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

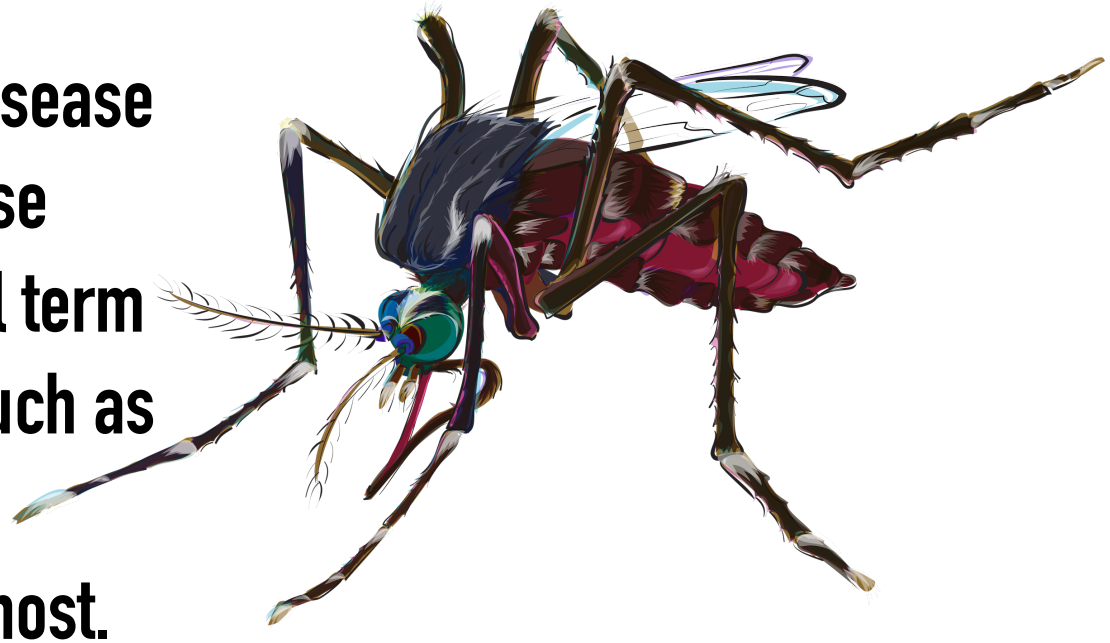
- A disease transmission model for mosquito vector borne diseases
- Disease Guide highlights; a resource guide when telling the story

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’

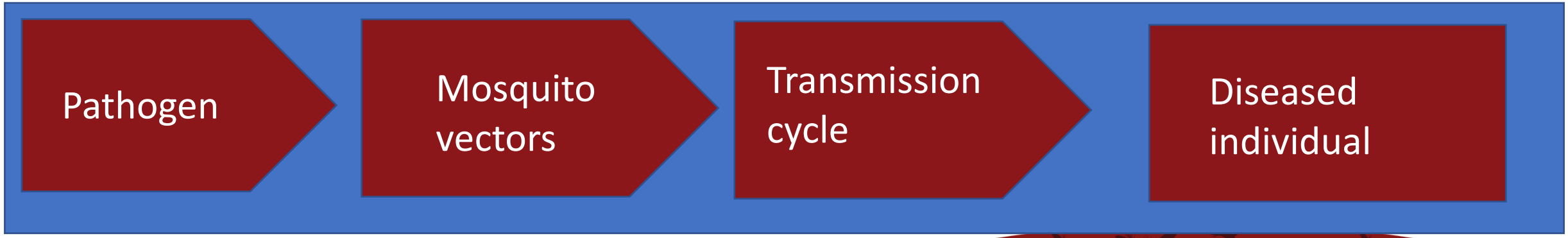
- Pathogen – biological agent that causes a disease
- Vector – an organism that transmits a disease
- Arbovirus – (arthropod-borne virus) general term for any virus transmitted by an Arthropod (such as a mosquito).
- Parasite – an organism that lives in or on a host.



Mosquito Vector Borne Disease Story

General Disease Transmission Model

Specific Mosquito Vector Transmission Model



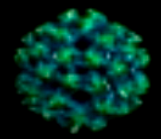
https://parasitesandvectors.biomedcentral.com/articles/10.1186/1756-3305-3-19

