted DEN virus, higher than *Ae. albopictus* (18.7%) and *Ae. aegypti* (13.3%) from the same sites (Angel & Joshi, 2008). *Aedes vittatus* is involved in the sylvatic transmission cycle of yellow fever to monkeys; YFV is also passes transovarially in *Ae. vittatus*.

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Common Diagnostic Characters

Scutum:

Aedes (Stg.) aegypti
Aedes (Stg.) albopictus
Aedes (Fre.) vittatus

Hindleg:

Aedes (Gym.) mediovittatus
Aedes (Stg.) aegypti
Aedes (Stg.) albopictus
Habitat Suitability *Aedes aegypti* and *Ae. albopictus*

Boosted regression tree model of habitat suitability for *Ae. aegypti*, Puerto Rico. Kraemer et al. 2015

Boosted regression tree model of habitat suitability for *Ae. albopictus*, Puerto Rico. Kraemer et al. 2015

Month of maximum precipitation compiled from the 50 year average of the WorldClim dataset.

Month of maximum temperature compiled from the 50 year average of the WorldClim dataset.

For more detailed surveillance data and additional habitat suitability models, visit [VectorMap.si.edu](http://VectorMap.si.edu)

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Dengue Virus Transmission Maps (CDC)

From CDC Disease Maps: National & State Maps (including county-level data) from 2003 to present

Locally Acquired Human disease cases of Dengue Fever reported to CDC by county, 2021 (last updated April 2021)

Locally Acquired Human disease cases of Dengue Fever reported to CDC by county, 2020

Locally Acquired Human disease cases of Dengue Fever reported to CDC by county, 2019
Chikungunya Virus Transmission Map (CDC)

From CDC Disease Maps: National & State Maps (including county-level data) from 2003 to present

Locally Acquired Human disease cases of chikungunya reported to CDC by county, 2019

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Zika Virus Transmission Map (CDC)

From CDC Disease Maps: National & State Maps (including county-level data) from 2003 to present

Locally Acquired Human disease cases of Zika fever reported to CDC by county, **2021** (last updated 21 Apr 2021)

Locally Acquired Human disease cases of Zika fever reported to CDC by county, **2020**

Locally Acquired Human disease cases of Zika fever reported to CDC by county, **2019**

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