

# Why GO Mosquito Habitat Mapper? Because Mosquito Vector Borne Disease!



GLOBE Mission Mosquito Campaign  
Wednesday, July 24, 2019  
Citizen Science webinar 7



# Mosquito Vector Borne Disease Story

- **A disease transmission model for mosquito vector borne diseases**
- **Disease Guide highlights; a resource guide when telling the story**





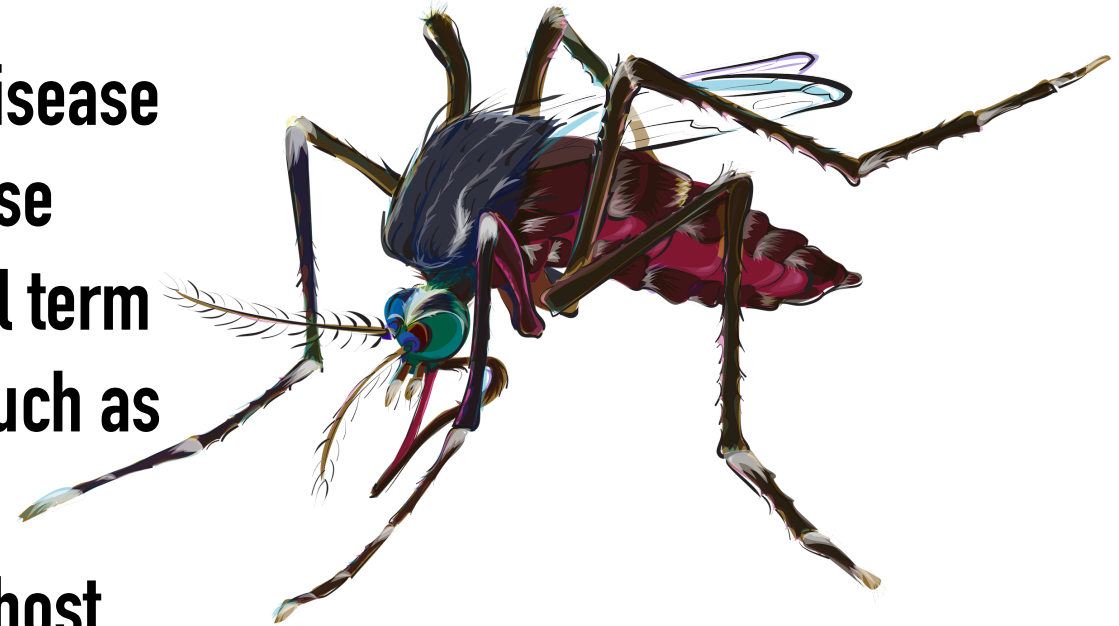
# The elements of the mosquito story . . . .

- **Characters:** mosquitoes, humans, viruses, parasites
- **Setting:** everywhere (except Antarctica)
- **Plot:** Unintentional, yet often devastating, events unfold during the species-perpetuating quest by female mosquitoes for certain proteins found in human blood.
- **Conflict:** The female mosquito gets the blood proteins she wants; the humans who donate that blood may get diseases they do not want.



# Mosquito-lingo used in the 'story'

- **Pathogen** – biological agent that causes a disease
- **Vector** – an organism that transmits a disease
- **Arbovirus** – (arthropod-borne virus) general term for any virus transmitted by an Arthropod (such as a mosquito).
- **Parasite** – an organism that lives in or on a host.