The principle Arboviruses Transmitted by mosquito

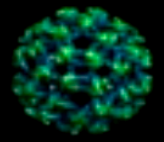
Dengue

Zika

Chikungunya

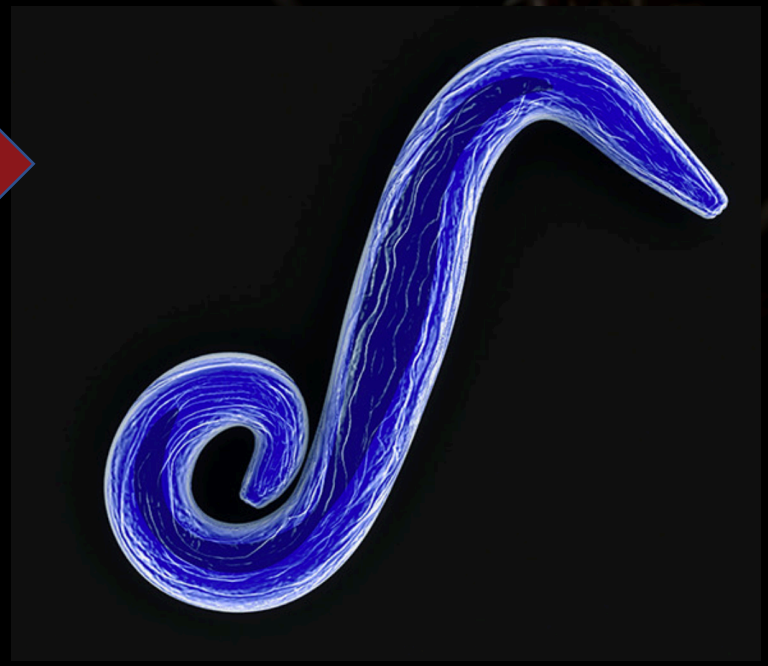


Yellow Fever



West Nile Fever

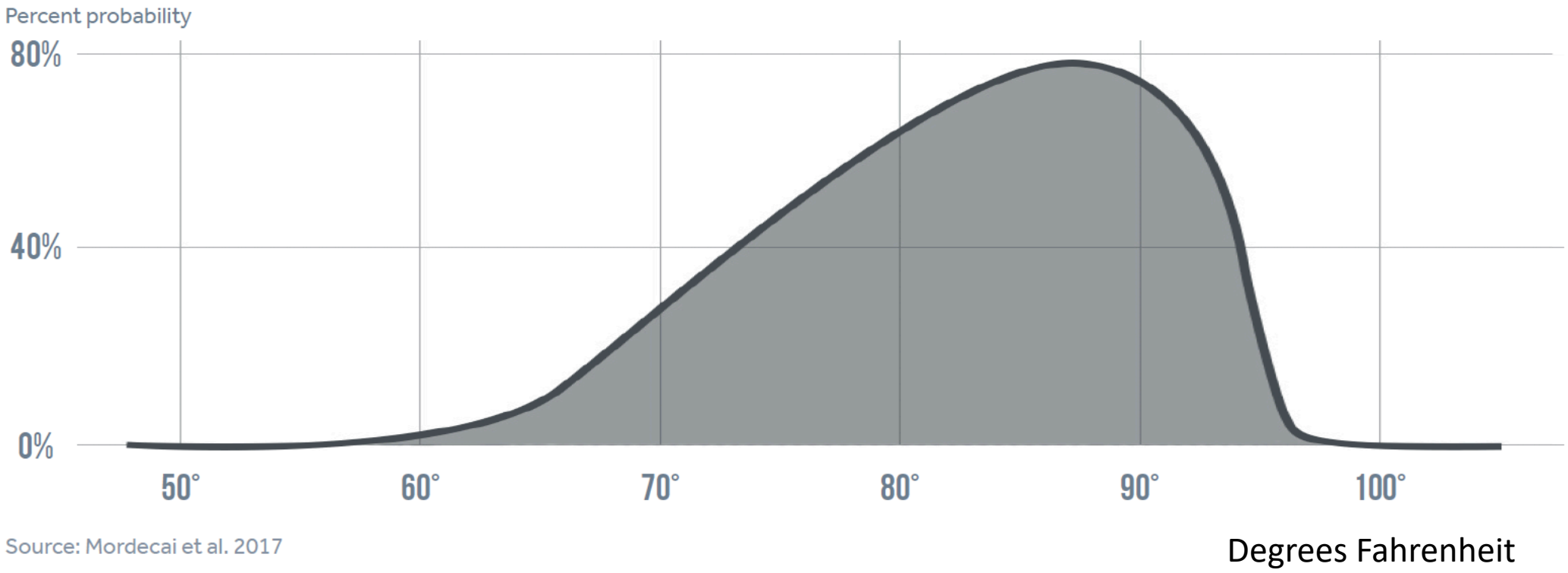
- Pathogen



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**



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

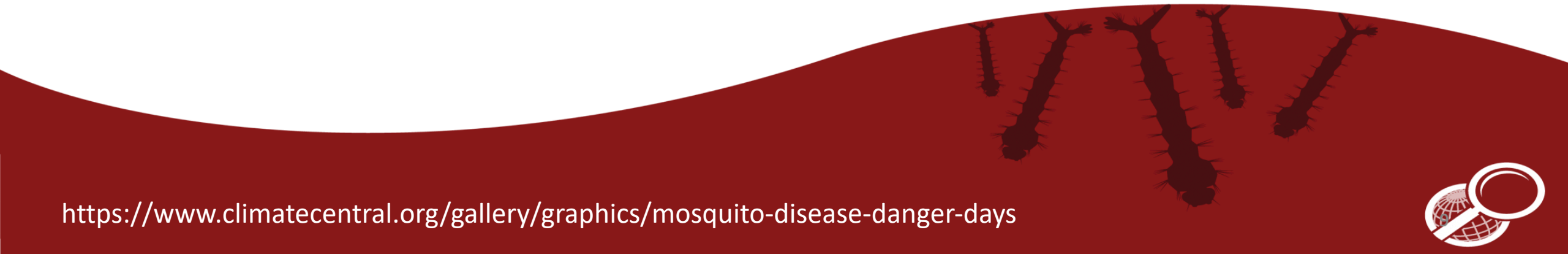
There is an ideal climate for both the survival of mosquitoes and for the transmission of pathogens

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

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

Disease and Climate Change

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.

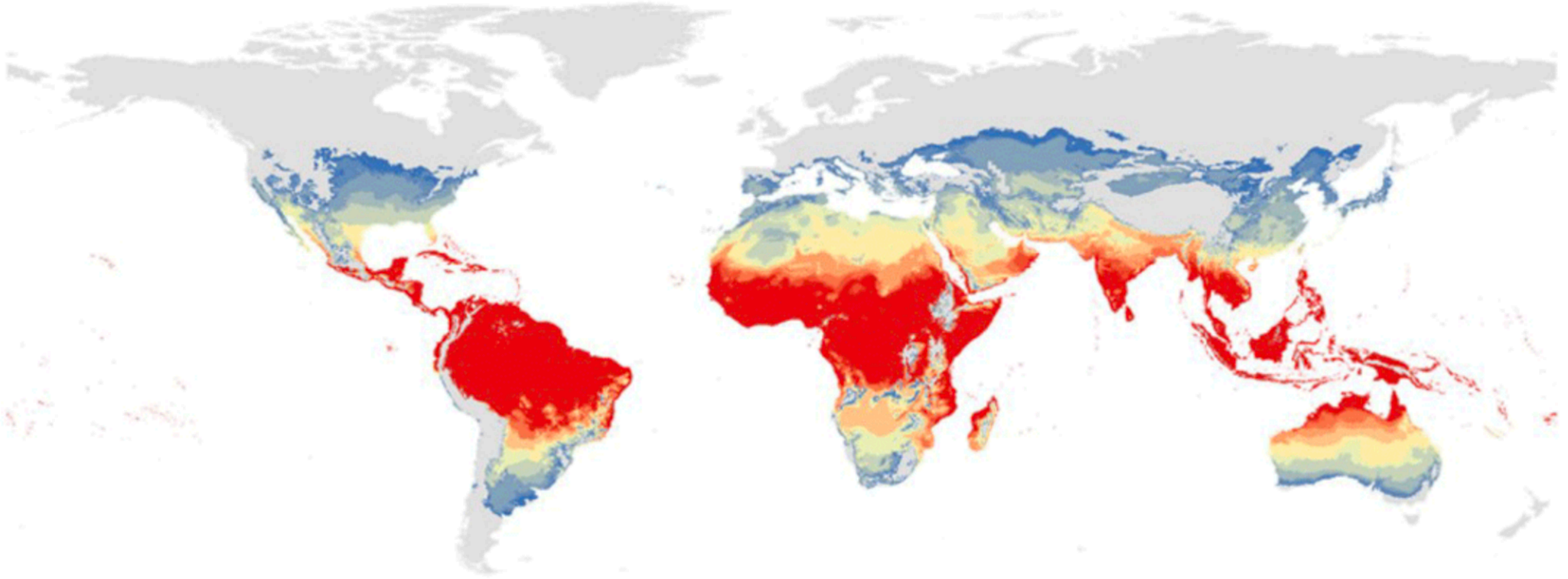
https://www.youtube.com/watch?v=lnIEvefMW5Y&feature=youtu.be

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

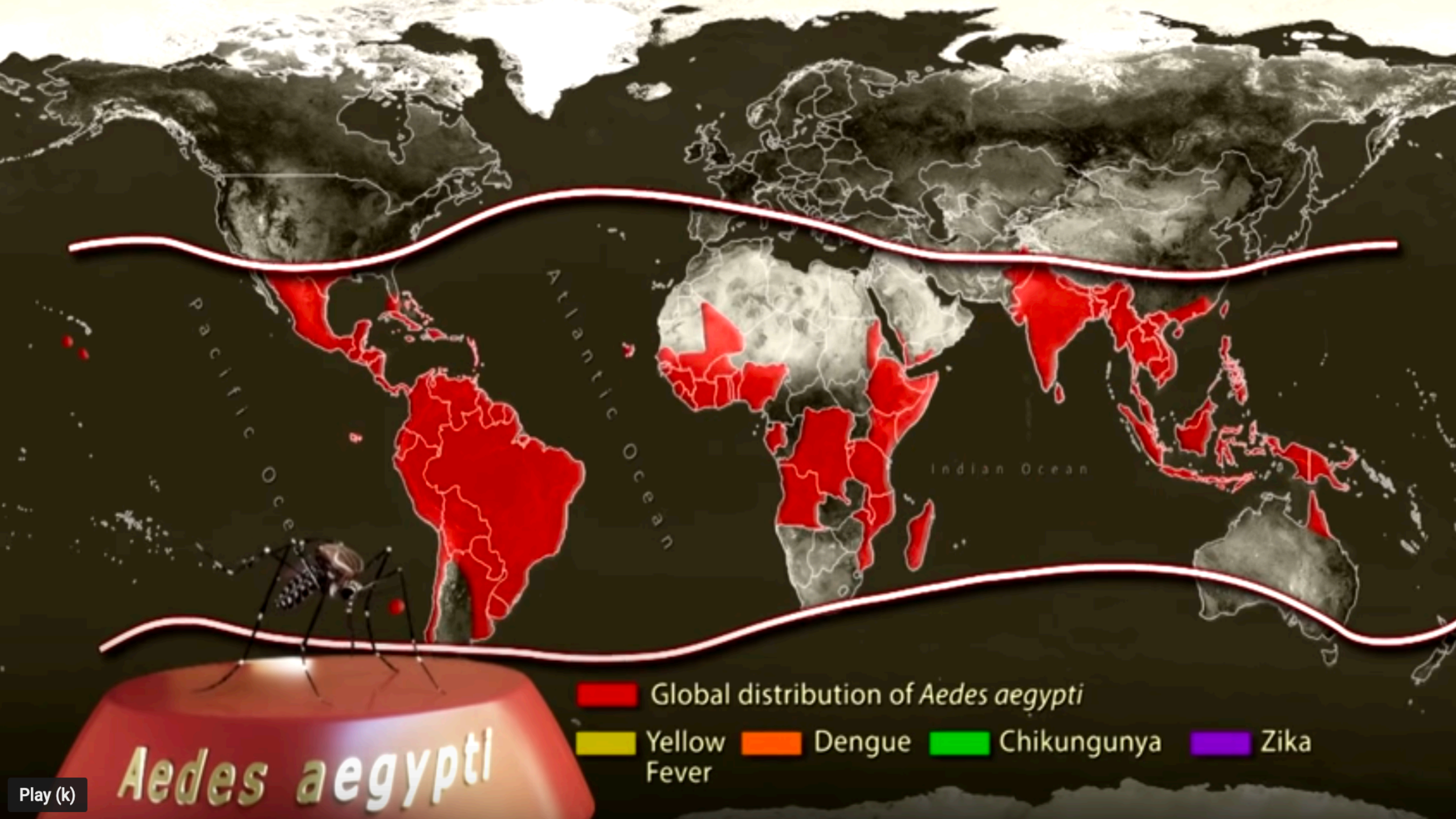
THIS PROJECTION IS BASED ON A WORST-CASE SCENARIO
WITH THE IMPACT OF CLIMATE CHANGE UNMITIGATED.



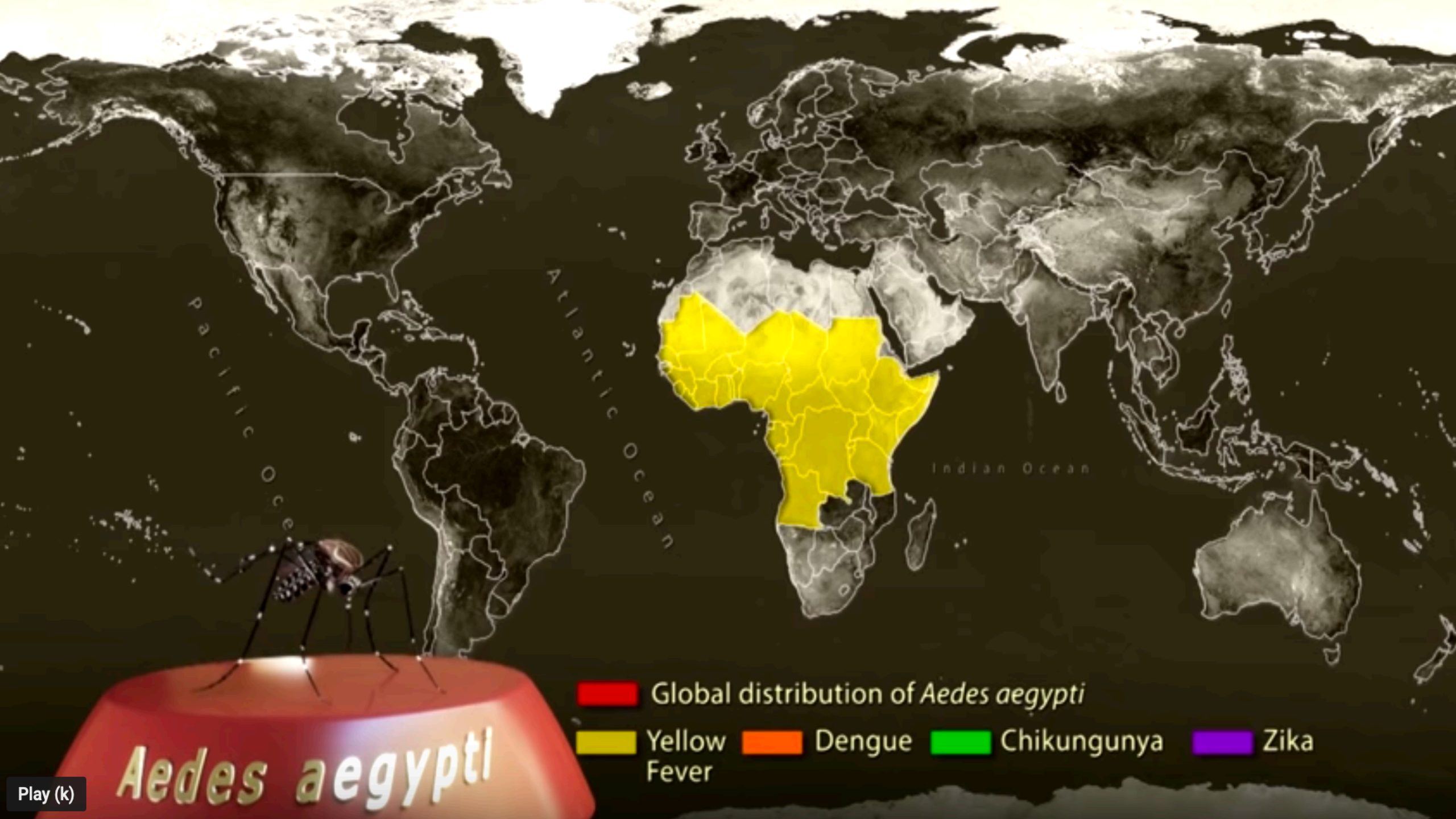
Number of months per year when disease transmission by *Aedes aegypti* mosquito is possible