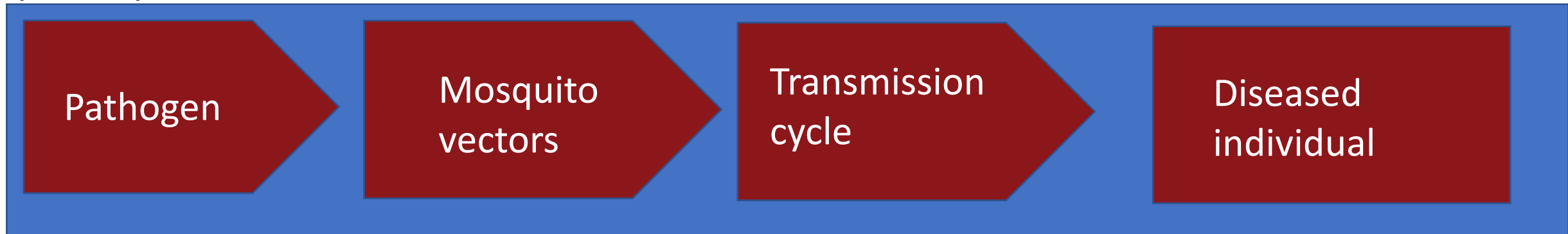


# Mosquito Vector Borne Disease Story

## General Disease Transmission Model



## Specific Mosquito Vector Transmission Model



# THE PRINCIPLE ARBOVIRUSES TRANSMITTED BY MOSQUITO



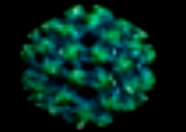
DENGUE



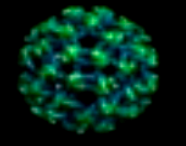
ZIKA



CHIKUNGUNYA

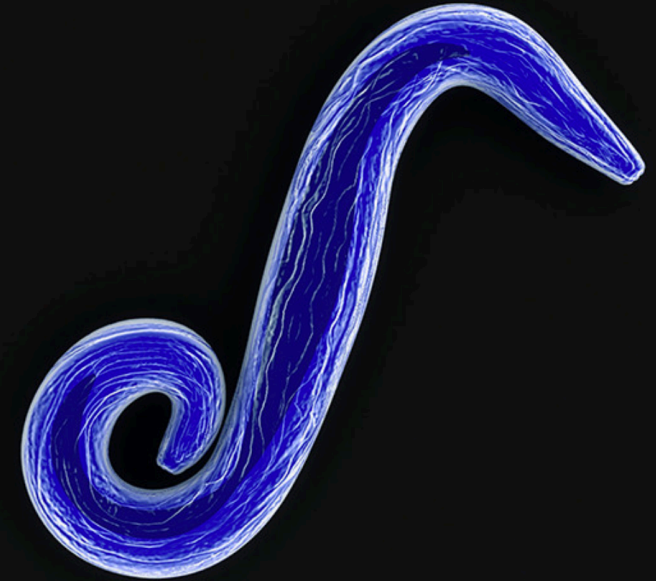


YELLOW FEVER



WEST NILE FEVER

- Pathogen



AND PLASMODIUM,  
PATHOGEN FOR  
MALARIA

# There is an ideal climate for both the survival of mosquitoes and for the transmission of pathogens

*Aedes aegypti*: 50-102 °F; range; peak 73-93 °F

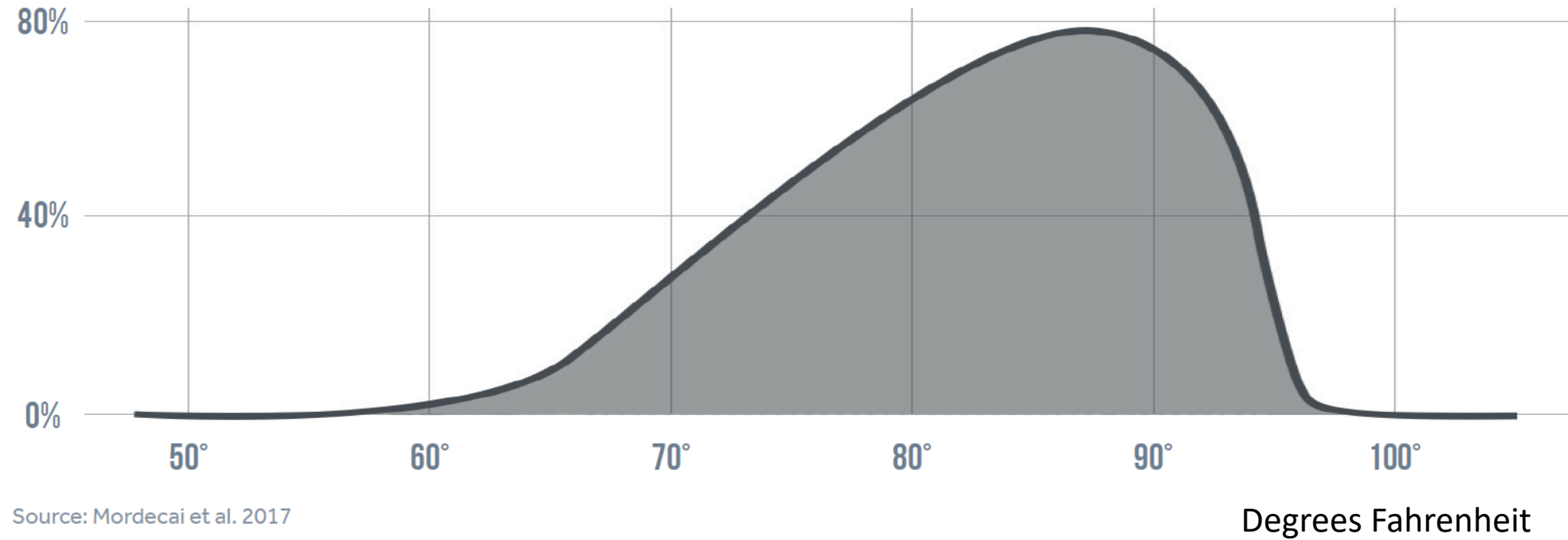
*Aedes albopictus*: 59-95 degrees °F

*Culex*: 50-95 °F, peak 82-89 degrees °F

## Transmission Risk

When mosquitoes are likely to spread disease

Percent probability



Source: Mordecai et al. 2017

<https://www.climatecentral.org/news/us-faces-a-rise-in-mosquito-disease-danger-days-21903>



# There is an ideal climate for both the survival of mosquitoes and for the transmission of pathogens

	Survival range	Peak rates for lifecycle stages	Optimized Extrinsic Incubation period Selected pathogens
<i>A. albopictus</i>	59-95°F 15-35 °C	73-93 °F 23-34 °C	
<i>Culex sp.</i>	50-95 °F 10-35 °C	82-89 °F 28-32 °C	89 °F (32°C) (West Nile)
<i>A. aegypti</i>	50-102 °F 10-39 °C	73-93 °F 23-34 °C	95 °F (35°C) (dengue) 97 °F (36 °C) (Zika)



# Disease and Climate Change

[www.climatecentral.org/gallery/graphics/mosquito-disease-danger-days](http://www.climatecentral.org/gallery/graphics/mosquito-disease-danger-days)

<https://www.climatecentral.org/gallery/graphics/mosquito-disease-danger-days>



# Disease and Climate Change

Organisms have their own ecological tolerances- the range of conditions that enable survival, above and below which survival is not possible

These conditions exist for mosquito vectors of disease

These conditions also exist for the pathogens of disease

**Our ground level observations using Mosquito Habitat Mapper will help us to trace changes in mosquito populations as an impact of climate change.**







<https://www.youtube.com/watch?v=lnIEvefMW5Y&feature=youtu.be>

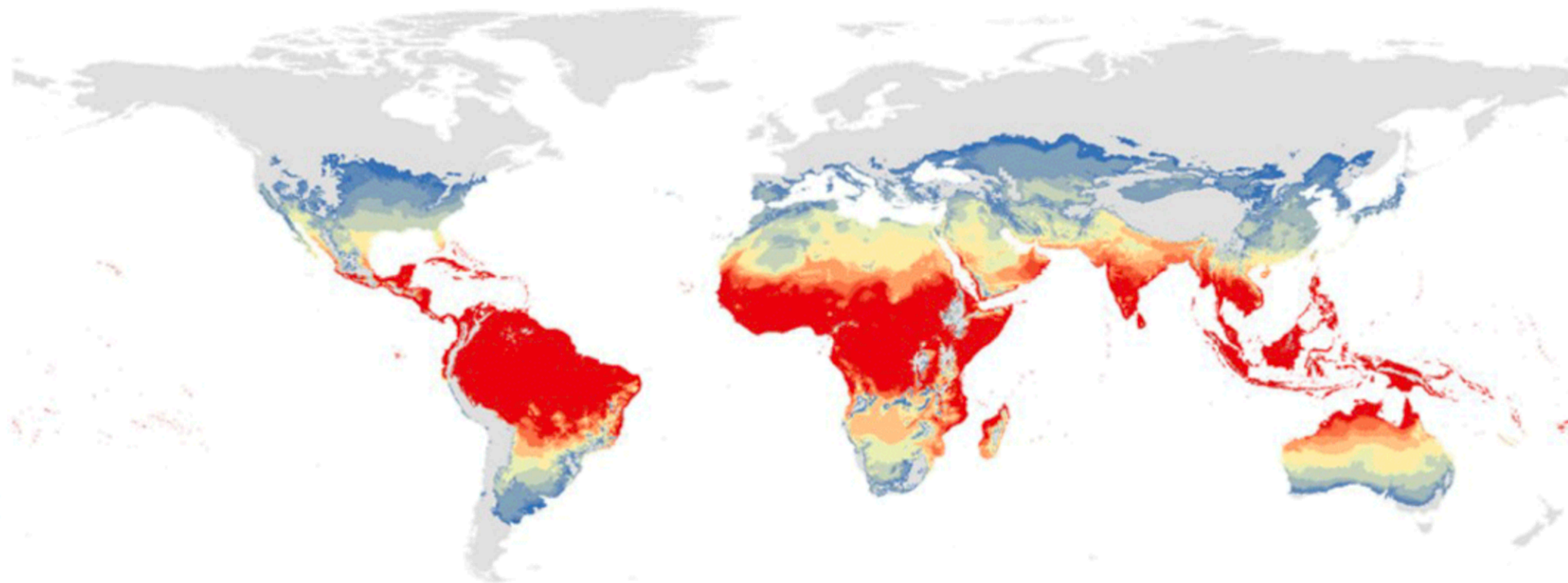
This video shows how a viral infection propagates in a mosquito host and then transmits to human.

The temperature plays a role in how long it takes for the infection to proceed and then be passed to humans

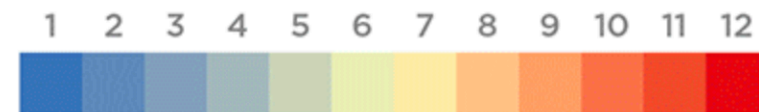
2019

# Mosquito Habitat: Current & Projected

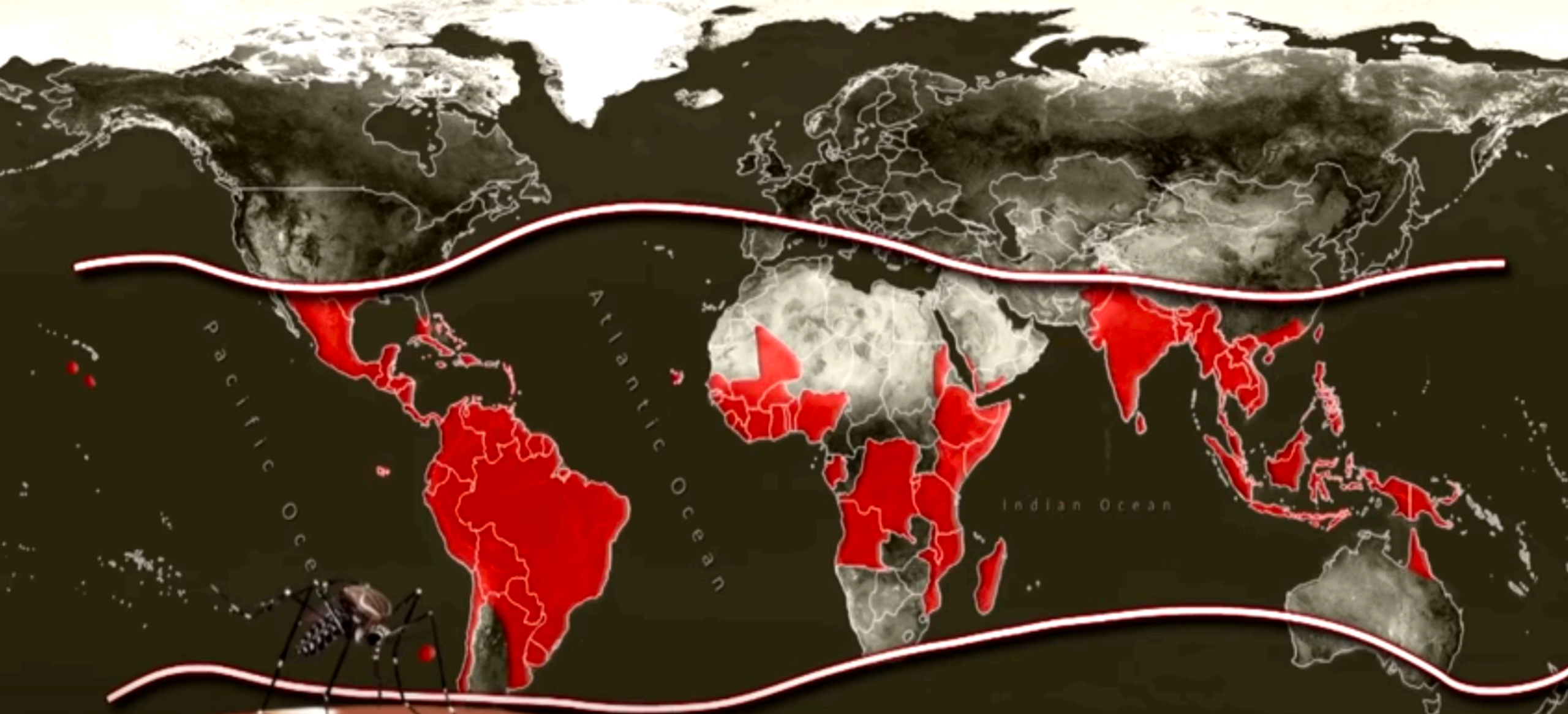
THIS PROJECTION IS BASED ON A WORST-CASE SCENARIO WITH THE IMPACT OF CLIMATE CHANGE UNMITIGATED.