1 2 3 4 5 6 7 8 9 10 11 12

https://www.npr.org/assets/graphics/2019/03/mosquito-habitat.gif&utm_source=nprnews&utm_medium=app&utm_campaign=storyredirect


Pacific Ocean
Atlantic Ocean
Indian Ocean
Aedes aegypti
Global distribution of Aedes aegypti
Yellow Fever
Dengue
Chikungunya
Zika

Play (k)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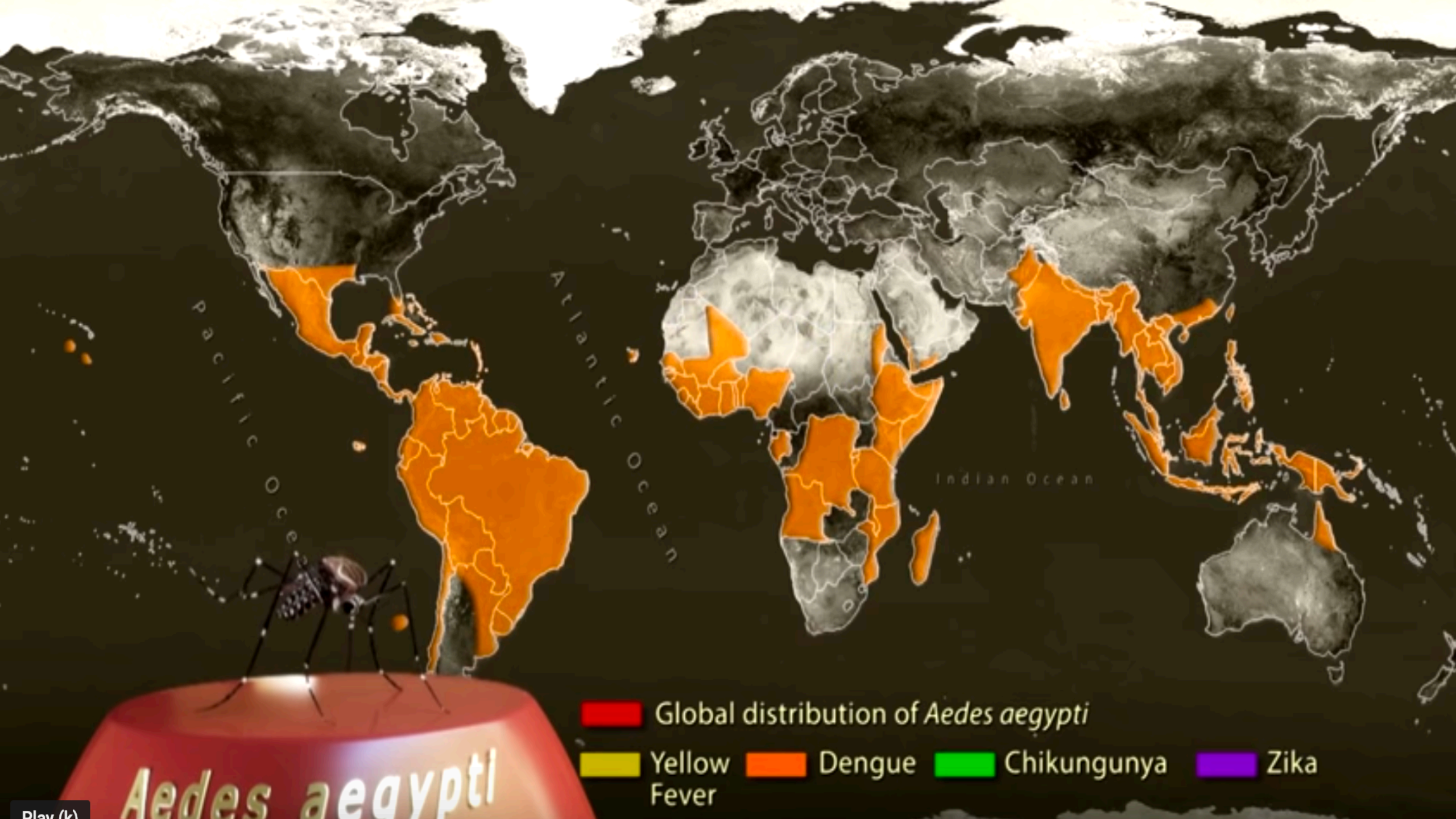