Number of months per year when disease transmission by *Aedes aegypti* mosquito is possible



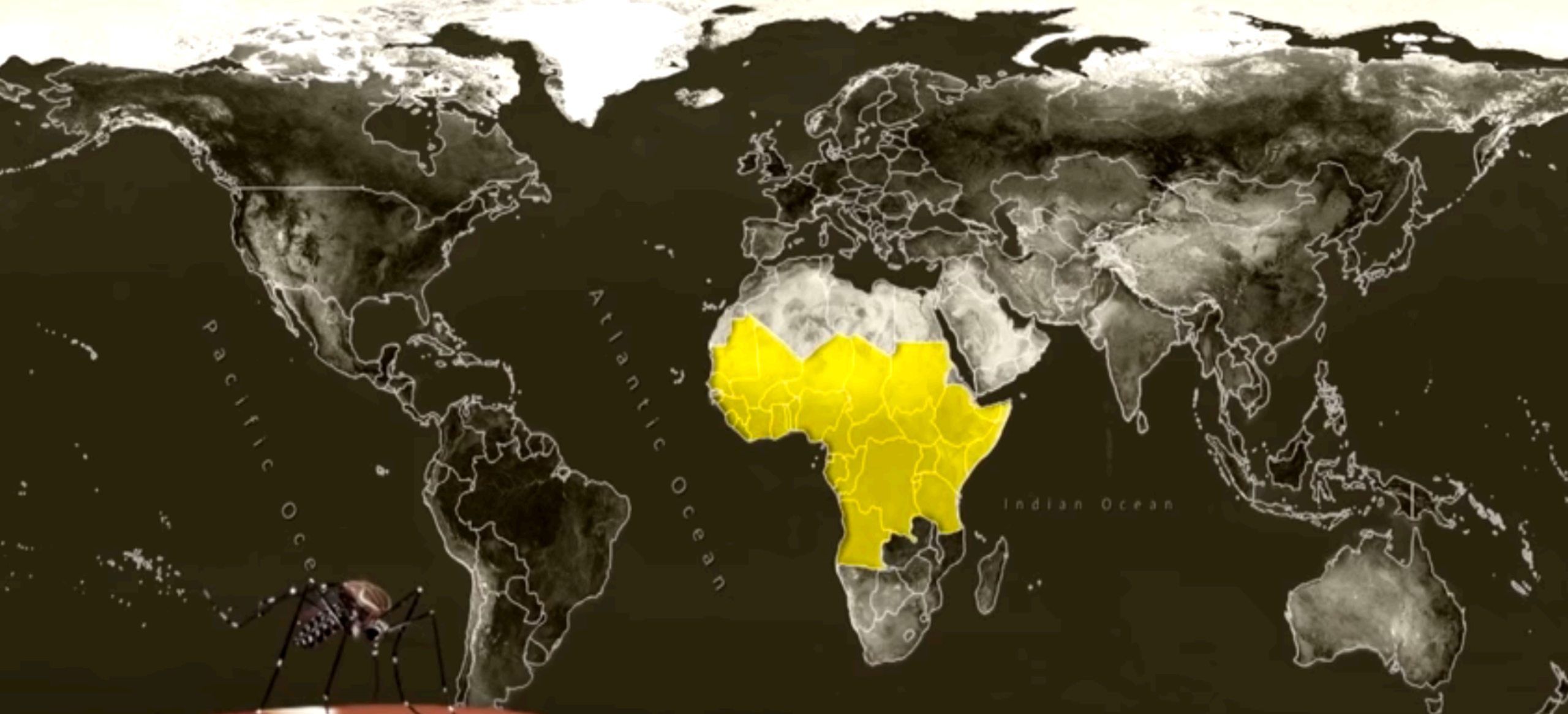




# *Aedes aegypti*

- Global distribution of *Aedes aegypti*
- Yellow Fever
- Dengue
- Chikungunya
- Zika