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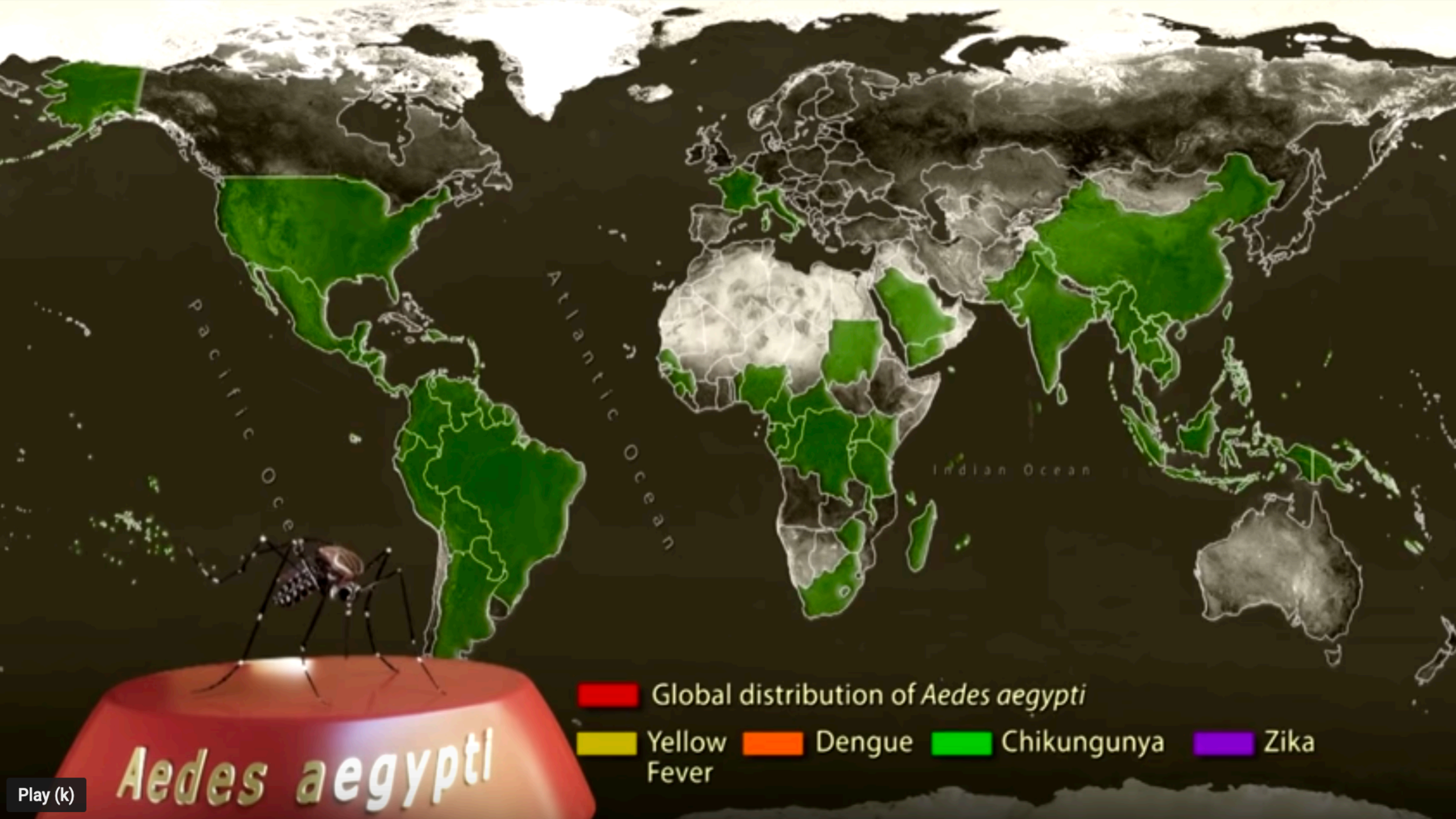
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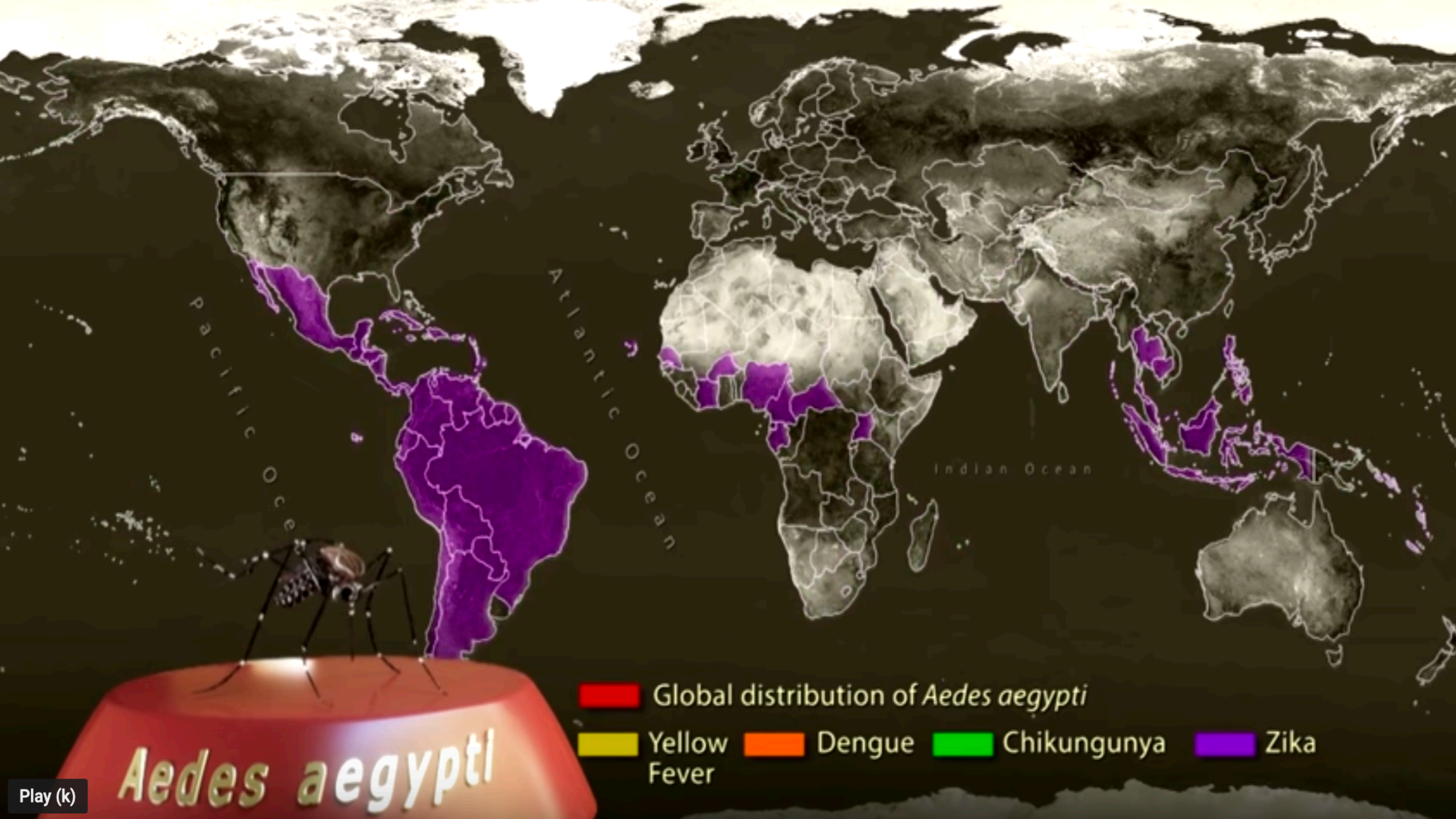
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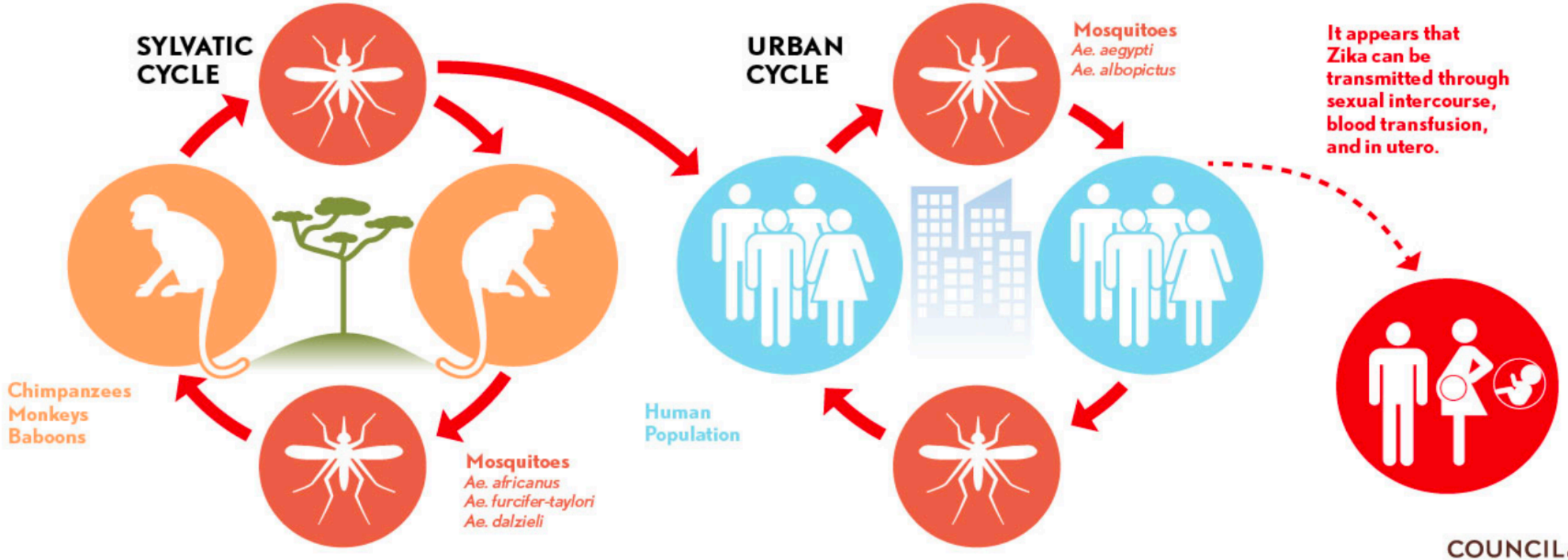
Play (k)

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.

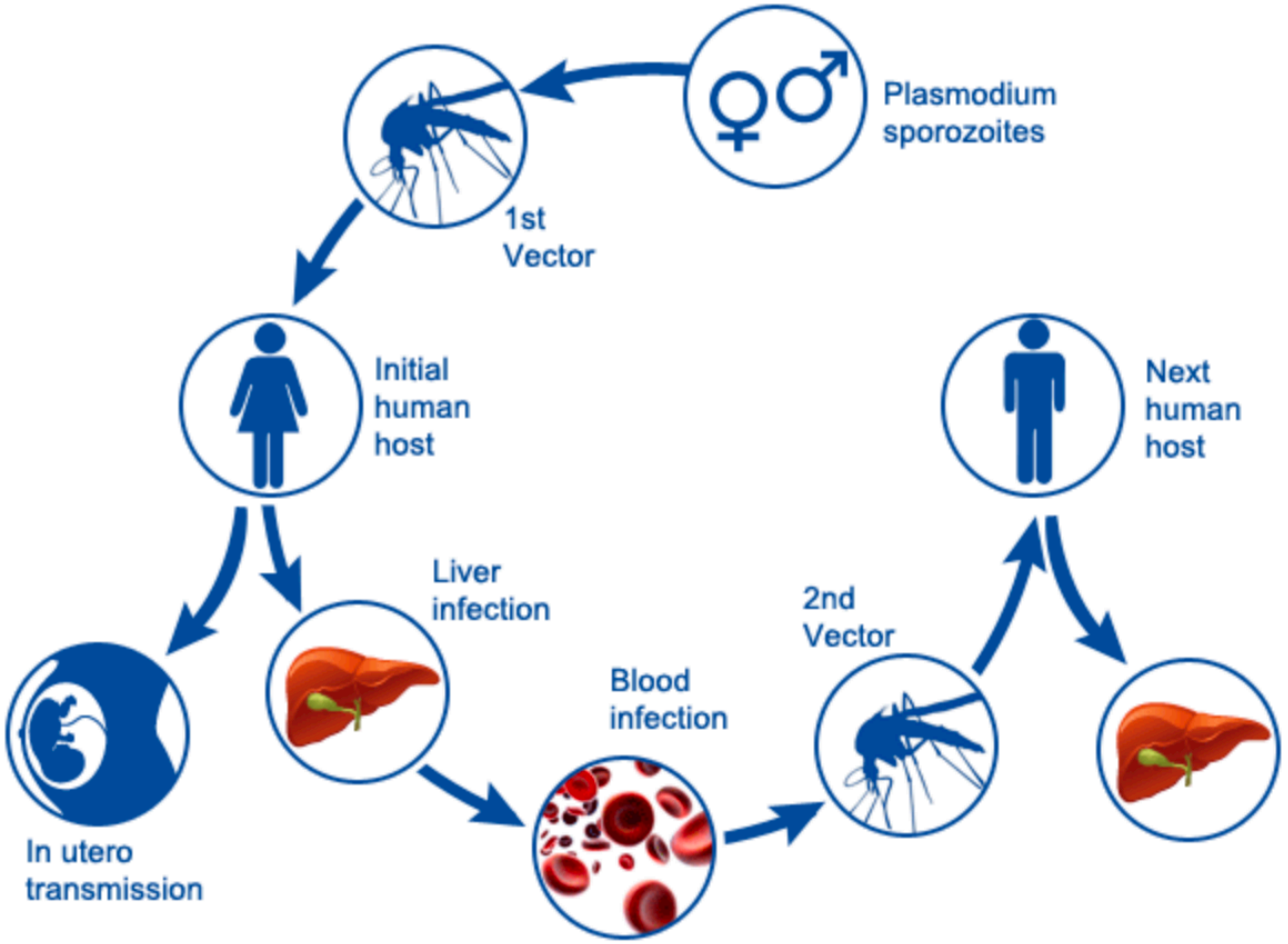


Sources: CDC, PLOS, Reuters Credits: David Foster, Laurie Garrett, Doug Halsey, Gabriella Meltzer

COUNCIL on FOREIGN RELATIONS

https://www.cfr.org/backgrounder/zika-virus

Malaria Transmission Cycle



https://www.jenner.ac.uk/about-malaria

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.