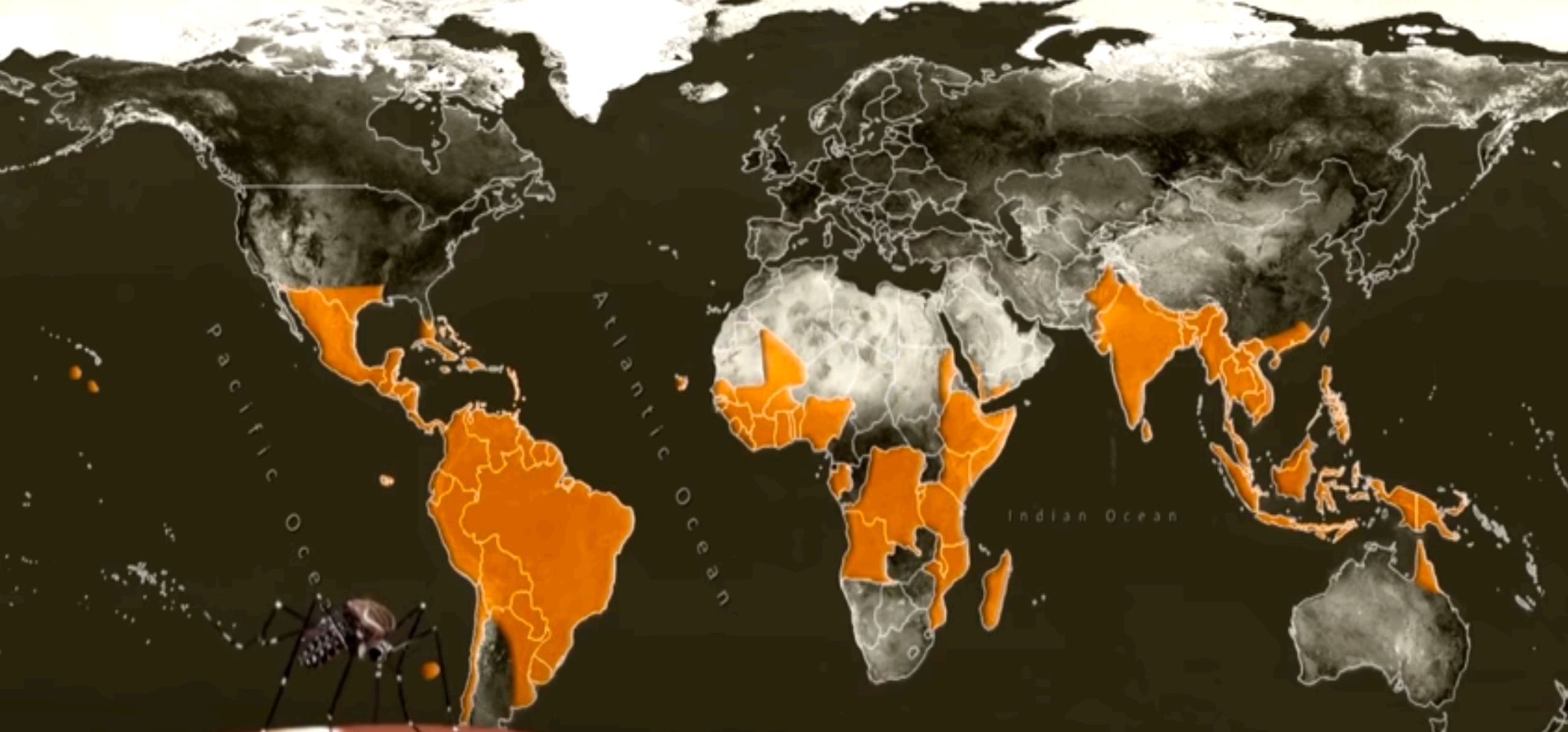




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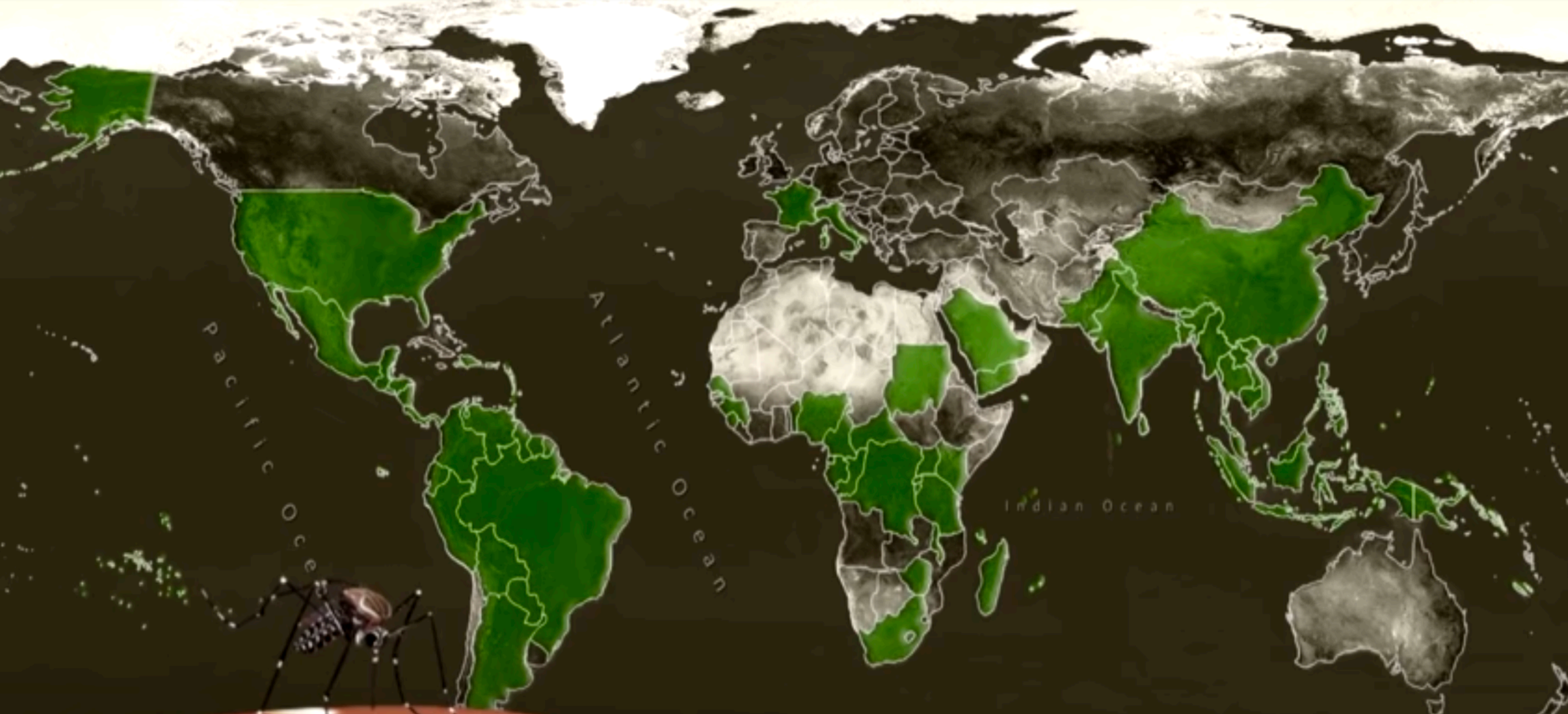





- Global distribution of *Aedes aegypti*
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*Aedes aegypti*