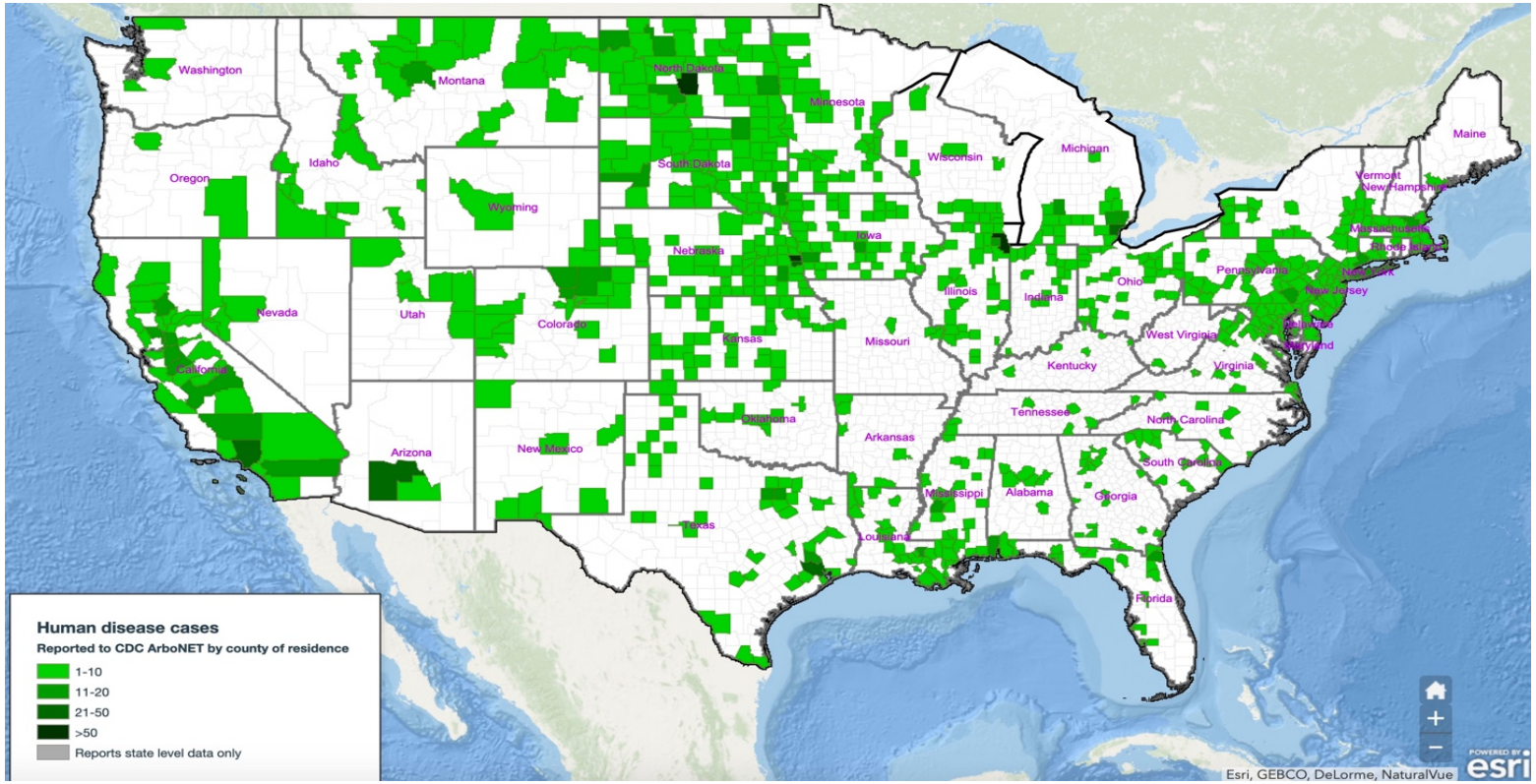
Incidence (rate or frequency): WNV is the leading cause of domestically acquired mosquito-borne disease in the United States. In 2012 the U.S. had its first WNV epidemic which killed 286 people. Today it is the mosquito-borne disease of most concern for those living the United States. In 2018 case numbers 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 ncubation 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.

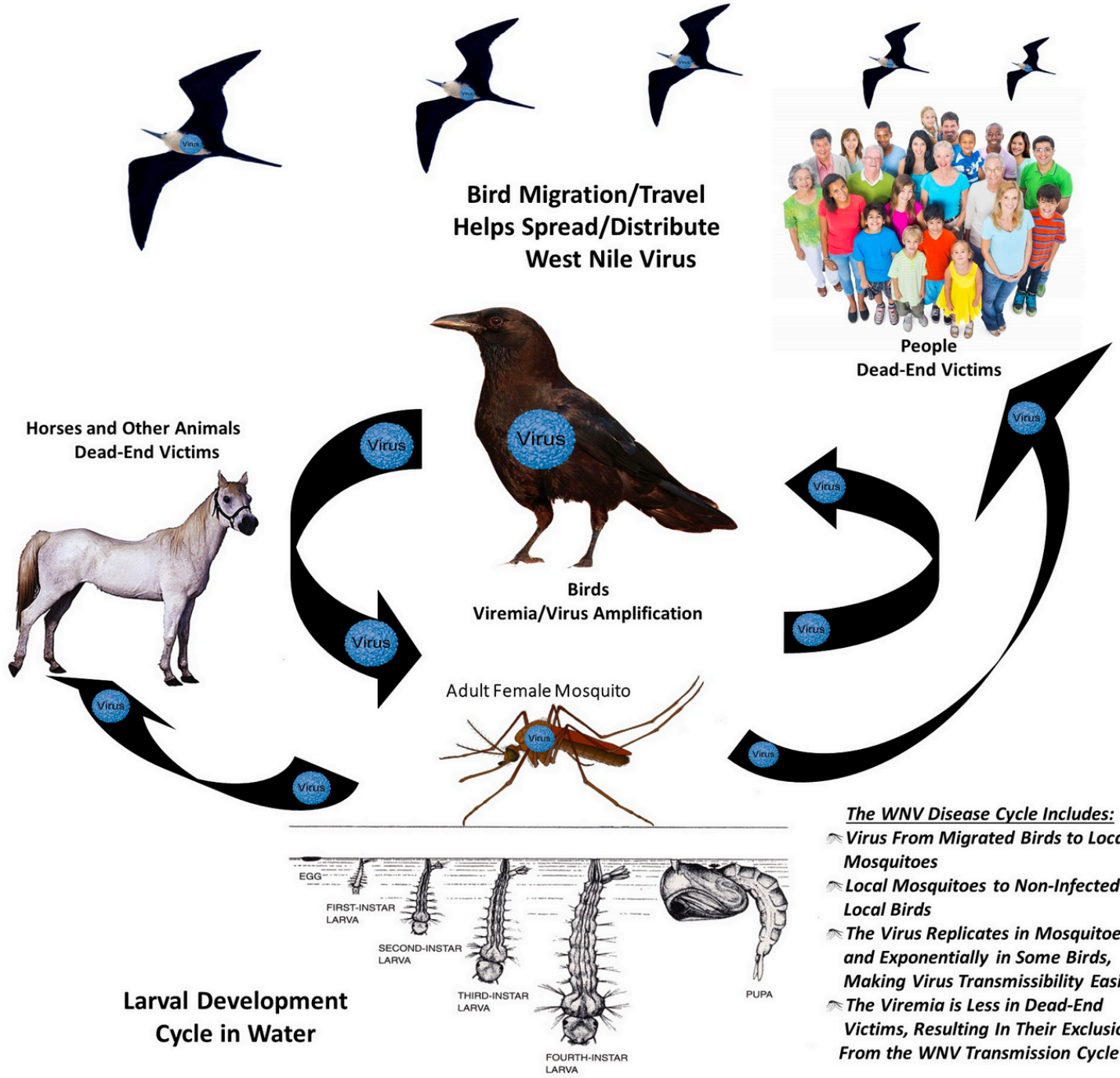


Human WNV disease cases, 2019. (CDC). Screenshot of an interactive map, retrieved from

https://wwwn.cdc.gov/arbonet/Maps/ADB_Diseases_Map/index.html

Transmission Cycle
West Nile Virus (WNV)

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



Mosquito Resource Library

Tutorials | Activities | Reference Materials | Videos | Books

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 . . .