 Global distribution of *Aedes aegypti*

 Yellow  
Fever

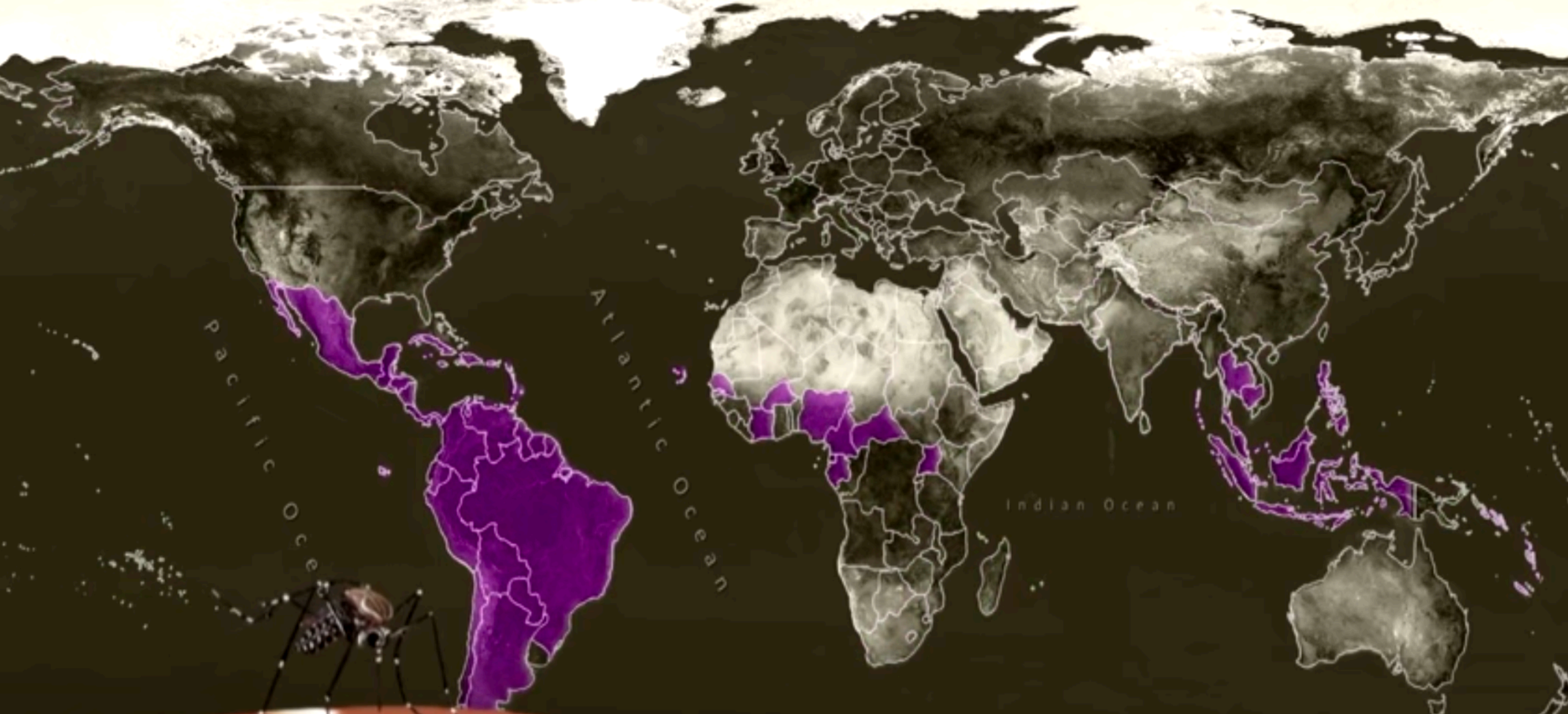
 Dengue

 Chikungunya

 Zika

*Aedes aegypti*



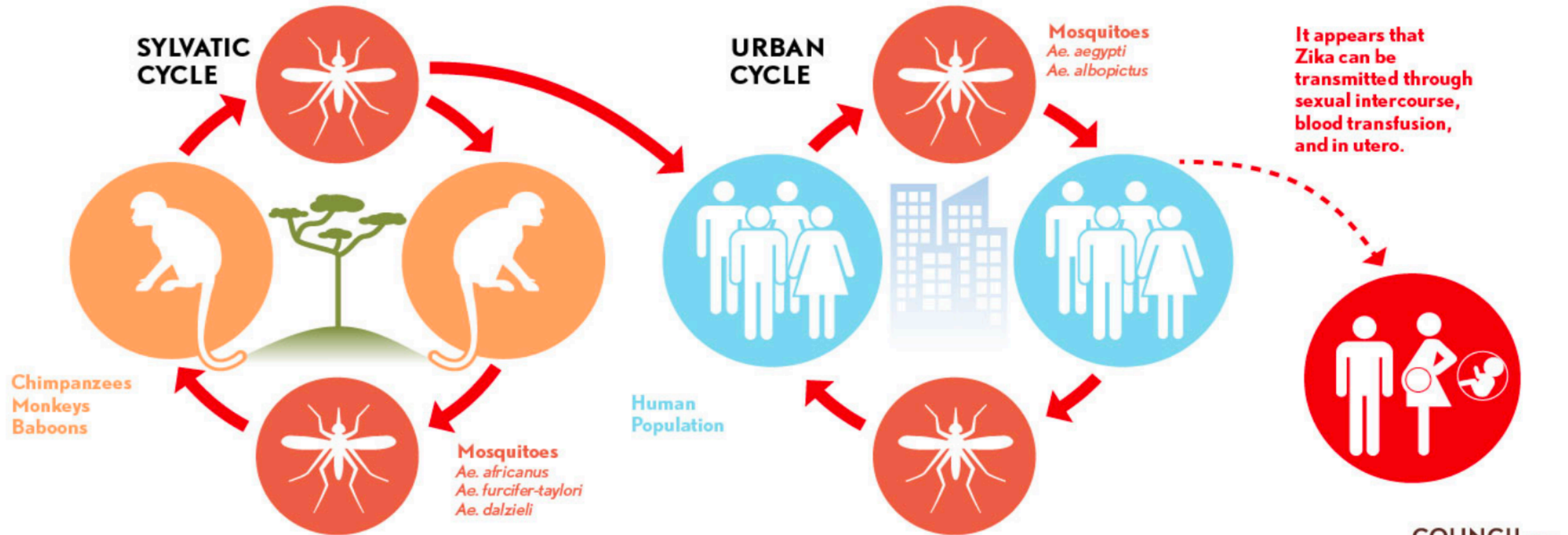


- Global distribution of *Aedes aegypti*
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- Zika

*Aedes aegypti*

# How the Zika Virus Enters the Human Population

The virus originates with nonhuman primates in tropical rainforests but can infect humans. Warm, urban environments with standing pools of water attract mosquitoes, and can lead to the virus's spread.

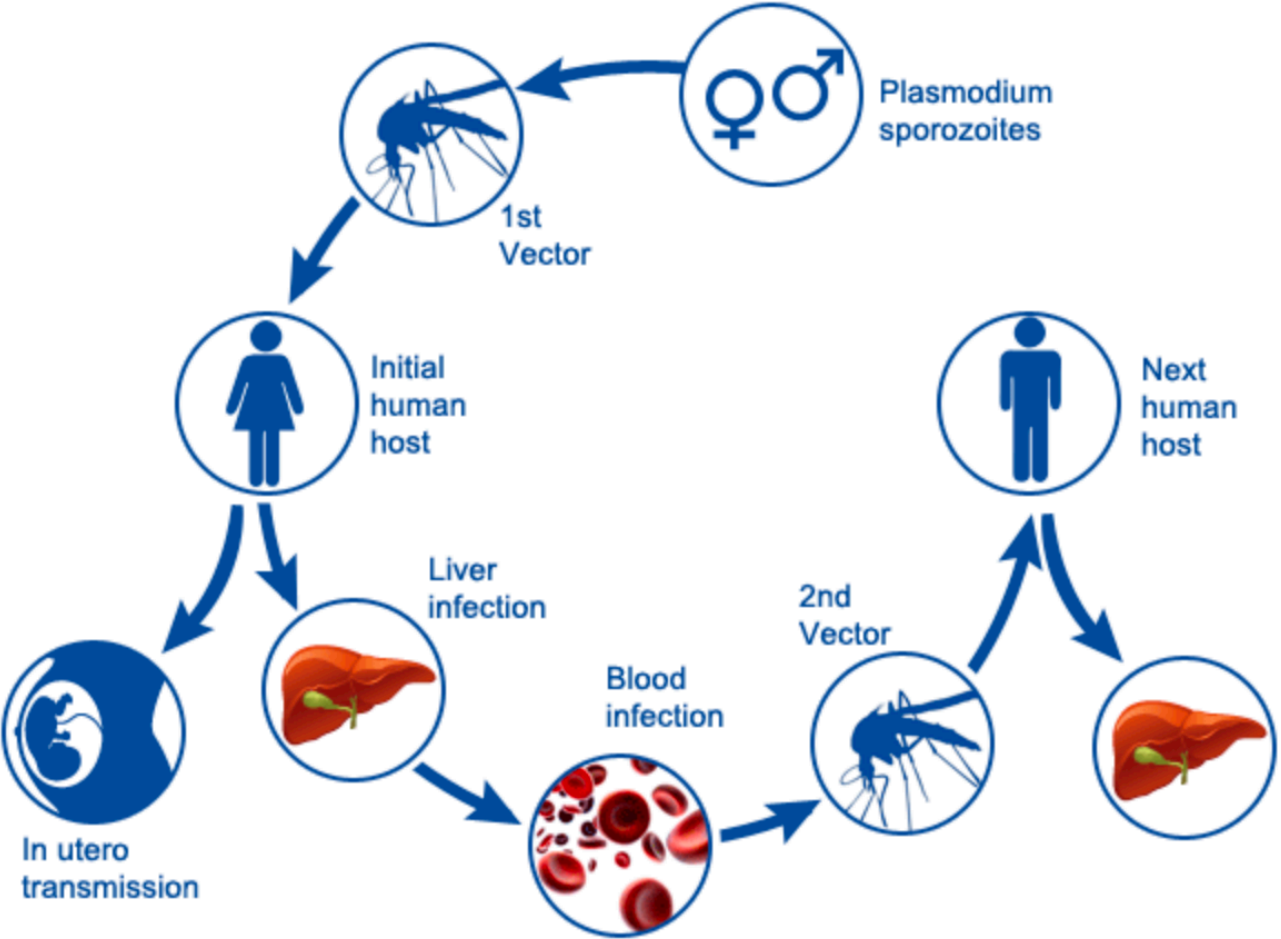


Sources: CDC, PLOS, Reuters Credits: David Foster, Laurie Garrett, Doug Halsey, Gabriella Meltzer





# Malaria Transmission Cycle



# Beyond the Bite

Each *Beyond the Bite* contains these elements of the mosquito story:

- Vital Point
- Cause
- Mosquito Vector(s)
- Range
- Transmission
- Incidence (rate or frequency)
- Symptoms
- Treatment
- General Information
- History
- Link to most current CDC disease cases

*Beyond the Bite* for:

- West Nile Virus
- Chikungunya
- Dengue
- Malaria
- Yellow Fever
- Zika



# Beyond the Bite: West Nile Virus



**Vital Point:** Mosquitoes, humans, birds, horses and other animals are all hosts for West Nile virus (WNV) or play a role in the transmission of this virus. Birds are the most common reservoir hosts. Mosquitoes acquire the virus from birds and subsequently then transfer it to humans, horses, and other mammals. Vaccines are available for horses but not yet for humans (Source: WHO).