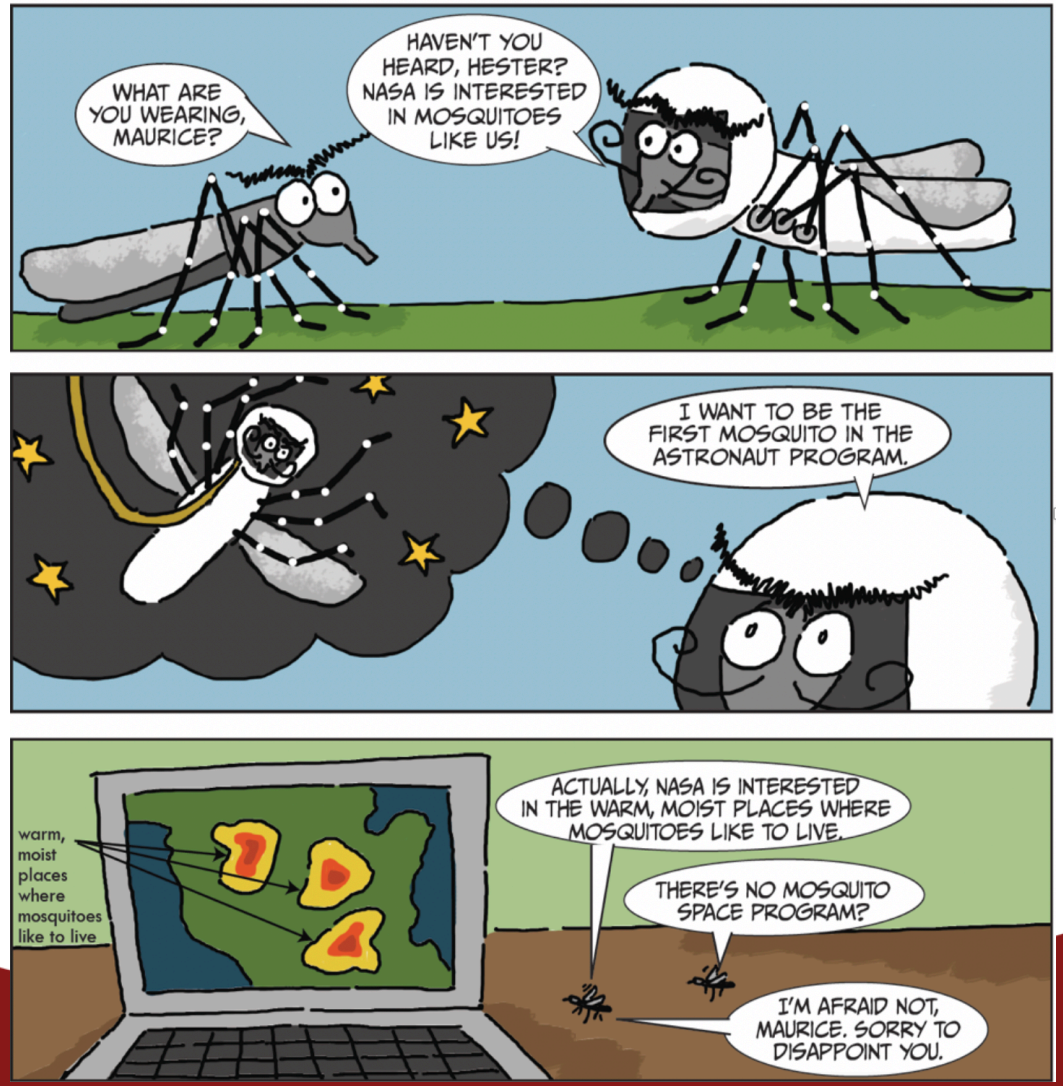
https://observer.globe.gov/do-globe-observer/mosquitoes/mosquitoes-resource-library

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).
3. visit GLOBE Observer Mosquito Habitat Toolkit at 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

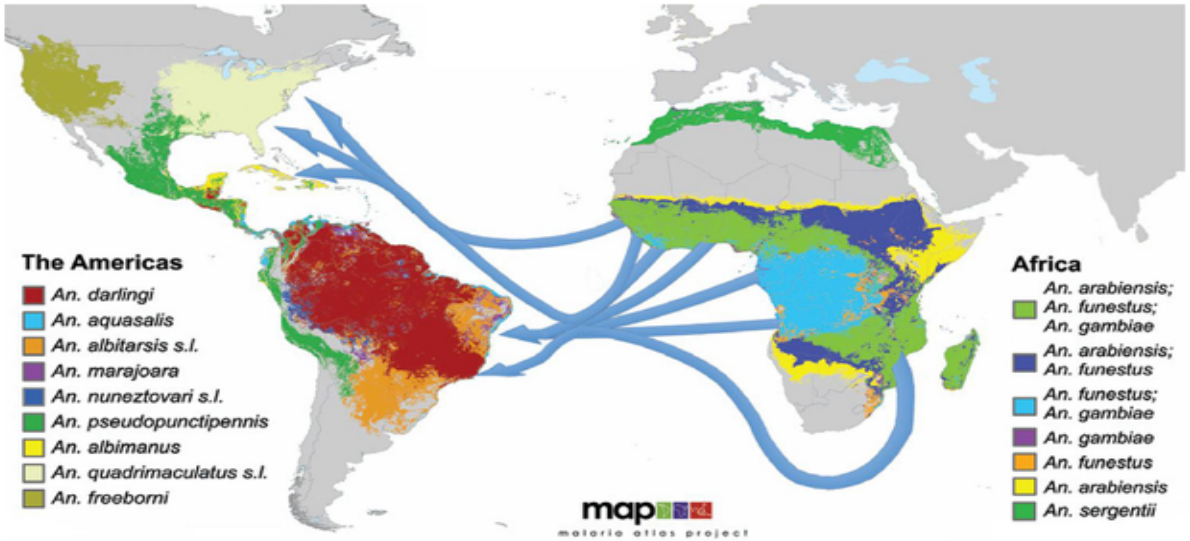


Image graphic credits to: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0074-02762014000500662

Around the World with Mission Mosquito

August 7 @ 8pm ET

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

GLOBE Mission Mosquito

Thank you

Dr. Rusty Low (rusty_low@strategies.org)
Liz Burck (liz_burck@strategies.org)
Cassie Soeffing (cassie_Soeffing@strategies.org)