**Cause:** West Nile virus is caused by a flavivirus, a genus of viruses found in arthropods (primarily ticks and mosquitoes) and hosted by humans and other animals, such as birds and horses.

**Mosquito Vector(s):** Over 65 species of *Culex* mosquitos have been shown to be infected by West Nile virus. Some of the common species with competence for both infection and transmission of West Nile virus include *C. tarsalis*, *C. pipens*, *C. quinquefasciatus*, *C. stigmatosoma*, *C. thriambus*, and *C. nigripalpus*.

**Range:** Currently, WNV has a pandemic distribution, including all of Africa, and parts of Europe, Middle East, West Asia, and Australia. Since its introduction in 1999 into North America, the virus has spread and become widely established from Canada through the U.S. to Central and South America.

**Transmission:** Birds are the natural hosts of the virus. Mosquitoes acquire the virus when they extract blood from infected birds. The virus eventually infiltrates the mosquito's salivary glands; then it is released into a human during a mosquito bite, completing the bird to mosquito to human transmission. *Culex* mosquitoes tend to bite from dusk to dawn.

**Incidence (rate or frequency):** WNV is the leading cause of domestically acquired mosquito-borne disease in the United States. In 2012 the U.S. had its first WNV epidemic which killed 286 people. Today it is the mosquito-borne disease of most concern for those living the United States. In 2018 case numbers were unusually high in Nebraska, California, North Dakota, Illinois, and South Dakota while in Europe, the number of cases exceeded the total from the previous seven years combined. People over the age of 50 are at higher risk for serious illness.

**Symptoms:** The viral incubation period is usually 3-14 days. Diagnosis is difficult with eight out of ten victims (80%) showing no symptoms. If present, those symptoms include fever, headache, body ache, joint pains, vomiting, diarrhea, and rash. One in

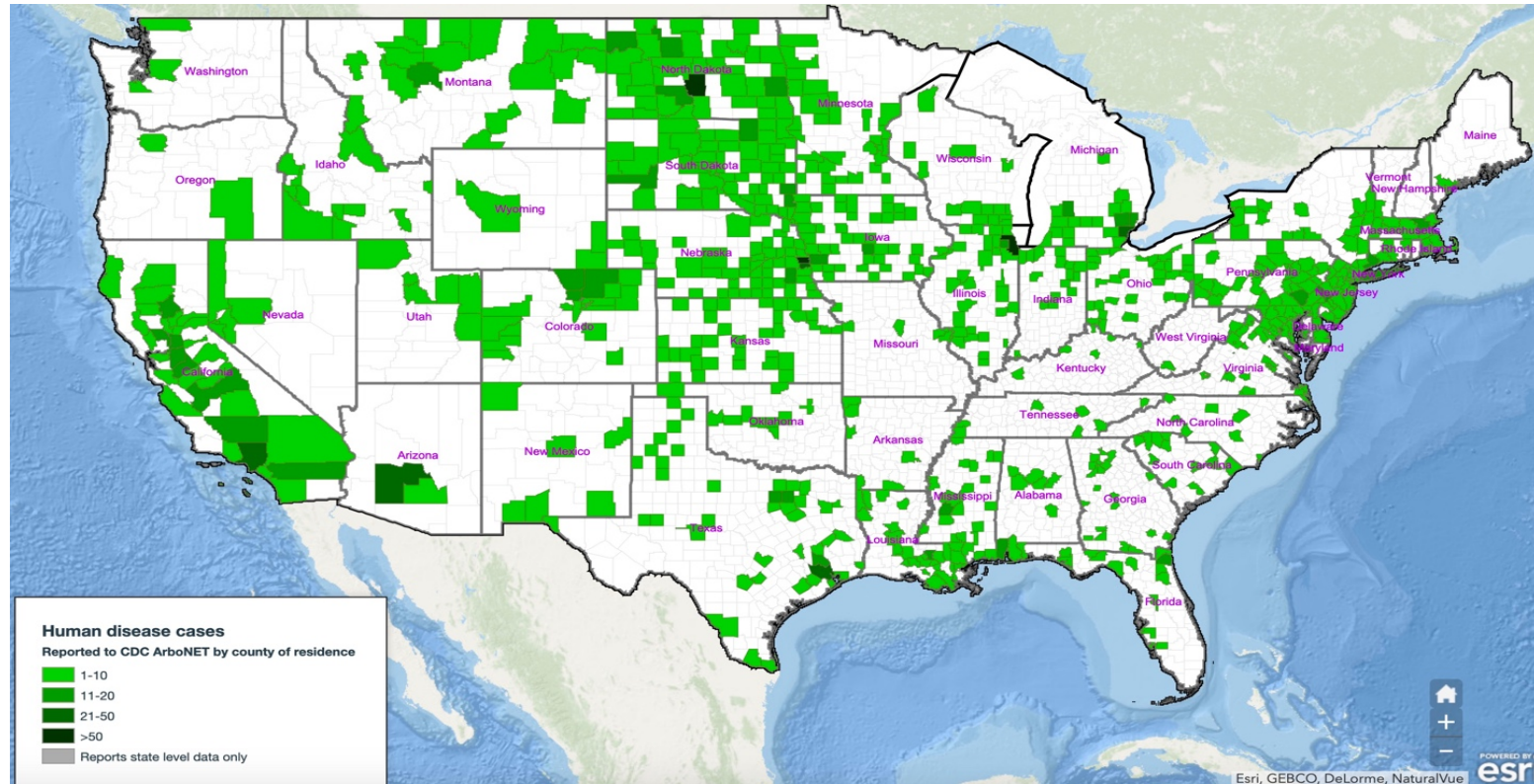
150 will develop severe encephalitis (inflammation of the brain), and/or meningitis (inflammation of the membranes surrounding the brain/spinal cord). Effects on the brain and spinal cord may be permanent; one out of ten affected neurologically will die.

**Treatment:** There is neither a vaccine nor a specific treatment for WNV. Over-the-counter medicines can be used to relieve some symptoms. Hospitalization is required when the brain and/or spinal cord are affected (infected).

**General Information:** The disease derives from the West Nile District in Uganda. Outbreaks often occur along major migratory routes of birds with several species of birds carrying the virus. Some birds, such as crows and jays, can die from WNV. Reporting dead birds and having them examined for WNV is one way to check for the presence of WNV in the environment. West Nile virus can also infect horses and other mammals. Humans, horses and other mammals are considered "dead-end" hosts – none of them can develop high enough levels of the virus in their blood for mosquitoes to pick up during a bite. Birds are called an "amplifier" host- they develop levels of the virus high enough for mosquitoes to acquire and transfer.

**History:** WNV was first discovered in 1937 in the blood of a woman from the West Nile District of Uganda. The virus was identified in birds in the Nile delta regions in 1953. The mode of arrival into the U.S. in 1999 is still unresolved; however, West Nile virus may have come from an infected bird or by an infected mosquito brought in through shipping ports.





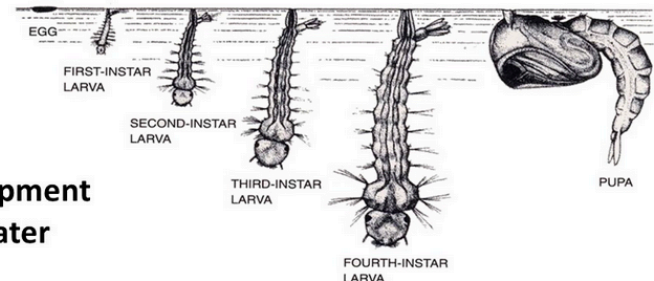
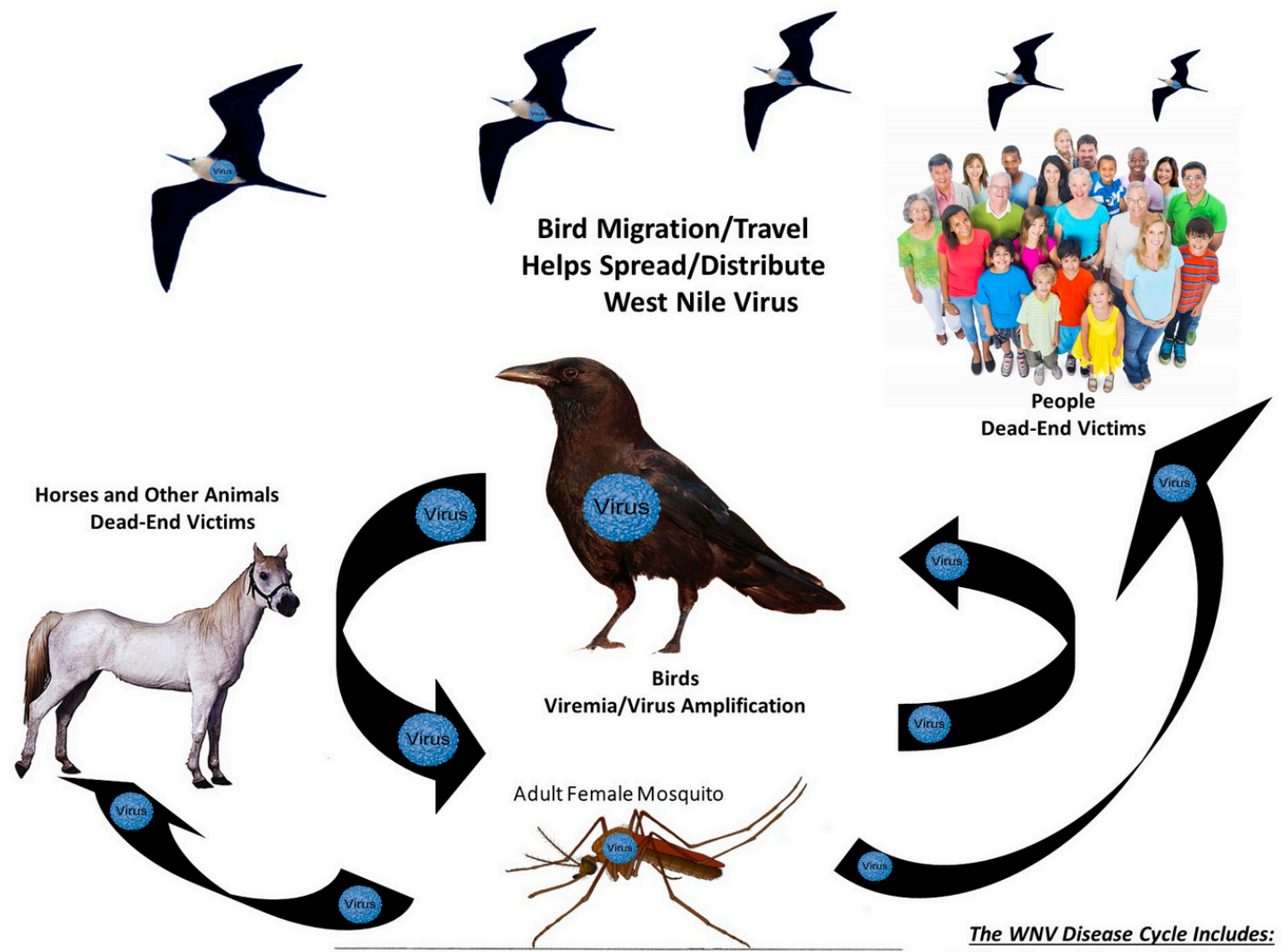
**Human WNV disease cases, 2019. (CDC). Screenshot of an interactive map, retrieved from**

[https://wwwn.cdc.gov/arboNET/Maps/ADB\\_Diseases\\_Map/index.html](https://wwwn.cdc.gov/arboNET/Maps/ADB_Diseases_Map/index.html)





# Transmission Cycle West Nile Virus (WNV)



Larval Development Cycle in Water

- The WNV Disease Cycle Includes:**
- Virus From Migrated Birds to Local Mosquitoes
  - Local Mosquitoes to Non-Infected Local Birds
  - The Virus Replicates in Mosquitoes and Exponentially in Some Birds, Making Virus Transmissibility Easier
  - The Viremia is Less in Dead-End Victims, Resulting In Their Exclusion From the WNV Transmission Cycle

<https://acvcsd.org/programs-services/mosquitoes-2/west-nile-virus/>



## Mosquito Resource Library

### Tutorials



#### MHM Infographic

A step-by-step infographic on the use of the GLOBE Observer Mosquito Habitat Mapper tool.

[Static PDF Infographic](#)

[Interactive ePub file \(requires ePub reader\)](#)

[Full Screen, Interactive Infographic](#)



#### Step-by-Step Mosquito Habitat Mapper Tutorial

Step-by-step illustrated guide to collecting specimens and observations with the GLOBE Observer Mosquito Habitat Mapper.



# In the toolkit . . .

**Beyond the Bite: Disease Guide Overview**

Introduction to mosquito-borne disease

One of the goals of GLOBE Observer Mosquitoes is to build an awareness of common mosquito-borne diseases. This guide focuses on six of these: Chikungunya, Dengue, Zika, West Nile, Yellow Fever, and Zika.

The "bite" that causes the problem

Many of the diseases transmitted by mosquitoes to humans have a similar life cycle. But they are not all the same. The "bite" of a mosquito is a tiny injection of saliva. Some mosquitoes have the ability to transmit a disease. Others do not. This is why some mosquitoes are considered "biters" and others are not. It is important to know what mosquito it is that you are biting.

The mosquito is not the problem. It is a pathogen. Of the six mosquito-borne diseases included in this guide, only one is caused by a parasite. The others are caused by viruses.

There are significant biological differences between the six mosquito-borne diseases included in this guide. In most cases, the symptoms of a disease are not the same. In some cases, the symptoms are the same.

**Mosquito Habitat Mapper**

PLAY ZIKA ZAPP BINGO

TO PLAY ZIKA ZAPP BINGO YOU WILL NEED . . .

- Game boards (up to 30 available)
- Zika Zapp instruction Guide
- Zika Zapp Call Sheet

• Play the Zika Zapp game with friends to learn about mosquitoes.

• Download the GLOBE Observer App and open Mosquito Habitat Mapper. Take your observations with you.

• Download your personal observations with visible observations can help track mosquito-borne disease outbreaks across various regions.

**MOSQUITO PREVENTION AND PROTECTION**

Learn more at [observer.globe.gov](http://observer.globe.gov)

• Play the Mosquito Prevention and Protection game with a friend to learn about mosquitoes.

• Download the GLOBE Observer App and open Mosquito Habitat Mapper. Take your observations with you.

• Download your personal observations with visible observations can help track mosquito-borne disease outbreaks across various regions.

Smithsonian SCIENCE for Global Goals

**MOSQUITO!**  
GUÍA DE INVESTIGACIÓN COMUNITARIA

¿CÓMO PODEMOS GARANTIZAR LA SALUD DE TODOS ANTE LAS ENFERMEDADES TRANSMITIDAS POR MOSQUITOS?

desarrollado por Smithsonian Science Education Center

en colaboración con iap SCIENCE FOR GLOBAL GOALS HEALTH

Smithsonian SCIENCE for Global Goals

**Meet the Team**  
Mosquito Task 1-6 Defining the Problem

**RUSTY LOW**  
SENIOR EARTH SCIENTIST

Why is the mosquito problem such an important issue around the world?

Mosquitoes are the most dangerous animal on the planet for humans! Mosquito-borne diseases affect half a billion people every year. Climate change is now affecting where some mosquitoes can live. These changes mean some mosquitoes and diseases are moving into new places. Many of these places have not had mosquito or disease problems recently. We have learned that all places must be prepared for this problem in the future.

Provide a brief description of your work on mosquito-borne diseases.

I have been working on developing the GLOBE Observer Mosquito Habitat Mapper. It is an app for smartphones and mobile devices. The app allows kids and adults to locate sites in their community that mosquitoes might like. People can share this information with one another. Then they can find out if the mosquitoes are the type that transmit diseases. The data is shared with the science community to help make decisions around the world. It is a fun way to use science to make a difference locally!

How much is still not known about mosquitoes and diseases in your field of work?

We still do not know many things about mosquitoes and diseases in your field. There are many opportunities for citizen scientists like you. We need your help to conduct local research. This research will help us all better understand mosquitoes. It will also help us know where mosquitoes live. Most of our understanding of mosquitoes comes from laboratory research. This is why we need the help of teams like yours. We need teams around the world to come together. We must share information about what is happening outside of the laboratory. We must share what is happening in our local communities. This will help us all learn more about this problem.

**ZIKA ZINE**  
THE STORY OF THREE Aedes MOSQUITOES AND THE ZIKA WITHIN THEM

Maurice, Hester, Wanda, Zika

L.S. GARDINER  
UCAR CENTER FOR SCIENCE EDUCATION

**THANK YOU ARE! Zika Zine Part 1**

Hi, I'm Hester and I'm a mosquito.

I'm Wanda and I'm a mosquito.

I'm also a mosquito.

Look, Hester! I found your baby book!

Hester's baby book.

You looked just like me!

She used to be so cute!

**ZIKAP? A CITIZEN SCIENTIST?**

WHO IS SHE?

SHE'S A CITIZEN SCIENTIST!

Citizen scientists are people who volunteer with science research - for example by making and recording observations.

WHERE ARE WE?

AND THEMSELVES ON A WHITE PLATE.

IF SOMEONE GOING TO GET US?

AND THEN...





# In Summary

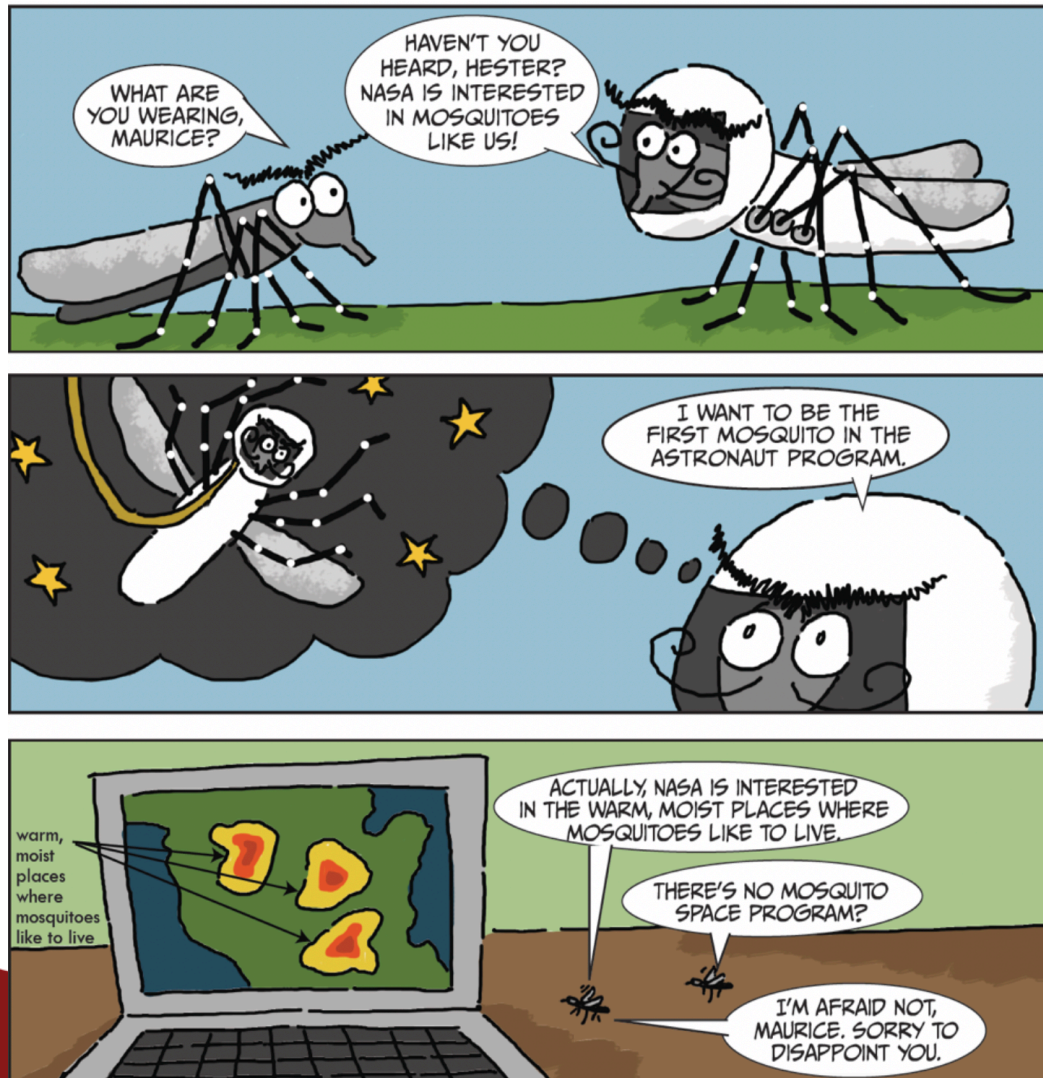
We recommend:

1. watch the entire 40-minute video from which sections were taken for this presentation (<http://bit.ly/2SyucmM>).
2. Download and use the MHM to document breeding habitats and to reduce the chance of breeding habitats ([observer.globe.gov](http://observer.globe.gov)).
3. visit GLOBE Observer Mosquito Habitat Toolkit at [observer.globe.gov](http://observer.globe.gov) to download the disease guides and additional resources.
4. Visit the Mission Mosquito website at <https://www.globe.gov/web/mission-mosquito/>





# At our next Citizen Science Webinar, Dr. Lisa Gardiner



August 21, 2pm ET

Register: <http://bit.ly/Buzz-CS8>



# Our next Education Webinar

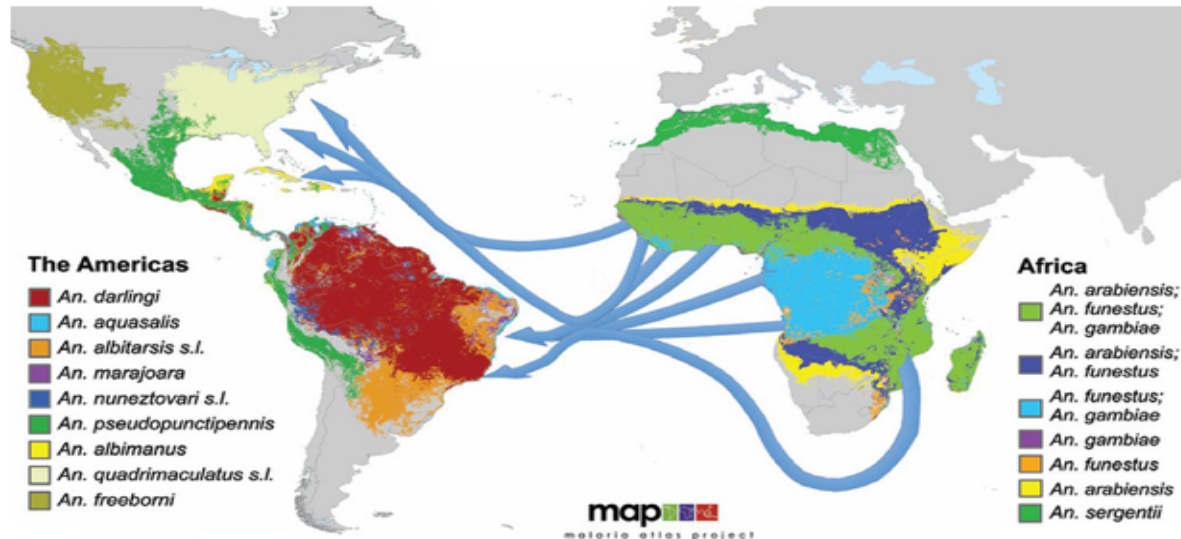


Image graphic credits to: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0074-02762014000500662](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0074-02762014000500662)

## Around the World with Mission Mosquito

August 7 @ 8pm ET

Register: <http://bit.ly/Buzz-GO10>

**MISSION MOSQUITO**  
GLOBE



# Thank you

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Liz Burck ([liz\\_burck@strategies.org](mailto:liz_burck@strategies.org))

Cassie Soeffing ([cassie\\_Soeffing@strategies.org](mailto:cassie_Soeffing@strategies.org))

